uniongas
A Spectra Energy Company

October 30, 2013

Ontario Energy Board
2300 Yonge Street, 27th Floor
Toronto, Ontario
M4P 1E4

Attention: Ms. Kirsten Walli, Board Secretary

Re: Union Gas Limited – 2012 Demand Side Management Audit and Results

Dear Ms. Walli:

Union wrote a letter dated June 14, 2013 to inform the Board that Union would not be in a position to file its 2012 Demand Side Management Audit and Results by June 30, as outlined in Section 2.1.12 of the Board's Reporting and Record Keeping Requirement Rule. Union wrote a second letter dated August 26, 2013 stating more time was needed to resolve the outstanding elements of the Audit and finalize the required reports.

Please find attached Union's 2012 Annual Report and associated Appendices, the 2012 Audit Report and the 2012 Audit Committee Summary Report. Union worked in consultation with the auditor (EnerNOC) and the Audit Committee to file with consensus. Due to the size of the electronic file, it will be provided on CD along with the hard copy.

If you have any questions on this matter, please contact me at (519) 436-5334.

Yours truly,

Vanessa Innis
Manager, Regulatory Initiatives

FINAL
Demand Side Management
2012 Annual Report

October 22, 2013

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Table of Contents

Glossary of Terms

Adjustment Factor The adjustment factor reflects the percentage of savings being claimed. Typically, adjustment factor inputs include the percentage of participants who installed the measure (and kept it installed) which is determined by conducting verification studies.

Audit Informed by the processes agreed to in the Stakeholder Engagement Terms of Reference, a third party auditor is hired annually by Union. While hired by Union, the auditor is independent and ultimately serves to protect the interests of ratepayers with respect to Union's DSM claims.

Avoided Costs Avoided costs are a measurement of the reduction in the delivered costs of supplying all resources (natural gas, electricity and water) to customers as a consequence of a program.

Base Case The base case is a projection of the future without the effects of the utility's DSM program. Base cases are required for each DSM scenario. The difference between the base case and the energy efficient case represents the saving attributable to the energy efficient measure.

Building Envelope The building envelope refers to the exterior surfaces (such as walls, windows, roof and floor) of a building that separate the conditioned space from the outdoors.

Channel Partner A Channel Partner is a company that, in the course of its business, can influence consumers to choose gas over competing fuels. Examples of Channel Partners include: appliance retailers; HVAC contractors; engineers; and architects.

Cost Effectiveness Cost effectiveness refers to the analysis to determine whether or not the benefits of a project/measure are greater than the costs. It is based on the net present value of savings over the equipment life of the measures.

Demand Side Management ("DSM") The modification of perceived consumer demand for a product through various methods such as financial incentives, education and other programs. While the focus of Union's DSM is natural gas savings and the reduction in greenhouse gases emissions, it may also result in the saving of a number of other resources such as electricity, water, propane, and heating fuel oil.

Demand Side Management Variance Account ("DSMVA") An account used to track the variance between actual DSM spending by rate class versus the budgeted amount included in rates by rate class. A natural gas utility may record in the DSMVA in any one year, a variance amount of no more than 15% above its DSM budget for that year. The natural gas utility should apply annually for disposition of the balance in its DSMVA, together with carrying charges, after the completion of the annual third party audit.

Discount Rate The interest rate used to calculate the [net] present value of expected yearly benefits and costs. The Ontario Energy Board ("the Board") directed the Utilities to use a rate equal to the approved weighted average cost of capital ("WACC").

DSM Incentive The incentive available to Union to encourage the aggressive pursuit of DSM savings and recognize exemplary performance.

Free Ridership Free riders are program participants who would have installed the energy efficient measure without the influence of Union's DSM programs. Free rider rates are estimated based on research, market penetration studies or through negotiations in prior evaluation processes. The free rider rates are applied to the gross program savings results to derive actual savings.

Incentive An incentive is a transfer payment from the utility to DSM participants. The incentive encourages participation in a DSM program.

Input Assumptions Assumptions such as operating characteristics and associated units of resource savings for a list of DSM technologies and measures. These cover a range of typical DSM activities, measures and technologies with residential and commercial applications.

Incremental Cost The incremental cost is the difference in price between the efficient technology or measure and the base case technology. In some early retirements and retrofits, the full cost of the efficient technology is the incremental cost.

Lifetime Cumulative cubic meters ("cumulative m^3") Total natural gas savings over the life of a DSM measure. Frequently used at the measure or program level and can also summarize the benefits of an entire portfolio.

Lost Revenue Adjustment Mechanism ("LRAM") *The* LRAM is the Board's approved method by which utilities recover the lost distribution revenues associated with DSM activity. These lost revenues are calculated for each rate class impacted by DSM energy efficiency programs.

Market Transformation Market Transformation facilitates fundamental changes that lead to greater market shares of energy efficient products and services and on influencing consumer behaviour and attitudes that support reduction in natural gas consumption.

Measure A measure is any particular energy efficient technology (e.g. a low-flow showerhead, an energy recovery ventilator, condensing boiler etc).

National Account National Account customers are those customers that have multiple property locations and are similar in design and use. National Account customers include retail chains, property management firms and foodservice chains.

Net Present Value ("NPV") The NPV is the sum of the discounted yearly benefits arising from an investment over the life-time of that investment.

Net-to-Gross Ratio Gross impacts are the program impacts prior to accounting for program attribution effects. Net impacts are the program impacts once program attribution effects have been accounted for. The net-to-gross ratio is defined as 1 – (free ridership ratio) + (spill-over ratio).

Offering An offering exists where there are either bundles of energy efficiency measures or performance/maintenance based enhancements to existing measures marketed together (e.g. energy savings kits, home retrofit measures, custom equipment/process/O&M) or where support is delivered through a suite of services (e.g. customer engagement, site energy assessments etc.).

Part 3 Building The Ontario Building Code lists a Part 3 Building as exceeding 600m^2 in building area or greater than three storeys in height. Classified as assembly occupancies, care or detention occupancies, high hazard industrial occupancies, residential occupancies, business and personal services occupancies, mercantile occupancies, or medium and low hazard industrial occupancies.

Part 9 Building The Ontario Building Code lists a Part 9 Building as three or fewer storeys' in building height and having a building area not exceeding 600m^2. Classified as residential occupancies, business and personal services occupancies, mercantile occupancies, or medium and low hazard industrial occupancies.

Participants The units used by Union to measure participation in its DSM programs. Participant units of measurement include customers, projects and measures or technologies installed. Not all participants result in energy savings.

Persistence Persistence is the extent to which a DSM measure remains installed and performing as originally predicted. Persistence of DSM savings takes into account how long a DSM measure is kept in place relative to its useful life, the net impact of the measure relative to the base case scenario, and the impact of technical degradation.

Program A program is the utility specific approach to providing one or more demand-side options to customers. A program includes the combination of various offerings available to a definable target market within a program type.

Program Costs DSM program include the following components:

- Development and Start-up
- Promotion
- Incentives
- Delivery
- Evaluation, Measurement and Verification ("EM&V") and Monitoring
- Administration

Of the above costs, only start-up, promotion, incentives, delivery, and a portion of the evaluation and verification costs are applicable to individual programs. Other costs related to the design and deliveries of DSM programs are appropriately considered at the DSM portfolio level. These include development, a portion of the evaluation costs, monitoring, tracking and administration costs.

Program Evaluation Program evaluation refers to activities related to the collection, analysis, and reporting of data for purposes of measuring program impacts from past, existing or potential program impacts.

Realization Rate Realization rate is the ratio that compares actual savings to claimed savings. Realization rates are estimated parameters used to extrapolate audited savings from a sample of projects on to all projects.

Research Costs Research costs are Union's costs associated with the research and evaluation of DSM programs. They are not included in direct costs because they may affect more than one program.

Resource Acquisition Programs that seek to achieve direct, measurable savings customer-by-customer through the incenting/promotion of specific energy efficiency upgrades.

Social & Assisted Housing Residential social housing includes all non-profit housing developed, acquired or operated under a federal, provincial or municipally funded program including shelters and hostels.

Total Resource Cost Test ("TRC") The TRC Test provides a measure of the benefits and costs that accrue to society as a result of the installation of a DSM measure. The TRC test has a provision allowing externality benefits, when quantified, can be included in the result.

Trade Allies Trade allies include organizations (e.g. architectural and engineering firms, building contractors, appliance manufacturers and dealers, and banks) that influence the energy-related decisions of customers who might participate in DSM programs.

Executive Summary

As the first year delivering Demand Side Management ("DSM") programming under the new Ontario Energy Board ("the Board") Guidelines for Natural Gas Utilities ("the Guidelines"), 2012 represented a pivotal shift for Union Gas Ltd ("Union"). In particular, the change from screening total resource cost at a measure level to the program level presented new opportunities to support and incentivize technologies that drive deeper and longer savings for customers. Driving deeper and longer savings for customers is further emphasized by the movement to a performance scorecard measurement of success that focus on lifetime cumulative cubic meters of natural gas savings. Given the changes in approach, after successfully delivering DSM programs to customers for fifteen years, 2012 has proven to be a learning year for Union.

Program screening and measurement were not the only noteworthy changes in 2012. The new framework also established a new, highly collaborative stakeholder engagement process. In addition to the annual formation of a committee of three intervenors to act in an advisory capacity to the Audit, the newly formed natural gas Technical Evaluation Committee was launched in June. With three intervenor members, two independent members, Enbridge and Union, this committee presents an exciting new phase in stakeholder collaboration with the ultimate goal of standardizing technology and evaluation for natural gas utilities in Ontario. Exceeding the minimum requirements for consultation as presented in the Guidelines, Union welcomes the opportunity to participate in these leading edge stakeholder engagement processes.

As Union continues to evolve its approach to DSM to optimize the opportunities that the new framework presents, the company is pleased to report that the 2012 DSM portfolio generated 2.336 billion m^3 of cumulative natural gas savings, earning a Utility Shareholder Incentive of $8.210 million. Program spend was $31.322 million, which was 1.2% over the 2012 DSM budget of $30.954 million. To date, Union's commitment to DSM initiatives has translated to approximately 1.113 billion m^3 of annual natural gas savings, equivalent to more than $2.292 billion in net Total Resource Cost benefits.

1. Introduction

This Demand Side Management (DSM) Annual Report presents a retrospective of Union's energy efficiency initiatives and results in terms of scorecards, budget spend, DSM Incentive, and Lost Revenue Adjustment Mechanism (LRAM) for 2012. It also provides an avenue for Union to benchmark the results in this first year under the new multi-year DSM plan, highlight successes and lessons learned, and summarize evaluation work conducted.

Union's 2012 DSM portfolio included programs directed towards Residential, Commercial/Industrial, Low-Income, Market Transformation and Large Industrial Rate T1 and Rate 100 customers as listed below:

Residential Program

- Energy Savings Kit (ESK) Offering
- Home Retrofit Offering

Commercial/Industrial Program

- Prescriptive & Quasi-Prescriptive Offering
    - Water Heating Initiatives
        - Hot Water Conservation (HWC)
        - Condensing Gas Water Heaters
        - Front Load Clothes Washers
        - Ozone Laundry Equipment
    - Space Heating Initiatives
        - Energy Recovery Ventilators (ERVs) & Heat Recovery Ventilators (HRVs)
        - Condensing Boilers
        - High Efficiency Non-Condensing Boilers
        - Infrared Heaters
        - Destratification Fans
        - Condensing Make-up Air Units
        - Air Curtains
    - Commercial Kitchen Initiatives
        - Demand Control Kitchen Ventilation
        - Cooking Equipment – Energy Star fryers, steam cookers and convection oven
        - Efficient Pre-Rinse Spray Nozzles
        - Energy Star Dishwashers
- Custom Offering
    - Customer Engagement – Communication and Education
    - Engineering Feasibility and Process Improvement Studies
    - Operation and Maintenance Practices
    - New Equipment and Processes
    - Energy Management

Low-Income Program

- Helping Homes Conserve (Basic) Offering
- New Helping Homes Conserve Offering

- Affordable Housing Conservation Offering

Large Industrial Rate T1 and Rate 100 Program

- Custom Offering
    - Customer Engagement – Communication and Education
    - New Equipment & Processes
    - Operations & Maintenance
    - Process Improvement Studies
    - Engineering Feasibility Studies
    - Steam Trap Surveys
    - Boiler Tune-ups

Market Transformation Program

- Optimum Home

Major cumulative m^3 drivers for the 2012 DSM efforts are outlined in Figure 1.0.

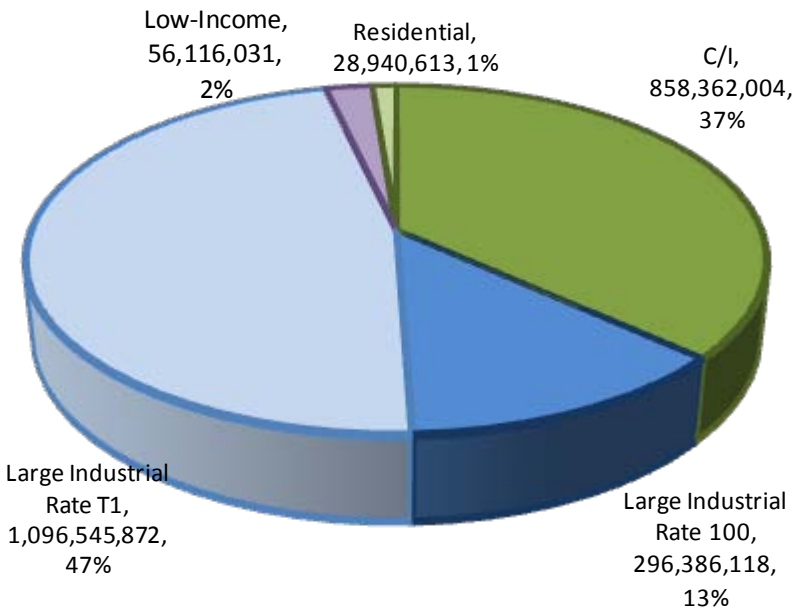


Figure 1.0, Major Drivers in Natural Gas Savings (Cumulative m^3 and Percentage)

2. Demand Side Management Framework

On June 30, 2011, the Ontario Energy Board (Board) issued EB-2008-0346 Demand Side Management Guidelines for Natural Gas Utilities (Guidelines). These Guidelines were developed following an extensive consultation process that examined both best practices in selected North American jurisdictions and stakeholder insight obtained from the many years of practicing DSM in Ontario.

Under the new Guidelines, the Board directed the distributors design DSM programs and the overall portfolio be guided by the following three objectives:

- Maximization of cost effective natural gas savings;
- Prevention of lost opportunities; and
- Pursuit of deep energy savings.

These objectives along with the overarching DSM framework (e.g., cost effectiveness screening, scorecard metrics, incentives, consultative process) are intended to provide adequate flexibility for distributors to adapt to changing market conditions[1].

In Section 16 of the Guidelines, the Board recognizes that the natural gas utilities are ultimately responsible and accountable for their DSM activities. However, the Board recommends a stakeholder engagement process be developed in consultation with all parties involved in development of the Guidelines. A new, more collaborative stakeholder engagement process was developed as a result and is outlined in Section 2.2 below.

The purpose of this section of the Annual Report is to provide background information on the DSM framework and Settlement Agreement. Union is not seeking approval of the information in this section.

2.1 Union Gas' 2012 – 2014 DSM Plan

On September 23, 2011, Union filed its 2012 - 2014 DSM Plan in accordance with the Guidelines and subsequently entered into a settlement process with all intervening parties.

On January 31, 2012, Union filed its Settlement Agreement and on February 21, 2012, the Board approved Union's 2012-2014 DSM plan based on the terms outlined in the Agreement.

Union's DSM activities are driving market change through focused efforts on delivering natural gas savings and related customer benefits.

2.2 Terms of Reference for Stakeholder Engagement

As part of the Guidelines, the Board recommended that Union and Enbridge consult with their stakeholders with respect to their DSM plans and develop joint Stakeholder Engagement Terms of Reference (ToR) for the purpose of outlining a stakeholder engagement process. Following a series of joint utility stakeholder consultation sessions, a joint ToR was developed and filed with the Board.

The ToR goes beyond the minimum requirements for consultation as presented in the Guidelines, Section 16.1. In addition to two plenary Consultative meetings and two Low Income Consultative

[1] Pg. 4, Ontario Energy Board Demand Side Management Guidelines for Natural Gas Utilities.

meetings each year, the objective and purpose of the ToR is to clarify and define the roles and responsibilities of intervenors, other stakeholders, the utilities, and the Board with respect to participating in the DSM stakeholder engagement process. These include processes relating to program design, DSM measure input assumptions, evaluation research, and the audit of DSM program annual results.

As described in the ToR, the new stakeholder engagement process includes the establishment of a common Technical Evaluation Committee (TEC) and a separate Audit Committee (AC) for each utility.

2.3 Technical Evaluation Committee

Comprised of three intervenor representatives, representatives from both natural gas utilities, and two independent members, the goal of the TEC is to establish DSM technical and evaluation standards for natural gas utilities in Ontario.

As described in the ToR, the TEC will endeavor to:

- Make recommendations to the Board on the annual Technical Reference Manual (TRM). This manual will document measure savings assumptions and all other cost effectiveness screening data;
- Produce and maintain a prioritized annual work list;
- Establish evaluation priorities; and
- Review and provide feedback on evaluation studies.

Following a series of preliminary discussions between Union, Enbridge and the intervenor representatives, the appointment of two Independent Members was made and the TEC was officially inaugurated in June, 2012.

Working together over a seven month period, the Committee established its operating guidelines and identified and completed a number of top evaluation priorities. The details of these efforts are outlined in Section 9.

2.4 Audit Committee

The purpose of the AC is to ensure that there is, each year, an effective and thorough audit of the utility's DSM results.

The AC s scope of work includes:

- Establishing the standard scope of the annual audit for the term 2012 to 2014 – goals versus tasks;
- To utilize the standard scope for the 2012 to 2014 term as part of the Request for Proposal (RFP) and the AC may alter the scope annually based on consensus;
- The AC will provide the auditor with input and guidance; and
- Make recommendations on the Audit Report regarding the utility's claims regarding DSM results and DSMVA, LRAM and utility incentives and any target adjustments through the AC Report submitted to the Board.

The AC consists of four members; three intervenor members and one utility representative. The 2012 AC members are as follows: Jay Shepherd (School Energy Coalition), Julie Girvan (Consumers Council of Canada), Kai Millyard (Green Energy Coalition) and Leslie Kulperger (Union Gas).

2.5 Program and Portfolio Design

As prescribed in the Guidelines, Union's DSM program activities fall within three program types:

- Resource Acquisition;
- Low-Income; and
- Market Transformation.

Resource Acquisition programs seek to achieve direct, measureable savings for an individual customer and involve the installation of energy efficient equipment.

Low-Income programs are similar in nature to resource acquisition programs, but are separated to recognize the unique needs of this customer base and that they may result in lower TRC net savings than non-low-income programs.

Market Transformation programs focus on facilitating fundamental changes that lead to greater market shares of energy-efficient products and services. They influence consumer behaviour and attitudes in support of reducing natural gas consumption.

2.6 Cost Effectiveness Screening

Cost effectiveness screening is mandated by the Board for determining the economic worthiness of a DSM program. As per the Guidelines, the Total Resource Cost (TRC) test is used to screen for cost-effectiveness at the program level. TRC benefits include the avoided costs associated with natural gas, electricity, and water savings over the life of the energy efficient equipment. TRC costs include the incremental equipment costs associated with the energy efficient equipment in relation to its non-efficient equivalent, as well as any program, administrative, and evaluation costs attributed directly to the program. [2] If the ratio of the *present value of the benefits* to the *present value of the costs* exceeds 1.0, the program is considered cost-effective for resource acquisition programs. To recognize that low-income natural gas programs may result in benefits not captured by the TRC test, these programs are screened using a TRC threshold of 0.7. Market transformation programs are assessed on their own merits based on the objectives of the program.

2.7 Program Evaluation

There are two broad categories of evaluation activities: impact evaluation and formative evaluation; impact evaluations focus on participation and related savings resulting from DSM programs, while formative evaluations focus on the effectiveness of program design and delivery to assess why effects occurred.

[2] Incremental costs include capital, cost of removal less salvage value, installation, operating and maintenance and/or fuel costs.

One of the guiding principles of the TEC, as described above, is to provide stakeholder input to the development of evaluation priorities for the natural gas utilities. From a broader DSM framework perspective, program impact and formative evaluation activities as well their associated budgets are managed by the utilities. As part of Union's commitment to DSM, impact evaluation studies are performed annually to examine the accuracy of claimed savings. Both impact and formative studies undertaken in 2012 are presented in Section 9 of this report.

2.8 Audit of the 2012 DSM Annual Report

To substantiate Union's DSM Portfolio results, this DSM Annual Report is subject to an independent external audit. The AC has selected EnerNOC Inc to conduct the audit for the 2012 program year. The intention of the audit is to confirm to stakeholders that claimed DSM savings are correct and that the DSM Incentive and LRAM calculations are appropriate. The Auditor provides a final opinion on whether the claimed DSM Incentive amount, LRAM, and Demand Side Management Variance Account (DSMVA) have been correctly calculated using reasonable assumptions. As described in Section 2.4, Union's 2012 AC plays an advisory role throughout the audit to facilitate the achievement of the audit objectives.

3. Overall 2012 DSM Program Results

With spending in the amount of $31,322,216, Union's DSM program generated 2,336,350,638 cumulative m³ in natural gas savings for customers. As illustrated in Figure 3.0, the Large Industrial Rate T1 and Rate 100 program delivered the largest portion of savings in 2012, followed by the Commercial/Industrial, Low-Income and Residential programs respectively.

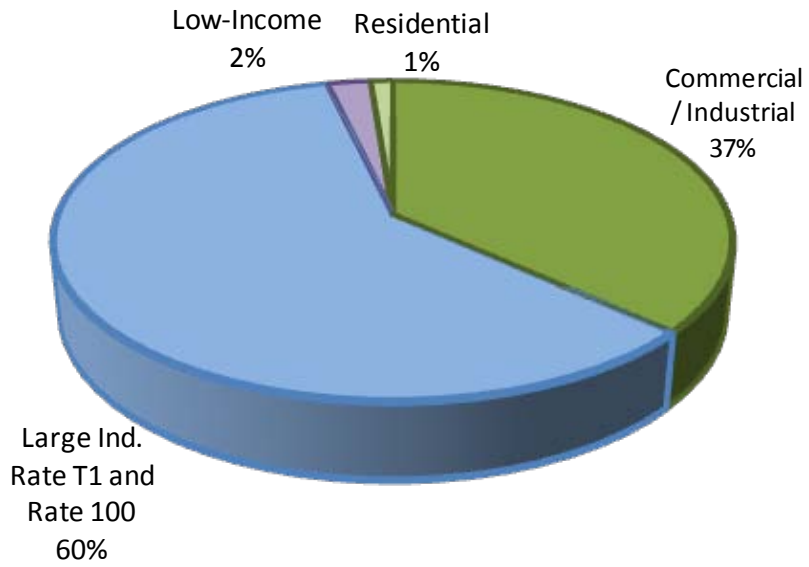


Figure 3.0, 2012 Cumulative Gas Savings by Program (Percentage)

Table 3.0 summarizes Union's DSM results by program for 2012, including annual and cumulative natural gas savings, number of units, expenditures, and the associated net TRC and TRC ratio. Figure 3.1 shows the total Union incentive achieved broken down by scorecard.

Table 3.0 – 2012 Program Results

Program	Annual Net Gas Savings (m^3)	Cumulative Net Gas Savings (m^3)	Units	Expenditures	Net TRC	TRC Ratio
Residential	2,686,138	28,940,613	62,737	$ 3,053,693	$ 11,305,039	5.07
Commercial / Industrial	49,127,369	858,362,004	27,144	$ 11,314,294	$ 82,480,234	3.07
Low-Income	2,842,901	56,116,031	40,646	$7,702,047	$ 2,488,180	1.32
Large Industrial Rate T1 Rate 100	82,782,080	1,392,931,990	341	$ 5,043,295	$ 139,118,713	6.33
Market Transformation	0	0	0	$ 434,823	$ 0	NA
Program Total	**137,438,488**	**2,336,350,638**	**130,868**	**$ 27,548,152**	**$ 235,392,165**	**4.07**
Portfolio Costs				$ 3,774,064		
Total 2012 Spend				**$ 31,322,216**	**$ 232,147,282**	**3.91**

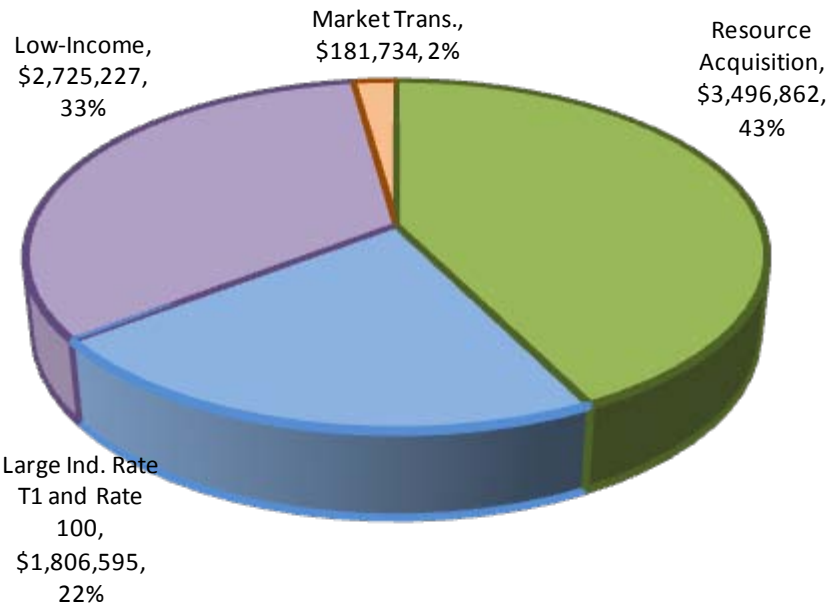


Figure 3.1, Scorecard Contribution to Union Incentive Achieved

DSM costs are detailed on a program level in Table 3.1.

Table 3.1 – 2012 Direct DSM Program Costs

Program	Administration	Evaluation	Promotion	Incentives	2012 Total
Residential	$ 515,269	$ 31,190	$ 1,364,900	$ 1,142,334	$ 3,053,693
Commercial/ Industrial	$ 2,405,403	$ 81,363	$ 1,330,780	$ 7,496,748	$ 11,314,294
Low-Income	$ 893,499	$ 188,205	$ 1,277,628	$ 5,342,715	$ 7,702,047
Large Industrial Rate T1 and Rate 100	$ 838,114	$ 37,549	$ 118,033	$ 4,049,599	$ 5,043,295
Optimum Home	$ 158,090	$ 0	$ 219,923	$ 56,810	$ 434,823
Program Total	**$ 4,810,375**	**$ 338,307**	**$ 4,311,264**	**$ 18,088,206**	**$ 27,548,152**
Portfolio Costs					
DWHR Sunset					$ 477,142
Research					$ 770,057
Evaluation					$ 489,102
Administration					$ 2,037,763
Portfolio Total					$ 3,774,064
Total 2012 Spend	**$ 4,810,375**	**$ 338,307**	**$ 4,311,264**	**$ 18,088,206**	**$ 31,322,216**

Net annual and cumulative savings[3] are provided in Table 3.2.

Table 3.2 – 2012 Net Natural Gas Savings

Program	Offering	Annual Net Gas Savings (m^3)	Cumulative Net Gas Savings (m^3)
Residential	Energy Savings Kit	2,596,169	27,141,243
	Home Retrofit	89,969	1,799,370
Residential Total		**2,686,138**	**28,940,613**
Commercial/ Industrial	Prescriptive	10,366,742	202,274,442
	Custom	38,760,627	656,087,561
Commercial/Industrial Total		**49,127,369**	**858,362,004**
Low-Income	Affordable Housing Conservation	601,126	11,871,819
	Helping Homes Conserve (Basic)	750,144	7,901,520
	New Helping Homes Conserve	1,491,631	36,342,693
Low-Income Total		**2,842,901**	**56,116,031**
Large Industrial Rate T1 and Rate 100	All Offerings	82,782,080	1,392,931,990
Large Industrial Rate T1 and Rate 100 Total		**82,782,080**	**1,392,931,990**
Optimum Home		0	0
Optimum Home Total		**0**	**0**
Portfolio Total		**137,438,488**	**2,336,350,638**

[3] Gross annual and cumulative gas savings total 282,176,715m^3 and 4,777,825,609 m^3 respectively. Gross savings refer to the results of Union's 2012 DSM programs without the exclusion of free riders.

4. Resource Acquisition Scorecard

Union has three performance metrics on its Resource Acquisition Scorecard with results attributable to programs addressing residential and commercial/industrial markets. Resource acquisition programs are programs that seek to achieve direct, measureable savings customer-by-customer through the installation of energy efficient equipment and/or energy management systems, as well as identifying and implementing process improvements and/or operation and maintenance activities.

For residential customers, these programs are oriented toward rebates for installing energy efficient water or space heating equipment or building envelope upgrades to new and existing homes.

Programs designed for commercial customers include incentives to invest in energy efficient technologies geared for new and existing commercial buildings such as the purchase and installation of efficient heating, ventilating and air conditioning (HVAC) systems, custom solutions specific to the customer's building and/or process needs. Due to the unique nature of industrial customers, solutions for these customers tend to be custom designed and engineered to meet the requirements of the customer's facility.

Union recognizes the inherent value contained in the educational content of its programs and continues to develop and refine the customer awareness and educational components of the resource acquisition programs.

Table 4.0 presents the results of the Resource Acquisition Scorecard, which illustrates an achievement of 119% of the overall scorecard target, resulting in an incentive of $3.497 million.

Table 4.0 – 2012 Resource Acquisition Scorecard Results

Metrics	Metric Target Levels			Weight	Achievement	% of Metric Achieved	Weighted % of Scorecard Achieved
	Lower Band	Target	Upper Band				
Cumulative Natural Gas Savings (m^3)	619,500,000	826,000,000	1,032,500,000	90%	887,302,617	115%	103%
Deep Savings – Residential	120	160	200	5%	73	-9%	-0.4%
Deep Savings - C/I	4%	5%	6%	5%	9.36%	318%	16%
					Total Scorecard Target Achieved		***119%***
					Scorecard Incentive Achieved		***$3,496,862***

As outlined in the Settlement Agreement, for the purpose of the Residential Deep Savings scorecard metric, homes have only been included if they a) achieve a minimum gas savings of 11,000 cumulative m^3 (based on HOT2000 software used in EnerGuide mode), and, b) implement a minimum of two major measures. In addition the aggregate of all of the homes counted towards the Residential Deep Savings metric must have achieved, on average, at least a 25% reduction in annual gas usage for space and

water heating (also based on HOT2000 software used in EnerGuide mode). Free ridership and spillover have not been included in the calculations for this metric. The current major measures are:

- Heating system replacement
- Water heating system replacement
- Attic insulation
- Wall insulation
- Basement insulation
- Air sealing (minimum reduction of at least 10% as measured by a blower door test)
- Window replacements
- Drain water heat recovery

Commercial/Industrial Deep Savings calculations are based on the percentage of baseline consumption achieved within all Commercial/Industrial custom projects undertaken in the program year. Union has calculated this metric by comparing the forecast weather normalized annual gas savings for all Commercial/Industrial custom projects against the actual consumption of the participants in those projects for the immediately preceding year. Actual 2011 consumption data for commercial customers with weather sensitive loads has been weather normalized for this calculation, whereas industrial process demands do not fluctuate as a result of weather have not been weather normalized. For any customer who completed a commercial/industrial custom project and also had a prescriptive measure installed, the savings relating to the prescriptive measure have also been included for the purpose of calculating the normalized annual gas savings. Savings associated with custom projects for new construction were not included in this metric.

Table 4.1 presents the results of the Residential and Commercial/Industrial Resource Acquisition programs. The total spend includes all program costs including incentives.

Table 4.1 – 2012 Resource Acquisition Program Results

Program	Offering	Units	Annual Net Gas Savings (m^3)	Cumulative Net Gas Savings (m^3)	Total Spend	Net TRC	TRC Ratio
Residential	Energy Savings Kit	62,641	2,596,169	27,141,243	$ 3,053,693	$ 11,305,039	5.07
	Home Retrofit	96	89,969	1,799,370			
Commercial/ Industrial	Prescriptive	26,377	10,366,742	202,274,442	$ 4,875,327	$ 16,836,551	2.33
	Custom	767	38,760,627	656,087,561	$ 6,438,967	$ 65,643,683	3.41
2012 Resource Acquisition Total		**89,881**	**51,813,507**	**887,302,617**	**$ 14,367,987**	**$ 93,785,273**	**3.20**

4.1 Residential Program

Residential programs are designed to achieve savings related to space and water heating for Union Gas' residential individually metered residences. These programs are marketed to residential customers and are delivered through a variety of channels including: retail partnerships, builders, and third party delivery agents. Working with new partnerships, existing trade allies and partners, as well as direct-to-

customer promotions, are strategic efforts to cost effectively promote energy efficiency within Union's residential customer base. In 2012, Union focused on the existing Energy Saving Kit (ESK) offering (Section 4.1.1) and the new Home Retrofit offering (Section 4.1.2).

Table 4.2 shows the results of the Residential program and Table 4.3 breaks down the total spend into its components.

Table 4.2 – 2012 Residential Program Results

Program	Offering	Units	Annual Net Gas Savings (m^3)	Cumulative Net Gas Savings (m^3)	Total Spend	Net TRC	TRC Ratio
Residential	Energy Savings Kit	62,641	2,596,169	27,141,243	$ 3,053,693	$ 11,305,039	5.07
	Home Retrofit	96	89,969	1,799,370			
2012 Residential Total		62,737	2,686,138	28,940,613	**$ 3,053,693**	$ 11,305,039	5.07

Table 4.3 – 2012 Residential Program Spend

Item	Total
Incentives	$ 1,142,334
Administration	$ 515,269
Evaluation	$ 31,190
Promotion	$ 1,364,900
2012 Total Residential Program Spend	**$ 3,053,693**

Table 4.4 shows the calculation of the Residential program's TRC ratio. With a TRC ratio of 5.07, the Residential program's net TRC benefits are over five times greater than its net TRC costs.

Table 4.4 – 2012 Residential Program Cost-Effectiveness

	TRC Benefits (a)	TRC Costs (b)	Net TRC (c)=(a-b)	TRC Ratio (d)=(a/b)
Measures	$ 14,084,740	$ 868,342	$ 13,216,398	16.22
Administration		$ 515,269		
Evaluation		$ 31,190		
Promotion		$ 1,364,900		
Residential Program Total	**$ 14,084,740**	**$ 2,779,701**	**$ 11,305,039**	**5.07**

4.1.1 Energy Savings Kit (ESK) Offering

ESKs have been distributed to Union's residential customers since 2000. In 2012, Union distributed 62,641 ESKs, a marked decline from 87,214 in 2011. As the market gets saturated, the focus has been to

reduce, but not eliminate this offering to ensure that the residential market as a whole continues to have access to energy efficiency measures.

ESKs are pre-packaged measures designed to reduce a customer's energy demand and water consumption. Each ESK contains the following components:

- Energy efficient showerhead (1.25 GPM)
- Energy efficient kitchen aerator (1.50 GPM)
- Energy efficient bathroom aerator (1.0 GPM)
- Pipe wrap (two 1 meter lengths)
- 1 roll of Teflon tape for ease of showerhead installation
- ESK Installation Guide and MyAccount paperless brochure
- $25 Programmable Thermostat rebate coupon

Target Market

The ESK offering is targeted to Union residential customers in detached, semi-detached, townhouses and individually metered row townhouses who have a natural gas water heater. Customers must have a natural gas furnace to be eligible for the programmable thermostat.

Market Incentive

All water saving measures in the ESK are provided at no cost to the customer. A $25 coupon for the programmable thermostat is also included in the ESK.

Market Delivery

The primary delivery approach for the ESK offering is mass marketing, supported by direct sales via Account Managers (AMs). In 2012, ESKs were distributed through a combination of channels that included: direct delivery, channel partners and events.

Retailer ESK Distribution Events

Union hosted ESK retail events, in partnership with Home Depot and Lowes, at various store locations across Union's franchise in the spring and fall. Union held more than 30 retail events in cities such as Milton, Guelph, Waterloo, Ancaster, Sault Ste Marie, London, Burlington, Oakville, Windsor & Hamilton throughout 2012. Retailers view Union Gas as a key partner in advancing their customer's awareness and uptake of energy efficient products and contributing to their corporate energy conservation and environmental stewardship profiles. These retailer events resulted in the distribution of 6500 ESKs.

Figure 4.0, Energy Savings Kit Retail Event Poster

Account Manager ESK Distribution

Since program inception, AMs have been working with their local communities to distribute ESKs through various events. Examples of local events include home shows, trade shows, business partner sales events, and community events. In 2012, approximately 4,500 ESKs were distributed.

Heating Ventilation Air Conditioning (HVAC) Partnership Initiative

This channel is designed to influence energy conservation decisions at the point of purchase. Incentives are paid directly to HVAC partners for the distribution or installation of an ESK or programmable thermostat. For 2012 the following incentives were available to qualified HVAC partners:

- $20 for the distribution of an energy saving kit to a qualified Union Gas customer;
- $40 for the installation of an energy saving kit to a qualified Union Gas customer; and
- $25 for the sale and installation of a programmable thermostat.

The result of these HVAC partnership initiatives in 2012 amounted to 130 ESKs installed and more than 9,000 ESKs distributed.

Pick-up Depots Partnership Initiative

Union continued to partner with strategically located retail stores within its franchise that served as distribution centres for ESKs. Examples of these stores are Home Depot, Sears as well as HVACs who own a showroom. Although no financial incentives are offered to these depots, the traffic created from the promotional bill inserts to Union's 1.1 million residential customers motivates participation. In 2012, customers accessed more than 12,000 ESKs through pick-up depots.

Figure 4.1, ESK Pick-up Depot Promotional Material

Direct Marketing

As ESKs saturate the market, it is becoming more and more challenging to reach those "hard to get" customers who might be interested in receiving an ESK but who may not have heard of the offering through existing outreach strategies. These types of customers include, but are not limited to, those living in rural regions who may not have access to a pick-up depot or retail event, or lack the ability to go online and order an ESK. In 2012, Union launched various direct marketing campaigns to reach these "hard to get" customers and to support retailers' events and drive customers to order an ESK online.

Radio Campaigns

Union launched radio campaigns targeting London and Hamilton to create traffic to local pick-up depots as well as to direct customers to Union's website to order an ESK online. These campaigns generated awareness with our customers on the benefits and cost savings associated with the installation of an ESK, and resulted in increased customer visits to the stores to receive the ESK and increased traffic to the web to order an ESK. An example follows:

> *Did you know that Union Gas is giving away FREE Energy Saving Kits? That's right! Valued at $60 dollars, the kit includes an energy-efficient showerhead, aerators and pipe insulation. Installing it will instantly reduce your water use, water heating costs, and help you save up to one hundred dollars a year on your energy bills.*
>
> *To order your FREE Energy Saving Kit or to find a pick-up location near you or go to uniongas.com/esk. Residential customers only. One per household… while quantities last. Some restrictions apply.*

News-Canada Radio Campaign

Union continued with the News Canada radio campaigns in efforts to reach the hard-to-get customers. News Canada is an agency that provides Canadian media outlets with ready to use copyright free news content for television, print, radio and web. Broadcasters and editors from these various media outlets

look to News Canada for stories when they have a gap in their current news line up or when they are looking for content that effectively enhances their broadcasts/publications. To leverage this channel of media, Union provided News Canada with a radio interview that highlighted the benefits and savings associated with installing an ESK.

The campaign was launched in the spring and fall. This approach was successful as more than 25 radio stations in different cities ran the ad each month reaching more than 1 million impressions monthly.

Direct Mail Campaigns

In 2012, Union continued with direct mail campaigns targeting customers who had not yet received an ESK. Target lists were created to identify customers who have not yet received an ESK, and to identify cities with a low ESK penetration.

The direct mail provided information on the components of the ESK as well as how to receive one (online, pick-up depots, mail back coupon). More than 500,000 direct mail letters were sent out covering over 30 cities; including Kingston, Hamilton, Thunder Bay, Milton, Trenton, Guelph, Quinte West, Napanee, and Belleville. Approximately 12,000 direct mail recipients participated in the offering.

Figure 4.2, ESK Direct Mail

ESK Door-to-Door Pilot- New Initiative

Union implemented a pilot ESK Door-to-Door program in Q4 2012 as a new channel to reach specific customers who had not participated in the ESK offering. This delivery method was designed to make participation in the offering easier by eliminating the need to visit a pick-up location or retail event. Union partnered with Ecofitt to act as the delivery agent of this offering. Ecofitt deployed certified technicians in field to visit pre-identified customers with the free ESK in the following cities:

- Milton
- Oakville
- Waterloo

Figure 4.3/4.4, Esk Door-to-Door Pilot: Door Hanger and Bag Insert

Ecofitt technicians wore an Ecofitt uniform and were equipped with an identification badge that also featured the Union Gas logo. Customers that received an ESK were asked to sign a customer acknowledgment form for tracking and reporting purposes and if a customer was not home, a door-hanger was left behind to encourage customers to call Ecofitt's toll free number or go to www.uniongas.com/esk to order an ESK. Approximately 6,000 ESKs were delivered through this channel.

Union uses a multi-channel approach to deliver ESKs to the residential market; pull, push and install approach. The results for each are shown in Table 4.5. In 2012 a total of 62,641 ESKs were distributed in Union's franchise area.

Table 4.5 - 2012 ESK Distribution Summary by Channel

Retail Event	AM Initiated	HVAC/Depot	Install	Direct Mail	Door to Door	Online	Total
6,500	4,500	21,000	290	11,651	6,000	12,700	62,641

Programmable Thermostat

In 2012, Union promoted a $25 on-bill rebate for the purchase and installation of a programmable thermostat to its customers. This rebate, offered in the form of a coupon, was distributed through a number of channels:

- Bill inserts
- ESK insert
- Home Depot, Lowes
- HVAC dealers
- Union Gas website

Figure 4.5, Programmable Thermostat: Bill Insert

In order to receive the on-bill rebate, customers had to submit their active Union Gas account number on the completed coupon which indicates whether they are replacing a non-programmable thermostat and submit it with a proof of purchase for the programmable thermostat.

Partnership with Green Impact Guelph (GIG)

In 2012, Union continued its partnership with City of Guelph, Guelph Hydro and Guelph Environmental Leadership (GEL) to launch the Green Impact Guelph (GIG). GIG is a delivery strategy that offers a free personalized in-home basic audit, completed by GEL. The audit aims at identifying water and energy saving opportunities and conducts retrofits on-site where appropriate and specifically the installation of ESK components. A pilot was launched in Q1 2012 targeting 250 home visits in Guelph's Hanlon Creek neighbourhood; 150 homes had ESK measures installed and an in-home basic audit performed.

Figure 4.6, Green Impact Guelph Program Overview

The GIG pilot program is promoted using flyers, posters, door hangers and through collaboration with local neighbourhood groups and community groups/institutions (i.e. schools, churches, etc.). All promotions focused solely on the targeted neighbourhood and did not include the broader community.

To be eligible, a participant must be:

- A resident of a detached, semi-detached or townhouse/row-house located in the city of Guelph constructed prior to 1996, with permission from the owners; and
- Be serviced by city of Guelph municipal water & wastewater system, Guelph Hydro Electric Systems Inc. and Union Gas.

4.1.2 Home Retrofit Offering

In August 2012, Union launched the Home Retrofit offering which targets residential homeowners in need of building envelope, space and water heating upgrades.

The offering encourages homeowners to install one or more measures in their homes to:

- Achieve significant energy and money savings each year;
- Put a stop to costly home energy loss;
- Enjoy a home that's warmer in the winter and cooler in the summer;
- Avoid unsightly mould and condensation that can be caused by poor insulation; and
- Improve health through better indoor air quality.

The offering provides customers with prescriptive incentive amounts for the installation of attic insulation, basement insulation, wall insulation, Energy Star windows, tankless water heaters and high-efficiency furnaces. Customers also receive incentives to assist with the costs of the pre and post audits that the program requires to determine the energy savings. In 2012, a total of 96 residential customers participated in the Home Retrofit Offering, 73 of which achieved 'deep' savings levels.

Target Market

The Home Retrofit offering targets Union's residential customers who live in a detached home built prior to 1994 and that is heated by natural gas.

In 2012, Union targeted the following cities:

- Oakville
- Burlington
- Hamilton
- London
- Guelph

Table 4.6 outlines the various measures of the Home Retrofit Program with the corresponding criteria and incentive.

Table 4.6 – Home Retrofit Program Offering Incentives

Measure	Criteria		Incentives
Ceiling/Attic Insulation	R-12 and less	$	350
	R12 - R25	$	200
Basement & Crawl Space Insulation	Insulate 50-100% of foundation wall area by R10 or greater	$	1,250
	Insulate 10-49% of foundation wall area by R10 or greater	$	350
Basement Headers	Minimum of R-20	$	125
Exterior Wall Insulation	Insulate 50-95% of total exterior wall area by greater than R9	$	1,250
	Insulate 10-49% of total exterior wall area by greater than R9	$	500
	Insulate 50-95% of total exterior wall area by R3.5-R9	$	750
	Insulate 10-49% of total exterior wall area by R3.5-R9	$	300
Air Sealing	Must be target assigned by EcoEnergy Audit	$	150
Furnace	Replace your heating system with a condensing gas furnace that has a 95.0 percent annual fuel utilization efficiency (AFUE) or higher. Must be accompanied with one more measure	$	500
Water Heater	Replace your domestic water heater with an ENERGY STAR and "ecoENERGY" qualified instantaneous, gas-fired water heater that has an EF of 0.82 or higher	$	300
Window	Replace your windows, doors or skylights with ENERGY STAR qualified models. Incentive is per window	$	40

Note: Program eligibility required customers to complete both a pre and post audit. Customers were eligible to $250 to conduct both audits.

Market Delivery

Union partnered with Direct Energy to provide a turn-key delivery service for customers. Direct Energy services included: managing a toll-free number, administering pre and post audits, supplying and installing all measure upgrades and tracking and reporting results.

To support Direct Energy and to create additional market traction to the offering, Union developed and launched a direct marketing campaign targeting customers who lived in detached homes in the following city centres:

- Oakville – approximately 18,000 customers
- Hamilton and Burlington – approximately 18,000 customers
- London – approximately 3,000 customers

Customers were directed to call Direct Energy to learn if they meet the program qualification requirements. Requirements include owning a single detached home built prior to 1994 with a natural gas furnace.

Figure 4.7, Home Retrofit Direct Mail

- Sell Sheet
  - A sell sheet was developed to be used by Direct Energy service technicians and sales associates during their customer calls to explain the program and to act as a leave behind for customer reference.

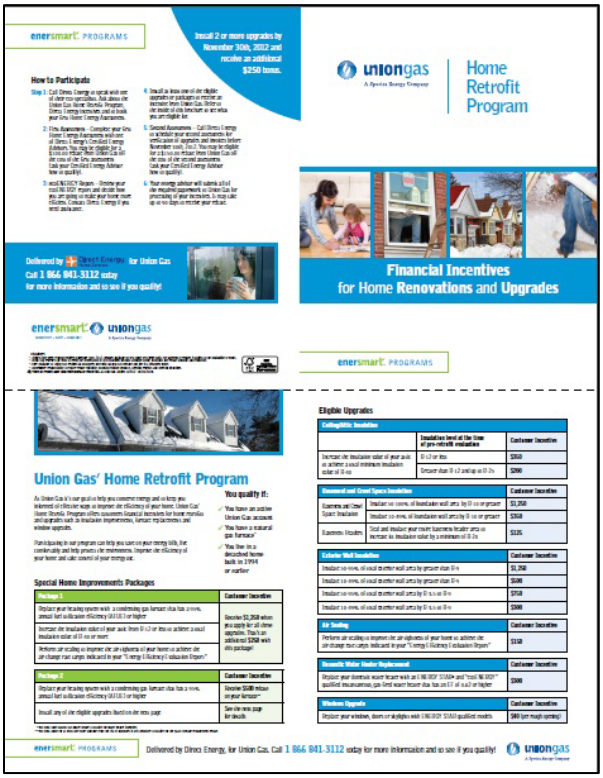


Figure 4.8, Home Retrofit Sell Sheet

- Door Hangers
    - Door hangers were used by Direct Energy service and sales teams to promote the offering during their visits. After the visit, the Direct Energy representatives would distribute the door hangers at homes on the same street.

Figure 4.9, Home Retrofit Door Hangers

- E-mail
    - An e-mail campaign was developed to target MyAccount customers (approximately 3,000 customers) who met the offering criteria. MyAccount is Union's online account management system.

Figure 4.10, Home Retrofit E-blast

- Website
    - Additionally, Union developed an onsite web presence for the offering: www.uniongas.com/homeretrofit

4.1.3 Education and Awareness Efforts

While education efforts in the residential sector do not generate incentive revenue, affecting consumer decisions relating to the benefits of DSM through awareness is crucial to the success of our DSM programs. Union targets educational outreach to customers to empower them to manage their energy costs. In 2012, Union continued to disseminate educational materials through a variety of media:

- Interactive website;
- Wise Energy Guides (WEG);
- InTouch monthly bill inserts;
- Bi-Annual Residential HVAC Newsletter; and
- Energy conservation ESK events.

Residential Energy Efficient Website

Energy Efficiency, environmental stewardship and conservation are a central focus of the Union Gas website. Within the residential section of the site, there is a dedicated Energy Conservation menu heading (uniongas.com/energyefficiency) with the following sub-sections:

- ***Energy Saving Programs***: Information and links to Union's different conservation initiatives (e.g. ESK and the programmable thermostat rebate).
- ***Education***: Information and links on buying a new home, energy efficient labels and a downloadable Wise Energy Guide.

- ***Industry Links and Programs***: Information on Union's major partners, stakeholders and affiliates as well as links to conservation-related programs, both gas and non-gas focused, in the Ontario marketplace.
- ***Manage My Bill***: 12 easy steps to help customers reduce their energy consumption and save money on their utility bill.

Features on the site include:

- Online videos (topics include: the ESK, air sealing, and programmable thermostats);
- A downloadable programmable thermostat rebate coupon;
- Downloadable educational materials;
- Comparison tools on energy costs;
- A listing of upcoming ESK events held by Union;
- A listing of ESK depots across Union's franchise that customers can visit in order to pick-up a free ESK;
- An online order form for customers to request an ESK and have it delivered to their home; and
- An overview of energy efficiency rebate programs offered in the province, as well as links to third party organizations involved in energy conservation.

MyAccount

Launched in 2008, MyAccount is Union's online account management system for residential and small business customers. After logging into MyAccount, customers can assess personalized tools to help them better understand their energy use including:

- An archive containing 24 months of natural gas use and billing history;
- A "compare bills" feature to graph consumption or bill amounts from two or more months; and
- A download feature to export energy data into a spreadsheet or energy management software.

The synergies of these tools provide customers with feedback that can:

- Break "bad habits" related to energy use and form new persistent habits;
- Build a greater understanding of how actions/behaviours relate to energy consumption; and
- Influence motivations related to the use of energy.

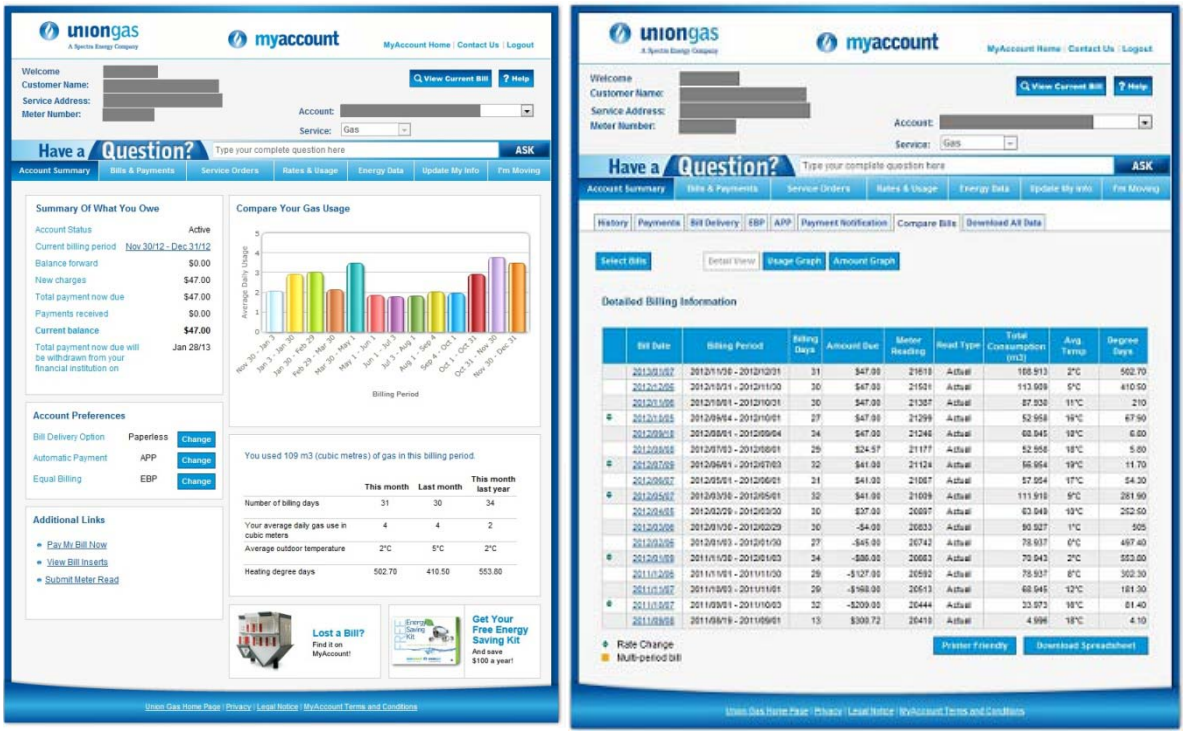


Figure 4.11, MyAccount

Wise Energy Guide

In 2012, Union continued to distribute copies of the Wise Energy Guide to customers. The guide includes up-to-date information on code changes, tips and solutions to reduce heat loss, ways to manage your bills, and an easy-to-use checklist to assist customers achieve energy efficiency in the home. The primary distribution method is Union's website, where customers can view a digital copy or order a printed version.

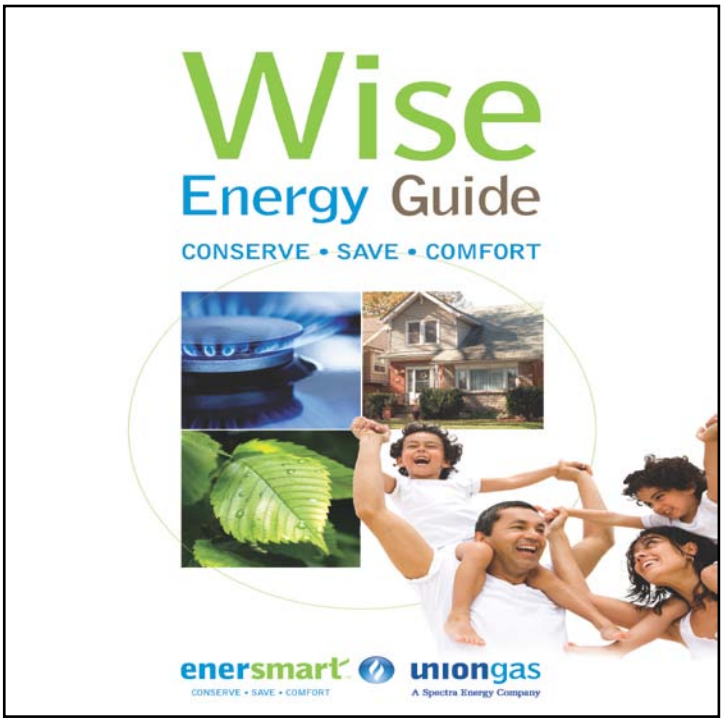


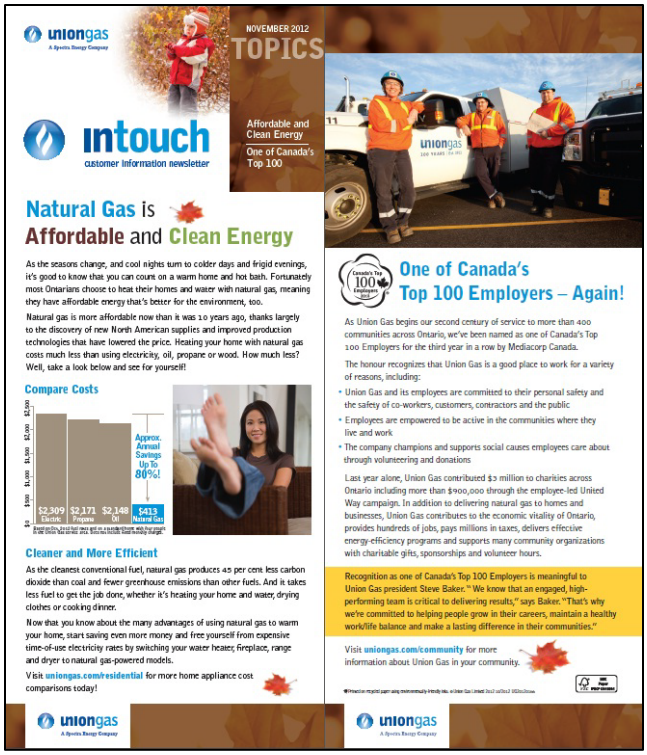
Figure 4.12, Wise Energy Guide

intouch Monthly Newsletter

Union continues to distribute the monthly *intouch* residential customer newsletter in both print and online versions. The newsletters include educational messages about energy efficiency, natural gas safety and the environmental and money savings related to using natural gas.

Feature topics in 2012 included:

- The importance of regular equipment maintenance;
- Seasonal tips to reduce energy use;
- Advantages of using natural gas;
- Carbon monoxide safety information;
- Understanding your natural gas bill; and
- Why you must call before you dig.



unongas
A Spectra Energy Company

NOVEMBER 2012
TOPICS
Affordable and Clean Energy
One of Canada's Top 100

intouch
customer information newsletter

Natural Gas is Affordable and Clean Energy

As the seasons change, and cool nights turn to colder days and frigid evenings, it's good to know that you can count on a warm home and hot bath. Fortunately most Ontarians choose to heat their homes and water with natural gas, meaning they have affordable energy that's better for the environment, too.

Natural gas is more affordable now than it was 10 years ago, thanks largely to the discovery of new North American supplies and improved production technologies that have lowered the price. Heating your home with natural gas costs much less than using electricity, oil, propane or wood. How much less? Well, take a look below and see for yourself!

Compare Costs

Cleaner and More Efficient

As the cleanest conventional fuel, natural gas produces 45 per cent less carbon dioxide than coal and fewer greenhouse emissions than other fuels. And it takes less fuel to get the job done, whether it's heating your home and water, drying clothes or cooking dinner.

Now that you know about the many advantages of using natural gas to warm your home, start saving even more money and free yourself from expensive time-of-use electricity rates by switching your water heater, fireplace, range and dryer to natural gas-powered models.

Visit uniongas.com/residential for more home appliance cost comparisons today!

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One of Canada's Top 100 Employers – Again!

As Union Gas begins our second century of service to more than 400 communities across Ontario, we've been named as one of Canada's Top 100 Employers for the third year in a row by Mediacorp Canada.

The honour recognizes that Union Gas is a good place to work for a variety of reasons, including:

- Union Gas and its employees are committed to their personal safety and the safety of co-workers, customers, contractors and the public
- Employees are empowered to be active in the communities where they live and work
- The company champions and supports social causes employees care about through volunteering and donations

Last year alone, Union Gas contributed $3 million to charities across Ontario including more than $900,000 through the employee-led United Way campaign. In addition to delivering natural gas to homes and businesses, Union Gas contributes to the economic vitality of Ontario, provides hundreds of jobs, pays millions in taxes, delivers effective energy-efficiency programs and supports many community organizations with charitable gifts, sponsorships and volunteer hours.

Recognition as one of Canada's Top 100 Employers is meaningful to Union Gas president Steve Baker. "We know that an engaged, high-performing team is critical to delivering results," says Baker. "That's why we're committed to helping people grow in their careers, maintain a healthy work/life balance and make a lasting difference in their communities."

Visit uniongas.com/community for more information about Union Gas in your community.

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Figure 4.13, *intouch* Newsletter

Residential HVAC Newsletter

In 2012, Union continued to target residential HVAC contractors through the GasFacts newsletter. This newsletter provides updates to the HVAC community related to Union's energy efficiency programs, codes and standards, recalls and manufacturers' notifications, as well as rebate offers from Union and third party organizations. In 2012, the GasFacts email list was expanded to include approximately 1600 email addresses.

Dedicated HVAC Webpage

The HVAC partners section of the Union website has been designed to inform HVAC's and the industry of relevant information, updates, codes and standards, in addition to driving further energy conservation messages and measures in the new construction and retrofit markets. The website hosts past GasFacts editions as well as FAQ's, rebate and incentive information, equipment and technical support, and other information.

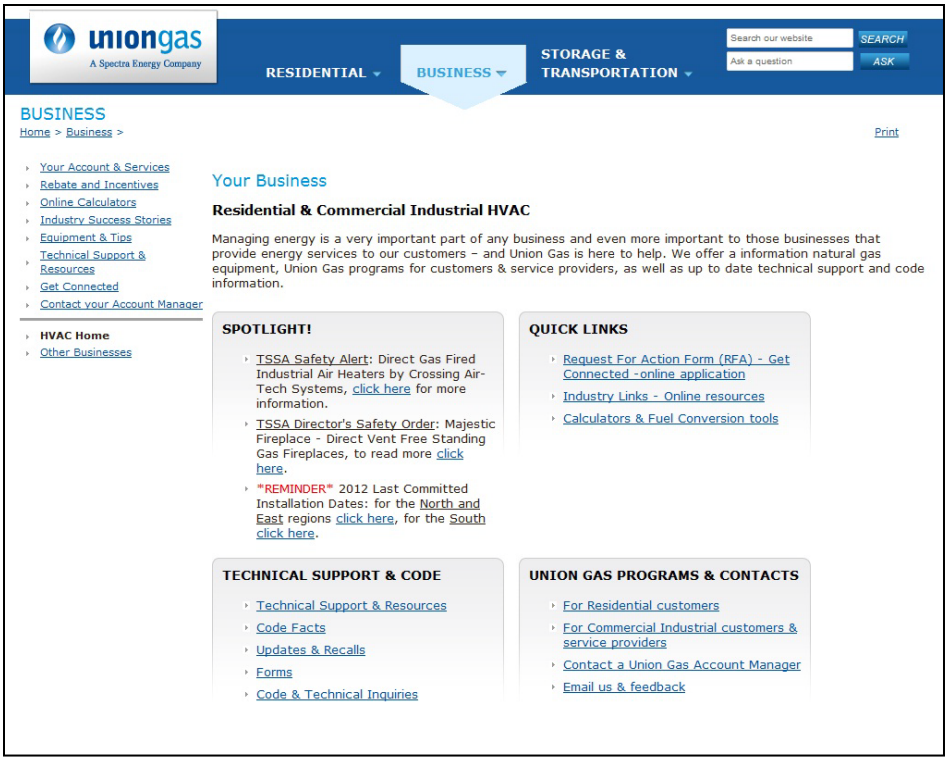


Figure 4.14, HVAC Webpage: www.uniongas.com/hvac

4.1.4 Lessons Learned

1. Direct Mail Campaigns

Union has been utilizing direct mail campaigns since 2010 to promote the offering to customers who hadn't previously received an ESK. Union's participation rate has been declining over that past few years, from 7% in 2010; 5% in 2011; to 3% in 2012. This has resulted in an increase in the distribution cost per ESK for this channel, rendering direct mail campaigns a less effective means to promote ESKs.

2. Retailer Events

Retailer events are becoming less cost effective and are yielding fewer ESKs per event. There are only a limited number or large retail locations within our franchise and most have hosted events in the past. The smaller retail locations have been tested in the past but have proven ineffective given the small amount of store traffic.

3. Home Retrofit Peak Seasons

The Home Retrofit Program was launched in August 2012. A total of 96 customers participated in the offering. Union anticipated seasonal peaks to renovations and upgrades which was further confirmed by service provider contacts; a focus on basement upgrades and exterior wall insulations in spring and heating system upgrades in the fall. Going forward, Union will be tailoring its marketing efforts to coincide with these two peak seasons.

4. Partnership Considerations

Union's partnership with Direct Energy for the delivery of the Home Retrofit offering raised some concerns from The Heating, Refrigeration and Air Conditioning Institute of Canada (HRAI) and its members. The primary concern was that partnering with a single entity on this offering created an unfair competitive advantage in the market for the chosen partner. HRAI felt that this offering should be open to all market players to create an even playing field in the market. Although it was never Union's intention to create an unfair advantage for any particular partner, Union heard and understood the concerns that HRAI raised and is working on addressing them in the new Home Retrofit market approach for 2013.

4.2 Commercial/Industrial Program

A portfolio of energy efficient technology related incentives were available to commercial/industrial customers in 2012. Union uses the EnerSmart brand platform to promote the adoption of high efficiency natural gas technologies and/or processes, as well as promote energy audits, surveys, studies etc. Union's Commercial/Industrial program is divided into two offerings: prescriptive, and custom. Program savings results, budget spend, and program TRC are presented in Tables 4.7, 4.8 and 4.9 below.

Table 4.7 – 2012 Commercial/Industrial Program Results

Program	Offering	Units	Annual Gas Savings (m^3)	Cumulative Gas Savings (m^3)	Total Spend	Net TRC	TRC Ratio
Commercial/ Industrial	Prescriptive	26,377	10,366,742	202,274,442	$ 4,875,327	$ 16,836,551	2.33
	Custom	767	38,760,627	656,087,561	$ 6,438,967	$ 65,643,683	3.41
2012 Commercial/Industrial Total		**27,144**	**49,127,369**	**858,362,004**	**$ 11,314,294**	**$ 82,480,234**	**3.07**

Table 4.8 – 2012 Commercial/Industrial Program Spend

Item	Total
Incentives	$ 7,496,748
Administration	$ 2,405,403
Evaluation	$ 81,363
Promotion Costs	$ 1,330,780
2012 Total Commercial/Industrial Program Spend	**$ 11,314,294**

Table 4.9 – 2012 Commercial/Industrial Program Cost-Effectiveness

	TRC Benefits (a)	TRC Costs (b)	Net TRC (c)=(a-b)	TRC Ratio (d)=(a/b)
Measures	$ 122,377,693	$ 36,079,913	$ 86,297,780	3.39
Administration		$ 2,405,403		
Evaluation		$ 81,363		
Promotion		$ 1,330,780		
Commercial/Industrial Program Total	**$ 122,377,693**	**$ 39,897,459**	**$ 82,480,234**	**3.07**

4.2.1 Prescriptive & Quasi-Prescriptive Offering

Union continues to offer a full suite of prescriptive and quasi-prescriptive measures to more than 100,000 commercial customers. These customers encompass eleven main customer segments: office, retail, multi-family, foodservice, hotel & motel, manufacturing, agriculture, warehouse, entertainment & recreation, education and healthcare and all fall within the commercial rate classes: M1, M2, M4, M5, M7, R01, R10 and R20.

1. ***Prescriptive Measures:*** These measures have predictable energy savings based on the size and classification of the equipment.

2. ***Quasi-Prescriptive Measures:*** These measures are slightly different than the prescriptive technologies. The key difference is that the potential energy savings for these technologies are 'quasi-prescriptive' not prescriptive. This means that the majority of the saving inputs will be prescriptive; however, there will be one or possibly few inputs that need to be customized for each installation to determine the cumulative m^3 savings. Examples of inputs that would have to be customized for each installation/claim are: where a piece of equipment is installed (new or existing building), type of business (e.g. Foodservice or Healthcare) and size of equipment (e.g. CFM or BTU).

Target Market

Union Gas continues to approach segments of the commercial market uniquely based on the business/industry type. Segmenting based on business type means that Union approaches 'like' customers in a harmonized way and targets each segment with more customized, relevant and valuable communications. This approach allows Union to use existing resources more effectively to educate business customers about potential energy savings. In addition, segmenting based on business type has provided Union with market insights; allowing better understanding of Union's commercial customer base and barriers for DSM uptake. Details specific to each of the prescriptive and quasi-prescriptive measures are provided below.

Market Incentive

Union offered the prescriptive incentives as outlined in Table 4.10 below, as well as some bonus incentives for a few of the initiatives as detailed in this section. In addition, National Account customers were also eligible for a multi-unit installation incentive. National Account customers have the ability to install various different energy efficient technologies within numerous locations across Union's franchise. As a result of the high number of savings opportunities, Union designed a bonus structure to encourage multiple installations by National Account customers within a given year. The following bonus was offered in 2012:

- 25% incentive increase on 6-30 installations per national account
- 50% incentive increase on >30 installations per national account

The key reasons for this initiative was to encourage more meaningful conversations with National Account franchises and corporate offices to adopt energy efficiency technologies broadly versus only in areas where the return on investment was the greatest. It also encouraged the early retirement of inefficient equipment and the opportunity to install emerging technologies.

Table 4.10 –Commercial/Industrial Prescriptive Offering Incentives

Initiative	Measure	Customer Incentive	Service Provider	Distributor Incentive
Water Heating	Hot Water Conservation*	Free		
	Condensing Gas Water Heaters - 100, 500 & 1,000 gal/day/tank	$ 150	$ 50	$ 50
	Front Loading Clothes Washer – CEE Tier 2 Program	$ 200	$ 50	
	Laundry Washing Equipment with Ozone - ≤ 120 lbs & 100,000 - 199,999 lbs/yr	$ 1,000	$ 100	
	Laundry Washing Equipment with Ozone - ≤ 120 lbs & ≥ 200,000 lbs/yr	$ 1,500	$ 100	
	Laundry Washing Equipment with Ozone - > 120 lbs & ≥ 260,000 lbs/yr	$ 6,000	$ 100	
Space Heating	Air Curtains - Pedestrian Single Door	$ 150	$ 100	
	Air Curtains - Pedestrian Double Door	$ 300	$ 100	
	Air Curtains - Shipping and Receiving (8x8, 8x10)	$ 600	$ 100	
	Air Curtains - Shipping and Receiving (10x10)	$ 1,200	$ 100	
	Condensing Boiler - ≤ 299 MBtu/hr	$ 600	$ 100	$ 50
	Condensing Boiler - 300 to 999 MBtu/hr	$ 1,500	$ 100	$ 50
	Condensing Boiler - ≥ 1,000 MBtu/hr	$ 4,500	$ 100	$ 50
	Condensing Rooftop Units (MUA) Improved efficiency 1,000 – 4,999 CFM	$ 300	$ 100	
	Condensing Rooftop Units (MUA) Efficiency + 2 speed 1,000 – 4,999 CFM	$ 800	$ 100	
	Condensing Rooftop Units (MUA) Improved efficiency ≥ 5,000 CFM	$ 1,000	$ 100	
	Condensing Rooftop Units (MUA) Efficiency + VFDs 1,000 – 4,999 CFM	$ 1,200	$ 100	
	Condensing Rooftop Units (MUA) Efficiency + 2 speed ≥ 5,000 CFM	$ 1,600	$ 100	
	Condensing Rooftop Units (MUA) Efficiency + VFDs ≥ 5,000 CFM	$ 2,400	$ 100	
	Destratification Fan	$ 1,300	$ 100	
	ERV - ≤ 1,999 CFM	$ 600	$ 100	$ 50
	ERV - ≥ 2,000 CFM	$ 1,500	$ 100	$ 50
	HRV Multi Family, Health Care, Nursing	$ 400	$ 100	$ 50
	HRV 500 - 1,999 CFM - Hotel, Rest, Retail, Rec, School, Off, Warehouse, Man	$ 400	$ 100	$ 50

Initiative	Measure	Customer Incentive	Service Provider	Distributor Incentive
	HRV ≥ 2,000 CFM - Hotel, Rest, Retail, Rec, School, Off, Warehouse, Man	$ 700	$ 100	$ 50
	Infrared Heating**	$ 300	$ 100	$ 50
	Non Condensing Boiler - ≤ 299 MBtu/hr	$ 250	$ 100	$ 50
	Non Condensing Boiler - 300 to 999 MBtu/hr	$ 1,000	$ 100	$ 50
	Non Condensing Boiler - ≥ 1,000 MBtu/hr	$ 3,500	$ 100	$ 50
Commercial Kitchen	Pre-rinse Spray Nozzle - Installed	Free		
	Energy Star Dishwasher - Stationary Rack & Under counter	$ 100	$ 50	
	Energy Star Dishwasher - Rack Conveyor - Single & Multi Tank	$ 400	$ 50	
	Cooking Equipment - Energy Star Fryer, Convection Oven, or Steam Cooker	$ 200	$ 50	
	DCKV Fast Food - ≤ 4,999 CFM	$ 1,000	$ 100	
	DCKV Full Menu - 5,000 – 9,999 CFM	$ 2,500	$ 100	
	DCKV Dinner House - 10,000 – 15,000 CFM	$ 3,500	$ 100	

*Additional incentives available. For more information, see details below.
**Service Provider Incentive to HVAC Contractors only.

Market Delivery

When targeting each segment, Union's highly skilled team of AMs and marketing support execute on one or more of the following approaches:

- ***Direct Sales Approach***: With this approach, Union's AMs work directly with the end-user to educate them on potential options to improve the energy efficiency of their facilities, offerings available to facilitate those options, and how the application process works. The direct sales approach requires working with multiple contacts within an organization as well as service providers, manufacturers and distributors who are instrumental in affecting a decision to install energy efficient technologies.
- ***Mass Market Approach***: Union Gas uses a number of mass marketing techniques to target the end-use customer such as direct mails, email blasts, and advertising as well as event based marketing including tradeshows and other similar events to reach a large number of customers and channel partners.
- ***National Account Approach***: Union's National AMs communicate and influence end-use customers using a top-down, centralized approach. National Account customers are those that have multiple property locations throughout Union's franchise area with similar design and use, such as retail chains, property management firms and foodservice chains.

Not only does Union reach and influence through the above direct sales, mass market and national account approaches, but support is also provided by a network of industry partners. These industry partners specify or install energy efficient equipment and/or directly educate or influence Union's customers to adopt natural gas energy efficient equipment. Maintaining and cultivating relationships with each of the following industry partners ensures that they are informed of Union's programs and that they can articulate the savings, benefits and incentives to customers.

- ***Service Providers:*** Architectural consultants, builders, HVACs, engineering consultants and energy service companies.

- ***Associations:*** Associations align with segment specific approach to market and provide industry insight necessary to designing programs that resonate with customers and drive action.
- ***Manufacturers:*** Manufacturers of the technologies that Union promotes provide insight into products' key benefits, as well as an effective method to influence the market.
- ***Distributors:*** Distributors influence the market and their contractor customers. Contractors then influence the end-user customers installing the equipment.

By employing the various approaches to market and tailoring initiatives to specific business segments, Union is able to ensure communication with customers is relevant to their needs. For the purpose of this Report, prescriptive and quasi-prescriptive measures are grouped in terms of 'initiatives' for Water Heating, Space Heating, and Kitchen as detailed below.

4.2.1.1 Water Heating Initiatives

The Water Heating initiative is designed to reduce a customer's energy use and water consumption. In 2012 Union offered the following:

- Hot Water Conservation (HWC) - Designed to reduce hot water consumption and the corresponding natural gas required to heat the water through the installation of energy efficient showerheads and faucet aerators. Union supplied the measures at no charge to customers for self-installation. In 2012, Union continued to offer an installation rebate to encourage immediate installation of the HWC products and also enable the program to collected additional end-user information.
- Condensing Gas Water Heaters - High-efficient gas water heaters that operate at 95% thermal efficiency. This thermal efficiency is higher than the conventional tank type water heaters that operate at 80% efficiency – which results in faster hot water cycle times and, therefore, reduced building operating/energy costs.
- Front-Loading Clothes Washers – This technology extracts more moisture from the clothes, thereby reducing the time, energy and cost of drying.
- Ozone Laundry System - A piece of auxiliary equipment added onto a new or existing commercial washing machine which reduces the amount of chemicals, detergents and hot washing and drying times required to achieve the same standard of cleaning.

Target Market

Within the Water Heating initiative, there are specific target markets depending on the technology as detailed below:

- HWC targeted multi-family facilities and non multi-family facilities including education, hotel/motels and 'other' (such as long-term care, retirement, and recreational facilities).
- Condensing gas water heaters were targeted to multi-family, foodservice, education, entertainment & recreation and healthcare customers. In 2012, Union extended the program to customers who use more than 100 gallons per day.
- Marketing for the front-loading clothes washers targeted the multi-family segment.
- Ozone laundry was marketed to customers with large volumes of laundry such as hotel/motels, laundry services, long-term care and healthcare segments.

Market Incentive

- HWC includes the following free measures for each shower and sink contained within each unit of their building:
    - 1.25 gpm showerhead
    - 1.5 gpm kitchen aerator eligible for kitchen in multi-unit family and commercial kitchens
    - 1.0 gpm bathroom aerators

  In addition, a $3 per product installation incentive was offered to the participants if the equipment was installed within eight weeks of shipment.

- The incentive for condensing gas water heaters was $150 per unit.

- The front-loading clothes washer incentive was $200 per unit.

- The incentive for the ozone laundry rental or leased equipment consisted of:
    - Washer Extractor(WE) ≤ 120 lbs capacity & 100,000 to 199,000 lbs/yr - $1,000 per unit
    - WE ≤ 120 lbs capacity & ≥ 200,000 lbs/yr - $1,500 per unit
    - WE > 120 lbs capacity & > 260,000 lbs/yr - $6,000 per unit

  Union offered a special segment-specific bonus incentive of $200, $500 and $800 per unit corresponding to the bullet list above to hotel/motel and laundromat customers to encourage program uptake.

Market Delivery

- Union continued to deliver HWC through Ecofitt in 2012. Ecofitt was responsible for tracking and managing all orders generated by Union's mass market campaigns through Ecofitt's online system or by fax, mail or phone. Through the Ecofitt delivery mechanism, Union distributed 23,564 individual units within the multi-family segment in 2012, a significant decline from 41,571 in 2011. HWC was promoted through:
    - Tradeshows and events, such as the Property Management Expo;
    - Key associations;
    - National Accounts approach; and
    - Union's business website.

- Condensing Gas Water Heater marketing efforts included promotion through a direct sales approach, mass market initiatives (individualized customer letters and email blasts), tradeshows, events, and key association publications.

- Union Gas made a conscious decision to ramp down efforts relating to the front-loading clothes washer measure in 2012 and concentrate program budget on measures that drive more cost effective natural gas savings.

- The ozone laundry marketing efforts included promotion through a direct sales approach by collaboration with technology manufacturers to effectively reach and influence early technology adopters. Union began a collaborative approach with the technology manufacturers to offer equipment demonstration in hotel/motel franchisees to illustrate the benefits of the technology to the customer prior to installation. In addition to the special demonstrations, and traditional marketing, Union offered a special segment-specific bonus incentive to hotel/motel and

laundromat customers to encourage program uptake as noted above. As a result of these efforts, there was a substantial increase in the ozone technology uptake in 2012.

Figure 4.15, Ozone Laundry Equipment Direct Mail

4.2.1.2 Space Heating Initiatives

The Space Heating Initiative is designed to stimulate customer action to retire older inefficient space heating equipment and install new energy efficient space heating equipment. In 2012, Union offered the following:

- Air curtain technology - Delivers a controlled stream of air that separates the indoor and outdoor environment. Air curtains reduce infiltration of cold or hot outside air through doorways, significantly reducing natural gas heating in winter and air conditioning in summer. Air curtains are often used where doors stay open for long periods of time. Typical examples include shipping docks and retail or office entrances.

- Condensing boiler - Recovers energy that would normally be discharged into the atmosphere through a flue. This improves heating efficiency by approximately 15-20% compared to a conventional boiler, resulting in reduced gas bills. It also requires less space, offering more flexibility in small space environments.

- Condensing Make-up Air – These units are indirect gas fired and provide fresh air to common areas in commercial buildings. The majority of furnaces built into rooftop units are mid-efficiency units with efficiencies ranging from 78% - 82%. Condensing technology offers improved efficiencies of 90% and above and the high 'turn down' feature results in lower operating costs, and better control and comfort. There are three sub-categories for this technology:

1. Improved efficiency
2. Efficiency + 2 speed
3. Efficiency + Variable Frequency Drives (VFDs)

Condensing technology is relatively new in the marketplace. As a new technology, the adoption rate continued to be minimal in 2012 but momentum is expected to increase throughout 2013.

- Destratification fans - Large downdraught fans ranging from 8 to 24 feet in diameter. They offer an inexpensive and efficient way to bring heat down from the ceiling to mix with cooler floor temperature air, ensuring a consistent and comfortable temperature where it is most needed. Facilities with large stratified temperature differences have the greatest potential for energy savings; typically, the greater the ceiling height, the greater the potential for savings in the heating load.

- ERV/HRV - ERVs capture heat and moisture, while HRVs capture heat. The recovered heat energy from the indoor air is used to heat air entering the building. ERVs & HRVs reduce the energy use associated with heating the space and related energy costs, and make the whole system operate more efficiently.

- High-Efficiency Non-Condensing Boilers - In 2012, Union launched the high efficiency non-condensing boiler technology for space heating, domestic water heating or a combination of both applications. Significant savings can be achieved through the installation of high efficiency non-condensing boilers with a combustion efficiency of over 85% in comparison to older boilers currently still being used in the market.

- Infrared Heaters – This measure helps customers conserve energy and money, as they deliver heat directly to where it's needed instead of heating the air within a space, like traditional forced air heating systems**.** Efficiency for this technology is especially evident in large volume buildings that do not require a steady state of heat or where there is a large amount of air exchange such as near a loading dock.

Target Market

Within the Space Heating initiative, there are specific target markets depending on the technology as detailed below:

- Air Curtains were targeted to warehouse and manufacturing segments.

- All commercial/industrial customers were eligible for the Condensing Boiler measure; however Union Gas mainly targets healthcare, multi-family and education customers.

- Condensing Make-up Air was targeted primarily to multi-family and healthcare segments as well as all other segments where the technology is appropriate.

- Destratification Fans were targeted to warehouse and manufacturing facilities with high ceilings.

- All commercial/industrial customer segments are eligible for ERVs/HRVs, provided an engineer stipulates that it is not a code requirement. Union mainly targets healthcare and education customers.

- High-Efficiency Non-Condensing Boilers are available to all commercial/industrial customers, however Union mainly targets healthcare, multi-family and education customers.

- For the Infrared Heater technology, Union targeted segments such as, warehouses, agriculture, retail and manufacturing.

Market Incentive

- Union offered end-use customers the following incentives for Air Curtains:
    - Shipping Doors: $600- $1,200 per unit
    - Pedestrian Doors: $150- $300 per unit

- For Condensing Boilers, Union offered end-use customers $600-$4,500 per unit.

- The incentives for Condensing Make-Up Air were as follows:
    - Improved efficiency $300-$1,000 per unit
    - Efficiency + 2 speed $800- $1,600 per unit
    - Efficiency + Variable Frequency Drives (VFDs) $1,200 - $2,400 per unit

- Destratification fans were eligible for $1,300 per unit.

- Union offered an end-use customer incentive of $400-$1,500 per unit for ERVs/HRVs.

- High-Efficiency Non-Condensing Boilers were eligible for incentives of $250 - $3,500 per unit.

- For Infrared Heaters, Union offered end-use customers $300 per unit.

Market Delivery

- Marketing efforts for Air Curtains included a direct mail to warehouse and manufacturing customers and a direct sales approach primarily with National Accounts customers. To build awareness and encourage adoption, an air curtain introductory bonus was offered until December 2012 at an additional $300 per unit.

- Condensing Boilers, ERVs/HRVs, and High-Efficiency Non-Condensing Boilers were promoted through:
    - Direct and national account sales approach;
    - Key healthcare and education association ads, press releases, newsletters, publications as well as through direct mails and email blasts to their membership who are also Union's customers;
    - Key healthcare and education tradeshows and events and speaking opportunities highlighting condensing boilers and customer testimonial success stories, such as the Ontario Association of School Business Officials;
    - Building and maintaining relationships with key service providers and manufacturers to ensure education and awareness of Union's programs, as well as promotion of the programs to their customers; and
    - Developed marketing collateral to be used as a leave behind with customers after a direct sales call.

Figure 4.16, Condensing Boiler Primer

- The marketing of Condensing Make-Up Air units included a direct sales approach, tradeshows, educational workshop opportunities to create knowledge and awareness, as well as targeted marketing materials, such as customized sales letters.

- Marketing efforts for Destratification Fans included working with manufacturers and targeting potential customers, such as warehousing and manufacturing segments, via mass marketing direct mail and targeted communication. Relationships with service providers and manufacturers continued to be a key focus in 2012 to ensure Union's offering was being consistently promoted to their customers.

- Union's promotion of Infrared Heaters was through a direct sales approach, and mass marketing initiatives such as direct mails, email blasts, and Union's website. Furthermore, Union promoted the technology though building/maintaining relationships with key service providers, distributors, contractors and manufacturers to ensure they are educated about Union's programs and to ensure they are promoting it to their customers.

Figure 4.17, Infrared Heater Poultry Barn Direct Mail

4.2.1.3 Commercial Kitchen Initiatives

The Commercial Kitchen Initiative is designed to encourage food establishment owners and operators to install high efficiency technologies and Energy Star cooking equipment which are designed to reduce hot water consumption and/or natural gas. In 2012, Union offered the following:

- Efficient Pre-Rinse Spray Nozzle - This technology involves a high pressure 0.64 gpm nozzle. This is the most efficient spray nozzle available in North America.

- Cooking Equipment (EnergyStar fryers, steam cookers and convection ovens) - High Efficiency and Energy Star Cooking Equipment is 20-50% more efficient than traditional cooking equipment. Eligible equipment includes Energy Star fryers, steam cookers and convection ovens.

- Demand Control Kitchen Ventilation (DCKV) - Traditional ventilation systems operate at only one speed, whereas the speed of demand control kitchen ventilation systems automatically respond to changes in cooking volume and heat, resulting in much greater efficiency. The prescriptive savings for DCKV were based on three ranges of total range hood exhaust: 0 – 4999 CFM, 5000–9999 CFM, and 10,000–14,999 CFM.

- Energy Star Dishwashers - Energy Star commercial dishwashers reduce energy, water consumption and improve performance. On average they are 25% more energy efficient and 25% more water efficient than standard models. Models include under counter, door and conveyor type as well as rack-less conveyor.

Target Market

Within the Commercial Kitchen initiative, there are specific target markets depending on the technology as detailed below:

- The Efficient Pre-Rinse Spray Nozzle measure is relevant to establishments with commercial kitchens. Union focused on the following segments: foodservice, hotel & motel, retail, long-term care, education and entertainment.

- Cooking Equipment, DCKV and Energy Star Dishwashers were targeted to the following commercial kitchen customer segments: foodservice, hotel/motel, education, and healthcare segments.

Market Incentive

- Eligible participants received a free Efficient Pre-Rinse Spray Nozzle including free installation.

- For Cooking Equipment, Union offered $200 for each unit.

- The incentives for DCKV were based on unit sizes:
    - Up to 4,999 CFM – $1,000 per unit
    - 5,000 to 9,999 CFM – $2,500 per unit
    - 10,000 to 15,000 CFM – $3,500 per unit

- Energy Star Dishwasher incentives were as follows:
    - Under counter and Stationary Rack models - $100 per unit
    - Rack Conveyor models - $400 per unit

Market Delivery

- In 2012, Union Gas exited the pre-rinse nozzle program offering. The decision to retire the program was based on the success of previous years' market efforts which appear to have resulted in market saturation of the technology. Union acquired a deeper portion of the market opportunity through its third party delivery partner Ecolab Corporation. As opportunities for program uptake diminished, Union decided to withdraw the measure from the offering.

- Marketing efforts for cooking equipment included mass marketing to commercial kitchen customers through email blast, and association newsletters and trade publications, as well as a direct marketing approach to the foodservice, hotel/motel, education and healthcare segments. Union also utilized a targeted National Accounts strategy to the foodservice segment to capitalize on program uptake from the key chains within Union's franchise. To further enhance Union's efforts, Union focused on continued relationship management with manufacturers to support awareness of Union's program and to ensure it was being promoted to their customers.

- Union works closely with manufacturers and end use customers to promote DCKV systems. Union marketed the benefits of DCKV through the following communication vehicles: industry trade magazine advertisements, mass marketing and personalized customer letters through direct mail, trade show participation and a National Accounts strategy and a multi-installation bonus with foodservice chains.

- The marketing of Energy Star Dishwashers included a direct sales approach with National Account customers, partnerships with manufacturers, tradeshows, as well as a targeted marketing materials e.g., personalized customer letters.

4.2.2 Custom Offering

Union focuses on advancing customer energy efficiency and productivity through providing a mix of custom incentives, education and awareness to commercial and industrial customers across all segments. The objective of the custom offering is to generate long-term and cost-effective energy savings for Union Gas customers.

Target Market

Custom offerings cover opportunities where energy savings are linked to unique building specifications or design concepts, processes or new technologies that are outside the scope of prescriptive and/or quasi-prescriptive measures. The offerings and incentives are targeted direct to the end-user, while trade allies involved in the design, engineering and consulting communities assist to expand the message of energy efficiency.

Market Incentive

Various incentives are available for custom participants specific to education and audit assessments, however the resource acquisition incentive value for projects is $0.10 per annual m^3 of natural gas saved.

Market Delivery

There are numerous approaches to delivering the custom offering, many of which involve customer education designed to increase awareness on energy efficiency opportunities and benefits. These include the following:

Engineering Feasibility and Process Improvement Studies

Union supported the completion of studies to identify and quantify potential energy savings measures. Furthermore, Union supported comprehensive process improvement studies to determine and assess financial costs and benefits of energy-efficiency opportunities, supporting the customer's internal decision making process.

Operation and Maintenance Practices

Union Gas provided financial incentives to support the completion of operation and maintenance actions and practices which result in saving natural gas, and which may also increase energy-efficiency and/or improve productivity of customers' operations. These incentives were available for customers, with or without an engineering feasibility or process improvement study.

New Equipment and Processes

Union Gas provided financial incentives to support the installation of new equipment and processes which result in saving natural gas, and which may also increase energy-efficiency and/or improve productivity of customer's operations. These incentives were available for customers, with or without an engineering feasibility or process improvement study.

Energy Management

Union Gas provided financial incentives to support the installation of energy meters, monitoring and management systems, allowing customers to manage the energy intensity of their operations actively and continuously.

2012 Custom Offering Highlights

Custom projects are no longer required to screen TRC positive on an individual basis. Rather the commercial/industrial program as a whole must screen TRC positive. This has allowed Union the ability to support customer projects with higher simple payback periods such as solar walls, window replacements and thermal barrier upgrades. Previously, each custom project was required to screen TRC positive for a financial incentive.

Union Gas continues to utilize a rigorous quality control process for all custom projects. Professional Engineers (P.Eng), licensed to practice in Ontario, assist customers with the quantification of energy savings prior to application submission. After application submission, all custom projects undergo a secondary P.Eng review to validate the reasonableness of the savings calculations, while ensuring appropriate supporting documentation is provided.

In the spirit of continuous improvement, two significant process improvements were instituted in 2012, with the intention of solidifying the electronic application and review process for custom projects:

1) Union Gas developed eight standard calculators to consistently estimate natural gas savings for common commercial custom projects. The standard calculators are as follows:
    - Formula 1 laundry
    - Destratification Fan
    - Make-up air VFD retrofit
    - Make-up air
    - Hot water heating
    - Roof insulation
    - Boiler combustion control
    - Window

2) All custom projects utilize an application summary excel workbook, to accurately summarize all key project inputs, variables and details. This summary workbook strengthened Union's secondary P.Eng. review, and was implemented to assist in the annual verification of custom projects.

4.2.3 Education & Awareness

Union offers a wide variety of materials and workshops aimed at building awareness for energy efficiency in the customer's facility. The focus is on educating the customer and their employees on how to identify energy conservation opportunities and supply them with the resources to research and evaluate possible solutions. Specific customer education and awareness efforts included:

High Performance Boiler Solution – Technical Workshop

Union Gas partnered with the Canadian Boiler Society to deliver three training workshops in London, Burlington and Ajax focusing on High Performance Boiler Solutions. The workshops presented common boiler solutions to increase energy-efficiency and save natural gas. Topics included; boiler combustion tuning, electronic boiler combustion control, feed-water economizer, blow-down heat recovery and operation & maintenance practice.

Steam System Performance Solution – Technical Workshop
Union Gas partnered with Swagelok Energy Advisors, a world-class leader in steam system solutions, to deliver three workshops in Sudbury, London and Burlington. These workshops focused on educating steam system operators and engineers on the best-in-class operation & maintenance practices to increase fuel-to-steam efficiency and overall system efficiency.

Hospital Steam System – Walkthrough Blitz
Union Gas partnered with Spirax Sarco, a leading steam system equipment and solutions provider, to conduct steam system walk-thru blitzes of seven hospitals. The blitzes were intended to be short, intense activities providing a fresh perspective review of complex steam systems to identify short-term and long-term energy savings measures.

4.2.4 Lessons Learned

Prescriptive & Quasi-Prescriptive Offering

1. Bonus incentives and limited time offers are important tools that assist in advancing energy efficiency projects. They create a sense of urgency with customers, generate new project leads, and result in early retirement of inefficient pieces of equipment. They also allow Union to target deeper energy efficiency opportunities within customer facilities and to better target segments that have been slower in adopting energy efficient technologies.

2. Equipment such as Ozone Laundry Equipment, Demand Control Kitchen Ventilation and Destratification Fans all help save energy in facilities, however they are not considered "vital" to the operation of a facility; therefore customers have appeared less interested in adopting them. In 2012, Union explored new methods to engage customers on these technologies (as with the Ozone Laundry Site Demonstrations) and will continue to explore new and innovative ways to increase technology adoption and influence the marketplace.

Custom Offering

1. Developing eight standard calculators for common commercial custom projects assisted in accurately estimating natural gas savings. In addition, using a common calculation method and input template, custom applications are streamlined for efficiency from both the customer and Union's perspective. At the time of their development, these eight calculators are expected to be useful for approximately 30% to 40% of all commercial custom applications – the remainder being customer specific.

2. All custom projects utilized a project application summary workbook to consistently summarize all key project inputs, variables and details. This summary workbook strengthened Union's internal quality control P.Eng review, and is also expected to improve the annual verification of custom projects from the third-party perspective.

5. Low-Income Scorecard

Low-Income programs are similar in nature to resource acquisition programs, but are separated to recognize the specific needs of this customer group. They may result in lower TRC net savings than non-low-income programs as well as various other benefits that are difficult to quantify[4]. These programs also more adequately address the challenges involved in identifying and providing DSM programs for and the special needs of this consumer segment. Like resource acquisitions programs, low-income programs seek to achieve direct, measureable savings customer-by-customer and involve the installation of energy efficient equipment.

Table 5.0 presents the results of the low-income scorecard. Union achieved 150% of the overall scorecard target, resulting in an incentive of $2.725 million.

Table 5.0 – 2012 Low-Income Scorecard Results

Metrics	Metric Target Levels			Weight	Achievement	% of Metric Achieved	Weighted % of Scorecard Achieved
	Lower Band	Target	Upper Band				
Cumulative Natural Gas Savings from Single Family (m^3)	20,600,000	30,000,000	37,500,000	65%	44,042,693	194%	126%
Cumulative Natural Gas Savings from Multi-Family (m^3)	9,750,000	13,000,000	16,250,000	35%	11,871,819	83%	29%
				Total Scorecard Target Achieved			***150%***[5]
				Scorecard Incentive Achieved			***$ 2,725,227***

The single family metric consists of cumulative m^3 saved from the Helping Homes Conserve offering (basic measures and insulation upgrades). The multi-family metric consists of cumulative m^3 saved from the Affordable Housing Conservation offering.

5.1 Low-Income Program

The Low-Income program is designed to reduce the energy burden facing low-income single family and multi-family dwelling customers. In 2012, Union's Low-Income single family offerings consisted of a standalone basic measure offering and a building envelope offering. While finalizing the 2012-2014 DSM Plan, Union agreed to retire the standalone basic measure offering by Q2 2012 and focus efforts on larger, long-lasting savings. To ensure this exit took place, Union agreed to a cap on the low-income scorecard of 7.7 million cumulative m^3 earned through the standalone basic measure offering. Details for these offerings are located in section 5.1.1 and 5.1.2.

[4] These various benefits not captured by the traditional net TRC savings measure may include reduction in arrears management costs, increased home comfort, improved safety and health of residents, avoided homelessness and dislocation, and reductions in school dropouts from low-income families

[5] Actual scorecard achievement result is 155%. Maximum achievement is capped at 150%.

Union introduced a social and assisted housing offering for the multi-family market in Q2 2012. This offering provides municipalities and social and assisted housing owners with enhanced incentives on all multi-family prescriptive and custom measures currently offered in the Commercial/Industrial Program. Details of this offering are located in section 5.1.3.

Table 5.1 shows the results of the Low-Income program. The total spend for the Low-Income program is administered on a program level and is not available per offering. Table 5.2 breaks down the total spend into its components.

Table 5.1 – 2012 Low-Income Program Results

Program	Offering	Units	Annual Gas Savings (m^3)	Cumulative Gas Savings (m^3)	Total Spend	Net TRC	TRC Ratio
Low-Income	Affordable Housing Conservation	6,756	601,126	11,871,819			
	Helping Homes Conserve (Basic) [6]	30,218	750,144	7,901,520	$ 7,702,047	$ 2,488,180	1.32
	New Helping Homes Conserve	3,672	1,491,631	36,342,693			
2012 Low-Income Total		40,646	2,842,901	56,116,031	$7,702,047	$2,488,180	1.32

Table 5.2 – 2012 Low-Income Program Spend

Item	Total
Incentives	$ 5,342,715
Administration	$ 893,499
Evaluation	$ 188,205
Promotion	$ 1,277,628
2012 Total Low-Income Program Spend	**$ 7,702,047**

Table 5.3 shows the calculation of the Low-Income program's TRC ratio. The Low-Income program's net TRC benefits exceed its net TRC costs by $2.488 million.

[6] While the Helping Homes Conserve (Basic) offering achieved savings of 7.9 million m^3, this offering is capped at 7.7 million m^3 when its results are applied to the Low-Income scorecard.

Table 5.3 – 2012 Low-Income Program Cost-Effectiveness

	TRC Benefits (a)	TRC Costs (b)	Net TRC (c)=(a-b)	TRC Ratio (d)=(a/b)
Measures	$ 10,339,502	$ 5,491,990	$ 4,847,512	1.88
Administration		$ 893,499		
Evaluation		$ 188,205		
Promotion		$ 1,277,628		
Low-Income Program Total	**$ 10,339,502**	**$ 7,851,322**	**$ 2,488,180**	**1.32**

5.1.1 Helping Homes Conserve Offering *(Basic)*

Union continued to deliver the Helping Homes Conserve basic measure offering in Q1 across 13 communities. Union ended the delivery of the standalone basic measure offering in March 2012, but continued to offer basic measures as part of the new, more comprehensive, Helping Homes Conserve offering (Section 5.1.2). The standalone basic measure offering provided low-income customers with the free installation of energy-efficient showerheads, pipe wrap, and a programmable thermostat. Bathroom and kitchen aerators were left with the customer for self-installation.

Target Market

This offering targeted customers who met the following criteria:

- Income is at or below 135% LICO;
- Private homeowner or tenant who pays their own gas bills or;
- Tenants residing in social and assisted housing, regardless of who pays the gas bills.

March 2012 marked the exit of the standalone HHC basic offering. As such, Union promoted it to fewer communities than in recent years. Efforts were focused in large centres (Windsor, Hamilton, London, Guelph, Sarnia, Brantford, Belleville, North Bay, Sudbury) and a few surrounding small centres.

Market Incentive

The standalone HHC basic offering was delivered at no cost to the customer. Customers participating in could expect savings of up to $200 per year on their energy bills.

Market Delivery

Union's main approach to delivering the standalone basic measure offering was direct delivery and installation through a targeted neighbourhood strategy. A target list of low-income customers was developed through third party postal code data that identified neighbourhoods with a high propensity of low-income residents. These postal codes were then cross-referenced against Union's internal customer data and target lists were created. To ensure the privacy of customers, customer names were omitted from marketing materials and were never supplied to Union's third-party installation contractor.

Prior to a technician entering a neighbourhood, the identified customers were sent a direct mail piece letter that explained the program benefits and notified them that a technician would be visiting their neighbourhood in the next few weeks. Customers then received a notification flyer two to three days

prior to a technician's visit to remind them that personnel would be in the neighbourhood performing installations. Technicians would then visit the homes offering customers installations and/or schedule an installation at a more convenient time. Once the installation was completed, the customer would sign an acknowledgement form and receive a programmable thermostat instruction sheet and education guide which includes low cost energy conservation tips tailored to low-income customers. If a customer was not home, a door hanger would be left behind to let them know a representative had visited and to encourage them to call the toll free number provided or visit the web to book an appointment.

5.1.2 *New* Helping Homes Conserve Offering (*formerly Home Retrofit*)

In 2012, Union ramped up efforts around the Home Retrofit offering which provides building envelope upgrades to qualified low-income customers' homes. This offering was branded as Helping Homes Conserve (HHC) in order to leverage the brand equity and trust that was gained with customers through the basic measure offering that was eliminated as a standalone initiative in March. The new HHC offering provides low-income customers with a free home energy audit and upgrades including: attic insulation, wall insulation, basement insulation and draft-proofing measures. Basic measures including showerheads, aerators, pipe insulation and programmable thermostats are provided to qualified customers at the time of the home energy audit if they have not previously received them.

Target Market

This offering targets customers who meet the following criteria:

- Income is at or below 135% LICO;
- Occupants of single detached and low-rise multi-family (3 stories or less);
- Private homeowner or tenant who pays their own gas bills or;
- Tenants residing in social and assisted housing, regardless of who pays the gas bills.

Income verification is required to participate in this offering.

Large municipalities in Union's franchise and a few small surrounding centres were targeted in 2012, including: Windsor, Hamilton, London, Cambridge, Waterloo, Woodstock, Belleville-Trenton, Dunnville, St Thomas, North Bay and Guelph, Brantford, Simcoe, Port Hope and Cobourg.

Market Incentive

Helping Homes Conserve is delivered at no cost to the customer. Customers participating can receive all recommended thermal envelope upgrades at no cost as determined through the free energy audit. Customers can expect to reduce gas consumption by up to 30% and benefit from a much more comfortable home.

Market Delivery

Union's main approach to delivering the HHC offering is to work with experienced and reliable delivery agents to perform energy audits and measure installation. A second service provider was hired to respond to the increase in program targets as well as expand the program offering into additional communities within the franchise area. Measures that are installed in the home are determined by a free home energy audit performed by a Certified Energy Auditor. All measures that screened at 0.7 TRC

ratio or greater were installed in the home. After the measures were installed, a second home energy audit was conducted to verify the gas savings realized.

Figure 5.0, Helping Homes Conserve Brochure

Union was successful in delivering the Helping Homes Conserve offering to 1,481 customers in the social housing market and 271 customers in the private market for a total of 1,755 customers. 70% of realized gas savings were derived from social housing and 30% from the private market.

Table 5.4 illustrates the distribution and gas savings of Helping Homes Conserve customers both by region and housing market.

Table 5.4 – Helping Homes Conserve Distribution

Region	Homes Completed in Social Housing (SH)	Homes Completed in Private Market	Total m³ SH	Total m³ Private	Total m³ Saved	% of Total m³
Windsor	270	132	151,389	227,246	378,634	25%
Hamilton	352	56	228,752	83,691	312,443	21%
London	335	44	177,723	57,226	234,950	16%
Belleville-Trenton	100	0	50,112	0	50,112	3%
Dunnville	35	0	25,517	0	25,517	2%
St Thomas	149	0	130,315	0	130,315	9%
Guelph	68	0	65,579	0	65,579	4%
Brantford	138	42	166,747	86,840	253,587	17%
Simcoe	34	0	40,495	0	40,495	3%
Total	**1,481**	**274**	**1,036,628**	**455,003**	**1,491,631**	**100%**

Social and Assisted Housing Strategies

Targeted outreach to housing departments was conducted to ascertain multi-unit property listings owned by social and assisted housing providers. The findings were used to build a master list. Twenty seven municipal social and assisted housing providers were identified, and Union used direct sales to target key influencers and decision makers within these municipal providers. AMs were leveraged to manage these relationships and provide leads to the appropriate delivery agent for program implementation.

Private Market Strategies

Union developed a turn-key private market approach to augment the existing lead generation process in the social and assisted housing market. Customer intelligence, LICO level and home characteristics including age of home, size of home, and natural gas consumption were utilized to assess a customer's potential to qualify for low-income programs and to develop targeted direct mailing lists.

The direct mail campaign was specifically designed to focus on encouraging customers to see if they met the qualification requirements rather than posing the offering as a low-income "helping" program. Key elements of the re-design features a 'house proud' customer that highlights the overall improvement of home comfort and the courteous nature of the installers at absolutely no cost to the customer. Participation rates doubled from 2% to 4% upon the redesign of the marketing material for this campaign.

Figures 5.1/5.2, Helping Homes Conserve Direct Mail Letter and Door Hanger

Union also engaged in discussions with the City of London to learn more about the current interactions between their Community Development Managers and the 'at-risk' neighbourhoods within the city. To complement the comprehensive program application package used for the direct mail campaigns, smaller sized postcard program information cards were developed and provided to Community Managers for distribution at local meetings and town halls to generate program interest.

Figure 5.3, Helping Homes Conserve Postcard

Online Self Serve Web Strategy

Union's Helping Homes Conserve webpage www.uniongas.com/helpinghomes was designed to support the direct-mail marketing campaigns and to allow private homeowners, renters and social housing providers to register for the program and begin the screening process. The HHC webpage outlines the details of the offering, the benefits of participating, eligibility criteria and how to register. Union will continue to enhance the webpage in 2013 to include an online application form that will closely resemble the format of the application form included within the direct mail package, as well a customer testimonial, descriptions and images of the work that could be completed in the home.

Figure 5.4, Helping Homes Conserve Lawn Sign

Health and Safety

Through the home audit process, it has been found that almost 8% of qualifying homes were ultimately deemed ineligible due to health and safety issues within the building envelope. Environmental concerns such as inadequate ventilation, mould, moisture, asbestos, vermiculite, excessive clutter, and lead paint can prevent a customer's home from qualifying for the program. These health and safety problems can be a result of poor structural design, age of the home, as well as the inability for the homeowner to address maintenance concerns due to lack of time, knowledge and money. As a result, Union developed a Health & Safety Policy in 2012 to address these problems and to avoid disqualifying homes based on treatable environmental hazards. Homes that were audited in 2012 and deferred based on health and safety issues will be addressed in 2013.

5.1.3 Affordable Housing Conservation Offering (*formerly Social and Assisted Housing*)

In April 2012, Union launched the Affordable Housing Conservation (AHC) offering, targeting the social and assisted housing market. This offering includes custom and prescriptive measures for multi-family buildings in the social and assisted housing sector. In recognition of the limited capital available for upgrades in social housing, Union introduced enhanced incentives for these providers to implement any energy efficient measures available to commercial customers. These improved incentives aim to help this market segment achieve greater energy and cost savings in their properties long term.

Target Market

This offering targets social and assisted housing corporation managers that manage multi-family housing stock. Social and assisted housing is defined as housing developed, acquired or operated under a federal, provincial or municipally funded program.

Examples of social and assisted housing are:

- Non-profit corporations as outlined in the *Social Housing Reform Act, 2000*;
- Public housing corporations owned by municipalities directly or through Local Housing Corporations;
- Non-profit housing co-operatives as defined in the *Co-operative Corporations Act, 1990*;
- Non-profit housing corporations that manage/own rural and native residential housing; and
- Non-profit housing corporations that manage/own residential buildings developed under the Affordable Housing Program.

Union conducted outreach to the housing departments of Ontario's Ministry of Municipal Affairs and Housing to identify a list of multi-unit social and assisted housing properties. This information was then compared against the past participation in the Commercial/Industrial multi-family initiative. Market intelligence such as housing stock mix and an inventory of their equipment was gathered to build a low-income multi-family customer database and to identify opportunities for prescriptive and custom projects. This list continues to be improved and will be key to assessing future multi-family DSM market opportunities.

Market Incentive

Prescriptive Measures

The AHC offering includes all of the prescriptive measures offered to the multi-family segment within the standard Commercial portfolio. However, the incentive levels offered to the low-income sub-segment of the market are higher in recognition of the capital barriers that face this group. Participating social and assisted housing providers were responsible for sourcing service providers for installation of these measures and they received the appropriate incentives from Union upon project completion as outlined in Table 5.5 below. Service providers include architectural consultants, builders, HVACs, engineering consultants and energy service companies.

Table 5.5 – Affordable Housing Conservation Offering

Measure	End-user Incentive	Service Provider Incentive
Condensing Boiler – up to 299 MBtu/h	$0.10 per cumulative m^3	$ 100
Condensing Boiler – 300 to 999 MBtu/h	$0.10 per cumulative m^3	$ 100
Condensing Boiler – over 1,000 MBtu/h	$0.10 per cumulative m^3	$ 100
Non-Condensing Boiler – up to 299 MBtu/h	$0.10 per cumulative m^3	$ 100
Non-Condensing Boiler – 300 to 999 MBtu/h	$0.10 per cumulative m^3	$ 100
Non-Condensing Boiler – over 1,000 MBtu/h	$0.10 per cumulative m^3	$ 100
Condensing Gas Water Heater (1000 gal/day) purchase	$1,900 flat incentive	$ 100
Condensing Gas Water Heater (500 gal/day) purchase	$1,000 flat incentive	$ 100
Condensing Gas Water Heater (100 gal/day) purchase	$500 flat incentive	$ 100
ERV (New Build) Multi-family 0-2,000 CFM	$0.10 per cumulative m^3	$ 100
HRV (New Build) Multi-family	$0.10 per cumulative m^3	$ 100
MUA Unit (Existing Build) Improved Efficiency 1,000-4,999 CFM	$0.10 per cumulative m^3	$ 100

Custom Initiative

Custom measures were also made available to social and assisted housing providers where there was an opportunity for cost-effective m^3 savings. Participating social and housing providers were responsible for driving the installation process for these measures and they received the incentives for participation as outlined below:

- $0.10 per cumulative $m^3$of gas saved
- Incentive cap: 50% of the eligible costs of the project

Building Assessments

This new offer was introduced to identify prescriptive and custom upgrade opportunities in social and assisted housing multi-family buildings. Union offered social and assisted housing providers a free comprehensive building assessment service for up to three of their multi-family buildings. These assessments resulted in a report that identified prescriptive and custom measure upgrade recommendations. Parameters for the site assessment offering were:

- Multi-family site assessments funded up to a maximum of $5,000 per site and up to a maximum of $25,000 per entity per year; and
- AMs follow existing commercial market protocols for assessing energy auditor reports and site assessment subsidization.

Market Delivery

The AHC Offering was delivered by the AMs. AMs focused their sales efforts on housing managers and decision-makers within the principal 27 municipal social housing corporations in the Union Gas franchise area. While the prospect of significant subsidization of capital expenditures through our offering may seem like an easy decision, there are many barriers to adoption. Social housing managers are extremely busy, under resourced and face tight budget constraints. To maximize program adoption Union took three main approaches for outreach: direct sales, secondary provider outreach and association marketing.

Direct Sales

- AMs met directly with key social and assisted housing managers amongst the 27 municipal providers in Union's franchise to present Union's suite of offerings and to elicit participation. An AHC sales package was developed to assist the AMs in their direct sales initiatives that clearly and concisely conveyed the offerings available to all multi-family and single-family stock managed by the social and assisted housing provider.
- Qualified prescriptive and custom measures were identified by the housing provider and a building assessment was considered if there was potential to discover projects.
- Social and assisted housing managers were responsible for sourcing contractors to implement prescriptive and custom measures which were followed by the applicable incentive payment from Union.

Secondary Provider Outreach

Union commenced an outreach to smaller secondary providers of social housing in Ontario that included non-profit and native housing agencies via a direct mail campaign. Over 200 secondary housing providers in Union's franchise were targeted. The first mailer outlined the suite of AHC measures available to this market. Two subsequent mailings focused on boiler incentives and free showerhead installation respectively.

Figure 5.5, Affordable Housing Conservation Offering Brochure

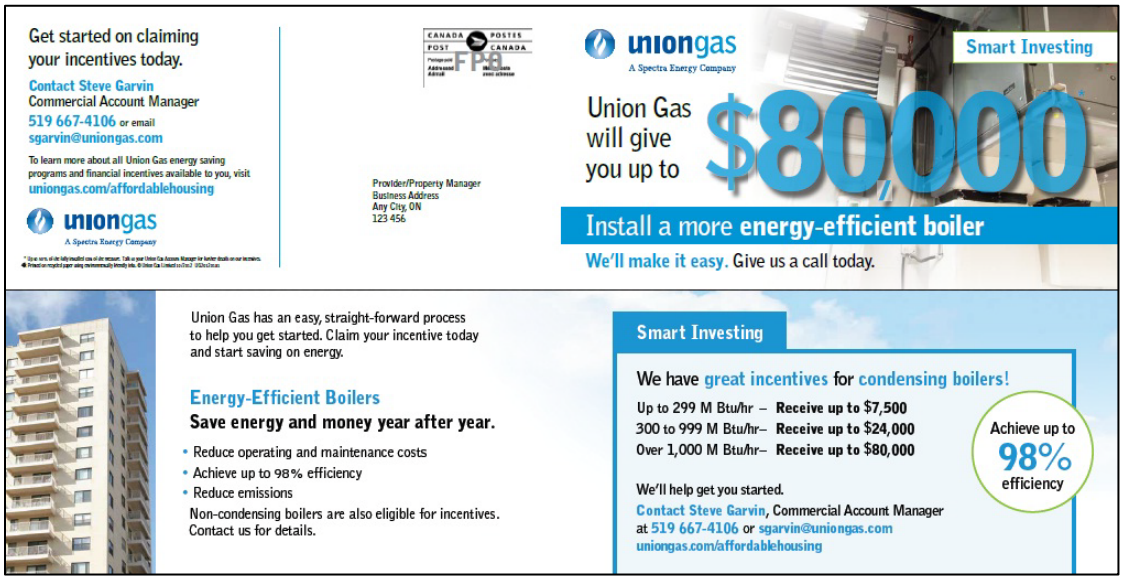


Figure 5.6, Affordable Housing Conservation Offering Boiler Direct Mail

Association Marketing

Union has developed and fostered relationships with relevant associations and organizations while educating them on our suite of offerings in the social and assisted housing sector.

Partnership with the Ontario Non-Profit Housing Association (ONPHA)

Union partnered with the Ontario Non-Profit Housing Association (ONPHA) in 2012 by placing advertisements in their bi-monthly newsletter, *Quick Connections* to promote Union's AHC offering to social and assisted housing providers. Moreover, Union sponsored ONPHA regional meetings in

Hamilton, London and Windsor to further promote energy conservation. Union also was a sponsor of the 2012 ONHPA tradeshow as well as an exhibitor which provided the opportunity to promote the Affordable Housing Conservation offering. Union found that this partnership was an effective means of educating social and assisted housing providers on the cost benefits of Union's AHC offering for multi-unit properties in order to drive installation appointments.

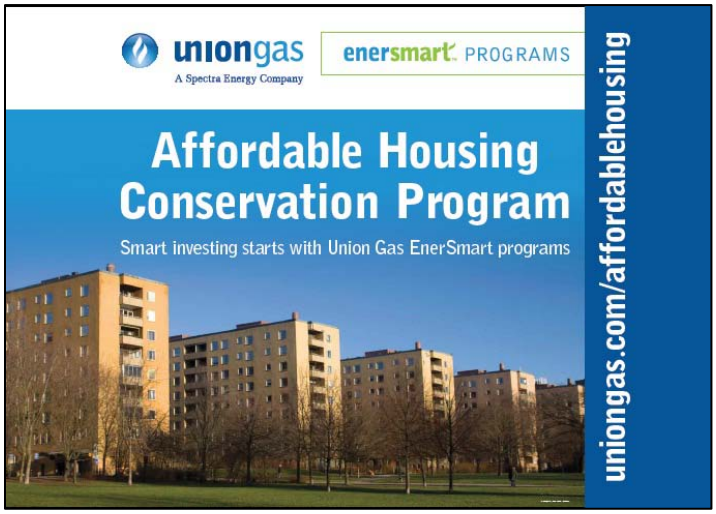


Figure 5.7, Affordable Housing Conservation Tradeshow Poster

Partnership with Housing Services Corporation (HSC)

HSC is a non-profit organization that delivers province wide programs that benefit Ontario's affordable housing sector. HSC has been a long standing key partner for Union in promoting the low-income DSM program. In 2012, Union continued to foster this relationship and presented the new suite of AHC offerings. Union also participated at their annual Regeneration Forum in May 2012 via a platinum level sponsorship.

Figure 5.8, Affordable Housing Conservation Program HSC Promotion

Free Showerhead Installation Initiative

This offer contains energy efficient showerheads and aerators. Union provides free installation of showerheads to eligible multi-unit social and assisted housing properties.

Target Market

This offering targets social and assisted housing corporation managers that manage multi-family housing stock. Customers can expect to save up to $50 per year in every unit in their building that receives the hot water conservation measures.

Market Incentive

The measures are provided at no cost to social and assisted housing organizations.

- Faucet Aerator – bath (1.0 gpm) left for tenant installation
- Faucet Aerator – kitchen (1.5 gpm) left for tenant installation
- Showerhead – 1.25 GPM - installed

Figure 5.9, Affordable Housing Conservation – Free Showerhead Installation Brochure

Market Delivery

Direct sales

- AMs presented this offering to decision-makers in the major municipal social housing corporations in Union's franchise.

Delivery Agent

- Union partnered with Ecofitt on the delivery of the free showerhead installation initiative. Ecofitt technicians performed installation of up to two energy efficient 1.25 GPM showerheads in each qualified unit and aerators were left for self installation.

Direct Mail

- To elicit participation among secondary municipal and private social and assisted housing providers, a direct mail campaign was delivered to these customers. The direct mail campaign

consisted of a postcard that outlined the offering and instructed customers to contact Union's delivery agent, Ecofitt, to book an appointment for free installation.

Figure 5.10, Affordable Housing Conservation – Free Showerhead Installation Direct Mail

Market Research

Low-Income DSM Offerings to Market-Rate Multi-Family Buildings

This secondary research project was agreed to in the 2012-2014 Settlement Agreement. The objective is to evaluate the viability of offering low-income programming to market-rate multi-family housing providers (in addition to the existing programming targeting social housing). Research commenced in 2012 and will be completed by Q2 2013.

Social Housing Provider Research

In 2012, Union started the preliminary stages of a research project that would target decision makers and influencers of social and assisted housing providers. The primary goal of the research is to deepen the understanding of social and assisted housing providers to increase participation and improve the effectiveness and delivery of Union's AHC offering. This research is exploring all aspects of the decision making process that would impact social and assisted housing providers participation in the program, as well as a broader investigation to better understand the competitive framework in which the offering operates. The final stages of the research will be completed in 2013.

5.1.4 Education and Awareness

Education has been, and will continue to be, an important part of the Low-Income Program. Union recognizes that there is a need not only to provide conservation programs directed to low-income customers, but also to educate customers on the direct benefits of energy-efficient behaviour. To date, Union has focused education efforts on private market customers through targeted education brochures and education workshops hosted at the community level.

Education Workshops

In Q1 of 2012, Union Gas continued to strategically offer education workshops as part of the HHC basic offering. Union hosted a total of four workshops in partnership with the following social service agencies: London Urban Services Organization, the South London Neighbourhood Resource Centre and the YMCA Hamilton. These one-hour interactive workshops were run by an AM and were designed to

educate participants on how to reduce their energy costs and increase their comfort through the application of basic weatherization materials in the home. These workshops also enabled Union to strengthen relationships with key agencies that are trusted faces in their communities and provided Union with the opportunity to promote the HHC offering to prospective participants. Each participant received a free weatherization kit that included a variety of basic weatherization materials to be used around the home. Participants were also provided with an assortment of education literature including an energy saving guide and information on Union's Low-Income offerings including eligibility criteria and application instructions.

Education Video

Union worked with energy consultant Gail Lawlor to develop a short education video to enhance the education workshops and to be used in other forums such as the web. This seven minute education video was designed to encourage the workshop participants to implement the demonstrated energy conservation practices at home, and to highlight other low-cost and no-cost energy saving tips and tricks for around the home. Each workshop participant received a copy of the video which is also available on Union's Helping Homes Conserve webpage www.uniongas.com/helpinghomes.

Education Guide

To provide further value to customers after installing the measures as part of the HHC program, Union provided each customer with an education guide specifically tailored to low-income customers that outlined low-cost and no-cost energy reduction tips for the home. The guide included energy tips for home heating, water heating, window and door weather stripping and lighting.

Reducing Energy Demand with Youth

Union partnered with Housing Services Corporation and its subsidiary, GLOBE (Green Light on a Better Environment) by sponsoring the Reducing Energy Demand with Youth (REDY) project in the Windsor-Essex area. The REDY program is a "green" training program targeted at youth 18-30 who are interested in learning about, and becoming involved in energy conservation type work. The five day hands on training program had an emphasis on building retrofits and provided a mobile training centre for the REDY participants to actually practise the various skills being taught (e.g. weather stripping and caulking, energy installations etc.). This initiative aligned with Union's mandate to deliver and support education programs at the community level, and also provided Union with the opportunity to help build capacity in the Windsor-Essex community for energy retrofit work. A Union representative delivered a presentation to the REDY class on Union's DSM programs being delivered in their community, and the REDY graduates were also connected with Union's delivery agents and subcontractors in the Windsor-Essex area for potential employment opportunities.

5.1.5 Lessons Learned

1. Accessibility Requirements in Social Housing

Union was successful in gaining the support of social housing providers in new communities in 2012. However, internal policies and limited staff resources resulted in delays to accessing units for energy audit and measure implementation purposes which slowed down the process. As a result, an agreement was developed and utilized in order to effectively communicate the expectations of the

social housing provider for preparation and implementation of the offering. Work within the units of the provider's housing stock would not commence until the agreement had been signed and the expectations were clearly understood.

2. Private Market Single Family Home Expansion

Union has worked closely with social housing providers since the introduction of the new HHC offering in order to improve the energy efficiency of their housing stock. Union has worked with its primary housing providers in order to address the units within their housing stock that required immediate assistance in order of priority. In 2012, Union found that a smaller level of natural gas savings were being realized from the primary housing providers given that their most at-need units have already been addressed through HHC. With the expansion into the private market, Union has found that private market homes yield natural gas savings two to three times the level of social housing stock in some cases. Despite the additional steps required to qualify private market customers, the resulting natural gas savings per home can offset the decline that Union has seen in the social housing market.

3. Sales Process for Social and Assisted Housing Providers

Union's incentives were well-received by the market and there was solid participation in the AHC offering by municipal social housing providers. The delivery team learned that in the social and assisted housing market the process of moving a project from conception to completion is often lengthy and can be impacted by a number of housing provider variables including budgets, internal process, human resources and policies. In 2013, the program delivery team will adjust the approach to market where appropriate to manage projects to the greatest efficiency based on our 2012 experiences.

6. Large Industrial Rate T1 and Rate 100 Scorecard

The Large Industrial Rate T1 and Rate 100 scorecard consists of cumulative m^3 saved from customers within Rate T1 and Rate 100. Table 6.0 presents the results of the Large Industrial Rate T1 and Rate 100 scorecard. Union achieved 150% of the overall scorecard target, resulting in an incentive of $1.807 million.

Table 6.0 – 2012 Large Industrial Rate T1 and Rate 100 Scorecard Results

Metrics	Metric Target Levels			Weight	Achievement	% of Metric Achieved	Weighted % of Scorecard Achieved
	Lower Band	Target	Upper Band				
Cumulative Natural Gas Savings (m^3)	750,000,000	1,000,000,000	1,250,000,000	100%	1,392,931,990	179%	*179%*
				Total Scorecard Target Achieved			***150%***[7]
				Scorecard Incentive Achieved			***$ 1,806,595***

6.1 Large Industrial Rate T1 and Rate 100 Program

Union's Commercial, Industrial and Large Industrial Rate T1 and Rate 100 programs are aligned under one brand platform, EnerSmart. This ensures a seamless, recognizable brand throughout Union's franchise.

For Large Industrial Rate T1 and Rate 100 customers, the EnerSmart program was designed with a particular focus on achieving savings in a process-specific energy application. AMs market the program directly to customers and indirectly through trade allies, channel partners, Energy Service Companies (ESCO's), engineering firms, and equipment manufacturers. AMs work to cost-effectively promote energy efficiency within Union's Large Industrial Rate T1 and Rate 100 customer base.

Large Industrial Rate T1 and Rate 100 custom projects are jointly delivered through Union's AMs and Technical Project Managers. Success is achieved by combining strong engineering expertise with the relationships established through the direct account-management approach. This approach is critical to influencing the market and achieving successful implementation of the program.

Table 6.1 shows the results of the Large Industrial Rate T1 and Rate 100 program and Table 6.2 breaks down the total spend into its components.

Table 6.1 – 2012 Large Industrial Rate T1 and Rate 100 Program Results

Program	Offering	Units	Annual Gas Savings (m^3)	Cumulative Gas Savings (m^3)	Total Spend	Net TRC	TRC Ratio
Large Industrial Rate T1 Rate 100	All Offerings	341	82,782,080	1,392,931,990	$ 5,043,295	$ 139,118,713	6.33
Large Industrial Rate T1 Rate 100 Total		**341**	**82,782,080**	**1,392,931,990**	**$ 5,043,295**	**$ 139,118,713**	**6.33**

[7] Actual scorecard achievement result is 179%. Maximum achievement is capped at 150%.

Table 6.2 – 2012 Large Industrial Rate T1 and Rate 100 Program Spend

Item	Total
Incentives	$ 4,049,599
Administration	$ 838,114
Evaluation	$ 37,549
Promotion	$ 118,033
2012 Total Large Industrial Rate T1 and Rate 100 Program Spend	**$ 5,043,295**

Table 6.3 shows the calculation of the Large Industrial Rate T1 and Rate 100 program's TRC ratio. With a TRC ratio of 6.33, the Large Industrial Rate T1 and Rate 100 program's net TRC benefits are over six times greater than its net TRC costs. This TRC ratio is the largest of all of Union's 2012 DSM programs.

Table 6.3 – 2012 Large Industrial Rate T1 and Rate 100 Program Cost-Effectiveness

	TRC Benefits (a)	TRC Costs (b)	Net TRC (c)=(a-b)	TRC Ratio (d)=(a/b)
Measures	$165,201,169	$ 25,088,760	$ 140,112,409	6.58
Administration		$ 838,114		
Evaluation		$ 37,549		
Promotion		$ 118,033		
Large Industrial Rate T1 and Rate 100 Program Total	**$165,201,169**	**$ 26,082,456**	**$ 139,118,713**	**6.33**

6.1.1 Program Offerings

Given the low level of new build activity in this sector, the Large Industrial Rate T1 and Rate 100 market is not differentiated into new build and existing buildings. The Large Industrial Rate T1 and Rate 100 market is highly heterogeneous, with most projects tied directly to unique processes or technology requirements.

The Large Industrial custom program goal is to generate long-term and cost-effective energy savings for Union Gas customers. Program offerings are outlined below.

Customer Engagement - Communication and Education

Union Gas provided education, training and technical expertise and offers a wide variety of materials aimed at building an increased awareness of energy-efficiency opportunities and benefits.

New Equipment and Processes

Union's role in promoting and implementing energy efficient options continued to help companies control energy costs and remain competitive in today's global economy. The instability of the current

economic climate is a threat to the industrial customer base in Union's franchise area. With the continual focus on cost reduction, many industries lack the resources to analyze potential energy saving opportunities. Union helps fill this gap with its reliable, knowledgeable and reputable Technical Project Managers in conjunction with incentives designed to influence equipment choices.

Operations & Maintenance

Union assisted customers maintain equipment standards at optimal performance levels by providing financial incentives for implementing operations and maintenance practices that save natural gas through repairs, replacements or retrofits of existing equipment.

Process Improvement Studies

Union provided customer incentives for conducting detailed engineering analysis and designing specific process equipment or operational improvements identified with or without a general plant audit. The program works to support performance testing and analyses of industrial boilers, total steam plants, thermal fluid heaters, vaporizers, furnaces and special process equipment. Testing identifies and quantifies energy saving opportunities, cost saving opportunities, implementation costs and payback periods as well as NOx and CO_2 impacts.

Engineering Feasibility Studies

Engineering Feasibility Studies that included an analysis of natural gas equipment as well as electricity, compressed air, water and wastewater were provided. These feasibility studies helped customers formulate a priority list of energy efficiency projects geared to site-specific energy plans and budgets. Union also assisted the customer's technical staff in generating business cases to enable the customer to secure corporate capital funding for energy efficient equipment and/or process changes.

Steam Trap Surveys

Steam trap surveys conducted by qualified service companies are designed to reduce losses from steam distribution systems. Each survey identifies leaking, over-sized or under-sized, blocked and/or flooded traps, as well as the need for improvements in condensate return systems.

Boiler Tune-ups

Union provided an incentive to large industrial customers for the optimization of their facilities boiler's air-to -fuel ratio, ensuring efficient combustion and natural gas savings.

Infrared Anti-Condensate Polyethylene Plastic

For the large greenhouse customers Union provided an incentive for the installation of IRAC polyethylene plastic to assist greenhouses in saving natural gas.

Similar to the commercial/industrial custom offering, Union continued a rigorous quality control process for all Large Industrial Rate T1 and Rate 100 custom projects. Professional Engineers (P.Eng), licensed to practice in Ontario, assist customers with the quantification of energy savings prior to application submission. All custom projects are then subjected to a secondary professional engineering review to validate the reasonability of the claimed savings, while ensuring appropriate supporting documentation is contained in the project files.

6.1.2 Large Industrial Rate T1 and Rate 100 Program 2012 Incentives

Table 6.4 shows the incentive guidelines for the 2012 Large Industrial Rate T1 and Rate 100 offerings.

Table 6.4 – 2012 Incentive Guidelines

Offer	Incentive
Engineering Feasibility Study	50% of the cost, up to $10,000
Process Improvement Study	66% of the cost, up to $20,000
Steam Trap Survey	50% of the cost, up to $6,000
New Equipment	$0.08 per cumulative m^3, up to $40,000
Operations & Maintenance	$0.08 per cumulative m^3, up to $20,000
Boiler Tune-Up	$250 per boiler
Meters – Gas/Steam/Hot-water	50% of the cost, up to $1,000
Infrared Polyethylene – IR Poly	$400 per growing acre
Demonstration of New Technologies	25% of the cost, up to $75,000

6.1.3 Education and Promotion

Customers have repeatedly told Union they find significant value in the training and educational material provided.

Union continues to expand and broaden distribution of the following educational and promotional tools, which contain information specifically geared towards Large Industrial Rate T1 and Rate 100 customers:

- GasWorks newsletter;
- EnerSmart brochures;
- EnerCase reports;
- Workshops to promote the efficient use of natural gas and increase the awareness of energy savings opportunities;
- Sponsorship of specific educational forums;
- Promotion and attendance at independent professional development groups, trade organizations, and government workshops; and,
- Developed an online calculator for greenhouse customers that lets them compare the cost of burning natural gas and extracting CO_2 to the cost of burning natural gas and buying liquid CO_2.

GasWorks is a technology and energy conservation newsletter, designed to assist large users of natural gas to better manage their business. *GasWorks* provides industry trend, technology and energy efficiency information to help businesses improve process productivity, enhance reliability of equipment and control energy expenses. The newsletter provides links to Union's website and energy efficiency programming as well as various tools, calculators, an online resource library, and an "Ask an Expert" service to provide technical advice.

Below is a summary of the most accessed articles of 2012:

- Steam System Optimization Series: Returning Condensate to the Boiler Reduces Operating Costs;
- Save Energy With a Pressurized Condensate System; and
- Winter Fuel Price Outlook for 2013.

Union's webpage, dedicated to the EnerSmart program, contains an application form, technology information, conversion calculations, technical presentations from customer meetings, and a series of links for additional references; including the newly developed brochures and inserts, which were added to an expanding library of ***EnerSmart*** and ***EnerCase*** brochures. These brochures include customer testimonials that speak to the customer challenges and solutions Union provided.

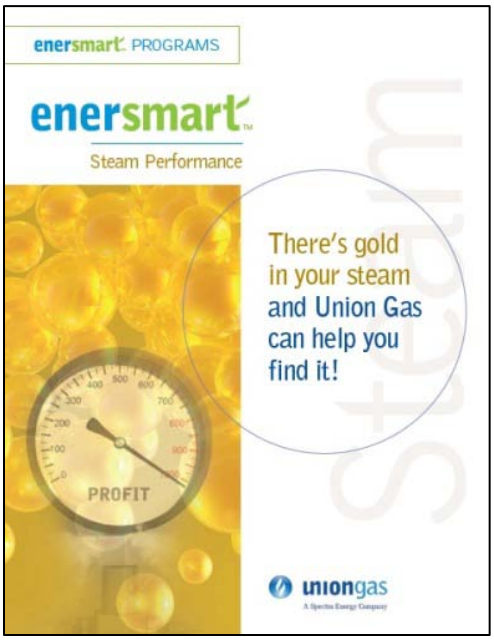


Figure 6.0, EnerSmart Steam Performance Brochure

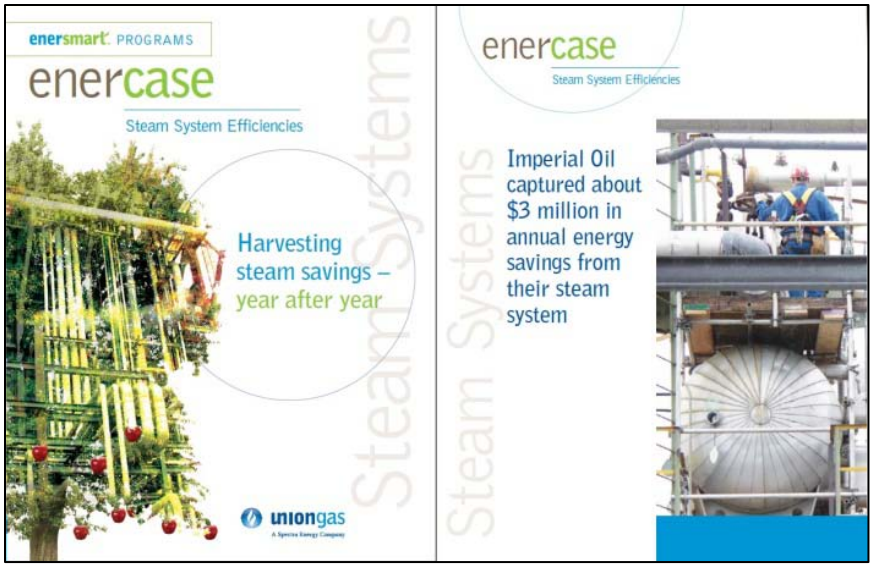


Figure 6.1, EnerCase Steam System Efficiencies Brochure

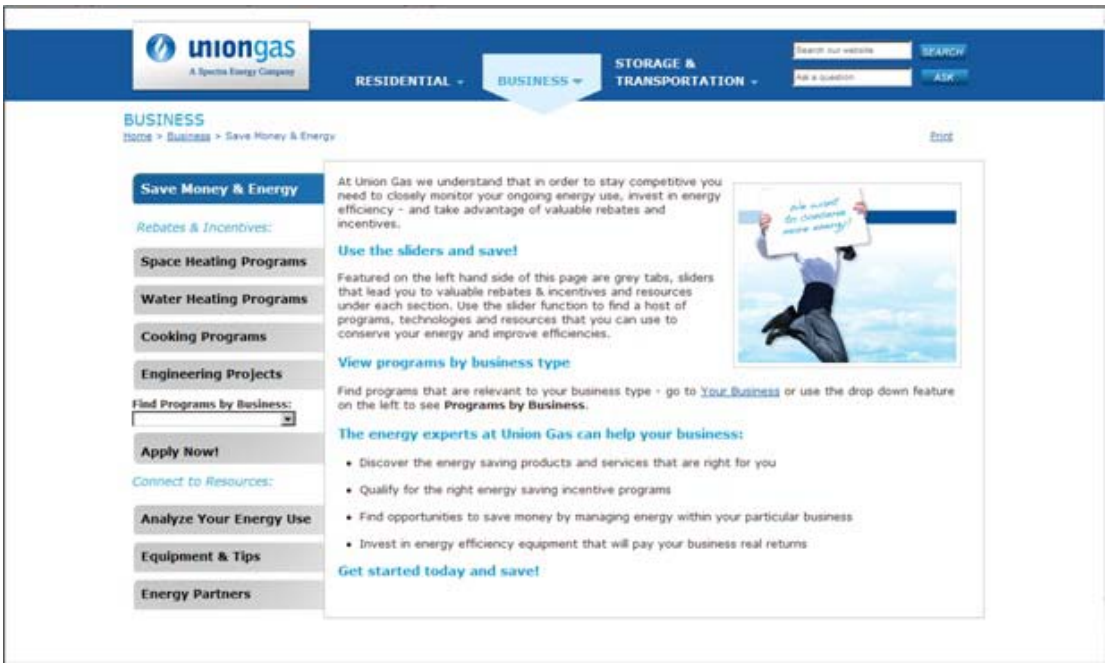


Figure 6.2, Website screenshot: http://uniongas.com/business/savemoneyenergy/index.asp

Union hosted several seminars throughout 2012 to promote energy conservation to Large Industrial Rate T1 and Rate 100 customers. These seminars were attended by 95 delegates in total. Table 6.5 provides a summary of seminars and number of participants.

Table 6.5 – Union Hosted Seminars

Name of Seminar	# of Participants
TAP your Steam Savings – Level 1	77
TAP your Steam Savings – Level 2	12
Integrated Energy Management Systems (IEMS)	6

In addition to hosting seminars, Union also showcased its program offerings and industry knowledge by attending industry tradeshows. Table 6.6 lists the tradeshows specific to Large Industrial Rate T1 and Rate 100 customers that Union attended in 2012.

Table 6.6 – Industry Tradeshow Participation

Industry Tradeshow Attendance	Date
Canadian Healthcare Engineering Society Conference	June 2012
Canadian Boiler Society Education & Training Forum	June 2012
Greenhouse Growers Trade Show and Open House Featuring Energy Efficiency Suppliers	September 2012

Education does not stop with customer training and seminars. Union prides itself on providing highly valued energy expertise, technical support, and resources for Large Industrial Rate T1 and Rate 100 customers. As a leader in energy efficiency committed to working closely with government, efficiency, environmental and professional organizations, Union fully understands the latest trends and technologies. This is not limited to potential solutions for individual customers, but also includes the co-benefit of shared learning. Some examples of industry partnerships include:

Consortium for Energy Efficiency (CEE)

Through this partnership, Union networked with efficiency program administrators from across the United States and Canada with a focus on developing common approaches to advancing energy efficiency.

Energy Solutions Centre (ESC)

Through the ESC, Union collaborated with energy utilities, municipal energy authorities, equipment manufacturers, and vendors to accelerate the acceptance and deployment of new energy-efficient, gas-fuelled technologies.

Natural Resources Canada (NRCan)

Union's involvement with NRCan includes participation in research activities, funding of industry-specific benchmark studies, and offering Union customers assistance in obtaining government funding for energy efficiency projects. Specific NRCan programs include:

- Office of Energy Efficiency (OEE)
- Canadian Industry Program for Energy Conservation (CIPEC)
- CANMET Energy Technology Centre

Canadian Boiler Society (CBS)

Union partnered with the Canadian Boiler Society to provide technical training to Union customers that will help them operate their equipment at optimum efficiency.

6.1.4 Lessons Learned

Union developed and implemented one significant process improvement in 2012, with the intention of solidifying the custom project application, review and approval process. All custom projects utilized a project application summary sheet, to consistently summarize all key project inputs, variables and detail. This summary sheet strengthened Union's secondary professional engineering review, and assisted in the annual verification of custom projects.

7. Market Transformation Scorecard

In 2012, Union shifted its focus from Drain Water Heat Recovery (DWHR) to the New Home Efficiency program, which was branded as Optimum Home.

Prior to 2012, Union's Market Transformation activities had been focused exclusively on the DWHR technology; however, as part of Union's 2012-2014 DSM Plan, the Drain Water Heat Recovery program was exited in 2012. Union had a $0.550 million budget available to sunset the DWHR program and this budget was used to support commitments already made to builders and other market participants as Union exited the program in 2012. There is no performance measurement associated with the DWHR program.

Table 7.0 presents the results of the market transformation scorecard. Union achieved 113% of the overall scorecard target, resulting in an incentive of $0.182 million.

Table 7.0 – 2012 Market Transformation Scorecard Results

Metrics	Metric Target Levels			Weight	Achievement	% of Metric Achieved	Weighted % of Scorecard Achieved
	Lower Band	Target	Upper Band				
Residential New Build - Top 10 Builders Participating	1	2	4	50%	3	125%	*63%*
Residential New Build - Top 50 Builders Participating	5	8	15	50%	8	100%	*50%*
				Total Scorecard Target Achieved			***113%***
				Scorecard Incentive Achieved			***$181,734***

The "top builders" is based on the number of housing starts in Union's franchise area in the prior calendar year. The metric results represent the number of home builders that participated in the Optimum Home Program by signing a Participation Contract within the program year.

Table 7.1 shows the results of the market transformation program.

Table 7.1 – 2012 Market Transformation Program Results

Program	Offering	Units	Total Spend
Market Transformation	Optimum Home	NA	$ 434,823
	Drain Water Heat Recovery	1,269	$ 477,142
2012 Market Transformation Total		**1,269**	**$ 911,965**

Table 7.2 breaks down the total spend into its components. As there were no optimum homes built in 2012 and no gas savings, an evaluation of the market transformation program was not needed.

Table 7.2 – 2012 Market Transformation Program Spend

Item		Total
Optimum Home Incentives	$	56,810
Optimum Home Administration	$	158,090
Optimum Home Evaluation	$	0
Optimum Home Promotion	$	219,923
DWHR Sunset	$	477,142
2012 Total Market Transformation Program Spend	**$**	**911,965**

7.1 Drain Water Heat Recovery Program (*sunset)*

The Ontario government released an OBC Supplementary Bulletin 12 (SB-12) on March 15, 2013, which includes a number of changes to the 2012 new Ontario Building Code (OBC). The most noteworthy change is that Drain Water Heat Recovery is now formally recognized as being amongst the choices for "paths to compliance" in the current OBC for the first time. The timing of this announcement provides additional support to transform the residential market towards adopting the DWHR technology in the wake of Union Gas' decision to sunset market transformation programming efforts on DWHR in favour of advancing efficiency in the residential new construction market as a whole.

Union provided sunset dollars to specific builders who had either made previous commitments to Drain Water Heat Recovery purchases prior to Union's announcement to exit the market, or to those builders that had extremely long sell cycles and had already made commitments to home buyers to include the technology as a result of Union's program.

Union provided builders with an incentive of up to $400 per participating home for the purchase and installation of DWHR units.

7.2 Optimum Home Program *(formerly New Home Efficiency)*

The Optimum Home Program is designed to accelerate residential home builder's energy efficiency practices such that they are ready and capable of building homes that meet an increased minimum efficiency standard expected in the next release of the Ontario Building Code (OBC) in 2017. Optimum Home is based on a whole-home, consultant based approach. It is not based on a single technology, there are no gas saving requirements and it is not tied to a specific label.

The program engages builders in a three year consulting process to build homes to a higher level of energy efficiency. Union partners participating builders with a leading building science consultant who can provide leading edge advice to get builders ready for the next set of OBC changes by helping them build 20% above the current OBC.

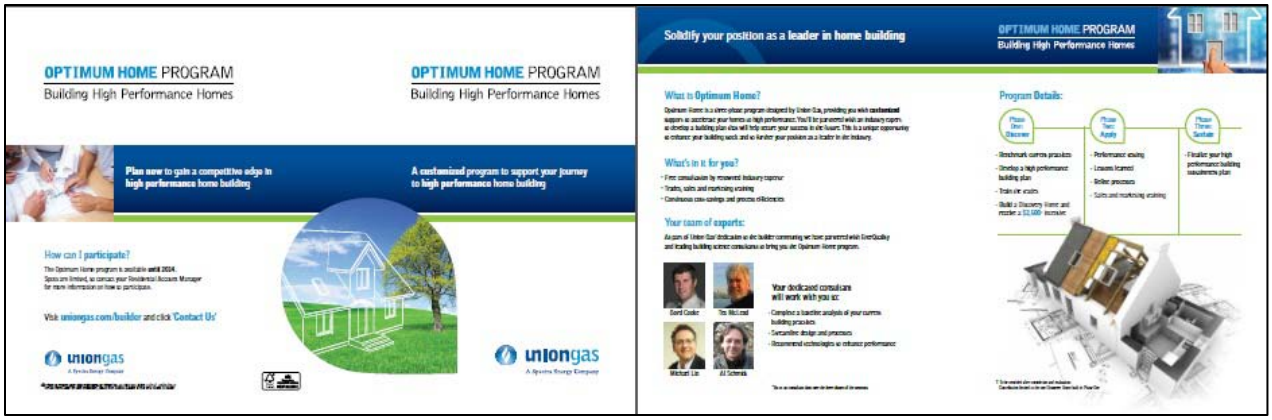


Figure 7.0, Optimum Home Brochure

These industry experts include Gord Cook, Al Schmidt, Michael Leo and Tex McLeod, and are the leading group of consultants in Ontario's residential building industry which reinforces the value proposition for builders.

The outcome of advanced building is achieved through a process which identifies and addresses barriers to the adoption of energy efficient construction. The consulting process deals with every aspect of the builder's business including marketing, sales, contracts, construction, service and trades.

Recognizing that every builder is different, Optimum Home is tailored to suit each builder's individual needs. The consultant works with the builder to build capacity within the organization to effectively build to a higher efficiency, and to understand opportunities to mitigate any incremental costs through business process improvements. Optimum Home consists of three phases:

- **Phase One - Discover:** Union Gas pairs builders with a leading building science consultant to develop a baseline by benchmarking current product and business practices and conducting an on-site audit. The consultant will lead discussion on new technologies, building practices and options, resulting in a Builder Options Package to assist the builder to build 20% above OBC 2012. The builder will build one Discovery Home at 20% above OBC 2012.
- **Phase Two - Apply:** The builder will work with the consultant to test the new Builder Options Package, examine lessons learned, establish training requirements and conduct training, engage sales and marketing in the discussion and conduct performance testing.
- **Phase Three – Sustain:** The consultant will work with the builder towards full implementation of the new specifications as identified throughout the Optimum Home process. Consultant sets out a sustainability plan to maintain momentum of building to a new level of efficiency. A minimum of 10% of the builder's total housing starts must be built to 20% above Code.

Target Market

This program targets the top fifty builders in Union's franchise area (based on 2011 housing starts).

In addition to the top fifty builders, the following groups play a secondary role in influencing a builder's decision to participate in Optimum Home. Influencing these parties will help drive demand for high-performance homes, and in turn, builder interest in the Optimum Home offering.

- **New home buyers** – who will ultimately purchase the higher efficiency homes.
- **Builder sales centres** – work on behalf of builders to promote new homes and upgrade features directly to new home buyers. They have a great deal of influence in obtaining customer take-up. Under the builder's direction, they will promote the programs that they believe will generate the most customer interest. There are many competing companies attempting to influence design/sales centres (such as manufacturers of faucets, cabinets, countertops, etc.), which can make it difficult for energy efficiency products to gain footing.

With the emphasis on builder recruitment in 2012, Union focused its efforts on the top 50 builder target market and is developing their marketing strategy for new home buyers and builder sales centres in 2013.

Market Incentive

Optimum Home is delivered at no cost to the builder. Participating builders receive the following:

- Free consultation by renowned industry experts[8];
- Trades, sales and marketing training;
- Continuous cost savings and process efficiencies; and
- $2,500 incentive towards the construction of a Discovery Home[9].

Market Delivery

A profile of the top 50 builders in Union's franchise area was completed in order to determine which builders would be targeted for 2012 participation. Union's delivery agent, EnerQuality, was leveraged to add additional market intelligence to the top 50 builder list such as key contact information and labelling practices. Union led the builder recruitment process and collaborated with EnerQuality and the consultants to conduct builder outreach where Union did not have established builder relationships.

Union developed a Builder Partnership Package to formally sign builders up for Optimum Home which included a Builder Partnership Agreement between the participating Builder and Union Gas and a Non Disclosure Agreement. An Optimum Home builder portfolio was also developed which included a brochure outlining the Optimum Home offering and its key benefits, a consultant biography piece to highlight the experience and credentials of the four leading building science consultants, a testimonial piece and a PowerPoint presentation that further articulated the Optimum Home offering.

[8] Up to 30 Consultant days over the three phases of the program.
[9] To be provided upon completion and evaluation. Limited to the one Discovery Home built in Phase One.

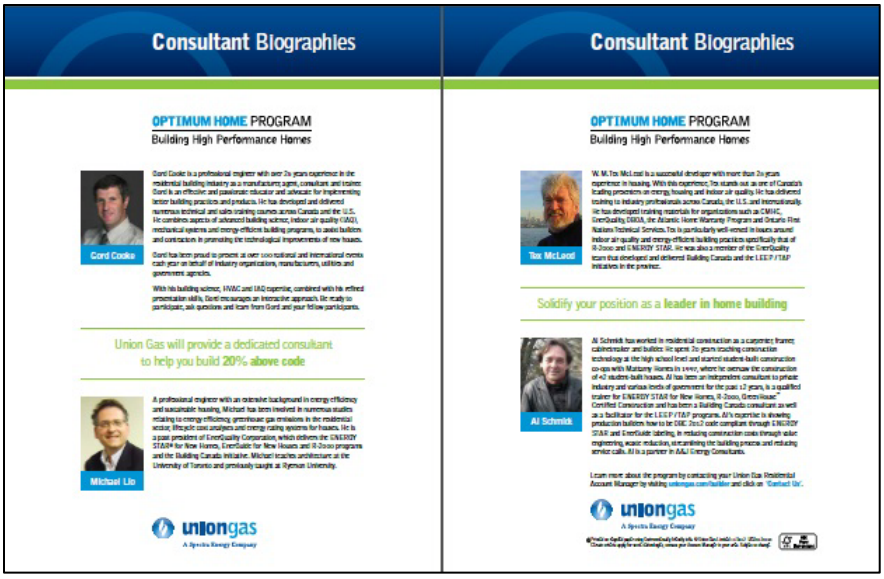
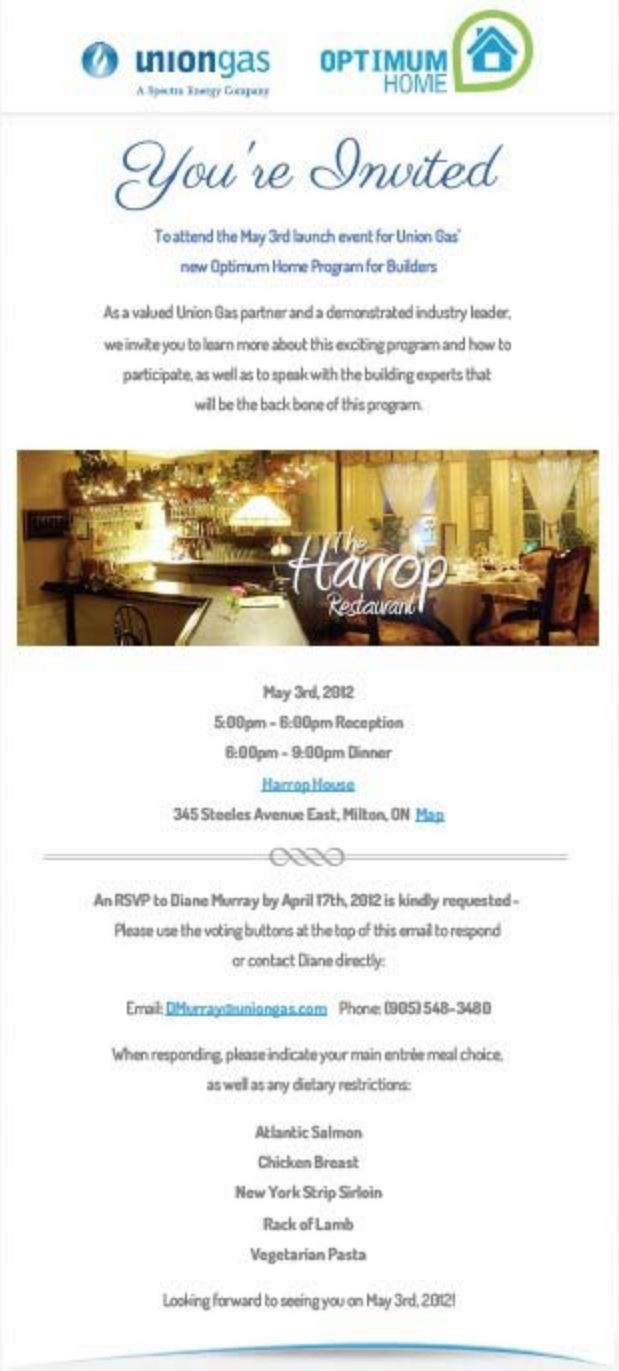


Figure 7.1, Optimum Home Consultant Biographies

Market Launch Event

Union held an exclusive Optimum Home market launch event in May 2012 for Union's top 10 builders. The Presidents and/or Chief Executive Officers of the top 10 builders were invited to this exclusive market launch event for the opportunity to be the first builders in the market to hear about Optimum Home. The builder representatives were provided with an overview of Optimum Home and the benefits of participating. The objective of this event was to secure program buy in and participation amongst these top 10 builders and have them commence Phase One in 2012. Union was successful in having four out of the top 10 builders sign the Builder Partnership Agreement following this event.

Figure 7.2, Optimum Home Event Gift Tag



uniongas
A Spectra Energy Company

OPTIMUM HOME

You're Invited

To attend the May 3rd launch event for Union Gas' new Optimum Home Program for Builders

As a valued Union Gas partner and a demonstrated industry leader, we invite you to learn more about this exciting program and how to participate, as well as to speak with the building experts that will be the back bone of this program.

May 3rd, 2012
5:00pm - 6:00pm Reception
6:00pm - 9:00pm Dinner
Harrop House
345 Steeles Avenue East, Milton, ON Map

An RSVP to Diane Murray by April 17th, 2012 is kindly requested - Please use the voting buttons at the top of this email to respond or contact Diane directly:

Email: DMurray@uniongas.com Phone: (905) 548-3480

When responding, please indicate your main entrée meal choice, as well as any dietary restrictions:

Atlantic Salmon
Chicken Breast
New York Strip Sirloin
Rack of Lamb
Vegetarian Pasta

Looking forward to seeing you on May 3rd, 2012!

Figure 7.3, Optimum Home Event Invite

Ontario Home Builders' Association (OHBA) Partnership

As part of Union's ongoing commitment to the builder community, Union partnered with the Ontario Home Builders' Association. Support of the OHBA has provided Union with the ability to boost its brand profile amongst multiple stakeholders, receive strategic input in the direction of our programs and regulatory issues and enhance market intelligence relating to energy efficiency, sustainability and

"better building" in the new housing market. Union participated in the 2012 OHBA conference that was held in September and attended various events throughout the year with the OHBA's local chapters.

7.3 Lessons Learned

1. Not all builders were prepared for the 2012 Ontario Building Code (OBC) – On January 1st 2012, the OBC changed to EnerGuide 80. For some builders, this was a monumental change to their building practices. As these builders were struggling to meet the new OBC requirements, it would be a stretch for them to build to the Optimum Home standards at 20% above OBC 2012. OBC 2017 was announced in November 2012 and is set to be 15% above the current OBC. As a result, Union focused on positioning Optimum Home as an enabling program that would get builders above and beyond the next set of code changes. Union recognized the need to emphasize that Optimum Home is not strictly designed to get builders to meet the next set of minimum requirements; rather it is designed to support their ability to position themselves to exceed future building efficiency improvement requirements from a technical standpoint, and do so with minimal to no incremental cost.

2. Re-evaluation of Optimum Home value proposition – The Optimum Home marketing material was developed prior to the market launch event in May based on Union's perceived needs of the builders. After having had the opportunity to present this offering to different builders, it was recognized that there was a need to reposition Optimum Home as an "enabling" program, providing customized support to builders in their journey to high performance home building. Union learned that builders are less concerned with building "green" but the idea of "high performance" home building resonated with them more. As a result, Union revamped its marketing material in Q3.

3. Marketing support required for builders – While working through the preliminary stages of Phase One with participating builders, it was recognized that builders are looking for marketing support including but not limited to, press releases, verbiage for their website on high performance homes and lawn signs to promote their Discovery Home. Builders are interested in leveraging high performance home building to differentiate themselves from their competition. Union will be defining what the marketing support offer is to builders, and the parameters around marketing Optimum Home in 2013.

8. Evaluation, Measurement and Verification

For the purpose of validating the accuracy of claimed savings, Union undertakes several verification studies each year. These verification evaluation projects are designed to ensure that the claimed participation and installation rates for technologies delivered through Union's programs are accurate. An assessment of claimed savings obtained through custom projects was also completed. For 2012 custom project verification included Low-Income Custom initiative, Commercial/Industrial Custom offering and Large Industrial Rate T1 and Rate 100 program with a total of 58 project verifications, a very large increase from last year of 38. In addition, Union carries out related research to better understand the overall impacts and benefits that specific programs provide its customers. For 2012, Union also commissioned verification studies for the Residential ESK offering, Low-Income HHC offering and Commercial HWC initiative as detailed in this section of the report.

8.1 Residential Verification

Union conducted a verification study specific to the Residential ESK program offering to validate the savings results presented in the Draft Annual Report. Beslin Communications Group Inc. was contracted to provide a statistically representative sample at the 90:10 confidence level and conduct the verification for the ESK offering via telephone survey. The study and the results that they generated are outlined below.

8.1.1 Energy Savings Kit Offering Verification

Union conducted a verification study across all five channels for the ESK offering to ensure the savings claimed were accurate, as outlined in Table 8.0. These studies determined the number of ESK measures that were installed and remained installed for 2012. Additionally, since the savings associated with the ESK showerheads relate to showering for an entire home, the verification also established the portion of showering that was attributable to the ESK showerhead. Furthermore, the verification process determined the percentage of ESK recipients that used a natural gas water heater to heat their home's water. Through these efforts, these studies provide adjustment factors that are applied to the savings claims made in this Draft Annual Report. Union also uses the collected information to assess areas of success and areas for potential improvement relating to the offering.

Table 8.0 - Summary of Residential Verification Studies

ESK Channel	Participants	Source	Primary Objectives
Push	Customers who received an ESK through Union-run events, and HVAC partners visiting their home	Beslin Communications Group Inc.	- Verify measure installation - Verify continued use of the measure - Verify percentage of showering under the efficient showerhead - Verify water heater type
Pull	Customers who received an ESK by responding to Direct Mail campaigns, retail events, and web requests	Beslin Communications Group Inc.	- Verify measure installation - Verify continued use of the measure - Verify percentage of showering under the efficient showerhead - Verify water heater type
Replacement (Push & Pull)	Customers who received an ESK through any Push or Pull channels, which already received an ESK in prior years, but are still eligible for the upgraded measures	Beslin Communications Group Inc.	- Verify measure installation - Verify continued use of the measure - Verify percentage of showering under the efficient showerhead - Verify water heater type
Door-to-Door (Push)	Customers who received an ESK through the door-to-door initiative	Beslin Communications Group Inc.	- Verify measure installation - Verify continued use of the measure - Verify percentage of showering under the efficient showerhead - Verify water heater type
Install	Customers who received an ESK when an HVAC partner visited their home, and elected to have the showerhead installed	Beslin Communications Group Inc.	- Verify measure installation - Verify continued use of the measure - Verify percentage of showering under the efficient showerhead - Verify water heater type

The final verified results for the offerings are presented in Tables 8.1, 8.2, 8.3, 8.4, 8.5, and 8.6 below as percent adjustments that have been applied to the claimed savings.

Table 8.1 - Adjustment Factors: ESK Push

Measure	Measure Verified Installed	Measure Remained Installed	% Showering Under Low-Flow Showerhead	% With Natural Gas Hot Water Heaters	Adjustment Factor
Kitchen Faucet Aerator	60%	59%		84%	50%
Bathroom Faucet Aerator	46%	39%		84%	33%
Pipe Wrap	62%	60%		84%	51%
Energy-efficient Showerhead	60%	51%	82%	84%	35%

Table 8.2 - Adjustment Factors: ESK Pull

Measure	Measure Verified Installed	Measure Remained Installed	% Showering Under Low-Flow Showerhead	% With Natural Gas Hot Water Heaters	Adjustment Factor
Kitchen Faucet Aerator	64%	58%		87%	50%
Bathroom Faucet Aerator	51%	46%		87%	40%
Pipe Wrap	71%	69%		87%	60%
Energy-efficient Showerhead	73%	67%	81%	87%	47%

Table 8.3 - Adjustment Factors: ESK Push Replacement

Measure	Measure Verified Installed	Measure Remained Installed	% Showering Under Low-Flow Showerhead	% With Natural Gas Hot Water Heaters	Adjustment Factor
Kitchen Faucet Aerator	88%	82%		100%	82%
Bathroom Faucet Aerator	90%	90%		100%	90%
Pipe Wrap	94%	94%		100%	94%
Energy-efficient Showerhead	91%	88%	85%	100%	74%

Table 8.4 - Adjustment Factors: ESK Pull Replacement

Measure	Measure Verified Installed	Measure Remained Installed	% Showering Under Low-Flow Showerhead	% With Natural Gas Hot Water Heaters	Adjustment Factor
Kitchen Faucet Aerator	80%	72%		100%	72%
Bathroom Faucet Aerator	81%	81%		100%	81%
Pipe Wrap	87%	87%		100%	87%
Energy-efficient Showerhead	79%	74%	81%	100%	60%

Table 8.5 - Adjustment Factors: ESK Door-to-door

Measure	Measure Verified Installed	Measure Remained Installed	% Showering Under Low-Flow Showerhead	% With Natural Gas Hot Water Heaters	Adjustment Factor
Kitchen Faucet Aerator	86%	83%		100%	83%
Bathroom Faucet Aerator	85%	85%		100%	85%
Pipe Wrap	92%	92%		100%	92%
Energy-efficient Showerhead	82%	80%	88%	100%	71%

Table 8.6 - Adjustment Factors: ESK Install

Measure	Measure Verified Installed	Measure Remained Installed	% Showering Under Low-Flow Showerhead	% With Natural Gas Hot Water Heaters	Adjustment Factor
Kitchen Faucet Aerator	87%	82%		100%	82%
Bathroom Faucet Aerator	92%	92%		100%	92%
Pipe Wrap	100%	100%		100%	100%
Energy-efficient Showerhead	95%	92%	78%	100%	72%

8.2 Low-Income Verification

Union conducted three verification studies specific to the Low-Income program to validate the savings results presented in the Draft Annual Report. Beslin Communications Group Inc. conducted the verification for the HHC offering via telephone survey; SeeLine Group Ltd. undertook the Low-Income AHC initiative on-site verification; while Michaels Energy conducted the custom project savings verification. These studies and the results that they generated are outlined below.

8.2.1 Helping Homes Conserve Offering Verification

Union verified the HHC offering to ensure the savings claimed were accurate, as listed in Table 8.7. Similar to the Residential ESK offering verification, this study also determined the installation and persistence rates of the showerheads, kitchen aerators, bathroom aerators and pipe wrap in addition to the percentage portion of showering that was attributable to the ESK showerhead. As with the ESK offering verification, the HHC survey also quantified the percentage of recipients that have a natural gas water heater in their home. Beslin Communications Group Inc. was contracted to provide a statistically representative sample for the HHC offering at the 90:10 confidence level.

Table 8.7 – Helping Homes Conserve Verification Parameters

Participants	Source	Primary Objectives
Customers who received a showerhead, bathroom aerator and kitchen aerator through the HHC offering	Beslin Communications Group Inc.	- Verify measure installation - Verify continued use of the measure - Verify percentage of showering under the efficient showerhead - Verify water heater type

The resulting adjustment factors depicted in Table 8.8 have been applied to the claimed savings and will also be used to help Union assess areas of success and areas for potential improvement.

Table 8.8 - Adjustment Factors: HHC Low-Income

Measure	Measure Verified Installed	Measure Remained Installed	% Showering Under Low-Flow Showerhead	% With Natural Gas Hot Water Heaters	Adjustment Factor
Kitchen Faucet Aerator	85%	81%		100%	81%
Bathroom Faucet Aerator	86%	86%		100%	86%
Pipe Wrap	94%	94%		100%	94%
Energy-efficient Showerhead	93%	92%	87%	100%	80%

8.2.2 Free Showerhead Installation Initiative Verification

Union conducted an on-site verification study for the Free Showerhead Installation initiative that specifically targets social & assisted housing low-rise and high-rise apartment buildings. The initiative offers a free installation of up to two energy-efficient 1.25 GPM showerheads in each unit in addition to a kitchen and bathroom aerator (left for the tenant to install).

SeeLine Group Ltd. was contracted to perform the verification study. The purpose was to provide an adjustment factor to be applied to the results of the initiative to ensure the associated savings appropriately reflect installation rates and persistence for all of the measures, as well as showering usage rates associated with the showerhead. As noted above, Union also uses the collected information to assess areas of success and potential improvements.

SeeLine Group worked with the Municipal Housing contacts to arrange site visits for the inspections. On-site visits involved an inspection and digital photo of the installed showerheads and aerators in a randomly selected number of units in the building.

Navigant Inc. was contracted to provide a statistically representative sample at the 90:10 confidence level for the initiative. The final verified results are presented in Table 8.9 below.

Table 8.9 - Adjustment Factors: Free Showerhead Installation Initiative

Measure	Adjustment Factor
Kitchen Faucet Aerator	34%
Bathroom Faucet Aerator	17%
Energy-efficient Showerhead	79%

8.2.3 Low-Income Custom Initiative Verification

Union's Low-Income Custom initiative was expanded in 2012 to social housing providers where there was an opportunity for cost-effective m^3 savings through an upgrade(s) that was not available as part of the prescriptive offering. Union conducted a verification study for this initiative.

Due to the small number of projects completed in 2012, Union decided to perform census verification on all of the 12 Low-Income custom projects instead of a sample. Michaels Energy provided the

verification services for the census. Of the 12 projects, 5 were verified on-site and 7 were verified by a telephone interview. For projects where the consultant determined that no increase in accuracy/confidence would reasonably be expected from a site visit; the consultant documented the rationale and completed the assessment without a site visit. This option was stated in the joint Union/Enbridge Custom Project Savings Verification Terms of Reference developed in collaboration with the Technical Evaluation Committee.

The results of the Low-Income Custom Project Savings Verification Study are presented in Table 8.10 below.

Table 8.10 - 2012 Low-Income Custom Project Verification Study Results

Resource	Claimed Savings	Verification Savings	Realization Rate
Cumulative Natural Gas Savings	**2,480,406**	**2,493,851**	**101%**
Water Savings	0	0	100%
Electricity Savings	56,798	22,516	40%
Incremental Cost	$1,665,216	$1,625,916	98%

8.3 Commercial/Industrial Verification

Union conducted verification studies for the Commercial/Industrial Hot Water Conservation initiative as well as the Commercial/Industrial Custom offering to provide confidence that the savings claimed were accurate. All of the sampling for these verification efforts was conducted by Navigant to achieve a 90:10 Confidence Level.

8.3.1 Hot Water Conservation Initiative Verification

Union contracted SeeLine Group Ltd. to perform the verification study for the HWC initiative. The two segments within the verification were “multi-family” and “non multi-family” (including Hotel/Motel, Long Term Care/Retirement Facilities, University Residences/Dorms, and “Other” such as food services, entertainment and recreational). The objective was to provide adjustment factors for both segments, to be applied to the claimed savings.

The HWC initiative offers customers up to two free energy-efficient 1.25 GPM showerheads, a 1.5 gpm Kitchen Aerator and a 1.0 gpm Bathroom Aerator for applicable units.

SeeLine Group worked with the property managers to arrange site visits for the inspections. On-site visits involved an inspection and digital photo of the installed showerheads and aerators in a randomly selected number of units in the building.

Navigant Inc. was contracted to provide a statistically representative sample for the HWC initiative. The final verified results for multi-family and non multi-family sectors are presented in Tables 8.11, 8.12 and 8.13 below.

Table 8.11 - Adjustment Factors: HWC Initiative Multi-Family Sector

Measure	Adjustment Factor
Kitchen Faucet Aerator	69%
Bathroom Faucet Aerator	40%
Energy-efficient Showerhead	81%

Table 8.12 - Adjustment Factors: HWC Initiative Non Multi-Family Sector

Measure	Adjustment Factor
Kitchen Faucet Aerator	47%
Bathroom Faucet Aerator	40%
Energy-efficient Showerhead	78%

The adjustment factors applied to the non multi-family sector are presented at an aggregate level in order to meet a 90:10 confidence level. Detailed results for each segment sampled in the non multi-family sector are presented in Table 8.13 below.

Table 8.13 - Verification Results: HWC Non Multi-Family Segments

Measure	% of Measures Verified as Installed		
	Hotel/Motel	Education	Other
Kitchen Faucet Aerator	0%	47 %	N/A
Bathroom Faucet Aerator	53%	27%	39 %
Energy-efficient Showerhead	67%	88 %	77 %

8.3.2 Commercial Custom Project Verification

Table 8.14 – Commercial Industrial Custom Project Verification

Description	n (Stratum)	Cumulative Natural Gas (m^3)
Large	12	155,371,509
Medium	9	32,646,413
Small	7	7,023,222
Very Small	1	92,442
Total Projects Sampled	**29**	**195,133,586**
C/I Custom Total Project Population	467	656,087,561
% of Population Sampled		**30%**

As shown in Table 8.14, Navigant pulled a sample of 29 projects for the 2012 Commercial/Industrial Custom Project Verification Study based on cumulative gas savings strata to achieve a 90:10 confidence interval. All of these projects were verified by Michaels Energy. Of the 29 projects, 26 were verified on-

site and 3 were verified by a telephone interview. For projects where the consultant determined that no increase in accuracy/confidence would reasonably be expected from a site visit; the consultant documented the rationale and completed the assessment without a site visit. This was stated in the joint Union/Enbridge Custom Project Savings Verification Terms of Reference developed in collaboration with the Technical Evaluation Committee.

The sample projects represent 30% of the total population in terms of cumulative natural gas (m^3). In completing the verifications, the focus was to validate whether or not the claimed savings reported through the custom projects were accurate and recommend any adjustment factors to the savings if required. At a high level, the objective of the custom project savings verification project is at a minimum to:

- Determination of whether the natural gas savings calculations in the application were reasonable based on information available at the time of verification;
- Review of the assumptions used in calculations;
- Discussion of variations between the project and savings ;
- Recommend adjustment factors based on the variance between the projected and evaluated savings; and
- Verify that the equipment installation was completed at the site.

Commercial/Industrial Custom Project Verification Study Results

Adjustment factors determined through the Commercial/Industrial Custom Project Verification Study are presented in Table 8.15 below. These adjustment factors have been applied to the Commercial/Industrial Custom Program savings claims for the purpose of this report.

Table 8.15 - 2012 Commercial/Industrial Custom Project Verification Study Results*

Resource	Claimed Savings	Verification Savings	Realization Rate
Cumulative Natural Gas Savings	**195,133,586**	**172,351,693**	**100%****
Water Savings	146,356,737	135,635,223	93%
Electricity Savings	9,749,876	7,465,546	77%
Incremental Cost	$13,475,049	$13,658,367	101%

**The claimed and verified results are represented by the total population.*
***The realization rate for cumulative natural gas savings has been calculated as per the TEC approved Sampling Methodology for Custom C/I Programs prepared by Navigant. Realization rates are calculated for each sample stratum and applied to each respective population for calculating total savings*.

8.4 Large Industrial Rate T1 and Rate 100 Custom Project Verification Study

As described in Section 8.3 above, a sample of 17 custom projects from the Large Industrial Rate T1 and Rate 100 program was selected for the verification study by Navigant. As above, the sample for the Large Industrial Rate T1 and Rate 100 program is stratified based on size of projects in terms of cumulative gas savings to achieve a 90:10 confidence interval. Table 8.16 summarizes the Large Industrial Rate T1 and Rate 100 sample.

Table 8.16 - Sample of Large Industrial Rate T1 and Rate 100 Custom Projects for Verification

Description	n (Stratum)	Cumulative Natural Gas (m^3)
Large	7	412,030,740
Medium	6	63,529,043
Small Very Small	4	12,462,984
Total Projects Sampled	**17**	**488,022,767**
Rate T1 and Rate 100 Custom Total Project Population	180	1,266,301,809
% of Population Sampled		**39%**

The 17 sampled projects represent 39% of the total unadjusted cumulative gas savings of all Large Industrial Rate T1 and Rate 100 custom projects based on the original claimed savings. On-site verification studies were conducted by Diamond Engineering. In completing this work, the focus was to validate whether or not the claimed savings reported through the custom projects were accurate and recommend any adjustment factors to the savings if required. The objectives of the verification studies included:

- Determination of whether savings calculations in the application were reasonable based on information available at the time of verification;
- Review of the assumptions used in calculations;
- Discussion of variations between project and savings ;
- Recommend adjustment factors based on the variance between the projected and evaluated savings; and,
- Verify that the equipment installation was completed at the site.

Large Industrial Rate T1 and Rate 100 Custom Project Verification Results

The results of the Large Industrial Rate T1 and Rate 100 custom project verification are presented in Table 8.17 below.

Table 8.17 - 2012 Large Industrial Rate T1 and Rate 100 Custom Project Verification Study Results*

Resource	Claimed Savings	Verification Savings	Realization Rate
Cumulative Natural Gas Savings	**488,022,767**	**568,971,286**	**110%****
Water Savings	191,700,033	197,841,000	103%
Electricity Savings	2,171,136	2,266,470	104%
Incremental Cost	$15,741,606	$15,937,806	101%

** The claimed and verified results are represented by the total population.*
***The realization rate for cumulative natural gas savings has been calculated as per the TEC approved Sampling Methodology for Custom C/I Programs prepared by Navigant. Realization rates are calculated for each sample stratum and applied to each respective population for calculating total savings.*

9. 2012 TEC Evaluation Activities

Throughout the first several months of its establishment, the TEC discussed a number of evaluation issues. Based on these discussions and in light of time available in the calendar year, the committee established a list of top evaluation priorities for 2012:

- Sampling Methodology for Custom Project Savings Verification
- Custom Project Savings Verification
- Commercial and Industrial Custom Free Ridership Jurisdictional Scan
- Update to Measure and Input Assumption List

The TEC has authored quarterly reports for public dissemination. The Q2, Q3, and Q4 Reports can be found in Appendix A for reference.

Sampling Methodology for Custom Project Savings Verification

Considering the new DSM framework, the TEC agreed to establish this study as a top priority for 2012. A similar study had been completed in March 2008 by Dan Violette of Summit Blue Consulting (now Navigant). The TEC agreed to appoint Dan Violette to undertake the 2012 study which focused on:

- The development of a new sampling methodology to meet the new DSM Guidelines for the 2012-2014 DSM Multi Year Plan; and
- A review of the approaches taken to calculate realization rates in other jurisdictions and recommend methods for use by Union and Enbridge.

The full report can be found in Appendix B.

Custom Project Savings Verification Standardized Terms of Reference

In an effort to better understand current Evaluation, Measurement and Verification (EM&V) practices for custom projects, the TEC held a three hour conference call with engineering firms that had been contracted by Union and Enbridge to conduct the Custom Project Savings Verification (CPSV). The firms provided the TEC with an overview of their procedures when performing a review of the Commercial and Industrial Custom Projects and issues related to verification process. This call served to inform the TEC for both short and longer term improvements.

Based on information gathered during the conference call and follow-up discussions, the TEC developed a set of new CPSV scope requirements for 2012 to improve the process. It is expected that these changes to verification process would eliminate the need for the Auditor to duplicate the work completed by the CPSV engineering firms. The additions to the CPSV scope were as follows:

- The CPSV ToR shall say: “Whenever possible, the consultant will conduct field measurements where it is reasonably expected to increase the accuracy in a cost appropriate manner.”
- For 2012 program year: The Audit Committee will assist in the selection of CPSV engineering firms, i.e., receive the RFP (as developed through TEC consultation), review and comment on the bidders’ list, and comment on proposals.
- Draft reports prepared by CPSV engineering firms will be simultaneously presented to the Auditor and the utilities.

Union has adopted and adhered to each of the scope additions made by the TEC.

Custom Free Ridership and Participant Spillover Jurisdictional Review

The Industrial and Commercial Custom Free-Ridership and Participant Spillover Jurisdictional Review was also deemed a priority deliverable by TEC. The TEC agreed to undertake a scan of net to gross (NTG) values for Commercial and Industrial custom programs used in other jurisdictions across North America. The results from this study, which are expected in early 2013, will be used to determine if it is reasonable to apply similar NTG values for Union and Enbridge's franchise areas in lieu of conducting a new custom free-ridership and participant spillover study.

Technical Reference Manual & Updates to Current Measure Inputs and Assumptions List

Following a series of committee discussions, the TEC agreed that a significant effort would be required to design and develop of the first edition of a Technical Reference Manual (TRM) for Ontario's natural gas industry. When completed, the manual will document consistent, reliable and transparent measure savings assumptions for use in Union and Enbridge's program planning and evaluation efforts.

The TEC has initiated a comprehensive TRM development project; however for the short-term, the TEC agreed that the Utilities would file an update to the current inputs and assumptions to capture changes based on the 2011 Audit outcomes, new measures, as well as updates to gain consistency on a select number of measures. On December 19th, the Utilities filed EB-2012-0441 - New and Updated DSM Measures Joint Submission from Enbridge Gas Distribution Inc. and Union Gas Ltd. with TEC endorsement of the updates to the specific measure assumptions which were included in this filing.

10. Status Updates for 2011 Auditor and EAC Recommendations

Commercial Quasi - Prescriptive Recommendations

Recommendation:

Change the annual electricity savings rate for Condensing Make-up Air Units to accurately reflect industry practice of including the 'fan law' in the savings calculations.

Status Update:

In consultation with the TEC, Union presented a revised substantiation document and included it in the input assumption update filing to the Board on December 19, 2012.

Recommendation:

For the 2012 program year, Union should begin tracking the number of two-stage infrared heater units installed, and use the gas savings assumptions for each type of heater rather than the blended gas savings across heater types.

Status Update:

Union updated and filed a new substantiation document on December 19, 2012 which presents the two-stage infrared heater savings separately from those of the high intensity and single-stage infrared heater savings. Union has also tracked all two-stage infrared heaters separately as recommended.

Recommendation:

Investigate the methods to disaggregate the blended incremental cost factor for infrared heaters.

Status Update:

Union has not yet disaggregated the incremental cost for the two-stage infrared heaters from single stage and high intensity infrared heaters. Since TRC is not tied to the utilities incentive, the TEC did not consider this an evaluation priority for 2012.

Recommendation:

Work with the TEC to develop a process for estimating free-ridership rates for new measures in the future. This recommendation followed the finding that Union adopted free rider rates for new measures that were unsupported by evaluation because no better information was available at the time.

Status Update

Union has broached the subject of establishing a process for estimating free-ridership rates for new measures in the future, however other evaluation work has been prioritized. Union will mention this for consideration for the TECs 2013 evaluation priorities.

Recommendation:

Starting with the 2012 program year, calculate realization rates using stratification weights from the sample drawn for verification. This approach is in line with industry best practices, and will improve the statistical accuracy of the realization rates.

Status Update:

A new Sampling Methodology was developed for custom projects for the new 2012-2014 DSM Plan period which includes the recommended process for applying the adjustments to the stratification weights for establishing the realization rates.

Recommendation:
Given limited resources for DSM evaluation and verification, the Audit Team recommends improving coordination among Union staff and consultants to reduce duplicative and potentially unnecessary efforts regarding the estimation of realization rates. The change means developing realization rates using the sampling stratification, and preparing final realization rate adjustments and the confidence and precision analysis after audited results are available.

Status Update:
As above, this has been captured by the new Sampling Methodology, and the practice has been applied to the 2012 Custom Project Savings Verification results.

Recommendation:
To improve the information available for Commercial Custom projects, the Audit Team makes the following recommendations:

- Collect pre-project documentation of whether the project involves an expansion of production capacity.
- Collect pre-project utility history for the facility or meter where the project will be affected.
- Record baseline conditions (operating hours, operating usage, baseline equipment configuration, etc.).
- Collect post-project documentation of what equipment and operating changes were made.
- Record upgraded condition (operating hours, operating parameters, upgraded equipment configuration, etc.).

Status Update:
Union has already captured the above documentation improvements in the custom project files, and has also created a new project file workbook that standardizes the way documentation is presented.

Recommendation:
The EAC requests that Union include a section in the DSM Annual Report that provides a status update on previous Audit recommendations.

Status Update:
Union has provided this section to fulfill this request.

11. Lost Revenue Adjustment Mechanism ("LRAM")

The Board approved LRAM allows Union to recover the lost distribution revenues associated with DSM activity. These lost revenues are calculated for each rate class impacted by DSM energy efficiency programs using the following formula:

Σ(Rate Class Volume Reduction x 2012 Delivery Rate) = LRAM Claimed

Under the Guidelines, LRAM is calculated on a monthly basis using the volumetric impact of the measures implemented in that month. This approach ensures that LRAM amounts closely reflect the actual timing of the implementation of the DSM measures.

For 2012, the LRAM amount of $0.948 million is based on 2012 delivery rates and annual natural gas savings of 94.8million m^3. The 2012 LRAM statement is detailed in Table 11.0 on the following page.

Table 11.0 - 2012 LRAM Statement

Rate class	DSM Volumes (10^3 m^3)												Total Volumes (10^3 m^3)	2012 Delivery Rates ($/$10^3$ m^3)	Revenue Impact ($)
	January	February	March	April	May	June	July	August	September	October	November	December	(a)	(b)	(a) x (b)
South															
M1 Residential	648	423	309	103	137	138	78	74	76	90	78	51	2,203	$38.350	$84,494
M1 Commercial	1,313	252	67	88	123	76	80	161	149	93	98	16	2,517	$38.350	$96,524
M1 Industrial	29	0	0	4	4	0	0	0	0	3	2	0	43	$38.350	$1,657
M2 Commercial	1,496	388	72	306	351	190	452	335	70	93	200	12	3,964	$41.147	$163,108
M2 Industrial	1,419	173	64	0	27	64	66	75	0	18	3	3	1,912	$41.147	$78,664
M4 Industrial	6,379	710	520	196	294	134	206	590	374	240	68	2	9,712	$5.534	$53,751
M5 Industrial	6,557	157	136	401	13	58	16	92	6	86	70	1	7,593	$18.227	$138,394
M7 Industrial	1,840	0	0	12	50	0	20	0	23	174	0	0	2,119	$0.663	$1,405
T1 Industrial	27,925	2,844	144	1,069	3,303	1,439	2,102	966	5,306	225	221	0	45,544	$1.127	$51,328
South Total	**47,604**	**4,947**	**1,312**	**2,179**	**4,303**	**2,100**	**3,019**	**2,292**	**6,005**	**1,022**	**738**	**84**	**75,607**		**$669,325**
North															
01 Residential	127	37	146	35	28	36	23	7	12	10	9	2	472	$89.288	$42,127
01 Commercial	275	80	16	74	105	15	73	14	43	8	11	3	718	$83.211	$59,724
10 Commercial	943	53	147	3	46	32	146	28	54	161	52	5	1,672	$57.093	$95,441
10 Industrial	817	57	24	0	25	19	0	48	1	1	2	0	994	$52.469	$52,166
20 Industrial	2,186	81	264	68	1,806	42	326	5	144	68	6	7	5,002	$2.615	$13,079
100 Industrial	3,945	0	16	1,074	495	2,717	431	145	358	1,045	139	0	10,365	$1.588	$16,464
North Total	**8,293**	**308**	**612**	**1,255**	**2,505**	**2,862**	**1,000**	**248**	**611**	**1,293**	**219**	**17**	**19,223**		**$279,001**
Total	**55,897**	**5,255**	**1,924**	**3,435**	**6,808**	**4,962**	**4,019**	**2,541**	**6,616**	**2,316**	**957**	**101**	**94,829**		**$948,326**

The 2012 LRAM statement is prepared by using the best available input assumptions at the time of the audit. These inputs include measure-level gas saving assumptions, participant numbers and measure install month. Install date and participation numbers are captured by Union's internal databases. Savings assumptions are found in Appendix D.

12. DSM Incentives

For 2012, Union is eligible to earn a shareholder incentive based on its performance against DSM targets presented within four separate scorecards: Resource Acquisition; Low-Income; Large Industrial Rate T1 and Rate 100; and Market Transformation. The target incentive for each scorecard is detailed in Table 12.0. Appendix F provides details on Union's processes used to track and report data used to calculate savings, program results and DSM incentives.

Table 12.0 – Target 2012 DSM Incentives per Scorecard

Scorecard	Target DSM Incentive	
Resource Acquisition	$	2,235,101
Large Industrial Rate T1 and Rate 100	$	722,638
Low-Income	$	1,090,091
Market Transformation	$	132,170
Total	**$**	**4,180,000**

The DSM incentive payments earned by Union for each scorecard is calculated using the methodology approved by the Board in EB-2011-0327:

- No incentive will be provided for achieving a scorecard weighted score of less than 50%;
- Union will earn 40% of the DSM incentive for achieving a scorecard weighted score of 100%, with the remaining 60% available for performance up to the 150% target level;
- Scorecard results will be linearly interpolated between the scorecard metric target levels; The incentive amount will be capped at the scorecard weighted score of 150%.

Union's 2012 results for each scorecard are presented in Tables 12.1 – 12.4 below.

Table 12.1 – 2012 Results - Resource Acquisition Scorecard

Metrics	Metric Target Levels			Weight	Achievement	% of Metric Achieved	Weighted % of Scorecard Achieved
	Lower Band	Target	Upper Band				
Cumulative Natural Gas Savings (m^3)	619,500,000	826,000,000	1,032,500,000	90%	887,302,617	115%	103%
Deep Savings – Residential	120	160	200	5%	73	-9%	-0.4%
Deep Savings - C/I	4%	5%	6%	5%	9.36%	318%	16%
				Total Scorecard Target Achieved			***119%***
				Scorecard Incentive Achieved			***$3,496,862***

Table 12.2 – 2012 Results - Low-Income Scorecard

Metrics	Metric Target Levels			Weight	Achievement	% of Metric Achieved	Weighted % of Scorecard Achieved
	Lower Band	Target	Upper Band				
Cumulative Natural Gas Savings from Single Family (m^3)	20,600,000	30,000,000	37,500,000	65%	44,042,693	194%	126%
Cumulative Natural Gas Savings from Multi-Family (m^3)	9,750,000	13,000,000	16,250,000	35%	11,871,819	83%	29%
				Total Scorecard Target Achieved			***150%***[10]
				Scorecard Incentive Achieved			***$ 2,725,227***

Table 12.3 – 2012 Results - Large Industrial Rate T1 and Rate 100 Scorecard

Metrics	Metric Target Levels			Weight	Achievement	% of Metric Achieved	Weighted % of Scorecard Achieved
	Lower Band	Target	Upper Band				
Cumulative Natural Gas Savings (m^3)	750,000,000	1,000,000,000	1,250,000,000	100%	1,392,931,990	179%	*179%*
				Total Scorecard Target Achieved			***150%***[11]
				Scorecard Incentive Achieved			***$1,806,595***

Table 12.4 – 2012 Results - Market Transformation Scorecard

Metrics	Metric Target Levels			Weight	Achievement	% of Metric Achieved	Weighted % of Scorecard Achieved
	Lower Band	Target	Upper Band				
Residential New Build - Top 10 Builders Participating	1	2	4	50%	3	125%	*63%*
Residential New Build - Top 50 Builders Participating	5	8	15	50%	8	100%	*50%*
				Total Scorecard Target Achieved			***113%***
				Scorecard Incentive Achieved			***$181,734***

[10] Scorecard achievement was actually 155%. Maximum achievement is capped at 150%.
[11] Scorecard achievement was actually 179%. Maximum achievement is capped at 150%.

Union achieved a total of $8.210 million in DSM incentives as a result of its program performance results in 2012. This amounts to 196% of the target 2012 DSM incentive across all four scorecards as shown in Table 12.5.

Table 12.5 – Summary of 2012 DSM Incentives Achieved

Scorecard	Target DSM Incentive	DSM Incentive Achieved
Resource Acquisition	$ 2,235,101	$ 3,496,862
Large Industrial Rate T1 and Rate 100	$ 722,638	$ 1,806,595
Low-Income	$ 1,090,091	$ 2,725,227
Market Transformation	$ 132,170	$ 181,734
Total	**$ 4,180,000**	**$ 8,210,417**

The Large Industrial Rate T1 and Rate 100 scorecard and the Low-Income scorecard each achieved its respective maximum incentive. The DSM incentive breakdown by rate class is shown in Table 12.6 below.

Table 12.6 – Breakdown of DSM Incentive by Rate Class

Line No.	Rate Class	2012 Amount
	South	
1	M1	$ 3,390,869
2	M2	$ 985,698
3	M4	$ 556,650
4	M5	$ 431,677
5	M7	$ 82,731
6	T1	$ 1,300,315
7		**$ 6,747,939**
	North	
8	Rate 01	$ 413,707
9	Rate 10	$ 274,908
10	Rate 20	$ 267,585
11	Rate 100	$ 506,279
12		**$ 1,462,479**
13	**Total**	**$ 8,210,417**

13. Budget

Union's 2012 DSM Budget as approved by the Board was $30.9 million. The total spend for 2012 was $31.3 million.

13.1 Budget Overspend

As per the Guidelines, Union can spend above the approved annual DSM budget to allow it to aggressively pursue DSM programs which are successful. The total amount of the overspend must not exceed 15% of the total DSM budget, and can only be used on scorecards once they have achieved their weighted scorecard target (i.e. 100%) on a pre-audit basis.

As part of the EB-2011-0327 Settlement Agreement ("the Settlement"), Union filed a 2012 DSM budget allocation by rate class (Appendix C of the Settlement). Parties agreed that actual spending would be limited to an increase of 100% of the budgeted amount in any rate class (not including Rate T1 and Rate 100).

For Rate T1 and Rate 100, Parties agreed that spending would be limited to the budget allocation in those rate classes as listed in Appendix C of the Settlement , plus inflation. Per the Settlement, Union could transfer up to $0.500 million between the two rate classes. Further, Parties agreed that Large Industrial Rate T1 and Rate 100 scorecard would be the only scorecard limited to an overspend of 15% of the budget allocated specifically to the Large Industrial Rate T1 and Rate 100 program, including allocated overheads and inflation.

The Guidelines require Union to inform the Board and stakeholders if cumulative fund transfers between DSM programs exceed 30% of the approved annual DSM budget for an individual natural gas DSM program.

In 2012, Union surpassed the weighted scorecard target on a pre-audit basis on all four scorecards. The over spend was used for the Resource Acquisition, Low-Income, and Large Industrial Rate T1 and Rate 100 scorecards. The over spend adhered to all overspend rules for the three scorecards, and Union did not transfer more than 30% of the approved annual DSM budget between programs.

13.2 Drain Water Heat Recovery Sunset Spend

As part of the Settlement , Parties agreed to a budget of $0.550 million to sunset the DWHR program. If any of this budget was not spent, it could not be transferred elsewhere and would be returned to ratepayers.

In 2012, Union spent $0.477 million on the DWHR program and returned $0.073 million to ratepayers.

13.3 Integrated Energy Management Systems Spend (IEMS)

As part of the Settlement , Parties agreed that at least $0.300 of the budget would be spent on the IEMS initiative. If any of this budget was not spent, it could be transferred to another program on the basis that Resource Acquisition target would be increased by 150 m^3 per dollar transferred. Otherwise, the unspent amount would be returned to ratepayers.

In 2012, Union spent $0.178 million on the IEMS initiative. The remaining $0.122 million was not transferred to another program, and was returned to ratepayers.

13.4 Evaluation Spend

As part of the Settlement , Parties agreed to a budget of $1.129 for evaluation spend, including portfolio evaluation and specific program evaluation. If any of this budget was not spent, it could not be transferred elsewhere and would be returned to ratepayers.

In 2012, Union spent $0.489 million on portfolio evaluation and $0.338 million on specific program evaluation, for a total evaluation spend of $0.827. The remaining $0.302 million will be returned to ratepayers.

14. 2013 Scorecards

The 2013 scorecard metrics for the Low-Income, Market Transformation, Large Industrial Rate T1, Rate T2 and Rate 100, and Resource Acquisition scorecards are provided below. The Low-Income and Market Transformation scorecards are as outlined in the Settlement.

Table 14.0 – 2013 Low-Income Scorecard

Metric	Metric Target Levels			Weight
	Lower Band	Target	Upper Band	
Cumulative Natural Gas Savings from Single Family (m^3)	19,500,000	26,000,000	32,500,000	60%
Cumulative Natural Gas Savings from Multi-Family (m^3)	13,200,000	17,600,000	22,000,000	40%

Table 14.1 – 2013 Market Transformation Scorecard

Metric	Metric Target Levels			Weight
	Lower Band	Target	Upper Band	
New Home Efficiency - Top 10 Builders Participating	6	8	15	60%
New Home Efficiency - Top 50 Builders Participating	20% of participating builders	30% of participating builders	40% of participating builders	40%

The 2013 Large Industrial scorecard per the EB-2012-0337 Decision is provided below.

Table 14.2 – 2013 Large Industrial Rate T1, Rate T2 and Rate 100 Scorecard

Metric	Metric Target Levels			Weight
	Lower Band	Target	Upper Band	
Rate T2 and Rate 100 Cumulative Natural Gas Savings (m^3)	75% of target	Three-year rolling average (2010-2012) post-audit Rate T2 and Rate 100 customer incentive cost effectiveness (m^3 per customer incentive dollar spent) × (2013 customer incentive budget for Rate T2 and Rate 100)	125% of target	40%
Rate T1 Cumulative Natural Gas Savings (m^3)	75% of target	Three-year rolling average (2010-2012) post-audit Rate T1 customer incentive cost effectiveness (m^3 per customer incentive dollar spent) × (2013 customer incentive budget for Rate T1)	125% of target	60%

The rolling three year cost effectiveness and 2013 customer incentive budgets are provided in Table 14.3.

Table 14.3 – Cost Effectiveness and Customer Incentive Budgets Used for the 2013 Large Industrial Scorecard Target Setting

Rate Class	2010 Cost Effectiveness	2011 Cost Effectiveness	2012 Cost Effectiveness	Three-year Average Cost Effectiveness	2013 Customer Incentive Budget
Rate T2 and Rate 100	671.97	451.07	360.35	494.46	$2,382,560
Rate T1	129.34	172.72	286.07	196.04	$1,104,440

The 2013 Large Industrial scorecard is thus as shown in Table 14.4.

Table 14.4 – 2013 Large Industrial Scorecard

Metric	Metric Target Levels			Weight
	Lower Band	Target	Upper Band	
Rate T2 and Rate 100 Cumulative Natural Gas Savings (m^3)	883,562,775	1,178,083,700	1,472,604,625	40%
Rate T1 Cumulative Natural Gas Savings (m^3)	162,388,056	216,517,409	270,646,761	60%

The 2013 Resource Acquisition Scorecard metrics are based upon Union's performance results of 2012 as shown in Table 14.5.

Table 14.5 – Metric-Setting Methodology - 2013 Resource Acquisition Scorecard

Metrics	Metric Target Levels			Weight
	Lower Band	Target	Upper Band	
Cumulative Natural Gas Savings (m^3)	75% of target	2012 Post-audit scorecard cost effectiveness (m^3 per promotion and incentive dollar spent) times $10.684M times 1.02	125% of target	90%
Deep Savings - Residential (Homes)[12]	2013 target minus 50 homes	2012 actual times 1.25	2013 target plus 50 homes	5%
Deep Savings - C/I (% of Baseline Consumption)	The higher of i) 2012 actual ii) 4.5%	The higher of i) 2012 actual + 1% ii) 5.5%	The higher of i) 2012 actual + 2% ii) 6.5%	5%

The 2013 Resource Acquisition cost-effectiveness factor is 78.3 as shown in Table 14.6.

[12] In the event the calculated 2013 target (2012 Actual times 1.25) is lower than the 2012 target (160 homes), the 2013 metric target levels will become the 2012 targets (lower band: 120, target: 160, upper band: 200).

Table 14.6 – 2013 Resource Acquisition Cost Effectiveness Factor

Program	Promotion & Incentive Budget Spend (a)	Cumulative Natural Gas Savings (m^3) (b)	Cost Effectiveness (m^3/$) (c) = (b)/(a)
Commercial Prescriptive	$ 3,441,139	202,274,442	58.8
Commercial Custom	$ 1,108,966	91,007,965	82.1
Small Industrial Custom	$ 4,277,423	565,079,596	132.1
Commercial/Industrial Program Total	$ 8,827,528	858,362,004	97.2
Residential Program	$ 2,507,234	28,940,613	11.5
Resource Acquisition Total	**$ 11,334,762**	**887,302,617**	**78.3**

The 2013 Resource Acquisition scorecard is thus as shown in Table 14.7.

Table 14.7 – 2013 Resource Acquisition Scorecard

Metrics	**Metric Target Levels**			**Weight**
	Lower Band	**Target**	**Upper Band**	
Cumulative Natural Gas Savings (m^3)	639,840,619	853,120,826	1,066,401,032	90%
Deep Savings - Residential (Homes)	120	160	200	5%
Deep Savings - C/I (% of Baseline Consumption)	9.36%	10.36%	11.36%	5%

14.1 2013 Avoided Costs

The Avoided Costs for 2013 are found in Table 14.8.

Table 14.8 – 2013 Avoided Costs

Gas Avoided Costs						
	Residential and Commercial				Industrial	
	Baseload ($/m^3)		Weather Sensitive ($/m^3)		Baseload ($/m^3)	
	Rate	NPV	Rate	NPV	Rate	NPV
1	$0.2050	$0.2050	$0.2029	$0.2029	$0.2038	$0.2038
2	$0.2103	$0.3999	$0.2139	$0.4012	$0.2121	$0.4004
3	$0.2149	$0.5845	$0.2187	$0.5890	$0.2168	$0.5866
4	$0.2197	$0.7594	$0.2235	$0.7670	$0.2216	$0.7630
5	$0.2246	$0.9251	$0.2285	$0.9356	$0.2266	$0.9302
6	$0.2296	$1.0821	$0.2336	$1.0953	$0.2316	$1.0885
7	$0.2347	$1.2308	$0.2388	$1.2466	$0.2367	$1.2385
8	$0.2399	$1.3717	$0.2441	$1.3899	$0.2420	$1.3806
9	$0.2452	$1.5051	$0.2495	$1.5257	$0.2474	$1.5153
10	$0.2507	$1.6316	$0.2550	$1.6544	$0.2528	$1.6428
11	$0.2562	$1.7514	$0.2607	$1.7763	$0.2585	$1.7636
12	$0.2619	$1.8648	$0.2665	$1.8917	$0.2642	$1.8781
13	$0.2677	$1.9723	$0.2724	$2.0011	$0.2701	$1.9866
14	$0.2737	$2.0742	$0.2784	$2.1047	$0.2761	$2.0893
15	$0.2797	$2.1707	$0.2846	$2.2029	$0.2822	$2.1866
16	$0.2860	$2.2621	$0.2909	$2.2959	$0.2884	$2.2788
17	$0.2923	$2.3487	$0.2974	$2.3840	$0.2948	$2.3662
18	$0.2988	$2.4307	$0.3040	$2.4675	$0.3014	$2.4489
19	$0.3054	$2.5084	$0.3108	$2.5465	$0.3081	$2.5273
20	$0.3122	$2.5821	$0.3176	$2.6214	$0.3149	$2.6016
21	$0.3191	$2.6518	$0.3247	$2.6924	$0.3219	$2.6719
22	$0.3262	$2.7179	$0.3319	$2.7596	$0.3291	$2.7386
23	$0.3335	$2.7805	$0.3393	$2.8233	$0.3364	$2.8017
24	$0.3409	$2.8398	$0.3468	$2.8837	$0.3438	$2.8616
25	$0.3484	$2.8960	$0.3545	$2.9408	$0.3515	$2.9182
26	$0.3562	$2.9492	$0.3624	$2.9950	$0.3593	$2.9719
27	$0.3641	$2.9996	$0.3704	$3.0463	$0.3672	$3.0228
28	$0.3722	$3.0474	$0.3786	$3.0949	$0.3754	$3.0710
29	$0.3804	$3.0926	$0.3871	$3.1409	$0.3837	$3.1166
30	$0.3889	$3.1355	$0.3956	$3.1845	$0.3923	$3.1599

Water and Electricity Avoided Costs				
	Residential/Commercial/Industrial			
	Water ($/m^3)		Electricity ($/kWh)	
	Rate	NPV	Rate	NPV
1	$2.1712	$2.1712	$0.0981	$0.0981
2	$2.2194	$4.2280	$0.1003	$0.1911
3	$2.2686	$6.1766	$0.1025	$0.2792
4	$2.3190	$8.0226	$0.1048	$0.3626
5	$2.3705	$9.7714	$0.1071	$0.4416
6	$2.4231	$11.4282	$0.1095	$0.5165
7	$2.4769	$12.9978	$0.1119	$0.5875
8	$2.5319	$14.4847	$0.1144	$0.6547
9	$2.5881	$15.8934	$0.1170	$0.7183
10	$2.6455	$17.2279	$0.1196	$0.7787
11	$2.7043	$18.4921	$0.1222	$0.8358
12	$2.7643	$19.6898	$0.1249	$0.8899
13	$2.8257	$20.8245	$0.1277	$0.9412
14	$2.8884	$21.8994	$0.1305	$0.9898
15	$2.9525	$22.9177	$0.1334	$1.0358
16	$3.0181	$23.8825	$0.1364	$1.0794
17	$3.0851	$24.7964	$0.1394	$1.1207
18	$3.1536	$25.6623	$0.1425	$1.1599
19	$3.2236	$26.4825	$0.1457	$1.1969
20	$3.2951	$27.2596	$0.1489	$1.2321
21	$3.3683	$27.9958	$0.1522	$1.2653
22	$3.4431	$28.6932	$0.1556	$1.2969
23	$3.5195	$29.3539	$0.1591	$1.3267
24	$3.5976	$29.9798	$0.1626	$1.3550
25	$3.6775	$30.5728	$0.1662	$1.3818
26	$3.7591	$31.1345	$0.1699	$1.4072
27	$3.8426	$31.6667	$0.1737	$1.4313
28	$3.9279	$32.1709	$0.1775	$1.4541
29	$4.0151	$32.6485	$0.1815	$1.4756
30	$4.1042	$33.1010	$0.1855	$1.4961

The inflation rate used in Table 14.8 was 2.22%. The discount factor used was 7.9%.

Appendix A: TEC Quarterly Reports

Technical Evaluation Committee (TEC)
2nd Quarter Report
June 2012

This quarterly report from the Natural Gas Technical Evaluation Committee (Committee) of Ontario is intended to provide interested stakeholders with an update on Committee matters and activities.

In keeping with the Ontario Energy Board's (OEB) Demand Supply Management (DSM) Guidelines for Natural Gas Utilities, and the Terms of Reference on Stakeholder Engagement, the Committee was officially established in June 2012 with the appointment of two Independent Members as selected by the Intervenor Representatives and Utility Representatives; Ted Kesik Ph.D., professor of building science at University of Toronto and Bob Wirtshafter, Ph.D., DSM planning and evaluation, market research and program design expert. The three Intervenor Representatives are Jay Shepherd, Julie Girvan and Chris Neme. The two Utility Representatives are Melinda Clarke from Union Gas Ltd. (Union) and John DeVenz from Enbridge Gas Distribution Inc. (Enbridge).

Following a series of preliminary meetings with Intervenor Members and the Utility Representatives, the Committee officially commenced with all members present on June 5th at the OEB offices. At this meeting, the members reviewed the Terms of Reference on Stakeholder Engagement and discussed business conduct protocols, or operating guidelines, for the Committee. These guidelines included the Committee's scope of work, notes on consensus and on values & relationships as well as the scheduling and attendance of meetings. Confidentiality, non-disclosure, future meeting dates, and the method for sharing of electronic documents were also discussed and agreed upon.

Following a presentation of Union and Enbridge's 2012 Demand Side Management (DSM) Portfolio, the Committee reviewed the list of evaluation priorities jointly brought forward by Utilities. This list included:

- Sampling Methodology for Custom Project Reviews;
- Terms of Reference for Custom Project Savings Verification;
- Industrial and Commercial Custom Free-Ridership and Spillover Study;
- Current Input and Assumptions List - New Measures and Assumption Table Harmonization;
- Verification Study Guidelines; and
- Approach / Guidelines to Free-Ridership Rates for Prescriptive Measures.

1. Sampling Methodology Study:

With both utilities now operating within a new regulatory framework for DSM, the Committee agreed to establish this study as a top priority for 2012. A similar study was completed in March 2008 by Dan Violette of Summit Blue Consulting (now Navigant), describing a sampling design that would meet OEB requirements and support the verification of annual claimed gas savings from custom Commercial and Industrial projects.

The committee agreed to appoint Dan Violette from Navigant Consulting to undertake the 2012 study which will focus on:

- The development of a new sampling methodology for the 2012-2014 Multi-Year Plan which will meet the new DSM Guidelines; and
- A review of the approaches taken to realization rates[1] in other jurisdictions and a recommended method for use by Union and Enbridge.

[1] Realization rates are used to extrapolate audited savings from the sample of custom projects to the entire portfolio of custom projects.

Final study results are expected by the end of September 2012.

2. Terms of Reference for Custom Project Savings Verification:

In an effort to better understand current Evaluation, Measurement and Verification (EM&V) practices for custom projects, the Committee held a three hour conference call with engineering firms contracted by Union and Enbridge to conduct the annual custom project savings verification. The firms provided the Committee with an overview of their procedures when performing a review of the Commercial and Industrial Custom Projects and issues related to verification process. This call served to inform the Committee for both short and longer term improvements.

The outcome of this review will be used to make recommendations to enhance the process and inform the Terms of Reference for the 2012 Custom Project Savings Verification.

3. Industrial and Commercial Custom Free-Ridership Study:

The 2012 Industrial and Commercial Custom Free-Ridership Study was deemed a priority deliverable by the Committee. In anticipation of potential overlap with other initiatives (i.e., Union's 2013 Large Industrial DSM Application) the Committee identified the need for Intervenor Members to make contact with IGUA, CME and APPRO about the upcoming study.

Study details, timelines and terms of reference will be discussed at the August meeting.

4. Current Input and Assumptions List - New Measures and Assumption Table Harmonization:

The Committee agreed there was an immediate need to update the current input and assumptions list with new measures and updates to some existing measures in preparation for a 2012 filing. However, longer term development of a Technical Reference Manual (TRM) which could include additional supporting industry and usage data would be more substantial in cost with timelines longer than 6 months.

The Committee will seek to review TRMs from other jurisdictions and consider various subject experts by end of August 2012.

5. Verification Study Guidelines and Guidelines to Developing Free Ridership Rates for New Prescriptive Measures:

The Utilities will present background papers on these issues in the fall of 2012. The background papers will include a history of the issue and impact on cumulative m3.

6. Other TEC Items

Technical Consultant:

The Committee agreed to defer discussions on the subject of the TEC Technical Consultant until further considerations regarding the development of the TRM have been made. Discussions with respect to ideal qualifications and potential candidates are expected to resume in August 2012.

Upcoming Meeting Dates:

August 23rd, September 27th, October 25th, November 14th and December 12th

Ontario Natural Gas Technical Evaluation Committee
3rd Quarter Report
September 2012

The Technical Evaluation Committee (TEC) is committed to providing interested stakeholders regular updates on Evaluation, Measurement and Verification (EM&V) matters relating to Natural Gas Demand Side Management (DSM) in Ontario. This report provides details on TEC activities during the period of July 1st to September 30th 2012. The structure of this report is based on current discussions and priorities for the TEC.

1. Sampling Methodology Study:

Dan Violette from Navigant Consulting Inc. undertook the 2012 study.

The initial Terms of Reference (ToR) for the project suggested a two-tailed 90% confidence interval with a 10% precision for the sample – i.e. a sampling protocol that would give us 90% confidence that the estimated savings levels were neither more than 10% over-stated nor more than 10% under-stated. However, it turns out that approach would have required much larger sample sizes than used in the past (when precision targets were less stringent) – with greater expense and increased difficulty in completing the custom C&I project reviews in sufficient time to meet auditing deadlines. After some discussion, the TEC ultimately agreed to a compromise approach that would retain the more stringent 10% precision requirement but apply it to only the lower bound tail. In other words, we would only ensure that estimated savings were no more than 10% *overstated*; we may not have similar assurances regarding potential understating of savings (though the precision on that tail would be able to be calculated after the sample was pulled and would likely still be greater than it has been in the past). The focus on minimizing potential for overstating savings would protect ratepayers against risk of higher-than-warranted DSM incentive payments to utility shareholders.

The first wave of project sample will be pulled for both Enbridge and Union in October 2012. A final report is expected by early October 2012.

2. Custom Project Savings Verification (CPSV) Process:

Following a Q2 conference call between the TEC and the engineering firms contracted by Union and Enbridge, the Committee developed the following recommendations, which have been designed to improve the CPSV process. The expectation is that this process should reduce of the CPSV engineering firm's work by the Auditor.

- The CPSV ToR shall say: "Whenever possible, the consultant will conduct field measurements where it is reasonably expected to increase the accuracy in a cost appropriate manner."
- For 2012 program year: Audit Committee to assist in the selection of CPSV engineering firms, i.e., to receive the RFP (as developed through TEC consultation), to review and comment on the bidders' list, and to comment on proposals in a timely manner if desired. Ultimately, the utility makes the final decision. Union did follow this process for the 2012 year. The first portion of this process was followed by Enbridge but, due to an oversight by the Company in implementing the new policy, the CPSV proposals received by Enbridge were not shared with their AC as requested. Enbridge has provided assurances that the new process will be followed in full for 2013.
- Draft reports prepared by CPSV engineering firms will be simultaneously presented to the Auditor and utilities for their review.

3. Commercial and Industrial Custom Free-ridership and Participant Spillover Jurisdictional Review:
Committee member Bob Wirtshafter prepared a presentation outlining the costs and benefits of different methodological approaches for free ridership and spillover studies. Following Bob's presentation the Committee agreed to undertake a scan of net to gross (NTG) values for Commercial and Industrial custom programs used in other jurisdictions across North America. The analysis will be undertaken and aligned based on market segments and program design features consistent with those used in Union and Enbridge's franchise areas. The results from this scan will be used to determine if it is reasonable to apply similar NTG values for Union and Enbridge's franchise areas in lieu of conducting a new custom free-ridership and participant spillover study.

The Committee expects to release a Request for Proposal by the end of October 2012.

4. 2012 Fall Update to the Current Input and Assumptions List:
The Committee agreed on the process for filing an update to measure assumptions with the Board, as per the Guidelines. The Committee notes that this is an interim step before the development of the TRM. The full Committee is supporting the changes that have been made to the measures in the update being filed by the utilities, but is not expressing an opinion with respect to the remainder of the assumptions in measure substantiation documents that are being carried forward from previous processes. The Committee discussed the process by which the Custom Project Effective Useful Life (EUL) assumptions are used as default unless better information supporting an alternate EUL is available.

A complete draft submission will be prepared jointly by the utilities for TEC review by the end of October 2012.

5. Technical Reference Manual (TRM):
The Committee reviewed TRMs from other jurisdictions and agreed to a list of desired features (i.e. version control, accessibility and security) and desired content (i.e. glossary of terms, prescriptive measure assumptions, description of the CPSV process, TRM maintenance and update process).

The Committee also began preliminary discussions on the qualifications it would seek from potential bidders to develop the Ontario gas TRM. The Committee agreed that experience developing TRMs in other jurisdictions, technical expertise and the ability to apply that expertise to the Ontario market (i.e. to understand how local market conditions would affect assumptions) were all important.

The Committee expects to continue its discussions on details of the Request for Proposal (RFP) in the coming months. A final RFP is expected to be released later this year.

6. Other TEC Items:
Technical Consultant
The Committee agreed to continue to defer discussions on the subject of the TEC Technical Consultant until further considerations regarding the development of the TRM have been made. Discussions are expected to resume following the development of the TRM RFP.

Upcoming Meeting Dates:
October 25th, November 14th and December 12th

Ontario Natural Gas Technical Evaluation Committee
4th Quarter Report
December 2012

The Technical Evaluation Committee (TEC) is continuing to report on a quarterly basis. This report highlights TEC discussions and activities during the period of October 1st to December 31st 2012.

1. Custom Project Savings Verification (CPSV) Process:
The Committee has completed its current review of the Custom Project Savings Verification (CPSV) process. The Committee agreed to reassess the effectiveness of the revised relationship between CPSV and the audit process in early 2013.

The first wave of sample projects has been pulled for both utilities and the CPSV process is currently underway. A second wave of sample projects is expected to be selected in early 2013.

2. Commercial and Industrial Custom Free-ridership and Participant Spillover Jurisdictional Review:
The Committee continued its discussions on the jurisdictional review, making final edits to the Request for Proposal (RFP) which was released in late October. In addition to releasing the RFP to public tender, a number of North American firms with experience in the assessment of net to gross factors were invited to submit a proposal including:

KEMA	Apex Analytics LLC	Heschong Mahone Group
NMR	The Cadmus Group	
Ken Keating	Tetra Tech	
Itron	Energy Market Innovations	
Evergreen Economics	Research into Action	
Navigant Consulting	Opinion Dynamics	
TecMarket Works	Johnson Consulting Group	

Nine proposals were received. The project subcommittee, (Jay Shepherd, Bob Wirtshafter and the Utility representatives), were tasked with reviewing the proposals and reporting their recommendations to the full TEC Committee. Navigant Consulting was selected as the winning bid. During the December 11th 2012 project kick-off meeting, two research priorities were established; to provide a comprehensive assessment of net to gross (NTG) values used in other jurisdictions across North America and determine whether there is sufficient information available from other jurisdictions to estimate Ontario NTG values without a full study.

An initial set of jurisdictions and studies has been identified. Preliminary data is expected from Navigant by the end of February 2013.

3. 2012 Fall Update to the Current Input and Assumptions List:
A complete draft submission was prepared jointly by the Utilities and presented to the full TEC for final review and comment at the December meeting.

On December 19th, the Utilities filed EB-2012-0441 - New and Updated DSM Measures Joint Submission from Enbridge Gas Distribution Inc. and Union Gas Ltd. with TEC endorsement of the updates to the

specific measure assumptions which were included in this filing. A response from the Ontario Energy Board (OEB) is expected in early January 2013.

4. Technical Reference Manual (TRM):

Throughout the quarter, the Committee continued its discussions on terms of reference for the Technical Reference Manual (TRM) project. The Committee agreed that the winning bidder must have a demonstrated ability to understand the Ontario market and appropriately apply TRM values in that context along with other key selection criteria (i.e. experience with natural gas technologies related to space and water heating in the residential, commercial and industrial sectors, previous experience in developing TRMs and project team composition).

An RFP was released on December 21st 2012 both publicly and to the following selected firms with demonstrated experience in developing TRMs:

VEIC
Optimal Energy
TecMarket Works
Rick Morgan & Associates
Kema
Itron
Navigant

As detailed in the RFP, proposals are to be submitted by January 21st 2013. A successful bidder will be selected by mid February with project start date expected by February 28th 2013. It is anticipated that an interim report will be delivered by August 2012 with a first edition submitted to the OEB by January 2014.

5. Other TEC Items:

Proposal Evaluation

The Committee agreed to develop a proposal evaluation framework for each study. The TEC will not share the specific details (e.g. evaluation criteria and weights assigned to those criteria) of the proposal evaluation framework with the bidders beforehand, but the project RFP will provide – at a high level – the key selection criteria.

TEC Subcommittee Accountability

In an effort to create management and communication efficiencies, the Committee agreed to create sub-committees for TEC related studies. Project sub-committees are responsible for the administrative requirements of projects and for making recommendations to the full Committee, but the full Committee will have ultimate responsibility for material decisions and the end results.

Sharing of TEC Evaluation Reports

The Committee agreed that all final reports produced in consultation with the TEC will be treated as public documents, provided that they do not contain any confidential information (e.g. customer-specific data). In the event that a member of the TEC has a concern regarding the release of a report – the report will not be made public until the TEC has had the opportunity to discuss the concern expressed and an appropriate resolution has been reached.

Upcoming Meeting Dates: January 24th, February 13th and March 21st

Appendix B: Sampling Methodology - Custom Project Savings Verification

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A Sampling Methodology for Custom C&I Programs

Prepared for:
Sub-Committee of the
Technical Evaluation Committee

November 12, 2012

Prepared by:
Dan Violette, Ph.D. & Brad Rogers, M.S., MBA

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Table of Contents

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1. Introduction

This report presents a sampling methodology intended for use in the evaluation of custom demand side management (DSM) programs delivered in commercial and industrial (C&I) sectors. The report provides a technical explanation of issues that have been raised in the evaluation processes. It also provides justification for the approaches recommended herein.

Past evaluation studies of Union Gas Limited (Union) and Enbridge Gas Distribution (Enbridge) custom programs have undergone third-party audits where the sample design and realization rate calculations are examined. The processes and judgments applied in these evaluation studies are audited to ensure that the analyses are transparent and accurate. The recommendations in this report along with the technical discussions are intended to better frame the issues for the third-party audit reviews and streamline the overall audit process.

The sample design methodology recommendations are presented in Section 5. The realization rate and achieved precision methodology recommendations are presented in Section 6. The report also contains three technical appendices discussing key issues and presenting the calculations required to develop statistical program estimates.

1.1 Background

Union and Enbridge have delivered DSM initiatives since 1997 and 1995, respectively. Union and Enbridge operate DSM programs, including programs that involve custom projects in the industrial, commercial, multi-residential, and new construction sectors. Custom projects cover opportunities where savings are linked to unique building and manufacturing specifications, end uses, and technologies. Each project is assessed individually for participation in the program. The DSM portfolio for both utilities includes several hundred custom projects annually.

Union and Enbridge DSM activities are regulated by the Ontario Energy Board (OEB) and adhere to the requirements as laid out in DSM Guidelines for Natural Gas Utilities.[1] For custom projects, the resource savings are determined through engineering calculations that are determined at the design stage of each project. There is a need to verify the resource savings through a third-party C&I engineering review.

A sampling methodology for custom projects was developed in 2008.[2,3] This methodology was intended to be used to evaluate future custom program impacts while the programs retained

[1] "Demand Side Management Guidelines for Natural Gas Utilities." EB-2008-0346. Ontario Energy Board. June 30, 2011.

[2] "Sampling Methodology for Engineering Review of Custom Projects." Enbridge Gas Distribution Inc. and Union Gas Limited. Prepared by Summit Blue Consulting. April 3, 2008.

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roughly the same distribution of projects in terms of size and segment. There have been some changes to the custom programs and Union and Enbridge are now preparing for the engineering review of custom projects for 2012. As a result, there is a need to update the sampling methodology. Both utilities seek a harmonized approach to evaluating custom programs that involves on-site reviews of selected custom projects within a representative sample of the respective utility project populations.

In 2012, both utilities entered into a new regulatory framework in Ontario that established a new intervener process with the creation of a common Technical Evaluation Committee (TEC) for both utilities. The goal of the TEC is to establish DSM technical and evaluation standards for natural gas utilities in Ontario. The TEC will make recommendations to the OEB on annual Technical Reference Manual (TRM) updates, establish evaluation priorities, and reach consensus on the design and implementation of evaluation studies.

1.2 OEB Requirements for Evaluating Custom Projects

The OEB's DSM Guidelines for Natural Gas Utilities draws special attention to custom projects. The Guidelines define custom projects:[4]

> *Custom projects are those projects that involve customized design and engineering, and where a natural gas utility facilitates the implementation of specialized equipment or technology not identified in the Board approved list of input assumptions. Projects that simply include a combination of several measures provided in the list of input assumptions are not considered to be custom projects.* (p.5)

The Guidelines go on to prescribe an evaluation approach for custom projects:

> *For custom resource acquisition projects, which usually involve specialized equipment, savings estimates should be assessed on a case by case basis. It is expected that each custom project will incorporate a professional engineering assessment of the savings. This assessment would serve as the primary documentation for the savings claimed.*
>
> *A special assessment program should be implemented for custom projects. The assessment should be conducted on a random sample consisting of 10% of the large custom projects; and the projects should represent at least 10% of the total volume savings of all custom projects. The minimum number of projects to be assessed should be 5. Where less than 5 custom projects have been undertaken, all projects should be assessed. The assessment should focus on verifying the equipment installation, estimated savings and equipment costs.*

---

[3] "Update Memorandum: Proposed Sampling Method for Custom Projects." Summit Blue Consulting. October 31, 2008.

[4] "Demand Side Management Guidelines for Natural Gas Utilities." EB-2008-0346.Ontario Energy Board. June 30, 2011.

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> *All program result evaluations should be conducted by the natural gas utilities' third-party evaluator(s). If possible, the natural gas utilities' third-party evaluator(s) should be selected from the [Ontario Power Authority's] OPA's third-party vendor of record list. The natural gas utilities' third-party evaluators should seek to follow the OPA's evaluation, measurement and verification protocols,[5] where applicable and relevant to the natural gas sector.* (p.39)

The recommended sample methodology contained in Sections 5 and 6 of this report conforms to the Guidelines for custom projects. Appendix B presents the detailed equations necessary to implement the recommended methodology.

1.3 Report Objective

The objective of this report is to develop a methodology for designing a sample and for calculating achieved realization rates and sample confidence and precision using the observed results from the sample. The recommended methodology must meet OEB requirements as well as address the technical and programmatic needs of Union and Enbridge custom programs. The steps taken to achieve this objective include the following:

- Understand the composition of Union and Enbridge custom programs (Sections 2 and 3)
- Review and analyze sample methodologies in selected jurisdictions (Section 4)
- Recommend a methodology for designing and selecting samples (Section 5)
- Recommend a methodology for calculating the achieved program realization rates and sample confidence and precision (Section 6)

The recommended statistical methodology can be described as two-stage stratified ratio estimation. A step-by-step approach to implementing the methodology for sample design is presented in Section 5.4.

The recommended sample methodology is intended to provide sufficient flexibility to allow Union and Enbridge to efficiently meet sample precision needs while the composition, participation, and impacts of their custom programs resemble the current 2011/2012 programs. If the nature of the custom programs changes, adjustments to the recommended methodology may be warranted.

[5] "EM&V Protocols and Requirements: 2011-2014." Ontario Power Authority. March 2011. (see page 129)

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2. Overview of Union Custom Programs

Union's T1/R100 and commercial/industrial (C/I) custom programs are aligned under one brand platform, the *EnerSmart* program. This ensures a seamless, recognizable brand throughout Union's franchise. The program scorecards are divided based on rate class.[6] The T1/R100 program consists of T1 rate customers in Union's Southern delivery zone whose annual consumption is over 5M m^3 and R100 rate customers in Union's other delivery zones whose annual consumption is over 25.6M m^3. The C/I program consists of Union customers in all other rate classes. The methodology in this report pertains only to the custom measures in these programs. Additionally, Union is adding a new Low Income custom segment for the 2012 program year.[7]

Figure 1 outlines the rate class divisions of Union's custom projects. The number of projects in the C/I program is more than twice the number of the projects in the T1/R100 program but represents less than half of the savings of that program.

Figure 1. Union 2011 Custom Projects Overview

Union Custom Sector	# of Custom Projects	Gas Savings	% of Custom Portfolio
T1/R100	200	98,702,955	68.3%
Commercial/Industrial	459	45,472,108	31.5%
Low Income*	13	348,525	0.2%
Total	**672**	**144,523,588**	**100%**

*Low Income values are forecast for 2012 as this is a new segment for Union in 2012.
Source: Union Gas Limited

Custom projects are highly heterogeneous, with most projects tied directly to unique processes or technology requirements. Each project is validated on a stand-alone basis by a comprehensive professional engineering review and the overall programs are required to pass a Total Resource Cost (TRC) screening process. The EnerSmart program was designed to achieve savings in process-specific energy applications, as well as space heating, water heating, and the building envelope. Given the customized nature by which tracking database savings estimates are generated, Union conducts a third-party, on-site engineering study to verify the results of a representative project sample.

Account managers market the program directly to customers for T1/R100 and a combination of directly and indirectly through trade allies, channel partners, energy service companies, engineering firms, and equipment manufacturers to all other rate classes. Account managers work to cost-effectively promote energy efficiency within Union's C&I customer base.

[6] Historically, the Union custom C&I program was divided based on whether the customer purchased gas under a firm distribution contract or through a general service contract.
[7] Low income includes commercial and industrial general service customers.

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3. Overview of Enbridge Custom Programs

Enbridge offers custom programs for the C&I sectors. A variety of incentive-based initiatives are offered to C&I sector customers. These initiatives include custom project incentives and a suite of prescriptive offerings aimed at promoting specific measures. Given the myriad of building types, end uses, ownership structures, and leasing arrangements, the C&I sector is a complex and variable segment in which to market and deliver energy efficiency.

Enbridge's Continuous Energy Improvement (CEI) initiative is focused on custom measures in the industrial segment. As part of ongoing modifications to this program, the industrial program will pursue greater targeting of small to mid-size operations and more flexibility in the incentives offered. As such, in 2012 Enbridge proposes to increase its custom incentive and expand its prescriptive offering to include more measures. Greater segment-focused marketing activities aimed at the mid-size facilities will augment the traditional marketing efforts for larger customers.

Figure 2 presents the commercial and industrial sector divisions of Enbridge custom projects in 2011. The number of projects in the commercial sector is more than six times the number of the projects in the industrial sector, but the average commercial sector project is only about one third the size of the average industrial sector project.

Figure 2. Enbridge 2011 Custom Projects Overview

Enbridge Custom Sector	# of Custom Projects	Gas Savings	% of Custom Portfolio
Commercial	780	37,470,116	68.2%
Industrial	127	17,482,847	31.8%
Total	**907**	**54,952,963**	**100%**

Source: Enbridge Gas Distribution Company

There are important differences in the Union and Enbridge custom programs. One difference is the average size of project. The average Enbridge commercial project is about 48K therms compared to about 99K therms for the Union C/I market projects. The average Enbridge industrial project is about 138K therms compared to the Union T1/R100 industrial projects, which average about 493K therms. In general terms, Enbridge's programs serve a market more dominated by commercial customers with smaller average project sizes, while Union's programs generally serve a market with more industrial customers, which results in larger projects in terms of savings. These factors need to be taken into account in an efficient sample design.

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4. Analysis of Sampling Methodologies in Selected Jurisdictions

This section presents the findings from a review of sampling methodologies used in the evaluation of custom project programs in North America, including those described in annual evaluation reports of selected utilities as well as methodologies contained within evaluation protocols. The reviewed methodologies are all contained within publicly available documents. Because the reviewed documents contain varying degrees of detail and explanation, the Navigant Consulting, Inc. (Navigant) team applied its best interpretation of these documents to synthesize the available information in a consistent manner.

4.1 Summary of Jurisdictions Reviewed

The analysis of the reviewed methodologies accounts for factors such as fuel type, customer segment, and program design factors that might influence the design of samples for realization rate analyses.

Seventeen documents[8] were reviewed covering 12 unique jurisdictions in North America listed below:

- Illinois (Chicago) – Commonwealth Edison Company[9]
- Michigan (Detroit) – DTE Energy[10]
- Massachusetts – Massachusetts Energy Efficiency Advisory Council[11] covering NSTAR, National Grid, and Western Massachusetts Electric Company
- New Mexico – El Paso Electric Company,[12] New Mexico Gas Company,[13] and Public Service Company of New Mexico[14]
- Pennsylvania (Philadelphia) – PECO Energy Company[15,16]
- Ohio – AEP Ohio[17]

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[8] Not counting the review of methodologies used by Union and Enbridge in prior evaluation cycles.

[9] "Evaluation Report: Smart Ideas for Your Business Custom Program." (Program Cycle 2010-2011.) Commonwealth Edison Company. Prepared by Navigant Consulting, Incorporated. May 16, 2012.

[10] "Reconciliation Report for DTE Energy's 2010 Energy Optimization Programs." DTE Energy Company. Prepared by Opinion Dynamics Corporation. April 15, 2011.

[11] "Impact Evaluation of 2008 and 2009 Custom CDA Installations." Massachusetts Energy Efficiency Advisory Council. Prepared by KEMA and SBW Consulting Incorporated. June 7, 2011.

[12] "Evaluation of 2011 DSM Portfolio." El Paso Electric Company. Prepared by ADM Associates Incorporated. May 2012.

[13] "Evaluation of 2011 DSM Portfolio." New Mexico Gas Company. Prepared by ADM Associates Incorporated. June 2012.

[14] "Evaluation of 2011 DSM & Demand Response Portfolio. "Public Service Company of New Mexico. Prepared by ADM Associates Incorporated. March 2012.

[15] "Annual Report to the Pennsylvania Public Utility Commission for the Period June 2010 through May 2011." PECO Energy Company. Prepared by Navigant Consulting. November 15, 2011.

[16] "Audit Plan and Evaluation Framework for Pennsylvania Act 129 Energy Efficiency and Conservation Programs. "Pennsylvania Public Utility Commission. Prepared by the PA Statewide Evaluation Team. November 4, 2011.

[17] "Program Year 2011 Evaluation Report: Business Custom Program." AEP Ohio. Prepared by Navigant Consulting, Incorporated. May 10, 2012.

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- Maryland – EmPOWER Maryland[18] covering Baltimore Gas & Electric, Potomac Electric Power Company, Delmarva Power, Southern Maryland Electric Cooperative, and Potomac Edison
- California – California Public Utilities Commission,[19,20,21] covering Pacific Gas & Electric, Southern California Edison, Southern California Gas, and San Diego Gas & Electric
- Vermont – Vermont Department of Public Service[22] covering Efficiency Vermont and Burlington Electric Department
- PJM Interconnection – covering participating utilities in the Midwest and Eastern U.S.[23]
- U.S. Federally Owned Facilities – U.S. Department of Energy[24]
- International Performance Measurement and Verification Protocol (IPMVP) – Efficiency Evaluation Organization[25]

Figure 3 provides a high-level summary comparing the reviewed studies and Appendix C presents more detail on methods used in selected jurisdictions.

4.2 *Key Findings – Review of Methods Used in Selected Jurisdictions*

Commercial and industrial programs across North America range in type and size, and they frequently use inconsistent nomenclature. It is common to see custom C&I programs separated from prescriptive programs; however, some utilities do combine custom and prescriptive measures into a single program. Stratification approaches and confidence and precision targets are determined differently, depending on each utility's regulatory requirements and program organization.

Many publicly available evaluation reports tend not to describe sampling methodologies in much detail. These reports focus more on reporting evaluation results rather than describing methods used. Certain attributes of the sampling methodologies can be deduced from the reports, but explicit detail on the sampling approach ranges from little to none. The Navigant team applied its best interpretation in assessing utility evaluation reports.

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[18] "EmPower Maryland 2011 Evaluation Report – Chapter 4: Commercial and Industrial Custom and Re-commissioning Programs." Baltimore Gas & Electric, Potomac Electric Power Company, Delmarva Power, Southern Maryland Electric Cooperative, and Potomac Edison. Prepared by Navigant Consulting, Incorporated.

[19] "Energy Efficiency Evaluation Report for the 2009 Bridge Funding Period." California Public Utilities Commission. January 2011.

[20] "The California Evaluation Framework." California Public Utilities Commission. Prepared by TecMarket Works. June 2004.

[21] "California Energy Efficiency Evaluation Protocols: Technical, Methodological, and Reporting Requirements for Evaluation Professionals." California Public Utilities Commission. Prepared by TecMarket Works. April 2006.

[22] "Verification of Efficiency Vermont's Energy Efficiency Portfolio for the ISO-NE Forward Capacity Market." Vermont Department of Public Service. Prepared by West Hill Energy and Computing Incorporated. July 29, 2010.

[23] "PJM Manual 18B: Energy Efficiency Measurement & Verification." PJM Forward Market Operations. March 1, 2010.

[24] "M&V Guidelines: Measurement and Verification for Federal Energy Projects Version 3." U.S. Department of Energy. Prepared by Nexant Incorporated. April 2008.

[25] "International Performance Measurement and Verification Protocol: Concepts for Determining Energy and Water Savings Volume 1." Efficiency Valuation Organization. January 2012.

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Figure 3. Summary Comparison of Sample Methodologies in Selected Jurisdictions

N°	Service Territory or Jurisdiction	Organizations Reviewed	Year	Service Type	Timing	Precison Target	Stratify by Size	Stratify by Segment	Ratio Estimation
1	Illinois (Chicago)	Commonwealth Edison Company	2011	Electric	2-stage	90/08 (3yr utility program)	✓		✓
2	Michigan (Detroit)	DTE Energy	2010	Gas & Electric	1-stage	90/10 (utility program)		✓	✓
3	Massachusetts	Massachusetts Energy Efficiency Advisory Council (NSTAR, National Grid, Western Massachusetts Electric Company)	2009	Gas & Electric	1-stage	90/10 (statewide custom C&I)			✓
4	New Mexico	El Paso Electric Company, New Mexico Gas Company, Public Service Company of New Mexico	2011	Gas & Electric	1-stage	90/10 (utility total portfolio)	✓		✓
5	Pennsylvania (Philadelphia)	PECO Energy Company	2011	Gas & Electric	3-stage	85/15 (utility C&I total)	✓	✓	✓
6	Ohio	AEP Ohio	2011	Electric	2-stage	90/10 (utility program, RTO zone)	✓	✓	✓
7	Maryland	EmPower Maryland (Baltimore Gas & Electric, Potomac Electric Power Company, Delmarva Power, Southern Maryland Electric Cooperative, and Potomac Edison)	2011	Gas & Electric	1-stage	80/20 one-sided (utility program)	✓		✓
8	California	California Public Utilities Commission (Pacific Gas & Electric Company, San Diego Gas & Electric, Southern California Edison, Southern California Gas Company)	2009	Gas & Electric	flexible	90/10 (utility program)	✓	✓	✓
9	Vermont	Vermont Department of Public Service (Efficiency Vermont and Burlington Electric Department)	2010	Electric	2-stage	80/10 (utility portfolio)	✓	✓	✓
10	PJM Interconnection (Midwest & Eastern US)	PJM Interconnection	2010	Electric	flexible	90/10 one-sided (utility program, RTO zone)	✓	✓	✓
11	US Federal Facilities	US Department of Energy	2008	not applicable	flexible	not applicable		✓	
12	General International	Efficiency Valuation Organization (IPMVP)	2012	not applicable	flexible	not applicable		✓	

Source: Navigant review of previously cited documents in selected jurisdictions

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Protocols for evaluating DSM projects in specific jurisdictions tend to provide a more detailed description of sampling methodologies used than the program evaluation reports. Protocols generally allow specific sampling options such as selecting between census, simple random sampling, and stratified sampling, as well as options for determining the appropriate basis for stratification. The reviewed protocols usually offer step-by-step processes for designing samples.

Meeting Precision Targets

Confidence and precision requirements vary widely across the reviewed methodologies. Both one-sided and two-sided confidence intervals are common. Confidence requirements range from 80% to 90%, and precision requirements ranged from 8% to 20%. These confidence and precision requirements frequently differ in the level at which they are applied, which could be for the program, the customer segment, the portfolio, or the transmission zone. One methodology[26] adheres to a relatively rigorous precision target of 90/08, but the target only applies to a 3-year term rather than annually.

On-site verification and evaluation is common industry practice for evaluating larger custom program impacts. There are cases where phone and engineering algorithm verifications have been used for custom programs in some years with more in-depth evaluation work performed in other years. Phone surveys are generally reserved for process evaluation and establishing free-ridership estimates. Phone surveys are less commonly used to estimate gross program impacts. The reviewed methodologies tend to contain a rather substantial description of the evaluation techniques used to estimate project savings, often describing in detail the engineering models applied and how parameters were measured and used. Several evaluation sample design methodologies apply more rigorous techniques or aim to achieve a census for large projects that represent a high concentration of savings in order to cost-effectively increase validity and accuracy of evaluation estimates at the project and program levels.[27,28]

Ratio estimation is used in nearly all of the reviewed methodologies and has now become a standard practice in the industry. Ratio estimation is a statistical technique whereby prior information from a tracking database—"tracked savings"—is employed to reduce the overall sample requirements. If stratification is used, the resulting precision is applied to the total based on applying the realization rate measured for each stratum.

An expected variance must be assumed to create an initial sample design. This assumption is made via an error ratio or coefficient of variation (CV). The CV is defined as the standard

[26] "Evaluation Report: Smart Ideas for Your Business Custom Program." (Program Cycle 2010-2011.) Commonwealth Edison Company. Prepared by Navigant Consulting, Incorporated. May 16, 2012.

[27] As a point of interest, the more rigorous evaluation approaches for selected large projects can, on occasion, produce a higher variance across the sample. This can produce the appearance of worsening sampling precision, but it is generally viewed as producing more appropriate levels of confidence and precision for the program.

[28] "EmPower Maryland 2011 Evaluation Report – Chapter 4: Commercial and Industrial Custom and Re-commissioning Programs." Prepared by Navigant Consulting, Inc.

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deviation of the sample divided by the mean. In the case of ratio estimation, the CV should be based on the variance of project-specific realization rates rather than the variance of savings. Industry practice is to conservatively rely on historic evaluation results in selecting a CV for sample design. When historic data are not available, conservative assumptions are made, typically ranging from 0.5 to 1.0 depending on the expected homogeneity of the population.[29] Ratio estimation can sometimes reduce the CV to levels around 0.3; however, these levels represent "best outcomes" and should not be viewed as conservative when designing a sampling framework.

The reviewed methodologies more commonly apply Z-values[30,31] than T-values in determining sample precision. At larger sample sizes (i.e., greater than 30) the differences are insignificant. But for smaller samples, application of the Z-value fails to account for the limited degrees of freedom in the sample and can lead to overstating the confidence and precision achieved by the sample.

Use of the finite population correction (FPC) factor is not frequently discussed. However, the FPC has a valid statistical basis and should be used when evaluating smaller populations. Two of the reviewed methodologies[32,33] do not appear to use the FPC, and instead recommend a census if the calculated sample size approached or exceeded the population size. Any sample size calculation that exceeds the population is not taking into account the basic principles of sample design. This approach is not statistically valid and can lead to excessive evaluation costs. Although this topic is not frequently discussed, it is reasonable to assume that the FPC is applied whenever size-based sampling was used since application of the FPC is necessary to take advantage of the concentrations of savings in large projects.

Use of Stratification

The reviewed methodologies applied stratification in the sample design when population sizes were not sufficiently small to achieve a census. Stratification approaches vary across the reviewed methodologies and appear to be customized to fit each utility's program structure, number of projects, sizes of projects, regulatory requirements, and stakeholder concerns.

The review yielded two common approaches for stratifying based on size. The first approach defines the large stratum based on very large projects in the population. Sometimes a census is

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[29] "PJM Manual 18B: Energy Efficiency Measurement & Verification." PJM Forward Market Operations. March 1, 2010. (See page 30)

[30] "Audit Plan and Evaluation Framework for Pennsylvania Act 129 Energy Efficiency and Conservation Programs." Pennsylvania Public Utility Commission. Prepared by the PA Statewide Evaluation Team. November 4, 2011.

[31] "The California Evaluation Framework." California Public Utilities Commission. Prepared by TecMarket Works. June 2004.

[32] "The California Evaluation Framework." California Public Utilities Commission. Prepared by TecMarket Works. June 2004. (See page 337)

[33] "Audit Plan and Evaluation Framework for Pennsylvania Act 129 Energy Efficiency and Conservation Programs." Pennsylvania Public Utility Commission .Prepared by the PA Statewide Evaluation Team. November 4, 2011. (see page 75)

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sought when the very large stratum contains only a few projects. The second approach divides the population into strata of roughly equal contribution to total savings.[34] In some cases, this approach seemed to follow textbook examples rather than examining the program projects to see if alternate approaches to stratification could be designed to increase precision. Simply dividing the population into three roughly equal strata may overlook more appropriate stratification designs that could yield higher precision and confidence. This approach is more applicable when project size declines smoothly from large to small projects. Some of the reviewed methodologies apply more rigorous evaluation and measurement approaches to projects in the large stratum or for strata with highly heterogeneous populations in a cost-efficient effort to improve accuracy.

Many of the reviewed methodologies stratify by segment instead of or in addition to stratifying by size. Segments used for stratification included market sector (e.g., education, multi-family, manufacturing, and other customer-type segments), geography, and project types (space heating, water heating, or industrial process). Stratification by segment can be used to increase precision for a given sample size as well as make the sample more representative of the population.

Sample Staging

Schedule requirements for reporting often necessitate a rolling sample or staged approach to sampling in order to begin evaluation efforts early enough to complete the evaluation tasks in time to report results on schedule. About half of the reviewed methodologies implement staged sampling. Most of the methodologies do not require reporting intermediate results, but rather focus only on the final population results.[35]

A two-stage approach is most common[36,37,38] where a stage one sample is drawn based on either the first two or first three quarters of the year. Single-stage sampling and three-stage sampling also occur in the reviewed methodologies. Details on the rationale underlying the calendar periods for the different stages, and the allocation of sample to the different stages, were generally not explicitly stated. In general, approaches were based on "reasonable judgment" by the evaluators.

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[34] "Program Year 2011 Evaluation Report: Business Custom Program." AEP Ohio. Prepared by Navigant Consulting, Incorporated. May 10, 2012. (See appendix J, page 33)

[35] Pennsylvania has a slight exception. Reporting quarterly results is required by Act 129. Although quarterly reporting has been interpreted as applying to unverified results, verified results are reported for the full year.

[36] "Evaluation Report: Smart Ideas for Your Business Custom Program." (Program Cycle 2010-2011.) Commonwealth Edison Company. Prepared by Navigant Consulting, Incorporated. May 16, 2012.

[37] "Program Year 2011 Evaluation Report: Business Custom Program." AEP Ohio. Prepared by Navigant Consulting, Incorporated. May 10, 2012. (See appendix J, page 33)

[38] "Verification of Efficiency Vermont's Energy Efficiency Portfolio for the ISO-NE Forward Capacity Market." Vermont Department of Public Service. Prepared by West Hill Energy and Computing Incorporated. July 29, 2010.

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Gas & Electric Service

Major differences in evaluating savings between electric and gas utilities were not found. Differences in evaluation methods are more likely based on program size and number of years evaluating and reporting program savings. Most jurisdictions count both electric and gas savings for custom C&I measures regardless of whether the administrating utility supplies both fuel types.

Bias in Results

Industry best practices prescribe a demonstration of effort to control for common sources of bias. Once a population of projects exists, the goal of the sample design is to estimate the gross savings resulting from that population.[39] The principal concern about bias is that certain elements of the population may be over- or underrepresented in the sample. Stratification is a good approach for reducing this potential bias. Bias can also result from non-random sample selection. Finally, bias can be introduced into the analysis by anomalous observations in the sample that for some reason are unique and not representative of other members of the population. If anomalous observations are also "influential" observations, then corrective action may be necessary to provide accurate information from the realization rate calculation, and the accompanying calculations of precision and confidence. The California Evaluation Framework notes:[40,41]

> *[If] there is substantial bias, perhaps due to self-selection, non-response, deliberate substitution of sample projects, or measurement bias, then the methods presented here can be seriously misleading. For example it is misleading and counterproductive to report that the average savings has been estimated with a relative precision of 10% at the 90% level of confidence if there is a serious risk that the results might be in error by 25% due to bias.* (p. 327)

The reviewed methodologies contain little description of efforts made to minimize bias. Additionally, there is little discussion on the composition of the sample, treatment of outliers, sample replacements, missing data points, or other sample adjustments. These discussions could be addressed in project memos rather than expanding what is often a lengthy final evaluation report. However, this is an area where standard industry practice may not be on par with evaluation practices in other fields. It is not clear whether this deficiency is related only to reporting or if it reflects limitations on current evaluation practice.

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[39] Issues such as self-selection bias in recruiting program participation are not an issue for sample designs whose purpose is to estimate the gross savings from those that did participate in the program. Once the frame of participant projects is determined, the biases of concern are typically based on ensuring random samples, ensuring representativeness, addressing extreme values, and using appropriate calculations consistent with the sample cases to produced unbiased estimates of the population parameters.

[40] "The California Evaluation Framework." California Public Utilities Commission. Prepared by TecMarket Works. June 2004.

[41] The California Evaluation Framework contains a substantive discussion on accuracy and bias in chapter 12.

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5. Recommended Sample Design Methodology

This section describes the recommended sample design methodology for DSM programs for Union and Enbridge. Sections 5.1–5.3 describe the key attributes of the recommended methodology and offer support for their use in evaluating Union and Enbridge custom programs. Section 5.4 presents steps for appropriate sample designs and sample selection. Sections 5.5–5.6 present examples for Union and Enbridge illustrating how the sample methodology might be implemented using representative tracking data.

Ratio estimation has become standard practice for the evaluation of large C&I programs, as it leverages information available on the population of projects with the sample. The sample design approaches discussed in this section are constructed to make full use of the ability to leverage sample data in combination with information on the population from the project tracking database. This is important given the relatively high cost of rigorously evaluating custom C&I projects. Ratio estimation has become a common industry practice in evaluation since it leverages information on the population to better interpret information from the sample. Stratification has also become a common industry practice, although its application varies, and its application may not result in strata that enhance the efficiency of the sample design. The methods presented in this section are aligned with these basic concepts of leveraging information to get the most out of the analysis.

The level of specification for sampling protocols observed in jurisdictions across North America ranges widely. An overly specified methodology may lead to incompatibilities in future evaluation efforts as the composition, participation, and distribution of impacts evolve. However, an overly general methodology may lead to sample designs that do not meet Union and Enbridge's confidence and precision requirements with cost-efficient methods. The recommended sample design methodology is intended to strike a balance between flexibility and specification to allow Union and Enbridge to best meet their evaluation needs now and in future program years.

5.1 Stratification

Stratification is recommended in designing samples for evaluating custom C&I programs. Stratification is the practice of disaggregating the population into sub-groups based on some criteria. Strata should be defined such that the strata sample frames are mutually exclusive (i.e., no overlap) and exhaustive (i.e., strata sample frames combine to represent the appropriate population sample frame). There are three generally accepted reasons to use stratification:

1. Sample Efficiency: To reduce the required sample size needed to achieve confidence and precision targets on an estimate. There are two common stratification practices that can increase sample efficiency:

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- Stratifying by project size may reduce the overall number of required samples by taking advantage of the concentrations of savings when relatively few projects contribute to a large fraction of total impacts. This is most commonly seen in C&I evaluations, and the majority of reviewed methodologies apply this approach.
- Stratifying based on qualitative segments (e.g., project type or customer segment) can reduce the effective variance compared to combining the segments in a single stratum when segments of a population produce different results. For example, if the project-level realization rate (RR) is expected to average 0.9 for lighting projects and 0.8 for heating, ventilating, and air conditioning (HVAC) projects, then the variance of these segments combined will usually be greater than their individual variances. Separating lighting from HVAC would then allow smaller sample sizes to meet the required precision criteria for total combined savings.

  Stratification design must reduce the effective sample variance in order to produce gains in precision. The simple rule is that projects within a sample should have a smaller variance within the strata than across strata. Lohr notes:[42]

  > *Observations within many strata tend to be more homogeneous than observations in the population as a whole, and the reduction in variance in the individual strata often leads to a reduced variance for the population estimate.* (p. 77)

- Stratification cannot make the problem worse (i.e., decrease precision). As a result, it is strongly recommended.

2. Segment Results Required: To ensure sufficient sample sizes that can answer questions pertaining to certain segments of the total population. For example, if stakeholders or interveners require results specifically for HVAC-related projects in order to improve program implementation in subsequent years, then creating strata for HVAC projects and establishing a minimum precision requirement for those strata would help ensure that sufficient data are collected to understand HVAC projects.
3. Reduced Potential for Bias by Improving the Representativeness of the Sample: For many evaluators, this is the most important reason for stratification as part of sample design. Stratification helps ensure that the sample appropriately represents the population. Since simple random sampling allows for the possibility of under-sampling certain segments, stratification can help ensure that the sample drawn provides the appropriate sample size for each segment. For example, stratifying by project type can ensure that each major project category is appropriately represented in the sample by explicitly drawing samples for each project type. Other frequently used dimensions for stratification include customer segments and site geographies. Representativeness quotas are sometimes used instead of strata to ensure representativeness.

[42] Lohr, S. L., "Sampling: Design and Analysis," Second Edition, 2010.

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The specific stratification approach will depend on evaluation of the population data. If the distribution of project savings for a program is relatively tight[43] and there is not an easily delineated group of large projects, then stratification by project size alone may not produce sampling efficiencies. However, if the distribution of project savings is wide or there is clear group of large projects, then stratifying by project size will likely produce sampling efficiencies.

It is important to note that when sample observations are collected based on a stratified sample design, the strata weights must be applied in the estimation of the population realization rate.

The general rule for stratification is to attempt to select strata that have smaller variance within the strata than between strata. Stratifying by segment may also be appropriate when realization rates are expected to vary by segment. Judgment should be applied to segment the population on the basis of mechanisms that lead to different realization rates, rather than simply using common predefined segments used in program administration. For example, if steam projects are expected to have a different realization rate than other project types—or even more widely varied realization rates across steam projects—then a potentially useful segmentation may be by steam projects vs. other non-steam projects. It is not necessary to segment by every major project category to achieve the desired sampling efficiency, only those where this effect is believed to be sizeable and where stratification may also help increase the representativeness of the final sample across important technology categories.

5.2 *Ratio Estimation*

The application of a ratio estimation approach is recommended. Ratio estimation is the statistical technique whereby the *accuracy* of "prior" tracked estimates is applied from the sample rather than directly applying the *absolute* estimates of the sample. For DSM evaluation efforts, the sample estimator is the realization rate for each stratum rather than the sampled savings for each stratum. Ratio estimation is often used to increase the precision of estimated means and totals. It is motivated by the desire to use information about a known auxiliary quantity (i.e., tracked savings) to obtain a more accurate estimator of the population total or mean (i.e., verified savings). When applying ratio estimation within a stratified population, the separate ratio estimator approach should be used where strata are defined and analyzed before combining strata.[44]

Ratio estimation would not be possible without initial savings estimates for the population. This technique relies on establishing the variance based on the errors between the savings predicted by the stratum average realization rates for each project and the actual savings measured for each project. Ratio estimation effectively develops verified savings estimates based on measuring the accuracy of the tracked savings. Therefore, it is necessary to ensure that the tracked savings in the tracking database represent the best possible estimate based on the available information.

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[43] A "tight" project savings distribution is generally considered to be within a single order of magnitude. Size-based stratification should be considered when the distribution of savings spans multiple orders of magnitude.

[44] Lohr, S. L., "Sampling: Design and Analysis," Second Edition, 2010. (Section 4.5)

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5.3 *Sample Staging*

A rolling sampling approach comprised of two sample draws (a two-stage sample approach) is recommended to ensure that spring reporting requirements can be met. Reporting schedules often do not provide sufficient time to design and evaluate a sample following the completion of the project year. This type of schedule constraint frequently occurred in the jurisdiction reviewed in Section 4. Sample staging can allow evaluation efforts to begin earlier on a preliminary sub-sample of projects completed early in the program year. Thus, staging can reduce the evaluation workload required between the end of the program year and the reporting deadline.

A two-stage sample is recommended, where the first stage takes a sample draw from projects completed in the first three quarters of the program year, and the second sample draw adds in projects completed in the fourth quarter.

The sample design for the first stage should estimate or extrapolate the numbers of projects in each stratum to the values expected at the end of the year.[45,46] Sample sizes should be determined for this preliminary sample frame as an indication of the final population. While judgment is needed to determine how much of the expected overall sample is drawn in the first stage, it is unlikely that the first stage sample would fully require three-quarters of the calculated sample sizes.[47] In general, practical considerations would support a lower split of the planned sample between the first and second stages. This would allow for a sample that adequately represents the year-end projects.

Union's and Enbridge's projects tend to come online more heavily in the fourth quarter, with roughly half to three-quarters (depending on which program) of projects completing in the last quarter. This would imply that a 50-50 split between sample stages would be reasonable, given constraints related to the calendar time needed to set up and conduct the verification studies. However, if the timing allows, Union and Enbridge might consider placing more of the sample into the fourth quarter when savings from projects completed in the fourth quarter are expected to contribute more than half of program savings. This recommendation is a compromise between the time and resources needed to perform the number of site verifications, and the need to meet program reporting deadlines. It simply is not possible for the utilities to wait until information on that year's full population of projects becomes available and then draw the sample and complete the site verifications while still meeting the program reporting deadlines.

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[45] This step is important because it will reduce the effect of finite population correction that could otherwise lead to underestimating the required sample sizes.

[46] If the final quarter of the program year is known to have very large projects in disproportion to the first three quarters, the strata weighting may be adjusted to account for this information.

[47] The sample sizes may be further reduced slightly to allow for the possibility that the assumed CV is overly conservative. If upon evaluation of the first stage, the assumed CV was not overly conservative, then additional samples may be added in the second stage.

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This rolling sample or two-stage approach is often used in program evaluation (see Section 4 above) to meet timely reporting deadlines.

The sample design for the second stage should consider the population of the program year in its entirety. Sample sizes should be determined for the entire population. The first stage sample is intended to fulfill about half of the overall sample. The second stage is intended to fulfill the remainder of the sample and should be selected from projects completed in the fourth quarter.[48] If analysis of the first stage sample observations indicates insufficient sample sizes, then the first stage may be reinforced in the second stage with additional projects selected at random from the full program year population. An analysis of sample data should investigate whether differences between sample stages are significant and adjustments are needed. Again, the goal is to produce good information for making decisions regarding the custom programs for both the utilities and stakeholders. Some judgment is needed in implementing this rolling two-stage sample selection approach.

5.4 *Recommended Sample Design Process—Seven Steps*

The sample study should be designed to estimate the impacts of the population of projects in each program year. At the time of this report, *cumulative* gas savings measured in cubic meters (m^3) is the primary impact to be studied and should serve as the basis of the sample design.[49] The recommended sample design methodology contains the following steps:

Step 1: Review project tracking database for accuracy and quality.
Prior to any stratification or sampling, large gains can be made in the resulting analysis and precision by reviewing the estimates in the tracking database and making sure that the best possible initial project-based engineering estimates are contained in the tracking database. It is also important to make sure that appropriate contact information is contained in the files to avoid having to replace drawn sample projects with supplemental projects held in reserve. One of the most cost-effective ways to enhance the precision and confidence in the evaluation results is to make the appropriate investment in the tracking database. A tracking database that is accurate will typically reduce the costs of the evaluation, yield project realization rates that are closer to one, and have a smaller variance across the project realization rates. Many utilities do a second check of the tracking database prior to the sample design and sample selection.

Identifying unique projects in the tracking database can help avoid outlier problems later in the analysis. Examples of unique projects may be those with the only instance of a certain efficient technology installed or even those with technologies whose impacts are difficult to predict.

[48] Although this approach is intended to achieve roughly equal proportions of projects for each quarter, disproportions by quarter should not be viewed as causing notable bias. Accordingly, if the first stage produces a small number of projects in excess of what is required in the second stage, these extra projects may be counted toward meeting the fourth quarter sample size requirements.

[49] This is a new basis for custom C&I evaluation studies beginning in program year 2012. The Technical Evaluation Committee may decide to change this basis in future years.

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These unique projects may be treated separately from the primary population to produce more efficient samples for the vast majority of the population. Identification of unique projects can also help ensure the representativeness of the selected sample and help eliminate problems in the interpretation of the analysis such as bias in the realization rate.

Step 2: Evaluate the population and define strata.
Examine the population for ways to leverage the sample design to improve efficiencies in meeting target confidence and precision levels. This includes three activities:

- *Exclusion of extremely small projects* – Ratio estimation weights project realization rates according to project savings. Very small projects typically exert only negligible influence on estimates of the total realization rate, the total savings, and the total achieved precision. For many very small projects, a 100% difference in realized savings would produce a negligible impact on the total estimates. The cost of evaluating the impacts of these small projects exceeds the value of the information obtained from them. Additionally, including projects that contribute only small fractions of a percent to program savings in the sample frame might result in the random selection of projects that includes a disproportionate number of these very small projects, which could reduce the accuracy with which the overall realization rate is estimated for a given sample size and reduce the overall representativeness of the sample. It is therefore considered reasonable to exclude the very small projects (i.e., representing up to 5% of the total program savings as appropriate) from the sample frame. The savings of the population of very small projects may be adjusted by an appropriate realization rate[50] and added to the program savings total.
- *Identification of project size strata bounds* – Efficiencies can be gained by stratifying by project size when the distribution of project savings is wide or there is a clear group of large projects. Sorting the projects by savings size can allow easy identification of discontinuities in the project size distribution. If it is unclear whether natural project size groupings exist; visualization of the project savings in a histogram should provide a clearer indication. Typically, strata are set such that program savings within a stratum fall within an order of magnitude.[51] Set strata bounds first based on natural breaks in the distribution that result in easily delineated groupings. If natural groupings do not exist, other approaches may be used such as stratifying into strata of roughly equal total savings. The number of size-based strata typically ranges from two to four, with three most commonly applied for C&I program evaluations.

[50] If the remaining population is stratified by size, then the average small stratum realization rate should be applied. Otherwise the population total realization rate should be applied. However, the savings accounted for by these projects is so small that alternative assumptions should not affect the overall program savings estimates. Some applications simply use a realization rate of 1.0 for these very small projects.

[51] One rule of thumb is to keep the expected coefficient of variation of project savings to less than 1.0 within a stratum.

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- *Identification of categorical characteristic strata bounds* – Efficiencies can be gained by defining strata along categorical qualities such that the coefficient of variation of project realization rates for each stratum is lower than the resulting CV of the aggregated group without the categorical strata. This basis for stratifying may be applicable when a certain segment of the project population is expected to have different or more variable realization rates than the rest of the population. Units that are generally more alike should be grouped together in a stratum. For commercial projects, strata could be defined by building type (e.g., schools, office building, and multi-family). Similar buildings could be expected to have a lower variance in the estimated realization rate across sites (i.e., within the stratum) than when combined with other building types. Although categorical strata bounds are frequently applied in many DSM studies, they are not mandatory and should be prudently applied.

The sample designer may be required to make trade-offs between stratification approaches. Defining the appropriate strata is often the most important part of sample design; however, it requires data analysis skills, subject matter expertise on the project types, and knowledge of program administration and participation issues.

Step 3: Estimate an appropriate variance for each stratum.
In ratio estimation, the variance considered is that of the residuals on the stratum average realization rate rather than the variance of the verified savings. Accordingly, a CV or error ratio should be based on the assumed distribution of individual realization rates for the population of projects in each stratum.

The CVs should be based on the un-weighted[52] realization rates historic sample data, when such data are available. Any changes in program composition, administration, or participation from the previous year will decrease the validity of applying prior year CVs, and the assumed CVs should be adjusted upward by 0.1-0.2 to prevent under-sampling. It is not recommended to apply a coefficient of variation less than 0.30, in order to ensure sample sizes sufficient for robust results and to allow for increasing variances that may result from evolving measurement approaches and program participation.

A two-staged sample provides an opportunity to adjust the assumed CVs in the second stage to incorporate the sample data already observed in the first stage. The observed CVs in the first stage should still be slightly adjusted upward to account for variance and size unknowns in the second stage sample.

A CV of 0.5 may be assumed when historic data are not available. This is a standard industry assumption and is generally conservative in ratio estimation if the population tracked savings in the tracking database are reasonably accurate. However, custom projects with poor tracking

[52] The realization rates are un-weighted rather than weighted because it is assumed that any correlation between the size of a project in a stratum and its realization rate is coincidental (especially in small sample sizes). So, applying the historic correlation could result in under-sampling or over-sampling in subsequent program evaluation efforts.

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database estimates may produces CVs as large as 1.0. It is not uncommon to observe program CV's lowering over time as programs mature and tracking estimates improve. CVs can also increase if more rigorous and precise methods are used to evaluate project savings; however, this should not be viewed as a negative since rigorous methods create a more accurate understanding of project and program results.

Step 4: Allocate observations to each stratum.
The overall sample should be designed to achieve 10% precision at a 90% one-sided confidence level (i.e., 90/10 one-sided).[53, 54] This confidence and precision target is meant to be used for each custom program in each year. If changes are made to this target, these changes can be addressed in the sample size calculations and do not necessarily warrant changes in the recommended methodology. Appendix A and Figure 19 provide additional explanation and illustration for the 90/10 one-sided confidence interval and the other reporting confidence intervals.

Allocating the sample across strata to achieve target confidence and precision is not a simple exercise and can often require an iterative approach. Proportional sampling is one technique that is often applied, where the total sample size is calculated for the population and subsequently allocated to strata in proportion to some characteristic such as savings. Proportional sampling, however, fails to realize the efficiencies gained from stratifying and very frequently results in over-sampling. Lohr notes:[55]

> *If the variances are more or less equal across all the strata, proportional allocation is probably the best allocation for increasing precision. In cases where the variances vary greatly [across strata], optimal allocation can result in lower costs. In practice, when we are sampling units of different sizes, the larger units are likely to be pre variable than the smaller units [in absolute terms] and we would like to sample them with a higher fraction.*[56]

The California Evaluation Framework notes the skills required:

> *Stratified ratio estimation is somewhat more complex [than simple random sampling]…it probably still requires someone to have basic training and/or experience in statistics to ensure that it is understood and applied correctly.*[57]

---

[53] Based on October 25, 2012 Technical Evaluation Committee decision, the sample design should be based on a 90/10 one-sided confidence interval. Reporting of achieved confidence and precision should present the precision achieved for three confidence intervals: 90% one-sided on the lower bound, 90% one-sided on the upper bound, and 90% two-sided intervals. Appendix A provides additional explanation and illustrative examples for these reporting confidence intervals.

[54] This target may be inferentially interpreted as the intent to ensure that there is a 90% likelihood that the actual savings of the program population exceeds 90% of the sample estimate of program population savings.

[55] Lohr, S. L., "Sampling: Design and Analysis," Second Edition.2010. (Section 3.4.2 discusses optimal allocation)

[56] Lohr, S. L., "Sampling: Design and Analysis," Second Edition.2010. (Section 3.4.2 discusses optimal allocation in more detail – p. 87.)

[57] "The California Evaluation Framework." California Public Utilities Commission. Prepared by TecMarket Works. June 2004, p. 316.

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Given the judgment needed to develop a sample design, it is important to test the robustness of the design by simulating different scenarios. Assessing several alternative allocations of the sample across strata can usually improve sample efficiency.

Step 5: Determine criteria for assessing sample representativeness. (optional)
There are often categorical characteristics of the population that are not used in defining strata but are still desired to ensure a reasonably representative sample.[58] For example, market segment may not have been used in defining strata; however, a random sample that fails to include certain major market segments would not be viewed as a representative sample. You could establish new strata for these factors; however, it is expected that a random draw will be representative across these factors and there is a benefit for a simple stratification design.

To address this, some criteria can be defined prior to randomly selecting a sample, which can be used to assess the representativeness of the sample. Criteria should be established only for the most important characteristics, and they should only be set for high-level characteristics that, if not met, would represent an extreme sample in terms of representing the population. Failure to meet the criteria will result in discarding the full original sample and selecting an alternate full sample. Criteria can be established only for the total population or specific strata as appropriate (See example in Section 5.5). Selection of a sample that does not meet representativeness criteria should be a rare occurrence. This approach is only meant to mitigate the possibility that a randomly selected sample might result in highly inaccurate statements about the entire population. The necessity to discard the original sample should not occur in most program years.

Step 6: Select a random sample.
The sample for each stratum should be selected at random from a uniform distribution. This provides an equal opportunity for each project within a stratum to be selected.[59] This can be accomplished in Microsoft Excel using the RAND() function[60] to assign a random number between 0 and 1 to each project in a stratum. The projects should be sorted within each stratum based on the random number assigned to it, and the projects with the highest random number should be selected for the sample until the target stratum sample size is reached.

The selected sample should be analyzed and documented. If criteria are set to assess the representativeness, the selected sample should be analyzed against these criteria at this point. If

[58] These criteria are not intended to be overly restrictive in selecting a sample. Rather, they are intended to prevent the unlikely but possible case where extreme over-representation or under-representation of certain project characteristics occurs in the sample.

[59] Sampling from a savings-weighted distribution can also be valid, but it is not recommended here since size-based strata are already employed.

[60] Note that the RAND() function will continue to generate a new set of random numbers each time a cell is updated. To prevent this, the values of the RAND() function can be copied and pasted (i.e., "paste values") into a separate column.

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the sample does not meet the criteria for representativeness, then the full population sample should be discarded and a new sample should be selected.

Recruiting the full selected sample is often not achievable since some program participants may not respond or refuse to participate in the sample. Even when agreement to participate in evaluation activities is required to participate in the program, full recruitment of the selected sample can often not be achieved. Therefore, a set of potential replacement projects may be provided to recruiters to fill in for non-recruited participants.

Potential replacements should be selected from the same random number list of the population from which the original sample was selected. Replacements should be selected in priority of assigned random number until full recruitment is achieved. The full population of a stratum should not be provided to recruiters, whose incentives are not usually aligned to follow the random prioritization of the sample, unless the full sample size is not expected to be achieved.

Step 7: Recruit the sample.
Recruitment of each stratum sample can begin once the sample has been selected and assessed. Recruitment typically occurs over the phone, and may or may not involve scheduling of the on-site evaluation visit. Ensuring the accuracy and completeness of contact information in the tracking database can streamline the recruitment task.

The list of potential replacements may be initially withheld from recruiters to ensure that the originally selected sample projects are pursued fully before being replaced by alternate projects. This can help reduce the possibility for non-response bias in the sample. The California Evaluation Framework notes:[61]

> *It is very important to use the backup sample correctly. The most efficient way to recruit a sample of the desired size may appear to be to contact both the primary and backup sample at once and to schedule those sites that are first to respond and agree. But this is generally not sound practice since this approach ensures that the response will be no better than 50%, assuming that the backup sample size is equal to the primary sample size. Instead, the initial recruiting effort should be limited to the primary sample. A backup should be used only if a primary sample site is impossible to contact or refuses to participate.* (p. 350)

A full effort should be made to recruit the original sample before resorting to replacements, and the same effort should be made to recruit each replacement before moving on to the next.

[61] "The California Evaluation Framework." California Public Utilities Commission. Prepared by TecMarket Works. June 2004.

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5.5 *Example Implementation of Sample Design Methodology (Union)*

This section demonstrates how the sample design methodology might be implemented for an example set of Union program data. The data used for this example has been randomized and does not indicate historic program achievements that have undergone regulatory review in prior years. The data for this example is intended to be representative of a typical program year and are used in this example for illustrative purposes only. This example is for reference and does not preclude the judgment needed to understand and address the idiosyncrasies of actual program data.

This example applies the seven steps of the sample design process presented in Section 5.4 above.

Step 1 reviews the project tracking database for accuracy and quality. Of particular emphasis is a check on the processes used to produce the initial estimates for savings contained in the database and the contact information. This step is usually undertaken by the utility and is done to provide the third-party evaluator with the best information possible. As mentioned above, a more accurate tracking database will make it more likely that confidence and precision targets will be met. This example assumes that the tracking database has been reviewed.

Step 2 evaluates the population and defines strata. Figure 4 and Figure 5 show representative project distributions of savings[62] for Union's T1/R100 and C/I programs, respectively. Analyzing the distribution of project sizes indicates that size-based stratification should produce sampling efficiencies. Other categorical bases for stratification are not chosen for this example, although Union may consider isolating new technologies into a unique stratum for future evaluation efforts.

[62] Net annual savings are used for illustration here. Beginning in 2012, the TEC will require cumulative savings to serve as the basis for evaluation studies.

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Figure 4. Illustrative Distribution of Savings for Union'sT1/R100 Projects

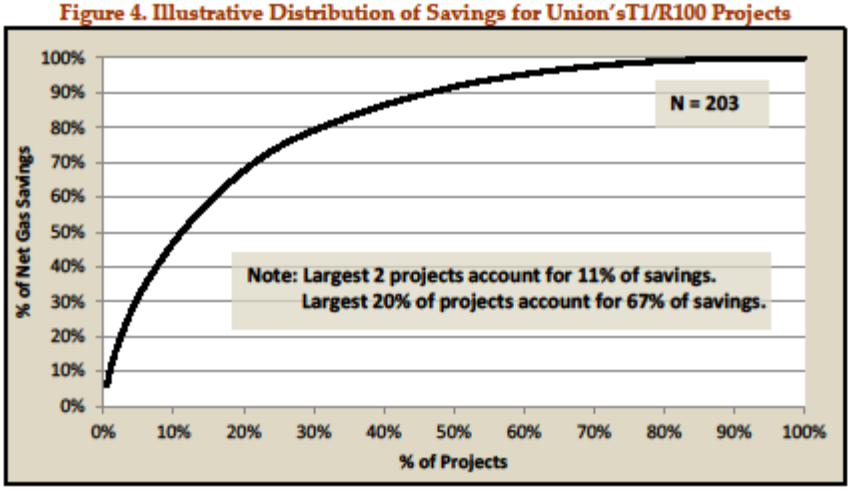
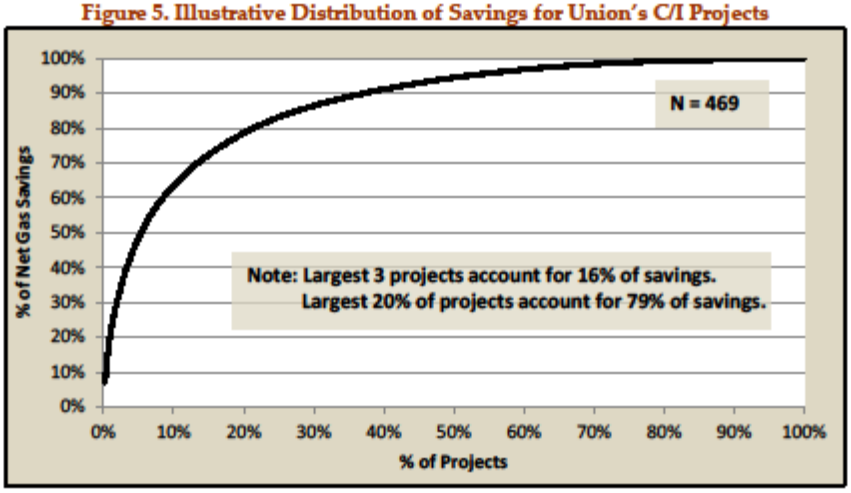


Figure 5. Illustrative Distribution of Savings for Union's C/I Projects



The sensitivity to sample sizes is investigated to determine appropriate savings thresholds for strata bounds. Figure 6 and Figure 7 show illustrative strata boundaries for Union's T1/R100 and C/I programs, respectively.

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Figure 6. Illustrative Strata Boundaries for Union's T1/R100 Projects

Stratum Size	Lower Threshold of Net Gas Savings (m^3)	Projects	Savings Represented (%)
Large	1,500,000	11	33.1%
Medium	800,000	24	29.5%
Small	100,000	97	33.9%
Very Small	0	71	3.4%

Figure 7. Illustrative Strata Boundaries for Union's C/I Projects

Stratum Size	Lower Threshold of Net Gas Savings (m^3)	Projects	Savings Represented (%)
Large	800,000	9	30.1%
Medium	200,000	44	36.1%
Small	20,000	225	30.4%
Very Small	0	191	3.3%

The "Very Small" projects—representing the bottom 3.4% of T1/R100 program savings and the bottom 3.3% of C/I program savings—are removed from the sample frame. These projects are small enough that the value of the information gained by evaluating them is not likely to be worth the cost. These projects should be adjusted by the Small Project stratum realization rate when re-introduced in the final sample analysis.

Step 3 estimates an appropriate variance for each stratum. Historical evaluation results indicate that CVs on project realization rates have been as low as 0.20 or as high as 0.40. However, typical CVs have been near 0.25. CVs are set at 0.30 for all strata in this example.

Step 4 allocates observations to each stratum. Figure 8 and Figure 9 indicate the sample sizes[63] and the assumptions used to allocate the samples when applying the calculations presented in Appendix B.

Figure 8. Illustrative Sample Allocation for Union's T1/R100 Projects

Stratum Size	Population Size	Sample Size	CV	T - value	FPC	Mean Gas Savings	Total Gas Savings	Stratum Weight
Large	11	7	0.3	1.94	0.63	2,618,182	28,800,000	0.34
Medium	24	7	0.3	1.94	0.86	1,070,000	25,680,000	0.31
Small	97	6	0.3	2.02	0.97	303,608	29,450,000	0.35
	132	20		1.73				1.00

[63] In previous program cycles when Union's custom programs were differentiated based on service contract rather than rate class, the differences between program sample sizes were much greater. Sample sizes will likely be more similar for the Union programs now that the programs differentiated based on rate class.

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Figure 9. Illustrative Sample Allocation for Union's C/I Projects

Stratum Size	Population Size	Sample Size	CV	T - value	FPC	Mean Gas Savings	Total Gas Savings	Stratum Weight
Large	9	6	0.3	2.02	0.61	1,532,222	13,790,000	0.31
Medium	44	7	0.3	1.94	0.93	375,909	16,540,000	0.37
Small	225	7	0.3	1.94	0.99	61,902	13,928,000	0.31
	278	20		1.73				1.00

The sample allocations are restricted to less than 75% of the total population for the two Large Project strata. This restriction allows for some backup projects to exist for the Large Project strata so that if recruitment of the original sample is unsuccessful, backup projects can be used and the sample will likely not require re-stratification or re-allocation.

Step 5 determines criteria for assessing sample representativeness. Note that this is listed as an optional step; however, it can be important for ensuring that the most appropriate information is provided from this analysis for making regulatory decisions such as payment of incentives and future program decisions. While the sample methodology applies techniques to minimize the required sample sizes, the smaller samples are at an increased risk that a random sample is not sufficiently representative. This is why ensuring representativeness is an import step.

This example establishes simple criteria to ensure representativeness of the sample across market segment in the R1/T100 and the C/I program sample.[64] Several market segments are specified in the tracking database, and their proportions are shown in Figure 10 and Figure 11.

Figure 10. Illustrative Representativeness Analysis of Project Market Segment for Union'sT1/R100 Program

Project Market Segment	Large Projects			Medium Projects			Small Projects		
	#	m^3	%	#	m^3	%	#	m^3	%
Agriculture	0	0	0%	0	0	0%	299	1,470,000	5%
Food Services	0	0	0%	0	0	0%	61	360,000	1%
Healthcare	0	0	0%	0	0	0%	370	910,000	3%
Manufacturing	66	28,800,000	100%	547	24,380,000	95%	6,344	24,400,000	83%
Resource	0	0	0%	0	0	0%	0	0	0%
Utility	0	0	0%	17	1,300,000	5%	1,074	2,310,000	8%
	66	28,800,000	100%	564	25,680,000	100%	8,148	29,450,000	100%

The main concern is that a randomly selected sample might under-represent the most important market segments, leading to a bias in program results. In these sample designs, less than ten sites may be drawn in a stratum; therefore, it is not impossible that this small sample size might be quite unrepresentative in some strata due to an unlucky sample draw. Increasing the sample sizes in each stratum could help resolve this issue, but the high cost of visiting each site and

[64] Union and its sampling advisor may determine that no criteria are needed or that other criteria are needed based on judgment and assessment of actual program data.

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gathering the verification data makes this very expensive. As a result, this representativeness check should be considered.

In the T1/R100 program, manufacturing is clearly the dominant market segment and ensuring that a representative sample from this segment across size categories is all that may be needed; however, an evaluator may want to check to see if the random project selection (in the next step) provides some projects from non-manufacturing segments such as agriculture and utility market segments. The most significant risk is likely to occur in the small projects sample where manufacturing accounts for 77% of the projects and 83% of the savings. It could be possible to have an "extreme" sample occur in a random draw where non-manufacturing sites are "overly" represented.[65] The sample for this stratum is only six projects. If five of these projects are non-manufacturing when manufacturing accounts for 83% of the savings, this sample may not provide the information desired from this verification effort. A criteria that at least three of the projects in this stratum be manufacturing projects may represent the minimum needed to consider the sample representative overall.

Figure 11. Illustrative Representativeness Analysis of Project Market Segment for Union's C/I Program

Project Market	Large Projects			Medium Projects			Small Projects		
Segment	#	m^3	%	#	m^3	%	#	m^3	%
Agriculture	0	0	0%	519	4,090,000	25%	10,784	4,301,000	31%
Education	7	4,400,000	32%	40	250,000	2%	2,438	1,210,000	9%
Entertainment	0	0	0%	0	0	0%	349	112,000	1%
Healthcare	0	0	0%	0	0	0%	3,306	918,000	7%
Manufacturing	38	9,390,000	68%	827	12,200,000	74%	19,337	6,896,000	50%
Multi-Family	0	0	0%	0	0	0%	569	152,000	1%
Resource	0	0	0%	0	0	0%	65	160,000	1%
Retail	0	0	0%	0	0	0%	172	43,000	0%
Transport	0	0	0%	0	0	0%	93	110,000	1%
Utility	0	0	0%	0	0	0%	237	26,000	0%
	45	13,790,000	100%	1,386	16,540,000	100%	37,350	13,928,000	100%

In the C/I program, the most important market segment is clearly manufacturing, followed by agriculture and education. To ensure that this is a representative sample, it may be important to be sure that the projects selected in the next step (random selection) contain some projects from each of these market segments. Manufacturing represents 64% of the overall savings. The agriculture and education market segments account for 18% and 13%, respectively, or 31% of total savings when taken together. Given a sample size of 20 overall, and no more than 7 in each stratum, a sample might be drawn that could be extreme in terms of its accurate representation of the population. Again, the concern is the high cost of conducting the site visits, which argues against simply expanding the sample size or adding new strata. To ensure that manufacturing does not entirely dominate the sample, it might be good to set representativeness criteria, for example, that at least four sites be non-manufacturing sites.

[65] What constitutes "overly" represented simply has to be defined by judgment exercised by the evaluator.

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Step 6 selects a random sample. The selection of the sample should be uniformly random within each stratum. This is accomplished by applying the RAND() function in Microsoft Excel and selecting the projects with the highest randomly assigned numbers to fulfill sample size requirements. The sample is reviewed to ensure that it meets any previously established criteria. Backup projects are also selected to replace any projects from the primary sample that are not successfully recruited.

Step 7 recruits the sample. Projects from the primary sample are only replaced after four recruitment attempts on four different dates. Projects that are not successfully recruited are documented before being replaced by backup projects.

These seven steps illustrate how the sample design methodology might be implemented using representative data. Following verification and evaluation of the sample, the sample data should be analyzed according to the realization rate methodology presented in Section 6 and according to the calculations presented in Appendix B.

5.6 *Example Implementation of Sample Design Methodology (Enbridge)*

This section demonstrates how the sample design methodology might be implemented for an example set of Enbridge program data. The data used for this example has been randomized and does not indicate historic program achievements that have undergone regulatory review in prior years. The data for this example is intended to be representative of a typical program year for illustrative purposes only. This example is for reference and does not preclude the judgment needed to understand and address the idiosyncrasies of actual program data.

This example applies the steps of the sample design process presented in Section 5.4.

Step 1 reviews the project tracking database for accuracy and quality. This example assumes that the tracking database has been reviewed.

Step 2 evaluates the population and defines strata. Figure 12 and Figure 13 show representative project distributions of savings[66] for Enbridge's commercial and industrial programs, respectively. Analyzing the distribution of project sizes indicates that size-based stratification should produce sampling efficiencies. Other categorical bases for stratification are not chosen for this example.

[66] Net annual savings are used for illustration here. Beginning in 2012, the TEC will require cumulative savings to serve as the basis for evaluation studies.

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Figure 12. Illustrative Distribution of Savings for Enbridge Commercial Projects

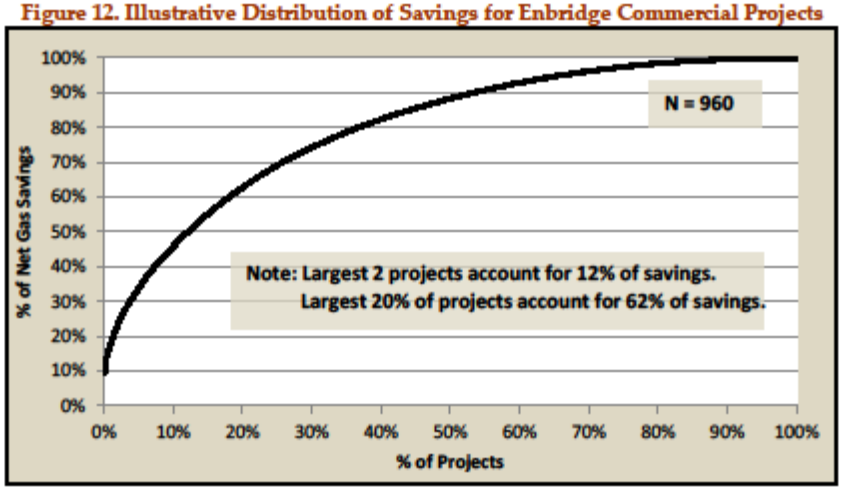
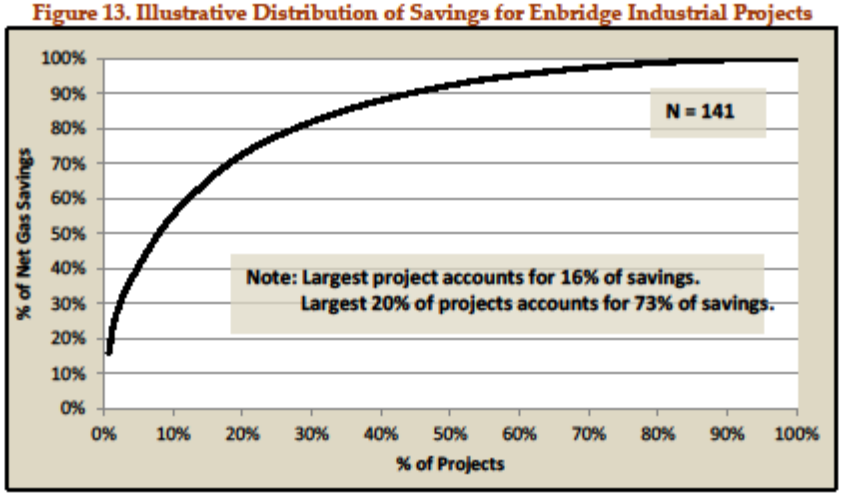


Figure 13. Illustrative Distribution of Savings for Enbridge Industrial Projects



The sensitivity to sample sizes is investigated to determine appropriate savings thresholds for strata bounds. Since the commercial program has a relatively large number of projects, it is necessary to balance the effects of strata weight with the effects of finite population correction when determining the threshold for the Large Project stratum. Figure 14 and Figure 15 show illustrative strata boundaries for Enbridge's commercial and industrial programs, respectively.

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Figure 14. Illustrative Strata Boundaries for Enbridge Commercial Projects

Stratum Size	Lower Threshold of Net Gas Savings (m^3)	Projects	Savings Represented (%)
Large	250,000	9	17.5%
Medium	70,000	125	35.8%
Small	10,000	563	43.5%
Very Small	0	263	3.2%

Figure 15. Illustrative Strata Boundaries for Enbridge Industrial Projects

Stratum Size	Lower Threshold of Net Gas Savings (m^3)	Projects	Savings Represented (%)
Large	400,000	8	42.9%
Medium	100,000	32	37.7%
Small	20,000	62	17.2%
Very Small	0	39	2.2%

The "Very Small" projects—representing the bottom 3.2% of commercial program savings and the bottom 2.2% of industrial program savings—are removed from the sample frame. These projects are small enough that the value of the information gained by evaluating them is not likely to be worth the cost. These projects should be adjusted by the Small Project stratum realization rate when re-introduced in the final sample analysis.

Step 3 estimates an appropriate variance for each stratum. Historical evaluation results indicate that CVs on project realization rates have been very low, sometimes less than 0.10. However, applying CVs less than 0.30 is not recommended in order to ensure sample sizes sufficient for robust results and to allow for increasing variances that may result from evolving measurement approaches and program participation. CVs are set at 0.30 for all strata in this example.

Step 4 allocates observations to each stratum. Figure 16 and Figure 17 indicate the sample sizes and the assumptions used to allocate the samples when applying the calculations presented in Appendix B.

Figure 16. Illustrative Sample Allocation for Enbridge's Commercial Program

Stratum Size	Population Size	Sample Size	CV	T - value	FPC	Mean Gas Savings	Total Gas Savings	Stratum Weight
Large	9	5	0.3	2.13	0.71	751,111	6,760,000	0.18
Medium	98	8	0.3	1.89	0.97	110,384	13,798,000	0.37
Small	590	11	0.3	1.81	0.99	29,766	16,758,000	0.45
	697	24		1.71				1.00

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Figure 17. Illustrative Sample Allocation for Enbridge's Industrial Program

Stratum Size	Population Size	Sample Size	CV	T - value	FPC	Mean Gas Savings	Total Gas Savings	Stratum Weight
Large	8	6	0.3	2.02	0.53	947,500	7,580,000	0.44
Medium	32	6	0.3	2.13	0.92	208,125	6,660,000	0.39
Small	62	5	0.3	2.35	0.97	48,903	3,032,000	0.18
	102	17		1.75				1.00

The key reason that the required sample size is smaller for the industrial program than the commercial program is that a larger fraction of the savings is concentrated in a smaller number of projects for the industrial program. The sample allocations are restricted to less than 75% of the total population for the two Large Project strata. This restriction allows for some backup projects to exist for the Large Project strata so that if recruitment of the original sample is unsuccessful, backup projects can be used and the sample will likely not require re-stratification or re-allocation.

Step 5 determines criteria for assessing sample representativeness. This can be important for ensuring that the most appropriate information is provided from this analysis for making regulatory decisions such as payment of incentives and future program decisions. While the sample methodology applies techniques to minimize the required sample sizes, the smaller samples are at an increased risk that a random sample is not sufficiently representative. This is why ensuring representativeness is an important step.

This example establishes a simple criterion to ensure representativeness of load type in the commercial program sample.[67] Three load types are specified in the tracking database, and their proportions are shown in Figure 18.

Figure 18. Illustrative Analysis of Project Load Types for Enbridge's Commercial Program

Project Load Type	Large Projects			Medium Projects			Small Projects		
	#	m^3	%	#	m^3	%	#	m^3	%
Space Heating	7	6,190,000	92%	111	11,853,000	86%	485	14,874,000	89%
Water Heating	1	320,000	5%	3	368,000	3%	65	1,386,000	8%
Combined	1	250,000	4%	11	1,577,000	11%	13	498,000	3%
	9	6,760,000	100%	125	13,798,000	100%	563	16,758,000	100%

The main concern is that a randomly selected sample might over-represent water heating to the detriment of properly representing space heating projects simply due to an unlucky draw of insufficiently representative projects. As example criteria, it might be reasonable to require that space heating projects must account for at least 70% of the savings in each stratum. A sample

[67] Enbridge and its sampling advisor may determine that no criteria are needed or that other criteria are needed based on judgment and assessment of actual program data.

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that does not meet these criteria would be viewed as unrepresentative and would be discarded and re-selected.

Step 6 selects a random sample. The selection of the sample should be uniformly random within each stratum. This is accomplished by applying the RAND() function in Microsoft Excel and selecting the projects with the highest randomly assigned numbers to fulfill sample size requirements. The sample is reviewed to ensure that it meets any previously established criteria. Backup projects are also selected to replace any projects from the primary sample that are not successfully recruited.

Step 7 recruits the sample. Projects from the primary sample are only replaced after four recruitment attempts on four different dates. Projects that are not successfully recruited are documented before being replaced by backup projects.

These seven steps illustrate how the sample design methodology might be implemented using representative data. Following verification and evaluation of the sample, the sample data should be analyzed according to the realization rate methodology presented in Section 6 and according to the calculations presented in Appendix B.

5.7 *Summary of Sample Design Methodology*

The sample design methodology described in this section is meant to apply advanced industry practices to create a cost-efficient sample by leveraging preexisting project and program information to the greatest extent possible. The methodology can be described as employing a "stratified ratio-estimation" approach. The sample is administered in two stages to make the best use of early observations that can be collected prior to completion of the program year. The methodology provides a step-by-step description of sample design tasks, but leaves flexibility to accommodate program changes in future years and cycles.

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6. Recommended Realization Rate Methodology

This section describes the recommended methodology for determining realization rates and achieved confidence and precision based on sample observations of custom DSM programs for Union and Enbridge. Section 6.1 describes the approach to determine verified realization rates. Section 6.2 describes the approach to determine the precision on the realization rate and total savings achieved by the sample. Section 6.3 discusses several potential adjustments that may be needed to ensure that the results appropriately characterize the population and provide the information needed by the utilities and stakeholders.

It is important ensure the quality of sample observation data prior to calculating achieved realization rates and savings. Data quality issues can sometimes be discovered when analyzing the sample, but it can be costly to correct the data at that point. Undetected data quality issues would result in inaccuracies of total savings and precision estimates.

6.1 Determining Verified Realization Rates

Realization rates should be calculated for each stratum sample and applied to each respective stratum population when estimating total savings. Applying realization rates to population strata is more complicated than assessing the results in a simple random sample without strata, but it is necessary when efficiencies are sought through stratification.[68] Again, efficiencies are important in this application due to the high cost of gathering the verification data at each sample site. Lohr notes:

> *The population total is the [sum across all strata of the estimated stratum population mean times the stratum population size]…This is a weighted average of the sample stratum averages; the weights are the relative sizes of the strata. To use stratified sampling, the sizes or relative sizes of the strata must be known.* [69]

Also, Wadsworth notes:

> *The estimator of the total of a stratified population can be expressed as the sum of strata of estimators of the individual stratum totals. This representation suggests the valid generalization that the estimator of the total in a stratum need not be limited to the expansion estimator, but could be any appropriate estimator of the population in the stratum, including a ratio estimator…then an estimate of the total in a stratified population may be constructed as a sum over strata.* [70]

---

[68] There are examples in the evaluation literature where strata weights have not been used in the calculation of the mean realization weight. This is clearly an oversight in these evaluations as it is a simple matter to weight the mean ratios of each stratum by the appropriate stratum weight (i.e., the proportion of the population in that stratum).

[69] Lohr, S. L., "Sampling: Design and Analysis," Second Edition. 2010, p. 69.

[70] Wadsworth, H.M., "Handbook of Statistical Methods for Engineers and Scientists," 1990, p. 9.25.

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These are standard procedures for developing population estimates from a stratified sample. The methods for estimating the population parameters must take into account the strata weights when stratification is used. The calculations needed to develop a verified realization rate from stratified sample data are shown in Appendix B. This approach is based on widely recognized methods published by Lohr.[71]

This approach for determining realization rates is consistent with the recommended sample design methodology presented in Section 5.

6.2 *Determining Achieved Confidence & Precision*

A precision level cannot be calculated without first establishing the confidence level. The calculation for both confidence and precision comes from the same basic equation. Either confidence or precision is first established, then the other is solved for. For example, a precision of +/- 10% implies that the stated confidence level should span +/- 10% from the mean estimate. The confidence may turn out to be 90%, 82% or another value. The confidence level is more typically established and the precision is solved for. For example, the level of precision achieved at a 90% level of confidence can be calculated and may turn out to be 10%, 12%, 15% or some other number (as illustrated in Appendix A). Regardless, the calculating confidence and precision are part of the same equation and one cannot be estimated without establishing the other. Misunderstanding this basic concept frequently leads to problems in presenting and discussing evaluation results in the industry. Additional discussion on confidence and precision can be found in Appendix A.

Confidence and precision calculations also have to take into account the fact that a stratified random sample has been used. The equations for calculating confidence and precision from a stratified sample design are shown in Appendix B. This approach for determining confidence and precision is consistent with the recommended sampling methodology in Section 5, and it is consistent with the population realization rate and savings estimates described in Section 6.1.

Communications with the TEC indicated that they were interested in both the likelihood that savings exceeds a given value and the likelihood that it falls above a given value. As a result, the recommendation is to report achieved confidence and precision in three ways:[72]

1. Achieved precision corresponding to 90% one-sided confidence on the lower bound
2. Achieved precision corresponding to 90% one-sided confidence on the upper bound[73]
3. Achieved precision corresponding to a 90% two-sided confidence interval

[71] Lohr, S. L., "Sampling: Design and Analysis," Second Edition.2010. (Sections 4.1-4.5)

[72] The achieved precision is a result of analyzing the sample data, and will usually differ to some extent from the targeted precision applied in designing the sample.

[73] Achieved precision of the upper bound represents a simple inversion of the confidence interval for the lower bound. Reporting on the upper bound is intended to facilitate an understanding that sampling uncertainties can just as likely lead to underestimation of the realization rate and therefore underestimating overall program savings as they are to result in overestimates.

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Appendix A provides additional explanation and illustrative examples for the reporting of confidence and precision in the estimated realization rate. The Figures in Appendix A are intended to clarify the interpretation of confidence and precision in making decisions based on the estimated realization rate.

6.3 *Sample Adjustments & Related Issues*

This section discusses several sampling adjustments that may be needed to accurately synthesize the total population realization rate and savings estimates. The following three types of adjustments are discussed:

1. Treatment of outliers and influential observations
2. Replacing sample projects
3. Post-stratification

Appropriately treating outliers and influential observations is important in accurately estimating the realized savings for DSM programs. Parties to a discussion of estimating program savings should understand appropriate treatment of outliers and influential observations when estimates are based on a sample of the population.

Treatment of Outliers & Influential Observations

This section first presents a conceptual discussion. Following this discussion, an example from a recent Union custom program evaluation is presented. Most statistical analyses should examine the data for outliers and test to determine whether these outliers may be "influential observations" that can skew the accuracy of a sample. Kennedy states the rationale for treating outliers:

> *The rationale for looking for outliers is that they may have a strong influence on the estimates…an influence that may not be desired.* [74]

In other words, the reason for looking for evaluating outliers is that there may be a sample case drawn that is well outside the expected bounds of the distribution and that this observation may exert undue influence on the estimates of the analysis (i.e., an influential observation). Osborne and Overbay further describe the effect of outliers:

> *The presence of outliers can lead to inflated error rates and substantial distortions of parameter and statistic estimates when using either parametric or nonparametric tests (e.g., Zimmerman, 1994, 1995, 1998). Casual observation of the literature suggests that researchers rarely report checking for outliers of any sort.* [75]

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[74] Kennedy, P. "A Guide to Econometrics." Third Edition. MIT Press, 1992, p. 279.

[75] Osborne, J., Overbay, A. "The Power of Outliers and Why Researchers Should Always Check for Them."2004 Practical Assessment, Research & Evaluation, volume 9, section 6. Link: http://pareonline.net/getvn.asp?v=9&n=6

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The issue is whether it is appropriate for a single observation to swing the overall results in a substantial manner.[76] If such an observation is found, then further study is needed to determine the most appropriate course of action. In general, a sample of 10 from a population of 100 projects implies that each sample point represents 10 projects. However, if a selected sample point is truly a unique case and does not represent other projects in the population, then an adjustment may be warranted. Osborne and Overbay go on to state:

> *[The appropriate treatment] depends in large part on why an outlier is in the data in the first place. Where outliers are illegitimately included in the data, it is only common sense that those data points should be removed… Few should disagree with that statement.*

The sample analysis should seek to determine whether or not outliers and influential observations can be viewed as representative members of the main population upon which population estimates may be inferred. Barnett and Lewis note:[77]

> *If they are not [suitable]…they may frustrate attempts to draw inferences about the original (main) population.*

One example can be taken from the analysis of the sample observation in Union's 2011 custom program. Two outliers were identified in the Distribution Contract (DC) custom program. One verified project observed a gas savings realization rate of 3.75 and a second project observed a realization rate of 0.18. A sensitivity analysis tested for the influence of these two observations by removing[78] them and noting the changes in results.[79]

The estimated overall realization rate for gas savings when including both observations was 1.25. This is a relatively high realization rate when compared to evaluation efforts across North America, but not an unheard of result. Excluding the high observation lowered the estimated overall estimate from 1.25 to 1.05. Excluding the low observation raised the overall estimate from 1.25 to 1.32. Excluding both outliers produced an overall realization rate on gas savings of 1.11.

Discussions were held with Union concerning the two outlier observations. It is important not to exclude an observation without examining the reasons that may contribute to the

---

[76] A simple intuitive example of the impacts an outlier can have on a statistical analysis can be found in a Wikipedia contribution (8/20/2012): *Naive interpretation of statistics derived from data sets that include outliers may be misleading. For example, if one is calculating the average temperature of 10 objects in a room, and nine of them are between 20 and 25 degrees Celsius, but an oven is at 175 °C, the median of the data could be between 20 and 25 °C but the mean temperature will be between 35.5 and 40 °C. In this case, the median better reflects the temperature of a randomly sampled object than the mean; however, naively interpreting the mean as "a typical sample", equivalent to the median, is incorrect. As illustrated in this case, outliers may be indicative of data points that belong to a different population than the rest of the sample set.*

[77] Barnett, V., Lewis, T., "Outliers in Statistical Data." Wiley Series in Probability & Statistics, 1998/1994.

[78] Removing or excluding an outlier entails isolating the sample point in a unique stratum such that the sample point still counts in the analysis, but it is not used for extrapolating results for the un-sampled population.

[79] Note that some observations may be identified as outliers but do not significantly influence the analysis results.

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observation's extreme value. If the observation is representative of other projects in the population, it should be left in. If it can be shown to result from a one-time construct and is not likely to be replicated by other members of the population, then exclusion of this observation should be considered. The discussions with Union indicated that both observations were likely due to unique calculation issues and technologies involved.

The most conservative position in treating this outlier issue was taken—the high observation was removed and the low observation was retained in the sample data set. This produces the lowest overall program realization rate given the choices in addressing the identified outliers. However, removing outliers in strata with small sample sizes may also adversely affect the confidence and precision results and the sample may require augmentation to achieve confidence and precision targets.

Projects that implement new technologies—whose savings estimates have had less validation—or certain technology classes that are complex and difficult to estimate for the tracking database may be at an increased likelihood to result in outlier realization rates. Identifying such projects in the program tracking database could help isolate them and reduce their chance of skewing program estimates. These projects could be placed into a separate category with different confidence and precision targets for new technologies. Any projects that are truly unique should be identified and addressed during sample design. These steps would not eliminate these projects in terms of their contribution to overall program savings, but would allow for appropriate methods to more accurately estimate program savings. If sampled, these unique projects should not be considered representative of other projects in the main program. As a result, addressing this issue in advance could improve the sample analysis and the resulting program estimates.

Replacing Sample Projects

The final recruited sample should be analyzed and summarized, especially when replacement projects are substituted into the originally selected sample. Recruiters should document the reasons for unsuccessful recruitment of original sample members. Replacement samples should always be selected in priority based on the assigned random number, and full effort should be made to recruit selected replacements before substituting other replacements. If recruitment rates are very poor, this may introduce a significant non-response bias. Low recruitment rates should be investigated and documented, and recommendations may be made to improve recruitment in subsequent evaluation years.

Post-Stratification

If a sample did not achieve the desired confidence and precision and the stratification basis is thought to be sub-optimal, post-stratification may be used to retrospectively re-stratify a sample along more appropriate dimensions to demonstrate an improved precision achieved by the sample. Often, post-stratification will not improve achieved precision, especially at relatively small sample sizes; however, under certain circumstances this technique may be useful. The Ontario Power Authority notes that:

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> *A technique known as post-stratification may be used to develop estimates about sub-populations after the study is complete and can be used if characteristics about the sub-populations are unknown at the time the study in conducted.*
>
> *This advanced technique should be reserved for special situations and utilized only after careful consideration of other options and well documented in the experimental approach of the Draft Evaluation Plan.* [80]

Post-stratification should not be used on a normal basis, and if necessary should inform subsequent program evaluation cycles to improve the sample frame and prevent the need for post-stratification in future years.

6.4 Summary of Realization Rate Methodology

This section presents the method for calculating verified ex-post realization rates as well as for appropriately calculating the confidence and precision levels for the estimated realization rate and overall program savings. It also discusses three issues that can lead to adjustments to the sample and recalculation of the realization rate along with confidence and precision levels. There are several important concepts presented in this section:

- The program realization rate is inferred from the sample observations based on the separate realization rates for each stratum.
- The realization rate calculations should apply the strata weights to accurately interpret sample observations. This adds a bit of complexity, but no alternate application of the observed data would be appropriate. This is considered standard practice in the application of a stratification approach in statistics.
- There are some important and legitimate considerations that should be examined when inferring estimates for a population from an observed sample. The following three factors are discussed in this section:
    1. Outliers and influential observations
    2. Replacement projects when data cannot be gathered from the originally sampled project
    3. Post-stratification to provide higher precision and greater confidence in the results

The equations needed to calculate the realization rates and achieve confidence and precision from the sample data are contained in Appendix B.

[80] "EM&V Protocols and Requirements: 2011-2014." Ontario Power Authority. March 2011, p. 130.

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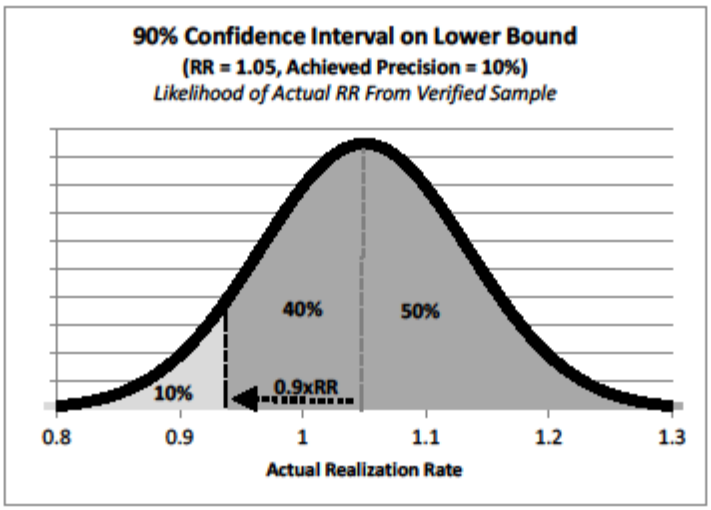
Appendix A. Explanatory Note on Confidence & Precision

The level of certainty associated with a statistical sample is most often stated in terms of a confidence interval. A confidence interval contains two components: confidence level and precision. Confidence level indicates the likelihood that an actual variable either exceeds a value (i.e., one-sided confidence) or falls within a range (i.e., two-sided confidence). Precision[81] indicates the bounding values of the corresponding confidence level. Confidence and precision are both necessary to sufficiently describe a confidence interval.[82]

At the time of this report, the target confidence interval for the design of the sample is established as 90/10 one-sided.[83] Figure 19 illustrates a 90% one-sided confidence interval with 10% precision for a sample whose realization rate (RR) is estimated to be 1.05.

Figure 19. Illustration of a 90% One-Sided Confidence Interval on the Lower Bound



[81] Relative precision (e.g., 10% of the estimate) is most often used to set the precision as a percentage of the estimated value rather than in absolute terms.

[82] Also, the shape (i.e., one-sided or two-sided) is often used to fully specify the confidence interval.

[83] Based on October 25, 2012 Technical Evaluation Committee decision the sample design should be based on a 90/10 one-sided confidence interval. Reporting of achieved confidence and precision should present the precision achieved for both the 90% one-sided and 90% two-sided intervals.

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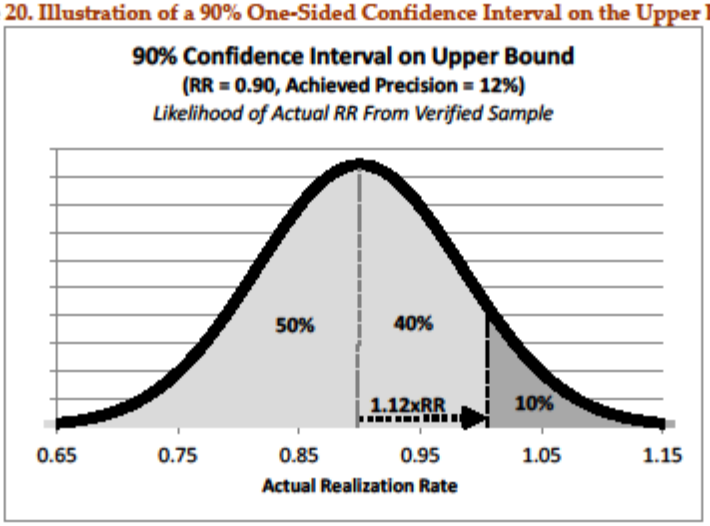
Reading off of Figure 19, this confidence interval can be interpreted as showing that:[84]

- There is a 10% likelihood that the actual value is less than 10% below the mean sample estimate of 1.05.
- There is a 40% likelihood that the actual value falls between 10% below the sample estimate and the sample estimate of 1.05.
- There is a 50% likelihood that the actual value exceeds the sample estimate of 1.05.

The reporting recommendations in Section 6.2 of the main report also call for the reporting of a one-tailed test around an upper bound and a two-tailed test at a 90% confidence level. These are illustrated in Figure 20 and Figure 21. Figure 20 illustrates a 90% one-sided confidence interval on the upper bound. For this illustration a different realization rate estimate is use that was used in Figure 19. In this case, the estimated realization rate is 0.90 and the level of precision achieved at the 90% confidence level is observed from the sample to be 12%. This confidence interval illustrates that the actual value has a 10% likelihood of exceeding the estimated realization rate of 0.90 plus 12% (i.e., exceeding a realization rate 1.01). This likelihood is illustrated by the dark shaded portion of the distribution in the Figure.

Figure 20. Illustration of a 90% One-Sided Confidence Interval on the Upper Bound



[84] This interpretation of the confidence interval is based on statistical inference, which assumes that the sample provides an adequate representation of the population.

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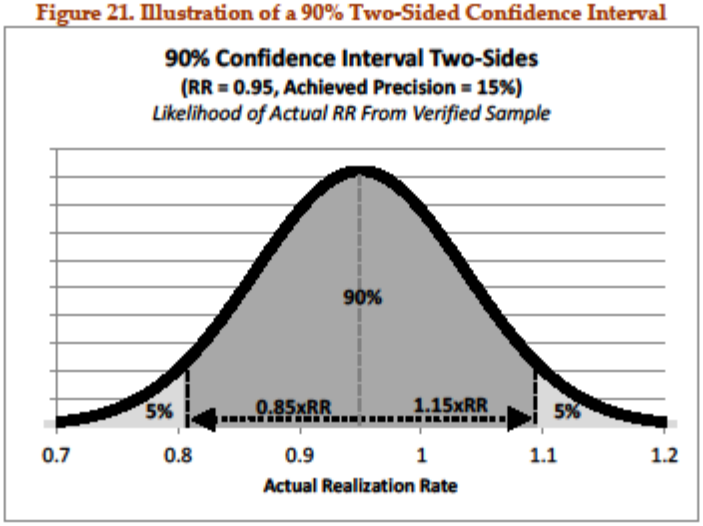
Figure 21 illustrates a 90% two-sided confidence interval on a sample whose realization rate is observed to be 0.95 and whose achieved precision is 15%. The dark shaded area in the middle of the distribution represents the 90% confidence level that the actual value would fall between the bounds set dat plus or minus 15% of the observed sample estimate. There is only a 5% likelihood that the actual value would fall below the lower bound.

Figure 21. Illustration of a 90% Two-Sided Confidence Interval



Appendix B presents the detailed calculation methods for determining the confidence and precision achieved by a sample.

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B.1 Calculating Target Sample Confidence & Precision from Assumed CV

(Note: The formulae in this appendix are based on application of Lohr[85] and Cochran,[86] and are adapted to the vocabulary of the stratified realization rate problem of efficiency program evaluation.)

The standard error of the total savings of stratum h based on tracked ex ante savings[87] is given by,

$$SE'_h = FPC_h \times \frac{CV_h}{\sqrt{n_h}} \times TS'_h$$

Where CV_h[88] is the estimated coefficient of variation in stratum h, defined as the expected stratum standard deviation divided by the expected stratum mean.[89] Where FPC_h is the finite population correction factor of stratum h, n_h is the sample size of stratum h, and TS'_h is the tracked ex ante total savings in stratum h.[90] FPC_h is given by,

$$FPC_h = \sqrt{\frac{N_h - n_h}{N_h - 1}}$$

Where N_h is the population size of stratum h. The relative precision at the stated confidence level of stratum h is given by,

$$RP'_h = t_h \times \frac{SE'_h}{TS'_h} \times 100\%$$

Where t_h is the t-value derived from the confidence requirement and the sample size of stratum h. The overall standard error can be calculated by aggregating the sample according to each stratum's weighting (i.e., expected percent contribution to total program savings). The overall standard error of the tracked ex ante total savings of the program is given by,

[85] Lohr, S. L., "Sampling: Design and Analysis," Second Edition, 2010.

[86] Cochran, W. G., "Sampling Techniques," Third Edition, 1977.

[87] The prime symbol (apostrophe) is used to indicate that these values are based on tracked ex ante values rather than verified ex post values.

[88] In cases of ratio estimation, the error ratio is substituted for the coefficient of variation.

[89] The coefficient of variation may be based on savings or realization rate, as in the case of ratio estimation.

[90] Total tracked ex ante is not necessarily required to compute relative precision since this term is also in the denominator of the relative precision calculation.

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$$SE'_P = \sqrt{\sum_h SE_h^{\,2}}$$

The overall relative precision at the stated confidence level is given by,

$$RP'_P = t_P \times \frac{SE'_P}{TS'_P} \times 100\%$$

Where t_P is the t-value derived from the confidence requirement and the overall sample size in the population, and TS'_P is the estimated total savings across all strata based on verified ex post savings.

B.2 *Calculating Achieved Realization Rates*

Defining $x_{i,h}$ as the tracked ex ante estimate and $y_{i,h}$ as the verified ex post estimate of a single sample point i in stratum h, the effective realization rate of a single sample point i in stratum h is given by,

$$RR_{i,h} = \frac{y_{i,h}}{x_{i,h}}$$

The stratum sample realization rate of stratum h is the sum of all verified ex post savings in the sample of stratum h divided by the sum of all tracked ex ante savings in the sample of stratum h, given by,

$$RR_h = \frac{\sum_{i \in h} y_{i,h}}{\sum_{i \in h} x_{i,h}}$$

In stratified ratio estimation, the stratum realization rate should be applied to the tracked ex ante estimates of each member j[91] of the full population of stratum h to produce the total savings estimate for stratum h. The verified total savings estimate for stratum h is the sum of all tracked ex ante estimates in stratum h multiplied by the stratum realization rate, given by,

$$TS_h = RR_h \times \sum_{j \in h} x_{j,h}$$

[91] Note that i members of the sample are a subset of j total members of the applicable population.

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The verified total savings of the program can be calculated by aggregating strata results. The program verified total savings estimate is given by,

$$TS_P = \sum_h TS_h$$

The overall realization rate across all strata is the verified total savings of the program divided by the tracked ex ante total savings of the program, given by,

$$RR_P = \frac{TS_P}{TS'_P}$$

B.3 *Calculating Achieved Sample Confidence & Precision*

A predicted estimate can be made for each member of stratum h based on the stratum realization rate, where the predicted estimate is the tracked ex ante estimate of each member of the stratum multiplied by the stratum realization rate. A residual error can be calculated for each sample point in stratum h based on the difference between the verified ex post savings of the sample point and the predicted estimate. The residual of each sampled point is given by,

$$e_{i,h} = y_{i,h} - RR_h \times x_{i,h}$$

The sample variance[92] of the verified total savings in stratum h is derived from the stratum residuals, given by:

$$V_h = \frac{1}{n_h - 1} \sum_{i \in h} e_{i,h}^2$$

The standard error of the sample of stratum h can be calculated using the stratum sample variance and the finite population correction factor. The standard error of the verified total savings of stratum h is given by,

$$SE_h = FPC_h \times \frac{\sqrt{V_h}}{\sqrt{n_h}} \times N_h$$

[92] Sample variance is based on residuals of the verified measurement compared to the predicted estimate using the stratum realization rate when applying ratio estimation.

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The relative precision for the stated confidence level of the verified estimate of stratum h is given by,

$$RP_h = t_h \times \frac{SE_h}{TS_h} \times 100\%$$

The resulting confidence interval can be stated in terms of the realization rate or the total estimate. The absolute two-sided confidence interval for the stratum realization rate and verified total savings of stratum h is given by,

$$RR_h \pm (RR_h \times RP_h) \quad and \quad TS_h \pm (TS_h \times RP_h)$$

The absolute one-sided confidence interval for the stratum realization rate and verified total savings of stratum h is given by,

$$> RR_h - (RR_h \times RP_h) \quad and \quad > TS_h - (TS_h \times RP_h)$$

The standard error of the verified total savings of the program is given by,

$$SE_P = \sqrt{\sum_h SE_h^2}$$

The overall relative precision at the stated confidence level is given by,

$$RP_P = t_P \times \frac{SE_P}{TS_P} \times 100\%$$

The absolute two-sided confidence interval for the overall program realization rate and verified total savings of the program is given by,

$$RR_P \pm (RR_P \times RP_P) \quad and \quad TS_P \pm (TS_P \times RP_P)$$

The absolute one-sided confidence interval for the overall program realization rate and verified total savings of the program is given by,

$$> RR_P - (RR_P \times RP_P) \quad and \quad > TS_P - (TS_P \times RP_P)$$

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Appendix C. Summaries of Custom C&I Samples in Selected Jurisdictions

This appendix presents brief summaries of the sampling approaches used in custom commercial and industrial (C&I) programs in selected jurisdictions. The reviewed approaches are all contained within publicly available documents. Because the reviewed documents contain varying degrees of detail and explanation, the Navigant team applied its best interpretation of these documents to synthesize the available information in a consistent manner. Eight jurisdictions are discussed below. Published information on the sampling procedures allowed for a useful summary to be produced.

C.1 Summary from Illinois (ComEd)

The Commonwealth Edison Company (ComEd) Smart Ideas for Your Business program offers all eligible commercial and industrial customers financial incentives for upgrading their facilities with energy-efficient equipment. The program offers prescriptive incentives, available for qualified equipment commonly installed as part of retrofit and equipment replacement projects, or custom incentives, available for less common and more complex energy-saving measures. Examples of custom projects include heating, ventilating, and air conditioning (HVAC) measures (such as chiller upgrades and centralized thermostat control systems), large commercial refrigeration measures, air compressor system upgrades, high-rise building domestic water pumping systems, industrial process renovations, and non-prescriptive lighting measures. In 2011, the custom incentive levels were $0.03/kilowatt-hour (kWh) for equipment with less than a five-year life and $0.07/kWh for equipment with a five-year life or greater.[93] These incentive levels were applied for the first $100,000 in incentives and then reduced by half for the next $100,000, up to the project cost cap. In 2011, ComEd provided financial incentives to 887 projects. Of these, 32 projects were selected for evaluation to achieve confidence and precision targets of 90% and 8% over the three-year program.[94]

A two-stage sampling methodology was implemented, with the first projects being sampled in April of 2011 and the remaining projects sampled in July. The sampling approach stratified the population of projects by project size. All custom projects were sorted into three strata based on *ex ante* energy (kWh) savings, such that each stratum contained one-third of the total claimed energy savings.[95] The evaluation sample was drawn to represent the population distribution by stratum. Figure 22 shows the total number of projects and the evaluation sample by stratum. This sample represents 100% of the population's claimed energy savings in the first stratum,

[93] Any project involving Energy Management System programming is eligible for the $0.03/kWh incentive. To receive the $0.07/kWh custom incentive, equipment must have a minimum payback of one year and a maximum payback of seven years.

[94] A thirty-third project had been selected but after the site-visit it was moved into the following program year (FY4).

[95] Note that ComEd's custom program application does not require that applicants submit an estimate of savings, suggesting that the claimed savings may be underestimated. In addition, more projects may be assigned to stratum 3, resulting in a less precise estimation of *ex post* gross impacts.

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59% in the second, and 5% in the third. In total, the 32 projects represent 45% of the program's custom projects' *ex ante* energy savings.

Figure 22. ComEd 2011 C&I Sample Summary

Sampling Stratum	Total Number of Projects	Evaluation Sample
1	2	2
2	27	15
3	858	15
Total	**887**	**32**

Source: Navigant Review of Evaluation Report[96]

C.2 *Summary from Michigan (DTE Energy)*

The DTE Energy C&I non-prescriptive program offers business customers financial incentives for the installation of "innovative and unique" energy efficiency equipment and controls. Examples of custom measures include energy management system controls, variable-speed air compressors, and ultrasonic HVAC humidification systems. Ineligible customer measures include on-site electricity generation, renewable energy, peak-shifting, fuel switching, or changes in operational/maintenance practices that do not involve capital costs. The custom incentive levels are $0.08/kWh, based on the first year of estimated energy savings, up to 50% of the project cost. Projects require a one-year minimum payback and an eight- year maximum payback.

In 2010, DTE Energy provided financial incentives for 515 energy efficiency measures associated with 381 unique projects. Of these projects, 56 were selected for evaluation to achieve confidence and precision targets of 90% and 10%, respectively, at the program level. This sample of 56 was based on a proportional sampling of measures from each of the three major technology groups: custom lighting, custom electric and custom gas.[97] Figure 23 shows the number of energy efficiency measures, unique projects, and evaluation sample size by group. The sample of custom lighting measures, custom electric measures, and custom gas measures represents 60%, 45%, and 90% of *ex ante* gross energy savings, respectively, for the population.

[96] "Evaluation Report: Smart Ideas for Your Business Custom Program." (Program Cycle 2010-2011.) Commonwealth Edison Company. Prepared by Navigant Consulting, Incorporated. May 16, 2012.

[97] Due to the small sample of "custom electric", several additional measure types were consolidated into this group to avoid a potential distortion in the realization rate. For example, custom HVAC, custom motors, and measures installed through a grocery RFP are included in the "custom electric" category.

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Figure 23. DTE Energy 2010 Custom C&I Sample Summary

Sampling Stratum	Total Number of Measures	Total Number of Projects	Evaluation Sample
Custom Lighting	321	252	27
Custom Electric	150	93	9
Custom Gas	44	36	20
Total	**515**	**381**	**56**

Source: Navigant Review of Evaluation Report[98]

C.3 *Summary from Massachusetts (National Grid, NSTAR, and Western Massachusetts Electric Company)*

The C&I energy efficiency program run by the Massachusetts Program Administrators offers financial incentives to business customers for installing energy-efficient equipment. Custom projects are categorized as either a comprehensive design (CD) project or a comprehensive chiller (CC) project. CD projects typically involve the new construction of commercial, industrial, or municipal buildings that include at least four energy conservation measures (ECMs) that achieve a minimum of 20% energy savings relative to code.[99] CC projects typically involve the installation of a new chiller and multiple other ECMs in an existing building that achieve a minimum of 20% savings.

In 2008 and 2009, 25 custom projects were installed in National Grid, NSTAR, and Western Massachusetts Electric Company (WMECO) service territories.[100] Custom projects were stratified for National Grid, NSTAR, and WMECO separately, resulting in three strata for National Grid and one stratum for both NSTAR and WMECO. Although not specified in the evaluation report, it appears that stratification was based on project size. Figure 24 lists the number of projects and evaluation sample in each stratum by program administrator. Of these projects, five were selected for evaluation to achieve confidence and precision targets of 90% and 10%, respectively, three from National Grid and one each from NSTAR and WMECO.

[98] "Reconciliation Report for DTE Energy's 2010 Energy Optimization Programs." DTE Energy Company. Prepared by Opinion Dynamics Corporation. April 15, 2011.

[99] Examples of ECMs are building envelope upgrades, lighting fixtures and controls, cooling system upgrades, and Energy Management System controls.

[100] Twenty-two custom projects occurred in National Grid service territory, 2 in NSTAR, and 1 in WMECO.

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Figure 24. Massachusetts 2008-2010 Custom C&I Sample Summary

Sampling Stratum	Total Number of Projects	Maximum Gross Savings (kWh)	Evaluation Sample
National Grid, 1	12	332,480	1
National Grid, 2	6	608,237	1
National Grid, 3	4	1,108,409	1
NSTAR, 1	2	3,352,840	1
WMECO, 1	1	496,579	1

Source: Navigant Review of Evaluation Report[101]

C.4 *Summary from New Mexico (New Mexico Public Service Company and New Mexico Gas Company)*

New Mexico Gas Company and the Public Service Company of New Mexico have programs that offer financial incentives to commercial and industrial customers for custom energy efficiency projects.[102] The custom C&I program offered by the New Mexico Gas Company is called "Commercial Solutions" and provides low-flow faucet aerators and pre-rinse spray valves at no cost, as well as a $0.75/therm incentive for custom measures (e.g., water heating, HVAC, building envelope, and industrial process improvements). The custom C&I program offered by the Public Service Company of New Mexico is called the "Commercial Comprehensive Program" and provides rebates for a range of prescriptive and custom measures. Projects are classified as either retrofit, new construction, or QuickSaver direct-install.

The sampling methodology to evaluate C&I programs utilizes stratified random sampling to achieve 90% confidence and 10% precision levels. Projects are stratified by project size. New Mexico Gas Company stratified into three strata. The Public Service Company of New Mexico implemented the sampling strategy for retrofit, new construction, and quick-saver projects separately. Due to the large population of projects for retrofit and QuickSaver, projects were stratified into five strata, while new construction projects were stratified into three strata. Figure 25 and Figure 26 show the number of projects and evaluation sample by stratum.

[101] "Impact Evaluation of 2008 and 2009 Custom CDA Installations." Massachusetts Energy Efficiency Advisory Council. Prepared by KEMA and SBW Consulting Incorporated. June 7, 2011.

[102] El Paso Electric Company also offers a custom C&I program. However, during 2010 and 2011 there were no participants and as a result an evaluation of the program was not conducted.

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Figure 25. New Mexico Gas Company 2011 Custom C&I Sample Summary

Sampling Stratum	Total Number of Projects	Evaluation Sample
< 1,000 therms	16	3
1,000 – 5,000 therms	7	3
> 4,000 therms	5	5
Total	**28**	**11**

Source: Navigant Review of Evaluation Report[103]

Figure 26. Public Service Company of New Mexico 2011 Custom C&I Sample Summary

Retrofit		
Sampling Stratum	**Total Number of Projects**	**Evaluation Sample**
< 26.5 MWh	95	5
26.5-50 MWh	38	4
50-150 MWh	48	4
150-500MWh	29	5
>500 MWh	9	9
Total	**224**	**27**

QuickSaver		
Sampling Stratum	**Total Number of Projects**	**Evaluation Sample**
< 10 MWh	192	4
10-20 MWh	150	4
20-40 MWh	88	4
40-95 MWh	44	4
> 95 MWh	10	10
Total	**484**	**26**

New Construction		
Sampling Stratum	**Total Number of Projects**	**Evaluation Sample**
< 70 MWh	12	3
70-250 MWh	9	4
> 250 MWh	2	2
Total	**23**	**9**

Source: Navigant Review of Evaluation Report[104]

C.5 *Summary from Pennsylvania (PECO Energy)*

The PECO Energy Company Smart Equipment Incentives program offers financial incentives for installing energy-efficient equipment in commercial and industrial facilities and in master-metered multifamily residential buildings. The program offers incentives for both prescriptive and custom measures. Examples of custom projects include energy management systems,

[103] "Evaluation of 2011 DSM Portfolio." New Mexico Gas Company. Prepared by ADM Associates Incorporated. June 2012.

[104] "Evaluation of 2011 DSM & Demand Response Portfolio." Public Service Company of New Mexico. Prepared by ADM Associates Incorporated. March 2012.

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compressed air systems, process equipment and chillers, industrial systems, whole building systems, and outdoor lighting. Custom incentive levels are $0.12/kWh for estimated on-peak energy savings and $0.08/kWh for estimated off-peak energy savings, up to 100% of project costs.[105]

In 2010, PECO provided financial incentives to 1,085 non-multi-tenant projects and 490 multi-tenant projects. Of these projects, 39 were selected for evaluation to achieve confidence and precision targets of 85% and 10%, respectively, at the program level.[106] The sample is stratified by project size, based on *ex ante* energy savings, and by project-type (lighting, non-lighting, custom). A three-stage sampling strategy was implemented, with the first stage occurring after the end of Q2, the second stage after Q3, and the third stage after Q4.[107,108] Within the sample, custom projects make up the majority of stratum 1, accounting for 49% of *ex ante* energy savings for the sample population.[109]

C.6 Summary from Ohio (AEP Ohio)

AEP Ohio offers commercial and industrial customers energy efficiency incentives through a number of programs. The custom program provides financial incentives for "less common or more complex energy-saving measures" that are installed as part of a qualified retrofit project or equipment replacement project. Examples of custom measures include lighting retrofits, HVAC measures such as VFDs, equipment controls, and process efficiency improvements. Custom incentive levels are based on both energy (kWh) and demand (kW) savings in the first year. Specifically, the incentive levels are $0.08/kWh, $100/kW, up to 50% of the project cost. In 2011, AEP Ohio provided financial incentives to 220 custom projects. Of these, 54 projects were selected for evaluation.

The sampling methodology stratified projects both by geography and by project size. At the time, AEP Ohio had gone through a merger of two regional operating companies so that participants in the custom program were distributed across two rate zone territories. The sample design was conducted separately for each rate zone, targeting confidence and precision levels of 90% and 10%, respectively, for each zone. A two-stage sampling methodology was implemented, with the first wave of projects sampled in November of 2011 and the second wave sampled in February of 2012. Projects were first separated by zone, then stratified based on *ex ante* energy (kWh) savings. Projects were assigned to one of three strata such that there

[105] On-peak hours include 12pm-8pm, June 1 – September 30 (excluding holiday weekdays). Off-peak hours include 8:01pm-11:59am, June 1-September 30, and all hours from October 1-May 31. https://peco.icfi.com/sites/peco/files/2011_PECO_CUSTOM_Incentive_Levels.pdf

[106] The evaluation plan targeted confidence and precision levels of 85% and 15%, respectively. However, the final sample design allowed for 85/10 confidence and precision targets.

[107] The first stage included projects implemented in both Q1 and Q2 due to low levels of participation in the program during Q1.

[108] Note that PECO reports unverified savings quarterly.

[109] Lighting and non-lighting measures account for 19% and 32%, respectively.

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was a relatively even distribution of cumulative standard deviation in energy savings between strata. Figure 27 shows the number of total projects and the number of projects in the evaluation sample for each zone and stratum. In total, the evaluation sample represents 62% of *ex ante* gross energy savings for the population.

Figure 27. AEP Ohio 2011 Custom C&I Sample Summary

Sampling Stratum	Total Number of Projects	Evaluation Sample
Zone 1, Stratum 1	5	5
Zone 1, Stratum 2	19	7
Zone 1, Stratum 3	85	12
Zone 2, Stratum 1	8	5
Zone 2, Stratum 2	18	11
Zone 2, Stratum 3	85	14
Total	**220**	**54**

Source: Navigant Review of Evaluation Report[110]

C.7 *Summary from Maryland (covers five Maryland utilities)*

The five EmPOWER Maryland utilities (Baltimore Gas and Electric, Potomac Electric Power Company, Delmarva Power, Southern Maryland Electric Cooperative, and Potomac Edison) offer large commercial and industrial customers financial incentives for the installation of efficiency measures that are complex and/or unique, such as commercial HVAC and industrial process improvements. Baltimore Gas and Electric (BGE) and Southern Maryland Electric Cooperative (SMECO) offer rebates for up to 50% of retrofit projects and up to 75% of the incremental cost of new construction projects. Potomac Electric Power Company (PEPCO) and Delmarva Power (DPL) programs were implemented jointly and offer $0.16/kWh for energy savings in the first year.[111] Potomac Edison (PE) offers $0.05/kWh of *ex ante* energy savings. The target evaluation sample for each utility was 12 projects to achieve confidence and precision levels of 80% and 20%, respectively. At the time the evaluation samples were drawn, only BGE had enough participants to reach the targeted sample of 12. PEPCO/DPL had 10 custom projects completed, SMECO had 7, and PE had 11. For these utilities, the entire population was used as the evaluation sample.[112]

For BGE, the sampling strategy calculated the percentage of population energy (kWh) and demand (kW) savings for each project using equal weights. These percentages were used to sort the population of projects into three strata such that each stratum represented approximately one-third of population savings. Random numbers were then assigned to projects within each

[110] "Program Year 2011 Evaluation Report: Business Custom Program." AEP Ohio. Prepared by Navigant Consulting, Incorporated. May 10, 2012.

[111] As a result, participants in PEPCO and DPL's programs were combined into a single sample.

[112] The final evaluation sample for PEPCO/DPL was reduced to eight due to barriers in doing on-site verification for two custom projects.

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stratum. Sample projects from each stratum were selected based on the random number designation. For BGE, the evaluation sample represents 58% of *ex ante* energy savings for the population.

C.8 Summary from Vermont (Efficiency Vermont)

Efficiency Vermont offers financial incentives for installing energy-efficient equipment in commercial and industrial facilities as well as multi-family buildings. The evaluation was conducted for two program years, 2007 and 2008. The sample size was chosen to achieve an 80% confidence level and 10% precision level for the entire portfolio of Efficiency Vermont programs.

Sampling occurred in two stages, with the first wave including projects completed by April 30, 2008, and the second wave including projects completed during the remainder of 2008. The sampling methodology categorizes projects by market type (retrofit or new construction/market opportunities) and end use (lighting, HVAC, and other).

The sample of retrofit projects includes projects of all end uses, whereas the evaluation sample of new construction/market opportunities projects only includes lighting projects. Projects were stratified into three strata based on *ex ante* peak demand savings. Because demand reductions are claimed separately for winter and summer, the population of projects/end uses was further stratified by season. In particular, if the estimated peak reduction was higher during winter, projects/end uses were assigned to "winter." If the estimated peak reduction was higher during summer or was roughly equivalent during winter and summer, projects/end uses were assigned to "summer/non-seasonal." Within each stratum, a random number was assigned to each project/end use and ordered. The evaluation sample was then selected from the top of each group. Figure 28 shows the total number of retrofit and NC/MOP projects, as well as the evaluation samples stratified by project size and seasonality.

Figure 28. Efficiency Vermont 2007-2008 Custom C&I Sample Summary

	Total Number of Projects		Evaluation Sample			
Sampling Stratum	Retrofit	NC/MOP	Retrofit, Winter	Retrofit, Summer	NC/MOP, Winter	NC/MOP, Summer
0.8-5 kW	263	652	8	8	15	15
5-35 kW	244	315	16	17	23	26
> 35 kW	64	35	49	49	21	23
Total	**571**	**1,002**	**73**	**74**	**59**	**64**

Source: Navigant Review of Evaluation Report[113]

[113] "Verification of Efficiency Vermont's Energy Efficiency Portfolio for the ISO-NE Forward Capacity Market." Vermont Department of Public Service. Prepared by West Hill Energy and Computing Incorporated. July 29, 2010.

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Appendix C: Custom Project Verification

NAVIGANT

Memorandum

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To: **Ehsan Dibaji, Meredith Lamb, Leslie Kulperger – Union Gas Ltd.**

From: **Brad Rogers, Dan Violette, Lisa Cassell, Justin Spencer – Navigant Consulting**

Date: **October 17, 2013**

Re: **Sample Design and Evaluation Results for Union Gas 2012 Custom Projects**

This memorandum presents the sample design and results for the evaluation of Union Gas custom projects completed during the 2012 program year including projects in the Commercial/Industrial (C/I) program and the T1/R100 "large volume customer" program. This memorandum is organized according to the following section headings:

1. Summary of the Custom Program Population
2. Description of the Sample Frame
3. Determination of Evaluation Sample Sizes
4. Approach to Selecting the Sample
5. Summary of the Selected Sample
6. Sampled Project Evaluation Results
7. Evaluation Study Results

The approach taken to design and analyze the sample for 2012 Custom Programs reflects the prescribed methodology. [1,2] The verified cumulative savings results of the evaluation study are:

- **C/I verified cumulative savings of 656,087,561 m^3 with a realization rate (RR) of 1.00**
- **T1/R100 verified cumulative savings of 1,392,931,990 m^3 with a realization rate (RR) of 1.10**

The results for the T1/R100 program were achieved at the 90/11 one-sided confidence interval. The C/I program met the 90/10 target confidence interval.

1. Summary of the Custom Program Population

Figure 1 below shows that 647 custom projects were implemented during the 2012 project year. All custom projects in the population reported cumulative gas savings, which served as the

[1] "A Sampling Methodology for Custom C&I Programs." Prepared for the Technical Evaluation Committee, Union Gas, and Enbridge by Navigant Consulting Inc. (Violette, D. M., and B. Rogers), November 12, 2012.
[2] For the rationale underlying the approaches used, see the Sampling Methodology Report cited in footnote 1, available from Union Gas.

basis for grouping projects into size-based strata.[3] The C/I program accounts for about three quarters of the total number of custom projects, but only represents about one-third of the reported custom cumulative gas savings. The T1/R100 program accounts for about one quarter of the total custom projects, but represents two-thirds of the custom cumulative gas savings.

Figure 1. Cumulative Savings (m^3) for Union 2012 Custom Projects

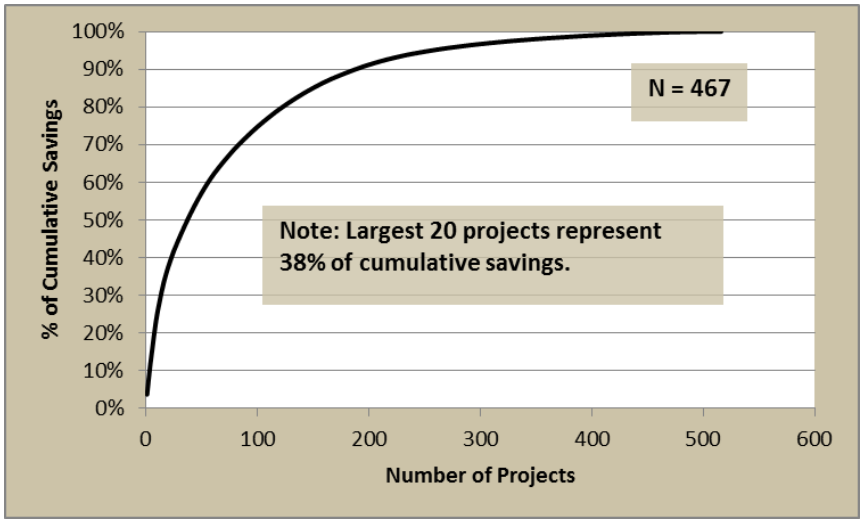
Custom Program	Projects (N)	Reported Cumulative Gas Savings (m^3)	% of Total Gas Savings by Program
Commercial/Industrial	467	656,087,561	34%
T1/R100	180	1,266,301,809	66%
Total	**647**	**1,922,389,370**	**100%**

2. Description of the Sample Frame

Separate samples were designed for the C/I program and the T1/R100 program. Within each program segment, strata were defined based on the amount of reported cumulative gas savings. Stratifying by project size reduced the overall sample size (i.e., number of sites drawn) by taking advantage of the concentrations of savings when relatively few projects contribute to a large fraction of total impacts.[4] The very small sites representing about 1% of each program's cumulative gas savings were excluded from the sample selection in order to ensure cost-effective use of evaluation budget.

Figure 2 and Figure 3 below illustrate how the large projects represent a disproportionately large fraction of program savings, while the very small projects contribute almost negligibly.

Figure 2. Distribution of Cumulative Savings from Union's Commercial/Industrial Program



[3] This differs from the 2011 Custom project analysis where the basis was on Total Resource Cost benefits.
[4] "A Sampling Methodology for Custom C&I Programs." Prepared for the Technical Evaluation Committee, Union Gas, and Enbridge by Navigant Consulting Inc. (Violette, D. M., and B. Rogers), November 12, 2012. (See Section 5.1 Stratification)

Figure 3. Distribution of Cumulative Savings from Union's T1/R100 Program

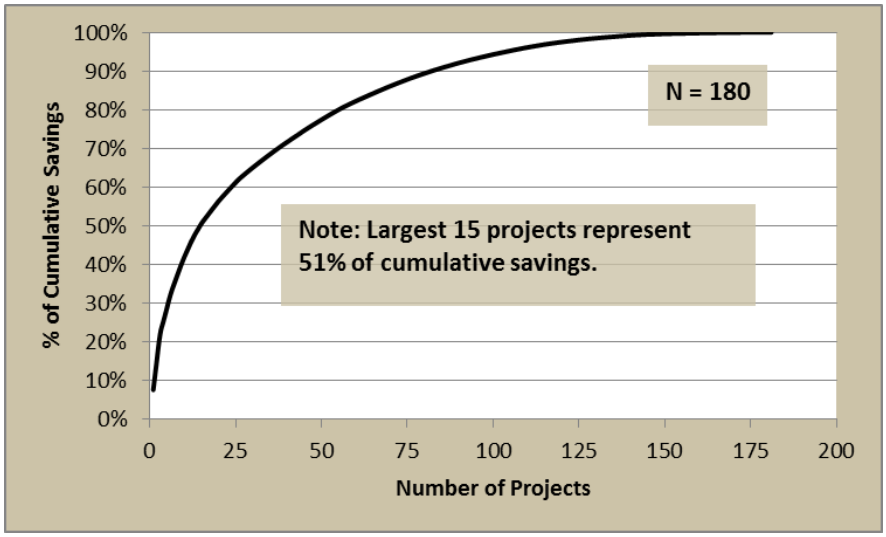


Figure 4 below indicates the cumulative gas savings thresholds applied to each stratum.

Figure 4. Program Segmentation Thresholds (Based on Cumulative Gas Savings)

Stratum	Commercial/Industrial	T1/R100
Large	>6M m^3	>20M m^3
Medium	>2M m^3	>4M m^3
Small	>100K m^3	>100K m^3
Very Small	<100K m^3	<100K m^3

Figure 5 below indicates the number of projects, the cumulative gas savings, and the percent contribution to total program cumulative gas savings represented in each stratum.

Figure 5. Program Segment Characteristics

Program	Stratum	Population	Reported Cumulative Gas Savings (m^3)	% of Program Gas Savings
Commercial/Industrial	Large	20	248,172,614	38%
	Medium	61	212,235,935	32%
	Small	291	190,490,444	29%
	Very Small	95	5,188,568	1%
	Total	**467**	**656,087,561**	**100%**
T1/R100	Large	13	601,969,386	48%
	Medium	64	518,502,786	41%
	Small	92	145,211,442	11%
	Very Small	11	618,195	0.05%
	Total	**180**	**1,266,301,809**	**100%**

3. Determination of Evaluation Sample Sizes

The sample was designed to target 90% confidence that the actual population gas savings would exceed 90% of the sample estimate (i.e., 90/10 one-sided confidence interval) for both the C/I and T1/R100 programs individually. Coefficients of variation (CV) of 0.4 and 0.3 were applied for the C/I program and the T1/R100 program respectively based on historically observed results from Union custom programs. The finite population correction factor was applied in order to take advantage of the concentrations of benefits in the large project strata. Strata were weighted based on their contribution to total program cumulative gas savings. T-values were applied to standard errors in order to estimate the relative precision for 90% one-sided confidence coverage.

These assumptions were applied to estimate the minimum sample sizes required to hit the 90/10 one-sided confidence interval target by appropriately allocating sample projects to each stratum based on reported cumulative gas savings.

Figure 6 below indicates the designed sample sizes for each stratum that are expected to achieve the desired precision targets. A sample size of 17 is estimated for the T1/R100 program, and a sample size of 29 is estimated for the C/I program.[5]

Figure 6. Sample Sizes by Custom Program Segment

Stratum	Commercial/Industrial	T1/R100
Large	12	7
Medium	9	6
Small	7	4
Very Small[6]	1	-
Total	**29**	**17**

4. Approach to Selecting the Sample

The sample was designed based on cumulative gas savings. Projects were randomly selected from each stratum to meet the target sample size for each stratum. Each stratum sample was inspected for reasonable representativeness across market segments (e.g., manufacturing, education, healthcare, etc.) and also across location (e.g. North, South). A preliminary sample was selected following Q3 of 2012 in order to begin evaluating projects early enough to ultimately meet the reporting deadline. The sample design was updated at the end of 2012 to account for the final population, and a final sample was selected.

[5] "A Sampling Methodology for Custom C&I Programs." Prepared for Union Gas and Enbridge by Navigant Consulting Inc. (Violette, D. M., and B. Rogers), November 12, 2012.
[6] One C/I "Small" site was sample that was later reclassified as "Very Small."

5. Summary of the Selected Sample

Figure 7 and Figure 8 below show the percent of the population projects and population savings represented by the sample for each stratum. The sample size for C/I represents about 6% of the population projects and 30% of population savings. The sample for T1/R100 represents about 9% of the population projects and 39% of the population savings.

Figure 7. Commercial/Industrial Sample Summary

Stratum	Sample size (n)	Population (N)	% of Population per Stratum	Sample Reported Cumulative Gas Savings (m^3)	Population Reported Cumulative Gas Savings (m^3)	% of Stratum Gas Savings
Large	12	20	60%	155,371,509	248,172,614	63%
Medium	9	61	15%	32,646,413	212,235,935	15%
Small	7	291	2%	7,023,222	190,490,444	4%
Very Small	1	95	1%	92,442	5,188,568	2%
Total	**29**	**467**	**6%**	**195,133,586**	**656,087,561**	**30%**

Figure 8. T1/R100 Sample Summary

Stratum	Sample size (n)	Population (N)	% of Population per Stratum	Sample Reported Cumulative Gas Savings (m^3)	Population Reported Cumulative Gas Savings (m^3)	% of Stratum Gas Savings
Large	7	13	54%	412,030,740	601,969,386	68%
Medium	6	64	9%	63,529,043	518,502,786	12%
Small	4	92	4%	12,462,984	145,211,442	9%
Very Small	0	11	0%	-	618,195	-
Total	**17**	**180**	**9%**	**488,022,767**	**1,266,301,809**	**39%**

6. Sampled Project Evaluation Results

Figure 9 and Figure 10 below summarize the reported and verified savings for sampled projects from the C/I and T1/R100 programs respectively.

Figure 9. Commercial/Industrial Sampled Project Evaluation Results

Project Identification No.	Population Stratum	Reported Annual Gas Savings (m^3)	Reported Measure Life (yrs)	Free Rider Rate	Reported Cumulative Gas Savings (m^3)	Verified Annual Gas Savings (m^3)	Verified Measure Life (yrs)	Verified Cumulative Gas Savings (m^3)	Project Realization Rate
2012-COM-0102	Large	1,058,190	20	0.54	9,735,348	896,997	20	8,252,372	0.85
2012-IND-0160	Large	691,732	20	0.54	6,363,932	699,078	20	6,431,514	1.01
2012-IND-0171	Large	1,667,381	20	0.54	15,339,905	1,649,101	15	11,378,794	0.74
2012-IND-0176	Large	1,597,771	20	0.54	14,699,493	1,351,320	25	18,231,445	1.06
2012-IND-0187	Large	1,129,396	30	0.54	15,585,665	868,643	25	9,989,396	0.64
2012-IND-0188	Large	1,115,675	14	0.54	7,184,947	1,254,586	7	4,039,766	0.56
2012-IND-0216	Large	1,200,528	20	0.54	11,044,858	1,301,912	10	5,988,795	0.54
2012-IND-0230	Large	2,018,082	20	0.54	18,566,354	1,824,140	20	16,782,085	0.9
2012-IND-0251	Large	712,243	20	0.54	6,552,636	392,080	15	2,705,352	0.41
2012-IND-0477	Large	1,811,219	20	0.54	16,663,215	1,534,337	20	14,115,898	0.85
2012-IND-0524	Large	1,034,849	20	0.54	9,520,614	1,030,323	20	9,478,973	1
2012-IND-0532	Large	5,242,292	10	0.54	24,114,543	2,100,000	10	9,660,000	0.40
2012-COM-0020	Medium	415,905	20	0.54	3,826,326	350,685	20	3,226,301	0.84
2012-COM-0092	Medium	255,454	20	0.54	2,350,177	381,623	20	3,510,932	1.49
2012-IND-0049	Medium	581,045	20	0.54	5,345,614	694,171	20	6,386,375	1.19
2012-IND-0079	Medium	318,377	20	0.54	2,929,068	377,436	20	3,472,408	1.19
2012-IND-0107	Medium	450,156	20	0.54	4,141,435	586,487	20	5,395,676	1.30
2012-IND-0156	Medium	1,920,653	5	0.54	4,417,502	2,010,051	10	9,246,237	2.09
2012-IND-0168	Medium	366,741	20	0.54	3,374,017	520,680	15	3,592,691	1.06
2012-IND-0225	Medium	296,704	20	0.54	2,729,677	222,316	20	2,045,310	0.75
2012-IND-0351	Medium	383,978	20	0.54	3,532,598	339,819	20	3,126,333	0.88
2012-COM-0057	Small	51,040	15	0.54	352,176	13,497	15	93,132	0.26
2012-COM-0069	Small	43,431	15	0.54	299,674	43,045	15	297,012	0.99
2012-IND-0127	Small	111,700	20	0.54	1,027,640	115,793	20	1,065,294	1.04
2012-IND-0130	Small	224,110	15	0.54	1,546,359	234,322	15	1,616,819	1.05
2012-IND-0155	Small	428,837	7	0.54	1,380,855	467,718	7	1,506,051	1.09
2012-IND-0213	Small	166,374	20	0.54	1,530,641	239,635	20	2,204,644	1.44
2012-IND-0220	Small	275,117	7	0.54	885,877	268,112	7	863,320	0.97
2012-IND-0088	Very Small	50,240	4	0.54	92,442	43,577	5	100,227	1.08

Figure 10. T1/R100 Sampled Project Evaluation Results

Project Identification No.	Population Stratum	Reported Annual Gas Savings (m^3)	Reported Measure Life (yrs)	Free Rider Rate	Reported Cumulative Gas Savings (m^3)	Verified Annual Gas Savings (m^3)	Verified Measure Life (yrs)	Verified Cumulative Gas Savings (m^3)	Project Realization Rate
2012-IND-0030	Large	9,655,436	20	0.54	88,830,011	10,465,000	30	144,417,000	1.63
2012-IND-0282	Large	3,347,642	20	0.54	30,798,306	4,208,000	20	38,713,600	1.26
2012-IND-0290	Large	6,956,258	30	0.54	95,996,360	6,017,000	30	83,034,600	0.86
2012-IND-0430	Large	3,631,134	20	0.54	33,406,433	3,508,000	20	32,273,600	0.97
2012-IND-0443	Large	4,593,133	20	0.54	42,256,824	4,593,000	20	42,255,600	1.00
2012-IND-0486	Large	10,055,761	20	0.54	92,513,001	12,280,000	20	112,976,000	1.22
2012-IND-0543	Large	3,068,457	20	0.54	28,229,804	3,401,000	20	31,289,200	1.11
2012-IND-0024	Medium	5,902,120	7	0.54	19,004,826	5,822,000	7	18,746,840	0.99
2012-IND-0027	Medium	2,818,056	7	0.54	9,074,140	2,703,000	7	8,703,660	0.96
2012-IND-0057	Medium	5,473,070	2	0.54	5,035,224	2,737,000	2	2,518,040	0.50
2012-IND-0152	Medium	2,321,976	4	0.54	4,272,436	2,154,500	4	3,964,280	0.93
2012-IND-0241	Medium	1,240,811	20	0.54	11,415,461	1,271,000	30	17,539,800	1.54
2012-IND-0431	Medium	1,600,756	20	0.54	14,726,955	1,601,000	20	14,729,200	1.00
2012-IND-0068	Small	1,039,637	7	0.54	3,347,631	1,040,000	7	3,348,800	1.00
2012-IND-0151	Small	2,414,818	2	0.54	2,221,633	2,296,250	2	2,112,550	0.95
2012-IND-0153	Small	1,705,572	4	0.54	3,138,252	853,000	4	1,569,520	0.50
2012-IND-0157	Small	408,208	20	0.54	3,755,514	593,500	20	5,460,200	1.45

7. Evaluation Study Results

The primary goal of the evaluation study was to estimate the verified cumulative gas savings. Figure 11 and Figure 12 below present the verified cumulative gas savings for each program by stratum and in total. The C/I program met the 90/10 target confidence interval. The results for the T1/R100 program were achieved at the 90/11 one-sided confidence interval.

Figure 11. Commercial/Industrial Evaluation Results

Stratum	Population Size (N)	Reported Cumulative Gas Savings (m^3)	Verified Realization Rate	Verified Cumulative Gas Savings (m^3)†	Achieved Relative Precision
Large	20	248,172,614	0.74	183,647,734	9%
Medium	61	212,235,935	1.23	261,050,200	16%
Small	291	190,490,444	1.09	207,634,584	19%
Very Small*	95	5,188,568	1.08	5,603,653	-
Total	**467**	**656,087,561**	**1.00**	**656,087,561**	**8.7%**

** One site was verified from the Very Small stratum, which produced a site RR of 1.08. This value was applied to the Very Small stratum rather than the program weighted average RR (i.e., 1.01) since it was reasonably consistent with the Small stratum rate of 1.09.*
†The verified values are exactly equal to the reported cumulative savings multiplied by the realization rates rounded to two decimal places. Therefore the total verified cumulative savings shown here does not equal the sum of the strata due to rounding error.

Figure 12. T1/R100 Evaluation Results

Stratum	Population Size (N)	Reported Cumulative Gas Savings (m3)	Verified Realization Rate	Verified Cumulative Gas Savings (m3)†	Achieved Relative Precision
Large	13	601,969,386	1.18	710,323,875	14%
Medium	64	518,502,786	1.04	539,242,897	20%
Small	92	145,211,442	1.00	145,211,442	68%
Very Small*	11	618,195	1.10	680,015	-
Total	**180**	**1,266,301,809**	**1.10**	**1,392,931,990**	**11.2%**

**Note: Large/Med/Small Stratum weighted average RR is applied to the Very Small Stratum which was not sampled.*
†The verified values are exactly equal to the reported cumulative savings multiplied by the realization rates rounded to two decimal places. Therefore the total verified cumulative savings shown here does not equal the sum of the strata due to rounding error.

The verified cumulative savings results of the evaluation study are:

- C/I verified cumulative savings of 656,087,561 m^3 with a realization rate (RR) of 1.00,
- T1/R100 verified cumulative savings of 1,392,931,990 m^3 with a realization rate (RR) of 1.10.

The realization rates and achieved precision were calculated in accordance with the prescribed methodology. [7]

[7] "A Sampling Methodology for Custom C&I Programs." Prepared for the Technical Evaluation Committee, Union Gas, and Enbridge by Navigant Consulting Inc. (Violette, D. M., and B. Rogers), November 12, 2012.

Appendix D: Measure Inputs

	Measure Name	Equip Life	Energy Load	Free Rider	Adj. Factor	Natural Gas Savings m^3/Unit	Water Savings L/Unit	Elec Savings kWh/Unit	Inc Costs $/Unit
Basic	Basic-Faucet Aerator-Bath	10	Baseload	1%	86%	10	3,435	0	$0.59
	Basic-Faucet Aerator-Kitchen	10	Baseload	1%	81%	23	7,797	0	$1.29
	Basic-Pipe Insulation - 2 m	10	Baseload	1%	94%	18	0	0	$0.98
	Basic-Showerhead-1.25 gpm existing 2.0-2.5	10	Baseload	1%	80%	46	14,294	0	$3.79
	Basic-Showerhead-1.25 gpm existing 2.6+	10	Baseload	1%	80%	88	22,580	0	$3.79
	Basic-Showerhead-Replacement	10	Baseload	1%	80%	33	11,584	0	$3.79
HHC	Faucet Aerator-Bath	10	Baseload	1%	86%	10	3,435	0	$0.59
	Faucet Aerator-Kitchen	10	Baseload	1%	81%	23	7,797	0	$1.29
	Pipe Insulation - 2 m	10	Baseload	1%	94%	18	0	0	$0.98
	Showerhead-1.25 gpm existing 2.0-2.5	10	Baseload	1%	80%	46	14,294	0	$3.79
	Showerhead-1.25 gpm existing 2.6+	10	Baseload	1%	80%	88	22,580	0	$3.79
ESK	Install - Faucet Aerator - Bath - 1.0 gpm	10	Baseload	33%	92%	6	2,004	0	$0.49
	Install - Faucet Aerator - Kitchen - 1.5 gpm	10	Baseload	33%	82%	23	7,797	0	$1.29
	Install - Pipe Insulation - 2m	10	Baseload	4%	100%	18	0	0	$0.98
	Install - Showerhead - 1.25gpm exist 2.6+	10	Baseload	10%	72%	88	22,580	0	$3.79
	Install - Showerhead - 1.25gpm	10	Baseload	10%	72%	44	13,885	0	$3.79
	Install - Showerhead - 1.25gpm - Replacement	10	Baseload	10%	72%	33	11,584	0	$3.79
	Pull - Faucet Aerator - Bath - 1.0pgm	10	Baseload	33%	40%	6	2,004	0	$0.49
	Pull - Faucet Aerator - Kitchen - 1.5gpm	10	Baseload	33%	50%	23	7,797	0	$1.29
	Pull - Pipe Insulation - 2m	10	Baseload	4%	60%	18	0	0	$0.98
	Pull - Showerhead - 1.25gpm	10	Baseload	10%	47%	44	13,885	0	$3.79
	Pull - Showerhead - 1.25gpm - Replacement	10	Baseload	10%	60%	33	11,584	0	$3.79
	Push - Faucet Aerator - Bath - 1.0gpm	10	Baseload	33%	33%	6	2,004	0	$0.49
	Push - Faucet Aerator - Kitchen - 1.5gpm	10	Baseload	33%	50%	23	7,797	0	$1.29
	Push - Pipe Insulation - 2m	10	Baseload	4%	51%	18	0	0	$0.98
	Push - Showerhead - 1.25gpm	10	Baseload	10%	35%	44	13,885	0	$3.79
	Push - Showerhead - 1.25gpm - Replacement	10	Baseload	10%	74%	33	11,584	0	$3.79
	D2D - Faucet Aerator - Bath - 1.0gpm	10	Baseload	33%	85%	6	2,004	0	$0.49
	D2D - Faucet Aerator - Kitchen - 1.5gpm	10	Baseload	33%	83%	23	7,797	0	$1.29
	D2D - Pipe Insulation - 2m	10	Baseload	4%	92%	18	0	0	$0.98
	D2D - Showerhead - 1.25gpm	10	Baseload	10%	71%	44	13,885	0	$3.79
	D2D - Showerhead - 1.25gpm - Replacement	10	Baseload	10%	71%	33	11,584	0	$3.79
HWC	Faucet Aerator-Bath 1.0gpm Hotel/Motel	10	Baseload	10%	40%	6	2,221	0	$0.59
	Faucet Aerator-Bath 1.0gpm LTC/Retire Reside	10	Baseload	10%	40%	10	2,254	0	$0.59
	Faucet Aerator-Bath 1.0gpm MURB	10	Baseload	10%	40%	7	2,371	0	$0.59
	Faucet Aerator-Bath 1.0gpm Other	10	Baseload	10%	40%	8	2,065	0	$0.59
	Faucet Aerator-Bath 1.0gpm Univ/College Dorm	10	Baseload	10%	40%	8	1,719	0	$0.59
	Faucet Aerator-Bath Hotel/Motel Rebate	10	Baseload	10%	40%	6	2,221	0	$0.59
	Faucet Aerator-Bath MURB Rebate	10	Baseload	10%	40%	7	2,371	0	$0.59
	Faucet Aerator-Bath Other Rebate	10	Baseload	10%	40%	8	2,065	0	$0.59
	Faucet Aerator-Bath Univ/College Dms Rebate	10	Baseload	10%	40%	8	1,719	0	$0.59
	Faucet Aerator-Kitchen 1.5gpm Hotel/Motel	10	Baseload	10%	47%	16	5,377	0	$1.29
	Faucet Aerator-Kitchen 1.5gpm LTC/Retire Res	10	Baseload	10%	47%	16	5,377	0	$1.29
	Faucet Aerator-Kitchen 1.5gpm MURB	10	Baseload	10%	69%	16	5,377	0	$1.29
	Faucet Aerator-Kitchen 1.5gpm Other	10	Baseload	10%	47%	16	5,377	0	$1.29
	Faucet Aerator-Kitchen 1.5gpm Univ/College	10	Baseload	10%	47%	16	5,377	0	$1.29
	Faucet Aerator-Kitchen MURB Rebate	10	Baseload	10%	69%	16	5,377	0	$1.29
	Faucet Aerator-Kitchen Other Rebate	10	Baseload	10%	47%	16	5,377	0	$1.29
	Faucet Aerator-Kitchen Univ/College Rebate	10	Baseload	10%	47%	16	5,377	0	$1.29
	Showerhead-1.25 gpm Hotel/Motel	10	Baseload	10%	78%	18	5,250	0	$3.79
	Showerhead-1.25 gpm LTC/Retire Residences	10	Baseload	10%	78%	24	6,526	0	$3.79
	Showerhead-1.25 gpm MURB	10	Baseload	10%	81%	32	9,585	0	$3.79
	Showerhead-1.25 gpm Other	10	Baseload	10%	78%	24	6,700	0	$3.79
	Showerhead-1.25 gpm Univ/College Dorms	10	Baseload	10%	78%	32	8,326	0	$3.79
	Showerhead-1.5 gpm Handheld LTC/Retire Res	10	Baseload	10%	78%	24	6,526	0	$3.79

	Measure Name	Equip Life	Energy Load	Free Rider	Adj. Factor	Natural Gas Savings m^3/Unit	Water Savings L/Unit	Elec Savings kWh/Unit	Inc Costs $/Unit
	Showerhead-Hotel/Motel Rebate	10	Baseload	10%	78%	18	5,250	0	$3.79
	Showerhead-MURB Rebate	10	Baseload	10%	81%	32	9,585	0	$3.79
	Showerhead-Other Rebate	10	Baseload	10%	78%	24	6,700	0	$3.79
	Showerhead-Replacement MURB	10	Baseload	10%	81%	24	7,933	0	$3.79
	Showerhead-Replacement MURB Rebate	10	Baseload	10%	81%	24	7,933	0	$3.79
	Showerhead-Univ/College Dorms Rebate	10	Baseload	10%	78%	32	8,326	0	$3.79
NC/ BR[20]	Air Curtains-Pedestrian Door 8X6	15	Weather Sensitive	5%	100%	667	0	172	$1,650
	Air Curtains-Shipping Door 10X10	15	Weather Sensitive	5%	100%	20,605	0	-936	$10,170
	Air Curtains-Shipping Door 8X8	15	Weather Sensitive	5%	100%	7,565	0	-5,380	$8,242
	CEE Tier 2 Front-Loading Clothes Washer	11	Baseload	10%	100%	117	58,121	396	$600
	Condensing Gas Water Heater 1- 100gal/day	13	Baseload	5%	100%	332	0	0	$2,230
	Condensing Gas Water Heater 1- 500gal/day	13	Baseload	5%	100%	873	0	0	$2,230
	Condensing Gas Water Heater 2- 1000gal/day	13	Baseload	5%	100%	1,551	0	0	$2,230
	Condensing Gas Water Heater 2- 500gal/day	13	Baseload	5%	100%	873	0	0	$2,230
	Condensing Gas Water Heater 3- 1000gal/day	13	Baseload	5%	100%	1,551	0	0	$2,230
	DCKV < 5000 CFM	15	Weather Sensitive	5%	100%	4,801	0	13,521	$10,000
	DCKV 10000-15000 CFM	15	Weather Sensitive	5%	100%	18,924	0	49,102	$20,000
	DCKV 5000 - 9999 CFM	15	Weather Sensitive	5%	100%	11,486	0	30,901	$15,000
	Dishwasher - Rack Conveyor Single HT	20	Baseload	27%	100%	2,203	310,271	9,811	$2,375
	Dishwasher - Stationary Rack Door Type HT	15	Baseload	20%	100%	619	87,119	3,553	$-350
	Dishwasher - Stationary Rack Door Type LT	15	Baseload	20%	100%	841	118,369	855	$-350
	Dishwasher - Stationary Rack Single Rack LT	15	Baseload	20%	100%	841	118,369	855	$-350
	Dishwasher - Undercounter HT	10	Baseload	40%	100%	801	112,795	3,754	$-13
	Dishwasher - Undercounter LT	10	Baseload	40%	100%	326	45,891	559	$-13
	Energy Star Convection Oven	12	Baseload	20%	100%	847	0	1	$875
	Energy Star Front Load Clothes Washer	11	Baseload	48%	100%	76	19,814	201	$150
	Energy Star Fryer	12	Baseload	20%	100%	1,083	0	17	$1,028
	Non-Condensing Boiler DHW- => 1,500 MBtu/h	25	Baseload	5%	100%	7,475	0	0	$7,400
	Non-Condensing Boiler DHW- => 1,500 MBtu/h MF	25	Baseload	20%	100%	7,475	0	0	$7,400
	Non-Condensing Boiler DHW- 1,000 to 1,499 MBtu/h	25	Baseload	5%	100%	5,431	0	0	$10,300
	Non-Condensing Boiler DHW -600 to 999 MBtu/h NMF	25	Baseload	12%	100%	3,076	0	0	$6,000
	Non-Condensing Boiler SH - => 2,000 MBtu/h MF	25	Weather Sensitive	20%	100%	27,325	0	0	$7,050
	Non-Condensing Boiler SH - => 2,000 MBtu/h NMF	25	Weather Sensitive	12%	100%	27,325	0	0	$7,050
	Non-Condensing Boiler SH -1,000 to 1,499 MBtu/h MF	25	Weather Sensitive	20%	100%	12,141	0	0	$10,300
	Non-Condensing Boiler SH -1,500 to 1,999 MBtu/h MF	25	Weather Sensitive	20%	100%	19,189	0	0	$7,400
	Non-Condensing Boiler SH -300 to 599 MBtu/h MF	25	Weather Sensitive	20%	100%	3,496	0	0	$4,500
	Non-Condensing Boiler SH -600 to 999 MBtu/h MF	25	Weather Sensitive	20%	100%	6,633	0	0	$6,000
	Non-Condensing Boiler SH -600 to 999 MBtu/h NMF	25	Weather Sensitive	12%	100%	6,633	0	0	$6,000
	Non-Condensing Boiler SH-1,000 to 1,499 MBtu/h	25	Weather Sensitive	5%	100%	12,141	0	0	$10,300
	Non-Condensing Boiler SH-1,000 to 1,499 MBtu/h NMF	25	Weather Sensitive	12%	100%	12,141	0	0	$10,300
	Non-Condensing Boiler SH-1,500 to 1,999	25	Weather	5%	100%	19,189	0	0	$7,400

[20] New Construction / Building Retrofit (or Replacement)

	Measure Name	Equip Life	Energy Load	Free Rider	Adj. Factor	Natural Gas Savings m^3/Unit	Water Savings L/Unit	Elec Savings kWh/Unit	Inc Costs $/Unit
	MBtu/h		Sensitive						
	Non-Condensing Boiler SH-1,500 to 1,999 MBtu/h NMF	25	Weather Sensitive	12%	100%	19,189	0	0	$7,400
	MUA 01- MURB&LTC Imp Effic 1000-4999 CFM	15	Weather Sensitive	5%	100%	Quasi	Quasi	Quasi	Quasi
	MUA 02- MURB&LTC Imp Effic =>5000 CFM	15	Weather Sensitive	5%	100%	Quasi	Quasi	Quasi	Quasi
	MUA 05- MURB&LTC Effic + VFD 1000-4999 CFM	15	Weather Sensitive	5%	100%	Quasi	Quasi	Quasi	Quasi
	MUA 07- Other Comm Imp Effic 1000-4999 CFM	15	Weather Sensitive	5%	100%	Quasi	Quasi	Quasi	Quasi
	MUA 08- Other Comm Imp Effic => 5000 CFM	15	Weather Sensitive	5%	100%	Quasi	Quasi	Quasi	Quasi
	MUA 10- Other Comm Effic + 2 speed =>5000 CFM	15	Weather Sensitive	5%	100%	Quasi	Quasi	Quasi	Quasi
	MUA 12- Other Comm Effic + VFD =>5000 CFM	15	Weather Sensitive	5%	100%	Quasi	Quasi	Quasi	Quasi
	Ozone WE =< 120 lbs cap & => 200,000 lbs/yr	15	Baseload	8%	100%	Quasi	Quasi	Quasi	Quasi
	Ozone WE =< 120 lbs cap & 100,000 to 199,999lbs/yr	15	Baseload	8%	100%	Quasi	Quasi	Quasi	Quasi
	Ozone WE > 120 lbs cap & 260,000 lbs/yr and Up	15	Baseload	8%	100%	Quasi	Quasi	Quasi	Quasi
	Building Optimization Weather	Actual	Weather Sensitive	0%	100%	Actual	Actual	Actual	Actual
	Custom Equip Baseload	Actual	Baseload	54%	100%	Actual	Actual	Actual	Actual
	Custom Equip Weather	Actual	Weather Sensitive	54%	100%	Actual	Actual	Actual	Actual
	Custom Infrared Poly Baseload	Actual	Baseload	54%	100%	Actual	Actual	Actual	Actual
	Demonstration Baseload	Actual	Baseload	54%	100%	Actual	Actual	Actual	Actual
	Demonstration Weather	Actual	Weather Sensitive	54%	100%	Actual	Actual	Actual	Actual
NC only	Condensing Boiler - 300 to 999 MBtu/h	25	Weather Sensitive	5%	100%	Quasi	Quasi	Quasi	Quasi
	Condensing Boiler - => 1,000 MBtu/h	25	Weather Sensitive	5%	100%	Quasi	Quasi	Quasi	Quasi
	Condensing Boiler - up to 299 MBtu/h	25	Weather Sensitive	5%	100%	Quasi	Quasi	Quasi	Quasi
	Destratification Fan	15	Weather Sensitive	10%	100%	Quasi	Quasi	Quasi	Quasi
	ERV 1- up to 1999 CFM MURB,Healthcare,Nursing	14	Weather Sensitive	5%	100%	Quasi	Quasi	Quasi	Quasi
	ERV 2- => 2000 CFM MURB,Healthcare,Nursing	14	Weather Sensitive	5%	100%	Quasi	Quasi	Quasi	Quasi
	ERV 3- up to 1999 CFM Hotel,Restaurant,Retail	14	Weather Sensitive	5%	100%	Quasi	Quasi	Quasi	Quasi
	ERV 4- => 2000 CFM Hotel,Restaurant,Retail	14	Weather Sensitive	5%	100%	Quasi	Quasi	Quasi	Quasi
	ERV 5- up to 1999 CFM Office,Warehouse,School	14	Weather Sensitive	5%	100%	Quasi	Quasi	Quasi	Quasi
	ERV 6- => 2000 CFM Office,Warehouse,School	14	Weather Sensitive	5%	100%	Quasi	Quasi	Quasi	Quasi
	HRV 1- 500 to 1999 CFM-Hotel,Restaurant,Retail,Rec	14	Weather Sensitive	5%	100%	Quasi	Quasi	Quasi	Quasi
	HRV 2- =>2,000 CFM-Hotel,Restaurant,Retail,Rec	14	Weather Sensitive	5%	100%	Quasi	Quasi	Quasi	Quasi
	HRV 3- 500 to 1999 CFM-School,Office,Warehouse,Man	14	Weather Sensitive	5%	100%	Quasi	Quasi	Quasi	Quasi
	HRV 4- =>2,000 CFM-School,Office,Warehouse,Man	14	Weather Sensitive	5%	100%	Quasi	Quasi	Quasi	Quasi
	HRV 5- MURB,Healthcare,Nursing	14	Weather Sensitive	5%	100%	Quasi	Quasi	Quasi	Quasi
	Infrared Heating 1- 20 to 99 MBtu/hr 1-Stage	20	Weather	33%	100%	Quasi	Quasi	Quasi	Quasi

	Measure Name	Equip Life	Energy Load	Free Rider	Adj. Factor	Natural Gas Savings m^3/Unit	Water Savings L/Unit	Elec Savings kWh/Unit	Inc Costs $/Unit
			Sensitive						
	Infrared Heating 2- 100-300 MBtu/hr 1-Stage	20	Weather Sensitive	33%	100%	Quasi	Quasi	Quasi	Quasi
	Infrared Heating 3- 20 to 99 MBtu/hr 2-Stage	20	Weather Sensitive	33%	100%	Quasi	Quasi	Quasi	Quasi
	Infrared Heating 4- 100-300 MBtu/hr 2-Stage	20	Weather Sensitive	33%	100%	Quasi	Quasi	Quasi	Quasi
	Non-Condensing Boiler SH - up to 299 MBtu/h	25	Weather Sensitive	12%	100%	Quasi	Quasi	Quasi	Quasi
BR only	MF-Faucet Aerator-Bath 1.0gpm	10	Baseload	1%	17%	7	2,371	0	$0.56
	MF-Faucet Aerator-Kitchen 1.5gpm	10	Baseload	1%	34%	16	5,377	0	$1.14
	MF-Showerhead-1.25 gpm existing 2.0-2.5	10	Baseload	1%	79%	33	9,892	0	$3.79
	MF-Showerhead-1.25 gpm existing 2.6+	10	Baseload	1%	79%	64	15,549	0	$3.79
	MF-Showerhead-Replacement 1.5gpm	10	Baseload	1%	79%	8	3,846	0	$3.79
	MF-Showerhead-Replacement 2.0gpm	10	Baseload	1%	79%	24	7,933	0	$3.79
	Pre-Rinse Low-Flow Spray Nozzle-Full 0.64gpm	5	Baseload	0%	100%	1,286	252,000	0	$150
	Pre-Rinse Low-Flow Spray Nozzle-Limited 0.64gpm	5	Baseload	0%	100%	339	66,400	0	$150
	Pre-Rinse Spray Nozzle-Full 0.64 Replacement	5	Baseload	0%	100%	457	97,292	0	$150
	Pre-Rinse Spray Nozzle-Limited 0.64 Replacement	5	Baseload	0%	100%	90	19,197	0	$150
	Pre-Rinse Spray Nozzle-Other 0.64 Replacement	5	Baseload	0%	100%	109	23,166	0	$150
	Pstat- D2C $25	15	Weather Sensitive	43%	100%	53	0	54	$25
	Pstat- HVAC $25	15	Weather Sensitive	43%	100%	53	0	54	$25
	Pstat- HVAC No Incent$	15	Weather Sensitive	43%	100%	53	0	54	$25
	Thermostat - Programmable - HHC	15	Weather Sensitive	1%	100%	53	0	54	$26.95
	Condensing Boiler - 300 to 999 MBtu/h	25	Weather Sensitive	5%	100%	Quasi	Quasi	Quasi	Quasi
	Condensing Boiler - => 1,000 MBtu/h	25	Weather Sensitive	5%	100%	Quasi	Quasi	Quasi	Quasi
	Condensing Boiler - up to 299 MBtu/h	25	Weather Sensitive	5%	100%	Quasi	Quasi	Quasi	Quasi
	ERV 2- => 2000 CFM MURB,Healthcare,Nursing	14	Weather Sensitive	5%	100%	Quasi	Quasi	Quasi	Quasi
	ERV 4- => 2000 CFM Hotel,Restaurant,Retail	14	Weather Sensitive	5%	100%	Quasi	Quasi	Quasi	Quasi
	HRV 1- 500 to 1999 CFM-Hotel,Restaurant,Retail,Rec	14	Weather Sensitive	5%	100%	Quasi	Quasi	Quasi	Quasi
	HRV 3- 500 to 1999 CFM-School,Office,Warehouse,Man	14	Weather Sensitive	5%	100%	Quasi	Quasi	Quasi	Quasi
	HRV 4- =>2,000 CFM-School,Office,Warehouse,Man	14	Weather Sensitive	5%	100%	Quasi	Quasi	Quasi	Quasi
	HRV 5- MURB,Healthcare,Nursing	14	Weather Sensitive	5%	100%	Quasi	Quasi	Quasi	Quasi
	Infrared Heating 1- 20 to 99 MBtu/hr 1-Stage	20	Weather Sensitive	33%	100%	Quasi	Quasi	Quasi	Quasi
	Infrared Heating 2- 100-300 MBtu/hr 1-Stage	20	Weather Sensitive	33%	100%	Quasi	Quasi	Quasi	Quasi
	Infrared Heating 3- 20 to 99 MBtu/hr 2-Stage	20	Weather Sensitive	33%	100%	Quasi	Quasi	Quasi	Quasi
	Infrared Heating 4- 100-300 MBtu/hr 2-Stage	20	Weather Sensitive	33%	100%	Quasi	Quasi	Quasi	Quasi
	MUA 11- Other Comm Effic + VFD 1000-4999 CFM	15	Weather Sensitive	5%	100%	Quasi	Quasi	Quasi	Quasi
	MUA 12- Other Comm Effic + VFD =>5000 CFM	15	Weather Sensitive	5%	100%	Quasi	Quasi	Quasi	Quasi
	Non-Condensing Boiler SH - up to 299 MBtu/h	25	Weather	5%	100%	Quasi	Quasi	Quasi	Quasi

Measure Name	Equip Life	Energy Load	Free Rider	Adj. Factor	Natural Gas Savings m^3/Unit	Water Savings L/Unit	Elec Savings kWh/Unit	Inc Costs $/Unit
		Sensitive						
Attic Insulation	20	Weather Sensitive	0%	100%	Actual	Actual	Actual	Actual
Basement Insulation	25	Weather Sensitive	0%	100%	Actual	Actual	Actual	Actual
Deep Measure	20	Weather Sensitive	25%	100%	Actual	Actual	Actual	Actual
Non-Deep Measure	20	Weather Sensitive	25%	100%	Actual	Actual	Actual	Actual
Wall Insulation	30	Weather Sensitive	0%	100%	Actual	Actual	Actual	Actual
Custom O&M Baseload	Actual	Baseload	54%	100%	Actual	Actual	Actual	Actual

Appendix E: 2012 Gas Savings by Scorecard and Measure

Table E.1 – Gas Savings by Measure for the Low-Income Scorecard

Segment	Measure	Average Net Cumulative Gas Savings (m^3/Unit)	Units	Net Cumulative Gas Savings (m^3)
Low-Income Single Family	Attic Insulation	7,033	567	3,987,820
	Basement Insulation	15,986	1,282	20,494,100
	Basic-Faucet Aerator-Bath	85	74	6,300
	Basic-Faucet Aerator-Kitchen	184	75	13,833
	Basic-Pipe Insulation - 2 m	168	75	12,563
	Basic-Showerhead-1.25 gpm existing 2.0-2.5	364	13	4,736
	Basic-Showerhead-1.25 gpm existing 2.6+	697	48	33,454
	Basic-Showerhead-Replacement	261	2	523
	Draft Sealing	5,576	1,279	7,132,254
	ESK- HHC-Faucet Aerator-Bath	85	7,178	611,135
	ESK- HHC-Faucet Aerator-Kitchen	184	7,179	1,324,073
	ESK- HHC-Pipe Insulation - 2 m	168	7,182	1,203,042
	ESK- HHC-Showerhead-1.25 gpm existing 2.0-2.5	364	4,278	1,558,561
	ESK- HHC-Showerhead-1.25 gpm existing 2.6+	697	2,876	2,004,457
	Thermostat - Programmable - HHC	787	1,525	1,200,251
	Wall Insulation	18,121	257	4,657,110
Low-Income Single Family Total			33,890	44,244,213
Low-Income Social Housing Custom	Custom Equip Baseload	262,075	4	1,048,300
	Custom Equip Weather	182,113	8	1,456,908
Low-Income Social Housing Custom Total			12	2,505,208
Low-Income Social Housing Prescriptive	Condensing Boiler - 300 to 999 MBtu/h	143,322	12	1,719,861
	Condensing Boiler - => 1,000 MBtu/h	830,167	1	830,167
	Condensing Boiler - up to 299 MBtu/h	52,335	16	837,363
	Condensing Gas Water Heater 1- 500gal/day	10,782	4	43,126
	Condensing Gas Water Heater 2- 1000gal/day	19,155	1	19,155
	HRV 5- MURB,Healthcare,Nursing	8,876	12	106,517
	MF-Faucet Aerator-Bath 1.0gpm	12	2,193	25,380
	MF-Faucet Aerator-Kitchen 1.5gpm	54	2,169	117,501
	MF-Showerhead-1.25 gpm existing 2.0-2.5	259	1,631	422,015
	MF-Showerhead-1.25 gpm existing 2.6+	502	204	102,369
	MF-Showerhead-Replacement 1.5gpm	63	203	12,733
	MF-Showerhead-Replacement 2.0gpm	188	274	51,561
	MUA 11- Other Comm Effic + VFD 1000-4999 cfm	80,705	5	403,526
	MUA 12- Other Comm Effic + VFD =>5000 cfm	250,827	6	1,504,962
	Non-Condensing Boiler DHW- => 1,500 MBtu/h	177,531	2	355,063
	Non-Condensing Boiler DHW- 1,000 to 1,499 MBtu/h	128,986	3	386,959
	Non-Condensing Boiler SH - up to 299 MBtu/hr	14,350	2	28,700
	Non-Condensing Boiler SH-1,000 to 1,499 MBtu/h	288,349	2	576,698
	Non-Condensing Boiler SH-1,500 to 1,999 MBtu/h	455,739	4	1,822,955
Low-Income Social Housing Prescriptive Total			6,744	9,366,611
Low-Income Scorecard Total			40,646	56,116,031

Table E.2 – Gas Savings by Measure for the Resource Acquisition Scorecard

Segment	Measure	Average Net Cumulative Gas Savings (m^3/Unit)	Units	Net Cumulative Gas Savings (m^3)
Commercial/ Institutional	Air Curtains-Pedestrian Door 8X6	9,505	13	123,562
	Air Curtains-Shipping Door 10X10	293,621	2	587,243
	Air Curtains-Shipping Door 8X8	107,801	7	754,609
	Building Optimization Weather	122,150	2	244,300
	CEE Tier 2 Front-Loading Clothes Washer	1,158	251	290,733
	Condensing Boiler - 300 to 999 MBtu/h	117,927	245	28,892,183
	Condensing Boiler - => 1,000 MBtu/h	481,367	118	56,801,355
	Condensing Boiler - up to 299 MBtu/h	50,089	66	3,305,891
	Condensing Gas Water Heater 1- 100gal/day	4,100	8	32,802
	Condensing Gas Water Heater 2- 500gal/day	10,782	31	334,228
	Condensing Gas Water Heater 3- 1000gal/day	19,155	70	1,340,840
	Custom Equip Baseload	959,625	404	387,688,632
	Custom Equip Weather	339,460	125	42,432,524
	Custom Infrared Poly Baseload	188,615	12	2,263,375
	Custom O&M Baseload	978,960	222	217,329,135
	DCKV < 5000 cfm	68,414	6	410,486
	DCKV 10000-15000 cfm	269,667	4	1,078,668
	DCKV 5000 - 9999 cfm	163,676	7	1,145,729
	Demonstration Baseload	5,646,596	1	5,646,596
	Demonstration Weather	483,000	1	483,000
	Destratification Fan	310,244	17	5,274,140
	Dishwasher - Rack Conveyor Single HT	32,164	10	321,638
	Dishwasher - Stationary Rack Door Type HT	7,428	42	311,976
	Dishwasher - Stationary Rack Door Type LT	10,092	127	1,281,684
	Dishwasher - Stationary Rack Single Rack LT	10,092	1	10,092
	Dishwasher - Undercounter HT	4,806	11	52,866
	Dishwasher - Undercounter LT	1,956	7	13,692
	Energy Star Convection Oven	8,131	2	16,262
	Energy Star Front Load Clothes Washer	435	2	869
	Energy Star Fryer	10,397	100	1,039,680
	ERV 1- up to 1999 cfm MURB,Healthcare,Nursing	38,513	7	269,591
	ERV 2- => 2000 cfm MURB,Healthcare,Nursing	414,637	21	8,707,368
	ERV 3- up to 1999 cfm Hotel,Restaurant,Retail	44,943	13	584,254
	ERV 4- => 2000 cfm Hotel,Restaurant,Retail	321,088	14	4,495,227
	ERV 5- up to 1999 cfm Office,Warehouse,School	19,854	120	2,382,443
	ERV 6- => 2000 cfm Office,Warehouse,School	162,628	57	9,269,800
	HRV 1- 500 to 1999cfm-Hotel,Restaurant,Retail,Rec	20,512	9	184,609
	HRV 2- =>2,000cfm-Hotel,Restaurant,Retail,Rec	187,305	4	749,219
	HRV 3- 500 to 1999cfm-School,Office,Warehouse,Man	14,709	12	176,513
	HRV 4- =>2,000cfm-School,Office,Warehouse,Man	79,255	9	713,292
	HRV 5- MURB,Healthcare,Nursing	43,341	26	1,126,874
	HWC - Faucet Aerator-Bath 1.0gpm Hotel/Motel	21	867	18,518
	HWC - Faucet Aerator-Bath 1.0gpm LTC/Retire Reside	36	407	14,488
	HWC - Faucet Aerator-Bath 1.0gpm MURB	25	2,352	59,270
	HWC - Faucet Aerator-Bath 1.0gpm Other	28	99	2,819
	HWC - Faucet Aerator-Bath 1.0gpm Univ/College Dorm	28	178	5,069

Segment	Measure	Average Net Cumulative Gas Savings (m^3/Unit)	Units	Net Cumulative Gas Savings (m^3)
	HWC - Faucet Aerator-Bath Hotel/Motel Rebate	21	149	3,182
	HWC - Faucet Aerator-Bath MURB Rebate	25	2,462	62,042
	HWC - Faucet Aerator-Bath Other Rebate	28	14	399
	HWC - Faucet Aerator-Bath Univ/College Dms Rebate	28	2,222	63,277
	HWC - Faucet Aerator-Kitchen 1.5gpm Hotel/Motel	68	172	11,732
	HWC - Faucet Aerator-Kitchen 1.5gpm LTC/Retire Res	68	66	4,502
	HWC - Faucet Aerator-Kitchen 1.5gpm MURB	99	2,016	199,439
	HWC - Faucet Aerator-Kitchen 1.5gpm Other	68	44	3,001
	HWC - Faucet Aerator-Kitchen 1.5gpm Univ/College	68	73	4,979
	HWC - Faucet Aerator-Kitchen MURB Rebate	99	2,095	207,254
	HWC - Faucet Aerator-Kitchen Other Rebate	68	9	614
	HWC - Faucet Aerator-Kitchen Univ/College Rebate	68	700	47,747
	HWC - Showerhead-1.25 gpm Hotel/Motel	126	818	102,726
	HWC - Showerhead-1.25 gpm LTC/Retire Residences	167	287	48,056
	HWC - Showerhead-1.25 gpm MURB	233	2,997	699,140
	HWC - Showerhead-1.25 gpm Other	167	52	8,707
	HWC - Showerhead-1.25 gpm Univ/College Dorms	223	1,055	235,535
	HWC - Showerhead-1.5 gpm Handheld LTC/Retire Res	167	82	13,730
	HWC - Showerhead-Hotel/Motel Rebate	126	286	35,916
	HWC - Showerhead-MURB Rebate	233	2,539	592,298
	HWC - Showerhead-Other Rebate	167	14	2,344
	HWC - Showerhead-Replacement MURB	175	1,105	193,331
	HWC - Showerhead-Replacement MURB Rebate	175	245	42,865
	HWC - Showerhead-Univ/College Dorms Rebate	223	159	35,498
	Infrared Heating 1- 20 to 99 MBtu/hr 1-Stage	11,886	161	1,913,584
	Infrared Heating 2- 100-300 MBtu/hr 1-Stage	26,825	651	17,462,938
	Infrared Heating 3- 20 to 99 MBtu/hr 2-Stage	23,844	17	405,350
	Infrared Heating 4- 100-300 MBtu/hr 2-Stage	49,875	188	9,376,556
	MUA 01- MURB&LTC Imp Effic 1000-4999cfm	40,698	3	122,094
	MUA 02- MURB&LTC Imp Effic =>5000 cfm	104,139	1	104,139
	MUA 05- MURB&LTC Effic + VFD 1000-4999 cfm	147,299	3	441,898
	MUA 07- Other Comm Imp Effic 1000-4999 cfm	14,219	5	71,097
	MUA 08- Other Comm Imp Effic => 5000 cfm	29,213	10	292,125
	MUA 10- Other Comm Effic + 2 speed =>5000cfm	142,500	3	427,500
	MUA 12- Other Comm Effic + VFD =>5000 cfm	308,592	8	2,468,734
	Non-Condensing Boiler DHW- => 1,500 MBtu/h MF	149,500	2	299,000
	Non-Condensing Boiler DHW -600 to 999 MBtu/h NMF	67,672	2	135,344
	Non-Condensing Boiler SH - => 2,000 MBtu/h MF	546,500	2	1,093,000
	Non-Condensing Boiler SH - => 2,000 MBtu/h NMF	601,150	10	6,011,500
	Non-Condensing Boiler SH - up to 299 MBtu/hr	10,144	2	20,288
	Non-Condensing Boiler SH -1,000 to 1,499 MBtu/h MF	242,820	11	2,671,020
	Non-Condensing Boiler SH -1,500 to 1,999 MBtu/h MF	383,780	12	4,605,360
	Non-Condensing Boiler SH -300 to 599 MBtu/h MF	69,920	1	69,920
	Non-Condensing Boiler SH -600 to 999 MBtu/h MF	132,660	3	397,980
	Non-Condensing Boiler SH -600 to 999 MBtu/h NMF	145,926	4	583,704
	Non-Condensing Boiler SH-1,000 to 1,499 MBtu/h NMF	267,102	13	3,472,326
	Non-Condensing Boiler SH-1,500 to 1,999 MBtu/h NMF	422,158	5	2,110,790
	Ozone WE =< 120 lbs cap & => 200,000 lbs/yr	148,005	66	9,768,311
	Ozone WE =< 120 lbs cap & 100,000 to 199,999lbs/yr	56,582	31	1,754,048
	Ozone WE > 120 lbs cap & => 260,000 lbs/yr	260,211	4	1,040,846

Segment	Measure	Average Net Cumulative Gas Savings (m^3/Unit)	Units	Net Cumulative Gas Savings (m^3)
	Pre-Rinse Low-Flow Spray Nozzle-Full 0.64gpm	6,430	15	96,450
	Pre-Rinse Low-Flow Spray Nozzle-Limited 0.64gpm	1,695	12	20,340
	Pre-Rinse Spray Nozzle-Full 0.64 Replacement	2,285	98	223,930
	Pre-Rinse Spray Nozzle-Limited 0.64 Replacement	450	16	7,200
	Pre-Rinse Spray Nozzle-Other 0.64 Replacement	545	15	8,175
Commercial/Institutional Total			27,144	858,362,004
Residential	Deep Measure	22,863	73	1,669,020
	ESK - Install - Faucet Aerator - Bath - 1.0 gpm	62	249	15,348
	ESK - Install - Faucet Aerator - Kitchen - 1.5 gpm	126	249	31,464
	ESK - Install - Pipe Insulation - 2m	173	249	43,027
	ESK - Install - Showerhead - 1.25gpm	285	230	65,578
	ESK - Install - Showerhead - 1.25gpm - Replacement	214	42	8,981
	ESK - Install - Showerhead - 1.25gpm exist 2.6+	570	19	10,835
	ESK - Pull - Faucet Aerator - Bath - 1.0pgm	27	36,056	966,303
	ESK - Pull - Faucet Aerator - Kitchen - 1.5gpm	77	36,484	2,811,072
	ESK - Pull - Pipe Insulation - 2m	104	35,971	3,729,425
	ESK - Pull - Showerhead - 1.25gpm	186	36,398	6,774,433
	ESK - Pull - Showerhead - 1.25gpm - Replacement	178	4,619	823,070
	ESK - Push - Faucet Aerator - Bath - 1.0gpm	33	18,554	604,353
	ESK - Push - Faucet Aerator - Kitchen - 1.5gpm	92	19,274	1,768,382
	ESK - Push - Pipe Insulation - 2m	110	18,266	2,004,501
	ESK - Push - Showerhead - 1.25gpm	181	18,914	3,415,782
	ESK - Push - Showerhead - 1.25gpm - Replacement	219	2,419	530,041
	Non-Deep Measure	5,667	23	130,350
	Pstat- D2C $25	453	2,538	1,150,095
	Pstat- HVAC $25	453	5,206	2,359,099
	Pstat- HVAC No Incent$	453	65	29,455
Residential Total			235,897	28,940,613
Resource Acquisition Scorecard Total			263,041	887,302,617

Table E.3 – Gas Savings by Measure for the Large Industrial Rate T1 and Rate 100 Scorecard

Segment	Measure	Average Net Cumulative Gas Savings (m^3/Unit)	Units	Net Cumulative Gas Savings (m^3)
Large Industrial Rate 100	Custom Equip Baseload	11,492,984	13	149,408,791
	Custom O&M Baseload	3,972,360	37	146,977,328
Large Industrial Rate T1	Custom Equip Baseload	1,418,756	184	261,051,090
	Custom O&M Baseload	7,808,362	107	835,494,782
Large Industrial Scorecard Total			341	1,392,931,990

Appendix F: DSM Tracking & Reporting Processes

Tracking Systems Overview

Union Gas uses two 2003 Windows web-based proprietary applications, DSMt and AIMS. Both applications interact with Banner and utilize Crystal Reports to pull data from the applications. The following are descriptions of these four components, their respective functions and how they are connected.

Banner

Banner is Union's (CIS) customer information and billing system that is used to store current customer information including rate class and historical consumption.

DSMt

DSMt is a custom 2003 Windows web-based database that is run using Oracle 10G. DSMt stores all information required to track customer-specific applications and produce DSM reporting requirements specific to the current DSM Framework. DSMt also receives automated uploads from Banner to ensure that customer information remains up-to-date. Uploads are constant and every time an account is accessed, the most current Banner rate class info is provided. DSMt content includes:

- Customer information including name, address, rate class, sector, measures installed, installation date
- Measure details or input assumptions for each DSM measure including number of units, measure life, resource savings, incremental cost, project description, basecase, and net-to-gross adjustment factors
- Customer incentive details

AIMs

Account Information Management System (AIMS) is a custom 2003 Windows web-based application that is run using Oracle 10G. AIMS houses Customer and Service provider information including mailing addresses and customer contact information for customer and service providers that participate in custom DSM programs. Custom project details, including all attachments associated with the custom project submission, are housed in AIMS.

Crystal Reports

Crystal Reports is used to extract data and generate reports from the information contained in DSMt. There are several pre-defined monthly reports produced in DSMt that contain information such as cumulative m^3 savings, LRAM amounts, TRC values and incentive dollars paid by rate class. A General Extraction Report of most data fields tracked in DSMt is also generated monthly and used for additional reporting. The general extraction of data is referred to as the End User Measure (EUM) report. This

report is generated automatically from DSMt and is exported directly into Excel. The EUM report is found as the DSMt Results tab in the 2012 Audit Tool.

Data Collection and Data Entry

Customer applications, participant forms and rebate forms come from multiple sources depending on the offering. The following table summarises how data is collected for each of Union's DSM offerings.

Table F1 – Data Collection Method for Various Program Offerings

Offering	Data Collection Method
C/I Prescriptive and Quasi-Prescriptive Offering	Account managers are responsible for completing C/I prescriptive applications on behalf of the participant. Completed applications are received by DSM Tracking & Reporting (DSM T&R) directly from account managers via email. Applications are verified for completeness and eligibility as per Union's QA protocol by DSM T&R and entered accordingly by the DSM T&R
C/I Hot Water Conservation Offering	Hot Water Conservation participants are tracked by Service providers administering the program. The applications are reviewed by Commercial Marketing and sent to DSM T&R via email. The Applications are verified for completeness and eligibility as per Union's QA protocol by DSM T&R and entered accordingly.
C/I Custom and Large Industrial Custom Offerings	Custom applications are first entered into the AIMS application by account managers and project managers. The files are then reviewed by another team of engineers in the Commercial Industrial Energy Efficiency Program group (CIEEP) prior to submission into DSMt, where the customer information and incentive levels are validated by DSM T&R. The custom project files, including all the supporting documents are retained in the AIMS application.
Residential and Low-Income ESKs and Programmable Thermostat Offerings	Customers complete an application for an ESK kit and/or a free programmable thermostat on the Union Gas website.[21] Customers can also receive an ESK kit at a service provider depot or event giveaway and complete a tracking form onsite. A third delivery option is via direct mail campaigns or bill inserts where the customer completes a coupon for an ESK and/or a programmable thermostat and submits this coupon directly to DSM T&R. The Applications are verified for completeness and eligibility as per Union's QA protocol by DSM T&R and entered accordingly
Low Income Helping Homes Conserve Offering	Delivery Agents submit a workplan to the Low Income marketing team. The marketing team reviews all of the documents for accuracy and completion and submits a final tracking sheet to DSM T&R for entry into DSMt. The Applications are verified for completeness and eligibility as per Union's QA protocol by DSM T&R and entered accordingly
Low Income Affordable Housing Conservation Offering	The data collection method for this offering is the same as for C/I Prescriptive and Quasi-Prescriptive Offering & C/I Custom Offerings

[21] The energy conservation website can be accessed at http://www.uniongas.com/residential/energy-conservation/energy-savings

Offering	Data Collection Method
Residential Home Retrofit Offering	Delivery Agents submit a workplan to the Residential marketing team. The marketing team reviews all of the documents for accuracy and completion and submits a final tracking sheet to DSM T&R for entry into DSMt. The Applications are verified for completeness and eligibility as per Union's QA protocol by DSM T&R and entered accordingly.

Quality Assurance Protocol

Union Gas has QA protocol that ensures that data entered into DSMt meets the rigour required to accurately track program participation and eligibility requirements, as well as calculate resource savings, LRAM amounts, TRC values, customer incentives and company DSM incentives. All applications are screened for completeness and accuracy by the DSM Tracking & Reporting team. Each incentive payment is also reviewed and approved by the DSM T&R Manager to ensure it falls within the guidelines of each program. The following is a list of items verified as part of Union's tracking system QA process:

- Is the customer a valid Union Gas customer?
- Is the customer's application or project claim a duplicate of an existing entry?
- Are the correct program and program offering selected?
- Is customer information (name, address, phone number, account number, account status) to Banner complete?
- Does customer meet program and incentive eligibility criteria?
- Does the measure or project type meet program and incentive eligibility requirements?
- Is the number of installed measures correctly captured?
- Are measure details sufficient to calculate TRC, LRAM, customer incentives and DSM incentives?
- Are the project description and basecase adequately captured in the database?
- Is the measure eligible upon the basis of commission or application date?
- Are all required data fields populated?
- Are the checklists complete and all appropriate documentation for custom projects attached to the AIMS project?

Customers and measures that are identified as not being eligible for any reason continue to be tracked in DSMt with a Does Not Qualify (DNQ) demarcation. An email is sent to the Account Managers notifying them that their application has been disqualified for follow-up with a customer.

Final Report Following
An Audit of the Union Gas
ESK—Residential Program
Door-to-Door Drop-off Initiative (2012)

Introduction

This Report follows our administration of a survey involving householders who received an Energy Savings Kit (ESK) in conjunction with Union Gas' ESK—Door-to-Door Drop-off Initiative. The Initiative offers financial support/incentives to help promote the use of high-efficiency natural gas products and accessories amongst residential customers.

Our firm conducted this Audit in February 2013, employing the methodology outlined on Page 3 of this Report. The primary purpose of this research project was to validate the accuracy of information on Tracking Sheets sent to Union Gas by technicians who delivered the kits. Comprising a separate Union Gas database, the tracking sheet files contain customer information (name, address & phone number), program identifier and product/installation information. Installation sites included only residential locations.

Additional objectives for this research project were to understand end-users' knowledge of energy efficiency and their motivations for installing the items, as well as determine their usage habits and satisfaction level regarding the items in the kit.

This research project has been conducted according to generally accepted guidelines designed to ensure objectivity and personal confidentiality. Research-gathering procedures have yielded statistically valid results. We are confident our analysis of findings represents and interprets accurately the views and perspectives of respondents, who were co-operative and forthright in sharing information with us.

In submitting this report, we wish to express our appreciation to the staff of Union Gas for their active participation and support during the project. We particularly appreciate the assistance provided internally by [redacted], Analyst, DSM Research & Evaluation, who served as Project Coordinator.

Respectfully submitted by:

Ralph Beslin

Ralph Beslin, ABC
President

Objectives of this ESK—Residential—Door-to-Door Drop-off Initiative Audit

The **primary objectives** for this Audit research project were as follows:

1. To validate consumers' awareness of the products received from participating channel partners and determine the products that were actually installed and remain installed.

2. To determine customers' satisfaction with the products in the kit they received and their usage habits with respect to the measures installed

The **secondary objectives** for this Audit research project were as follows:

3. To gauge residential end-users' understanding regarding the benefits of energy- efficient products

4. To determine the factors affecting residential end-users' decision to install the products and who actually installed the products

Methodology for the ESK—Residential Audit: Door-to-Door Drop-off Initiative Telephone Surveying of End-Users

Random selection techniques were used to create a survey sample from files within Union Gas databases containing approximately 7,500 Tracking Sheet records submitted by Union Gas representatives (technicians). Controls were applied and monitored to ensure appropriate representation of segments within the customer base. Segmentation criteria included: city and age group of the kit recipients.

We employed a modified version of the survey instrument used in other ESK audits—approximately 7 minutes in length. This was administered to randomly selected end-users—all of whom were qualified as kit recipients—within a survey population comprised of customers who received Energy Savings Kits during a front-door visit by a Union Gas representative (technician). Size and segmentation of the survey population are identified in the chart below.

A total of 100 survey completions was achieved, which was the target number set for the audit. The number of completions results in a high level of confidence in the findings: 95% ± 10%.

Readers are encouraged to consult the survey instrument for exact wording of questions and response options. *(See questionnaire in the Appendix.)*

End-User Response Groups Profile: ESK-Residential-Door-to-Door Drop-off Audit re 2012 Initiative

Total Completions = 100

Distribution Channel	Total completions
Visit by UG rep (technician) to front door	100 (100%)
Area Code	***Age Group***
Milton ON = 50 (50%)	*18 - 34 = 8 (8%)*
Oakville ON = 50 (50%)	*35 - 44 = 26 (26%)*
	45 - 54 = 36 (36%)
	55 - 64 = 23 (23%)
	65+ = 7 (7%)

Executive Summary

Primary Objective: Awareness & Installation of Products Received

- Information in the Union Gas database regarding receipt of the kit was confirmed [100%]. All respondents received the kit at home from a Union Gas representative (technician); and all (100%) verified the site/address of the front-door visit. In addition, 100% of total respondents verified that they have a natural gas water heater in their home.
- Information related to individual products received was verified as extremely accurate for all products: Showerhead (100%), kitchen faucet aerator (98%), bathroom faucet aerator (98%) and pipe wrap (98%).
- Regarding installation of individual products, approximately eight in ten respondents indicated they had installed each of the four products: Showerhead (82%), kitchen faucet aerator (86%), bathroom faucet aerator (85%) and pipe wrap (92%). Verification rates from 94% - 100% strongly indicate that once installed, products remain installed in the home.

Objective #2: Customers' Usage Habits with respect to the Measures Installed

- Almost three-quarters (74%) of respondents who installed the showerhead item indicated all of the showering done in their home is now done under the new showerhead. Additionally, 8% indicated most (more than three quarters) is done under the new showerhead; and approximately 16% indicated half is done under the new showerhead.

Objective #3: Understanding re Benefits of Energy-Efficient Products

- Almost all (93%) of total respondents indicated they believe high-efficiency heating equipment can play a significant role in saving money on home energy costs, including more than one-quarter (26%) who said it could be very significant.
- Some 87% of total respondents agreed the products in the kit will help them save money on home energy costs, including 25% who strongly agreed.

Objective #4: Factors Affecting End-Users' Decision to Install Kit Products

- The main reasons end-users decided to install products are to conserve energy, to save money on the heating bill and the items were free.
- It appears likely that the recipient will install the products themselves. More than two-thirds of total respondents indicated this.

ESK—Res—Door-to-Door Drop-off Research Findings—Section 1: Findings re Awareness & Installation of Products Received

Findings related to Project Objectives #1 & 2:

To validate consumers' awareness of the products received from participating channel partners and to determine the products that were actually installed / remain installed, as well as usage habits regarding products that are still installed and general satisfaction with the kit

Verification of Consumers' Awareness, Installation of Products Received, Usage Habits re Products that are Installed and Satisfaction Level (Qs #1-4, 7, 8 & 11)

D2D-1.1 All (100%) respondents indicated they received the kit during a front-door visit by a Union Gas representative/technician. (Qs#1&2)

- In response to our request for verification regarding the site, 100% of respondents indicated the Tracking Sheet information was correct.

D2D-1.2 Information re receipt of the kit was verified by 100% of total respondents. (Q#1) Regarding individual products in the kit, verification was as noted in the following table (Q#3).

- Ownership of a natural gas water heater was verified by 100% of total respondents. Ownership of a natural gas furnace also was verified by 100% of total respondents. (Q#3)

ESK-Residential Audit: Door-to-Door Drop-off Products Received in 2012	Column A Respondents: # Verified—Received	Column B Respondents: Total # survey completions	Column C Respondents: % Verified—Received
Energy-efficient Showerhead	100	100	100%
Kitchen Faucet Aerator	98	100	98%
Bathroom Faucet Aerator	98	100	98%
Pipe Wrap	98	100	98%
$25 Programmable Thermostat Coupon	92	100	92%
Booklet (How-to-install)	89	100	89%
	Yes	No	Don't know
Does your home have a natural gas water heater?	100 (100%)	0 (0%)	0 (0%)

D2D-1.3 More than 80% of total respondents indicated they had installed the products they received. Once installed, the products remain installed. (Qs7&8)

ESK-Residential- Door-to-Door Drop-off Products installed in 2012 Total = 100 completions	A. Respondents: # Verified—Installed	B. Respondents: % Verified—Installed *(Base=100)*	C. Respondents: # Verified—Still Installed	D. Respondents: % Verified—Still Installed *(Base=# in A)*
Energy-efficient Showerhead	82	82%	80	98%
Kitchen Faucet Aerator	86	86%	83	97%
Bathroom Faucet Aerator	85	85%	85	100%
Pipe Wrap	92	92%	92	100%

D2D-1.4 Regarding level of satisfaction with the kit, all (100%) respondents indicated they are satisfied with the kit and the products they received, including 57% who are very satisfied. (Q#11)

D2D-1.5 Regarding level of satisfaction with the performance of the Union Gas representative (technician) who delivered the kit, all (100%) respondents indicated they are satisfied, including 57% who are very satisfied. (Q#11)

ESK—Residential-Door-to-Door Drop-off Initiative Research Findings—Section 2: Findings re End-User Understanding of the Benefits of Energy-Efficient Products and Energy Efficiency

Findings related to Project Objective #3:

To gauge end-users' understanding regarding the benefits of energy-efficient products

Measurement of ESK—Residential-Door-to-Door Drop-off End-Users' Knowledge Level re Energy-Efficient Products (Qs #5, 6, 13 14)

D2D-2.1 Almost all respondents indicated they have a Programmable Thermostat in their home. (Qs# 6&13)

- Some 90% of total respondents verified they have a Programmable Thermostat in their home.
- Also, 57% of total respondents indicated they used the $25 programmable thermostat coupon include in the ESK package.

D2D-2.2 Respondents displayed indecisiveness as to whether higher-efficiency heating products can play a significant role in saving money on home heating costs (Q#5).

- Some 93% of total respondents believe high-efficiency heating products can play a significant role in saving money on home heating costs, yet only 26% said it could be very significant.
- Some 87% of total respondents agreed that the products they received in the kit will help to save money on home energy costs; yet only 25% strongly agreed.

D2D-2.3 With respect to other types of incentives to encourage energy efficiency in homes, respondents who installed items in this kit indicated the following would be useful to them: (Q#14—aided)

- Insulation products = 8 (8%)
- Appliances such as furnaces, water heaters = 66 (66%)
- Windows = 25 (25%)
- None of the above / No response = 1 (1%)

ESK—Residential-Door-to-Door Drop-off Research Findings—Section 3: Findings re Factors Affecting End-Users' Decision to Install & Usage Habits re Installed Products

Findings related to Project Objectives #2 & 4:

To determine the factors affecting residential end-users' decision to install the products, who actually installed them and end-users' usage habits regarding products that are still installed

Identification of Factors Affecting End-Users' Installation Decision and Usage Habits re Products that are Still Installed (Qs# 7-10)

D2D-3.1 More than 80% of total respondents indicated they had installed the products they received. Once installed, products remain installed. (Q#7)

ESK-Residential-Door-to-Door Drop-off Products installed in 2012 (Total = 100 completions)	A. Respondents: # Verified—Installed	B. Respondents: % Verified—Installed *(Base=100)*	C. Respondents: # Verified—Still Installed	D. Respondents: % Verified—Still Installed *(Base=# in A)*
Energy-efficient Showerhead	82	82%	80	98%
Kitchen Faucet Aerator	86	86%	83	97%
Bathroom Faucet Aerator	85	85%	85	100%
Pipe Wrap	92	92%	92	100%

D2D-3.2 Regarding installation of products, more than two-thirds of respondents installed the products themselves. (Q#8) (NB: Union Gas representatives (technicians) did not enter the house and therefore did not install products.)

ESK-Residential: Door-to-Door Drop-off Products Installed in 2012	Column A Products: Total # Verified—Installed	Column B Products: #(%) Installed by respondent *(Base=# in A)*	Column C Products: #(%) Installed by other in household *(Base=# in A)*	Column D Don't know / Don't Recall #(%) *(Base=# in A)*
Energy-efficient Showerhead	82	51 (62%)	27 (33%)	4 (5%)
Kitchen Faucet Aerator	86	56 (65%)	26 (30%)	4 (5%)
Bathroom Faucet Aerator	85	56 (66%)	25 (29%)	4 (5%)
Pipe Wrap	92	63 (69%)	25 (27%)	4 (4%)

NB: Two reasons were cited by respondents who did not install products they received: The products were not compatible (i.e. did not fit) or they have no time now but do plan to install the products.

D2D-3.3 The following table contains the complete list of factors presented to respondents, as well as the percentages of total respondents who, on an aided basis, identified a factor as their main reason for installing some or all of the items in the kit (Q#10):

ESK-Residential: Door-to-Door Drop-off Initiative 2012: Main Reason for Installing Product(s)—Aided	Main Reason (% of total respondents who installed items—Cite one only)
To conserve energy/Use energy wisely	38
To save money on my heating bill	11
To reduce my environmental footprint	6
Items were free	24
To conserve energy/use energy wisely AND to save money on my heating bill*	21
** Unaided—cited both combined as main reason*	

D2D-3.4 Specifically regarding the Energy-efficient Showerhead, two questions were asked to respondents who received this item. (Q#9) The following findings are noted:

- More than three-quarters (74%) of total respondents who received showerhead(s) indicated all of the showering in their home now is done under a new showerhead. Slightly less than one-quarter of total respondents indicated that most (8%) or about half (16%) of the showering in their home now is done under a new showerhead.

Table 2: ESK-Door-to-Door Drop-off Initiative Products installed in 2012 (Total = 100 completions)	A. Respondents: # Verified—Installed	B. Respondents: % Verified—Installed *(Base=100)*	C. Respondents: # Verified—Still Installed	D. Respondents: % Verified—Still Installed *(Base=# in Col A)*
Energy-efficient Showerhead	82	82%	80	98%
Of all the showering done in your home, how much is done under a New Showerhead? (# & % of total still installed—Col C)			*All (100%) = 59 Most (75%+) = 6 Half (50%) =13 1/3 (30%) or less = 2 None =0*	*NB: Base = 80 (Col C) All (100%) = 74% Most (75%+) = 8% Half (50%) = 16% 1/3 (30%) or less= 2% None = 0%*

Final Report Following An Audit of the Union Gas ESK—Residential Program Install Initiative (2012)

Introduction

This Report follows our administration of a survey involving householders who received an Energy Savings Kit (ESK) in conjunction with Union Gas' ESK—Install Initiative. The Initiative offers financial support/incentives to registered Channel Partners to help promote the use of high-efficiency natural gas products and accessories amongst residential customers.

Our firm conducted this Audit in February 2013, employing the methodology outlined on Page 3 of this Report. The primary purpose of this research project was to validate the accuracy of information on Tracking Sheets sent to Union Gas by Partners claiming incentives. Comprising a separate Union Gas database, the tracking sheet files contain customer information (name, address & phone number), program identifier and product/installation information. Installation sites included only residential locations.

Additional objectives for this research project were to understand end-users' knowledge of energy efficiency and their motivations for installing the items, as well as determine their usage habits and satisfaction level regarding the items in the kit.

This research project has been conducted according to generally accepted guidelines designed to ensure objectivity and personal confidentiality. Research-gathering procedures have yielded statistically valid results. We are confident our analysis of findings represents and interprets accurately the views and perspectives of respondents, who were co-operative and forthright in sharing information with us.

In submitting this report, we wish to express our appreciation to the staff of Union Gas for their active participation and support during the project. We particularly appreciate the assistance provided internally by [redacted], Analyst, DSM Research & Evaluation, who served as Project Coordinator.

Respectfully submitted by:

Ralph Beslin

Ralph Beslin, ABC
President

Objectives of this ESK—Residential—Install Initiative Audit

The **primary objectives** for this Audit research project were as follows:

1. To validate consumers' awareness of the products received from participating channel partners and determine the products that were actually installed and remain installed.

2. To determine customers' satisfaction with the products in the kit they received and their usage habits with respect to the measures installed

The **secondary objectives** for this Audit research project were as follows:

3. To gauge residential end-users' understanding regarding the benefits of energy- efficient products

4. To determine the factors affecting residential end-users' decision to install the products and who actually installed the products

Methodology for the ESK—Residential—Install Initiative Audit
Telephone Surveying of End-Users

Random selection techniques were used to create a survey sample from files within Union Gas databases containing approximately 150 Tracking Sheet records submitted by registered Channel Partners and Union Gas representatives. Controls were applied and monitored to ensure appropriate representation of segments within the customer base. Segmentation criteria included: region (area code) of the province where the kit was delivered; and a qualifying question was used to ensure the kit was delivered directly by a channel partner (contractor) during a visit to a residence.

We employed a modified version of the survey instrument used in other ESK audits—approximately 7 minutes in length. This was administered to randomly selected end-users—all of whom were qualified as kit recipients—within a survey population comprised of customers who received Energy Savings Kits during a home visit by a contractor. Size and segmentation of the survey population are identified in the chart below. Readers are encouraged to consult the survey instrument for exact wording of questions and response options. *(See questionnaire in the Appendix.)*

A total of 38 survey completions was achieved, representing a satisfactory level of confidence for this audit—approximately one-quarter of the survey population. NB: There were a large number of declines, attributed primarily to lack of time; however, a strong majority of declining respondents confirmed they had received the kit and were very satisfied with items they received.

End-User Response Groups Profile:
ESK-Residential-Install
Audit re 2012 Initiative
Total Completions = 38

Distribution Channel	Total completions
Contractor visit to home	100 (100%)
Area Code	***Age Group***
519 =30 (80%)	*18 - 34 = 2 (5%)*
705 = 2 (5%)	*35 - 44 = 7 (18%)*
905 = 6 (15%)	*45 - 54 = 8 (21%)*
	55 - 64 = 16 (42%)
	65+ = 5 (13%)

Executive Summary

Primary Objective: Awareness & Installation of Products Received

- Information in the Union Gas database regarding receipt of the kit was confirmed [100%]. With respect to respondents who indicated they received the kit at home from a contractor, the site of the visit (100%) was verified as extremely accurate. In addition, 100% of total respondents verified that they have a natural gas water heater in their home.
- Information related to individual products received was verified as extremely accurate for all products: Showerhead (100%), kitchen faucet aerator (97%), bathroom faucet aerator (100%) and pipe wrap (100%).
- Regarding installation of individual products, almost nine in ten respondents indicated they had installed each of the four products: Showerhead (95%), kitchen faucet aerator (89%), bathroom faucet aerator (92%) and pipe wrap (100%). Verification rates from 94% - 100% strongly indicate that once installed, products remain installed in the home.

Objective #2: Customers' Usage Habits with respect to the Measures Installed

- Slightly more than half (54%) of respondents who installed the showerhead item indicated all of the showering done in their home is now done under the new showerhead. Additionally, 3% indicated most (more than three quarters) is done under the new showerhead; and approximately 43% indicated half is done under the new showerhead.

Objective #3: Understanding re Benefits of Energy-Efficient Products

- Almost all (95%) of total respondents indicated they are knowledgeable about energy efficiency in the home, including more than one-third (37%) who indicated very knowledgeable.
- Some 89% indicated they believe high-efficiency heating equipment can play a significant role in saving money on home heating costs; including 29% who said it could be very significant.
- Some 82% of total respondents agreed the products in the kit will help them save money on home energy costs, including 26% who strongly agreed.

Objective #4: Factors Affecting End-Users' Decision to Install Kit Products

- The main reasons end-users decided to install products are to conserve energy, to save money on the heating bill and because of the contractor's advice.
- It appears more likely that the recipient will install the aerators and pipe wrap, while in almost all cases the contractor will install the showerhead.

ESK—Res—Install Research Findings—Section 1: Findings re Awareness & Installation of Products Received

Findings related to Project Objectives #1 & 2:

To validate consumers' awareness of the products received from participating channel partners and to determine the products that were actually installed / remain installed, as well as usage habits regarding products that are still installed and general satisfaction level with the kit

Verification of Consumers' Awareness, Installation of Products Received and Usage Habits re Products that are Installed (Qs #1, 2 6, 7, 11)

INS-1.1 All (100%) respondents indicated they received the kit at home during a routine visit by a contractor. (Qs#1&2)

- In response to our request for verification regarding the site, 100% of respondents indicated the Tracking Sheet information was correct.

INS-1.2 Information re receipt of the kit was verified by 100% of total respondents. (Q#1) Regarding individual products in the kit, verification was as noted in the following table (Q#3).

- Ownership of a natural gas water heater was verified by 100% of total respondents. Ownership of a natural gas furnace also was verified by 100% of total respondents. (Q#2)

ESK-Residential-Install Audit: Products Received in 2012	Column A Respondents: # Verified—Received	Column B Respondents: Total # survey completions	Column C Respondents: % Verified—Received
Energy-efficient Showerhead	38	38	100%
Kitchen Faucet Aerator	37	38	97%
Bathroom Faucet Aerator	38	38	100%
Pipe Wrap	38	38	100%
	Yes	No	Don't know
Does your home have a natural gas water heater?	100 (100%)	0 (0%)	0 (0%)

INS-1.3 Almost all total respondents indicated they had installed the products they received. Once installed, the products remain installed. (Qs#6&7)

ESK-Residential-Install Products installed in 2012 (Total = 38 completions)	A. Respondents: # Verified—Installed	B. Respondents: % Verified—Installed *(Base=38)*	C. Respondents: # Verified—Still Installed	D. Respondents: % Verified—Still Installed *(Base=# in A)*
Energy-efficient Showerhead	36	95%	35	97%
Kitchen Faucet Aerator	33	89%	31	94%
Bathroom Faucet Aerator	35	92%	35	100%
Pipe Wrap	38	100%	38	100%

INS-1.4 Regarding level of satisfaction with the kit, all (100%) respondents indicated they are satisfied with the kit and the products they received, including 79% who are very or extremely satisfied. (Q#11)

ESK—Residential-Install Initiative Research Findings—Section 2: Findings re End-User Understanding of the Benefits of Energy-Efficient Products and Energy Efficiency

Findings related to Project Objective #3:

To gauge end-users' understanding regarding the benefits of energy-efficient products

Measurement of ESK—Residential-Install End-Users' Knowledge Level re Energy-Efficient Products (Qs #4, 5, 12, 13)

INS-2.1 Almost all respondents indicated the furnace in their home is a high-efficiency model. (Q#5)

- Some 92% of total respondents verified their furnace is a high-efficiency model.

INS-2.2 Respondents appear to be knowledgeable about energy efficiency in the home. (Qs#4, 12)

- Almost 95% of total respondents indicated they are knowledgeable about energy efficiency in the home, including 37% who indicated they are very knowledgeable.

INS-2.3 Respondents displayed indecisiveness as to whether higher-efficiency heating products can play a significant role in saving money on home heating costs (Q#4).

- Some 89% of total respondents believe high-efficiency heating products can play a significant role in saving money on home heating costs, yet only 29% said it could be very significant.
- Some 82% of total respondents agreed that the products they received in the kit will help to save money on home energy costs; yet only 26% strongly agreed.

INS-2.4 With respect to other types of incentives to encourage energy efficiency in homes, respondents who installed items in this kit indicated the following would be useful to them: (Q#13—aided)

- Insulation products = 20 (53%)
- Weather-stripping products = 12 (32%)
- Rebates after purchasing high-efficiency products = 3 (8%)
- None of the above / No response = 3 (8%)

ESK—Residential-Install Research Findings—Section 3: Findings re Factors Affecting End-Users' Decision to Install & Usage Habits re Installed Products

Findings related to Project Objectives #2 & 4:

To determine the factors affecting residential end-users' decision to install the products, who actually installed them and end-users' usage habits regarding products that are still installed

Identification of Factors Affecting End-Users' Installation Decision and Usage Habits re Products that are Still Installed (Qs# 6-10)

INS-3.1 Almost all respondents indicated they had installed the products they received. Once installed, the products remain installed. (Qs#6&7)

ESK-Residential- Install Products installed in 2012 (Total = 38 completions)	A. Respondents: # Verified—Installed	B. Respondents: % Verified—Installed *(Base=38)*	C. Respondents: # Verified—Still Installed	D. Respondents: % Verified—Still Installed *(Base=# in A)*
Energy-efficient Showerhead	36	95%	35	97%
Kitchen Faucet Aerator	33	89%	31	94%
Bathroom Faucet Aerator	35	92%	35	100%
Pipe Wrap	38	100%	38	100%

INS-3.2 Regarding installation of products, it was more likely that the respondent or someone else in the household installed the aerators and pipe wrap, while in almost all cases the contractor installed the showerhead. (Q#7)

ESK-Residential-Install Products Installed in 2012	Column A Products: Total # Verified—Installed	Column B Products: #(%) Installed by respondent *(Base=# in A)*	Column C Products: #(%) Installed by other in household *(Base=# in A)*	Column D Products: #(%) Installed by Contractor *(Base=# in A)*
Energy-efficient Showerhead	36	2 (6%)	4 (11%)	30 (83%)
Kitchen Faucet Aerator	33	24 (73%)	4 (12%)	5 (15%)
Bathroom Faucet Aerator	35	26 (74%)	4 (11%)	5 (14%)
Pipe Wrap	38	29 (76%)	4 (11%)	5 (13%)

NB: Three reasons were cited by respondents who did not install products they received: The products were not compatible (i.e. did not fit) or they have no time now but do plan to install the products or they are currently renovating their home and plan to install the products eventually.

INS-3.3 The following table contains the complete list of factors presented to respondents, as well as the percentages of total respondents who, on an aided basis, identified a factor as their main reason for installing some or all of the items in the kit (Q#10):

ESK-Residential-Install 2012 Audit: Main Reason for Installing Product(s)—Aided	Main Reason (% of total respondents who installed items—Cite one only)
To conserve energy/Use energy wisely	16%
To save money on my heating bill	18%
Recommended by relatives/friends	0%
Because of the contractor's advice	34%
To conserve energy/use energy wisely AND to save money on my heating bill*	32%
** Unaided—cited both combined as main reason*	

INS-3.4 Specifically regarding the Energy-efficient Showerhead, two questions were asked to respondents who received this item. (Qs#8-9) The following findings are noted:

- Most respondents (61%) who received the showerhead(s) indicated they have two showers in their home; the remainder indicated they have one shower (34%) or three showers (5%).
- Approximately half (54%) of total respondents who received showerhead(s) indicated all of the showering in their home now is done under a new showerhead. Slightly less than half of total respondents indicated that most (3%) or about half (43%) of the showering in their home now is done under a new showerhead.

Table 2: ESK-Install Products installed in 2012 (Total = 38 completions)	A. Respondents: # Verified—Installed	B. Respondents: % Verified—Installed *(Base=38)*	C. Respondents: # Verified—Still Installed	D. Respondents: % Verified—Still Installed *(Base=# in Col A)*
Energy-efficient Showerhead	36	95%	35	97%
Of all the showering done in your home, how much is done under a New Showerhead? (# & % of total still installed—Col C)			*All (100%) = 19 Most (75%+) = 1 Half (50%) =15 1/3 (30%) or less = 0 None =0*	*NB: Base = 35 (Col C)* *All (100%) = 54% Most (75%+) = 3% Half (50%) = 43% 1/3 (30%) or less= 0% None = 0%*

Final Report Following
An Audit of the Union Gas
ESK—Residential-Pull Initiative 2012

Introduction

This Report follows our administration of a survey involving customers who received an Energy Savings Kit (ESK) via the Union Gas website, at an event at selected retail outlets or at another type of location, in conjunction with Union Gas' ESK Initiative. The Initiative offers financial support/incentives to Partners to help promote the purchase of high-efficiency natural gas products and accessories amongst their (residential) customers.

Our firm conducted this Residential-Pull Audit in Nov/Dec 2012, employing the methodology outlined on Page 3 of this Report.

The primary purpose of the Energy Efficiency Audits research project is to validate the accuracy of information on Tracking Sheets sent to Union Gas by Partners claiming incentives. Comprising a separate Union Gas database, the tracking sheet files contain customer information (name, address & phone number), program identifier and product/installation/delivery information.

Additional objectives for this research project are to understand end-users' knowledge of energy efficiency and motivations regarding installation of products, as well as usage of and satisfaction with the products they installed.

This audit has been conducted according to generally accepted guidelines designed to ensure objectivity and personal confidentiality. Research-gathering procedures have yielded statistically valid results. We are confident our analysis of findings represents and interprets accurately the views and perspectives of respondents, who were co-operative and forthright in sharing information with us.

In submitting this report, we wish to express our appreciation to the staff of Union Gas for their active participation and support during the project. We particularly appreciate the assistance provided internally by [redacted], Analyst, DSM Research & Evaluation, who served as Project Coordinator.

Respectfully submitted by:

Ralph Beslin

Ralph Beslin, ABC
President

Objectives of this ESK—Residential-Pull Audit

The **primary objectives** for this ESK—Residential-Pull Audit research project were as follows:

1. To validate customers' awareness of the products received in the kit and determine the products that were actually installed and remain installed.

2. To determine customers' usage habits with respect to the measures installed, as well as satisfaction with the kit and the products they installed

The **secondary objectives** for this ESK—Residential-Pull Audit research project were as follows:

3. To gauge customers' understanding regarding the benefits of energy-efficient products

4. To determine the factors that affect residential end-users' decision to install the products, reasons for installing or not installing products and who actually installed them.

Methodology for the ESK—Residential-Pull Audit: Telephone Surveying of End-Users

Random selection techniques were used to create a survey sample from a population encompassing approximately 40,000 Union Gas Tracking Sheet records. Controls were applied and monitored to ensure appropriate representation of segments within the customer base. Segmentation criteria included area code and distribution channel (ordered directly from Union Gas website, at an event at a retailer location or at another location).

We used a slightly revised version of the survey instrument—approximately 7 minutes in length—used in the previous year's Audit. This instrument was administered to end-users—all of whom were qualified as kit recipients—within a survey population comprised of customers who received Energy Savings Kits from the UG website or at events at a retailer or other location in 2012.

A total of 168 survey completions was achieved, exceeding the target number (165) set for the audit. The number of completions results in a high level of confidence in the findings: 99% ± 10%.

Readers are encouraged to consult the survey instrument for exact wording of questions and responses. The questionnaire can be found in the Appendix.

End-User Response Groups Profile:
ESK-Residential-Pull Audit re 2012 Initiative
Total completions = 168

Distribution Channel	
Ordered from Union Gas Website	*44 (26%)*
Retailer event at Home Depot, Rona, Lowe's	*71 (42%)*
Picked it up from a local pick-up depot	*33 (20%)*
Another way / Another retail location	*20 (12%)*
Area Code	**Age**
416 = 5 (3%)	*18-34 = 17 (10%)*
519 = 82 (49%)	*35-44 = 23 (14%)*
613 = 18 (11%)	*45-54 = 29 (17%)*
705 = 16 (9%)	*55-64 = 42 (25%)*
807 = 5 (3%)	*65+ = 54 (32%)*
905 = 42 (25%)	*No response = 3 (2%)*

Executive Summary

Primary Objective: Awareness & Installation of Products Received

- Information in the Union Gas database regarding receipt of the kit [100%]and address of the recipients (96%) was confirmed. In addition, approximately 90% of total respondents verified that they have a natural gas water heater in their home.
- Information related to individual products received was verified as extremely accurate for the showerhead (97%), kitchen faucet aerator (95%) and pipe wrap (95%). Verification was very accurate for the bathroom faucet aerator (73%).
- Regarding installation of individual products, a majority of respondents indicated they had installed each of the four products: Showerhead (73%), kitchen faucet aerator (64%), bathroom faucet aerator (51%) and pipe wrap (71%). Verification rates from 90% - 97% strongly indicate that once installed, products remain installed in the home.
- A strong majority (84%) of total respondents indicated they are satisfied with the kit they received, including 62% who indicated they are very to extremely satisfied.

Objective #2: Customers' Usage Habits with respect to the Measures Installed

- Some 58% of respondents who installed the showerhead item indicated all of the showering done in their home is now done under the new showerhead. Additionally, 16% indicated most (more than three quarters) is done under the new showerhead; and approximately 16% indicated almost half is done under the new showerhead.
- Some 48% of respondents whose showerhead item is still installed indicated that had they received a second showerhead, they would have installed it.

Objective #3: Understanding re Benefits of Energy-Efficient Products

- Some 95% indicated they believe high-efficiency heating equipment can play a significant role in saving money on home heating costs; including 44% who said it could be very significant.
- About three-quarters (74%) of total respondents indicated they have a programmable thermostat in their home

Objective #4: Factors Affecting End-Users' Decision to Install Kit Products

- The main reasons end-users decided to install products are to conserve energy and save money on the heating bill.
- The reasons cited by respondents as the main reasons why they did **not** install an item in the kit is that they did not need it/already had it or they had no time/not gotten around to it. In the case of the aerators, more than one-quarter of respondents cited "item did not fit".
- It is extremely likely that the recipient or someone else in the household will install the items. Contractors appear to be responsible for installing fewer than 2% of the items.

ESK—Residential-Pull Research Findings—Section 1: Findings re Awareness & Installation of Products Received

Findings related to Project Objectives #1 & 2:

To validate customers' awareness of the products received in the kit and to determine the products that were actually installed / remain installed, as well as customers' usage habits and level of satisfaction with respect to the products they installed

Verification of Customers' Awareness, Installation of Products Received and Usage Habits re Installed Products (Qs#1-4, 9, 10, 11, 13)

PLL-1.1 Information re receipt of the kit was verified by 100% of total respondents. (Q#1)

- Ownership of a natural gas water heater, a requirement for receipt of the kit, was verified by approximately 90% of respondents. (Q#9)
- Additionally, about three quarters (74%) of total respondents indicated they have a Programmable Thermostat. (Q#9)
- Regarding individual products in the kit, verification was as noted in the following chart (Q#4):

ESK-Residential-Pull: Products Verified Received in 2012	Column A Respondents: # Verified—Received	Column B Respondents: Total # survey completions	Column C Respondents: % Verified—Received
Energy-efficient Showerhead	163	168	97%
Kitchen Faucet Aerator	159	168	95%
Bathroom Faucet Aerator	123	168	73%
Pipe Wrap	160	168	95%
$25 Programmable Thermostat Rebate Coupon	89	168	53%
	Yes	No	No response
Do you have a natural gas water heater?	146 (90%)	16 (10%)	6

PLL-1.2 Information related to home address of the recipient of the kit was verified as extremely accurate (Q#2a).

- In response to our request for verification of the customer's address identified on the Tracking Sheet, approximately 96% of total respondents indicated the information was correct.

PLL-1.3 Information related to how respondents received the kit was verified as extremely accurate. (Q#2b)

- Of the 44 respondents identified in the Union Gas database as having received the kit by ordering it from the website, 100% verified that this was how they received the kit.

- Of the 104 respondents identified in the Union Gas database as having received the kit at a retailer location or pick-up depot, 100% verified that this was how they received the kit.

- Twenty (20) respondents indicated they received the kit at another location, although the database indicated 17 of them had received it via one of the three established distribution channels.

PLL-1.4 When asked—on an aided basis—to identify the purpose for their visit to the retailer store on the day they received the kit, a majority (56%) of respondents indicated they went ESPECIALLY to get a kit [39%]or for other reasons *AND* to pick up a kit [17%] (Q#3).

- Retail-location respondents who indicated they had heard about the availability of the kit before entering the store identified three main ways: Through word-of-mouth [2%], in a bill insert [80%] or some other way [18%].

- Approximately 42% of retail-location respondents indicated they went to the retailer store [unaware of kit distribution] and while there picked up a kit.

- Retail-location respondents who did not hear about the availability of the kit until they were in the store identified two main ways they became aware: Most likely from greeters on the day of the event or by seeing a poster.

PLL-1.5 Of the four products in the kit that require installation, all of the products were installed by a majority of respondents, as noted in the following table. In Column D, note that verification rates ranging from 90% to 97% strongly indicate that once installed, the products remain installed in the home. (Qs#10, 11)

ESK-Residential-Pull: Products Verified Installed in 2012	Column A Respondents: # Verified—Installed	Column B Respondents: % Verified—Installed *(Base=168)*	Column C Respondents: # Verified—Still Installed	Column D Respondents: % Verified—Still Installed *(Base=# in Col A)*
Energy-efficient Showerhead	122	73%	112	92%
Kitchen Faucet Aerator	107	64%	97	91%
Bathroom Faucet Aerator	86	51%	77	90%
Pipe Wrap	119	71%	116	97%

PLL-1.6 With respect to all four items in the kit requiring installation, the items were most likely to be installed by the respondents themselves (69 %+). Alternatively, the items were likely to be installed by someone else in their household. (Q#11)

PLL-1.7 A strong majority (84%) of total respondents indicated they are satisfied with the kit they received, including 62% who indicated they are very to extremely satisfied. (Q#13)

ESK—Residential-Pull Research Findings—Section 2: Findings re End-User Understanding of the Benefits of Energy-Efficient Products and Energy Efficiency

Findings related to Project Objective #3:

To gauge customers' understanding regarding the benefits of energy-efficient products

Measurement of ESK—Residential-Pull End-Users' Knowledge Level re Energy-Efficient Products (Qs#6, 9, 14-15)

PLL-2.1 Respondents generally believe higher-efficiency heating products can play a significant role in saving money on home heating costs (Q#6).

- Some 95% of total respondents indicated they believe high-efficiency heating products can play a significant role in saving money on home heating costs, including 44% who said it could be very significant.

- Respondents generally agree high-efficiency heating products can help save money on their heating costs. (Q#14).

- About 91% of total respondents agreed with the following statement: "The products I installed from the Energy Savings Kit will help save money on my home energy costs"; including 31% who strongly agreed with this statement.

PLL-2.2 About three quarters (74%) of total respondents indicated they have a Programmable Thermostat. (Q#9b)

- Only about 7% of total respondents indicated they had used the Programmable Thermostat Rebate Coupon that was included with the package. (Q#15a)

- Noting that only 44 of total respondents did not already a Programmable Thermostat, it appears that more than one-quarter (27%) of these respondents may have used the coupon.

PLL-2.3 With respect to other types of incentives to encourage energy efficiency in homes, a significant percentage of respondents who installed items in this kit indicated the following would be useful to them: (Q#15)

- Insulation products = 29%
- Weather stripping products = 36%
- Rebates after purchasing a programmable thermostat = 14%
- *None of the above = 21%*

ESK—Residential-Pull Research Findings—Section 3: Findings re Factors Affecting End-Users' Decision to Install

Findings related to Project Objectives #2 & 4:

To determine the factors that affect residential end-users' decision to install the products, who actually installed the products and end-users' usage habits regarding products that are still installed

Identification of Factors Affecting Residential-Pull End-Users' Installation Decision and Usage Habits re Products that are Still Installed (Qs#10-12)

PLL-3.1 Of the four products in the kit that require installation, all products had been installed by a majority of respondents, as noted in the following table. (Q#11)

ESK-Residential-Pull: Products Verified Installed in 2012	Column A Respondents: # Verified—Installed	Column B Respondents: % Verified—Installed *(Base=168)*	Column C Respondents: # Verified—Still Installed	Column D Respondents: % Verified—Still Installed *(Base=# in Col A)*
Energy-efficient Showerhead	122	73%	112	92%
Kitchen Faucet Aerator	107	64%	97	91%
Bathroom Faucet Aerator	86	51%	77	90%
Pipe Wrap	119	71%	116	97%

PLL-3.2 Respondents who indicated they did not install items in the kit cited a variety of reasons for not doing so, as noted in the following table: (Q#10)

ESK-Residential-Pull: Reason Did NOT Install Product (in 2012)	Showerhead: *% of did not installs*	K-Faucet Aerator: *% of did not installs*	B-Faucet Aerator: *% of did not installs*	Pipe Wrap: *% of did not installs*
a. Did not need/Already had one	31	9	9	21
b. Did not know how to install it	5	4	6	10
c. Did not like it/Needed a different one	7	3	5	4
d. Kit item did not fit	14	42	25	2
e. Have not gotten around to it/No time	35	27	28	44
f. Don't know/No response/Not sure received/Other reason	8	15	27	19

PLL-3.3 Regarding installation of the products, for all items it was most likely that the individual respondent or, alternatively, someone else in the household installed the item, Fewer than 2% of respondents indicated an item had been installed by a contractor. (Q#11)

PLL-3.4 The following chart contains the complete list of factors presented to respondents, as well as the percentages of total respondents who, on an aided basis, identified a factor as their main reason for installing some or all of the items in the kit (Q#12):

ESK-Residential-Pull: Main Reason for Installing Product(s) in 2012	Main Reason (% of total respondents that installed products—Cite one only)
To conserve energy/Use energy wisely	42
To save money on my heating bill	42
The items were free	11
Other	*4*
No reason	*<1*

PLL-3.5 Specifically with respect to the Showerhead, several questions were asked to those respondents who decided to install this item in their home. (Q#11a9-11) The following findings are noted:

- Some 58% of respondents who installed the showerhead item indicated all of the showering done in their home is now done under the new showerhead. Additionally, 16% indicated most (more than three quarters) is done under the new showerhead; and approximately 16% indicated almost half is done under the new showerhead.
- Some 48% of respondents whose showerhead item is still installed indicated that had they received a second showerhead, they would have installed it. A further 3% indicated *Maybe*.
- Respondents who indicated they would have installed a second showerhead had they received one estimated that all [67%] or most [11%] of the showering in their home would be done under the two showerheads combined.

ESK—Residential-Pull **Showerhead Product installed in 2012** **(Total = 168 completions)**	A. Respondents: # Verified— Installed	B. Respondents: % Verified— Installed *(Base=168)*	**C.** **Respondents:** **# Verified—** **Still Installed**	**D.** **Respondents:** **% Verified—** **Still Installed** *(Base=# in A)*
Energy-efficient Showerhead	122	73%	112	92%
Of all the showering done in your home, how much is done under the New Showerhead? (# & % of total still installed—Col C)			All (100%) = 65 Most (75%+) = 18 Half (50%) =18 1/3(30%) or less = 11 Don't know = 0	All (100%) = 58% Most (75%+) = 16% Half (50%) = 16% 1/3(30%) or less=10% Don't know = 0%

Final Report Following
An Audit of the Union Gas
ESK—Residential-Push Initiative 2012

Introduction

This Report follows our administration of a survey involving homeowners who received an Energy Savings Kit (ESK) in conjunction with Union Gas' ESK Initiative. The Initiative offers financial support/incentives to registered Channel Partners to help promote the purchase of high-efficiency natural gas products and accessories amongst their residential customers.

Our firm conducted this ESK Audit in Nov/Dec.2012, employing the methodology outlined on Page 3 of this Report. The primary purpose of this research project was to validate the accuracy of information on Tracking Sheets sent to Union Gas by Partners claiming incentives. Comprising a separate Union Gas database, the tracking sheet files contain customer information (name, address & phone number), program identifier and product/installation information. Installation sites included only residential locations.

Additional objectives for this research project were to understand end-users' knowledge of energy efficiency and motivations regarding installation of products, as well as usage of and satisfaction with the products they installed.

This research project has been conducted according to generally accepted guidelines designed to ensure objectivity and personal confidentiality. Research-gathering procedures have yielded statistically valid results. We are confident our analysis of findings represents and interprets accurately the views and perspectives of respondents, who were co-operative and forthright in sharing information with us.

In submitting this report, we wish to express our appreciation to the staff of Union Gas for their active participation and support during the project. We particularly appreciate the assistance provided internally by [redacted] Analyst, DSM Research & Evaluation, who served as Project Coordinator.

Respectfully submitted by:

Ralph Beslin

Ralph Beslin, ABC
President

Objectives of this ESK—Residential-Push Audit

The **primary objectives** for this ESK—Residential-Push Audit research project were as follows:

1. To validate consumers' awareness of the products received from participating channel partners and determine the products that were actually installed and remain installed.

2. To determine customers' usage habits with respect to the measures installed and level of satisfaction with the kit and products they installed

The **secondary objectives** for this ESK—Residential-Push Audit research project were as follows:

3. To gauge residential end-users' understanding regarding the benefits of energy- efficient products

4. To determine the factors that affect residential end-users' decision to install the products and who installed them.

Methodology for the ESK—Residential-Push Audit: Telephone Surveying of End-Users

Random selection techniques were used to create a survey sample from files within Union Gas databases containing approximately 15,000 Tracking Sheet records submitted by registered Channel Partners and Union Gas representatives. Controls were applied and monitored to ensure appropriate representation of segments within the customer base. Segmentation criteria included: region (area code) of the province where the kit was delivered and whether the kit was delivered by a channel partner directly at a residence or at a special giveaway event.

We employed a slightly revised version of the same survey instrument—approximately 7 minutes in length—used in the previous year's Audit. This was administered to end-users—all of whom were qualified as kit recipients—within a survey population comprised of customers who received Energy Savings Kits during a home visit by a contractor, during a door-to-door delivery or at a special giveaway event in 2012. Size and segmentation of the survey population are identified in the chart below.

A total of 167 survey completions was achieved, exceeding the target number (165) set for this audit. The number of completions results in a high level of confidence in the findings: 99% ± 10%, the target level set for this survey.

Readers are encouraged to consult the survey instrument for exact wording of questions and response options. The questionnaire can be found in the Appendix.

ESK-Residential-Push
2012
End-User Response Groups
By Region / Reason for Site Visit / Age

Region	Area Code 519	Area Code 613	Area Code 705	Area Code 807	Area Code 905
Total Completions = 167 *Kit delivered by:* *Channel Partner at a home visit =25* *Channel Partner at a special giveaway event = 142*	85 (51%)	15 (9%)	25 (15%)	7 (4%)	35 (21%)
Age*	18-34	35-44	45-54	55-64	65+
** No response = 1*	26 (16%)	27 (16%)	33 (20%)	38 (23%)	42 (25%)

Executive Summary

Primary Objective: Awareness & Installation of Products Received

- Information in the Union Gas database regarding receipt of the kit was confirmed [100%]. With respect to respondents who indicated they received the kit at home from a contractor, the site of the visit (100%) was verified as extremely accurate. In addition, approximately 87% of total respondents verified that they have a natural gas water heater in their home.
- Information related to individual products received was verified as extremely accurate for the showerhead (98%), kitchen faucet aerator (86%) and pipe wrap (91%). Verification was very accurate for the bathroom faucet aerator (59%).
- Regarding installation of individual products, more than or nearly a majority of respondents indicated they had installed each of the four products: Showerhead (60%), kitchen faucet aerator (60%), bathroom faucet aerator (46%) and pipe wrap (62%). Verification rates from 84% - 97% strongly indicate that once installed, products remain installed in the home.

Objective #2: Customers' Usage Habits with respect to the Measures Installed

- Some 61% of respondents who installed the showerhead item indicated all of the showering done in their home is now done under the new showerhead. Additionally, 15% indicated most (more than three quarters) is done under the new showerhead; and approximately 13% indicated half is done under the new showerhead.
- Some 44% of respondents whose showerhead item is still installed indicated that had they received a second showerhead, they would have installed it.

Objective #3: Understanding re Benefits of Energy-Efficient Products

- Some 90% indicated they believe high-efficiency heating equipment can play a significant role in saving money on home heating costs; including 40% who said it could be very significant.
- Almost 80% of total respondents indicated they have a programmable thermostat in their home

Objective #4: Factors Affecting End-Users' Decision to Install Kit Products

- The main reasons end-users decided to install products are to conserve energy and save money on the heating bill.
- The reasons cited by respondents as the main reasons why they did **not** install an item in the kit is that they did not need it/already had it or they had no time/not gotten around to it. In the case of the aerators, a significant percentage of respondents cited "item did not fit".
- It is extremely likely that the recipient or someone else in the household will install the items. Contractors appear to be responsible for installing fewer than 3% of the items.

ESK—Residential-Push Research Findings—Section 1: Findings re Awareness & Installation of Products Received

Findings related to Project Objectives #1 & 2:

To validate consumers' awareness of the products received and determine the products that were actually installed / remain installed, as well as consumers' usage habits.

Verification of Consumers' Awareness, Installation of Products Received and Usage Habits re Products that are Still Installed (Qs#2-4, 10, 11, 13)

PSH-1.1 Information re receipt of the kit was verified by 100% of total respondents. (Q#1) Regarding individual products in the kit, verification was as noted in the following table (Q#4).

- Ownership of a natural gas water heater, a requirement for receiving a kit during a residential site visit, was verified by 87% of respondents. (Q#2)

ESK-Residential-Push: Products Received in 2012	Column A Respondents: # Verified—Received	Column B Respondents: Total # survey completions	Column C Respondents: % Verified—Received
Energy-efficient Showerhead	163	167	98%
Kitchen Faucet Aerator	144	167	86%
Bathroom Faucet Aerator	98	167	59%
Pipe Wrap	152	167	91%
$25 Programmable Thermostat Rebate Coupon	93	167	56%
	Yes	No	
Does your home have a natural gas water heater?	141 (87%)	21 (13%)	

PSH-1.2 Amongst the 25 respondents who received the kit at home, the site of the contractor's visit was verified as extremely accurate (Q#2).

- In response to our request for verification regarding the site, 100% of respondents indicated the Tracking Sheet information was correct.

PSH-1.3 Information related to the contractor who conducted the site visit was verified as very accurate (Q#3).

- Twenty-five respondents (15% of total respondents) verified they had received the kit during a visit by a contractor to their home.
- Approximately half (48%) of these respondents indicated that the reason for the contractor's visit was to install/convert/replace equipment, while 20% indicated that the reason was to conduct a regular maintenance appointment. No respondent indicated that the kit was received from a representative delivering kits door-to-door. One-third (32%) indicated another reason. (Q#3)

PSH-1.4 Of the four products in the kit that require installation, a majority of respondents indicated that they had installed three of these products, as noted in the following table. Slightly less than a majority (46%) indicated they had installed the bathroom faucet aerator. In Column D, note that verification rates ranging from 84% to 97% strongly indicate that once installed, the products remain installed in the home. (Q#11)

ESK-Residential-Push: Products Installed in 2012 Total # survey completions = 167	Column A Respondents: # Verified—Installed	Column B Respondents: % Verified—Installed *(Base=167)*	Column C Respondents: # Verified—Still Installed	Column D Respondents: % Verified—Still Installed *(Base=# in Col A)*
Energy-efficient Showerhead	101	60%	85	84%
Kitchen Faucet Aerator	101	60%	98	97%
Bathroom Faucet Aerator	77	46%	65	84%
Pipe Wrap	104	62%	101	97%

PSH-1.5 A strong majority (82%) of total respondents indicated they are satisfied with the kit they received, including 62% who indicated they are very to extremely satisfied. (Q#13)

ESK—Residential-Push Research Findings—Section 2: Findings re End-User Understanding of the Benefits of Energy-Efficient Products and Energy Efficiency

Findings related to Project Objective #3:

To gauge end-users' understanding regarding the benefits of energy-efficient products

Measurement of ESK—Residential-Push End-Users' Knowledge Level re Energy-Efficient Products (Qs#6, 8, 14-15)

PSH-2.1 With respect to saving money on their home energy costs, respondents believe higher efficiency products help save money. (Q#6)

- Some 90% of total survey respondents believe higher efficiency products can play a very or somewhat significant role in saving money on home heating costs. (Approximately 40% indicated very significant.)

- In addition, some 87% agreed that the products they installed will save money on home heating costs, including one-quarter (27%) who strongly agreed.

PSH-2.2 Almost 80% of total respondents indicated they have a programmable thermostat in their home. (Q#8b)

PSH-2.3 About 7% of total respondents indicated they used the $25 Programmable Thermostat Rebate Coupon that was included with the package. (Q#15)

- Noting that only 32 of the total respondents did not already have a programmable Thermostat, it appears that approximately one-third of these respondents may have used the coupon.

PSH-2.4 With respect to other types of incentives to encourage energy efficiency in homes, respondents who installed items in this kit indicated the following would be useful to them: (Q#15—aided)

- Insulation products = 20%
- Weather stripping products = 51%
- Rebates after purchasing a programmable thermostat = 10%
- None of the above = 19%

ESK—Residential-Push Research Findings—Section 3: Findings re Factors Affecting End-Users' Decision to Install

Findings related to Project Objectives #2 & 4:

To determine the factors that affect residential end-users' decision to install the products, who actually did the installation and usage habits regarding products that are still installed

Identification of Factors Affecting End-Users' Installation Decision and Usage Habits re Products that are Still Installed (Qs# 10-12)

PSH-3.1 Of the four products in the kit that require installation, a majority of respondents indicated that they had installed three of these products, as noted in the following table. Slightly less than a majority (46%) indicated they had installed the bathroom faucet aerator. (Q#11)

ESK-Residential-Push: Products Installed in 2012 Total # survey completions = 167	Column A Respondents: # Verified—Installed	Column B Respondents: % Verified—Installed *(Base=167)*	Column C Respondents: # Verified—Still Installed	Column D Respondents: % Verified—Still Installed *(Base=# in Col A)*
Energy-efficient Showerhead	101	60%	85	84%
Kitchen Faucet Aerator	101	60%	98	97%
Bathroom Faucet Aerator	77	46%	65	84%
Pipe Wrap	104	62%	101	97%

PSH-3.2 Respondents who indicated they did not install kit items cited a variety of reasons for NOT doing so, as noted in the following table: (Q#10)

ESK-Residential-Push: Reason Did NOT Install Product(s) received in 2012	Showerhead: *% of did not installs*	K-Faucet Aerator: *% of did not installs*	B-Faucet Aerator: *% of did not installs*	Pipe Wrap: *% of did not installs*
a. Did not need/Already had one	44	26	17	36
b. Did not know how to install it	10	3	3	10
c. Did not like it/Needed a different one	10	5	3	3
d. Kit item did not fit	8	18	15	9
e. Have not gotten around to it/No time	28	20	18	22
f. Didn't receive/Don't know/Other	0	28	44	20

PSH-3.3 Regarding installation of the products, for all items it was most likely that the individual respondent or, alternatively, someone else in the household installed the item. Fewer than 3% indicated an item had been installed by a contractor. (Q#11)

PSH-3.4 The following chart contains the complete list of factors presented to respondents, as well as the percentages of total respondents who, on an aided basis, identified a factor as their main reason for installing some or all of the items in the kit (Q#12):

ESK-Residential-Push: Main Reason for Installing Product (in 2012)	2012 Main Reason (% of total who installed product: Cite 1 reason only)	*Main Reason (Compare 2011)*
a. To conserve energy/Use energy wisely	45	*43*
b. To save money on my heating bill	35	*34*
c. The items were free	14	*10*
d. Other	*6*	*1*

PSH-3.5 Specifically with respect to the Energy-efficient Showerhead, several questions were asked to respondents who decided to install this item in their home. (Q#11)

The following findings are noted:

- Some 61% of respondents who installed the showerhead item indicated all of the showering done in their home now is done under the new showerhead. Approximately 15% indicated most (more than three quarters) is done under the new showerhead; and 13% indicated about half is done under the new showerhead.

- Some 44% of respondents whose showerhead item is still installed indicated that had they received a second showerhead, they would have installed it. A further 6% indicated maybe.

- Respondents who indicated they would have installed a second showerhead, had they received one, some 93% estimated that all [64%] or most [29%] of their showering in their home would be done under the two showerheads combined.

ESK—Residential Push **Showerhead Product installed in 2012** **(Total = 167 completions)**	A. Respondents: # Verified—Installed	B. Respondents: % Verified—Installed *(Base=167)*	**C. Respondents: # Verified—Still Installed**	**D. Respondents: % Verified—Still Installed** *(Base=# in A)*
Energy-efficient Showerhead	101	60%	85	84%
Of all the showering done in your home, how much is done under the New Showerhead? (# & % of total still installed—Col C)			All (100%) = 52 Most (75%+) = 13 Half (50%) =11 1/3 (30%) or less = 8 Don't know = 1	All (100%) = 61% Most (75%+) = 15% Half (50%) = 13% 1/3(30%) or less= 9% Don't know = 1%

Final Report Following An Audit of the Union Gas ESK—Residential Replacement Program (2012)

Introduction

This Report follows our administration of a survey involving householders who received a replacement Energy Savings Kit (ESK) in conjunction with Union Gas' ESK Residential—Replacement Initiative. The ESK Residential Program offers financial support/incentives to registered Channel Partners to help promote the use of high-efficiency natural gas products and accessories amongst residential customers.

Our firm conducted this Audit in January.2013, employing the methodology outlined on Page 3 of this Report. The primary purpose of this research project was to validate the accuracy of information on Tracking Sheets collected by Union Gas to claim incentives. Comprising a separate Union Gas database, the tracking sheet files contain customer information (name, address & phone number), program identifier and product/installation information. Installation sites included only residential locations.

Additional objectives for this research project were to understand end-users' knowledge of energy efficiency, their motivations for installing the items and usage of those items, as well as their level of satisfaction with the kit..

This research project has been conducted according to generally accepted guidelines designed to ensure objectivity and personal confidentiality. Research-gathering procedures have yielded statistically valid results. We are confident our analysis of findings represents and interprets accurately the views and perspectives of respondents, who were co-operative and forthright in sharing information with us.

In submitting this report, we wish to express our appreciation to the staff of Union Gas for their active participation and support during the project. We particularly appreciate the assistance provided internally by [redacted], Analyst, DSM Research & Evaluation, who served as Project Coordinator.

Respectfully submitted by:

Ralph Beslin

Ralph Beslin, ABC
President

Objectives of this ESK—Residential—Replacement Initiative Audit

The **primary objectives** for this Audit research project were as follows:

1. To validate consumers' awareness of the products received from participating channel partners and determine the products that were actually installed and remain installed.

2. To determine customers' satisfaction with the products in the kit they received and their usage habits with respect to the items they installed

The **secondary objectives** for this Audit research project were as follows:

3. To gauge residential end-users' understanding regarding the benefits of energy- efficient products

4. To determine the factors affecting residential end-users' decision to install the products and who actually installed the products

Methodology for this ESK—Residential—Replacement Initiative Audit Telephone Surveying of End-Users

Random selection techniques were used to create a survey sample from files within Union Gas databases containing approximately 8,200 Tracking Sheet records (Push=2,500 / Pull=5,700). Controls were applied and monitored to ensure appropriate representation of segments within the customer base. Segmentation criteria included: region (area code) of the province where the kit was delivered and how the kit was received: After seeing a brochure, at a special give-away or retailer-sponsored event, after placing an order on the Union Gas website or during a visit by a contractor to their home.

We employed a modified version of the survey instruments used in the previous ESK Residential Push/Pull Audits—approximately 7 minutes in length. This was administered to randomly selected end-users—all of whom were qualified as kit recipients—within a survey population comprised of customers who received Energy Savings Kits to replace an original kit they had received in the past. Readers are encouraged to consult the survey instrument—see Appendix—for exact wording of questions and response options.

A total of 180 survey completions was achieved, equaling the target number set for the survey and comprised of: 90 end-users who received a replacement kit as a result of a PUSH activity and 90 end-users who received a kit as a result of a PULL activity. The total number of completions results in a high level of confidence in the findings: 99% ± 10%, the target level set for this survey.

End-User Response Groups Profile: ESK-Res-Replacement Initiative Audit of the 2012 Program *Push Recipients*		End-User Response Groups Profile: ESK-Res-Replacement Initiative Audit of the 2012 Program *Pull Recipients*	
Distribution Channel	**Total completions = 90**	**Distribution Channel**	**Total completions = 90**
At special local giveaway event	*44 (49%)*	*At a special retailer event*	*61 (68%)*
Ordered from UG website	*5 (6%)*	*Ordered from UG website*	*27 (30%)*
Calling after seeing brochure	*34 (38%)*	*From local pick-up depot*	*2 (2%)*
From contractor visiting home	*7 (8%)*		
Area Code	**Age of Respondent**	**Area Code**	**Age of Respondent**
519 =42 (47%)	*18 to 34 = 4 (4%)*	*519 =40 (44%)*	*18 to 34 = 8 (9%)*
613 = 6 (7%)	*35 to 44 = 22 (24%)*	*613 = 10 (11%)*	*35 to 44 = 23 (26%)*
705 = 15 (17%)	*45 to 54 = 24 (27%)*	*705 = 18 (20%)*	*45 to 54 = 20 (22%)*
807 = 5 (5%)	*55 to 64 = 25 (28%)*	*807 = 6 (7%)*	*55 to 64 = 17 (19%)*
905 = 19 (21%)	*65+r = 15 (17%)*	*905 = 14 (16%)*	*65+r = 22 (24%)*
GTA = 3 (3%)		*GTA = 2 (2%)*	

Executive Summary

Primary Objective: Awareness & Installation of Products Received

- Information in the Union Gas database regarding receipt of the kit was confirmed [100%]. With respect to respondents who indicated they received the kit at home, all (100%) verified the address as accurate. All (100%) of total respondents verified that they have a natural gas water heater in their home. In addition, 91% of PUSH total respondents and 82% of PULL total respondents indicated they received a kit in the past, verifying the new kit was indeed a replacement.
- Information related to individual products received was verified as extremely accurate for all products. PUSH respondents verified receipt: Showerhead (100%), kitchen faucet aerator (98%), bathroom faucet aerator (100%) and pipe wrap (98%). PULL respondents verified receipt: 100% for all products.
- Regarding installation of individual products, more than 90% of PUSH total respondents indicated they had installed each of the four products: Showerhead (91%), kitchen faucet aerator (90%), bathroom faucet aerator (90%) and pipe wrap (97%). More than 75% of PULL total respondents indicated they had installed each of the four products: Showerhead (79%), kitchen faucet aerator (80%), bathroom faucet aerator (81%) and pipe wrap (87%)Verification rates from 90% - 100% strongly indicate that once installed, products remain installed in the home.
- Regarding replacement of an old item with a new item (i.e. from the new kit), PUSH respondents verified replacement: Showerhead (65%), kitchen faucet aerator (49%), bathroom faucet aerator (73%) and pipe wrap (88%). PULL respondents verified replacement: Showerhead (46%), kitchen faucet aerator (43%), bathroom faucet aerator (56%) and pipe wrap (60%).

Objective #2: Customers' Usage Habits with respect to the Measures Installed

- Some 67% of PUSH respondents and 63% of PULL respondents who installed the showerhead item indicated all of the showering done in their home is now done under the new showerhead. Additionally, approximately 33% of PUSH respondents and 36% of PULL respondents indicated at least half is done under the new showerhead.

Objective #3: Understanding re Benefits of Energy-Efficient Products

- Some 89% of PUSH and 90% of PULL respondents indicated they believe high-efficiency heating equipment can play a significant role in saving money on home heating costs; including 30% (PUSH) and 30% (PULL) who said it could be very significant.
- Almost all PUSH and PULL respondents—98% and 100%, respectively—indicated they have a programmable thermostat in their home.

Objective #4: Factors Affecting End-Users' Decision to Install Kit Products

- The main reasons end-users decided to install products are to conserve energy AND save money on the heating bill and the items were free.

ESK—Res—Replacement Research Findings—Section 1: Findings re Awareness & Installation of Products Received

Findings related to Project Objectives #1 & 2:

To validate consumers' awareness of the products received and to determine the products that were actually installed / remain installed, as well as consumers' satisfaction with the kit and usage habits re items installed.

Verification of Consumers' Awareness & Installation of Products Received, Satisfaction Level & Usage Habits re Installed Items (Qs #1, 2, 4, 10, 11, 13)

REP-1.1 Amongst both PUSH and PULL respondents, the home address of the respondent receiving the kit was verified as extremely accurate (Q#2).

- In response to our request for verification regarding the address, 100% of respondents indicated the Tracking Sheet information was correct.
- The seven (7) PUSH respondents who received the kit from a contractor verified that the reason the contractor was visiting their home was to install/convert to new equipment.

REP-1.2 Information re receipt of the kit was verified by 100% of total PUSH respondents. (Q#1) In addition:

- As noted in the following table, approximately 91% of PUSH total respondents indicated they had received a kit in the past, verifying the new kit was indeed a replacement of the original kit. (Q#11)
- Ownership of a natural gas water heater, a requirement for receiving a kit, was verified by 100% of total respondents. (Q#2)
- Regarding individual products in the kit, verification was as noted in the following table (Q#4):

ESK-Residential-Replacement Products Received in 2012: PUSH Respondents	Column A Respondents: # Verified—Received	Column B Respondents: Total # survey completions	Column C Respondents: % Verified—Received
Energy-efficient Showerhead	90	90	100%
Kitchen Faucet Aerator	88	90	98%
Bathroom Faucet Aerator	90	90	100%
Pipe Wrap	88	90	98%
Programmable Thermostat Coupon ($25)	75	90	83%
	Yes	No	Don't recall
Does your home have a natural gas water heater?	90 (100%)	0 (0%)	0 (0%)
Did you receive an Energy Savings Kit in the past?	82 (91%)	2 (2%)	6 (7%)

REP-1.3 Almost all PUSH respondents indicated they had installed the products they received. Once installed, products remain installed. (Qs#10, 11)

ESK-Residential-Replacement Products Received in 2012: PUSH Respondents	Column A Respondents: # Verified—Installed	Column B Respondents: % Verified—Installed *(Base=90)*	Column C Respondents: # Verified—Still Installed	Column D Respondents: % Verified—Still Installed *(Base=# in Col A)*	*Column E Respondents: #(%) Still installed—Verified—Replaced old item with new item*
Energy-efficient Showerhead	82	91%	79	96%	*51 (65%)*
Kitchen Faucet Aerator	79	90%	74	94%	*36 (49%)*
Bathroom Faucet Aerator	81	90%	81	100%	*63 (73%)*
Pipe Wrap	85	97%	85	100%	*75 (88%)*

REP-1.4 Information re receipt of the kit was verified by 100% of total PULL respondents. (Q#1) In addition:

- As noted in the following table, 82% of total PULL respondents indicated they had received a kit in the past, verifying the new kit was indeed a replacement of the original kit.
- Ownership of a natural gas water heater, a requirement for receiving a kit, was verified by 100% of total respondents. (Q#9a)
- Regarding individual products in the kit, verification was as noted in the following table (Q#4):

ESK-Residential-Replacement Products Received in 2012: PULL Respondents	Column A Respondents: # Verified—Received	Column B Respondents: Total # survey completions	Column C Respondents: % Verified—Received
Energy-efficient Showerhead	90	90	100%
Kitchen Faucet Aerator	90	90	100%
Bathroom Faucet Aerator	90	90	100%
Pipe Wrap	90	90	100%
Programmable Thermostat Coupon ($25)	87	90	97%
	Yes	**No**	**Don't recall**
Does your home have a natural gas water heater?	90 (100%)	0 (0%)	0 (0%)
Did you receive an Energy Savings Kit in the past?	74 (82%)	6 (7%)	10 (11%)

REP-1.5 Almost all PULL respondents indicated they had installed the products they received. Once installed, the products remain installed. (Qs#10, 11)

ESK-Residential-Replacement Products Received in 2012: PULL Respondents	Column A Respondents: # Verified—Installed	Column B Respondents: % Verified—Installed *(Base=90)*	Column C Respondents: # Verified—Still Installed	Column D Respondents: % Verified—Still Installed *(Base=# in Col A)*	*Column E Respondents: #(%) Still installed—Verified—Replaced old item with new item*
Energy-efficient Showerhead	71	79%	67	94%	*31 (46%)*
Kitchen Faucet Aerator	72	80%	65	90%	*28 (43%)*
Bathroom Faucet Aerator	73	81%	73	100%	*41 (56%)*
Pipe Wrap	78	87%	78	100%	*47 (60%)*

REP-1.6 A majority (56%) of PULL respondents who received the kit at a retail store indicated they went to the store especially to get a kit (53%) or for other reasons AND to get a kit (3%). Also, more than two-thirds of these respondents heard about kit distribution before going to the store, mostly by word-of-mouth (34%) or in a bill insert (34%). (Q#3a/b)

REP-1.7 Regarding level of satisfaction with the kit and the products they received, both PUSH and PULL respondents are satisfied: (Q#13)

- All (100%) PUSH respondents indicated they are satisfied, including almost three-quarters (74%) who indicated very or extremely satisfied.
- All (100%) PULL respondents indicated they are satisfied, including almost three-quarters (72%) who indicated very or extremely satisfied.

ESK—Res-Replacement Initiative Research Findings—Section 2: Findings re End-User Understanding of the Benefits of Energy-Efficient Products and Energy Efficiency

Findings related to Project Objective #3:

To gauge end-users' understanding regarding the benefits of energy-efficient products

Measurement of ESK-Replacement End-Users' Knowledge Level re Energy-Efficient Products (Qs#6, 9 & 14, 15)

REP-2.1 Almost all respondents indicated they have a programmable thermostat in their home. (Q#9)

- Amongst PUSH respondents, approximately 98% verified they have a programmable thermostat in their home. Amongst PULL respondents, 100% verified they have a programmable thermostat in their home.

REP-2.2 Respondents displayed indecisiveness as to whether higher-efficiency heating products can play a significant role in saving money on home heating costs (Q#6).

- Some 89% of PUSH respondents indicated they believe high-efficiency heating products can play a significant role in saving money on home heating costs; yet only about one-third (30%) said it could be very significant.
- Some 90% of PULL respondents indicated they believe high-efficiency heating products can play a significant role in saving money on home heating costs; yet only about one-third (30%) said it could be very significant.

REP-2.3 Respondents displayed indecisiveness as to whether the higher-efficiency heating products they installed from the kit will help save money on home energy costs (Q#14).

- Some 92% of PUSH respondents agreed the products they installed will help save money on home energy costs, yet only 12% strongly agreed.
- Some 78% of PULL respondents indicated the products they installed will help save money on home energy costs, yet only 21% strongly agreed.

REP-2.4 With respect to other types of incentives to encourage energy efficiency in homes, respondents who installed items in this kit indicated the following would be useful to them: (Q#15).

Incentives	Push	Pull
Insulation products	52 (58%)	60 (67%)
Weather-stripping products	10 (11%)	8 (9%)
Rebates after purchasing high-efficiency natural gas products	19 (21%)	11 (12%)
None of the above / No response	9 (10%)	11 (12%)

ESK—Res-Replacement Initiative Research Findings—Section 3: Findings re Factors Affecting End-Users' Decision to Install

Findings related to Project Objectives #2 & 4:

To determine the factors affecting residential end-users' decision to install the products, who actually installed the products and usage habits regarding products that are still installed

Identification of Factors Affecting End-Users' Installation Decision and Usage Habits of Products that are Still Installed (Qs#10, 11, 12 & 15)

REP-3.1 Almost all respondents indicated they had installed the products they received. Once installed, the products remain installed. (Q#10)

- Regarding the $25 Programmable Thermostat Coupon included in the kit, almost two-thirds (64%) of total PUSH respondents indicated they used the rebate coupon, while approximately two-thirds (64%) of total PULL respondents indicated they used the coupon.

ESK-Residential-Replacement Products Received in 2012: PUSH Respondents	Column A Respondents: # Verified—Installed	Column B Respondents: % Verified—Installed *(Base=90)*	Column C Respondents: # Verified—Still Installed	Column D Respondents: % Verified—Still Installed *(Base=# in Col A)*
Energy-efficient Showerhead	82	91%	79	96%
Kitchen Faucet Aerator	79	90%	74	94%
Bathroom Faucet Aerator	81	90%	81	100%
Pipe Wrap	85	97%	85	100%
	Yes	No	Don't recall	
Did you use the $25 Programmable Thermostat coupon?	58 (64%)	17 (19%)	15 (17%)	

ESK-Residential-Replacement Products Received in 2012: PULL Respondents	Column A Respondents: # Verified—Installed	Column B Respondents: % Verified—Installed *(Base=90)*	Column C Respondents: # Verified—Still Installed	Column D Respondents: % Verified—Still Installed *(Base=# in Col A)*
Energy-efficient Showerhead	71	79%	67	94%
Kitchen Faucet Aerator	72	80%	65	90%
Bathroom Faucet Aerator	73	81%	73	100%
Pipe Wrap	78	87%	78	100%
	Yes	No	Don't recall	
Did you use the $25 Programmable Thermostat coupon?	58 (64%)	29 (32%)	3 (3%)	

REP-3.2 Regarding installation of the products, in the case of PUSH respondents, approximately two-thirds of respondents indicated they had installed the items themselves; and in the case of PULL respondents, nearly or slightly more than half indicated they had installed the items themselves. (Q#11)

ESK-Residential-Replacement Products Installed in 2012 PUSH Respondents	Column A Products: Total # Verified—Installed	Column B Products: #(%) Installed by respondent *(Base=# in A)*	Column C Products: #(%) Installed by other in household *(Base=# in A)*	Column D Products: #(%) Installed by Contractor *(Base=# in A)*
Energy-efficient Showerhead	82	50 (61%)	26 (32%)	6 (7%)
Kitchen Faucet Aerator	79	53 (67%)	26 (33%)	0 (0%)
Bathroom Faucet Aerator	81	53 (65%)	28 (35%)	0 (0%)
Pipe Wrap	85	59 (69%)	26 (31%)	0 (0%)

ESK-Residential-Replacement Products Installed in 2012 PULL Respondents	Column A Products: Total # Verified—Installed	Column B Products: #(%) Installed by respondent *(Base=# in A)*	Column C Products: #(%) Installed by other *(Base=# in A)*	Column D Products: #(%) Installed by Contractor *(Base=# in A)*
Energy-efficient Showerhead	71	35 (49%)	33 (47%)	3 (4%)
Kitchen Faucet Aerator	72	36 (50%)	33 (46%)	3 (4%)
Bathroom Faucet Aerator	73	37 (51%)	33 (45%)	3 (4%)
Pipe Wrap	78	43 (55%)	32 (41%)	3 (4%)

REP-3.3 Respondents who indicated they had not installed items cited two main reasons for not doing so: They were currently renovating and planned to install the items once the renovation is completed or they presently did not have the time but do plan to install the items.
(NB: Regarding the showerhead and kitchen faucet aerator, some respondents indicated these were incompatible—i.e. did not fit.)

The following table contains the complete list of factors presented to respondents, as well as the percentages of total PUSH and PULL respondents who, on an aided basis, identified a factor as their main reason for installing some or all of the items in the kit (Q#12):

ESK-Residential-Replacement Main Reason for Installing Product(s) in 2012—Aided	PUSH Respondents: Main Reason (% of total—Cite one only)	*PULL* Respondents: Main Reason (% of total—Cite one only)
To conserve energy/Use energy wisely	20	*16*
To save money on my heating bill	0	*7*
To conserve energy/use energy wisely AND to save money on my heating bill*	26	*34*
Items were free	54	*30*
To reduce my environmental footprint	0	*13*
** Cited both combined as main reason*		

REP-3.4 Respondents were asked whether they had replaced the item received in the original kit they had received in the past with the new item they had just received in 2012. (Q#11) See results in table below.

Specifically regarding the Energy-efficient Showerhead, a question was asked to respondents who received this item with respect to the amount of showering done under the new showerhead. (Q#11j) See table below.

ESK—Residential Replacement-Push Products installed in 2012 (Total = 90 completions)	A. Respondents: # (%) Verified—Installed	B. Respondents: # Verified—Still Installed	C. Respondents: % Verified—Still Installed *(Base= # in A except % showering=# in B)*	D. Respondents: # Verified—Replaced old item with new item	E. Respondents: % Verified—Replaced old item with new item *(Base=# in B)*
Energy-efficient Showerhead	82 (91%)	79	96%	51	65%
Of all the showering done in your home, how much is done under a New Showerhead? (# & % of total still installed in Col B)		*All (100%) = 53 Most (75%+) = 4 Half (50%) =22 1/3(30%) or less = 0 Don't know = 0*	*All (100%) = 67% Most (75%+) =5% Half (50%) = 28% 1/3(30%) or less= 0% Don't know = 0%*		
Kitchen Faucet Aerator	79 (90%)	74	94%	36	49%
Bathroom Faucet Aerator	81 (90%)	81	100%	63	73%
Pipe Wrap	85 (97%)	85	100%	75	88%

ESK—Residential Replacement-Pull Products installed in 2012 (Total = 90 completions)	A. Respondents: # Verified—Installed	B. Respondents: # Verified—Still Installed	C. Respondents: % Verified—Still Installed *(Base= # in A except % showering=# in B)*	D. Respondents: # Verified—Replaced old item with new item	E. Respondents: % Verified—Replaced old item with new item *(Base=# in B)*
Energy-efficient Showerhead	71 (79%)	67	94%	31	46%
Of all the showering done in your home, how much is done under a New Showerhead? (# & % of total still installed in Col B)		*All (100%) = 42 Most (75%+) = 0 Half (50%) =24 1/3(30%) or less = 1 None/Don't know= 0*	*All (100%) = 63% Most (75%+) = 0% Half (50%) = 36% 1/3(30%) or less= 1% Don't know = 0%*		
Kitchen Faucet Aerator	72 (80%)	65	90%	28	43%
Bathroom Faucet Aerator	73 (81%)	73	100%	41	56%
Pipe Wrap	78 (87%)	78	100%	47	60%

Final Report Following
An Audit of the Union Gas
ESK—Helping Homes Conserve—HHC—Program
Low-income Initiative 2012

Introduction

This Report follows our administration of a survey involving low-income householders who received an Energy Savings Kit (ESK) in conjunction with Union Gas' ESK Helping Homes Conserve Program—Low-income Initiative. The Initiative offers financial support/incentives to registered Channel Partners to help promote the use of high-efficiency natural gas products and accessories amongst residential customers.

Our firm conducted this Audit in two waves in Nov/Dec.12, employing the methodology outlined on Page 3 of this Report. The primary purpose of this research project was to validate the accuracy of information on Tracking Sheets sent to Union Gas by Partners claiming incentives. Comprising a separate Union Gas database, the tracking sheet files contain low-income customer information (name, address & phone number), program identifier and product/installation information. Installation sites included only residential locations.

Additional objectives for this research project were to understand end-users' knowledge of energy efficiency and their motivations for installing the items.

This research project has been conducted according to generally accepted guidelines designed to ensure objectivity and personal confidentiality. Research-gathering procedures have yielded statistically valid results. We are confident our analysis of findings represents and interprets accurately the views and perspectives of respondents, who were co-operative and forthright in sharing information with us.

In submitting this report, we wish to express our appreciation to the staff of Union Gas for their active participation and support during the project. We particularly appreciate the assistance provided internally by [redacted], Analyst, DSM Research & Evaluation, who served as Project Coordinator.

Respectfully submitted by:

Ralph Beslin

Ralph Beslin, ABC
President

Objectives of this ESK—Residential—HHC Program: Low-income Initiative Audit

The **primary objectives** for this Audit research project were as follows:

1. To validate consumers' awareness of the products received from participating channel partners and determine the products that were actually installed and remain installed.

2. To determine customers' usage habits with respect to the measures installed

The **secondary objectives** for this Audit research project were as follows:

3. To gauge residential end-users' understanding regarding the benefits of energy- efficient products

4. To determine the factors affecting residential end-users' decision to install the products and who actually installed the products

Methodology for the ESK—Residential—HHC: Low-income Initiative Audit Telephone Surveying of End-Users

Random selection techniques were used to create a survey sample from files within Union Gas databases containing approximately 7,500 Tracking Sheet records submitted by registered Channel Partners and Union Gas representatives. Controls were applied and monitored to ensure appropriate representation of segments within the customer base. Segmentation criteria included: region (area code) of the province where the kit was delivered and whether the kit was delivered directly by a channel partner during a visit to a residence or as a result of an installation booking after seeing a brochure.

We employed a modified version of the survey instrument used in the previous year's audit—approximately 7 minutes in length. This was administered to randomly selected end-users—all of whom were qualified as kit recipients—within a survey population comprised of customers who received Energy Savings Kits during a home visit by a contractor, during a door-to-door delivery, or as a result of a booking after seeing a brochure. Size and segmentation of the survey population are identified in the chart below.

A total of 165 survey completions was achieved, the target number set for this audit. The number of completions results in a high level of confidence in the findings: 99% ± 10%, the target level set for this survey.

Readers are encouraged to consult the survey instrument for exact wording of questions and response options. *(See questionnaire in the Appendix.)*

End-User Response Groups Profile: ESK-Residential-HHC Low-income Audit re 2012 Initiative
Total Completions = 165

Distribution Channel	Total completions	
Contractor visit to home	153 (93%)	
Booking after seeing brochure	12 (7%)	
Area Code	***Type of Dwelling***	***Age of Dwelling***
289 = 12 (7%)	*Detached house = 92 (56%)*	*Less than 10 years = 2 (1%)*
416 = 1 (1%)	*Semi-detached = 40 (24%)*	*10-20 years = 10 (6%)*
519 = 45 (27%)	*Townhouse = 16 (10%)*	*20-30 years = 23 (14%)*
613 = 20 (12%)	*Apt/Condo = 12 (7%)*	*30 -40 years = 33 (20%)*
705 = 10 (6%)	*Duplex = 5 (3%)*	*40-50 years = 71 (43%)*
905 = 77 (47%)	*Own=140 (85%)/ Rent=25 (15%)*	*50+ years = 26 (16%)*

Executive Summary

Primary Objective: Awareness & Installation of Products Received

- Information in the Union Gas database regarding receipt of the kit was confirmed [100%]. With respect to respondents who indicated they received the kit at home from a contractor, the site of the visit (100%) was verified as extremely accurate. In addition, all (100%) of total respondents verified that they have a natural gas water heater in their home.
- Information related to individual products received was verified as extremely accurate for all products: Showerhead (99%), kitchen faucet aerator (95%), bathroom faucet aerator (90%) and pipe wrap (96%).
- Regarding installation of individual products, more than four in five of total respondents indicated they had installed each of the four products: Showerhead (93%), kitchen faucet aerator (85%), bathroom faucet aerator (86%) and pipe wrap (94%). Verification rates from 96% - 100% strongly indicate that once installed, products remain installed in the home.

Objective #2: Customers' Usage Habits with respect to the Measures Installed

- Some 74% of respondents who installed the showerhead item indicated all of the showering done in their home is now done under the new showerhead. Additionally, 2% indicated most (more than three quarters) is done under the new showerhead; and approximately 23% indicated half is done under the new showerhead.

Objective #3: Understanding re Benefits of Energy-Efficient Products

- Some 86% indicated they believe high-efficiency heating equipment can play a significant role in saving money on home heating costs; including 41% who said it could be very significant.
- Respondents appear to be knowledgeable about energy-efficiency in the home, as almost 98% of total respondents indicated they are knowledgeable, including 69% who indicated they are very knowledgeable.
- More than two-thirds (70%) of total respondents indicated the furnace in their home is a high-efficiency model.
- Approximately 90% of total respondents indicated they use weather stripping in their home.

Objective #4: Factors Affecting End-Users' Decision to Install Kit Products

- The main reasons end-users decided to install products are to conserve energy and save money on the heating bill.
- It appears most likely that the recipient will install all items (although in this audit, almost 40% of respondents indicated the contractor installed the showerhead).

ESK—Res—HHC: L-I Initiative Research Findings—Section 1: Findings re Awareness & Installation of Products Received

Findings related to Project Objectives #1 & 2:

To validate consumers' awareness of the products received from participating channel partners and to determine the products that were actually installed / remain installed, as well as usage habits regarding products that are still installed

Verification of Consumers' Awareness, Installation of Products Received and Usage Habits re Products that are Installed (Qs#2, 3, 7)

HHC-1.1 Amongst respondents who received the kit at home, the site of the contractor's visit was verified as extremely accurate (Q#2).

- In response to our request for verification regarding the site, 100% of respondents indicated the Tracking Sheet information was correct.

HHC-1.2 Information re receipt of the kit was verified by 100% of total respondents. (Q#1) Regarding individual products in the kit, verification was as noted in the following table (Q#3).

- Ownership of a natural gas water heater was verified by 100% of total respondents. Ownership of a natural gas furnace was verified by 95% of total respondents. (Q#2)

ESK-Residential-HHC: Low-income Audit: Products Received in 2012	Column A Respondents: # Verified—Received	Column B Respondents: Total # survey completions	Column C Respondents: % Verified—Received
Energy-efficient Showerhead	164	165	99%
Kitchen Faucet Aerator	156	165	95%
Bathroom Faucet Aerator	148	165	90%
Pipe Wrap	158	165	96%
	Yes	No	Don't know
Do you have a natural gas water heater?	165 (100%)	0 (0%)	0 (0%)

HHC-1.3 Almost all respondents indicated they had installed the products they received. Once installed, the products remain installed. (Q#7)

ESK-Residential HHC: Low-income Products Installed in 2012 Total survey completions = 165	Column A Respondents: # Verified—Installed	Column B Respondents: % Verified—Installed *(Base=165)*	Column C Respondents: # Verified—Still Installed	Column D Respondents: % Verified—Still Installed *(Base=# in Col A)*
Energy-efficient Showerhead	153	93%	151	99%
Kitchen Faucet Aerator	140	85%	134	96%
Bathroom Faucet Aerator	142	86%	142	100%
Pipe Wrap	155	94%	155	100%
NB: Amongst respondents who did not install one or more items, the most often cited reasons for non-installation were: item not compatible and plan to install after renovation.				

ESK—Res-HHC: L-I Initiative Research Findings—Section 2: Findings re End-User Understanding of the Benefits of Energy-Efficient Products and Energy Efficiency

Findings related to Project Objective #3:

To gauge end-users' understanding regarding the benefits of energy-efficient products

Measurement of ESK—HHC-LI End-Users' Knowledge Level re Energy-Efficient Products (Qs#4-5, 14-17, 20)

HHC-2.1 Most respondents indicated the furnace in their home is a high-efficiency model. (Q#5)

- Some 70% of total respondents verified their furnace is a high-efficiency model.
- Approximately 90% of total respondents indicated they use weather stripping in their home.
- Only 20% of total respondents indicated they use window film in their home.

HHC-2.2 Respondents appear to be knowledgeable about energy efficiency in the home. (Q#4)

- Almost 98% of total respondents indicated they are knowledgeable about energy efficiency in the home, including 69% who indicated they are very knowledgeable.

HHC-2.3 Respondents appear to be somewhat indecisive as to whether higher-efficiency heating products can play a significant role in saving money on home heating costs (Q#4).

- While some 86% of total respondents believe high-efficiency heating products can play a significant role in saving money on home heating costs, less than a majority (41%) said it could be very significant.

HHC-2.4 Respondents were asked—on an aided basis—to describe the current level of natural gas usage, as well as the level of insulation and replacement of windows, in their home. (Qs#14-17)

Tabulated responses appear in the following table:

ESK-Residential-HHC: Low-income 2012 Initiative Current Natural Gas Usage / Insulation Levels / Replacement of Windows	High	Med	Low	None/ Nothing	Don't know	Don't have
% of Total Respondents (165)						
Natural Gas Usage	5%	84%	11%			
Insulation Levels						
Attic	13%	63%	7%	-	-	17%
Main Walls	41%	59%	-	-	-	-
Basement	21%	62%	9%	-	-	8%
	Yes	No	Don't know			
Have your windows been replaced in the last 20 years?	38%	53%	9%			

HHC-2.5 Respondents were asked whether they had previously participated in any other conservation program in the past—either through the government or a utility. Tabulated responses were as follows: (Q#20)

- Yes = 93 (56%)
- No = 42 (26%)
- Don't know = 30 (18%)

ESK—Res-HHC: LI Initiative Research Findings—Section 3: Findings re Factors Affecting End-Users' Decision to Install

Findings related to Project Objectives #2 & 4:

To determine the factors affecting residential end-users' decision to install the products, who actually installed them and end-users' usage habits regarding products that are still installed

Identification of Factors Affecting End-Users' Installation Decision and Usage Habits re Products that are Still Installed (Qs# 7-12)

HHC-3.1 Almost all respondents indicated they had installed the products they received. Once installed, the products remain installed. (Q#7)

ESK-Residential HHC: Low-income Initiative Products Installed in 2012 Total survey completions = 165	Column A Respondents: # Verified—Installed	Column B Respondents: % Verified—Installed *(Base=(165)*	Column C Respondents: # Verified—Still Installed	Column D Respondents: % Verified—Still Installed *(Base=# in Col A)*
Energy-efficient Showerhead	153	93%	151	99%
Kitchen Faucet Aerator	140	85%	134	96%
Bathroom Faucet Aerator	142	86%	142	100%
Pipe Wrap	155	94%	155	100%

HHC-3.2 Regarding installation of products, it was more likely that the respondent or someone else in the household installed the aerators and pipe wrap. However a significant percentage (39%) of respondents indicated that the contractor installed the showerhead. (Q#8)

ESK-Residential-HHC: Low-income Initiative Products Installed in 2012	Column A Products: Total # Verified—Installed	Column B Products: #(%) Installed by respondent *(Base=# in A)*	Column C Products: #(%) Installed by other in household *(Base=# in A)*	Column D Products: #(%) Installed by Contractor *(Base=# in A)*
Energy-efficient Showerhead	153	75 (49%)	19 (12%)	59 (39%)
Kitchen Faucet Aerator	140	98 (70%)	34 (24%)	8 (6%)
Bathroom Faucet Aerator	142	97 (68%)	37 (26%)	8 (5%)
Pipe Wrap	155	110 (71%)	40 (26%)	5 (3%)

NB: Two reasons were cited by respondents who did not install products they received: The products were not compatible (i.e. did not fit) or they are currently renovating their home and planned to install the products eventually.

HHC-3.3 The following chart contains the complete list of factors presented to respondents, as well as the percentages of total respondents who, on an aided basis, identified a factor as their main reason for installing some or all of the items in the kit (Qs#9&12):

ESK-Residential-HHC: Low-income Initiative 2012 Main Reason for Installing Product(s)—Aided	2012 Main Reason (% of total respondents—Cite one only)	*Compare 2011 Main Reason* (% of total respondents—Cite one only)
To conserve energy/Use energy wisely	14	*16*
To save money on my heating bill	20	*22*
To conserve energy/use energy wisely AND to save money on my heating bill*	65	*62*
Because of the contractor's advice	1	*0*
** Unaided—cited both combined as main reason*		

HHC-3.4 Specifically regarding the Energy-efficient Showerhead, several questions were asked to respondents who received this item. (Qs#9-10) The following findings are noted:

- Most respondents (56%) who received the showerhead(s) indicated they have one shower in their home; the remainder indicated they have two showers (42%) or three showers (2%).
- Approximately three-quarters (74%) of total respondents who received showerhead(s) indicated all of the showering in their home now is done under a new showerhead. More than one-quarter of total respondents indicated that most (2%) or about half (23%) of the showering in their home now is done under a new showerhead.

HHC—Low-income Initiative Showerhead product installed in 2012 (Total = 165 completions)	A. Respondents: # Verified—Installed	B. Respondents: % Verified—Installed *(Base=165)*	C. Respondents: # Verified—Still Installed	D. Respondents: % Verified—Still Installed *(Base=# in A)*
Energy-efficient Showerhead	153	93%	151	99%
Of all the showering done in your home, how much is done under a New Showerhead? (# & % of total still installed—Col C)			All (100%) = 112 Most (75%+) = 3 Half (50%) =34 1/3 (30%) or less = 2 Don't know = 0	All (100%) = 74% Most (75%+) = 2% Half (50%) = 23% 1/3(30%) or less= 1% Don't know = 0%

VERIFICATION RESULTS:

2012 Low Income Free Showerhead Installation Initiative (Multi-family)

Final Report

SUBMITTED TO:

[redacted]

Program Evaluator, DSM Research & Evaluation

Union Gas Ltd., 777 Bay Street, Suite 2801, PO Box 153, Toronto, Ontario, M5G 2C8

By

SeeLine Group Ltd.

416-703-8695

April 19, 2013

Table of Contents

1.0 Executive Summary

In November 2012, Union Gas Ltd. (UGL) contracted with SeeLine Group Ltd. (SLG) to provide onsite verification and documentation of results for the Low Income Free Showerhead Installation Initiative.

A total of 24 facilities were visited and 120 suites were verified onsite for installed showerheads, bathroom faucet aerators, and kitchen faucet aerators. The verification effort took place from January to February 2013.

A random sample was provided to SLG by an independent third party for each phase. SLG agents contacted each facility contact person and arranged an inspection time & date. Each suite was randomly selected. The randomly selected suites were inspected for the installation of showerheads and faucet aerators. The data were captured on a summary sheet, which was signed by the inspector as well as the facility supervisor. Photographs of the installed measures were also taken as further proof of installation. Data capture sheets and photographs can be found in the accompanying appendices.

Key results included:

- There were 95 (79.2%) showerheads observed installed and 25 (20.8%) were not.
- There were 20 (16.7%) bathroom aerators observed installed and 100 (83.3%) were not.
- There were 41 (34.2%) kitchen faucet aerators observed installed and 79 (65.8%) were not.

The table below summarizes the overall findings:

Observed Measure	Installed	Not Installed	Total
Showerhead Aerators	**95** (79.2%)	**25** (20.8%)	**120**
Bathroom Sink Aerators	**20** (16.7%)	**100** (83.3%	**120**
Kitchen Faucet Aerators	**41** (34.2%)	**79** (65.8%)	**120**

2.0 Background & Objective

The Low Income Free Showerhead Installation Initiative is designed to reduce natural gas usage associated with hot water consumption. The program provides a choice of a suite of measures at no cost to participants including: 1.25gpm showerhead, 1.5gpm kitchen aerator, and a 1.0gpm bathroom aerator for applicable Low Income social and assisted housing multi-family facilities.

The Low Income social and assisted housing multi-family segment is defined as dwellings with more than 3 floors and more than 5 suites owned and operated by non-profit Low Income housing providers. The verification work occurred in one phase in January and February 2013.

2.1 Objective

Through onsite verification, the main goal of this study was to confirm the installation of showerheads and aerators distributed to Free Showerhead Installation Initiative participants who received measures in 2012.

At least 100 suites needed to be verified across 20 different facilities to ensure a confidence interval of 90/10 was met. Through this effort, 120 suites were verified at 24 facilities.

UGL also required that SLG quantify the percentage use of installed showerheads for suites that had more than one shower. When a second shower was encountered in a suite, a brief survey questionnaire was deployed to the participant to ascertain the percentage of showering in each unique bathroom.

3.0 Methodology

A random sample of participants was developed by an independent third party and provided to SLG. To ensure a confidence interval of 90/10 was met, SLG was required to verify 100 suites, across at least 20 facilities. Through this initiative, 24 facilities were visited and 120 suites were inspected.

To ensure adequate geographic reach and to optimize cost effectiveness, it was determined that a maximum of 5 suites was the appropriate limit for verification at each facility.

A meeting request by telephone to verify the installed measures was then placed with the facility contact person. A meeting time and date were arranged. Meeting times and dates were assigned to an SLG agent. The SLG agent made final arrangements with the onsite facility supervisor.

The SLG agent arrived onsite and randomly selected up to 5 suites for verification. A random number generator was used to make the random suite selections. The onsite facility supervisor brought the agent to each randomly selected suite. The SLG agent gained access to the suite and searched for the 3 installed measures:

- 1.25gpm showerhead
- 1.5gpm kitchen faucet aerator
- 1.0gpm bathroom faucet aerator

Physical samples of the models were provided to SLG agents by UGL staff prior to the inspections. These models were brought to the field to make direct comparisons. As well, detailed photographs of the measures were provided by UGL, so that SLG agents could positively identify the measures in the field. The models provided through the Free Showerhead Installation Initiative are unique to the Ontario market, so it was assumed that a positively identified measure was only acquired through participation in the initiative. SLG agents also took detailed photographs of the installed measures in the field, so that a visual record would be

available after the verification had occurred. A unique identifying tag was affixed to each installed measure for organization. See Appendix F for the photographs.

The verification details were recorded in a data-capture 'sign-off' sheet. This document recorded the results of the inspection, and required the facility supervisor to sign off on the inspection along with the SLG agent. See Appendix B for the template of the sign-off sheet, and Appendix D for copies of the completed sign-off sheets.

In total, 24 facilities were visited and 120 suites were verified. Phone calls were placed throughout the month of February to arrange meeting times. The verification visits occurred throughout the month of February. All the onsite verification meetings had been concluded by the first week of March 2013.

4.0 Results

4.1 Showerheads

Result	Showerheads	
	#	%
Yes	95	79.2%
No	25	20.8%
Total (N)	120	100.0%

Quantitative Findings

A total of 120 bathroom showerheads were inspected. 95 of the installed measures were positively identified as Free Showerhead Installation Initiative showerheads, while 25 were not. Photographs of all the showerheads that were inspected have been provided in the Appendix F.

Qualitative findings

After speaking with facility supervisors and tenants it is clear that the fate of the showerheads is not altogether uniform. Three main outcomes were identified: not installed, installed, and un-installed (removed).

4.2 Bathroom Faucet Aerators

Result	Bathroom Aerators	
	#	%
Yes	20	16.7%
No	100	83.3%
Total (N)	120	100.0%

Quantitative Findings

A total of 120 bathroom faucet aerators were inspected. 20 of the installed measures were positively identified as Free Showerhead Installation Initiative bathroom faucet aerators, while

100 were not. Photographs of all the bathroom faucet aerators that were inspected can be found in Appendix F.

Qualitative findings

The percentage of bathroom faucet installations was lower than that of the showerhead installations, and much lower than that of the kitchen aerators. A number of possible reasons were identified in the field. One is that bathroom faucet fixtures were quite variable. Not all of the faucet fixtures were compatible with the Free Showerhead Installation Initiative faucet aerator measure. Another reason was the reported increased 'splash-back' that could occur. This is a potential issue where relatively strong water pressure creates a strong flow into a shallow basin. Compatibility with the fixtures and perceived performance issues may help to explain the low percentage of observed installations.

4.3 Kitchen Faucet Aerators

Result	Kitchen Aerators	
	#	%
Yes	41	34.2%
No	79	65.8%
Total (N)	120	100.0%

Quantitative Findings

A total of 120 kitchen faucet aerators were inspected. 41 of the installed measures were positively identified as Free Showerhead Installation Initiative kitchen faucet aerators, while 79 were not. Photographs of all the kitchen faucet aerators that were inspected have been provided in Appendix F.

Qualitative Findings

The percentage of observed installations of kitchen faucet aerators was higher than bathroom faucet aerators. Kitchen faucets were generally more uniform and there appears to be fewer issues regarding installation and perceived performance. There were some participants who indicated that they had challenges with affixing the measure to the faucet, and some who indicated splash-back occurred (especially with smaller kitchen sinks), however not to the same degree as with bathroom faucets.

4.4 Second Bathrooms

In total, 1 suite had a second bathroom with a second showerhead out of 120 suites that were observed. The survey was not implemented, because the second showerhead was identified as a Free Showerhead Installation Initiative 1.25 gpm showerhead.

5.0 Conclusion

A total of 120 suites were verified at 24 facilities. The verification effort focused on observing showerhead aerators, bathroom faucet aerators, and kitchen faucet aerators installed in social and assisted housing multi-family buildings for the Low Income segment.

The key findings of the verification effort were:

- Showerheads: 79.2% installations observed (95/120)
- Bathroom Sink Faucet Aerators: 16.7% installations observed (20/120)
- Kitchen Sink Faucet Aerators: 34.1% installations observed (41/120)

Overall, it is clear that Free Showerhead Installation Initiative participants do not just simply order the measures, install them right away, and keep them installed for the life of the model. Some participants never install the measures while others may remove them over time. The installation rate for showerheads is the highest of the 3 measures while both the bathroom and kitchen faucet aerators are relatively low, possibly due to the installation and operational challenges.

APPENDICES -

The following Appendices were provided in a separate document:

Appendix A – List of Buildings

Appendix B – Sample Sign-Off Sheet

Appendix C – Second Bathroom Survey

Appendix D – Sign-Off Sheets (Field Data)

Appendix E – Field Data in Excel Format

Appendix F – Photographs of Installed Measures

Appendix A – List of Buildings

Building Addresses	
1	[redacted]
2	[redacted]
3	[redacted]
4	[redacted]
5	[redacted]
6	[redacted]
7	[redacted]
8	[redacted]
9	[redacted]
10	[redacted]
11	[redacted]
12	[redacted]
13	[redacted]
14	[redacted]
15	[redacted]
16	[redacted]
17	[redacted]
18	[redacted]
19	[redacted]
20	[redacted]
21	[redacted]
22	[redacted]
23	[redacted]
24	[redacted]

Appendix B – Sample Sign-Off Sheet:

Union Gas Ltd. – Hot Water Conservation (HWC) Program Review

Inspection Details

Inspector Name & Phone: _____ _____
(Full Name – Print Clearly) (Phone)

Inspection Date & Time: _____ _____
(Date) (Time)

Facility Details – MULTI-FAMILY

Super / Owner Name & Phone: _____ _____
(Full Name – Print Clearly) (Phone)

Location Address: _____ _____ _____
(Street Address) (#Units) (#Floors)

ORDER DETAIL	
SH:	
KA:	
BA:	

	Suite #	Floor #	Tenant (Y/N)	Bathroom 1				Bathroom 2					Survey			
				Shower		Aerator			Shower		Aerator					
				Shower (Y/N)	Shower Picture #	Aerator (Y/N)	Aerator Picture #	Exists? (Y/N)	Shower (Y/N)	Shower Picture #	Aerator (Y/N)	Aerator Picture #	Complete? (Y/N)	Result (A,B,C,D or E)	Incentive Paid? (Y/N)	Letter? (Y/N)
1																
2																
3																
4																
5																

General Comments:

Sign-Off Area

The undersigned hereby acknowledge that on this date the above mentioned units were inspected for Hot Water Conservation measures.

X_____ X_____

(Facility Super Intendant / Owner) (Inspector)

Appendix C – Second Bathroom Survey:

uniongas
A Spectra Energy Company

enersmart
Conserve - Save - Comfort

We noticed your suite has two bathrooms.

1. **Was a new showerhead installed in each of your bathrooms?**

   Yes ☐ No ☐

   If you checked yes, that is all we need to know. Thank you!

2. **If you checked no, of all the showering that is done in your home, how much is done under the new showerhead?**

   ☐ **0% - 30%** - I hardly use the new showerhead.

   ☐ **31-69%** - I use the new showerhead about half the time.

   ☐ **70-99%** - I use the new showerhead most of the time.

   ☐ **100%** - I use the new showerhead all of the time.

Please call the number on the front of this page with your responses to receive your free $25 Tim Horton's Gift Certificate! Thank you for your time!

Appendix D – Sign-Off Sheets:

uniongas

enersmart

Union Gas Ltd. – Hot Water Conservation (HWC) Program Review

Inspection Details

Inspector Name & Phone: [redacted]

Inspection Date & Time:

Facility Details – MULTI-FAMILY [redacted]

Super / Owner Name & Phone:

Location Address:

(Street Address) (#Units) (#Floors)

ORDER DETAILS	
SM:	118
KA:	126
BA:	126

	Suite #	Floor #	Tenant (Y/N)	Kitchen Aerator		Bathroom 1				Bathroom 2					Survey			
						Shower		Aerator		Shower			Aerator					
				Aerator (Y/N)	Kitchen Aerator Picture #	Shower (Y/N)	Shower Picture #	Aerator (Y/N)	Aerator Picture #	Exists? (Y/N)	Shower (Y/N)	Shower Picture #	Aerator (Y/N)	Aerator Picture #	Com-plete? (Y/N)	Result (A,B,C, D,E)	In-centive? (Y/N)	Letter? (Y/N)
1	[redacted]		N	N	03	Y	01	N	02	N								
2			N	N	06	Y	04	N	05									
3			Y	N	09	Y	07	N	08									
4			Y	N	12	N	10	N	11									
5			Y	Y	15	N	13	N	14									
6																		

[redacted]

Sign-Off Area

The undersigned hereby acknowledge that on this date the above mentioned units were inspected for Hot Water Conservation measures.

[redacted]

uniongas

enersmart

Union Gas Ltd. – Hot Water Conservation (HWC) Program Review

Inspection Details

Inspector Name & Phone: [redacted]

Inspection Date & Time:

Facility Details – MULTI-FAMILY [redacted]

Super / Owner Name & Phone:

Location Address:

(Street Address) (#Units) (#Floors)

ORDER DETAIL

SH: 228

KA: 232

BA: 235

Suite #	Floor #	Tenant (Y/N)	Kitchen Aerator		Bathroom 1 Shower		Bathroom 1 Aerator		Bathroom 2 Shower			Bathroom 2 Aerator		Survey			
			Aerator (Y/N)	Kitchen Aerator Picture #	Shower (Y/N)	Shower Picture #	Aerator (Y/N)	Aerator Picture #	Exists? (Y/N)	Shower (Y/N)	Shower Picture #	Aerator (Y/N)	Aerator Picture #	Com-plete? (Y/N)	Result (A,B,C, D,E)	In-centive? (Y/N)	Letter? (Y/N)
[redacted]		N	N	18	N	16	N	17	N								
		Y	N	21	Y	19	N	20									
		Y	N	24	Y	22	N	23									
		N	N	27	Y	25	N	26									
		Y	Y	30	Y	28	N	29									

[redacted]

Sign-Off Area

The undersigned hereby acknowledge that on this date the above mentioned units were inspected for Hot Water Conservation measures.

[redacted]

uniongas

enersmart

Union Gas Ltd. – Hot Water Conservation (HWC) Program Review

Inspection Details

Inspector Name & Phone: [redacted]

Inspection Date & Time:

(Date) (Time)

Facility Details – MULTI-[redacted]

Super / Owner Name & P[redacted]

Location Address:

(Street Address) (#Units) (#Floors)

ORDER DETAILS	
SH:	80
KA:	80
BA:	80

	Suite #	Floor #	Tenant (Y/N)	Kitchen Aerator Aerator (Y/N)	Kitchen Aerator Kitchen Aerator Picture #	Bathroom 1 Shower Shower (Y/N)	Bathroom 1 Shower Shower Picture #	Bathroom 1 Aerator Aerator (Y/N)	Bathroom 1 Aerator Aerator Picture #	Bathroom 2 Shower Exists? (Y/N)	Bathroom 2 Shower Shower (Y/N)	Bathroom 2 Shower Shower Picture #	Bathroom 2 Aerator Aerator (Y/N)	Bathroom 2 Aerator Aerator Picture #	Survey Com-plete? (Y/N)	Survey Result (A,B,C, D,E)	Survey In-centive? (Y/N)	Survey Letter? (Y/N)
1	[redacted]		N	Y	33	Y	31	N	32	N								
2			N	Y	36	Y	34	N	35									
3			N	Y	39	Y	37	N	38									
4			N	Y	42	Y	40	N	41									
5			N	Y	45	Y	43	N	44									
6																		

General Comments:

Sign-Off Area

The undersigned hereby acknowledge that on this date the above mentioned units were inspected for Hot Water Conservation measures.

[redacted]

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Union Gas Ltd. – Hot Water Conservation (HWC) Program Review

Inspection Details

Inspector Name & Phone: [redacted]

Inspection Date & Time:

(Date) (Time)

Facility Details – MULTI-FAMI [redacted]

Super / Owner Name & Phone

Location Address:

(Street Address) (#Units) (#Floors)

ORDER DETAIL	
SH:	146
KA:	146
BA:	146

	Suite #	Floor #	Tenant (Y/N)	Kitchen Aerator		Bathroom 1 Shower		Bathroom 1 Aerator		Bathroom 2 Shower			Bathroom 2 Aerator		Survey			
				Aerator (Y/N)	Kitchen Aerator Picture #	Shower (Y/N)	Shower Picture #	Aerator (Y/N)	Aerator Picture #	Exists? (Y/N)	Shower (Y/N)	Shower Picture #	Aerator (Y/N)	Aerator Picture #	Com-plete? (Y/N)	Result (A,B,C, D,E)	In-centive? (Y/N)	Letter? (Y/N)
1	[redacted]		Y	N	48	Y	44	N	47	N								
2			Y	N	51	N	49	N	50									
3			Y	Y	54	N	52	N	53									
4			Y	N	57	Y	55	N	56									
5			Y	Y	60	Y	58	Y	59									
6																		

[redacted]

Sign-Off Area

The undersigned hereby acknowledge that on this date the above mentioned units were inspected for Hot Water Conservation measures

[redacted]

uniongas

enersmart

Union Gas Ltd. – Hot Water Conservation (HWC) Program Review

Inspection Details

Inspector Name & Phone: [redacted]

Inspection Date & Time:

(Date) (Time)

Facility Details – MULTI-FAMILY [redacted]

Super / Owner Name & Phone:

Location Address:

(Street Address) (#Units) (#Floors)

ORDER DETAIL

SH: 18

KA: 19

BA: 20

	Suite #	Floor #	Tenant (Y/N)	Kitchen Aerator: Aerator (Y/N)	Kitchen Aerator: Kitchen Aerator Picture #	Bathroom 1 Shower: Shower (Y/N)	Bathroom 1 Shower: Shower Picture #	Bathroom 1 Aerator: Aerator (Y/N)	Bathroom 1 Aerator: Aerator Picture #	Bathroom 2 Shower: Exists? (Y/N)	Bathroom 2 Shower: Shower (Y/N)	Bathroom 2 Shower: Shower Picture #	Bathroom 2 Aerator: Aerator (Y/N)	Bathroom 2 Aerator: Aerator Picture #	Survey: Com-plete? (Y/N)	Survey: Result (A,B,C, D,E)	Survey: In-centive? (Y/N)	Survey: Letter? (Y/N)
1	[redacted]		N	N	63	Y	11	N	62	N								
2			T	N	66	Y	64	N	65									
3			N	N	69	N	67	N	68									
4			Y	N	72	Y	70	N	71									
5			N	N	75	N	73	N	74									
6																		

[redacted]

Sign-Off Area

The undersigned hereby acknowledge that on this date the above mentioned units were inspected for Hot Water Conservation measures.

[redacted]

(Facility Super Intendant / Owner) (Inspector)

uniongas

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Union Gas Ltd. – Hot Water Conservation (HWC) Program Review

Inspection Details

Inspector Name & Phone: [redacted]

Inspection Date & Time:

(Date) (Time)

Facility Details – MULTI-FAMIL [redacted]

Super / Owner Name & Phone:

Location Address:

(Street Address) (#Units) (#Floors)

ORDER DETAIL	
SH:	32
KA:	34
BA:	34

Suite #	Floor #	Tenant (Y/N)	Kitchen Aerator		Bathroom 1 Shower		Bathroom 1 Aerator		Bathroom 2 Shower			Bathroom 2 Aerator		Survey			
			Aerator (Y/N)	Kitchen Aerator Picture #	Shower (Y/N)	Shower Picture #	Aerator (Y/N)	Aerator Picture #	Exists? (Y/N)	Shower (Y/N)	Shower Picture #	Aerator (Y/N)	Aerator Picture #	Com-plete? (Y/N)	Result (A,B,C, D,E)	In-centive? (Y/N)	Letter? (Y/N)
[redacted]		N	N	78	N	76	N	77	N								
		Y	N	81	N	79	N	80									
		Y	N	84	Y	82	N	83									
		Y	N	87	N	85	N	86									
		Y	N	90	Y	88	N	89									

[redacted]

Sign-Off Area

The undersigned hereby acknowledge that on this date the above mentioned units were inspected for Hot Water Conservation measures.

[redacted]

(Facility Super Intendant / Owner) (Inspector)

uniongas

enersmart

Union Gas Ltd. – Hot Water Conservation (HWC) Program Review

Inspection Details

Inspector Name & Phone: [redacted]

Inspection Date & Time:

(Date) (Time)

Facility Details – MULTI-FAMILY [redacted]

Super / Owner Name & Phone:

Location Address:

(Street Address) (#Units) (#Floors)

SH:	50
NA:	50
RA:	48

	Suite #	Floor #	Tenant (Y/N)	Kitchen Aerator		Bathroom 1				Bathroom 2					Survey			
						Shower		Aerator		Shower			Aerator					
				Aerator (Y/N)	Kitchen Aerator Picture #	Shower (Y/N)	Shower Picture #	Aerator (Y/N)	Aerator Picture #	Exists? (Y/N)	Shower (Y/N)	Shower Picture #	Aerator (Y/N)	Aerator Picture #	Com-plete? (Y/N)	Result (A,B,C, D,E)	In-centive? (Y/N)	Letter? (Y/N)
1	[redacted]		Y	Y	93	Y	91	N	92	N								
2			Y	N	96	Y	94	N	95									
3			Y	N	99	Y	97	N	98									
4			Y	N	102	Y	100	N	101									
5			N	N	105	N	103	N	104									
6																		

[redacted]

Sign-Off Area

The undersigned hereby acknowledge that on this date the above mentioned units were inspected for Hot Water Conservation measures.

[redacted]

uniongas

enersmart

Union Gas Ltd. – Hot Water Conservation (HWC) Program Review

Inspection Details

Inspector Name & Phone: [redacted]

Inspection Date & Time:

(Date) (Time)

Facility Details – MULTI-FAMIL[redacted]

Super / Owner Name & Phone:

Location Address:

(Street Address) (#Units) (#Floors)

ORDER DETAIL	
SH:	13
KA:	16
BA:	17

	Suite #	Floor #	Tenant (Y/N)	Kitchen Aerator		Bathroom 1				Bathroom 2					Survey			
				Aerator		Shower		Aerator		Shower			Aerator					
				Aerator (Y/N)	Kitchen Aerator Picture #	Shower (Y/N)	Shower Picture #	Aerator (Y/N)	Aerator Picture #	Exists? (Y/N)	Shower (Y/N)	Shower Picture #	Aerator (Y/N)	Aerator Picture #	Com-plete? (Y/N)	Result (A,B,C, D,E)	In-centive? (Y/N)	Letter? (Y/N)
1	[redacted]		Y	N	106	Y	106	N	107	N								
2			N	N	111	Y	109	N	110									
3			Y	N	114	Y	112	N	113									
4			Y	N	117	Y	115	N	116									
5			Y	N	120	N	118	N	119									
6																		

[redacted]

Sign-Off Area

The undersigned hereby acknowledge that on this date the above mentioned units were inspected for Hot Water Conservation measures

X_[redacted]

(Facility Superintendant / Owner) (Inspector)

uniongas

enersmart

Union Gas Ltd. – Hot Water Conservation (HWC) Program Review

Inspection Details

Inspector Name & Phone: [redacted]

Inspection Date & Time:

(Date) (Time)

Facility Details – MULTI-FAMILY [redacted]

Super / Owner Name & Phone:

Location Address:

(Street Address) (#Units) (#Floors)

ORDER DETAIL	
SH:	99
KA:	102
BA:	104

	Suite #	Floor #	Tenant (Y/N)	Kitchen Aerator Aerator (Y/N)	Kitchen Aerator Kitchen Aerator Picture #	Bathroom 1 Shower Shower (Y/N)	Bathroom 1 Shower Shower Picture #	Bathroom 1 Aerator Aerator (Y/N)	Bathroom 1 Aerator Aerator Picture #	Bathroom 2 Shower Exists? (Y/N)	Bathroom 2 Shower Shower (Y/N)	Bathroom 2 Shower Shower Picture #	Bathroom 2 Aerator Aerator (Y/N)	Bathroom 2 Aerator Aerator Picture #	Survey Com-plete? (Y/N)	Survey Result (A,B,C, D,E)	Survey In-centive? (Y/N)	Survey Letter? (Y/N)
1	[redacted]		Y	N	122	Y	128	N	123	N								
2			Y	N	125	N	123	N	124									
3			Y	N	128	Y	126	N	127									
4			Y	N	129	Y	129	N	130									
5			Y	N	134	Y	132	N	133									
6																		

[redacted]

Sign-Off Area

The undersigned hereby acknowledge that on this date the above mentioned units were inspected for Hot Water Conservation measures.

[redacted]

uniongas

enersmart

Union Gas Ltd. – Hot Water Conservation (HWC) Program Review

Inspection Details

Inspector Name & Phone: [redacted]

Inspection Date & Time:

(Date) (Time)

Facility Details – MULTI-FAMIL [redacted]

Super / Owner Name & Phone:

Location Address:

(Street Address) (#Units) (#Floors)

ORDER DETAIL

SH: 50

KA: 52

BA: 53

	Suite #	Floor #	Tenant (Y/N)	Kitchen Aerator: Aerator (Y/N)	Kitchen Aerator: Kitchen Aerator Picture #	Bathroom 1 Shower: Shower (Y/N)	Bathroom 1 Shower: Shower Picture #	Bathroom 1 Aerator: Aerator (Y/N)	Bathroom 1 Aerator: Aerator Picture #	Bathroom 2 Shower: Exists? (Y/N)	Bathroom 2 Shower: Shower (Y/N)	Bathroom 2 Shower: Shower Picture #	Bathroom 2 Aerator: Aerator (Y/N)	Bathroom 2 Aerator: Aerator Picture #	Survey: Com plete? (Y/N)	Survey: Result (A,B,C, D,E)	Survey: In-centive? (Y/N)	Survey: Letter? (Y/N)
1	[redacted]		Y	N	136	N	135	N	135B	N								
2			Y	N	139	Y	137	N	138									
3			Y	~~N~~ Y	142	Y	140	Y	141									
4			Y	~~N~~ N	145	Y	143	N	144									
5			Y	N	148	Y	146	N	147									
6																		

[redacted]

Sign-Off Area

The undersigned hereby acknowledge that on this date the above mentioned units were inspected for Hot Water Conservation measures.

[redacted]

uniongas

enersmart

Union Gas Ltd. – Hot Water Conservation (HWC) Program Review

Inspection Details

Inspector Name & Phone: [redacted]

Inspection Date & Time:

(Date) (Time)

Facility Details – MULTI-FAMILY- Low Income

Super / Owner Name & Phone [redacted]

Location Address:

(Street Address) (#Units) (#Floors)

PAPER DETAIL

SH:	240
KA:	240
BA:	0

	Suite #	Floor #	Tenant (Y/N)	Kitchen Aerator: Aerator (Y/N)	Kitchen Aerator: Kitchen Aerator Picture #	Bathroom 1 Shower: Shower (Y/N)	Bathroom 1 Shower: Shower Picture #	Bathroom 1 Aerator: Aerator (Y/N)	Bathroom 1 Aerator: Aerator Picture #	Bathroom 2 Shower: Exists? (Y/N)	Bathroom 2 Shower: Shower (Y/N)	Bathroom 2 Shower: Shower Picture #	Bathroom 2 Aerator: Aerator (Y/N)	Bathroom 2 Aerator: Aerator Picture #	Survey: Com-plete? (Y/N)	Survey: Result (A,B,C, D,E)	Survey: In-centive? (Y/N)	Survey: Letter? (Y/N)
1	[redacted]		Y	N	759	N	757	N	758	N								
2			Y	N	762	N	760	N	761									
3			N	Y	765	Y	764	N	766									
4			Y	Y	768	N	266	N	267									
5			Y	Y	271	N	269	N	270									
6																		

[redacted]

Sign-Off Area

The undersigned hereby acknowledge that on this date the above mentioned units were inspected for Hot Water Conservation measures.

[redacted]

uniongas

enersmart

Union Gas Ltd. – Hot Water Conservation (HWC) Program Review

Inspection Details

Inspector Name & Phone: [redacted]

Inspection Date & Time:

(Date) (Time)

Facility Details – MULTI-FAMIL [redacted]

Super / Owner Name & Phone:

Location Address:

(Street Address) (#Units) (#Floors)

SH:	85
KA:	89
BA:	89

Suite #	Floor #	Tenant (Y/N)	Kitchen Aerator: Aerator (Y/N)	Kitchen Aerator: Kitchen Aerator Picture #	Bathroom 1 Shower: Shower (Y/N)	Bathroom 1 Shower: Shower Picture #	Bathroom 1 Aerator: Aerator (Y/N)	Bathroom 1 Aerator: Aerator Picture #	Bathroom 2 Shower: Exists? (Y/N)	Bathroom 2 Shower: Shower (Y/N)	Bathroom 2 Shower: Shower Picture #	Bathroom 2 Aerator: Aerator (Y/N)	Bathroom 2 Aerator: Aerator Picture #	Survey: Com-plete? (Y/N)	Survey: Result (A,B,C, D,E)	Survey: In-centive? (Y/N)	Survey: Letter? (Y/N)
[redacted]		Y	Y	362	Y	365	Y	361	N								
		N	Y	365	Y	363	Y	364	N								
		N	Y	368	Y	366	Y	367	N								
		Y	Y	371	Y	369	Y	370	N								
		Y	Y	374	Y	372	Y	373	N								

[redacted]

Sign-Off Area

The undersigned hereby acknowledge that on this date the above mentioned units were inspected for Hot Water Conservation measures.

[redacted]

uniongas

enersmart

Union Gas Ltd. – Hot Water Conservation (HWC) Program Review

Inspection Details

Inspector Name & Phone: [redacted]

Inspection Date & Time: [redacted]

(Date) (Time)

Facility Details – MULTI-FAMI [redacted]

Super / Owner Name & Phone [redacted]

Location Address: [redacted]

(Street Address) (#Units) (#Floors)

DAILY DETAIL	
SH:	51
KA:	50
BA:	52

	Suite #	Floor #	Tenant (Y/N)	Kitchen Aerator: Aerator (Y/N)	Kitchen Aerator: Kitchen Aerator Picture #	Bathroom 1 Shower: Shower (Y/N)	Bathroom 1 Shower: Shower Picture #	Bathroom 1 Aerator: Aerator (Y/N)	Bathroom 1 Aerator: Aerator Picture #	Bathroom 2 Shower: Exists? (Y/N)	Bathroom 2 Shower: Shower (Y/N)	Bathroom 2 Shower: Shower Picture #	Bathroom 2 Aerator: Aerator (Y/N)	Bathroom 2 Aerator: Aerator Picture #	Survey: Complete? (Y/N)	Survey: Result (A,B,C,D,E)	Survey: Incentive? (Y/N)	Survey: Letter? (Y/N)
1	[redacted]		N	N	377	Y	378	N	379	N								
2			N	N	379	Y	378	Y	379B	N								
3			N	N	382	Y	380	N	381	N								
4			N	N	385	Y	383	N	384	N								
5			Y	N	389	Y	386	N	387	Y	Y	387B	N	388	NA			
6																		

[redacted]

Sign-Off Area

The undersigned hereby acknowledge that on this date the above mentioned units were inspected for Hot Water Conservation measures.

[redacted]

uniongas

enersmart

Union Gas Ltd. – Hot Water Conservation (HWC) Program Review

Inspection Details

Inspector Name & Phone: [redacted]

Inspection Date & Time:

(Date) (Time)

Facility Details – MULTI-FAMIL [redacted]

Super / Owner Name & Phone:

Location Address:

(Street Address) (#Units) (#Floors)

ORDER DETAIL	
SH:	243
KA:	252
BA:	252

	Suite #	Floor #	Tenant (Y/N)	Kitchen Aerator		Bathroom 1 Shower		Bathroom 1 Aerator		Bathroom 2 Shower			Bathroom 2 Aerator		Survey			
				Aerator (Y/N)	Kitchen Aerator Picture #	Shower (Y/N)	Shower Picture #	Aerator (Y/N)	Aerator Picture #	Exists? (Y/N)	Shower (Y/N)	Shower Picture #	Aerator (Y/N)	Aerator Picture #	Complete? (Y/N)	Result (A,B,C,D,E)	Incentive? (Y/N)	Letter? (Y/N)
1	[redacted]		N	N	184	Y	192	N	193	N								
2			N	Y	187	N	185	N	186									
3			Y	Y	190	Y	188	N	189									
4			N	N	193	Y	191	N	192									
5			Y	N	196	N	194	N	195									
6																		

[redacted]

Sign-Off Area

The undersigned hereby acknowledge that on this date the above mentioned units were inspected for Hot Water Conservation measures.

[redacted]

union gas
A Spectra Energy Company

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Union Gas Ltd. – Hot Water Conservation (HWC) Program Review

Low-income

Inspection Details

Inspector Name & Phone: [redacted]

Inspection Date & Time: [redacted]

(Date) (Time)

Facility Details – MULTI-FAMILY

Super / Owner Name [redacted]

Location Address: [redacted]

(Street Address) (#Units) (#Floors)

ORDER DETAIL	
SH:	40
KA:	40
BA:	40

	Suite #	Floor #	Tenant (Y/N)	Kitchen Aerator		Bathroom 1 Shower		Bathroom 1 Aerator		Bathroom 2 Shower			Bathroom 2 Aerator		Survey			
				Aerator (Y/N)	Kitchen Aerator Picture #	Shower (Y/N)	Shower Picture #	Aerator (Y/N)	Aerator Picture #	Exists? (Y/N)	Shower (Y/N)	Shower Picture #	Aerator (Y/N)	Aerator Picture #	Complete? (Y/N)	Result (A,B,C,D,E)	Incentive? (Y/N)	Letter? (Y/N)
1	[redacted]		Y	N	P-38	Y	P-39	N	P-40									
2			Y	N	P-43	Y	P-41	N	P-42									
3			Y	N	P-44	Y	P-45	N	P-46									
4			Y	N	P-47	Y	P-48	N	P-49									
5			Y	Y	P-50	Y	P-51	N	P-52									
6																		

[redacted]

Sign-Off Area

The undersigned hereby acknowledge that on this date the above mentioned units were inspected for Hot Water Conservation measures.

X [redacted]

(Facility Super Intendant / Owner) (Inspector)

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Union Gas Ltd. – Hot Water Conservation (HWC) Program Review

Low income

Inspection Details

Inspector Name & Phone: [redacted]

Inspection Date & Time: [redacted]

(Date) (Time)

Facility Details – MULTI-FAMILY

Super / Owner Name [redacted]

Location Address: [redacted]

(Street Address) (#Units) (#Floors)

ORDER DETAIL

SH: 91

KA: 91

BA: 91

	Suite #	Floor #	Tenant (Y/N)	Kitchen Aerator		Bathroom 1 Shower		Bathroom 1 Aerator		Bathroom 2 Shower			Bathroom 2 Aerator		Survey			
				Aerator (Y/N)	Kitchen Aerator Picture #	Shower (Y/N)	Shower Picture #	Aerator (Y/N)	Aerator Picture #	Exists? (Y/N)	Shower (Y/N)	Shower Picture #	Aerator (Y/N)	Aerator Picture #	Complete? (Y/N)	Result (A,B,C,D,E)	Incentive? (Y/N)	Letter? (Y/N)
1	[redacted]		Y	N	P-53	Y	P-54	N	P-55									
2			N	N	P-56	Y	P-57	N	P-58									
3			N	N	P-59	Y	P-60	N	P-61									
4			N	N	P-62	Y	P-63	N	P-64									
5			N	N	P-65	N	P-66	N	P-67									
6																		

[redacted]

Sign-Off Area

The undersigned hereby acknowledge that on this date the above mentioned units were inspected for Hot Water Conservation measures.

[redacted]

(Facility Superintendant / Owner) (Inspector)

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Union Gas Ltd. – Hot Water Conservation (HWC) Program Review

low-income

Inspection Details

Inspector Name & Phone: [redacted]

Inspection Date & Time: [redacted]

(Date) (Time)

Facility Details – MULTI-FAMILY

Super / Owner Na[redacted]

Location Address [redacted]

(Street Address) (#Units) (#Floors)

ORDER DETAIL	
SH:	120
KA:	120
BA:	0

	Suite #	Floor #	Tenant (Y/N)	Kitchen Aerator: Aerator (Y/N)	Kitchen Aerator: Kitchen Aerator Picture #	Bathroom 1 Shower: Shower (Y/N)	Bathroom 1 Shower: Shower Picture #	Bathroom 1 Aerator: Aerator (Y/N)	Bathroom 1 Aerator: Aerator Picture #	Bathroom 2 Shower: Exists? (Y/N)	Bathroom 2 Shower: Shower (Y/N)	Bathroom 2 Shower: Shower Picture #	Bathroom 2 Aerator: Aerator (Y/N)	Bathroom 2 Aerator: Aerator Picture #	Survey: Complete? (Y/N)	Survey: Result (A,B,C,D,E)	Survey: Incentive? (Y/N)	Survey: Letter? (Y/N)
1	[redacted]		N	Y	P-68	Y	P-69	N	P-70									
2			Y	Y	P-71	Y	P-72	N	P-73									
3			Y	Y	P-76	Y	P-74	N	P-75									
4			Y	Y	P-77	Y	P-78	N	P-79									
5			N	Y	P-80	Y	P-81	N	P-82									
6																		

[redacted]

Sign-Off Area

The undersigned hereby acknowledge that on this date the above mentioned units were inspected for Hot Water Conservation measures

[redacted]

(Facility Super Intendant / Owner) (Inspector)

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Union Gas Ltd. – Hot Water Conservation (HWC) Program Review

low-income

Inspection Details

Inspector Name & Phone: [redacted]

Inspection Date & Time: [redacted]

(Date) (Time)

Facility Details – MULTI-FAMILY

Super / Owner Na[redacted]

Location Address [redacted]

(Street Address) (#Units) (#Floors)

ORDER DETAIL	
SH:	40
KA:	40
BA:	40

	Suite #	Floor #	Tenant (Y/N)	Kitchen Aerator		Bathroom 1 Shower		Bathroom 1 Aerator		Bathroom 2 Shower			Bathroom 2 Aerator		Survey			
				Aerator (Y/N)	Kitchen Aerator Picture #	Shower (Y/N)	Shower Picture #	Aerator (Y/N)	Aerator Picture #	Exists? (Y/N)	Shower (Y/N)	Shower Picture #	Aerator (Y/N)	Aerator Picture #	Complete? (Y/N)	Result (A,B,C,D,E)	Incentive? (Y/N)	Letter? (Y/N)
1	[redacted]		Y	N	P-83	Y	P-84	N	P-85									
2			Y	N	P-86	Y	P-87	N	P-88									
3			Y	N	P-89	Y	P-90	N	P-91									
4			Y	N	P-92	Y	P-93	N	P-94									
5			Y	N	P-95	Y	P-96	N	P-97									
6																		

[redacted]

Sign-Off Area

The undersigned hereby acknowledge that on this date the above mentioned units were inspected for Hot Water Conservation measures.

X [redacted]

(Facility Super Intendant / Owner) (Inspector)

uniongas
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Union Gas Ltd. – Hot Water Conservation (HWC) Program Review

low income

Inspection Details

Inspector Name & Phone: [redacted]

Inspection Date & Time: [redacted]

(Date) (Time)

Facility Details – MULTI-FAMILY

Super / Owner Na[redacted]

Location Address: [redacted]

(Street Address) (#Units) (#Floors)

ORDER DETAIL	
SH:	49
KA:	49
BA:	49

	Suite #	Floor #	Tenant (Y/N)	Kitchen Aerator Aerator (Y/N)	Kitchen Aerator Aerator Picture #	Bathroom 1 Shower Shower (Y/N)	Bathroom 1 Shower Shower Picture #	Bathroom 1 Aerator Aerator (Y/N)	Bathroom 1 Aerator Aerator Picture #	Bathroom 2 Shower Exists? (Y/N)	Bathroom 2 Shower Shower (Y/N)	Bathroom 2 Shower Shower Picture #	Bathroom 2 Aerator Aerator (Y/N)	Bathroom 2 Aerator Aerator Picture #	Survey Complete? (Y/N)	Survey Result (A,B,C,D,E)	Survey Incentive? (Y/N)	Survey Letter? (Y/N)
1	[redacted]		N	N	P-98	Y	P-99	N	P-100									
2			N	N	P-101	Y	P-102	N	P-103									
3			Y	N	P-104	Y	P-105	N	P-106									
4			N	N	P-107	Y	P-108	N	P-109									
5			Y	N	P-110	Y	P-111	N	P-112									
6																		

[redacted]

Sign-Off Area

The undersigned hereby acknowledge that on this date the above mentioned units were inspected for Hot Water Conservation measures.

X [redacted] X _____

(Facility Super Intendant / Owner) (Inspector)

union gas
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Union Gas Ltd. – Hot Water Conservation (HWC) Program Review

Inspection Details

Inspector Name & Phone: [redacted]

Inspection Date & Time: [redacted]

(Date) (Time)

Facility Details – MULTI-FAMILY

Super / Owner Na[redacted]

Location Address: [redacted]

(Street Address) (#Units) (#Floors)

ORDER DETAIL	
SH:	22
KA:	22
BA:	22

	Suite #	Floor #	Tenant (Y/N)	Kitchen Aerator		Bathroom 1 Shower		Bathroom 1 Aerator		Bathroom 2 Shower			Bathroom 2 Aerator		Survey			
				Aerator (Y/N)	Kitchen Aerator Picture #	Shower (Y/N)	Shower Picture #	Aerator (Y/N)	Aerator Picture #	Exists? (Y/N)	Shower (Y/N)	Shower Picture #	Aerator (Y/N)	Aerator Picture #	Complete? (Y/N)	Result (A,B,C,D,E)	Incentive? (Y/N)	Letter? (Y/N)
1	[redacted]		Y	N	P-113	Y	P-114	N	P-115									
2			Y	N	P-116	Y	P-117	N	P-118									
3			Y	N	P-119	Y	P-120	N	P-121									
4			Y	N	P-122	N	P-123	N	P-124									
5			Y	N	P-125	Y	P-126	N	P-127									
6																		

General Comments: [redacted]

Sign-Off Area

The undersigned hereby acknowledge that on this date the above mentioned units were inspected for Hot Water Conservation measures.

X [redacted]

(Facility Super Intendant / Owner) (Inspector)

union gas
A Spectra Energy Company

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Conserve · Save · Comfort

Union Gas Ltd. – Hot Water Conservation (HWC) Program Review

low-income

Inspection Details

Inspector Name & Phone: [redacted]

Inspection Date & Time: [redacted]

(Date) (Time)

Facility Details – MULTI-FAMILY

Super / Owner Nan[redacted]

Location Address: [redacted]

(Street Address) (#Units) (#Floors)

ORDER DETAIL	
SH:	31
KA:	35
BA:	31

	Suite #	Floor #	Tenant (Y/N)	Kitchen Aerator Aerator (Y/N)	Kitchen Aerator Kitchen Aerator Picture #	Bathroom 1 Shower Shower (Y/N)	Bathroom 1 Shower Shower Picture #	Bathroom 1 Aerator Aerator (Y/N)	Bathroom 1 Aerator Aerator Picture #	Bathroom 2 Shower Exists? (Y/N)	Bathroom 2 Shower Shower (Y/N)	Bathroom 2 Shower Shower Picture #	Bathroom 2 Aerator Aerator (Y/N)	Bathroom 2 Aerator Aerator Picture #	Survey Complete? (Y/N)	Survey Result (A,B,C,D,E)	Survey In-centive? (Y/N)	Survey Letter? (Y/N)
1	[redacted]		Y	Y	P-128	Y	P-129	N	P-130									
2			Y	N	P-131	N	P-132	N	P-133									
3			N	Y	P-134	N	P-135	N	P-136									
4			Y	N	P-137	Y	P-138	N	P-139									
5			Y	N	P-140	Y	P-141	N	P-142									
6																		

General Comments: [redacted]

Sign-Off Area

The undersigned hereby acknowledge that on this date the above mentioned units were inspected for Hot Water Conservation measures.

X [redacted]

(Facility Superintendant / Owner) (Inspector)

unionGas

enersmart

Union Gas Ltd. – Hot Water Conservation (HWC) Program Review

Inspection Details

Inspector Name & Phone: [redacted]

Inspection Date & Time:

(Date) (Time)

Facility Details – MULTI-FAMI [redacted]

Super / Owner Name & Phone

Location Address:

ORDER DETAIL	
SH:	56 ✓
KA:	28
BA:	56

	Suite #	Floor #	Tenant (Y/N)	Kitchen Aerator		Bathroom 1 Shower		Bathroom 1 Aerator		Bathroom 2 Shower			Bathroom 2 Aerator		Survey			
				Aerator (Y/N)	Kitchen Aerator Picture #	Shower (Y/N)	Shower Picture #	Aerator (Y/N)	Aerator Picture #	Exists? (Y/N)	Shower (Y/N)	Shower Picture #	Aerator (Y/N)	Aerator Picture #	Com-plete? (Y/N)	Result (A,B,C, D,E)	In-centive? (Y/N)	Letter? (Y/N)
1	[redacted]		Y	Y	D-52	Y	D-53	Y	D-54									
2			N	Y	D-55	Y	D-56	Y	D-57									
3			Y	Y	D-58	Y	D-59	Y	D-60									
4			Y	Y	D-61	Y	D-62	Y	D-63									
5			N	Y	D-64	Y	D-65	Y	D-66									
6																		

[redacted]

Sign-Off Area

The undersigned hereby acknowledge that on this date the above mentioned units were inspected for Hot Water Conser [redacted]

X_____

(Inspector)

uniongas

enersmart

Union Gas Ltd. – Hot Water Conservation (HWC) Program Review

Inspection Details

Inspector Name & Phone: [redacted]

Inspection Date & Time:

(Date) (Time)

Facility Details – MULTI-FAMI [redacted]

Super / Owner Name & Phone

Location Address:

Suite	36
Kit.	0
BA	0

Suite #	Floor #	Tenant (Y/N)	Kitchen Aerator: Aerator (Y/N)	Kitchen Aerator: Kitchen Aerator Picture #	Bathroom 1 Shower: Shower (Y/N)	Bathroom 1 Shower: Shower Picture #	Bathroom 1 Aerator: Aerator (Y/N)	Bathroom 1 Aerator: Aerator Picture #	Bathroom 2 Shower: Exists? (Y/N)	Bathroom 2 Shower: Shower (Y/N)	Bathroom 2 Shower: Shower Picture #	Bathroom 2 Aerator: Aerator (Y/N)	Bathroom 2 Aerator: Aerator Picture #	Survey: Complete? (Y/N)	Survey: Result (A,B,C,D,E)	Survey: Incentive? (Y/N)	Survey: Letter? (Y/N)
1 [redacted]		Y	N	D-124	Y	D-122	N	D-123									
2		Y	N	D-127	Y	D-125	N	D-126									
3		Y	N	D-128	N	D-129	Y	D-130									
4		Y	Y	D-131	Y	D-132	Y	D-133									
4		Y	Y	D-134	Y	D-135	Y	D-136									
6																	

General Comments: [redacted]

Sign-Off Area

The undersigned hereby acknowledge that on this date the above mentioned units were inspected for Hot Water C [redacted]

(Inspector)

uniongas

enersmart

Union Gas Ltd. – Hot Water Conservation (HWC) Program Review

Inspection Details

Inspector Name & Phone: [redacted]

Inspection Date & Time:

(Date) (Time)

Facility Details – MULTI-FAMI [redacted]

Super / Owner Name & Phone

Location Address:

(Street Address) (#Units) (#Floors)

ORDER OF VALI	
SH:	4
KA:	4
BA:	131

Suite #	Floor #	Tenant (Y/N)	Kitchen Aerator		Bathroom 1 Shower		Bathroom 1 Aerator		Bathroom 2 Shower			Bathroom 2 Aerator		Survey			
			Aerator (Y/N)	Kitchen Aerator Picture #	Shower (Y/N)	Shower Picture #	Aerator (Y/N)	Aerator Picture #	Exists? (Y/N)	Shower (Y/N)	Shower Picture #	Aerator (Y/N)	Aerator Picture #	Com-plete? (Y/N)	Result (A,B,C, D,E)	In-centive? (Y/N)	Letter? (Y/N)
[redacted]		Y	Y	D-107	Y	D-108	Y	D-109									
		N	Y	D-112	Y	D-110	Y	D-111									
		N	Y	D-113	Y	D-114	Y	D-115									
		Y	Y	D-116	Y	D-117	Y	D-118									
		Y	Y	D-119	N	D-120	N	D-121									

[redacted]

Sign-Off Area

The undersigned hereby acknowledge that on this date the above mentioned units were inspected for Hot Water C [redacted]

(Inspector)

Appendix E – Field Data:

VERIF DATE / TIME	Building Address	Unit	Tenant (Y/N)	Shower (Y/N)	Shower Picture	Bathroom Aerator (Y/N)	Bathroom Aerator Picture	Kitchen Aerator (Y/N)	Kitchen Aerator Picture	2nd Bathroom	Shower2 (Y/N)	Shower2 Picture	Bathroom 2 Aerator (Y/N)	Bathroom 2 Aerator Picture	Survey Complete	Survey Result	Incentive Paid	Initial UGL Letter Recieved Y/n	Letter Left Ensuite	SH,BA, KA
Thu-Feb-14 - 9 00 AM	[redacted]	[redacted]	n	y	MK01	N	MK02	N	MK03	N								Y		118,126,126
		[redacted]	n	y	MK04	N	MK05	N	MK06	N										
		[redacted]	y	y	MK07	N	MK08	N	MK09	N										
		[redacted]	y	n	MK10	N	MK11	N	MK12	N										
		[redacted]	y	n	MK13	N	MK14	Y	MK15	N										
Thu-Feb-14 - 9 45 AM	[redacted]	[redacted]	n	N	MK16	N	MK17	N	MK18	N								Y		228, 235, 232
		[redacted]	y	Y	MK19	N	MK20	N	MK21	N										
		[redacted]	y	Y	MK22	N	MK23	N	MK24	N										
		[redacted]	n	Y	MK25	N	MK26	N	MK27	N										
		[redacted]	y	Y	MK28	N	MK29	Y	MK30	N										
Thu-Feb-14 - 10 45 AM	[redacted]	[redacted]	n	Y	MK31	N	MK32	Y	MK33	N								Y		80, 80, 80
		[redacted]	n	Y	MK34	N	MK35	Y	MK36	N										
		[redacted]	n	Y	MK37	N	MK38	Y	MK39	N										
		[redacted]	n	Y	MK40	N	MK41	Y	MK42	N										
		[redacted]	n	Y	MK43	N	MK44	Y	MK45	N										
Thu-Feb-14 - 11 30 AM	[redacted]	[redacted]	y	y	MK46	n	MK47	n	MK48	N								Y		146, 146, 146
		[redacted]	y	n	MK49	n	MK50	n	MK51	N										
		[redacted]	y	n	MK52	n	MK53	y	MK54	N										
		[redacted]	y	y	MK55	n	MK56	n	MK57	N										
		[redacted]	y	y	MK58	y	MK59	y	MK60	N										
Fri- Feb- 15th 10 00 am	[redacted]	[redacted]	n	y	MK61	n	MK62	n	MK63	N								y		18,20,19
		[redacted]	y	y	MK64	n	MK65	n	MK66	N										
		[redacted]	n	n	MK67	n	MK68	n	MK69	N										
		[redacted]	y	y	MK70	n	MK71	n	MK72	N										
		[redacted]	n	n	MK73	n	MK74	n	MK75	N										
Fri- Feb- 15th 11 00 am	[redacted]	[redacted]	n	n	MK76	n	MK77	n	MK78	N								y		32, 34, 34
		[redacted]	y	n	MK79	n	MK80	n	MK81	N										
		[redacted]	y	y	MK82	n	MK83	n	MK84	N										
		[redacted]	y	n	MK85	n	MK86	n	MK87	N										
		[redacted]	y	y	MK88	n	MK89	n	MK90	N										
Fri- Feb- 15th 12 00 pm	[redacted]	[redacted]	y	y	MK91	n	MK92	y	MK93	N								y		50, 48, 50
		[redacted]	y	y	MK94	n	MK95	n	MK96	N										
		[redacted]	y	y	MK97	n	MK98	n	MK99	N										
		[redacted]	y	y	MK100	n	MK101	n	MK102	N										
		[redacted]	n	n	MK103	n	MK104	n	MK105	N										
Fri- Feb- 15th 12 30 pm	[redacted]	[redacted]	y	y	MK106	n	MK107	n	MK108	N								y		13,17,16
		[redacted]	n	y	MK109	n	MK110	n	MK111	N										
		[redacted]	y	y	MK112	n	MK113	n	MK114	N										
		[redacted]	y	y	MK115	n	MK116	n	MK117	N										
		[redacted]	y	n	MK118	n	MK119	n	MK120	N										
Fri- Feb- 15th 1 00 pm	[redacted]	[redacted]	y	y	MK120B	n	MK121	n	MK122	N								y		99, 104, 102
		[redacted]	y	n	MK123	n	MK124	n	MK125	N										
		[redacted]	y	y	MK126	n	MK127	n	MK128	N										
		[redacted]	y	y	MK129	n	MK130	n	MK131	N										
		[redacted]	y	y	MK132	n	MK133	n	MK134	N										
Fri- Feb- 15th 1 30 pm	[redacted]	[redacted]	y	n	MK135	n	MK135B	n	MK136	N								y		50, 53, 52
		[redacted]	y	y	MK137	n	MK138	n	MK139	N										
		[redacted]	y	y	MK140	y	MK141	y	MK142	N										
		[redacted]	y	y	MK143	n	MK144	n	MK145	N										
		[redacted]	y	y	MK146	n	MK147	n	MK148	N										
Thur-Feb 21- 11 00 am	[redacted]	[redacted]	y	n	MK257	n	MK258	n	MK259	n								n		240,0,240
		[redacted]	y	n	MK260	n	MK261	n	MK262	n										
		[redacted]	n	y	MK263	n	MK264	y	MK265	n										
		[redacted]	y	n	MK266	n	MK267	y	MK268	n										
		[redacted]	y	n	MK269	n	MK270	y	MK271	n										

VERIF DATE / TIME	Building Address	Unit	Tenant (Y/N)	Shower (Y/N)	Shower Picture	Bathroom Aerator (Y/N)	Bathroom Aerator Picture	Kitchen Aerator (Y/N)	Kitchen Aerator Picture	2nd Bathroom	Shower2 (Y/N)	Shower2 Picture	Bathroom 2 Aerator (Y/N)	Bathroom 2 Aerator Picture	Survey Complete	Survey Result	Incentive Paid	Initial UGL Letter Recieved y/n	Letter Left Ensuite	SH,BA, KA
Thur-Feb 29- 11 30 am	[redacted]	[redacted]	y	y	MK360	y	MK361	y	MK362	n								y		85, 89,89
		[redacted]	n	y	MK363	y	MK364	y	MK365	n										
		[redacted]	n	y	MK366	y	MK367	y	MK368	n										
		[redacted]	y	y	MK369	y	MK370	y	MK371	n										
		[redacted]	y	y	MK372	y	MK373	y	MK374	n										
Thur-Feb 29- 12 30 am	[redacted]	[redacted]	n	y	MK375	n	MK376	n	MK377	n								y		51, 52, 50
		[redacted]	n	y	MK378	y	MK378B	n	MK379	n										
		[redacted]	n	y	MK380	n	MK381	n	MK382	n										
		[redacted]	n	y	MK383	n	MK384	n	MK385	n										
		[redacted]	y	y	MK386	n	MK387	n	MK389	y	y	MK387B	N	MK388	NA					
Wed-Feb-20th- 11 045 am	[redacted]	[redacted]	n	y	MK182	n	MK183	n	MK184	n									y	243, 252, 252
		[redacted]	n	n	MK185	n	MK186	y	MK187	n										
		[redacted]	y	y	MK188	n	MK189	y	MK190	n										
		[redacted]	n	y	MK191	n	MK192	n	MK193	n										
		[redacted]	y	n	MK194	n	MK195	n	MK196	n										
Thu-14-Feb – 9 00 AM	[redacted]	[redacted]	Y	Y	P-39	N	P-40	N	P-38	n									[redacted]	40,40,0
		[redacted]	Y	Y	P-41	N	P-42	N	P-43	n										
		[redacted]	Y	Y	P-45	N	P-46	N	P-44	n										
		[redacted]	Y	Y	P-48	N	P-49	N	P-47	n										
		[redacted]	Y	Y	P-51	N	P-52	Y	P-50	n										
Thu-14-Feb – 10 00 AM	[redacted]	[redacted]	Y	Y	P-54	N	P-55	N	P-53	n									[redacted]	91,91,91
		[redacted]	N	Y	p-57	N	P-58	N	p-56	n										
		[redacted]	N	Y	P-60	N	P-61	N	P-59	n										
		[redacted]	N	Y	P-63	N	P-64	N	P-62	n										
		[redacted]	N	N	p-66	N	P-67	N	P-65	n										
Thu-14-Feb – 10 40 AM	[redacted]	[redacted]	N	Y	P-69	N	P-70	Y	P-68	n									[redacted]	120,120,0
		[redacted]	Y	Y	P-72	N	P-73	Y	P-71	n										
		[redacted]	Y	Y	P-74	N	P-75	Y	P-76	n										
		[redacted]	Y	Y	P-78	N	P-79	Y	P-77	n										
		[redacted]	N	Y	p-81	N	P-82	Y	P-80	n										
Thu-14-Feb – 11 30 AM	[redacted]	[redacted]	Y	Y	P-84	N	p-85	N	P-83	n									[redacted]	40,40,40
		[redacted]	Y	Y	P-87	N	P-88	N	P-86	n										
		[redacted]	Y	Y	P-90	N	P-91	N	P-89	n										
		[redacted]	Y	Y	P-93	N	P-94	N	P-92	n										
		[redacted]	Y	Y	P-96	N	P-97	N	P-95	n										
Thu-14-Feb -- 12 20 PM	[redacted]	[redacted]	N	Y	P-99	N	P-100	N	P-98	n									[redacted]	49,49,49
		[redacted]	N	Y	P-102	N	P-103	N	P-101	n										
		[redacted]	Y	Y	P-105	N	P-106	N	P-104	n										
		[redacted]	N	Y	P-108	N	P-109	N	P-107	n										
		[redacted]	Y	Y	P-111	N	P-112	N	P-110	n										
Thu-14-Feb -- 12 50 PM	[redacted]	[redacted]	Y	Y	P-114	N	P-115	N	P-113	n									[redacted]	22,22,22
		[redacted]	Y	Y	P-117	N	P-118	N	P-116	n										
		[redacted]	Y	Y	P-120	N	P-121	N	P-119	n										
		[redacted]	Y	Y	P-123	N	P-124	N	p-122	n										
		[redacted]	Y	Y	P-126	N	P-127	N	P-125	n										
Thu-14-Feb – 1 20 PM	[redacted]	[redacted]	Y	Y	P-129	N	P-130	Y	P-128	n									[redacted]	N/A
		[redacted]	Y	N	P-132	N	p-133	N	P-131	n										
		[redacted]	N	N	p-135	N	p-136	Y	P-134	n										
		[redacted]	Y	Y	P-138	N	P-139	N	P-137	n										
		[redacted]	Y	Y	P-141	N	P-142	N	P-140	n										
Weds-25-Feb--9 00 AM	[redacted]	[redacted]	N	Y	D53	Y	D54	Y	D52	N/A									n	56, 56, 28
		[redacted]	N	Y	D56	Y	D57	Y	D55	N/A										
		[redacted]	Y	Y	D59	Y	D60	Y	D58	N/A										
		[redacted]	Y	Y	D62	Y	D63	Y	D61	N/A										
		[redacted]	N	Y	D65	Y	D66	Y	D64	N/A										
Thur-26-Feb--11 00 AM	[redacted]	[redacted]	Y	Y	D122	N	D123	N	D124	N/A									n	36, 0, 0
		[redacted]	Y	y	D125	N	D126	N	D127	N/A										
		[redacted]	Y	N	D129	Y	D130	N	D128	N/A										
		[redacted]	Y	y	D132	Y	D133	Y	D131	N/A										
		[redacted]	y	Y	D135	Y	D136	Y	D134	N/A										
Weds-25-Feb--1 30 PM	[redacted]	[redacted]	Y	Y	D108	Y	D109	Y	D107	N/A									n	4, 131, 4
		[redacted]	N	Y	D110	Y	D111	Y	D112	N/A										
		[redacted]	N	Y	D114	Y	D115	Y	D113	N/A										
		[redacted]	Y	Y	D117	Y	D118	Y	D116	N/A										
		[redacted]	Y	N	D120	N	D121	Y	D119	N/A										

Appendix F – Photos of Installed Measures:


MK – 07
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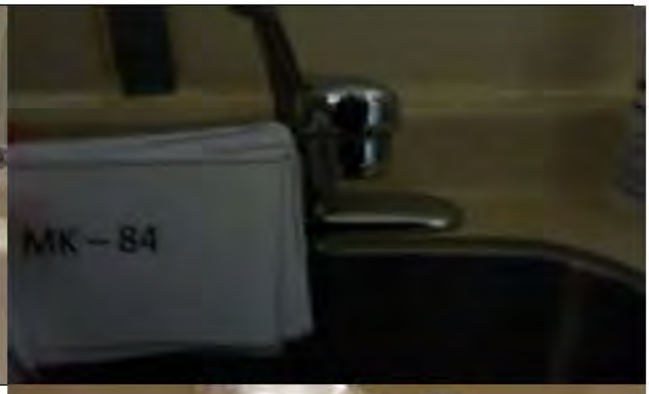
MK – 83


MK – 84


MK – 85


MK – 86


MK – 87


MK – 88


MK -89
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COOL MINT
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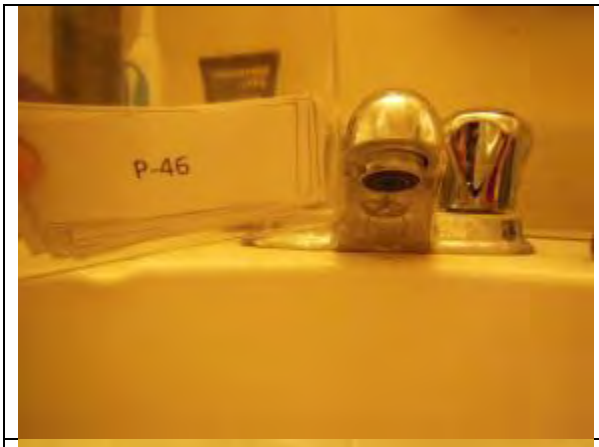
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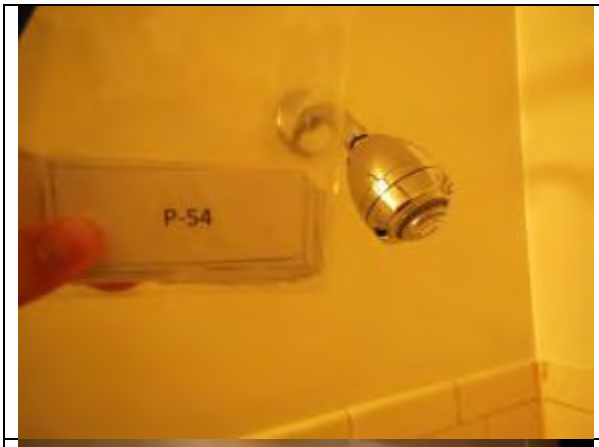
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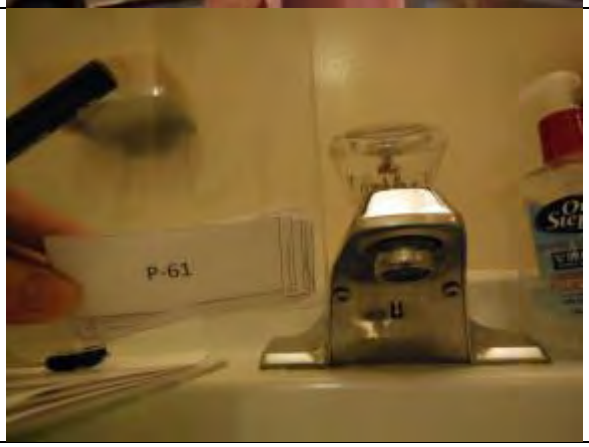
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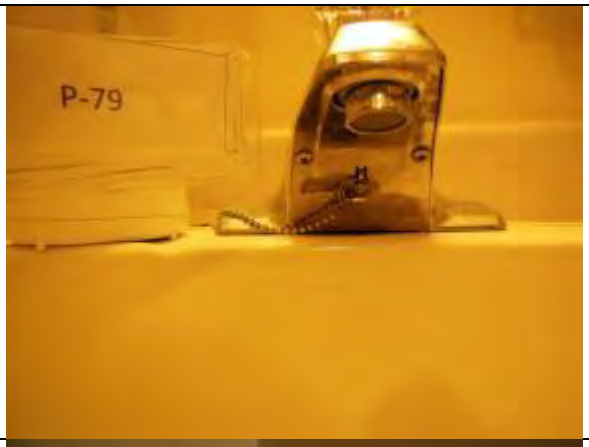
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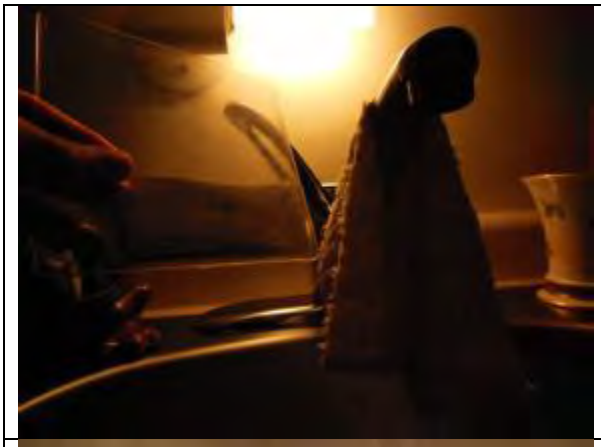


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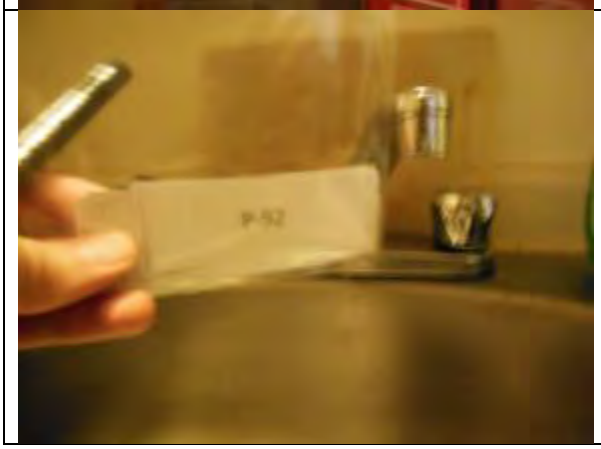
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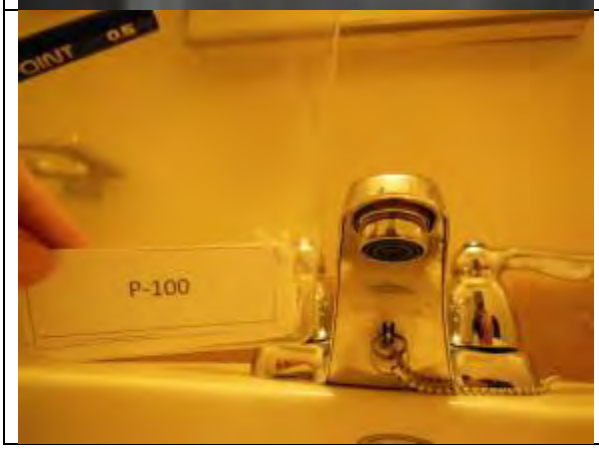
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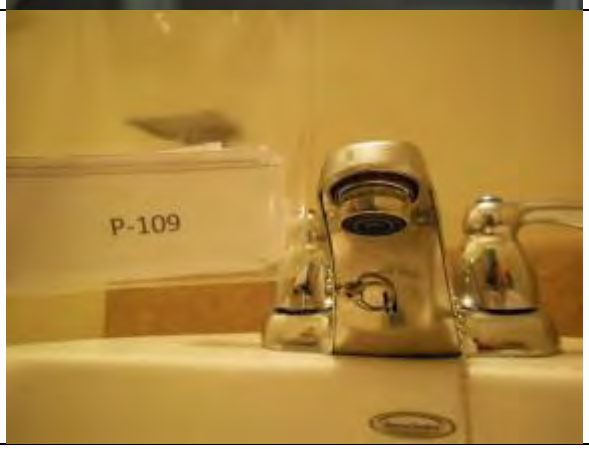
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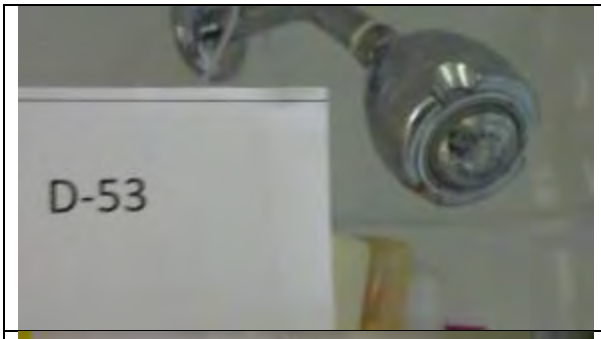
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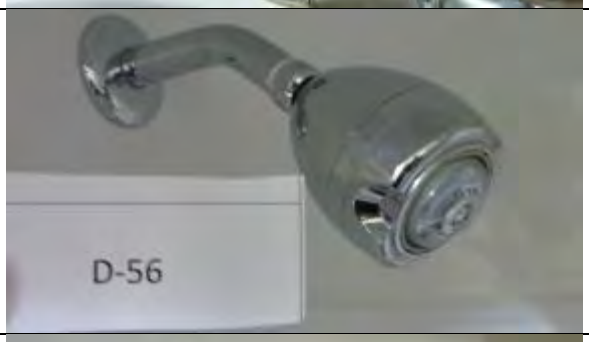
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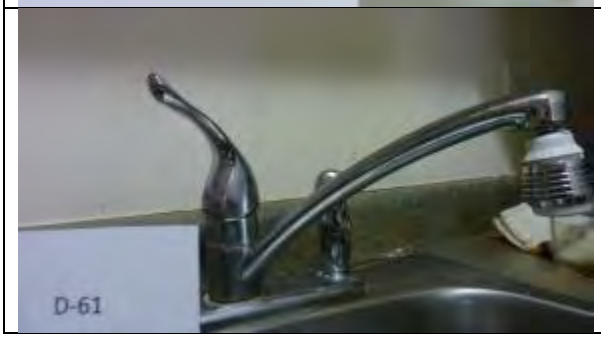
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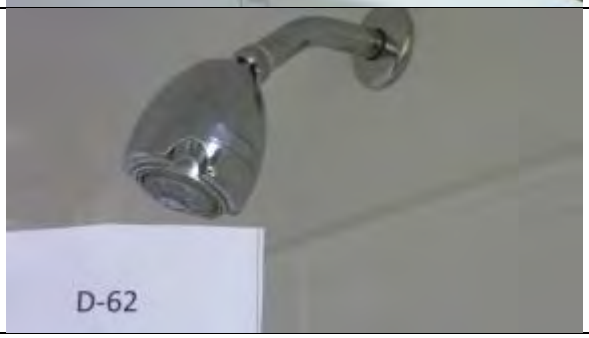
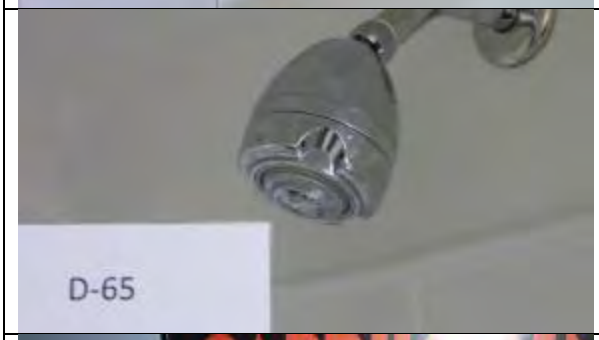

D-62


D-63


D-64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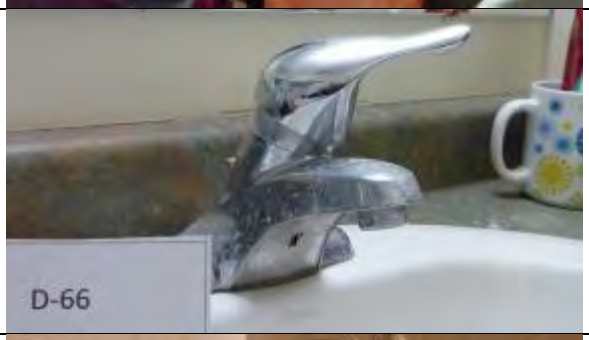
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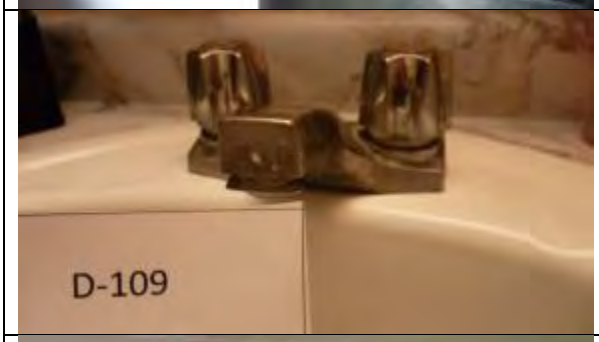
D-107


D-108


D-109

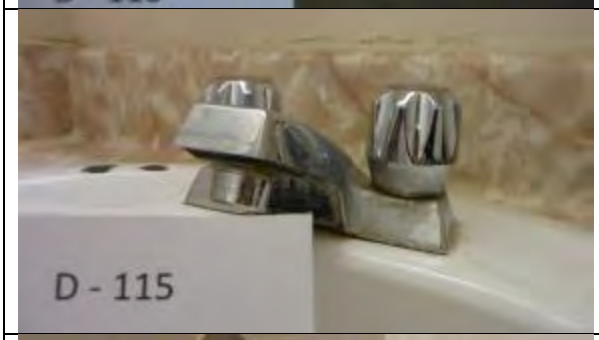

D-110


D - 111


D - 112


D - 113


D - 114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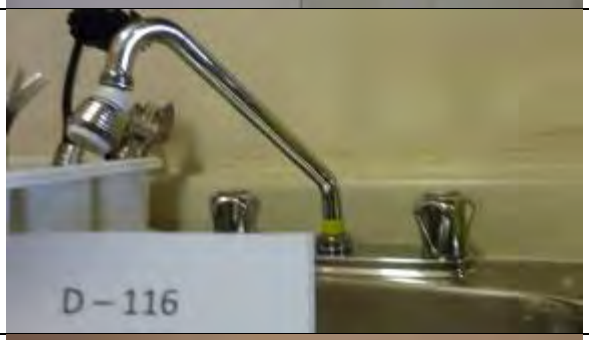
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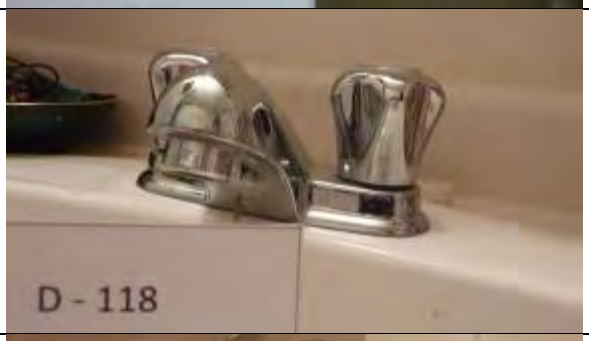
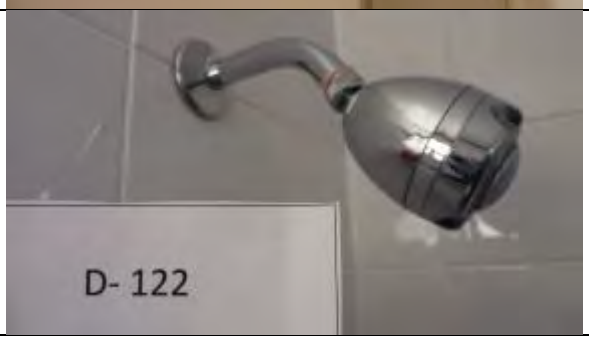
D – 117


D - 118

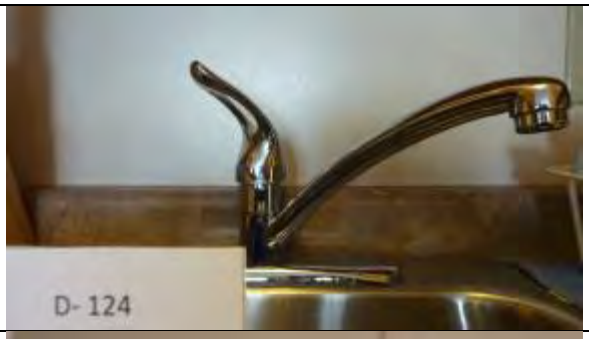

D - 119


D- 120


D- 121


D- 122


D- 123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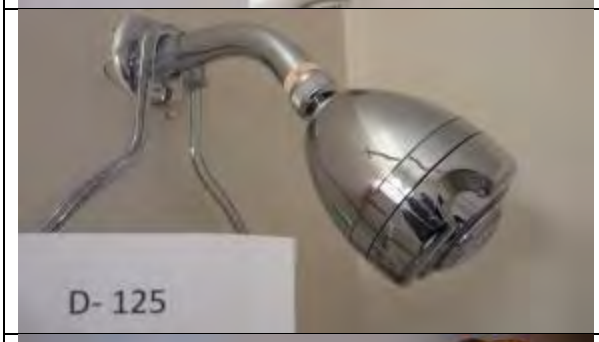
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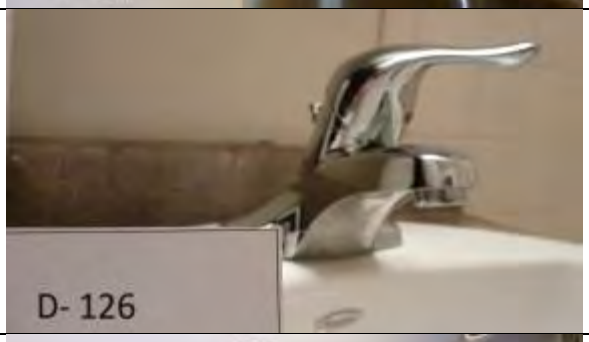
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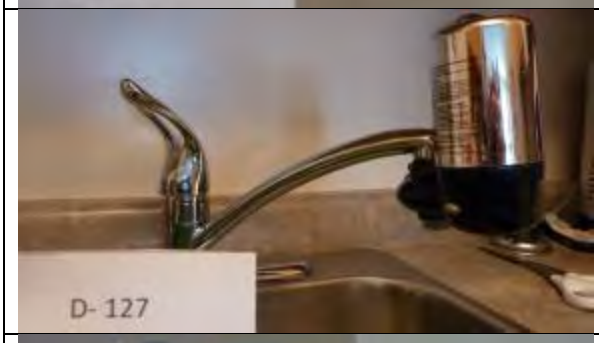
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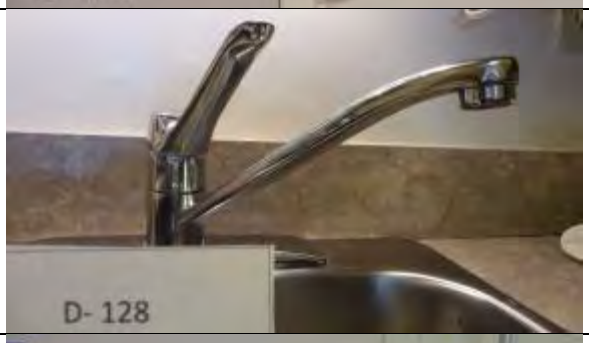
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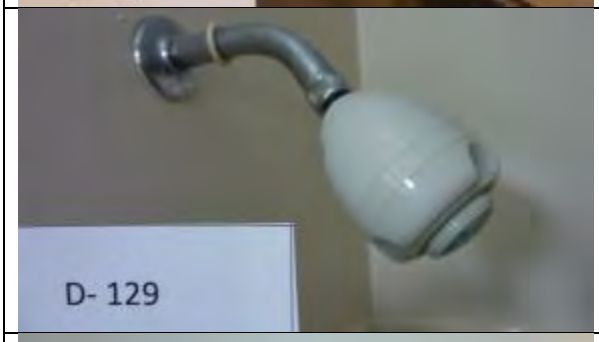
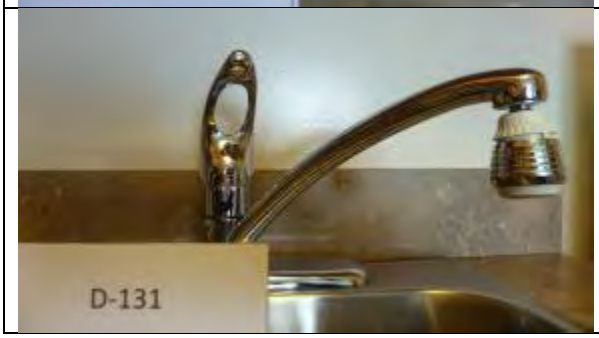

D- 129


D-130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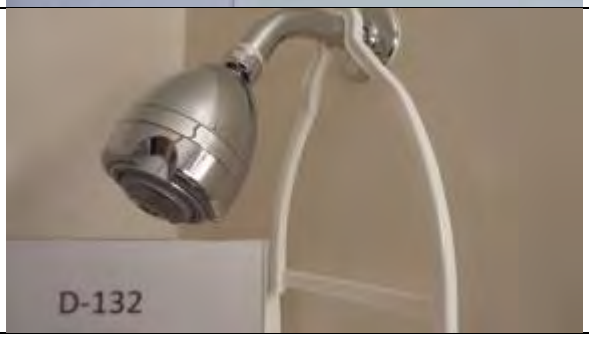
D-132


D-133
D-134
D-135
D-136

VERIFICATION RESULTS

2012 Commercial Hot Water Conservation Initiative (Multi-Family)

Final Report

SUBMITTED TO:

[redacted]

Program Evaluator, DSM Research & Evaluation

Union Gas Ltd., 777 Bay Street, Suite 2801, PO BOX 153, Toronto, Ontario, M5G 2C8

By

SeeLine Group Ltd.

416-703-8695

April 19, 2013

Table of Contents

1.0 Executive Summary

In October 2012, Union Gas Ltd. (UGL) contracted with SeeLine Group Ltd. (SLG) to provide onsite verification and documentation of results for the Commercial Hot Water Conservation (HWC) Initiative (Multi-Family).

As part of this verification, a total of 23 facilities were visited and 115 suites were verified onsite for installed showerheads, bathroom faucet aerators, and kitchen faucet aerators.

The verification effort took place in two phases. Phase 1 occurred in November 2012, and 80 suites were verified at 16 facilities. Phase 2 occurred in February 2013, and 35 suites were verified at 7 facilities.

A random sample was provided to SLG by an independent third party for each phase. SLG agents contacted each facility and arranged an inspection time & date with the facility supervisor. Each suite was randomly selected. The randomly selected suites were inspected for the installation of showerheads and faucet aerators. The data were captured on a summary sheet, which was signed by the inspector as well as the facility supervisor. Photos of the installed measures were also taken as further proof of installation. Data capture sheets and photos can be found in the accompanying appendices.

Key results included:

- There were 95 (82.6%) showerheads observed installed and 20 (17.4%) were not.
- There were 46 (40%) bathroom aerators observed installed and 69 (60%) were not.
- There were 79 (68.7%) kitchen faucet aerators observed installed and 48 (31.3%) were not.

The table below summarizes the overall findings:

Observed Measure	Installed	Not Installed	Total
Showerhead Aerators	**95** (82.6%)	**20** (17.4%)	**115**
Bathroom Sink Aerators	**46** (40%)	**69** (60%)	**115**
Kitchen Faucet Aerators	**79** (68.7%)	**36** (31.3%)	**115**

2.0 Background & Objective

The HWC Initiative (Multi-Family) is designed to reduce natural gas usage associated with hot water consumption. The HWC Initiative (Multi-Family) provides a choice of a suite of measures at no cost to participants including: 1.25gpm showerhead, 1.5gpm kitchen aerator, and a 1.0gpm bathroom aerator for applicable multi-family suites. The multi-family segment is defined as dwellings with more than 3 floors and more than 5 suites.

SLG provided onsite verification and documentation of results for the measures distributed as part of the initiative. The verification work occurred in 2 phases; phase 1 included verification of participants from Q1 to Q3 in 2012, and phase 2 included verification of participants from Q1 to Q4 in 2012.

2.1 Objective

Through onsite verification, the main goal of this study was to confirm the installation of showerheads and aerators distributed to HWC Initiative (Multi-Family) participants who received measures in 2012. At least 100 suites needed to be verified across 20 different facilities. In phase 1, to ensure a confidence interval of 90/10 was met, SLG was required to verify 65 suites, across at least 13 facilities. In phase 2, to ensure a confidence interval of 90/10 was met, SLG was required to verify 35 suites, across at least 7 facilities.

Through this effort, 115 suites were verified at 23 facilities: 80 suites were verified in phase 1 at 16 facilities, while 35 suites were verified in phase 2 at 7 facilities.

UGL also required that SLG quantify the percentage use of installed showerheads for suites that had more than one shower. When a second bathroom was encountered in a suite, a brief survey questionnaire was deployed to the participant to ascertain the percentage of showering in each unique bathroom.

3.0 Methodology

A random sample of participants was developed for both phases by an independent third party and provided to SLG. To ensure adequate geographic reach and to optimize cost effectiveness, it was determined that a maximum of 5 suites was the appropriate limit for verification at each facility.

In total, a random sample of 27 facilities was developed by an independent third party for both phases, and provided to SLG.

Phase 1

A random sample of participants for phase 1 was developed by an independent third party and provided to SLG. The random sample included 16 facilities and was intended to provide a confidence internal of 90/10.

Phase 2

In phase 2, the random sample included 11 facilities and was intended to provide a confidence internal of 90/10.

Approach to Both Phases

For both phases, prior to any customer contact performed by SLG, a letter was sent from UGL to the sample list of customers informing them that their facility could be visited for the purpose of the onsite verification study. A meeting request by telephone to verify the installed measures was then placed with the facility supervisor. A meeting time and date was arranged. Meeting times and dates were assigned to an SLG agent. The SLG agent made final arrangements with the facility supervisor.

The SLG agent arrived onsite and randomly selected up to 5 suites for verification. A random number generator was used to make the suite selections. The facility supervisor brought the agent to each randomly selected suite. The SLG agent gained access to the suites and searched for the 3 installed measures:

- 1.25gpm showerhead
- 1.5gpm kitchen faucet aerator
- 1.0gpm bathroom faucet aerator

Physical samples of the models were provided to SLG agents by UGL staff prior to the inspections. These models were brought to the field to make direct comparisons. As well, detailed photographs of the measures were provided by UGL, so that SLG agents could positively identify the measures in the field. The models provided through the HWC Initiative are unique to the Ontario market, so it was assumed that a positively identified measure was only acquired through participation in the HWC initiative. SLG agents also took detailed photographs of the installed measures in the field, so that a visual record would be available after the verification had occurred. A unique identifying tag was affixed to each installed measure for organization. See Appendix F for the photographs.

The verification details were recorded in a data-capture ‘sign-off’ sheet. This document recorded the results of the inspection, and required the facility supervisor to sign off on the inspection along with the SLG agent. See Appendix B for the template of the sign-off sheet, and Appendix D for copies of the completed sign-off sheets.

For phase 1, a total of 16 facilities were visited and 80 suites were verified. Phone calls were placed in the first 2 weeks of November to arrange meeting times. The verification visits occurred throughout the month of November. All the onsite verification meetings had been concluded by November 30th 2012.

In phase 2, a total of 7 facilities were visited and 35 suites were verified. Phone calls were placed throughout the month of February to arrange meeting times. The verification visits occurred throughout the month of February. All the onsite verification meetings had been concluded by the first week of March 2013.

4.0 Results

4.1 Showerheads

Showerhead Aerators	Results	
	#	%
Yes	95	82.6%
No	20	17.4%
Total	115	100.0%

Quantitative Findings

A total of 115 bathroom showerheads were inspected. 95 of the installed measures were positively identified as HWC Initiative showerheads, while 20 were not. Photographs of all the showerheads that were inspected have been provided in Appendix F.

Qualitative findings

After speaking with property owners, facility supervisors, and tenants it is clear that the fate of the showerheads is not altogether uniform. Three main outcomes were identified: not installed, installed, and un-installed (removed).

4.2 Bathroom Faucet Aerators

Bathroom Faucet Aerators	Results	
	#	%
Yes	46	40.0%
No	69	60.0%
Total	115	100.0%

Quantitative Findings

A total of 115 bathroom faucet aerators were inspected. 46 of the installed measures were positively identified as HWC Initiative bathroom faucet aerators, while 69 were not. Photographs of all the bathroom faucet aerators that were inspected can be found in Appendix F.

Qualitative findings

The percentage of bathroom faucet installations was lower than that of the showerhead installations, and much lower than that of the kitchen aerators. A number of possible reasons were identified in the field. One is that bathroom faucet fixtures were quite variable. Not all of the faucet fixtures were compatible with the HWC Initiative faucet aerator measure. Another reason was the reported increased 'splash-back' that could occur. This is a potential issue where relatively strong water pressure creates a strong flow into a shallow basin. Compatibility with the fixtures and perceived performance issues may help to explain the low percentage of observed installations.

4.3 Kitchen Faucet Aerators

Kitchen Aerators	Results	
	#	%
Yes	79	68.7%
No	36	31.3%
Total	115	100.0%

Quantitative Findings

A total of 115 kitchen faucet aerators were inspected. 79 of the installed measures were positively identified as HWC Initiative kitchen faucet aerators, while 36 were not. Photographs of all the kitchen faucet aerators that were inspected have been provided in Appendix F.

Qualitative Findings

The percentage of observed installations of kitchen faucet aerators was higher than that of the bathrooms. Kitchen faucets were generally more uniform and there appears to be fewer issues regarding installation and perceived performance. There were some participants who indicated that they had challenges with affixing the measure to the faucet, and some who indicated splash-back occurred (especially with smaller kitchen sinks), however not to the same degree as with bathroom faucets.

4.4 Second Bathrooms

Second Bathrooms	Results	
	#	%
Yes	7	77.8%
No	2	22.2%
Total	9	100.0%

In the field, SLG agents encountered suites with more than one shower. In total, 9 suites had a second shower out of the 115 suites that were observed. Of the 9 second showers, 7 had a HWC Initiative showerhead installed, and 2 did not.

4.5 Second Bathroom Survey

A survey was developed to ascertain the relative use of the second bathroom.[1] SLG agents deployed the survey for the 2 suites that did not have a HWC Initiative showerhead installed in the second shower. One response was collected from the tenant who was onsite during the inspection. This tenant responded: 'C' – 'Most of the Time', which corresponds to 70-99% of the time. In the other case, the tenant was not present, so a printed copy of the survey was left

[1] Appendix C provides the survey tool

onsite in the tenant's suite. An incentive was provided to call a toll free number and provide a response to the survey, however the tenant did not respond.

5.0 Conclusion

A total of 115 suites were verified at 23 facilities. The verification effort focused on observing showerhead aerators, bathroom faucet aerators, and kitchen faucet aerators installed in multi-family buildings.

The key findings of the verification effort were:

- Showerheads: 82.6% installations observed (95/115)
- Bathroom Sink Faucet Aerators: 40% installations observed (26/115)
- Kitchen Sink Faucet Aerators: 68.7% installations observed (79/115)

Furthermore, 9 second showers were discovered by the agents in the field. Only 2 of the 9 second showers did not have a HWC Initiative showerhead installed, and survey results were obtained for 1 of these suites.

Overall, it is clear that HWC Initiative (Multi-Family) participants do not just simply order the measures, install them right away, and keep them installed for the life of the model. Some participants never install the measures while others may remove them over time. The installation rate for showerheads is the highest of the 3 measures while the bathroom faucet aerators is relatively low, given its installation and operational challenges.

APPENDICES –

The following Appendices were provided in a separate document:

Appendix A – List of Buildings

Appendix B – Sample Sign-Off Sheet

Appendix C – Second Bathroom Survey

Appendix D – Sign-Off Sheets (Field Data)

Appendix E – Field Data in Excel Format

Appendix F – Photographs of Installed Measures

Appendix A – List of Buildings

Building Addresses Phase 1	
1	[redacted]
2	[redacted]
3	[redacted]
4	[redacted]
5	[redacted]
6	[redacted]
7	[redacted]
8	[redacted]
9	[redacted]
10	[redacted]
11	[redacted]
12	[redacted]
13	[redacted]
14	[redacted]
15	[redacted]
16	[redacted]

Building Addresses Phase 2	
1	[redacted]
2	[redacted]
3	[redacted]
4	[redacted]
5	[redacted]
6	[redacted]
7	[redacted]

Appendix B – Sample Sign-Off Sheet:

Union Gas Ltd. – Hot Water Conservation (HWC) Program Review

Inspection Details

Inspector Name & Phone: _____ _____
(Full Name – Print Clearly) (Phone)

Inspection Date & Time: _____ _____
(Date) (Time)

Facility Details – MULTI-FAMILY

Super / Owner Name & Phone: _____ _____
(Full Name – Print Clearly) (Phone)

Location Address: _____ _____ _____
(Street Address) (#Units) (#Floors)

ORDER DETAIL	
SH:	
KA:	
BA:	

	Suite #	Floor #	Tenant (Y/N)	Bathroom 1				Bathroom 2					Survey			
				Shower		Aerator			Shower		Aerator					
				Shower (Y/N)	Shower Picture #	Aerator (Y/N)	Aerator Picture #	Exists? (Y/N)	Shower (Y/N)	Shower Picture #	Aerator (Y/N)	Aerator Picture #	Complete? (Y/N)	Result (A,B,C,D or E)	Incentive Paid? (Y/N)	Letter? (Y/N)
1																
2																
3																
4																
5																

General Comments:

Sign-Off Area

The undersigned hereby acknowledge that on this date the above mentioned units were inspected for Hot Water Conservation measures.

X_____ X_____

(Facility Super Intendant / Owner) (Inspector)

Appendix C – Second Bathroom Survey:

uniongas
A Spectra Energy Company

enersmart
Conserve - Save - Comfort

We noticed your suite has two bathrooms.

1. **Was a new showerhead installed in each of your bathrooms?**

   Yes ☐ No ☐

   If you checked yes, that is all we need to know. Thank you!

2. **If you checked no, of all the showering that is done in your home, how much is done under the new showerhead?**

   ☐ **0% - 30%** - I hardly use the new showerhead.

   ☐ **31-69%** - I use the new showerhead about half the time.

   ☐ **70-99%** - I use the new showerhead most of the time.

   ☐ **100%** - I use the new showerhead all of the time.

Please call the number on the front of this page with your responses to receive your free $25 Tim Horton's Gift Certificate! Thank you for your time!

Appendix D – Sign-Off Sheets:

uniongas

enersmart

Union Gas Ltd. – Hot Water Conservation (HWC) Program Review

Inspection Details

Inspector Name & Phone: [redacted]

Inspection Date & Time:

(Date) (Time)

Facility Details – MULTI-FAMILY

Super / Owner Name & Phon [redacted]

Location Address:

(Street Address) (#Units) (#Floors)

SH	✓
KA	✓
BA	✓

Unit #	Floor #	Tenant (Y/N)	Kitchen Aerator		Bathroom 1 Shower		Bathroom 1 Aerator		Bathroom 2 Shower			Bathroom 2 Aerator		Survey			
			Aerator (Y/N)	Kitchen Aerator Picture #	Shower (Y/N)	Shower Picture #	Aerator (Y/N)	Aerator Picture #	Shower (Y/N)	Shower (Y/N)	Shower Picture #	Aerator (Y/N)	Aerator Picture #	Completed? (Y/N)	Result (A,B,C, D,E)	Re-contact? (Y/N)	Letter # (Y/N)
[redacted]		N	N	24	Y	25	N	28	N								
		N	Y	27	Y	28	Y	26									
		N	Y	30	Y	28	Y	29									
		Y	N	33	Y	31	N	32									
		Y	Y	36	Y	34	Y	33									

[redacted]

Sign-Off Area

The undersigned hereby acknowledge that on this date the above mentioned units were inspected for Hot Water Conservation measures.

X_ [redacted]

SeeLine Group Ltd.

union gas

enersmart

Union Gas Ltd. – Hot Water Conservation (HWC) Program Review

Inspection Details

Inspector Name & Phone : [redacted]

Inspection Date & Time:

(Date) (Time)

ORDER DETAIL

SH: 11

KA:

BA:

Facility Details – **Multi-Family** [redacted]

Contact Name & Phone: [redacted]

Location Address:

(Street Address) (#Units) (# Floors)

Suite #	Floor #	Tenant (Y/N)	Kitchen Aerator: Aerator (Y/N)	Kitchen Aerator: Kitchen Aerator Picture #	Bathroom 1 Shower (Y/N)	Bathroom 1 Shower Picture #	Bathroom 1 Aerator (Y/N)	Bathroom 1 Aerator Picture #	Bathroom 2 Shower: Exists? (Y/N)	Bathroom 2 Shower (Y/N)	Bathroom 2 Shower Picture #	Bathroom 2 Aerator (Y/N)	Bathroom 2 Aerator Picture #	Survey: Complete? (Y/N)	Survey: Result (A,B,C,D,E)	Survey: Incentive? (Y/N)	Survey: Letter (Y/N)
[redacted]		N	Y	64	Y	62	N	63	N								
		Y	Y	68	Y	66	Y	67									
		Y	Y	71	Y	69	Y	70									
		Y	Y	74	Y	72	Y	73									
		Y	Y	77	Y	75	Y	76									

[redacted]

Sign-Off Area

The undersigned hereby acknowledge that on this date the above mentioned units were inspected for Hot Water Conservation measures.

[redacted]

SeeLine Group Ltd.

union gas

enersmart

Union Gas Ltd. – Hot Water Conservation (HWC) Program Review

Inspection Details

Inspector Name & Phone: [redacted]

Inspection Date & Time:

(Date) (Time)

Facility Details – MULTI-FAMILY

Super / Owner Na [redacted]

Location Address:

(Street Address) (#Units) (#Floors)

UNIT DETAIL	
SH:	40
KA:	40
BA:	

Suite #	Floor #	Tenant (Y/N)	Kitchen Aerator: Aerator (Y/N)	Kitchen Aerator: Kitchen Aerator Picture #	Bathroom 1 Shower: Shower (Y/N)	Bathroom 1 Shower: Shower Picture #	Bathroom 1 Aerator: Aerator (Y/N)	Bathroom 1 Aerator: Aerator Picture #	Bathroom 2 Shower: Exists? (Y/N)	Bathroom 2 Shower: Shower (Y/N)	Bathroom 2 Shower: Shower Picture #	Bathroom 2 Aerator: Aerator (Y/N)	Bathroom 2 Aerator: Aerator Picture #	Survey: Complete? (Y/N)	Survey: Result (A,B,C,D,E)	Survey: Incentive? (Y/N)	Survey: Letter? (Y/N)
1 [redacted]		Y	Y	105	Y	103	N	104	N	—	—						
2		Y	Y	108	Y	106	N	107	N	—	—						
3		N	Y	111	Y	109	Y	110	N	—	—						
4		N	N	113-B	Y	112	N	113-A	N	—	—						
5		N	Y	115	Y	114	Y	115	N	—	—						
6																	

General Comments: [redacted]

Sign-Off Area [redacted]

The undersigned hereby acknowledge that on this date the above mentioned units were inspected for Hot Water Conservation measures.

[redacted]

uniongas

enersmart

Union Gas Ltd. – Hot Water Conservation (HWC) Program Review

Inspection Details

Inspector Name & Phone: [redacted]

Inspection Date & Time:

(Date) (Time)

Facility Details – MULTI-FAMILY

Super / Owner Na[redacted]

Location Address:

(Street Address) (#Units) (#Floors)

DRYER DETAIL	
SH.	8
K.A.	8
BA:	

Suite #	Floor #	Tenant (Y/N)	Kitchen Aerator: Aerator (Y/N)	Kitchen Aerator: Kitchen Aerator Picture #	Bathroom 1 Shower: Shower (Y/N)	Bathroom 1 Shower: Shower Picture #	Bathroom 1 Aerator: Aerator (Y/N)	Bathroom 1 Aerator: Aerator Picture #	Bathroom 2 Shower: Exists? (Y/N)	Bathroom 2 Shower: Shower (Y/N)	Bathroom 2 Shower: Shower Picture #	Bathroom 2 Aerator: Aerator (Y/N)	Bathroom 2 Aerator: Aerator Picture #	Survey: Complete? (Y/N)	Survey: Result (A,B,C,D,E)	Survey: Incentive? (Y/N)	Letter? (Y/N)
[redacted]		Y	Y	118	Y	116	N	117	N								
		Y	Y	121	Y	119	N	120									
		Y	Y	124	Y	122	N	123									
		Y	Y	128	Y	126	N	127									
		Y	Y	131	Y	129	N	130									

General Comments: [redacted]

Sign-Off Area

The undersigned hereby acknowledge that on this date the above mentioned units were inspected for Hot Water Conservation measures.

[redacted]

SeeLine Group Ltd.

uniongas

enersmart

Union Gas Ltd. – Hot Water Conservation (HWC) Program Review

Inspection Details

Inspector Name & Phone: [redacted]

Inspection Date & Time:

(Date) (Time)

Facility Details – MULTI-FAMILY

Super / Owner Na[redacted]

Location Address:

(Street Address) (#Units) (#Floors)

SH:	NA
KA:	NA
BA:	NA

Suite #	Floor #	Tenant (Y/N)	Kitchen Aerator: Aerator (Y/N)	Kitchen Aerator: Kitchen Aerator Picture #	Bathroom 1 Shower: Shower (Y/N)	Bathroom 1 Shower: Shower Picture #	Bathroom 1 Aerator: Aerator (Y/N)	Bathroom 1 Aerator: Aerator Picture #	Bathroom 2 Shower: Exists? (Y/N)	Bathroom 2 Shower: Shower (Y/N)	Bathroom 2 Shower: Shower Picture #	Bathroom 2 Aerator: Aerator (Y/N)	Bathroom 2 Aerator: Aerator Picture #	Survey: Complete? (Y/N)	Survey: Result (A,B,C,D,E)	Survey: Incentive? (Y/N)	Survey: Letter? (Y/N)
[redacted]		Y	Y	90	~~Y~~ N	88	N	89	N								
		Y	N	93	N	91	N	92									
		N	N	96	Y	94	N	95									
		Y	Y	99	Y	97	~~Y~~ N	98									
		N	~~N~~ Y	102	N	100	Y	101									

General Comments: – [redacted]

Sign-Off Area

The undersigned hereby acknowledge that on this date the above mentioned units were inspected for Hot Water Conservation measures.

[redacted]

SeeLine Group Ltd.

uniongas

enersmart

Union Gas Ltd. – Hot Water Conservation (HWC) Program Review

Inspection Details

Inspector Name & Phone: [redacted]

Inspection Date & Time: [redacted]

(Date) (Time)

Facility Details – MULTI-FAMILY [redacted]

Super / Owner Name & Phone:

(Full Name – Print Clearly) (Phone)

Location Address: [redacted]

(Street Address) (#Units) (#Floors)

ORDER DETAIL

SH: 28

KA:

BA:

FA: 14

Suite #	Floor #	Tenant (Y/N)	Kitchen Aerator: Aerator (Y/N)	Kitchen Aerator: Kitchen Aerator Picture #	Bathroom 1 Shower: Shower (Y/N)	Bathroom 1 Shower: Shower Picture #	Bathroom 1 Aerator: Aerator (Y/N)	Bathroom 1 Aerator: Aerator Picture #	Bathroom 2 Shower: Exists? (Y/N)	Bathroom 2 Shower: Shower (Y/N)	Bathroom 2 Shower: Shower Picture #	Bathroom 2 Aerator: Aerator (Y/N)	Bathroom 2 Aerator: Aerator Picture #	Survey: Complete? (Y/N)	Survey: Result (A,B,C,D,E)	Survey: Incentive? (Y/N)	Survey: Letter? (Y/N)
[redacted]		Y	N	148	N	146	N	147	N								
		Y	Y	149	N	148	N	150									
		Y	N	154	N	152	N	153									
		Y	N	157	N	155	N	156									
		Y	Y	160	Y	158	N	159									

[redacted]

Sign-Off Area

The undersigned hereby acknowledge that on this date the above mentioned units were inspected for Hot Water Conservation measures.

X [redacted]

SeeLine Group Ltd.

uniongas
A Spectra Energy Company

enersmart
Conserve · Save · Comfort

Union Gas Ltd. – Hot Water Conservation (HWC) Program Review

Inspection Details

Inspector Name & Phone: [redacted]

Inspection Date & Time:

(Date) (Time)

FA: 27L

Facility Details – MULTI-FAMILY

Super / Owner Name & Phon [redacted]

Location Address:

(Street Address) (#Units) (#Floors)

ORDER DETAIL

SH: 136

KA:

BA:

	Suite #	Floor #	Tenant (Y/N)	Kitchen Aerator: Aerator (Y/N)	Kitchen Aerator: Kitchen Aerator Picture #	Bathroom 1 Shower: Shower (Y/N)	Bathroom 1 Shower: Shower Picture #	Bathroom 1 Aerator: Aerator (Y/N)	Bathroom 1 Aerator: Aerator Picture #	Bathroom 2 Shower: Exists? (Y/N)	Bathroom 2 Shower: Shower (Y/N)	Bathroom 2 Shower: Shower Picture #	Bathroom 2 Aerator: Aerator (Y/N)	Bathroom 2 Aerator: Aerator Picture #	Survey: Complete? (Y/N)	Survey: Result (A,B,C,D,E)	Survey: Incentive? (Y/N)	Survey: Letter? (Y/N)
1	[redacted]		N	Y	189	Y	187	N	188	N								
2			N	N	192	Y	190	N	191	N								
3			Y	Y	195	Y	193	N	194									
4			N	N	198	Y	196	N	197									
5			N	N	201	N	199	N	200	N								
6																		

[redacted]

Sign-Off Area

The undersigned hereby acknowledge that on this date the above mentioned units were inspected for Hot Water Conservation measures.

X [redacted]

SeeLine Group Ltd.

uniongas
A Spectra Energy Company

enersmart

Union Gas Ltd. – Hot Water Conservation (HWC) Program Review

Inspection Details

Inspector Name & Phone: [redacted]

Inspection Date & Time:

(Date) (Time)

Facility Details – MULTI-FAMILY

Super / Owner Name & Phon [redacted]

Location Address:

(Street Address) (#Units) (#Floors)

DISTRIBUTION
SH: 136
KA:
BA:

Suite #	Floor #	Tenant (Y/N)	Kitchen Aerator: Aerator (Y/N)	Kitchen Aerator: Kitchen Aerator Picture #	Bathroom 1 Shower: Shower (Y/N)	Bathroom 1 Shower: Shower Picture #	Bathroom 1 Aerator: Aerator (Y/N)	Bathroom 1 Aerator: Aerator Picture #	Bathroom 2 Shower: Exists? (Y/N)	Bathroom 2 Shower: Shower (Y/N)	Bathroom 2 Shower: Shower Picture #	Bathroom 2 Aerator: Aerator (Y/N)	Bathroom 2 Aerator: Aerator Picture #	Survey: Complete? (Y/N)	Survey: Result (A,B,C,D,E)	Survey: Incentive? (Y/N)	Survey: Letter? (Y/N)
1 [redacted]		N	Y	177	Y	171	N	172	N								
2		Y	Y	177	Y	175	N	176	N								
3		N	Y	180	N	178	N	179	N								
4		N	Y	183	Y	181	N	182	N								
5		N	Y	186	Y	184	N	185	N								
6																	

[redacted]

Sign-Off Area

The undersigned hereby acknowledge that on this date the above mentioned units were inspected for Hot Water Conservation measures.

X_ [redacted]

SeeLine Group Ltd.

uniongas
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Union Gas Ltd. – Hot Water Conservation (HWC) Program Review

Inspection Details

Inspector Name & Phone: [redacted]

Inspection Date & Time:

(Date) (Time)

Facility Details – MULTI-FAMILY

Super / Owner Name & Ph[redacted]

Location Address:

(Street Address) (#Units) (#Floors)

ORDER DETAIL

SH:

KA:

BA:

Suite #	Floor #	Tenant (Y/N)	Kitchen Aerator		Bathroom 1 Shower		Bathroom 1 Aerator		Bathroom 2 Shower			Bathroom 2 Aerator		Survey			
			Aerator (Y/N)	Kitchen Aerator Picture #	Shower (Y/N)	Shower Picture #	Aerator (Y/N)	Aerator Picture #	Exists? (Y/N)	Shower (Y/N)	Shower Picture #	Aerator (Y/N)	Aerator Picture #	Com-plete? (Y/N)	Result (A,B,C, D,E)	In centive? (Y/N)	Letter? (Y/N)
1 [redacted]		Y	Y	257	Y	255	Y	256	N								
2		Y	Y	260	N	258	Y	259	N								
3		Y	Y	[illegible]	Y	261	Y	262	Y	[illegible]	263	Y	264				
4		N	Y	268	N	266	Y	267	N								
5		Y	Y	270	Y	269	Y	269B	N								
6																	

General Comments: [redacted]

Sign-Off Area

The undersigned hereby acknowledge that on this date the above mentioned units were inspected for Hot Water Conservation measures

X [redacted]

SeeLine Group Ltd.

uniongas

A Spectra Energy Company

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Union Gas Ltd. – Hot Water Conservation (HWC) Program Review

Inspection Details

Inspector Name & Phone: [redacted]

Inspection Date & Time:

(Date) (Time)

Facility Details – MULTI-FAMILY

Super / Owner Name & Pho[redacted]

Location Address:

(Street Address) (#Units) (#Floors)

ORDER DETAIL

SH: ~200

KA: 150

BA: ~206

Suite #	Floor #	Tenant (Y/N)	Kitchen Aerator: Aerator (Y/N)	Kitchen Aerator: Kitchen Aerator Picture #	Bathroom 1 Shower: Shower (Y/N)	Bathroom 1 Shower: Shower Picture #	Bathroom 1 Aerator: Aerator (Y/N)	Bathroom 1 Aerator: Aerator Picture #	Bathroom 2 Shower: Exists? (Y/N)	Bathroom 2 Shower: Shower (Y/N)	Bathroom 2 Shower: Shower Picture #	Bathroom 2 Aerator: Aerator (Y/N)	Bathroom 2 Aerator: Aerator Picture #	Survey: Complete? (Y/N)	Survey: Result (A,B,C,D,E)	Survey: Incentive? (Y/N)	Survey: Letter? (Y/N)
[redacted]		~	Y	240	Y	236	Y	237	Y	Y	238	~	239				
		~	Y	243	Y	241	Y	242	~	—							
		~	Y	246	N	244	Y	245	~	—							
		N	Y	~~249~~ 251	Y	247	Y	248	Y	Y	249	Y	250				
		Y	Y	254	N	252	Y	253	~	—							

[redacted]

Sign-Off Area

The undersigned hereby acknowledge that on this date the above mentioned units were inspected for Hot Water Conservation measures.

[redacted]

uniongas
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Union Gas Ltd. – Hot Water Conservation (HWC) Program Review

Inspection Details

Inspector Name & Phone: [redacted]

Inspection Date & Time: [redacted]

(Date) (Time)

Facility Details – MULTI-FAMILY

Super / Owner Name & Pho [redacted]

Location Address:

(Street Address) (#Units) (#Floors)

ORDER DETAIL
SH: MA
KA:
BA:

	Suite #	Floor #	Tenant (Y/N)	Kitchen Aerator: Aerator (Y/N)	Kitchen Aerator: Kitchen Aerator Picture #	Bathroom 1 Shower: Shower (Y/N)	Bathroom 1 Shower: Shower Picture #	Bathroom 1 Aerator: Aerator (Y/N)	Bathroom 1 Aerator: Aerator Picture #	Bathroom 2 Shower: Exists? (Y/N)	Bathroom 2 Shower: Shower (Y/N)	Bathroom 2 Shower: Shower Picture #	Bathroom 2 Aerator: Aerator (Y/N)	Bathroom 2 Aerator: Aerator Picture #	Survey: Complete? (Y/N)	Survey: Result (A,B,C,D,E)	Survey: Incentive? (Y/N)	Survey: Letter? (Y/N)
1	[redacted]		N	N	222	Y	220	N	221	N								
2			N	N	225	Y	223	N	224	N								
3			N	N	228	Y	226	Y	227	N								
4			Y	Y	231	N	229	N	230	N								
5			Y	N	235	N	232	N	233	Y	N	233B	N	234	Y	C	N	N
6																		

[redacted]

Sign-Off Area

The undersigned hereby acknowledge that on this date the above mentioned units were inspected for Hot Water Conservation measures.

X [redacted]

SeeLine Group Ltd.

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Union Gas Ltd. – Hot Water Conservation (HWC) Program Review

Inspection Details

Inspector Name & Phone: [redacted]

Inspection Date & Time:

(Date) (Time)

Facility Details – MULTI-FAMILY

Super / Owner Name & Phone: [redacted]

Location Address:

ORDER DETAIL

SH:

KA:

BA:

Suite #	Floor #	Tenant (Y/N)	Kitchen Aerator: Aerator (Y/N)	Kitchen Aerator: Kitchen Aerator Picture #	Bathroom 1 Shower: Shower (Y/N)	Bathroom 1 Shower: Shower Picture #	Bathroom 1 Aerator: Aerator (Y/N)	Bathroom 1 Aerator: Aerator Picture #	Bathroom 2 Shower: Exists? (Y/N)	Bathroom 2 Shower: Shower (Y/N)	Bathroom 2 Shower: Shower Picture #	Bathroom 2 Aerator: Aerator (Y/N)	Bathroom 2 Aerator: Aerator Picture #	Survey: Complete? (Y/N)	Survey: Result (A,B,C,D,E)	Survey: Incentive? (Y/N)	Survey: Letter? (Y/N)
[redacted]		N	Y	203	Y	201	Y	202	N								
		N	N	208	Y	204	Y	205	Y	Y	206	Y	207				
		N	N	213	Y	209	Y	210	Y	Y	211	Y	212				
		N	Y	216	N	214	Y	215	N								
		N	Y	219	N	217	Y	218	N								

General Comments: [redacted]

Sign-Off Area

The undersigned hereby acknowledge that on this date the above mentioned units were inspected for Hot Water Conservation measures.

X_ [redacted]

SeeLine Group Ltd.

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Union Gas Ltd. – Hot Water Conservation (HWC) Program Review

Inspection Details

Inspector Name & Phone: [redacted]

Inspection Date & Time: [redacted]

(Date) (Time)

Facility Details – MULTI-FAMILY

Super / Owner Nam [redacted]

Location Address: [redacted]

(Street Address) (#Units) (#Floors)

ORDER DETAIL

SH: 127

KA: KA+BA = 254

BA: ~~254~~ 254

Suite #	Floor #	Tenant (Y/N)	Kitchen Aerator: Aerator (Y/N)	Kitchen Aerator: Kitchen Aerator Picture #	Bathroom 1 Shower: Shower (Y/N)	Bathroom 1 Shower: Shower Picture #	Bathroom 1 Aerator: Aerator (Y/N)	Bathroom 1 Aerator: Aerator Picture #	Bathroom 2 Shower: Exists? (Y/N)	Bathroom 2 Shower: Shower (Y/N)	Bathroom 2 Shower: Shower Picture #	Bathroom 2 Aerator: Aerator (Y/N)	Bathroom 2 Aerator: Aerator Picture #	Survey: Complete? (Y/N)	Survey: Result (A,B,C,D,E)	Survey: Incentive? (Y/N)	Survey: Letter? (Y/N)
1 [redacted]		N	Y	P-81	Y	P-82	Y	P-83									
2		Y	Y	P-84	Y	P-85	N	P-86	—	—	—	N	P-87				
3		N	Y	P-88	Y	P-89	Y	P-90									
4		N	Y	P-91	Y	P-92	Y	P-93									
5		N	Y	P-94	Y	P-95	Y	P-96									
6																	

[redacted]

Sign-Off Area

The undersigned hereby acknowledge that on this date the above mentioned units were inspected for Hot Water Conservation measures.

X [redacted]

(Facility Super Intendant / Owner) (Inspector)

SeeLine Group Ltd.

union gas
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Union Gas Ltd. – Hot Water Conservation (HWC) Program Review

Inspection Details

Inspector Name & Phone: [redacted]

Inspection Date & Time: [redacted]

(Date) (Time)

Facility Details – MULTI-FAMILY

Super / Owner Name & [redacted]

Location Address: [redacted]

(Street Address) (#Units) (#Floors)

ORDER DETAIL

SH: 62

KA: Kat Ba=124

BA: 124

	Suite #	Floor #	Tenant (Y/N)	Kitchen Aerator: Aerator (Y/N)	Kitchen Aerator: Kitchen Aerator Picture #	Bathroom 1 Shower: Shower (Y/N)	Bathroom 1 Shower: Shower Picture #	Bathroom 1 Aerator: Aerator (Y/N)	Bathroom 1 Aerator: Aerator Picture #	Bathroom 2 Shower: Exists? (Y/N)	Bathroom 2 Shower: Shower (Y/N)	Bathroom 2 Shower: Shower Picture #	Bathroom 2 Aerator: Aerator (Y/N)	Bathroom 2 Aerator: Aerator Picture #	Survey: Complete? (Y/N)	Survey: Result (A,B,C,D,E)	Survey: Incentive? (Y/N)	Survey: Letter? (Y/N)
1	[redacted]		N	Y	P-97	Y	P-98	Y	P-99									
2			Y	Y	P-100	Y	P-101	N	P-102									
3			N	N	P-103	N	P-104	N	P-105									
4			Y	Y	P-106	Y	P-107	Y	P-108									
5			N	Y	P-109	Y	P110	Y	P111									
6																		

[redacted]

Sign-Off Area

The undersigned hereby acknowledge that on this date the above mentioned units were inspected for Hot Water Conservation measures.

X [redacted]

(Facility Super Intendant / Owner) (Inspector)

SeeLine Group Ltd.

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Union Gas Ltd. – Hot Water Conservation (HWC) Program Review

Inspection Details

Inspector Name & Phone: [redacted]

Inspection Date & Time: [redacted]

(Date) (Time)

Facility Details – MULTI-FAMILY

Super / Owner Name [redacted]

Location Address: [redacted]

(Street Address) (#Units) (#Floors)

ORDER DETAIL

SH: 5

KA: ~~44~~ BA=10

BA: 10

Suite #	Floor #	Tenant (Y/N)	Kitchen		Bathroom 1				Bathroom 2					Survey			
			Aerator		Shower		Aerator		Shower			Aerator					
			Aerator (Y/N)	Kitchen Aerator Picture #	Shower (Y/N)	Shower Picture #	Aerator (Y/N)	Aerator Picture #	Exists? (Y/N)	Shower (Y/N)	Shower Picture #	Aerator (Y/N)	Aerator Picture #	Complete? (Y/N)	Result (A,B,C,D,E)	Incentive? (Y/N)	Letter? (Y/N)
1 [redacted]		Y	Y	P-112	Y	P-113	Y	P-114									
2		N	Y	P-115	Y	P-116	Y	P-117									
3		N	Y	P-118	Y	P-119	Y	P-120									
4		N	Y	P-121	Y	P-122	Y	P-123									
5 [redacted]		Y	Y	P-124	Y	P-125	Y	P-126									
6																	

[redacted]

Sign-Off Area

The undersigned hereby acknowledge that on this date the above mentioned units were inspected for Hot Water Conservation measures

X [redacted]

(Facility Superintendant / Owner) (Inspector)

SeeLine Group Ltd.

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Union Gas Ltd. – Hot Water Conservation (HWC) Program Review

Inspection Details

Inspector Name & Phone: [redacted]

Inspection Date & Time: [redacted]

(Date) (Time)

Facility Details – MULTI-FAMILY

Super / Owner Nam [redacted]

Location Address: [redacted]

(Street Address) (#Units) (#Floors)

ORDER DETAIL

SH: 38

KA: ✓

BA: ✓

	Suite #	Floor #	Tenant (Y/N)	Kitchen Aerator		Bathroom 1 Shower		Bathroom 1 Aerator		Bathroom 2 Shower			Bathroom 2 Aerator		Survey			
				Aerator (Y/N)	Kitchen Aerator Picture #	Shower (Y/N)	Shower Picture #	Aerator (Y/N)	Aerator Picture #	Exists? (Y/N)	Shower (Y/N)	Shower Picture #	Aerator (Y/N)	Aerator Picture #	Com-plete? (Y/N)	Result (A,B,C,D,E)	In-centive? (Y/N)	Letter? (Y/N)
1	[redacted]		Y	N	P-129	Y	P-127	N	P-128									
2			Y	N	P-132	Y	P-130	N	P-131									
3			Y	N	P-135	Y	P-133	N	P-134									
4			N	N	P-138	Y	P-136	N	P-137									
5	[redacted]		N	N	P-141	Y	P-139	N	P-140									
6																		

[redacted]

Sign-Off Area

The undersigned hereby acknowledge that on this date the above mentioned units were inspected for Hot Water Conservation measures.

X [redacted]

(Facility Super Intendant / Owner) (Inspector)

union gas

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Union Gas Ltd. – Hot Water Conservation (HWC) Program Review

Inspection Details

Inspector Name & Phone: [redacted]

Inspection Date & Time: [redacted]

(Date) (Time)

Facility Details – MULTI-FAMILY

Super / Owner Name & Phone [redacted]

Location Address: [redacted]

(Street Address) (#Units) (#Floors)

ORDER DETAIL	
SH:	170
KA:	128
BA:	213

	Suite #	Floor #	Tenant (Y/N)	Kitchen		Bathroom 1				Bathroom 2					Survey			
				Aerator		Shower		Aerator		Shower			Aerator					
				Aerator (Y/N)	Kitchen Aerator Picture #	Shower (Y/N)	Shower Picture #	Aerator (Y/N)	Aerator Picture #	Exists? (Y/N)	Shower (Y/N)	Shower Picture #	Aerator (Y/N)	Aerator Picture #	Com-plete? (Y/N)	Result (A,B,C, D,E)	In-centive? (Y/N)	Letter? (Y/N)
1	[redacted]		N	N	150	Y	148	N	149	N								
2			N	Y	155	Y	151	N	152	Y	Y	153	N	154				
3			N	Y	158	Y	156	N	157	N								
4			N	Y	161	Y	159	Y	160	N								
5			N	Y	164	Y	162	N	163	N								
6																		

[redacted]

Sign-Off Area

The undersigned hereby acknowledge that on this date the above mentioned units were inspected for Hot Water Conservation measures.

[redacted]

uniongas

enersmart

Union Gas Ltd. – Hot Water Conservation (HWC) Program Review

Inspection Details

Inspector Name & Phone: [redacted]

Inspection Date & Time:

(Date) (Time)

Facility Details – MULTI-FAMI[redacted]

Super / Owner Name & Phone: [redacted]

Location Address:

(Street Address) (#Units) (#Floors)

ORDER DETAIL	
SH:	328
KA:	282
BA:	430

	Suite #	Floor #	Tenant (Y/N)	Kitchen Aerator: Aerator (Y/N)	Kitchen Aerator: Kitchen Aerator Picture #	Bathroom 1 Shower: Shower (Y/N)	Bathroom 1 Shower: Shower Picture #	Bathroom 1 Aerator: Aerator (Y/N)	Bathroom 1 Aerator: Aerator Picture #	Bathroom 2 Shower: Exists? (Y/N)	Bathroom 2 Shower: Shower (Y/N)	Bathroom 2 Shower: Shower Picture #	Bathroom 2 Aerator: Aerator (Y/N)	Bathroom 2 Aerator: Aerator Picture #	Survey: Complete? (Y/N)	Survey: Result (A,B,C,D,E)	Survey: Incentive? (Y/N)	Survey: Letter? (Y/N)
1	[redacted]		N	N	167	Y	165	N	166	N	—							
2			N	N	170	Y	168	N	169	N	—							
3			N	Y	175	Y	171	Y	172	Y	Y	173	Y	174	N	—	—	
4			N	Y	178	Y	176	N	177	N	—							
5			Y	N	181	N	179	Y	180	N	—							
6																		

[redacted]

Sign-Off Area

The undersigned hereby acknowledge that on this date the above mentioned units were inspected for Hot Water Conservation measures.

[redacted]

uniongas

enersmart

Union Gas Ltd. – Hot Water Conservation (HWC) Program Review

Inspection Details

Inspector Name & Phone: [redacted]

Inspection Date & Time:

(Date) (Time)

Facility Details – MULTI-FAMIL [redacted]

Super / Owner Name & Phone:

Location Address:

(Street Address) (#Units) (#Floors)

ORDER DETAIL	
SH:	203
IUA:	0
BA:	0

	Suite #	Floor #	Tenant (Y/N)	Kitchen Aerator: Aerator (Y/N)	Kitchen Aerator: Kitchen Aerator Picture #	Bathroom 1 Shower: Shower (Y/N)	Bathroom 1 Shower: Shower Picture #	Bathroom 1 Aerator: Aerator (Y/N)	Bathroom 1 Aerator: Aerator Picture #	Bathroom 2 Shower: Exists? (Y/N)	Bathroom 2 Shower: Shower (Y/N)	Bathroom 2 Shower: Shower Picture #	Bathroom 2 Aerator: Aerator (Y/N)	Bathroom 2 Aerator: Aerator Picture #	Survey: Com-plete? (Y/N)	Survey: Result (A,B,C, D,E)	Survey: In-centive? (Y/N)	Survey: Letter? (Y/N)
1	[redacted]		N	N	221	Y	2198	N	220	N								
2			N	N	233	Y	222	N	223									
3			N	N	226	Y	224	N	225									
4			N	N	229	Y	227	N	228									
5			N	N	232	Y	230	N	231									
6																		

[redacted]

Sign-Off Area

The undersigned hereby acknowledge that on this date the above mentioned units were inspected for Hot Water Conservation measures.

[redacted]

SeeLine Group Ltd.

uniongas

enersmart

Union Gas Ltd. – Hot Water Conservation (HWC) Program Review

Inspection Details

Inspector Name & Phone: [redacted]

Inspection Date & Time: [redacted]

(Date) (Time)

Facility Details – MULTI-FAMILY

Super / Owner Name & Phon[redacted]

Location Address: [redacted]

(Street Address) (#Units) (#Floors)

ORDER DETAIL	
SH:	71
KA:	71
BA:	71

Suite #	Floor #	Tenant (Y/N)	Kitchen Aerator		Bathroom 1 Shower		Bathroom 1 Aerator		Bathroom 2 Shower			Bathroom 2 Aerator		Survey			
			Aerator (Y/N)	Kitchen Aerator Picture #	Shower (Y/N)	Shower Picture #	Aerator (Y/N)	Aerator Picture #	Exists? (Y/N)	Shower (Y/N)	Shower Picture #	Aerator (Y/N)	Aerator Picture #	Com-plete? (Y/N)	Result (A,B,C, D,E)	In-centive? (Y/N)	Letter? (Y/N)
[redacted]		N	Y	244	Y	247	Y	243	N								
		N	Y	247	Y	245	Y	246									
		N	Y	250	Y	248	Y	249									
		Y	Y	253	Y	251	Y	252									
		N	Y	256	Y	254	Y	255									

[redacted]

Sign-Off Area - [redacted]

The undersigned hereby acknowledge that on this date the above mentioned units were inspected for Hot Water Conservation measures.

[redacted]

uniongas

enersmart

Union Gas Ltd. – Hot Water Conservation (HWC) Program Review

Inspection Details

Inspector Name & Phone: [redacted]

Inspection Date & Time: (Date) (Time)

Facility Details – MULTI-FAMI [redacted]

Super / Owner Name & Phone

Location Address: (Street Address) (#Units) (#Floors)

OWNER DETAIL	
SHI	51 ✓
KA:	50 ✓
BAC	53 ✓

Suite #	Floor #	Tenant (Y/N)	Kitchen Aerator		Bathroom 1 Shower		Bathroom 1 Aerator		Bathroom 2 Shower			Bathroom 2 Aerator		Survey			
			Aerator (Y/N)	Kitchen Aerator Picture #	Shower (Y/N)	Shower Picture #	Aerator (Y/N)	Aerator Picture #	Exists? (Y/N)	Shower (Y/N)	Shower Picture #	Aerator (Y/N)	Aerator Picture #	Com-plete? (Y/N)	Result (A,B,C, D,E)	In-centive? (Y/N)	Letter? (Y/N)
[redacted]		N	Y	332	Y	330	N	331	N								
		Y	Y	335	Y	333	N	334	N								
		N	Y	338	Y	336	N	337	N								
		Y	Y	341	Y	339	N	340	N								
		Y	Y	344	Y	342	N	343	N								

[redacted]

Sign-Off Area

The undersigned hereby acknowledge that on this date the above mentioned units were inspected for Hot Water Conservation measures.

[redacted]

uniongas

enersmart

Union Gas Ltd. – Hot Water Conservation (HWC) Program Review

Inspection Details

Inspector Name & Phone: [redacted]

Inspection Date & Time: [redacted]

(Date) (Time)

Facility Details – MULTI-FAMI [redacted]

Super / Owner Name & Phone

Location Address:

(Street Address) (#Units) (#Floors)

CONFIDENTIAL

SH:	100
KA:	29
BA:	140

Suite #	Floor #	Tenant (Y/N)	Kitchen Aerator Aerator (Y/N)	Kitchen Aerator Kitchen Aerator Picture #	Bathroom 1 Shower Shower (Y/N)	Bathroom 1 Shower Shower Picture #	Bathroom 1 Aerator Aerator (Y/N)	Bathroom 1 Aerator Aerator Picture #	Bathroom 2 Shower Exists? (Y/N)	Bathroom 2 Shower Shower (Y/N)	Bathroom 2 Shower Shower Picture #	Bathroom 2 Aerator Aerator (Y/N)	Bathroom 2 Aerator Aerator Picture #	Survey Complete? (Y/N)	Survey Result (A,B,C,D,E)	Survey Incentive? (Y/N)	Survey Letter? (Y/N)
[redacted]																	
1		Y	Y	347	Y	345	N	346	N								
2		N	N	350	N	348	N	349	N								
3		Y	N	353	Y	351	N	352	N								
4		N	Y	356	Y	354	N	355	N								
5		N	Y	359	Y	357	N	358	N								
6																	

[redacted]

Sign-Off Area

The undersigned hereby acknowledge that on this date the above mentioned units were inspected for Hot Water Conservation measures.

[redacted]

SeeLine Group Ltd.

uniongas

enersmart

Union Gas Ltd. – Hot Water Conservation (HWC) Program Review

Inspection Details

Inspector Name & Phone: [redacted]

Inspection Date & Time:

(Date) (Time)

Facility Details – MULTI-FAMILY

Super / Owner Name & Phone [redacted]

Location Address:

GROUP DETAIL	
SH:	61
KA:	61
BA:	61

	Suite #	Floor #	Tenant (Y/N)	Kitchen Aerator: Aerator (Y/N)	Kitchen Aerator: Kitchen Aerator Picture #	Bathroom 1 Shower: Shower (Y/N)	Bathroom 1 Shower: Shower Picture #	Bathroom 1 Aerator: Aerator (Y/N)	Bathroom 1 Aerator: Aerator Picture #	Bathroom 2 Shower: Exists? (Y/N)	Bathroom 2 Shower: Shower (Y/N)	Bathroom 2 Shower: Shower Picture #	Bathroom 2 Aerator: Aerator (Y/N)	Bathroom 2 Aerator: Aerator Picture #	Survey: Com-plete? (Y/N)	Survey: Result (A,B,C, D,E)	Survey: In-centive? (Y/N)	Survey: Letter? (Y/N)
1	[redacted]		N	Y	D-11	Y	D-10	N	D-9									
2			Y	Y	D-14	Y	D-13	N	D-12									
3			Y	Y	D-17	Y	D-16	N	D-15									
4			Y	Y	D-20	Y	D-18	N	D-19									
5			Y	Y	D-23	Y	D-21	N	D-22									
6																		

General Comments:

Sign-Off Area

The undersigned hereby acknowledge that on this date the above mentioned units were inspected for Hot Water Conservation measures.

[redacted]

(Super Intendant/Owner) (Inspector)

SeeLine Building Ltd.

Appendix E – Field Data:

VERIF DATE / TIME	Building Address	Unit	Tenant (Y/N)	Shower (Y/N)	Shower Picture	Bathroom Aerator (Y/N)	Bathroom Aerator Picture	Kitchen Aerator (Y/N)	Kitchen Aerator Picture	2nd Bathroom	Shower 2 (Y/N)	Shower2 Picture	Bathroom2 Aerator (Y/N)	Bathroom 2 Aerator Picture	Survey Complete	Survey Result	Incentive Paid	Letter Left Ensuite	Initial UGL Letter Recieved y/n/na (DONT KNOW)	SH,FA
Fri- 02-Nov-- 11 45 am	[redacted]	[redacted]	N	Y	MK22	N	MK23	N	MK24	N										
		[redacted]	N	Y	MK25	Y	MK26	Y	MK27	N										
		[redacted]	N	Y	MK28	Y	MK29	Y	MK30	N										
		[redacted]	Y	Y	MK31	N	MK32	N	MK33	N										
		[redacted]	Y	Y	MK34	Y	MK35	Y	MK36	N										
Fri- 06- Nov-- 12 45 pm	[redacted]	[redacted]	N	Y	MK62	N	MK63	Y	MK64	N										
		[redacted]	Y	Y	MK66	Y	MK67	Y	MK68	N										
		[redacted]	Y	Y	MK69	Y	MK70	Y	MK71	N										
		[redacted]	Y	Y	MK72	Y	MK73	Y	MK74	N										
		[redacted]	Y	Y	MK75	Y	MK76	Y	MK77	N										
Mon- 08- Nov-- 11 30 am	[redacted]	[redacted]	Y	Y	MK103	N	MK104	Y	MK105	N										
		[redacted]	Y	Y	MK106	N	MK107	Y	MK108	N										
		[redacted]	N	Y	MK109	Y	MK110	Y	MK111	N										
		[redacted]	N	Y	MK112	N	MK113	N	MK113 B	N										
		[redacted]	N	Y	MK114	Y	MK115	Y	MK125	N										
Mon- 08- Nov-- 12 00 pm	[redacted]	[redacted]	Y	Y	MK116	N	MK117	Y	MK118	N										
		[redacted]	Y	Y	MK119	N	MK120	Y	MK121	N										
		[redacted]	Y	Y	MK122	N	MK123	Y	MK124	N										
		[redacted]	Y	Y	MK126	N	MK127	Y	MK128	N										
		[redacted]	Y	Y	MK129	N	MK130	Y	MK131	N										
Mon- 08- Nov-- 10 30 am	[redacted]	[redacted]	Y	N	MK88	N	MK89	Y	MK90	N										
		[redacted]	Y	N	MK91	N	MK92	N	MK93	N										
		[redacted]	N	Y	MK94	N	MK95	N	MK96	N										
		[redacted]	Y	Y	MK97	N	MK98	Y	MK99	N										
		[redacted]	N	N	MK100	Y	MK101	Y	MK102	N										
Weds- 14- Nov-- 11 00 am	[redacted]	[redacted]	Y	N	MK146	N	MK147	N	MK148	N										
		[redacted]	Y	N	MK149	N	MK150	Y	MK151	N										
		[redacted]	Y	N	MK152	N	MK153	N	MK154	N										
		[redacted]	Y	N	MK155	N	MK156	N	MK157	N										
		[redacted]	Y	Y	MK158	N	MK159	Y	MK160	N										
Fri- 16- Nov-- 12 00 am	[redacted]	[redacted]	N	Y	MK187	N	MK188	Y	MK189	N										
		[redacted]	N	Y	MK190	N	MK191	N	MK192	N										
		[redacted]	Y	Y	MK193	N	MK194	Y	MK195	N										
		[redacted]	N	Y	MK196	N	MK197	N	MK198	N										
		[redacted]	N	N	MK199	N	MK200	N	MK201	N										
Fri- 16- Nov-- 12 30am	[redacted]	[redacted]	N	Y	MK171	N	MK172	N	MK173	N										
		[redacted]	Y	Y	MK175	N	MK176	Y	MK177	N										
		[redacted]	N	N	MK178	N	MK179	Y	MK180	N										
		[redacted]	N	Y	MK181	N	MK182	Y	MK183	N										
		[redacted]	N	Y	MK184	N	MK185	Y	MK186	N										
Fri-22-Nov-- 11 40 am	[redacted]	[redacted]	Y	Y	MK255	Y	MK256	Y	MK257	N										
		[redacted]	Y	N	MK258	Y	MK259	Y	MK260	N										
		[redacted]	Y	Y	MK261	Y	MK262	Y	MK265	Y	Y	MK263	Y	MK264	NOT APPLICABLE					
		[redacted]	N	N	MK266	Y	MK267	Y	MK268	N										
		[redacted]	Y	Y	MK269	Y	MK269 B	Y	MK270	N										
Fri-22-Nov-- 11 00 am	[redacted]	[redacted]	N	Y	MK236	Y	MK237	Y	MK240	Y	Y	MK238	N	MK239	NOT APPLICABLE					
		[redacted]	N	Y	MK241	Y	MK242	Y	MK243	N										
		[redacted]	N	N	MK244	Y	MK245	Y	MK246	N										
		[redacted]	N	Y	MK247	Y	MK248	Y	MK251	Y	Y	MK249	y	MK250	NOT APPLICABLE					
		[redacted]	Y	N	MK252	Y	MK253	Y	MK254	N										
Fri-22-Nov-- 10 40 am	[redacted]	[redacted]	N	Y	MK220	N	MK221	N	MK222	N										
		[redacted]	N	Y	MK223	N	MK224	N	MK225	N										
		[redacted]	N	Y	MK226	Y	MK227	N	MK228	N										
		[redacted]	Y	N	MK229	N	MK230	Y	MK231	N										
		[redacted]	Y	N	MK232	N	MK233	N	MK235	Y	N	MK233 B	N	MK234	Y	C	N	N		NA, NA
Fri-22-Nov-- 10 15 am	[redacted]	[redacted]	N	Y	MK201	Y	MK202	Y	MK203	N										
		[redacted]	N	Y	MK204	Y	MK205	N	MK208	Y	Y	MK206	Y	MK207	NOT APPLICABLE					
		[redacted]	N	Y	MK209	Y	MK210	N	MK213	Y	Y	MK211	Y	MK212	NOT APPLICABLE					
		[redacted]	N	N	MK214	Y	MK215	Y	MK216	N										
		[redacted]	N	N	MK217	Y	MK218	Y	MK219	N										

SeeLine Building Ltd.

VERIF DATE / TIME	Building Address	Unit	Tenant (Y/N)	Shower (Y/N)	Shower Picture	Bathroom Aerator (Y/N)	Bathroom Aerator Picture	Kitchen Aerator (Y/N)	Kitchen Aerator Picture	2nd Bathroom	Shower 2 (Y/N)	Shower2 Picture	Bathroom2 Aerator (Y/N)	Bathroom 2 Aerator Picture	Survey Complete	Survey Result	Incentive Paid	Letter Left Ensuite	Initial UGL Letter Recieved y/n/na (DONT KNOW)	SH,FA
Fri-16-Nov – 10:30 AM	[redacted]	[redacted]	N	Y	P-82	Y	P-83	Y	P-81	N										
			Y	Y	P-85	N	P-86	Y	P-84	Y	N		N	P-87						
			N	Y	P-89	Y	P-90	Y	P-88	N										
			N	Y	P-92	Y	P-93	Y	P-91	N										
			N	Y	P-95	Y	P-96	Y	P-94	N										
Fri-16-Nov – 11:30 AM	[redacted]	[redacted]	N	Y	P-98	Y	P-99	Y	P-97	N										
			Y	Y	P-101	N	P-102	Y	P-100	N										
			N	N	P-104	N	P-105	N	P-103	N										
			Y	Y	P-107	Y	P-108	Y	P-106	N										
			N	Y	P-110	Y	P-111	Y	P-109	N										
Fri-16-Nov – 12:30 PM	[redacted]	[redacted]	Y	Y	P-113	Y	P-114	Y	P-112	N										
			N	Y	P-116	Y	P-117	Y	P-115	N										
			N	Y	P-119	Y	P-120	Y	P-118	N										
			N	Y	P-122	Y	P-123	Y	P-121	N										
			Y	Y	P-125	Y	P-126	Y	P-124	N										
Fri-23-Nov – 10:00 AM	[redacted]	[redacted]	Y	Y	P-127	N	P-128	N	P-129	N										
			Y	Y	P-130	N	P-131	N	P-132	N										
			Y	Y	P-133	N	P-134	N	P-135	N										
			N	Y	P-136	N	P-137	N	P-138	N										
			N	Y	P-139	N	P-140	N	P-141	N										
Wed-Feb-20th- 10 00 am	[redacted]	[redacted]	n	y	MK148B	n	MK149	n	MK150	N/A										
			y	y	MK151	n	MK152	y	MK155	y	y	MK153	n	MK154	N/A				y	170, 213 128
			y	y	MK156	n	MK157	y	MK158	N/A										
			y	y	MK159	y	MK160	y	MK161	N/A										
			y	y	MK162	n	MK163	y	MK164	N/A										
Wed-Feb-20th- 10 045 am	[redacted]	[redacted]	n	y	MK165	n	MK166	n	MK167	N/A										
			n	y	MK168	n	MK169	n	MK170	N/A										
			n	y	MK171	y	MK172	y	MK175	y	y	MK173	y	MK174	N/A				y	328. 430 282
			n	y	MK176	n	MK177	y	MK178	N/A										
			y	n	MK179	y	MK180	n	MK181	N/A										
Wed-Feb-20th- 1 045 pm	[redacted]	[redacted]	n	y	MK219B	n	MK220	n	MK221	N/A									y	203, 0,0
			n	y	MK222	n	MK223	n	MK233	N/A										
			n	y	MK224	n	MK225	n	MK226	N/A										
			n	y	MK227	n	MK228	n	MK229	N/A										
			n	y	MK230	n	MK231	n	MK232	N/A										
Thur-Feb 21- 10:45 am	[redacted]	[redacted]	n	y	MK242B	y	MK243	y	MK244	N/A									n	71,71,71
			n	y	MK245	y	MK246	y	MK247	N/A										
			n	y	MK248	y	MK249	y	MK250	N/A										
			y	y	MK251	y	MK252	y	MK253	N/A										
			n	y	MK254	y	MK255	y	MK256	N/A										
Fri-Feb-29- 9 00 am	[redacted]	[redacted]	n	y	MK330	n	MK331	y	MK332	N/A									y	51 53 50
			y	y	MK333	n	MK334	y	MK335	N/A										
			n	y	MK336	n	MK337	y	MK338	N/A										
			y	y	MK339	n	MK340	y	MK341	N/A										
			y	y	MK342	n	MK343	y	MK344	N/A										
Fri-Feb-29- 9:30 am	[redacted]	[redacted]	y	y	MK345	n	MK346	y	MK347	N/A									y	100 140 29
			n	n	MK348	n	MK349	n	MK350	N/A										
			y	y	MK351	n	MK352	y	MK353	N/A										
			n	y	MK354	n	MK355	n	MK356	N/A										
			n	y	MK357	n	MK358	n	MK359	N/A										
Weds-13-Feb--12 00 PM	[redacted]	[redacted]	N	Y	D10	N	D09	Y	D11	N/A									y	61, 61, 61
			Y	Y	D13	N	D12	Y	D14	N/A										
			Y	Y	D16	N	D15	Y	D17	N/A										
			Y	Y	D18	N	D19	Y	D20	N/A										
			Y	Y	D21	N	D22	Y	D23	N/A										

Appendix F – Photos of Installed Measures:


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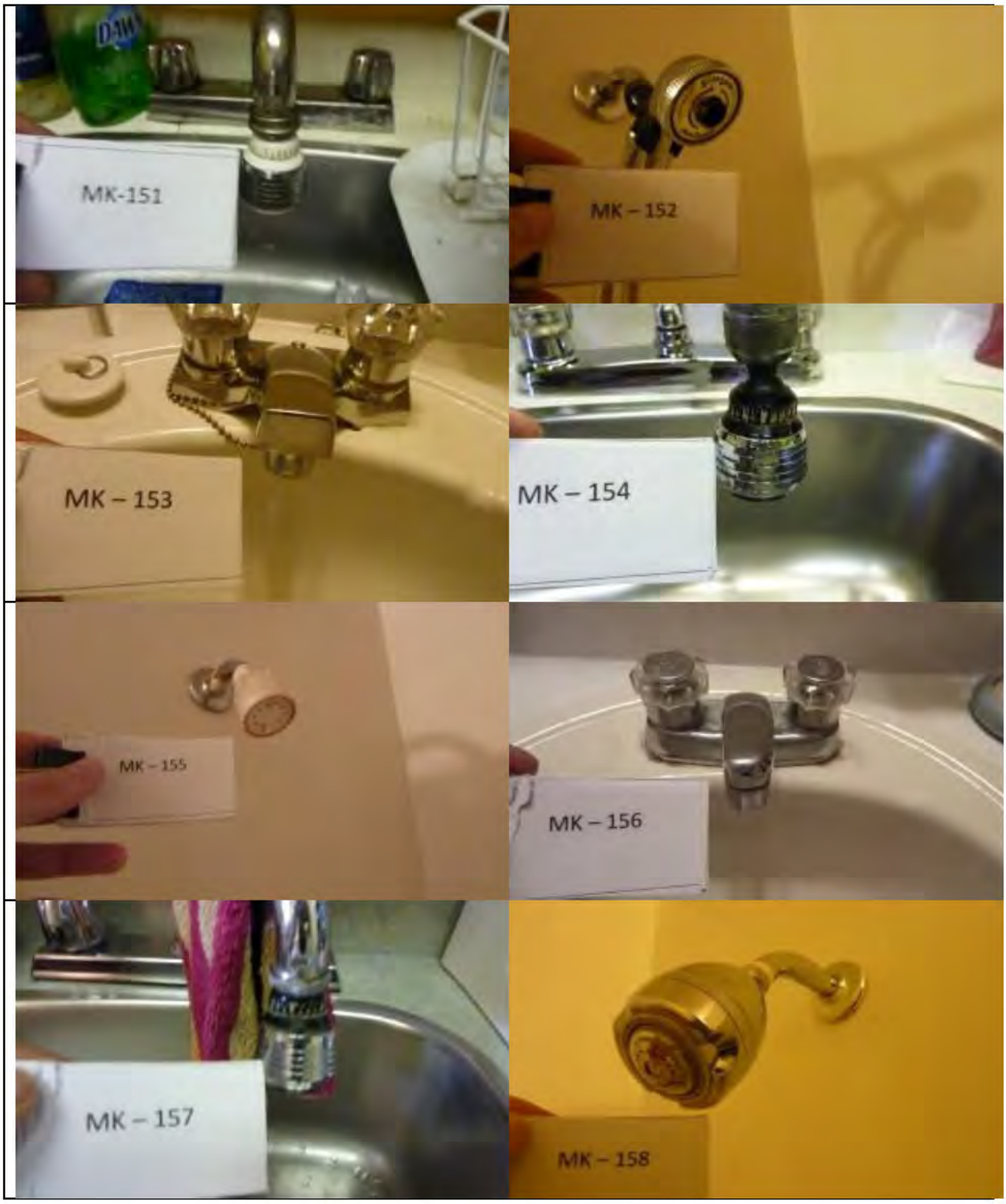
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MK – 266
LISTERINE
TOTAL CARE
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MK -269
MK -269
MK- 270


P-81

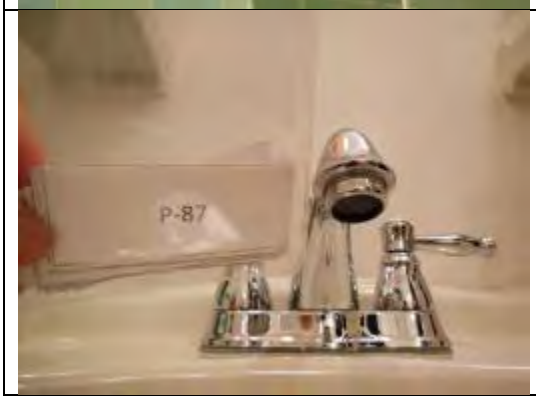

P-82


P-83


P-84


P-85


P-86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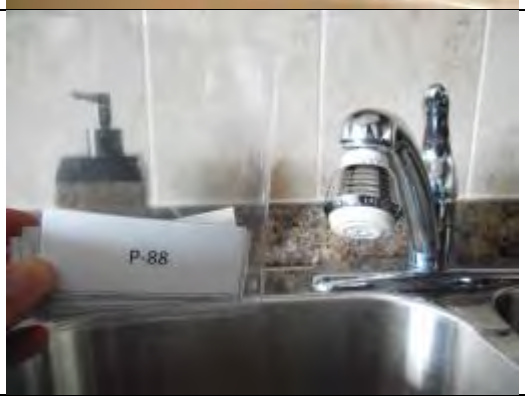
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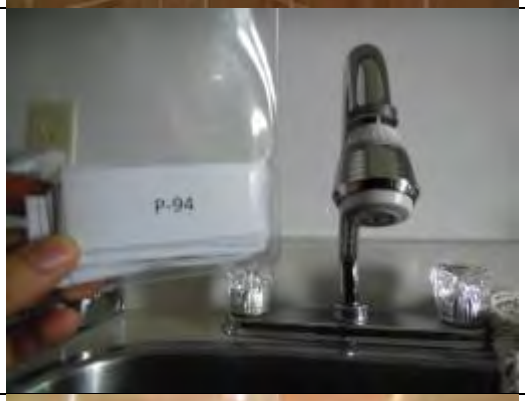
P-93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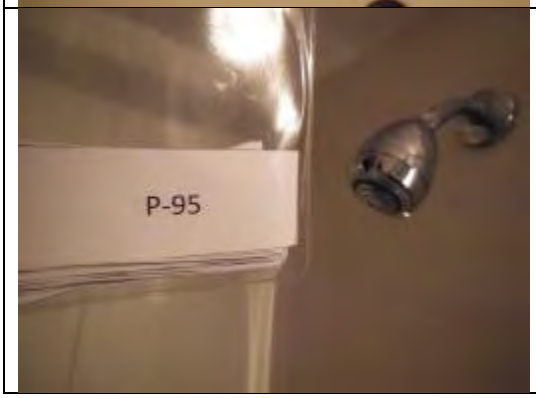
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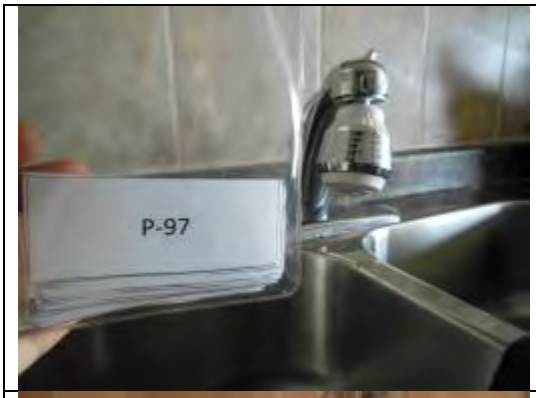
P-96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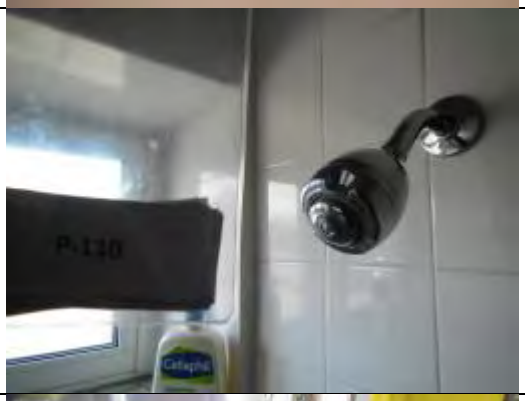
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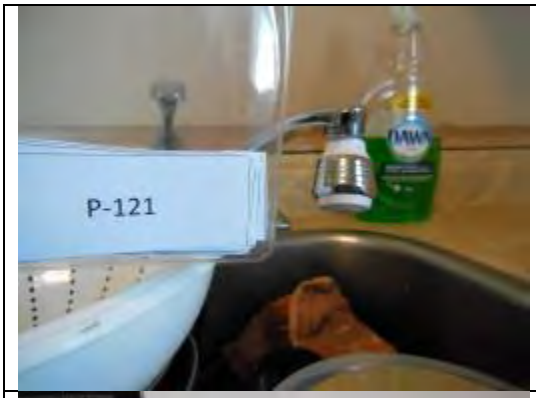
P-120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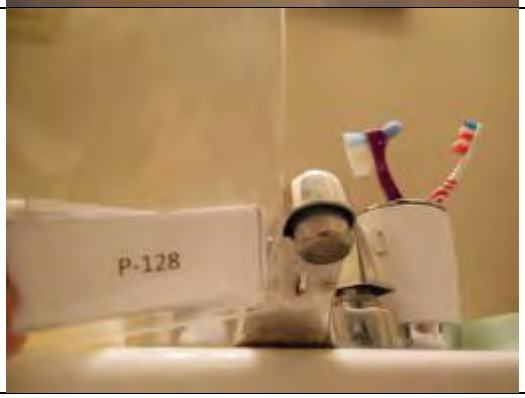
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MK -249
MK- 250
MK-251
MK – 252
MK – 253
MK – 254


MK – 255
MK – 256
MK- 330
MK-331
MK – 332
MK – 333


MK – 334
MK – 335
MK – 336
MK – 337
MK – 338
MK -339


MK- 340
MK-341
MK – 342
MK – 343
Sunlight
MK – 344
MK – 345


MK – 346
MK = 347
MK – 348
MK -349
K- 350
MK-351


MK – 352
MK – 353
MK – 354
MK – 355
MK – 356
MK – 357

 MK – 358	 MK -359


D - 9
D - 10
D-11
D-12
D-13
D-14
D-15
D-16


D-17
D-18
D-19
D-20
D-21
D-22
D-23

VERIFICATION RESULTS

2012 Commercial Hot Water Conservation Initiative (Non Multi-Family)

Final Report

SUBMITTED TO:

[redacted]

Program Evaluator, DSM Research & Evaluation

Union Gas Ltd., 777 Bay Street, Suite 2801, PO BOX 153, Toronto, Ontario, M5G 2C8

By

SeeLine Group Ltd.

416-703-8695

April 19, 2013

Table of Contents

1.0 Executive Summary

In October 2012, Union Gas Ltd. (UGL) contracted with SeeLine Group Ltd. (SLG) to provide onsite verification and documentation of results for the Commercial Hot Water Conservation (HWC) Initiative (Non Multi-Family).

A total of 30 facilities were visited and 148 suites were verified onsite for installed showerheads, bathroom faucet aerators, and kitchen faucet aerators.

The verification effort took place in two phases. Phase 1 occurred in November 2012, and 69 suites were verified at 14 facilities. Phase 2 occurred in February 2013, and 79 suites were verified at 16 facilities.

A random sample was provided to SLG by an independent third party for each phase. SLG agents contacted each facility and arranged an inspection time & date with the facility supervisor. Each suite was randomly selected. The randomly selected suites were inspected for the installation of showerheads and faucet aerators. The data were captured on a summary sheet, which was signed by the inspector as well as the facility supervisor. Photographs of the installed measures were also taken as further proof of installation. Data capture sheets and photos can be found in the accompanying appendices.

Due to the diverse nature of the non multi-family sector, the results are reported by the following three sub-sectors: Education, Hotel/Motel, and Other.

Key results by Sub-Sector included:

Education	Showerheads		Bathroom Aerators		Kitchen Aerators	
Results	#	%	#	%	#	%
Yes	33	67.3%	26	53.1%	18	47.4%
No	16	32.7%	23	46.9%	20	52.6%
Total	49	100.0%	49	100.0%	38	100.0%

Education

- Showerheads – There were 33 (67.3%) observed installed and 16 (32.7%) were not, based on a sample of 49.
- Bathroom Aerators – There were 26 (53.1%) observed installed and 23 (46.9%) were not, based on a sample of 49.
- Kitchen Aerators – There were 18 (47.4%) observed installed and 20 (52.6%) were not, based on a sample of 38.

Hotel / Motel Results	Showerheads		Bathroom Aerators	
	#	%	#	%
Yes	43	87.8%	13	26.5%
No	6	12.2%	36	73.5%
Total	49	100.0%	49	100.0%

Hotel / Motel

- Showerheads – There were 43 (87.8%) observed installed and 6 (12.2%) were not, based on a sample of 49.
- Bathroom Aerators – There were 13 (26.5%) observed installed and 36 (73.5%) were not, based on a sample of 49.

Other Results	Showerheads		Bathroom Aerators	
	#	%	#	%
Yes	24	77.4%	14	38.9%
No	7	22.6%	22	61.1%
Total	31	100.0%	36	100.0%

Other

- Showerheads – There were 24 (77.4%) observed installed and 7 (32.7%) were not, based on a sample of 31.
- Bathroom Aerators – There were 14 (38.9%) observed installed and 22 (61.1%) were not, based on a sample of 36.

2.0 Background & Objective

The HWC Initiative (Non Multi-Family) is designed to reduce natural gas usage associated with hot water consumption. The HWC Initiative (Non Multi-Family) provides a choice of a suite of measures at no cost to participants including: 1.25gpm showerhead, 1.5gpm kitchen aerator, and a 1.0gpm bathroom aerator.. This verification effort included non multi-family buildings in the Education, Hotel/Motel, and Other (including retail, entertainment, food services, etc.). The verification effort occurred in 2 phases. Phase 1 included a verification of participants from Q1 to Q3 in 2012. Phase 2 included a verification of participants from Q1 to Q4 2012.

2.1 Objective

Through onsite verification, the main goal of this study was to confirm the installation of showerheads and aerators distributed to HWC Initiative (Non Multi-Family) participants who received measures in 2012.

At least 125 suites needed to be verified across 25 different facilities. In phase 1, to ensure a confidence interval of 90/10 was met, SLG was required to verify 60 suites, across at least 12 facilities. In phase 2, to ensure a confidence interval of 90/10 was met, SLG was required to verify 65 suites, across at least 13 facilities.

Through this effort, 148 suites were verified at 30 facilities: 69 suites were verified in phase 1 at 14 facilities, while 79 suites were verified in phase 2 at 16 facilities.

UGL also required that SLG quantify the percentage use of installed showerheads for suites that had more than one shower. When a second shower was encountered in a suite, a brief survey questionnaire was deployed to the participant to ascertain the percentage of showering in each unique bathroom.

3.0 Methodology

A random sample of participants was developed for both phases by an independent third party and provided to SLG. To ensure adequate geographic reach and to optimize cost effectiveness, it was determined that a maximum of 5 suites was the appropriate limit for verification at each facility.

In total, a random sample of 30 facilities was provided to SLG by an independent thirst party.

Phase 1

The random sample included 14 facilities and was intended to provide a confidence internal of 90/10.

Phase 2

In phase 2, the random sample included 16 primary facilities and was intended to provide a confidence internal of 90/10.

Approach to Both Phases

Prior to any customer contact performed by SLG, a letter was sent from UGL to the entire sample informing them that their site could be visited for the purpose of the on-site verification study. A meeting request by telephone to verify the installed measures was then placed with the facility supervisor. A meeting time and date were arranged. Meeting times and dates were assigned to an SLG agent. The SLG agent made final arrangements with the facility supervisor.

The SLG agent arrived onsite and randomly selected up to 5 suites for verification. A random number generator was used to make the random suite selections.

The onsite facility supervisor brought the agent to each randomly selected suite. The SLG agent gained access to the suite and searched for the 3 installed measures:

- 1.25gpm showerhead
- 1.5gpm kitchen faucet aerator
- 1.0gpm bathroom faucet aerator

Physical samples of the models were provided to SLG agents by UGL staff prior to the inspections. These models were brought to the field to make direct comparisons. As well, detailed photographs of the measures were provided by UGL, so that SLG agents could positively identify the measures in the field. The models provided through the HWC initiative are unique to the Ontario market, so it was assumed that a positively identified measure was only acquired through participation in the HWC initiative. SLG agents also took detailed photographs

of the installed measures in the field, so that a visual record would be available after the verification had occurred. A unique identifying tag was affixed to each installed measure for organization. See Appendix F for the photographs.

The verification details were recorded in a data-capture 'sign-off' sheet. This document recorded the results of the inspection, and required the facility supervisor to sign off on the inspection along with the SLG agent. See Appendix B for the template of the sign-off sheet, and Appendix D for copies of the completed sign-off sheets.

In Phase 1, 14 facilities were visited and 69 suites were verified. Generally, phone calls were placed in early November to arrange meeting times. The verification visits occurred throughout the month of November. All the onsite verification meetings had been concluded by November 30th 2012.

In Phase 2, 16 facilities were visited and 79 suites were verified. In Phase 2, phone calls were placed in early February to arrange meeting times. The verification visits occurred throughout the month of February and the first week of March. All the onsite verification meetings had been concluded by March 4th 2013.

4.0 Results

4.1 Showerheads

Showerhead Results	Education		Hotel/Motel		Other		Total	
	#	%	#	%	#	%	#	%
Yes	33	67.3%	43	87.8%	24	77.4%	**100**	77.5%
No	16	32.7%	6	12.2%	7	22.6%	**29**	22.5%
Total	49	100.0%	49	100.0%	31	100.0%	**129**	100.0%

Quantitative Findings

A total of 147 bathroom showerheads were inspected. 100 of the installed measures were positively identified as HWC Initiative showerheads, while 29 were not. A further 18 observations were not applicable, because there was no shower in the bathroom. Photographs of all the showerheads that were inspected have been provided in Appendix F.

Showerheads-Education

The table above displays the observed showerheads in the 'Education' sub-sector. A total of 49 bathroom showerheads were inspected: 33 were positively identified, while 16 were not.

Showerheads-Hotel/Motel

The table above displays the observed showerheads in the 'Hotel/Motel' sub-sector. A total of 49 bathroom showerheads were inspected: 43 were positively identified, while 6 were not.

Showerheads-Other

The table above displays the observed showerheads in the 'Other' sub-sector. A total of 31 bathroom showerheads were inspected: 24 were positively identified, while 7 were not.

Qualitative findings

After speaking with facility supervisors it is clear that the fate of showerheads is not altogether uniform. Three main outcomes were identified: not installed, installed, and un-installed (removed).

4.2 Bathroom Faucet Aerators

Bathroom Aerators	Education		Hotel/Motel		Other		Total	
	#	%	#	%	#	%	#	%
Yes	26	53.1%	13	26.5%	14	38.9%	**53**	39.6%
No	23	46.9%	36	73.5%	22	61.1%	**81**	60.4%
Total	49	100.0%	49	100.0%	36	100.0%	**134**	100.0%

Quantitative Findings

A total of 134 bathroom faucet aerators were inspected. 53 of the installed measures were positively identified as HWC Initiative bathroom faucet aerators, while 81 were not. A further 14 observations were not applicable, as no bathroom sink existed. These fourteen 'Not Applicable' observations were 'basic' bathrooms with a small shower, a toilet, and no sink. Photographs of all the bathroom faucet aerators that were inspected can be found in Appendix F.

Bathroom Faucet Aerators-Education

The table above displays the observed bathroom faucet aerators in the 'Education' sub-sector. A total of 49 bathroom faucet aerators were inspected: 26 were positively identified, while 23 were not.

Bathroom Faucet Aerators-Hotel/Motel

The table above displays the observed bathroom faucet aerators in the 'Hotel/Motel' sub-sector. A total of 49 bathroom faucet aerators were inspected: 13 were positively identified, while 36 were not.

Bathroom Faucet Aerators-Other

The table above displays the observed bathroom faucet aerators in the 'Other' sub-sector. A total of 36 bathroom faucet aerators were inspected: 14 were positively identified, while 22 were not.

Qualitative findings
No specific qualitative information regarding installations was reported.

4.3 Kitchen Faucet Aerators

Kitchen faucet aerators were provided to the 'Education' sub-sector. Total results for kitchen faucet aerators are presented below.

Kitchen Aerators	Education	
	#	%
Yes	18	47.4%
No	20	52.6%
Total	38	100.0%

Quantitative Findings
The table above displays the observed kitchen faucet aerators in the 'Education' sub-sector. A total of 38 kitchen faucet aerators were inspects: 18 kitchen faucet aerators were positively identified while 20 were not.

Qualitative findings
No specific qualitative information regarding installations was reported.

5.0 Conclusion

In total, 148 suites were verified at 30 facilities. The verification effort occurred over 2 phases. The first phase was in November 2012, and the second phase was in February 2013. The verification effort focused on observing showerhead aerators, bathroom faucet aerators, and kitchen faucet aerators installed in non multi-family buildings.

Showerheads showed the highest rates of installation (77.5%). The 'Hotel / Motel' sub-sector had the highest observed installation rate (87.8%), followed by 'Other' (77.4%), and finally 'Education' (67.3%).

Bathroom faucet aerators showed lower overall rates of installation (39.6%) in comparison to showerheads. The Education sub-sector had the highest observed installation rate (53.1%), followed by Other (38.8%), and Hotel/Motel (26.5%)

A 47.4% installation rate was observed in the 'Education' sub-sector for kitchen faucet aerators.

APPENDICES -

The following Appendices were provided in a separate document:

Appendix A – List of Buildings

Appendix B – Sample Sign-Off Sheet

Appendix C – Second Bathroom Survey

Appendix D – Sign-Off Sheets (Field Data)

Appendix E – Field Data in Excel Format

Appendix F – Photographs of Installed Measures

Appendix A – List of Buildings

	Building Addresses - Phase 1	Building Type
1	[redacted]	Education
2	[redacted]	Education
3	[redacted]	Education
4	[redacted]	Education
5	[redacted]	Hotel / Motel
6	[redacted]	Hotel / Motel
7	[redacted]	Hotel / Motel
8	[redacted]	Hotel / Motel
9	[redacted]	Hotel / Motel
10	[redacted]	Hotel / Motel
11	[redacted]	Other
12	[redacted]	Other
13	[redacted]	Other
14	[redacted]	Other

	Building Addresses- Phase 2	Building Type
1	[redacted]	Education
2	[redacted]	Education
3	[redacted]	Education
4	[redacted]	Education
5	[redacted]	Education
6	[redacted]	Education
7	[redacted]	Education
8	[redacted]	Hotel / Motel
9	[redacted]	Hotel / Motel
10	[redacted]	Hotel / Motel
11	[redacted]	Hotel / Motel
12	[redacted]	Other
13	[redacted]	Other
14	[redacted]	Other
15	[redacted]	Other
16	[redacted]	Other

Appendix B – Sample Sign-Off Sheet:

Union Gas Ltd. – Hot Water Conservation (HWC) Program Review

Inspection Details

Inspector Name & Phone: _____ _____
(Full Name – Print Clearly) (Phone)

Inspection Date & Time: _____ _____
(Date) (Time)

Facility Details – MULTI-FAMILY

Super / Owner Name & Phone: _____ _____
(Full Name – Print Clearly) (Phone)

Location Address: _____ _____ _____
(Street Address) (#Units) (#Floors)

ORDER DETAIL	
SH:	
KA:	
BA:	

	Suite #	Floor #	Tenant (Y/N)	Bathroom 1				Bathroom 2					Survey			
				Shower		Aerator			Shower		Aerator					
				Shower (Y/N)	Shower Picture #	Aerator (Y/N)	Aerator Picture #	Exists? (Y/N)	Shower (Y/N)	Shower Picture #	Aerator (Y/N)	Aerator Picture #	Complete? (Y/N)	Result (A,B,C,D or E)	Incentive Paid? (Y/N)	Letter? (Y/N)
1																
2																
3																
4																
5																

General Comments:

Sign-Off Area

The undersigned hereby acknowledge that on this date the above mentioned units were inspected for Hot Water Conservation measures.

X_____ X_____

(Facility Super Intendant / Owner) (Inspector)

Appendix C – Second Bathroom Survey:

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We noticed your suite has two bathrooms.

1. **Was a new showerhead installed in each of your bathrooms?**

   Yes ☐ No ☐

   If you checked yes, that is all we need to know. Thank you!

2. **If you checked no, of all the showering that is done in your home, how much is done under the new showerhead?**

   ☐ **0% - 30%** - I hardly use the new showerhead.

   ☐ **31-69%** - I use the new showerhead about half the time.

   ☐ **70-99%** - I use the new showerhead most of the time.

   ☐ **100%** - I use the new showerhead all of the time.

Please call the number on the front of this page with your responses to receive your free $25 Tim Horton's Gift Certificate! Thank you for your time!

SeeLine Group Ltd.

Appendix D – Sign-Off Sheets:

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Union Gas Ltd. – Hot Water Conservation (HWC) Program Review

Inspection Details

Inspector Name & Phone: [redacted]

Inspection Date & Time: [redacted]
(Date) (Time)

ORDER DETAIL
SH: 48
KA: 78
BA:

Facility Details – Non Multi-Family

Customer (Hotel/Motel, School, Dorm, LTC Facility, Other): [redacted]

Contact Name & Phone [redacted]

Location Address: [redacted]

	Suite #	Floor #	Tenant (Y/N)	Kitchen Aerator Aerator (Y/N)	Kitchen Aerator Aerator Picture #	Bathroom 1 Shower Shower (Y/N)	Bathroom 1 Shower Shower Picture #	Bathroom 1 Aerator Aerator (Y/N)	Bathroom 1 Aerator Aerator Picture #	Bathroom 2 Shower Exists? (Y/N)	Bathroom 2 Shower Shower (Y/N)	Bathroom 2 Shower Shower Picture #	Bathroom 2 Aerator Aerator (Y/N)	Bathroom 2 Aerator Aerator Picture #	Survey Complete? (Y/N)	Survey Result (A,B,C,D,E)	Survey Incentive? (Y/N)	Survey Letter? (Y/N)
1	[redacted]		Y	N	05	N	01	N	02	Y	Y	03	Y	04	N			
2			N	N	08	Y	06	Y	07	N								
3			Y	Y	13	Y	09	Y	10	Y	Y	11	Y	12	Y			
4			N	N	16	Y	14	N	15	N								
5			Y	Y	21	Y	17	Y	18	Y	Y	19	Y	20	Y			
6																		

[redacted]

Sign-Off Area

The undersigned hereby acknowledge that on this date the above mentioned units were inspected for Hot Water Conservation measures.

[redacted]

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Union Gas Ltd. – Hot Water Conservation (HWC) Program Review

Inspection Details

Inspector Name & Phone: [redacted]

Inspection Date & Time: [redacted]

(Date) (Time)

ORDER DETAIL
SH:
KA:
BA:

Facility Details – Non Multi-Family

Customer (Hotel/Motel, School, Dorm, LTC Facility, Other): _____Dorm_____

Contact Name & Phone: [redacted]

Location Address: [redacted]

(Street Address) (#Units) (# Floors)

	Suite #	Floor #	Tenant (Y/N)	Kitchen Aerator: Aerator (Y/N)	Kitchen Aerator: Kitchen Aerator Picture #	Bathroom 1 Shower: Shower (Y/N)	Bathroom 1 Shower: Shower Picture #	Bathroom 1 Aerator: Aerator (Y/N)	Bathroom 1 Aerator: Aerator Picture #	Bathroom 2 Shower: Exists? (Y/N)	Bathroom 2 Shower: Shower (Y/N)	Bathroom 2 Shower: Shower Picture #	Bathroom 2 Aerator: Aerator (Y/N)	Bathroom 2 Aerator: Aerator Picture #	Survey: Complete? (Y/N)	Survey: Result (A,B,C,D,E)	Survey: Incentive? (Y/N)	Survey: Letter? (Y/N)
1	kitchen		N	Y	P-38													
2	main floor bathroom		N	—	—	—	—	~~N~~ Y	P-39									
3	upstairs bathroom		N	—	—	Y	P-40	~~N~~ Y	P-41									
4	basement bathroom		N			Y	P-42	Y	P-43	—	—	—	Y	P-44				
5																		
6	Laundry room			—	—	—	—	~~N~~ Y	P-45									

General Comments: House converted into student residence. Contains 3 bathrooms and one kitchen. Basement bathroom has 2 faucets. The kitchen is shared. Aerators will be fitted in laundry facility sinks. Basement bathroom has 2 sinks

Sign-Off Area

The undersigned hereby acknowledge that on this date the above mentioned units were inspected for Hot Water Conservation measures.

[redacted]

(Facility Super Intendant / Owner) (Inspector)

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Union Gas Ltd. – Hot Water Conservation (HWC) Program Review

Inspection Details

Inspector Name & Phone: [redacted]

Inspection Date & Time: [redacted]
(Date) (Time)

ORDER DETAIL
SH:
KA:
BA:

Facility Details – Non Multi-Family

Customer (Hotel/Motel, School, Dorm, LTC Facility, Other): _____Dorm_____

Contact Name & Phone: [redacted]

Location Address: [redacted]
(Street Address) (#Units) (# Floors)

	Suite #	Floor #	Tenant (Y/N)	Kitchen		Bathroom 1				Bathroom 2					Survey			
				Aerator		Shower		Aerator		Shower			Aerator					
				Aerator (Y/N)	Kitchen Aerator Picture #	Shower (Y/N)	Shower Picture #	Aerator (Y/N)	Aerator Picture #	Exists? (Y/N)	Shower (Y/N)	Shower Picture #	Aerator (Y/N)	Aerator Picture #	Com-plete? (Y/N)	Result (A,B,C,D,E)	In-cent ive? (Y/N)	Letter? (Y/N)
1	Kitchen	N		Y	P-46													
2	main floor	N				Y	P-47	Y	P-48									
3	upstairs bathroom 1	N				Y	P-49	Y	P-50									
4	upstairs bathroom 2	N				Y	P-51	Y	P-52									
5	basement bathroom 1	N		—	—	—	—		P-53									
6	basement bathroom 2	Y		—	—	Y	P-54	Y	P-55									

[redacted]

Sign-Off Area

The undersigned hereby acknowledge that on this date the above mentioned units were inspected for Hot Water Conservation measures.

[redacted]

(Facility Super Intendant / Owner) (Inspector)

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Union Gas Ltd. – Hot Water Conservation (HWC) Program Review

Inspection Details

Inspector Name & Phone: [redacted]

Inspection Date & Time: _____ _____ _____
(Date) (Time)

ORDER DETAIL
SH:
KA:
BA:

Facility Details – Non Multi-Family

Customer (Hotel/Motel, School, Dorm, LTC Facility, Other): _____Dorm_____

Contact Name & Phone: [redacted]

Location Address: _____ _____ _____
(Street Address) (#Units) (# Floors)

	Suite #	Floor #	Tenant (Y/N)	Kitchen		Bathroom 1				Bathroom 2					Survey			
				Aerator		Shower		Aerator		Shower			Aerator		Complete? (Y/N)	Result (A,B,C,D,E)	Incentive? (Y/N)	Letter? (Y/N)
				Aerator (Y/N)	Kitchen Aerator Picture #	Shower (Y/N)	Shower Picture #	Aerator (Y/N)	Aerator Picture #	Exists? (Y/N)	Shower (Y/N)	Shower Picture #	Aerator (Y/N)	Aerator Picture #				
1	[redacted]		Y	Y	P-58	Y	P-56	N	P-57									
2			N	N	P-59	N	P-60	N	P-61									
3			N	N	P-62	N	P-63	N	P-64									
4			Y	N	P-65	N	P-66	N	P-67									
5			Y	N	P-68	N	P-69	N	P-70									
6																		

[redacted]

Sign-Off Area

The undersigned hereby acknowledge that on this date the above mentioned units were inspected for Hot Water Conservation measures.

[redacted]

(Facility Super Intendant / Owner) (Inspector)

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Union Gas Ltd. – Hot Water Conservation (HWC) Program Review

Inspection Details

Inspector Name & Phone : [redacted]

Inspection Date & Time: [redacted]

(Date) (Time)

ORDER DETAIL

SH: 24

KA: 24

BA: 24

Facility Details – Non Multi-Family

Customer (Hotel/Motel, School, Dorm, LTC Facility, Other): Hotel/Motel

Contact Name & Phone: [redacted]

Location Address: [redacted]

(Street Address) (#Units) (# Floors)

	Suite #	Floor #	Tenant (Y/N)	Kitchen Aerator Aerator (Y/N)	Kitchen Aerator Kitchen Aerator Picture #	Bathroom 1 Shower Shower (Y/N)	Bathroom 1 Shower Shower Picture #	Bathroom 1 Aerator Aerator (Y/N)	Bathroom 1 Aerator Aerator Picture #	Bathroom 2 Shower Exists? (Y/N)	Bathroom 2 Shower Shower (Y/N)	Bathroom 2 Shower Shower Picture #	Bathroom 2 Aerator Aerator (Y/N)	Bathroom 2 Aerator Aerator Picture #	Survey Complete? (Y/N)	Survey Result (A,B,C,D,E)	Survey Incentive? (Y/N)	Survey Letter? (Y/N)
1	11	1	N	N	N	Y	37	Y	38	N								
2	12	1	N	Y		Y	39	Y	40	N								
3	13	1	N	Y	~~44~~ 43	Y	41	N	42	N								
4	21	1	N	Y	46	Y	44	Y	45	N								
5	23		N	Y	49	Y	47	~~Y~~ N	48	N								
6			N							N								

[redacted]

Sign-Off Area

The undersigned hereby acknowledge that on this date the above mentioned units were inspected for Hot Water Conservation measures.

X_ [redacted]

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ion Gas Ltd. – Hot Water Conservation (HWC) Program Review

Inspection Details

Inspector Name & Phone : [redacted]

Inspection Date & Time:

(Date) (Time)

ORDER DETAIL

SH: 78

KA:

BA:

Facility Details – Non Multi-Family

Customer (Hotel/Motel, School, Dorm, LTC Facility, Other): Hotel/Motel

Contact Name & Phone: [redacted]

Location Address:

(Street Address) (#Units) (# Floors)

Suite #	Floor #	Tenant (Y/N)	Kitchen Aerator		Bathroom 1 Shower		Bathroom 1 Aerator		Bathroom 2 Shower			Bathroom 2 Aerator		Survey			
			Aerator (Y/N)	Kitchen Aerator Picture #	Shower (Y/N)	Shower Picture #	Aerator (Y/N)	Aerator Picture #	Exists? (Y/N)	Shower (Y/N)	Shower Picture #	Aerator (Y/N)	Aerator Picture #	Com-plete? (Y/N)	Result (A,B,C, D,E)	In-centive? (Y/N)	Lett (Y/
1	1				Y	78	N	79	N								
3	1				Y	80	N	81									
6	1				Y	82	N	83									
9	1				Y	84	N	85									
12	1				Y	86	N	87									
	1																

[redacted]

Sign-Off Area

The undersigned hereby acknowledge that on this date the above mentioned units were inspected for Hot Water Conservation measures

X [redacted]

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enersmart

Union Gas Ltd. – Hot Water Conservation (HWC) Program Review

Inspection Details

Inspector Name & Phone: [redacted]

Inspection Date & Time: [redacted]

(Date) (Time)

ORDER DETAIL

SH: 66

KA:

BA:

Facility Details – Non Multi-Family

Customer (Hotel/Motel, School, Dorm, LTC Facility, Other): [redacted]

Contact Name & Pho[redacted]

Location Address: [redacted]

	Suite #	Floor #	Tenant (Y/N)	Kitchen Aerator: Aerator (Y/N)	Kitchen Aerator: Kitchen Aerator Picture #	Bathroom 1 Shower: Shower (Y/N)	Bathroom 1 Shower: Shower Picture #	Bathroom 1 Aerator: Aerator (Y/N)	Bathroom 1 Aerator: Aerator Picture #	Bathroom 2 Shower: Exists? (Y/N)	Bathroom 2 Shower: Shower (Y/N)	Bathroom 2 Shower: Shower Picture #	Bathroom 2 Aerator: Aerator (Y/N)	Bathroom 2 Aerator: Aerator Picture #	Survey: Complete? (Y/N)	Survey: Result (A,B,C,D,E)	Survey: Incentive? (Y/N)	Survey: Letter? (Y/N)
1	719	2	N		162	Y	161	Y	162	N								
2	722	2				Y	163	Y	164									
3	725	2				Y	165	Y	166									
4	302	3				Y	167	Y	168									
5	307	3				Y	169	Y	170									
6																		

[redacted]

Sign-Off Area

The undersigned hereby acknowledge that on this date the above mentioned units were inspected for Hot Water Conservation measures.

X_ [redacted]

SeeLine Group Ltd.

union gas
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enersmart
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Union Gas Ltd. – Hot Water Conservation (HWC) Program Review

Inspection Details

Inspector Name & Phone: [redacted]

Inspection Date & Time:

(Date) (Time)

ORDER DETAIL

SH:

KA:

BA:

Facility Details – Non Multi-Family

Customer (Hotel/Motel, School, Dorm, LTC Facility, Other): Hotel/Motel

Contact Name & P[redacted]

Location Address:

(Street Address) (#Units) (# Floors)

	Suite #	Floor #	Tenant (Y/N)	Kitchen Aerator Aerator (Y/N)	Kitchen Aerator Kitchen Aerator Picture #	Bathroom 1 Shower Shower (Y/N)	Bathroom 1 Shower Shower Picture #	Bathroom 1 Aerator Aerator (Y/N)	Bathroom 1 Aerator Aerator Picture #	Bathroom 2 Shower Exists? (Y/N)	Bathroom 2 Shower Shower (Y/N)	Bathroom 2 Shower Shower Picture #	Bathroom 2 Aerator Aerator (Y/N)	Bathroom 2 Aerator Aerator Picture #	Survey Complete? (Y/N)	Survey Result (A,B,C,D,E)	Survey Incentive? (Y/N)	Survey Letter? (Y/N)
1	25	1	Y	~~Y~~	~~004~~	~~Y~~	~~003~~	~~Y~~	~~004~~	~~Y~~	~~Y~~	~~004~~	~~Y~~	~~005~~				
2	25	1	Y	~~Y~~	~~007~~	Y	~~012~~	~~N~~	~~011~~	~~N~~	~~Y~~	—	Y	~~012~~	Y	C	Y	Y
3	16	1	N	—	—	Y	002	Y	001	—								
4	6	1	N	—	—	Y	003	N	004									
5	2	1	N	—	—	Y	005	Y	006									
6	1	1	N	—	—	Y	007	N	008									

G[redacted]

Sign-Off Area

The undersigned hereby acknowledge that on this date the above mentioned units were inspected for Hot Water Conservation measures.

[redacted]

(Facility Super Intendant / Owner) (Inspector)

SeeLine Group Ltd.

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Union Gas Ltd. – Hot Water Conservation (HWC) Program Review

Inspection Details

Inspector Name & Phone: [redacted]

Inspection Date & Time: [redacted]

(Date) (Time)

ORDER DETAIL
SH: 15
KA:
BA: 16

Facility Details – Non Multi-Family

Customer (Hotel/Motel, School, Dorm, LTC Facility, Other): ___Hotel/Motel_____

Contact Name & Phone: [redacted]

Location Address: [redacted]

(Street Address) (#Units) (# Floors)

	Suite #	Floor #	Tenant (Y/N)	Kitchen Aerator Aerator (Y/N)	Kitchen Aerator Kitchen Aerator Picture #	Bathroom 1 Shower Shower (Y/N)	Bathroom 1 Shower Shower Picture #	Bathroom 1 Aerator Aerator (Y/N)	Bathroom 1 Aerator Aerator Picture #	Bathroom 2 Shower Exists? (Y/N)	Bathroom 2 Shower Shower (Y/N)	Bathroom 2 Shower Shower Picture #	Bathroom 2 Aerator Aerator (Y/N)	Bathroom 2 Aerator Aerator Picture #	Survey Complete? (Y/N)	Survey Result (A,B,C,D,E)	Survey Incentive? (Y/N)	Survey Letter? (Y/N)
1	18	1	N	—	—	Y	P-13	N	R14	—	—	—	—	—	—	—	—	—
2	19	1	N	—	—	N	P-15	Y	R15	—	—	—	—	—	—	—	—	—
3	25	1	N	—	—	Y	P-17	Y	P-18	—	—	—	—	—	—	—	—	—
4	27	1	N	—	—	Y	P-19	N	P20	—	—	—	—	—	—	—	—	—
5	23	1	N	—	—	Y	P-21	N	P-22	—	—	—	—	—	—	—	—	—
6																		

[redacted]

Sign-Off Area

The undersigned hereby acknowledge that on this date the above mentioned units were inspected for Hot Water Conservation measures.

X [redacted]

(Facility Super Intendant / Owner) (Inspector)

SeeLine Group Ltd.

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Union Gas Ltd. – Hot Water Conservation (HWC) Program Review

Inspection Details

Inspector Name & Phone: [redacted]

Inspection Date & Time: [redacted]

(Date) (Time)

ORDER DETAIL
SH:
KA:
BA: ✓

Facility Details – Non Multi-Family

Customer (Hotel/Motel, School, Dorm, LTC Facility, Other): Hotel/Motel

Contact Name & Phone: [redacted]

Location Address: [redacted]

(Street Address) (#Units) (# Floors)

	Suite #	Floor #	Tenant (Y/N)	Kitchen Aerator: Aerator (Y/N)	Kitchen Aerator: Kitchen Aerator Picture #	Bathroom 1 Shower: Shower (Y/N)	Bathroom 1 Shower: Shower Picture #	Bathroom 1 Aerator: Aerator (Y/N)	Bathroom 1 Aerator: Aerator Picture #	Bathroom 2 Shower: Exists? (Y/N)	Bathroom 2 Shower: Shower (Y/N)	Bathroom 2 Shower: Shower Picture #	Bathroom 2 Aerator: Aerator (Y/N)	Bathroom 2 Aerator: Aerator Picture #	Survey: Complete? (Y/N)	Survey: Result (A,B,C,D,E)	Survey: Incentive? (Y/N)	Survey: Letter? (Y/N)
1	16	1	N	N	P-27	Y	P-28	Y	P-29									
2	18	1	N	—	—	Y	P-30	Y	P-31									
3	10	1	N	—	—	Y	P-32	N	P-33									
4	12	1	N	—	—	Y	P-34	N	P-35									
5	14	1	N	—	—	Y	P-36	N	P-37									
6																		

[redacted]

Sign-Off Area

The undersigned hereby acknowledge that on this date the above mentioned units were inspected for Hot Water Conservation measures.

[redacted]

(Facility Super intendant / Owner) (Inspector)

SeeLine Group Ltd.

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Union Gas Ltd. – Hot Water Conservation (HWC) Program Review

Inspection Details

Inspector Name & Phone : [redacted]

Inspection Date & Time: (Date) (Time)

ORDER DETAIL

SH: 102

KA:

BA:

FA 28

Facility Details – Non Multi-Family

Customer (Hotel/Motel, School, Dorm, LTC Facility, Other): Hotel/Motel

Contact Name & Phone: [redacted]

Location Address: (Street Address) (#Units) (# Floors)

	Suite #	Floor #	Tenant (Y/N)	Kitchen Aerator Aerator (Y/N)	Kitchen Aerator Kitchen Aerator Picture #	Bathroom 1 Shower Shower (Y/N)	Bathroom 1 Shower Shower Picture #	Bathroom 1 Aerator Aerator (Y/N)	Bathroom 1 Aerator Aerator Picture #	Bathroom 2 Shower Exists? (Y/N)	Bathroom 2 Shower Shower (Y/N)	Bathroom 2 Shower Shower Picture #	Bathroom 2 Aerator Aerator (Y/N)	Bathroom 2 Aerator Aerator Picture #	Survey Complete? (Y/N)	Survey Result (A,B,C,D,E)	Survey Incentive? (Y/N)	Survey Letter? (Y/N)
1	610	6		N	54	Y	50	N	51	N								
2	603	6	Y			Y	52	N	53									
3	510	5	N			Y	55	N	56									
4	503	5		N	59	Y	57	N	58									
5	309	3	N	N	62	Y	60	N	61									
6																		

[redacted]

Sign-Off Area

The undersigned hereby acknowledge that on this date the above mentioned units were inspected for Hot Water Conservation measures.

[redacted]

SeeLine Group Ltd.

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Union Gas Ltd. – Hot Water Conservation (HWC) Program Review

Inspection Details

Inspector Name & Phone: [redacted]

Inspection Date & Time: [redacted]

(Date) (Time)

ORDER DETAIL

SH: NM

KA: N/A

BA: N/A

Facility Details – Non Multi-Family

Customer (Hotel/Motel, School, Dorm, LTC Facility, Other): [redacted]

Contact Name & Phone [redacted]

Location Address: [redacted]

(Street Address) (#Units) (# Floors)

Suite #	Floor #	Tenant (Y/N)	Kitchen Aerator: Aerator (Y/N)	Kitchen Aerator: Kitchen Aerator Picture #	Bathroom 1 Shower: Shower (Y/N)	Bathroom 1 Shower: Shower Picture #	Bathroom 1 Aerator: Aerator (Y/N)	Bathroom 1 Aerator: Aerator Picture #	Bathroom 2 Shower: Exists? (Y/N)	Bathroom 2 Shower: Shower (Y/N)	Bathroom 2 Shower: Shower Picture #	Bathroom 2 Aerator: Aerator (Y/N)	Bathroom 2 Aerator: Aerator Picture #	Survey: Complete? (Y/N)	Survey: Result (A,B,C, D,E)	Survey: Incentive? (Y/N)	Survey: Letter? (Y/N)
[redacted]		N	N	133	N	132	N	131	N								
2			N	136	N	135	N	134									
3		N	N	129	N	127	N	128									
4		N	N	142	N	140	N	141			Pass tub Pressure						
5		N	N	144	N	145	N	143									
6																	

[redacted]

Sign-Off Area

The undersigned hereby acknowledge that on this date the above mentioned units were inspected for Hot Water Conservation measures.

X [redacted]

SeeLine Group Ltd.

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Union Gas Ltd. – Hot Water Conservation (HWC) Program Review

Inspection Details

Inspector Name & Phone: [redacted]

Inspection Date & Time: [redacted]
(Date) (Time)

ORDER DETAIL
SH: 1
KA:
BA: 2

Facility Details – Non Multi-Family

Customer (Hotel/Motel, School, Dorm, LTC Facility, Other): ___Other_____

Contact Name & Phone: [redacted]

Location Address: [redacted]
(Street Address) (#Units) (# Floors)

	Suite #	Floor #	Tenant (Y/N)	Kitchen Aerator Aerator (Y/N)	Kitchen Aerator Kitchen Aerator Picture #	Bathroom 1 Shower Shower (Y/N)	Bathroom 1 Shower Shower Picture #	Bathroom 1 Aerator Aerator (Y/N)	Bathroom 1 Aerator Aerator Picture #	Bathroom 2 Shower Exists? (Y/N)	Bathroom 2 Shower Shower (Y/N)	Bathroom 2 Shower Shower Picture #	Bathroom 2 Aerator Aerator (Y/N)	Bathroom 2 Aerator Aerator Picture #	Survey Complete? (Y/N)	Survey Result (A,B,C,D,E)	Survey Incentive? (Y/N)	Survey Leder? (Y/N)
1	~~[illegible]~~	~~[illegible]~~																
2	W.C	male		—		—		N	P-23									
3	W.C.	female						N	P-24									
4	kitchen	upstairs	N	P-25		—		—	—									
5	kitchen	downstairs	N	P-26		—		—	—									
6																		

[redacted]

Sign-Off Area

The undersigned hereby acknowledge that on this date the above mentioned units were inspected for Hot Water Conservation measures.

X_[redacted]

(Facility Super Intendant / Owner) (Inspector)

SeeLine Group Ltd.

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Union Gas Ltd. – Hot Water Conservation (HWC) Program Review

Inspection Details

Inspector Name & Phone: [redacted]

Inspection Date & Time: [redacted]
(Date) (Time)

ORDER DETAIL
SH:
KA:
BA:

Facility Details – Non Multi-Family

Customer (Hotel/Motel, School, Dorm, LTC Facility, Other): _____LTC Facility_____

Contact Name & Phone: [redacted]

Location Address: [redacted]

	Suite #	Floor #	Tenant (Y/N)	Kitchen		Bathroom 1				Bathroom 2					Survey			
				Aerator		Shower		Aerator		Shower			Aerator		Complete? (Y/N)	Result (A,B,C,D,E)	Intensive? (Y/N)	Letter? (Y/N)
				Aerator (Y/N)	Kitchen Aerator Picture #	Shower (Y/N)	Shower Picture #	Aerator (Y/N)	Aerator Picture #	Dual? (Y/N)	Shower (Y/N)	Shower Picture #	Aerator (Y/N)	Aerator Picture #				
1	[redacted]		N	—	—	Y	P-71	N	P-72									
2			N	—	—	Y	P-73	Y	P-74									
3			N	—	—	Y	P-75	Y	P-76									
4			Y	—	—	Y	P-77	Y	P-78									
5			N	—	—	Y	P-79	Y	P-80									
6																		

[redacted]

Sign-Off Area

The undersigned hereby acknowledge that on this date the above mentioned units were inspected for Hot Water Conservation measures.

[redacted]

(Facility Super Intendant / Owner) (Inspector)

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Union Gas Ltd. – Hot Water Conservation (HWC) Program Review

Inspection Details

Inspector Name & Phone: [redacted]

Inspection Date & Time: [redacted]

(Date) (Time)

SH:	230
KA:	136
BA:	214

Facility Details – Non Multi-Family

Customer (Hotel/Motel, School, Dorm, LTC Facility, Other): [redacted]

Contact Name & Phone [redacted]

Location Address: [redacted]

(Street Address) (#Units) (# Floors)

	Suite #	Floor #	Tenant (Y/N)	Kitchen Aerator		Bathroom 1 Shower		Bathroom 1 Aerator		Bathroom 2 Shower			Bathroom 2 Aerator		Survey			
				Aerator (Y/N)	Kitchen Aerator Picture #	Shower (Y/N)	Shower Picture #	Aerator (Y/N)	Aerator Picture #	Exists? (Y/N)	Shower (Y/N)	Shower Picture #	Aerator (Y/N)	Aerator Picture #	Com-plete? (Y/N)	Result (A,B,C, D,E)	In-centive? (Y/N)	Letter? (Y/N)
1	[redacted]		N	N	201	N	197	N	198	Y	Y	199	N	200	N			Y # 191
2			N	Y	206	Y	202	N	204	Y	Y	204	Y	205	N			N
3			N	N	211	Y	207	N	208	Y	Y	209	N	210	N			N
4			N	Y	216	Y	212	N	213	Y	Y	214	N	215	N			N
5			N	Y	219	N	217	N	218	N								
6																		

[redacted]

union gas

enersmart [redacted]

Union Gas Ltd. – Hot Water Conservation (HWC) Program Review

Inspection Details

Inspector Name & Phone: [redacted]

Inspection Date & Time: [redacted]

(Date) (Time)

ORDER DETAIL	
SH:	230
KA:	136
BA:	214

Facility Details – Non Multi-Family

Customer (Hotel/Motel, School, Dorm, LTC Facility, Other): [redacted]

Contact Name & Phone: [redacted]

Location Address: [redacted]

(Street Address) (#Units) (# Floors)

	Suite #	Floor #	Tenant (Y/N)	Kitchen Aerator Aerator (Y/N)	Kitchen Aerator Kitchen Aerator Picture #	Bathroom 1 Shower Shower (Y/N)	Bathroom 1 Shower Shower Picture #	Bathroom 1 Aerator Aerator (Y/N)	Bathroom 1 Aerator Aerator Picture #	Bathroom 2 Shower Exists? (Y/N)	Bathroom 2 Shower Shower (Y/N)	Bathroom 2 Shower Shower Picture #	Bathroom 2 Aerator Aerator (Y/N)	Bathroom 2 Aerator Aerator Picture #	Survey Complete? (Y/N)	Survey Result (A,B,C,D,E)	Survey Incentive? (Y/N)	Survey Letter? (Y/N)
1	[redacted]		N	N	276	N	272	273	273	Y	N	274	N	275	NA			
2			N	N	301	N	277	N	278	Y	N	279	N	300	NA			
3			Y	N	305	N	302	N	303	Y	N	[illegible]	N	304 A	NA			
4			N	N	303 B	N	305B	N	306	Y	N	308	N	307	NA			
5			N	N	310	N	[illegible]	N	308B	Y	N	309	N	309B	NA			
6																		

[redacted]

Sign-Off Area

The undersigned hereby acknowledge that on this date the above mentioned units were inspected for Hot Water Conservation measures.

[redacted]

SeeLine Group Ltd.

uniongas

enersmart

[redacted]

Union Gas Ltd. – Hot Water Conservation (HWC) Program Review

Inspection Details

Inspector Name & Phone: [redacted]

Inspection Date & Time:

SHOWERHEAD
SH: 230
KA: 136
BA: 214

Facility Details – Non Multi-Family

Customer (Hotel/Motel, School, Dorm, LTC Facility, Other): [redacted]

Contact Name & Phone: [redacted]

(Fu

Location Address: [redacted]

4 tenant kitchens (Street Address) (#Units) (# Floors)

	Suite #	Floor #	Tenant (Y/N)	Kitchen Aerator: Aerator (Y/N)	Kitchen Aerator: Kitchen Aerator Picture #	Bathroom 1 Shower: Shower (Y/N)	Bathroom 1 Shower: Shower Picture #	Bathroom 1 Aerator: Aerator (Y/N)	Bathroom 1 Aerator: Aerator Picture #	Bathroom 2 Shower: Exists? (Y/N)	Bathroom 2 Shower: Shower (Y/N)	Bathroom 2 Shower: Shower Picture #	Bathroom 2 Aerator: Aerator (Y/N)	Bathroom 2 Aerator: Aerator Picture #	Survey: Complete? (Y/N)	Survey: Result (A,B,C,D,E)	Survey: Incentive? (Y/N)	Survey: Letter? (Y/N)
1	[redacted]		Y	N	311B	Y	311B	N	311	N								
2			N	—	—	Y	312	Y	312B									
3			N	N	314	N	313	N	313B									
4			N	N	314B	Y	315	Y	315B									
5			N	N	316	Y	317	Y	317B									
6																		

[redacted]

Sign-Off Area

The undersigned hereby acknowledge that on this date the above mentioned units were inspected for Hot Water Conservation measures.

[redacted]

SeeLine Group Ltd.

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Union Gas Ltd. – Hot Water Conservation (HWC) Program Review

Inspection Details

Inspector Name & Phone: [redacted]

Inspection Date & Time:

ORDER DETAIL

SH: 114

KA: 35

BA: 56

Facility Details – Non Multi-Family

Customer (Hotel/Motel, School, Dorm, LTC Facility, Other): [redacted]

Contact Name & Phone [redacted]

(Full Nam

Location Address:

(Street Address) (#Units) (# Floors)

	Suite #	Floor #	Tenant (Y/N)	Kitchen Aerator: Aerator (Y/N)	Kitchen Aerator: Kitchen Aerator Picture #	Bathroom 1 Shower: Shower (Y/N)	Bathroom 1 Shower: Shower Picture #	Bathroom 1 Aerator: Aerator (Y/N)	Bathroom 1 Aerator: Aerator Picture #	Bathroom 2 Shower: Exists? (Y/N)	Bathroom 2 Shower: Shower (Y/N)	Bathroom 2 Shower: Shower Picture #	Bathroom 2 Aerator: Aerator (Y/N)	Bathroom 2 Aerator: Aerator Picture #	Survey: Com-plete? (Y/N)	Survey: Result (A,B,C, D,E)	Survey: In-centive? (Y/N)	Survey: Letter? (Y/N)
1	[redacted]		N	N	319	N	318	N	318B									
2			N	Y	320B	N	319B	Y	320									
3			Y	Y	322	N	321	Y	321B									
4			N	Y	322B	Y	322B	N	223									
5			N	N	325	Y	324	Y	324B									
6																		

[redacted]

Sign-Off Area [redacted]

The undersigned hereby acknowledge that on this date the above mentioned units were inspected for Hot Water Conservation measures.

X [redacted]

uniongas

ener

enersource

Union Gas Ltd. – Hot Water Conserv[redacted]

Inspection Details

Inspector Name & Phone: [redacted]

Inspection Date & Time:

(Date) (Time)

UNIT DETAIL	
SH:	[illegible]
KA:	[illegible]
BA:	[illegible]

Facility Details – Non Multi-Family

Customer (Hotel/Motel, School, Dorm, LTC Facility, Other): [redacted]

Contact Name & Phone [redacted]

(Full Nam[redacted]Phone)

Location Address:

(Street Address) (#Units) (# Floors)

	Suite #	Floor #	Tenant (Y/N)	Kitchen Aerator		Bathroom 1 Shower		Bathroom 1 Aerator		Bathroom 2 Shower			Bathroom 2 Aerator		Survey			
				Aerator (Y/N)	Kitchen Aerator Picture #	Shower (Y/N)	Shower Picture #	Aerator (Y/N)	Aerator Picture #	Exists? (Y/N)	Shower (Y/N)	Shower Picture #	Aerator (Y/N)	Aerator Picture #	Com-plete? (Y/N)	Result (A,B,C, D,E)	In-centive? (Y/N)	Letter? (Y/N)
1		2	N			Y	325B	Y	326									
2		2	|			Y	326B	Y	327									
[redacted]		1	|			—		Y	327B									
		1	|			Y	328	Y	328B									
		1	|	Y	329													

[redacted]

Sign-Off Area

The undersigned hereby acknowledge that on this date the above mentioned units were inspected for Hot Water Conservation measures.

X [redacted]

SeeLine Group Ltd.

uniongas

Union Gas Ltd. – Hot Water Conservation (HWC) Program Review

Inspection Details

Inspector Name & Phone: [redacted]

Inspection Date & Time: [redacted]

(Date) (Time)

Facility Details – non- MULTI-FAMILY- [redacted]

Super / Owner Name & Phone [redacted]

Location Address: [redacted]

ORDER DETAIL	
SK:	15
KA:	7
BA:	15

	Suite #	Floor #	Tenant (Y/N)	Kitchen Aerator: Aerator (Y/N)	Kitchen Aerator: Kitchen Aerator Picture #	Bathroom 1 Shower: Shower (Y/N)	Bathroom 1 Shower: Shower Picture #	Bathroom 1 Aerator: Aerator (Y/N)	Bathroom 1 Aerator: Aerator Picture #	Bathroom 2 Shower: Exists? (Y/N)	Bathroom 2 Shower: Shower (Y/N)	Bathroom 2 Shower: Shower Picture #	Bathroom 2 Aerator: Aerator (Y/N)	Bathroom 2 Aerator: Aerator Picture #	Survey: Com-plete? (Y/N)	Survey: Result (A,B,C, D,E)	Survey: In-centive? (Y/N)	Survey: Letter? (Y/N)
1	[redacted]			N	D-67	Y	D-69	Y	D-68									
2				Y	D-70	Y	D-71	Y	D-72									
3				Y	D-73	Y	D-74	Y	D-75									
4				Y	D-76	Y	D-77	Y	D-78									
5				Y	D-79	Y	D-80	Y	D-81									
6																		

[redacted]

Sign-Off Area

The undersigned hereby acknowledge that on this date the above mentioned units were inspected for Hot Water Conser[redacted]

X_____

(Inspector)

SeeLine Group Ltd.

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A Spectra Energy Company

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Union Gas Ltd. – Hot Water Conservation (HWC) Program Review

Inspection Details

Inspector Name & Phone: [redacted]

Inspection Date & Time: [redacted]

(Date) (Time)

Unit Info	
SH:	100 ✓
KA:	
BA:	

Facility Details – Non Multi-Family

Customer (Hotel/Motel, **School**, Dorm, LTC Facility, Other): [redacted]

Contact Name & Phone: [redacted]

Location Address:

(Street Address) (#Units) (# Floors)

	Suite #	Floor #	Tenant (Y/N)	Kitchen Aerator Aerator (Y/N)	Kitchen Aerator Kitchen Aerator Picture #	Bathroom 1 Shower Shower (Y/N)	Bathroom 1 Shower Shower Picture #	Bathroom 1 Aerator Aerator (Y/N)	Bathroom 1 Aerator Aerator Picture #	Bathroom 2 Shower Exists? (Y/N)	Bathroom 2 Shower Shower (Y/N)	Bathroom 2 Shower Shower Picture #	Bathroom 2 Aerator Aerator (Y/N)	Bathroom 2 Aerator Aerator Picture #	Survey Com-plete? (Y/N)	Survey Result (A,B,C,D,E)	Survey In-centive? (Y/N)	Survey Letter? (Y/N)
1			N	N/A		Y	D-27	N	D-29		Y	D-41	N	D-50				
2			N	N/A		Y	D-28				Y	D-42	N	D-51				
3			N	N/A		Y	D-30	N	D-32		Y	D-43						
4			N	N/A		Y	D-31				Y	D-44						
5			N	N/A		Y	D-33				Y	D-45						
6																		

General Comments:

- SWIMMING POOL HAS BATHROOM WITH 5 SHOWERS AND 2 AERATORS
- ADMINISTRATION BUILDING (BATHROOM 2) HAS BATHROOM WITH 5 SHOWERS AND 2 AERATORS
- BOTH BUILDINGS HAVE SAME ADDRESS.

Sign-Off Area

The undersigned hereby acknowledge that on this date the above mentioned units were inspected for Hot Water Conservation measures.

[redacted]

(Facility Super Intendant / Owner) (Inspector)

uniongas
A Spectra Energy Company

enersmart

Union Gas Ltd. – Hot Water Conservation (HWC) Program Review

Inspection Details

Inspector Name & Phone: [redacted]

Inspection Date & Time:

ORDER DETAIL

SH: 40

KA: 0

BA: 40

Facility Details – Non Multi-Family

Customer (Hotel/Motel, School, Dorm, LTC Facility, Other): Hotel

Contact Name & Phone: [redacted]

(Full Name – Print Clearly) (Phone)

Location Address: [redacted]

(Street Address) (#Units) (# Floors)

	Suite #	Floor #	Tenant (Y/N)	Kitchen Aerator		Bathroom 1 Shower		Bathroom 1 Aerator		Bathroom 2 Shower			Bathroom 2 Aerator		Survey			
				Aerator (Y/N)	Kitchen Aerator Picture #	Shower (Y/N)	Shower Picture #	Aerator (Y/N)	Aerator Picture #	Exists? (Y/N)	Shower (Y/N)	Shower Picture #	Aerator (Y/N)	Aerator Picture #	Complete? (Y/N)	Result (A,B,C,D,E)	Incentive? (Y/N)	Letter? (Y/N)
1	101	1	N	N	N	N	233	N	234	Y								
2	108	1	N	N	N	N	235	N	236									
3	114	1	N	N	N	N	237	N	238									
4	201	2	N	N	N	N	239	N	240									
5	201	2	N	N	N	N	241	N	242									
6																		

General Comments: [illegible]

Sign-Off Area

The undersigned hereby acknowledge that on this date the above mentioned units were inspected for Hot Water Conservation measures.

X_ [redacted]

SeeLine Group Ltd.

uniongas

enerspark

Union Gas Ltd. – Hot Water Conservation (HWC) Program Review

Inspection Details

Inspector Name & Phone: [redacted]

Inspection Date & Time: [redacted]

(Date) (Time)

ORDER OF TASK	
SH	26
KA	0
BA	26

Facility Details – Non Multi-Family

Customer (**Hotel/Motel**, School, Dorm, LTC Facility, Other): Motel

Contact Name & Phone: [redacted]

Location Address:

	Suite #	Floor #	Tenant (Y/N)	Kitchen		Bathroom 1				Bathroom 2					Survey			
				Aerator		Shower		Aerator		Shower			Aerator		Com-plete? (Y/N)	Result (A,B,C, D,E)	In-centive? (Y/N)	Letter? (Y/N)
				Aerator (Y/N)	Kitchen Aerator Picture #	Shower (Y/N)	Shower Picture #	Aerator (Y/N)	Aerator Picture #	Exists? (Y/N)	Shower (Y/N)	Shower Picture #	Aerator (Y/N)	Aerator Picture #				
1	18		N	N	N	Y	D-82	N	D-83									
2	15		N	N	N	Y	D-84	N	D-85									
3	7		N	N	N	Y	D-86	N	D-87									
4	6		N	N	N	Y	D-88	N	D-89									
5	4		N	N	N	Y	D-90	N	D-91									
6																		

General Comments: MOTEL

Sign-Off Area

The undersigned hereby acknowledge that on this date the above mentioned units were inspected for Hot Water Conservatio[redacted]

X_[redacted]

(Facility Superintendant / Owner) (Inspector)

SeeLine Group Ltd.

union gas
A Spectra Energy Company

enersmart
Conserve - Save - Comfort

Union Gas Ltd. – Hot Water Conservation (HWC) Program Review

Inspection Details

Inspector Name & Phone: [redacted]

Inspection Date & Time: [redacted]

(Date) (Time)

ORDER DETAIL

SH: 32

KA: 30

BA: 30

Facility Details – Non Multi-Family

Customer (Hotel/Motel, School, Dorm, LTC Facility, Other): Hotel

Contact Name & Phone: [redacted]

Location Address: [redacted]

(Street Address) (#Units) (# Floors)

	Suite #	Floor #	Tenant (Y/N)	Kitchen Aerator Aerator (Y/N)	Kitchen Aerator Kitchen Aerator Picture #	Bathroom 1 Shower Shower (Y/N)	Bathroom 1 Shower Shower Picture #	Bathroom 1 Aerator Aerator (Y/N)	Bathroom 1 Aerator Aerator Picture #	Bathroom 2 Shower Exists? (Y/N)	Bathroom 2 Shower Shower (Y/N)	Bathroom 2 Shower Shower Picture #	Bathroom 2 Aerator Aerator (Y/N)	Bathroom 2 Aerator Aerator Picture #	Survey Com-plete? (Y/N)	Survey Result (A,B,C D,E)	Survey In-centive? (Y/N)	Survey Letter? (Y/N)
1	16	1	N	—	—	Y	P-1	Y	P-2									
2	18	1	N	—	—	Y	P-3	Y	P-4									
3	14	1	N	—	—	Y	P-5	Y	P-6									
4	12	1	N	—	—	Y	P-7	Y	P-8									
5	8	1	N	—	—	Y	P-9	Y	P-10									
6																		

General Comments: No kitchens in rooms. Recieved 32 showerheads, 30 aerators and 30 kitchen aerators confirmed. Letter was recieved

Sign-Off Area

The undersigned hereby acknowledge that on this date the above mentioned units were inspected for Hot Water Conservation measures.

X [redacted]

(Facility Super Intendant / Owner) (Inspector)

SeeLine Group Ltd.

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Inspection Details

Inspector Name & Phone: [redacted]

Inspection Date & Time: [redacted]

(Date) (Time)

ORDER DETAIL
SH: 8
KA: 7
BA: 9

Facility Details – Non Multi-Family

Customer (Hotel/Motel, School, Dorm, LTC Facility, Other): ____Hotel_____

Contact Name & Phone [redacted]

Location Address: [redacted]

(Street Address) (#Units) (# Floors)

	Suite #	Floor #	Tenant (Y/N)	Kitchen Aerator (Y/N)	Kitchen Aerator Picture #	Bathroom 1 Shower (Y/N)	Bathroom 1 Shower Picture #	Bathroom 1 Aerator (Y/N)	Bathroom 1 Aerator Picture #	Bathroom 2 Shower Exists? (Y/N)	Bathroom 2 Shower (Y/N)	Bathroom 2 Shower Picture #	Bathroom 2 Aerator (Y/N)	Bathroom 2 Aerator Picture #	Survey Complete? (Y/N)	Survey Result (A,B,C,D,E)	Survey Incentive? (Y/N)	Survey Letter? (Y/N)
1	[illegible]	1	N	—	—	—	—	N	P-143									
2	[illegible]	1	N	—	—	Y	P-144	—	—									
3	[illegible]	[illegible]	N	N	P-145	Y	P-147	N	P-146									
4	2nd building kitchen & bath	N	N	P-148	Y	P-149	N	P-150										
5	2nd building upstairs bathroom	N	—	—	Y	P-151	N	P-152										
6																		

[redacted]

The undersigned hereby acknowledge that on this date the above mentioned units were inspected for Hot Water Conservation measures.

[redacted]

(Facility Super Intendant / Owner) (Inspector)

SeeLine Group Ltd.

uniongas

enersmart

Union Gas Ltd. – Hot Water Conservation (HWC) Program Review

Inspection Details

Inspector Name & Phone: [redacted]

Inspection Date & Time: [redacted]

(Date) (Time)

SH:	6
KA:	4
BA:	5

Facility Details – Non Multi-Family

Customer (Hotel/Motel, School, Dorm, LTC Facility, **Other**): [redacted]

Contact Name & [redacted]

Location Address: [redacted]

(Street Address) (#Units) (# Floors)

	Suite #	Floor #	Tenant (Y/N)	Kitchen		Bathroom 1				Bathroom 2					Survey			
				Aerator		Shower		Aerator		Shower			Aerator		Com-plete? (Y/N)	Result (A,B,C, D,E)	In-centive? (Y/N)	Letter (Y/N)
				Aerator (Y/N)	Kitchen Aerator Picture #	Shower (Y/N)	Shower Picture #	Aerator (Y/N)	Aerator Picture #	Exists? (Y/N)	Shower (Y/N)	Shower Picture #	Aerator (Y/N)	Aerator Picture #				
1	BASEMENT			Y	D105	Y	D97	Y	D103	N								
2	BASEMENT			Y	D106	Y	D98	Y	D104	N								
3	BASEMENT			N/A	N/A	Y	D99	N/A	N/A	N								
4	BASEMENT			N/A	N/A	Y	D100	N/A	N/A	N								
5	MAIN FLOOR			N/A	N/A	Y	D101	N/A	N/A	N								
6																		

[redacted]

Sign-Off Area

The undersigned hereby acknowledge that on this date the above mentioned units were inspected for Hot Water Conservatior [redacted]

X_____

(Facility Super Intendant / Owner) (Inspector)

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Union Gas Ltd. – Hot Water Conservation (HWC) Program Review

Inspection Details

Inspector Name & Phone: [redacted]

Inspection Date & Time: [redacted]

(Date) (Time)

CHECK DETAIL	
SH:	1
KA:	3
BA:	7

Facility Details – Non Multi-Family

Customer (Hotel/Motel, School, Dorm, LTC Facility, **Other**): [redacted]

Contact Name & Phone: [redacted]

Location Address: [redacted]

	Suite #	Floor #	Tenant (Y/N)	Kitchen Aerator		Bathroom 1 Shower		Bathroom 1 Aerator		Bathroom 2 Shower			Bathroom 2 Aerator		Survey			
				Aerator (Y/N)	Kitchen Aerator Picture #	Shower (Y/N)	Shower Picture #	Aerator (Y/N)	Aerator Picture #	Exists? (Y/N)	Shower (Y/N)	Shower Picture #	Aerator (Y/N)	Aerator Picture #	Complete? (Y/N)	Result (A,B,C,D,E)	Incentive? (Y/N)	Letter? (Y/N)
1	FIRST		N	N/A	N/A	N	D3	N	D-1	N								
2	GROUND		N	N	D-5	N/A	N/A	N	D-6	N								
3	GROUND		N	N	D-7	N/A	N/A	N/A	N/A	N								
4	GROUND		N	N	D-8	N/A	N/A	N/A	N/A	N								
5	GROUND		N.	N/A	N/A	N/A	N/A	N	D04	N								
6																		

Sign-Off Area

The undersigned here[redacted]ledge that on this date the above mentioned units were inspected for Hot Water Conservation m[redacted]

X_____ X_____

(Facility Super In[redacted]wner) (Inspector)

SeeLine Group Ltd.

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Union Gas Ltd. – Hot Water Conservation (HWC) Program Review

Inspection Details

Inspector Name & Phone: [redacted]

Inspection Date & Time:

(Date) (Time)

[redacted]	6
[redacted]	6
[redacted]	6

Facility Details – Non Multi-Family

Customer (Hotel/Motel, School, Dorm, LTC Facility, Other): [redacted]

Contact Name & Pho[redacted]

(Full Name – Print Clear[redacted]

Location Address:

(Street Address) (#Units) (# Floors)

	Suite #	Floor #	Tenant (Y/N)	Kitchen Aerator: Aerator (Y/N)	Kitchen Aerator: Kitchen Aerator Picture #	Bathroom 1 Shower: Shower (Y/N)	Bathroom 1 Shower: Shower Picture #	Bathroom 1 Aerator: Aerator (Y/N)	Bathroom 1 Aerator: Aerator Picture #	Bathroom 2 Shower: Exists? (Y/N)	Bathroom 2 Shower: Shower (Y/N)	Bathroom 2 Shower: Shower Picture #	Bathroom 2 Aerator: Aerator (Y/N)	Bathroom 2 Aerator: Aerator Picture #	Survey: Complete? (Y/N)	Survey: Result (A,B,C,D,E)	Survey: Incentive? (Y/N)	Survey: Letter? (Y/N)
1	FIRST	FLOOR	N	Y	D 138	N/A	N	N	D139	N/A								
2	MAIN	FLOOR	N	N	D 141		N	N	D 140	N/A								
3	BASEMENT		N	N	D 144	N/A	N	N	D 142	N/A								
4								N	D 143									
5																		
6																		

[redacted]

Sign-Off Area

The undersigned hereby acknowledge that on this date the above mentioned units were inspected for Hot Water Conservation measures.

[redacted]

(Facility Super Intendant / Owner) (Inspector)

SeeLine Group Ltd.

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Inspection Details

Inspector Name & Phone: [redacted]

Inspection Date & Time: [redacted]

(Date) (Time)

ORDER DETAIL
SH: 136
KA: 0
BA: 148

Facility Details – Non Multi-Family

Customer (Hotel/Motel, School, Dorm, LTC Facility, Other): ____LTC Facility_____

Contact Name & Phone [redacted]

Location Address: [redacted]

(Street Address) (#Units) (# Floors)

	Suite #	Floor #	Tenant (Y/N)	Kitchen Aerator Aerator (Y/N)	Kitchen Aerator Kitchen Aerator Picture #	Bathroom 1 Shower Shower (Y/N)	Bathroom 1 Shower Shower Picture #	Bathroom 1 Aerator Aerator (Y/N)	Bathroom 1 Aerator Aerator Picture #	Bathroom 2 Shower Exists? (Y/N)	Bathroom 2 Shower Shower (Y/N)	Bathroom 2 Shower Shower Picture #	Bathroom 2 Aerator Aerator (Y/N)	Bathroom 2 Aerator Aerator Picture #	Survey Complete? (Y/N)	Survey Result (A,B,C,D,E)	Survey Incentive? (Y/N)	Survey Letter? (Y/N)
1	[redacted]		N	Y	P-11	Y	P-12	Y	P-13									
2			N	—	—	Y	P-14	N	P-15									
3			Y	—	—	Y	P-16	Y	P-17									
4			Y	—	—	Y	P-18	Y	P-19									
5			Y	Y	P-22	Y	P-20	Y	P-21									
6																		

[redacted]

Sign-Off Area

The undersigned hereby acknowledge that on this date the above mentioned units were inspected for Hot Water Conservation measures.

X [redacted]

(Facility Super Intendant / Owner) (Inspector)

SeeLine Group Ltd.

union gas
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Union Gas Ltd. – Hot Water Conservation (HWC) Program Review

Inspection Details

Inspector Name & Phone: [redacted]

Inspection Date & Time: [redacted]
(Date) (Time)

ORDER DETAIL
SH: 40
KA: 40
BA: 40

Facility Details – Non Multi-Family

Customer (Hotel/Motel, School, Dorm, LTC Facility, Other): LTC Facility

Contact Name & Phone: [redacted]

Location Address: [redacted]
(Street Address) (#Units) (# Floors)

	Suite #	Floor #	Tenant (Y/N)	Kitchen		Bathroom 1				Bathroom 2					Survey			
				Aerator		Shower		Aerator		Shower			Aerator		Complete? (Y/N)	Result (A,B,C,D,E)	Incentive? (Y/N)	Letter (Y/N)
				Aerator (Y/N)	Kitchen Aerator Picture #	Shower (Y/N)	Shower Picture #	Aerator (Y/N)	Aerator Picture #	Exists? (Y/N)	Shower (Y/N)	Shower Picture #	Aerator (Y/N)	Aerator Picture #				
1	[redacted]		Y	Y	P-23	Y	P-24	Y	P-25									
2			Y	Y	P-26	Y	P-27	Y	P-28									
3			N	N	P-29	Y	P-30	N	P-31									
4			Y	Y	P-32	N	P-33	Y	P-34									
5			Y	Y	P-35	Y	P-36	Y	P-37									
6																		

[redacted]

Sign-Off Area

The undersigned hereby acknowledge that on this date the above mentioned units were inspected for Hot Water Conservation measures.

[redacted]
(Facility Super Intendant / Owner) (Inspector)

Appendix E – Field Data:

VERIF DATE / TIME	Building Type	Building Address	Unit	Tenant (Y/N)	Shower (Y/N)	Shower Picture	Bathroom Aerator (Y/N)	Bathroom Aerator Picture	Kitchen Aerator (Y/N)	Kitchen Aerator Picture	2nd Bathroom	Shower2 (Y/N)	Shower2 Picture	Bathroom 2 Aerator (Y/N)	Bathroom 2 Aerator Picture	Survey Complete	Survey Result	Incentive Paid	Letter Left Ensuite	Initial UGL Letter Recieved y/n/na (DONT KNOW)	SH,FA
Fri-02-Nov-- 11 00 am	Ed Lg Backup	[redacted]	[redacted]	Y	N	MK01	N	MK02	N	MK05	Y	Y	MK03	Y	MK04	Y	A	N			
	Ed Lg Backup		[redacted]	N	Y	MK06	Y	MK07	N	MK08	N										
	Ed Lg Backup		[redacted]	Y	Y	MK09	Y	MK10	Y	MK13	Y	Y	MK11	Y	MK12						
	Ed Lg Backup		[redacted]	N	Y	MK14	N	MK15	N	MK16	N										
	Ed Lg Backup		[redacted]	Y	Y	MK17	Y	MK18	Y	MK21	Y	Y	MK19	Y	MK20						
Tues-06-Nov-- 11 30 am	Other Lg Backup	[redacted]	[redacted]	N	Y	MK50	N	MK51	N	MK54	N										
	Other Lg Backup		[redacted]	Y	Y	MK52	N	MK53	NA	NA	N										
	Other Lg Backup		[redacted]	N	Y	MK55	N	MK56	NA	NA	N										
	Other Lg Backup		[redacted]	N	Y	MK57	N	MK58	N	MK59	N										
	Other Lg Backup		[redacted]	N	Y	MK60	N	MK61	N	MK62	N										
Tues-06-Nov-- 10 30 am	HM Lg Backup	[redacted]	[redacted]	N	Y	MK37	Y	MK38	NA	NA	N										
	HM Lg Backup		[redacted]	N	Y	MK39	Y	MK40	NA	NA	N										
	HM Lg Backup		[redacted]	N	Y	MK41	N	MK42	Y	MK43	N										
	HM Lg Backup		[redacted]	N	Y	MK44	Y	MK45	Y	MK46	N										
	HM Lg Backup		[redacted]	N	Y	MK47	N	MK48	Y	MK49	N										
Tues-06-Nov-- 12 20 pm	HM Sm Backup	[redacted]	[redacted]	N	Y	MK78	N	MK79	NA	NA	N										
	HM Sm Backup		[redacted]	N	Y	MK80	N	MK81	NA	NA	N										
	HM Sm Backup		[redacted]	N	Y	MK82	N	MK83	NA	NA	N										
	HM Sm Backup		[redacted]	N	Y	MK84	N	MK85	NA	NA	N										
	HM Sm Backup		[redacted]	N	Y	MK86	N	MK87	NA	NA	N										
Weds-14-Nov-- 12 30 pm	HM Lg Backup	[redacted]	[redacted]	N	Y	MK161	Y	MK162	NA	NA	N										
	HM Lg Backup		[redacted]	N	Y	MK163	Y	MK164	NA	NA	N										
	HM Lg Backup		[redacted]	N	Y	MK165	Y	MK166	NA	NA	N										
	HM Lg Backup		[redacted]	N	Y	MK167	Y	MK168	NA	NA	N										
	HM Lg Backup		[redacted]	N	Y	MK169	Y	MK170	NA	NA	N										
Weds-14-Nov-- 9 30 am	Other Sm Backup	[redacted]	[redacted]	N	N	MK132	N	MK131	N	MK133	N										
	Other Sm Backup		[redacted]	N	N	MK134	N	MK135	N	MK136	N										
	Other Sm Backup		[redacted]	N	N	MK137	N	MK138	N	MK139	N										
	Other Sm Backup		[redacted]	N	N	MK140	N	MK141	N	MK142	N										
	Other Sm Backup		[redacted]	N	N	MK145	N	MK143	N	MK144	N										
Wed-31-Oct – 11 30 AM	HM Sm Backup	[redacted]	[redacted]	Y	Y	P-10	N	P-11	Y	P-9	N			Y	P-12	Y	NA		P-101		
	HM Sm Backup		[redacted]	N	Y	P-2	N	P-11	NA	NA											
	HM Sm Backup		[redacted]	N	Y	P-3	N	P-4	NA	NA											
	HM Sm Backup		[redacted]	N	Y	P-5	N	P-6	NA	NA											
	HM Sm Backup		[redacted]	N	Y	P-7	N	P-8	NA	NA											
Tue-06-Nov – 12 00 PM	HM Sm Primary	[redacted]	[redacted]	N	Y	P-13	N	P-14	NA	NA											
	HM Sm Primary		[redacted]	N	N	P-15	N	P-16	NA	NA											
	HM Sm Primary		[redacted]	N	Y	P-17	N	P-18	NA	NA											
	HM Sm Primary		[redacted]	N	Y	P-19	N	P-20	NA	NA											
	HM Sm Primary		[redacted]	N	Y	P-21	N	P-22	NA	NA											

VERIF DATE / TIME	Building Type	Building Address	Unit	Tenant (Y/N)	Shower (Y/N)	Shower Picture	Bathroom Aerator (Y/N)	Bathroom Aerator Picture	Kitchen Aerator (Y/N)	Kitchen Aerator Picture	2nd Bathroom	Shower2 (Y/N)	Shower2 Picture	Bathroom 2 Aerator (Y/N)	Bathroom 2 Aerator Picture	Survey Complete	Survey Result	Incentive Paid	Letter Left Ensuite	Initial UGL Letter Recieved y/n/na (DONT KNOW)	SH,FA
Wed-07-Nov – 12 00 PM	Other Sm Backup	[redacted]	[redacted]	NA	NA	NA	N	P-23	NA	NA											
	Other Sm Backup	[redacted]	[redacted]	NA	NA	NA	N	P-24	NA	NA											
	Other Sm Backup	[redacted]	[redacted]	NA	NA	NA	NA	NA	N	P-25											
	Other Sm Backup	[redacted]	[redacted]	NA	NA	NA	NA	NA	N	P-26											
	Other Sm Backup																				
Wed-07-Nov – 1 00 PM	HM Sm Backup	[redacted]	[redacted]	N	Y	P-28	N	P-29	N	P-27											
	HM Sm Backup		[redacted]	N	Y	P-30	N	P-31	NA	NA											
	HM Sm Backup		[redacted]	N	Y	P-32	N	P-33	NA	NA											
	HM Sm Backup		[redacted]	N	Y	P-34	N	P-35	NA	NA											
	HM Sm Backup		[redacted]	N	Y	P-36	N	P-37	NA	NA											
Wed-14-Nov – 11 00 AM	Ed Sm Primary	[redacted]	[redacted]	N	NA	NA	NA	NA	Y	P-38											
	Ed Sm Primary		[redacted]	N	NA	NA	Y	P-39	NA	NA											
	Ed Sm Primary		[redacted]	N	Y	P-40	Y	P-41	NA	NA											
	Ed Sm Primary		[redacted]	N	Y	P-42	Y	P-43	NA	NA	N			Y	P-44						
	Ed Sm Primary		[redacted]	N	NA	NA	NA	NA	Y	P-45											
Wed-14-Nov – 11 30 AM	Ed Sm Primary	[redacted]	[redacted]	N	Y	P-47	Y	P-48	Y	P-46											
	Ed Sm Primary		[redacted]	N	Y	P-49	Y	P-50	NA	NA											
	Ed Sm Primary		[redacted]	N	Y	P-51	Y	P-52	NA	NA											
	Ed Sm Primary		[redacted]	N	NA	NA	Y	P-53	NA	NA											
	Ed Sm Primary		[redacted]	Y	Y	P-54	Y	P-55	NA	NA											
Wed-14-Nov – 1 00 PM	Ed Lg Primary	[redacted]	[redacted]	Y	Y	P-56	N	P-57	Y	P-58											
	Ed Lg Primary		[redacted]	N	N	P-60	N	p-61	N	P-59											
	Ed Lg Primary		[redacted]	N	N	P-63	N	p-64	N	P-62											
	Ed Lg Primary		[redacted]	Y	N	P-66	N	P-67	N	p-65											
	Ed Lg Primary		[redacted]	Y	N	p-69	N	P-70	N	p-68											
Wed-14-Nov – 2 00 PM	Other Lg Primary	[redacted]	[redacted]	N	Y	P-71	N	P-72	NA	NA											
	Other Lg Primary		[redacted]	N	Y	p-73	Y	p-74	NA	NA											
	Other Lg Primary		[redacted]	N	Y	P-75	Y	P-76	NA	NA											
	Other Lg Primary		[redacted]	Y	Y	P-77	Y	p-78	NA	NA											
	Other Lg Primary		[redacted]	N	Y	P-79	Y	P-80	NA	NA											

SeeLine Building Ltd

VERIF DATE / TIME	Building Type	Building Address	Unit	Tenant (Y/N)	Shower (Y/N)	Shower Picture	Bathroom Aerator (Y/N)	Bathroom Aerator Picture	Kitchen Aerator (Y/N)	Kitchen Aerator Picture	2nd Bathroom	Shower2 (Y/N)	Shower2 Picture	Bathroom 2 Aerator (Y/N)	Bathroom 2 Aerator Picture	Survey Complete	Survey Result	Incentive Paid	Letter Left Ensuite	Initial UGL Letter Recieved y/n/na (DONT KNOW)	SH,FA
Wed-Feb-20th- 12:15 pm	edu	[redacted]	[redacted]	n	n	MK197	n	MK198	n	MK201	y	y	MMK19	n	MK200	N			y - letter	y	230 214 136
	edu	[redacted]	[redacted]	n	y	MK202	n	MK203	y	MK206	y	y	MK204	y	MK205	N/A					
	edu	[redacted]	[redacted]	n	y	MK207	n	MK208	n	MK211	y	y	MK209	n	MK210	N/A					
	edu	[redacted]	[redacted]	n	y	MK212	n	MK213	y	MK216	y	y	MK214	n	MK215	N/A					
	edu	[redacted]	[redacted]	n	n	MK217	n	MK218	y	MK219	n										
Thur-Feb 21- 9 00 am	accom	[redacted]	[redacted]	n	n	MK233B	n	MMK234	N/A	n	n									n	40,40,0
	accom	[redacted]	[redacted]	n	n	MK235	n	MK236	N/A	n	n										
	accom	[redacted]	[redacted]	n	n	MK237	n	MK238	N/A	n	n										
	accom	[redacted]	[redacted]	n	n	MK239	n	MK240	N/A	n	n										
	accom	[redacted]	[redacted]	n	n	MK241	n	MK242	N/A	n	n										
Thur-Feb 21- 1 00 pm	edu	[redacted]	[redacted]	n	n	MK272	n	MK273	n	MK276	y	n	MK274	n	MK275	N/A				y	
	edu	[redacted]	[redacted]	n	n	MK277	n	MK378	n	MK301	y	n	MK279	n	MK300	N/A					
	edu	[redacted]	[redacted]	y	n	MK302	n	MK303	n	MK305	y	n	MK304	n	MK304A	N/A					
	edu	[redacted]	[redacted]	n	n	MK305B	n	MK306	n	MK307B	y	n	MK306B	n	MK307	N/A					
	edu	[redacted]	[redacted]	n	n	MK308	n	308B	n	MK310	y	n	MK309	n	MK309B	N/A					
Thur-Feb 21- 1:15 pm	edu	[redacted]	[redacted]	y	y	MK310B	n	MK311	n	MK311B	n									y	
	edu	[redacted]	[redacted]	n	y	MK312	y	MK312B	N/A	n	n										
	edu	[redacted]	[redacted]	n	n	MK313	n	MK313B	n	MK314	n										
	edu	[redacted]	[redacted]	n	y	MK315	y	MK315B	n	MK314B	n										
	edu	[redacted]	[redacted]	n	y	MK317	y	MK317B	n	MK316	n										
Thur-Feb 21- 2:15 pm	edu	[redacted]	[redacted]	n	n	MK318	n	MK318B	n	MK319	n									y	114,38,38
	edu	[redacted]	[redacted]	n	n	MK319B	y	MK320	y	MK320B	n										
	edu	[redacted]	[redacted]	y	n	MK321	y	MK321B	y	MK322	n										
	edu	[redacted]	[redacted]	n	y	MK322B	n	MK323	y	MK323B	n										
	edu	[redacted]	[redacted]	n	y	MK324	y	MK324B	y	MK325	n										
Thur-Feb 21- 2:15 pm	edu	[redacted]	[redacted]	n	y	MK325B	y	MK326	N/A	n	n									y	15,6,7
	edu	[redacted]	[redacted]	n	y	MK326B	y	MK327	N/A	n	n										
	edu	[redacted]	[redacted]	n	N/A	n	y	MK327B	N/A	n	n										
	edu	[redacted]	[redacted]	n	y	MK328	y	MK328B	N/A	n	n										
	edu	[redacted]	[redacted]	n	N/A	n	N/A	n	y	MK329	n										
Weds-25-Feb—9:45 AM	edu	[redacted]	[redacted]	N	Y	D69	Y	D68	N	D67	N/A									y	15, 15, 7
	edu	[redacted]	[redacted]	N	Y	D71	Y	D72	Y	D70	N/A										
	edu	[redacted]	[redacted]	N	Y	D74	Y	D75	Y	D73	N/A										
	edu	[redacted]	[redacted]	N	Y	D77	Y	D78	Y	D76	N/A										
	edu	[redacted]	[redacted]	N	Y	D80	Y	D81	Y	D79	N/A										

SeeLine Group Ltd.

VERIF DATE / TIME	Building Type	Building Address	Unit	Tenant (Y/N)	Shower (Y/N)	Shower Picture	Bathroom Aerator (Y/N)	Bathroom Aerator Picture	Kitchen Aerator (Y/N)	Kitchen Aerator Picture	2nd Bathroom	Shower2 (Y/N)	Shower2 Picture	Bathroom 2 Aerator (Y/N)	Bathroom 2 Aerator Picture	Survey Complete	Survey Result	Incentive Paid	Letter Left Ensuite	Initial UGL Letter Recieved y/n/na (DONT KNOW)	SH,FA
Weds-25-Feb--11 30 AM	accom	[redacted]	[redacted]	N	Y	D82	N	D83	N/A		N/A									n	26, 26,0
	accom		[redacted]	N	Y	D84	N	D85	N/A		N/A										
	accom		[redacted]	N	Y	D86	N	D87	N/A		N/A										
	accom		[redacted]	N	Y	D88	N	D89	N/A		N/A										
	accom		[redacted]	N	y	D90	N	D91	N/A		N/A										
Weds-13-Feb--1 30 PM	edu	[redacted]	[redacted]	N	Y	D41	N	D50	N/A		N/A										
	edu				Y	D42	N	D51	N/A												
	edu				Y	D43	N/A	N/A	N/A												
	edu				Y	D44	N/A	N/A	N/A												
	edu				Y	D45	N/A	N/A	N/A												
Weds-25-Feb--12 30 PM	other	[redacted]	[redacted]	N	Y	D97	Y	D103	Y	D105										n	6, 5, 4
	other				Y	D98	Y	D104	Y	D106											
	other				Y	D99	N/A		N/A												
	other				Y	D100	N/A		N/A												
	other				Y	D101	N/A		N/A												
Weds-Feb-13-9 40	other	[redacted]	[redacted]		N	D03	N	D01	N/A	N/A										n	1,2,3
	other		[redacted]		N/A	N/A	N	D06	N	D05											
	other		[redacted]		N/A	N/A	N/A	N/A	N	D07											
	other		[redacted]		N/A	N/A	N/A	N/A	N	D08											
	other				N/A	N/A	N	D04	N/A	N/A											
Tues-5-Mar--12 00 PM	other	[redacted]	[redacted]	N	N/A	N/A	N	D139	Y	D138	N/A									n	6, 6, 6
	other		[redacted]	N	N/A	N/A	N	D140	N	D141	N/A										
	other		[redacted]	N	N/A	N/A	N	D142	N	D144	N/A										
	other				N/A	N/A	N	D143	N/A	N/A											
Wed-13-Feb – 1 30 PM	accom	[redacted]	[redacted]	N	Y	P-1	Y	P-2	N/A	N/A										Yes	32,30,30
	accom		[redacted]	N	Y	P-3	Y	P-4	N/A	N/A											
	accom		[redacted]	N	Y	P-5	Y	P-6	N/A	N/A											
	accom		[redacted]	N	Y	P-7	Y	P-8	N/A	N/A											
	accom		[redacted]	N	Y	P-9	Y	P-10	N/A	N/A											
Wed-13-Feb – 3 15 PM	other	[redacted]	[redacted]	N	Y	P-12	Y	P-13	Y	P-11										NA	NA
	other		[redacted]	N	Y	P-14	N	P-15	N/A	N/A											
	other		[redacted]	Y	Y	P-16	Y	P-17	N/A	N/A											
	other		[redacted]	Y	Y	P-18	Y	p-19	N/A	N/A											
	other		[redacted]	Y	Y	P-20	Y	P-21	Y	P-22											
Wed-13-Feb – 3 30 PM	other	[redacted]	[redacted]	Y	Y	P-24	Y	P-25	Y	P-23										NA	NA
	other		[redacted]	Y	Y	P-27	Y	P-28	Y	P-26											
	other		[redacted]	N	Y	P-30	N	P-31	N	P-29											
	other		[redacted]	Y	N	P-33	Y	P-34	Y	P-32											
	other		[redacted]	Y	Y	P-36	Y	P-37	Y	P-35											
Thu-14-Feb – 3 30 PM	accom	[redacted]	[redacted]	N	N/A	N/A	N	P-143	N/A	N/A										N/A	N/A
	accom		[redacted]	N	Y	P-144	N/A	N/A	N/A	N/A											
	accom		[redacted]	N	Y	P-147	N	P-146	N	P-145											
	accom		[redacted]	N	Y	P-149	N	P-150	N	p-148											
	accom		[redacted]	N	Y	P-151	N	P-152	N/A	N/A											

Appendix F – Photos of Installed Measures:


MK -09
MK- 10
MK-11
MK – 12
MK – 13
MK – 14
MK – 15
MK – 16


MK – 17
MK – 18
MK -19
MK- 20
Sunlight
MK-21
MK – 37
MK – 38
MK -39


MK-40
MK-41
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MK – 43
MK – 44
MK – 45
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MK – 47


MK – 48
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MK – 56
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MK -59
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MK-61
MK – 62
MK – 78


MK -79
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MK-81
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MK – 84
MK – 85
MK – 86

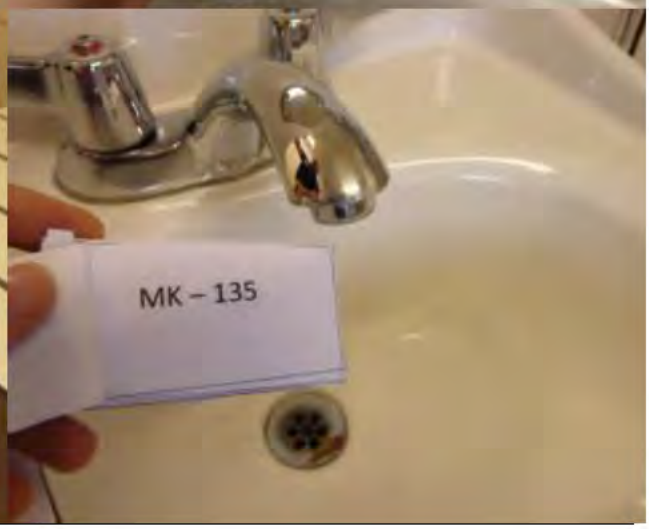

MK – 87


MK-131


MK – 132


MK – 133


MK – 134


MK – 135


MK – 136
MK – 137
MK – 138
MK -139
MK- 140
MK-141

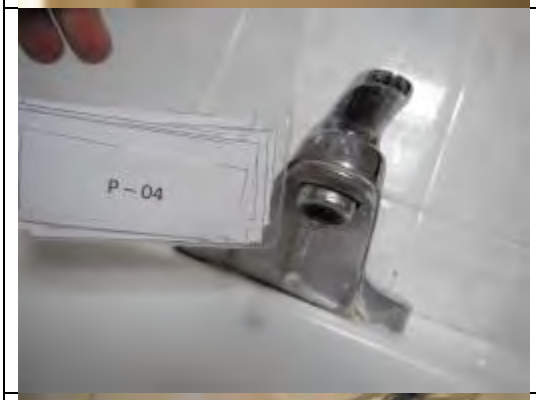

MK – 142
MK – 143
MK – 144
MK – 145
MK-161
MK – 162


MK – 163
MK – 164
MK – 165
MK – 166
MK – 167
MK – 168


MK -169
MK- 170


P-02


P – 03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P – 05


P – 06


P – 07


P – 08


P – 09


P-10

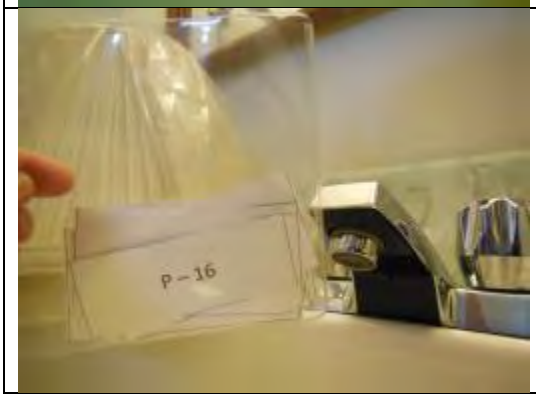

P-11


P-12


P-13


P-14


P-15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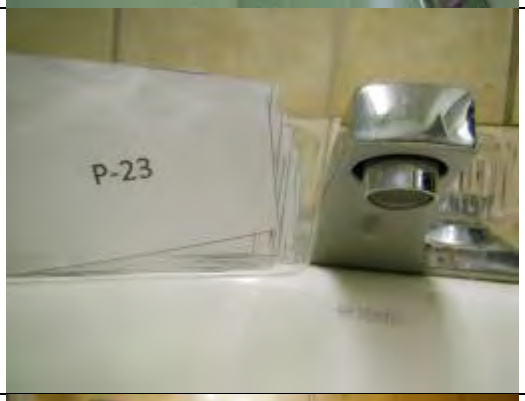
P – 18


P – 19


P – 20


P – 21


P-22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P -24


P- 25

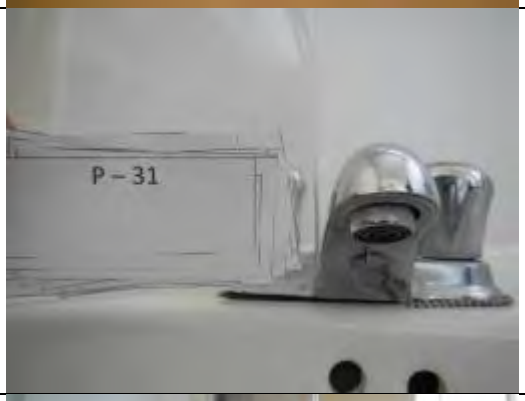

P-26


P – 27


P – 28


P – 29


P – 30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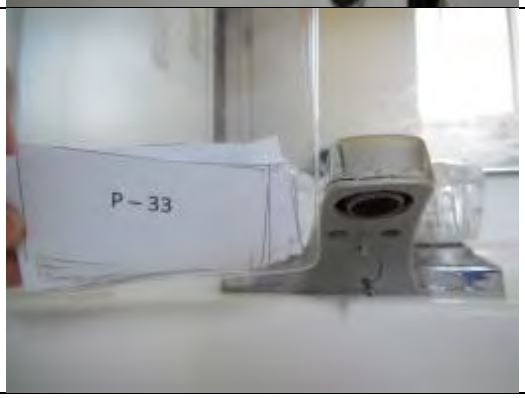
P – 32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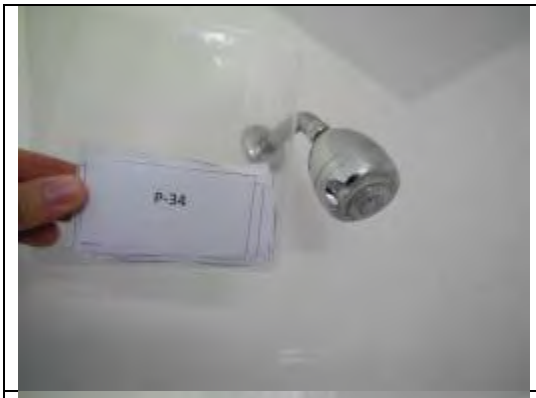
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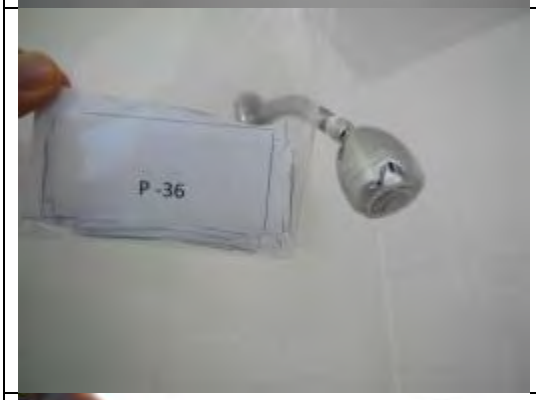
P-35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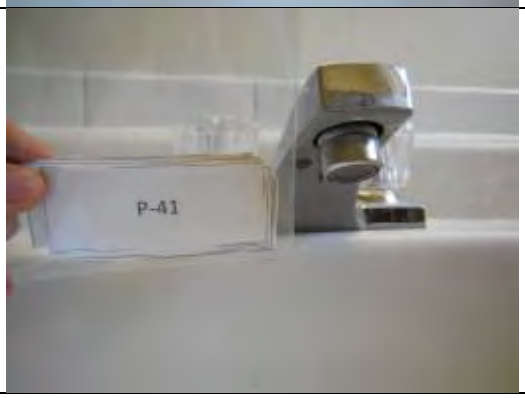
P-37


P-38


P-39


P-40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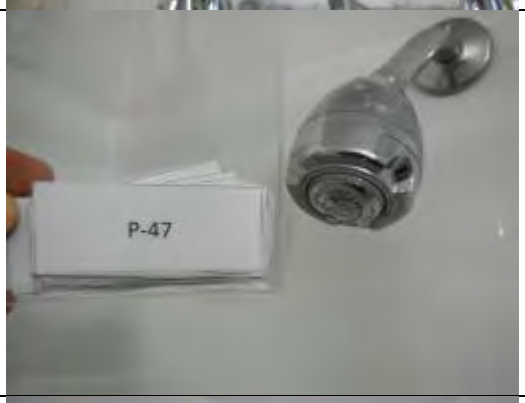
P-42


P-43


P-44


P-45


P-46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P-48


P-50


P-51

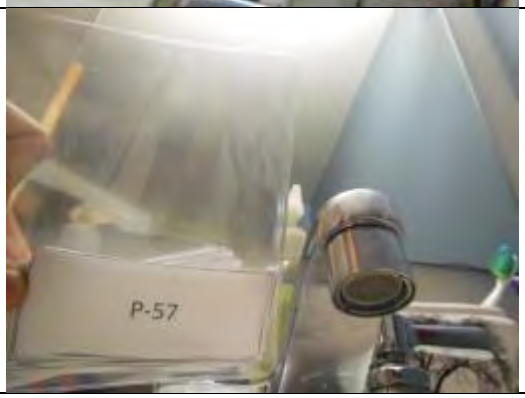

P-52


P-53


P-54


P-55


P-56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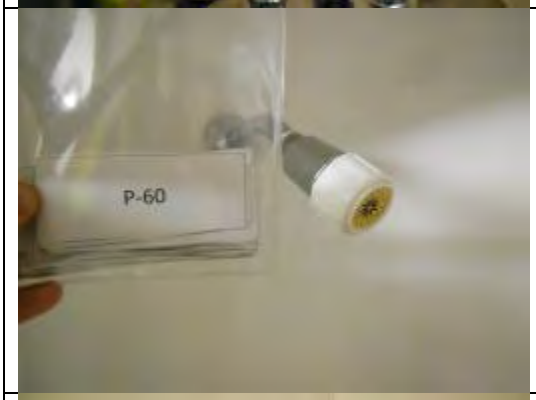
P-58


P-59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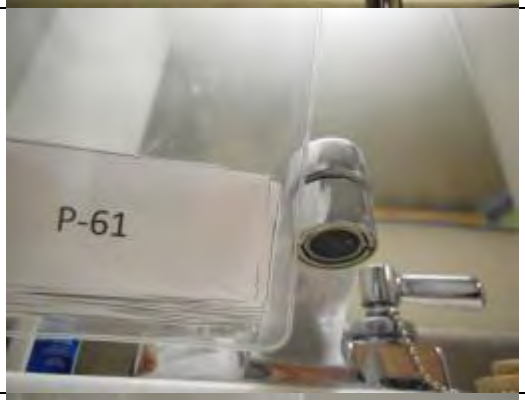
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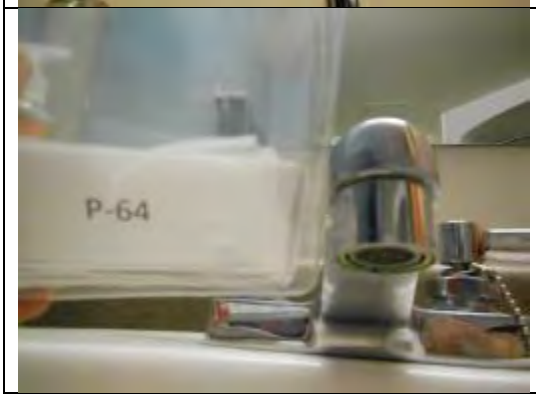
P-62


P-63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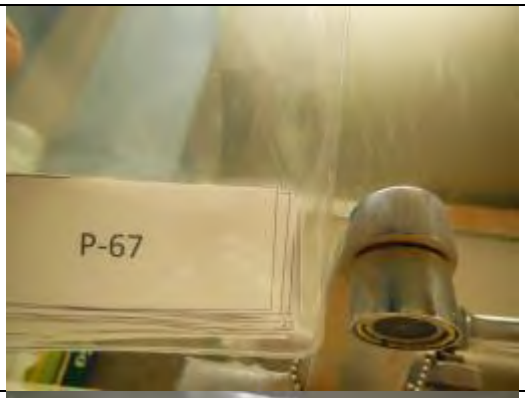
P-65

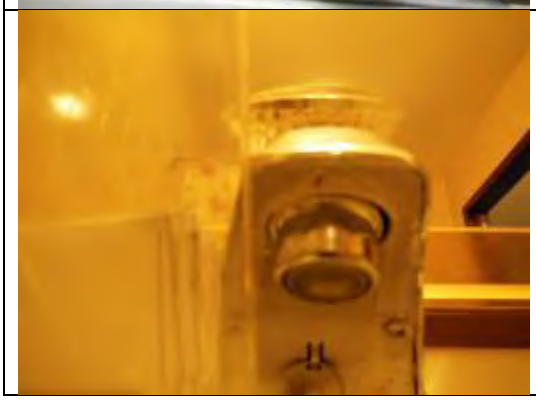

P-66


P-67


P-69


P-70


P-71



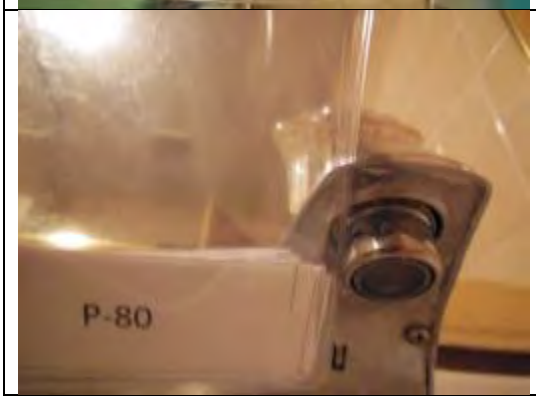

P-73


P-74


P-75


P-76


P-78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MK -199
MK- 200
MK-201
MK – 202
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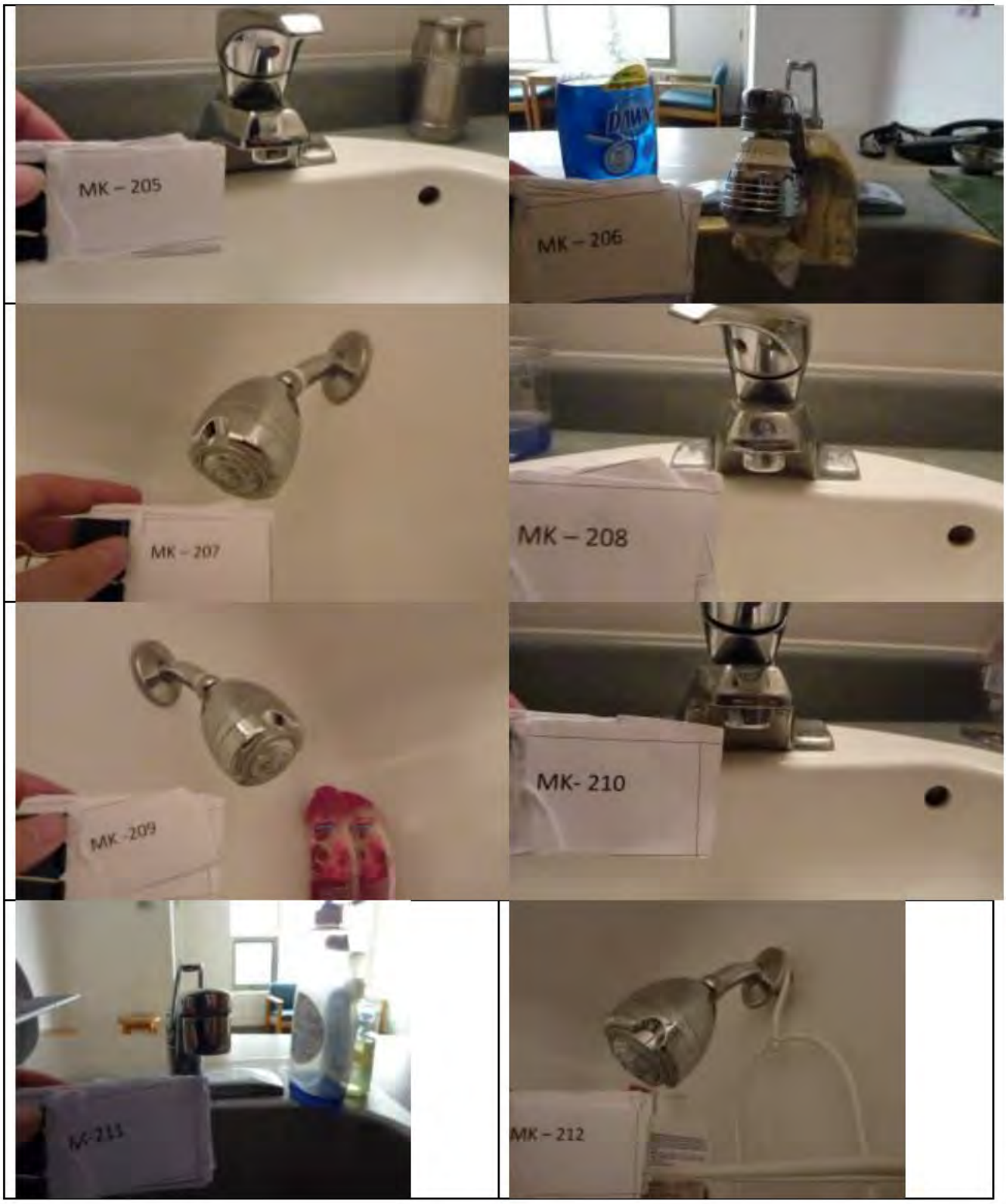
MK – 204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M-211
MK – 212


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MK – 218


MK -219
MK- 233
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MK – 238
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K- 240
K-241
MK – 272


MK – 273
MK – 274
MK – 275
MK – 276
MK – 277
MK – 278


MK-279
MK- 300
MK-301
MK – 302
MK – 303
MK – 304


MK – 304 A
IVORY
MK – 305
MK – 305 B
MK – 306
MK – 306 C
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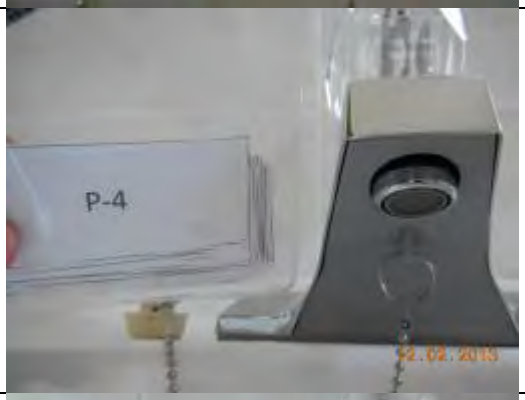
MK -329


P-1


P-2


P-3
12.02.2013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P-5


P-6

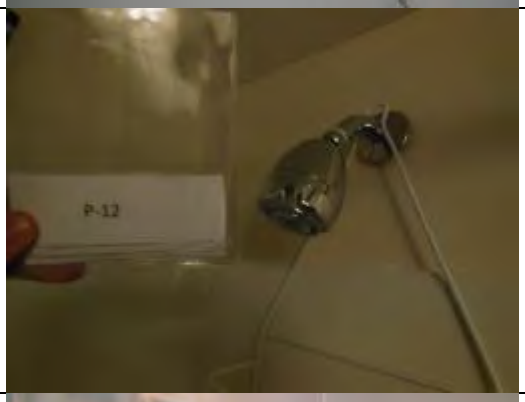

P-7
12.02.2013


P-8


P-9


P-10


P-11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P-13


P-14


P-15

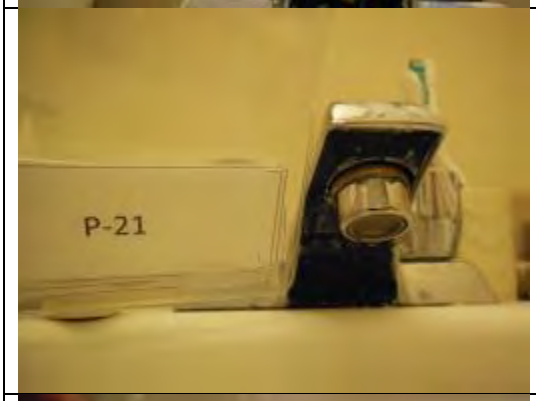

P-16


P-17


P-18


P-19


P-20


P-21


P-22


P-23


P-24


P-25


P-26


P-27


P-28


P-29


P-30


P-31


P-32


P-33


P-34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P-143


P-144


P-146

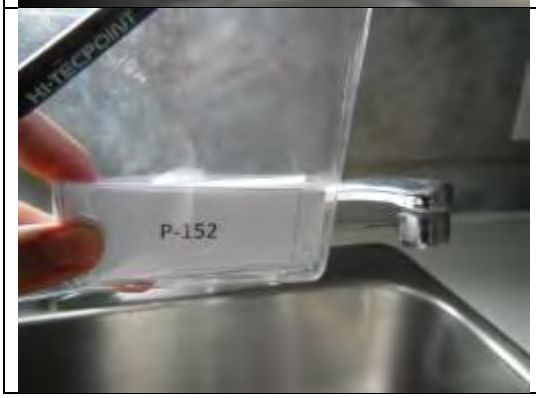

P-147


P-148


P-149


P-150


P-151


P-152


D - 1
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D - 5
D-6
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D-27


D-41
D-42
D-43
D-44
D-45
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D-68
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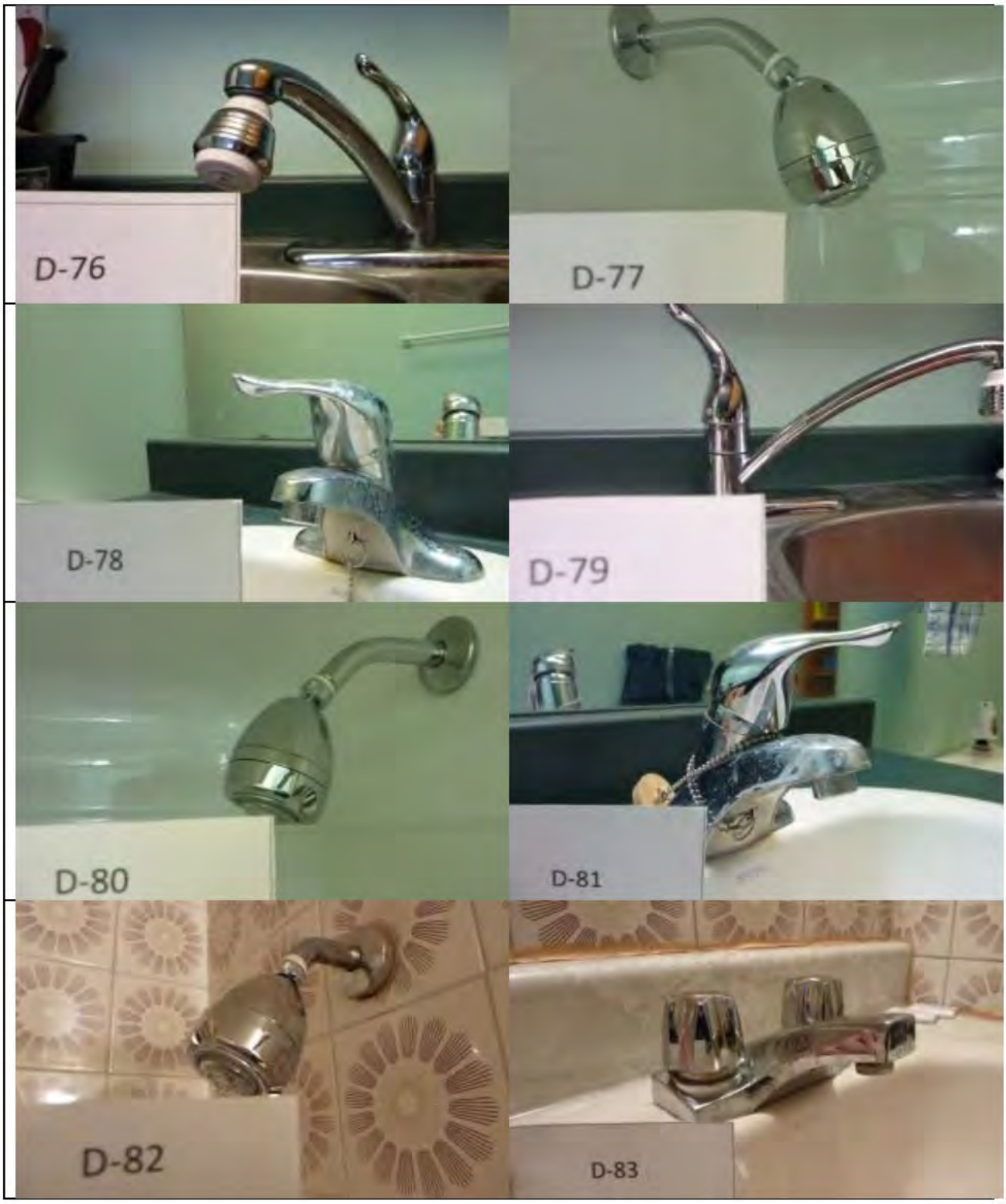
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D-83


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D-91


D-97
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D-101
D-103
D-104
D-105


D-106


D-138


D-139


D-140


D-141


D-142


D-143
D-144

Union Gas
2012 Commercial and Industrial and Low Income Project Verification

Union Gas
Toronto, ON

Michaels No.: UB512AAN

May 2013

400 Main Street, Suite 200
La Crosse, Wisconsin 54601
Phone 608-785-1900 Fax 608-784-2270
www.MichaelsEnergy.com

Union Gas 2012 Commercial and Industrial and Low Income Project Verification

Final Report

Table of Contents

Executive Summary

Union Gas delivers Demand Side Management (DSM) to their Ontario commercial, industrial, and low-income market customers through a Custom Rebate program. Incentives are based on energy savings relative to current actual use for retrofit projects, or relative to industry standard baselines in the case of new construction. Energy savings are calculated by trade allies, Union Gas staff, and/or Union Gas customers.

Michaels Energy was retained by Union Gas to perform technical project reviews and verification for the custom rebate portion of these demand side management programs. The main objectives of the review are:

1) Meet Ontario Energy Board requirements set forth in the "Demand Site Management Guidelines for Natural Gas Utilities" (EB-2008-0346) which indicates that evaluation "is a critical part of ensuring that programs are cost effective and generate the desired outcomes."
2) To provide an independent objective opinion on the reasonableness of the energy savings and equipment costs claimed by the custom projects through a review of a statistically representative sample of projects.

In order to complete the verification a total of twenty-nine projects were reviewed for the commercial and industrial program and twelve projects were reviewed for the low income program. Each project was reviewed and a subset of 26 commercial and industrial projects and 5 low income projects were selected for onsite inspection, while the remaining projects being verified by desk review.

A summary of the reported savings each of the projects selected for verification, as well as the verification methodology selected is presented in Table 1 for the Commercial and Industrial market projects and in Table 2 for the low income market projects.

Based on the results of the desk review and onsite inspection, the annual and lifetime natural gas savings, as well as the electric and water savings for each project was adjusted. As shown in Table 3 below, a total of 16 projects had the natural gas savings levels adjusted downwards, with the remaining 13 projects being adjusted upwards. Eleven projects were adjusted by less than 10%. Individual projects had gas savings realization rates ranging from 35.0% to 149.4% for annual savings and 35.0% to 209.3% for lifetime savings.

Similar to the commercial and industrial project, based on the results of the desk review and onsite inspection, the annual and lifetime natural gas savings, as well as the electric and water savings for each project was also adjusted. As shown in Table 4 below, a total of seven projects had the natural savings levels adjusted downwards, with three projects being adjusted upwards. Two projects were not adjusted. Six projects were adjusted by less than 10%. Individual projects had gas savings realization rates ranging from 60% to 158.9% for both annual and lifetime savings.

Table 1: Reported Costs and Savings for Commercial and Industrial Projects Reviewed

	Project	Technology	Natural Gas (m3)	Lifetime NG (m3)	Electrical (kWh)	Water (L)	Verification Method
Commercial & Industrial	**IND-0216**	EMS	1,200,528	11,044,858	1,448,820	-	Onsite
	COM-0102	Efficient Building	1,058,190	9,735,348	586,294	-	Onsite
	IND-0230	Building Rejuvination	2,018,082	18,566,354	5,885,639	7,610,052	Onsite
	IND-0176	Boiler	1,597,771	14,699,493	-	25,632,085	Onsite
	IND-0188	Boiler Repair	1,115,675	7,184,947	1,488,000	2,953,449	Onsite
	IN-0171	Burner Controls	1,667,381	15,339,905	-	-	Onsite
	IND-0156	Greenhouse curtain	1,920,653	4,417,502	-	-	Onsite
	IND-0220	Steam Traps	275,117	885,877	18,114	1,710,607	Onsite
	IND-0049	Heat Recovery	581,045	5,345,614	-	-	Onsite
	IND-0155	Steam Traps	428,837	1,380,855	-	550,366	Onsite
	IND-0079	[redacted] drying	318,377	2,929,068	-	43,049,034	Onsite
	COM-0020	Heat Recovery	415,905	3,826,326	-	-	Onsite
	IND-0225	[redacted] Dryer	296,704	2,729,677	152,500	-	Onsite
	COM-0057	Dock Doors	51,040	352,176	-	-	Onsite
	IND-0127	Heat Recovery	111,700	1,027,640	-	-	Onsite
	IND-0130	Plant Optimization	224,110	1,546,359	-	-	Onsite
	IND-0088	Greenhouse Glass	50,240	92,442	-	-	Onsite
	IND-0213	Linkageless controls	166,374	1,530,641	-	-	Onsite
	IND-0251	Temperature controls	712,243	6,552,636	-	-	Onsite
	IND-0532	Steam Leak Repair	5,242,292	24,114,543	-	64,851,144	Desk
	IND-0477	Process Improvements	1,811,219	16,663,215	-	-	Onsite
	IND-0187	Boiler	1,129,396	15,585,665	2,350	-	Onsite
	IND-0160	Temperature controls	691,732	6,363,932	-	-	Onsite
	IND-0524	Efficient Greenhouse	1,034,849	9,520,614	-	-	Onsite
	IND-0168	HVAC Controls	366,741	3,374,017	-	-	Desk
	COM-0092	[redacted] Dryer	255,454	2,350,177	24,000	-	Desk
	IND-0351	High-speed doors	383,978	3,532,598	-	-	Onsite
	IND-0107	High-speed doors	450,156	4,141,435	144,159	-	Onsite
	COM-0069	Heat Recovery	43,431	299,674	-	-	Onsite

Table 2: Reported Costs and Savings for Low Income Projects Reviewed

Project	Technology	Natural Gas (m3)	Lifetime NG (m3)	Electrical (kWh)	Water (L)	Verification Method
COM-0033	Roof Insulation	887	16,853	56,060	-	Desk
COM-0034	Boiler	23,277	486,489	-	-	Onsite
COM-0103	Windows	12,871	244,549	-	-	Desk
COM-0278	Heat Recovery	39,703	565,768	-	-	Onsite
COM-0277	Windows	5,608	106,552	-	-	Desk
COM-0287	Water Heater	2,167	41,173	-	-	Onsite
COM-0120	Water Heater	17,075	324,425	-	-	Onsite
COM-0274	Windows and doors	13,754	261,326	-	-	Desk
COM-0286	Roof Insulation	2,729	51,851	-	-	Desk
COM-0159	Weatherizing	4,865	92,435	-	-	Desk
COM-0157	Make-Up Air Unit	9,052	128,991	-	-	Onsite
COM-0116	Windows	7,655	159,990	738	-	Desk

Table 3: Overall Sample Realization Rates for Commercial and Industrial Projects

	Natural Gas (m3)			Lifetime NG (m3)			Electrical (kWh)			Water (L)			Incremental Cost		
	Ex Ante	Verified	RR	Ex Ante	Verified	RR	Ex Ante	Verified	RR	Ex Ante	Verified	RR	Ex Ante	Verified	RR
IND-0216	1,200,528	1,301,912	108.4%	11,044,858	7,186,553	65.1%	1,448,820	1,448,820	100.0%	-	-	N/A	$ 11,311	$ 11,311	100.0%
COM-0102	1,058,190	896,997	84.8%	9,735,348	8,252,372	84.8%	586,294	586,293	100.0%	-	-	N/A	$ 4,820,000	$ 4,820,000	100.0%
IND-0230	2,018,082	1,824,140	90.4%	18,566,354	16,782,085	90.4%	5,885,639	5,177,945	88.0%	7,610,052	2,262,088	29.7%	$ 2,500,000	$ 2,500,000	100.0%
IND-0176	1,597,771	1,351,320	84.6%	14,699,493	15,540,177	105.7%	-	-	N/A	25,632,085	-	0.0%	$ 435,562	$ 85,562	19.6%
IND-0188	1,115,675	1,254,586	112.5%	7,184,947	4,039,766	56.2%	1,488,000	-	0.0%	2,953,449	18,175,073	615.4%	$ 527,969	$ 527,969	100.0%
IND-0171	1,667,381	1,649,101	98.9%	15,339,905	9,103,036	59.3%	-	-	N/A	-	-	N/A	$ 38,091	$ 38,091	100.0%
IND-0156	1,920,653	2,010,051	104.7%	4,417,502	9,246,237	209.3%	-	-	N/A	-	-	N/A	$ 938,060	$ 938,060	100.0%
IND-0220	275,117	268,112	97.5%	885,877	863,320	97.5%	18,114	10,967	60.5%	1,710,607	3,377,506	197.4%	$ 18,252	$ 18,252	100.0%
IND-0049	581,045	694,171	119.5%	5,345,614	6,386,375	119.5%	-	-	N/A	-	-	N/A	$ 362,567	$ 362,567	100.0%
IND-0155	428,837	467,718	109.1%	1,380,855	1,506,051	109.1%	-	-	N/A	550,366	5,457,002	991.5%	$ 7,803	$ 7,803	100.0%
IND-0079	318,377	377,436	118.5%	2,929,068	3,472,408	118.5%	-	-	N/A	43,049,034	43,049,034	100.0%	$ 420,000	$ 949,620	226.1%
COM-0020	415,905	350,685	84.3%	3,826,326	3,226,301	84.3%	-	-	N/A	-	-	N/A	$ 10,755	$ 10,755	100.0%
IND-0225	296,704	222,316	74.9%	2,729,677	2,045,310	74.9%	152,500	24,000	15.7%	-	-	N/A	$ 640,000	$ 640,000	100.0%
COM-0057	51,040	13,497	26.4%	352,176	93,132	26.4%	-	-	N/A	-	-	N/A	$ 14,549	$ 14,549	100.0%
IND-0127	111,700	115,793	103.7%	1,027,640	1,065,294	103.7%	-	-	N/A	-	-	N/A	$ 69,999	$ 69,999	100.0%
IND-0130	224,110	234,322	104.6%	1,546,359	1,616,819	104.6%	-	-	N/A	-	-	N/A	$ 118,000	$ 118,000	100.0%
IND-0088	50,240	43,577	86.7%	92,442	100,227	108.4%	-	-	N/A	-	-	N/A	$ 9,849	$ 9,849	100.0%
IND-0213	166,374	239,635	144.0%	1,530,641	2,204,644	144.0%	-	-	N/A	-	-	N/A	$ 51,304	$ 51,304	100.0%
IND-0251	712,243	249,505	35.0%	6,552,636	2,295,448	35.0%	-	-	N/A	-	-	N/A	$ 8,225	$ 8,225	100.0%
IND-0532	5,242,292	4,805,708	91.7%	24,114,543	22,106,255	91.7%	-	-	N/A	64,851,144	61,855,200	95.4%	$ 28,435	$ 32,132	113.0%
IND-0477	1,811,219	1,534,337	84.7%	16,663,215	14,115,898	84.7%	-	-	N/A	-	-	N/A	$ 80,400	$ 80,400	100.0%
IND-0187	1,129,396	868,643	76.9%	15,585,665	9,989,396	64.1%	2,350	192,465	8190.0%	-	1,459,320	N/A	$ 285,000	$ 285,000	100.0%
IND-0160	691,732	699,078	101.1%	6,363,932	6,431,514	101.1%	-	-	N/A	-	-	N/A	$ 607,200	$ 607,200	100.0%
IND-0524	1,034,849	1,030,323	99.6%	9,520,614	9,478,973	99.6%	-	-	N/A	-	-	N/A	$ 1,056,453	$ 1,056,453	100.0%
IND-0168	366,741	520,680	142.0%	3,374,017	2,874,152	85.2%	-	-	N/A	-	-	N/A	$ 24,066	$ 24,066	100.0%
COM-0092	255,454	381,623	149.4%	2,350,177	3,510,932	149.4%	24,000	25,056	104.4%	-	-	N/A	$ 290,000	$ 290,000	100.0%
IND-0351	383,978	339,819	88.5%	3,532,598	3,126,333	88.5%	-	-	N/A	-	-	N/A	$ 27,800	$ 27,800	100.0%
IND-0107	450,156	586,487	130.3%	4,141,435	5,395,676	130.3%	144,159	-	0.0%	-	-	N/A	$ 64,500	$ 64,500	100.0%
COM-0069	43,431	43,045	99.1%	299,674	297,012	99.1%	-	-	N/A	-	-	N/A	$ 8,900	$ 8,900	100.0%

Table 4: Overall Sample Realization Rates for Low Income Projects

	Natural Gas (m3)			Lifetime NG (m3)			Electrical (kWh)			Water (L)			Incremental Cost		
	Ex Ante	Verified	RR	Ex Ante	Verified	RR	Ex Ante	Verified	RR	Ex Ante	Verified	RR	Ex Ante	Verified	RR
COM-0033	887	899	101.3%	16,853	17,076	101.3%	56,060	22,516	40.2%	-	-	N/A	$ 18,800	$ 18,800	100.0%
COM-0034	23,277	23,884	102.6%	486,489	567,252	116.6%	-	-	N/A	-	-	N/A	$ 262,500	$ 262,500	100.0%
COM-0103	12,871	11,100	86.2%	244,549	231,982	94.9%	-	-	N/A	-	-	N/A	$ 167,718	$ 167,718	100.0%
COM-0278	39,703	36,434	91.8%	565,768	519,180	91.8%	-	-	N/A	-	-	N/A	$ 233,626	$ 233,626	100.0%
COM-0277	5,608	4,154	74.1%	106,552	86,810	81.5%	-	-	N/A	-	-	N/A	$ 58,500	$ 58,500	100.0%
COM-0287	2,167	1,300	60.0%	41,173	24,700	60.0%	-	-	N/A	-	-	N/A	$ 68,637	$ 68,637	100.0%
COM-0120	17,075	14,150	82.9%	324,425	268,859	82.9%	-	-	N/A	-	-	N/A	$ 161,000	$ 161,000	100.0%
COM-0274	13,754	13,119	95.4%	261,326	274,188	104.9%	-	-	N/A	-	-	N/A	$ 353,315	$ 353,315	100.0%
COM-0286	2,729	2,729	100.0%	51,851	51,849	100.0%	-	-	N/A	-	-	N/A	$ 69,700	$ 69,700	100.0%
COM-0159	4,865	4,865	100.0%	92,435	92,442	100.0%	-	-	N/A	-	-	N/A	$ 44,400	$ 44,400	100.0%
COM-0157	9,052	7,388	81.6%	128,991	105,277	81.6%	-	-	N/A	-	-	N/A	$ 52,300	$ 13,000	24.9%
COM-0116	7,655	12,164	158.9%	159,990	254,228	158.9%	738	-	0.0%	-	-	N/A	$ 174,720	$ 174,720	100.0%

Based on the projects reviewed, the most common reason for adjustment to savings was that the equipment operated differently than expected or was installed differently than inspected, which accounted for the adjustments for 56% of the projects and accounted for 58% of the overall adjustments to natural gas savings. Calculation or engineering errors and inappropriate assumptions accounted for the remaining project adjustments, each accounting for approximately half of the number of projects and levels of natural gas savings adjustments.

In addition to verifying the savings estimates, the verification is tasked with providing recommendations to improve the program. Based on the projects verified, the following recommendations are made:

- ***Consider Expanding the Timeframe for Verification—***This year the work performed for the verification was greatly constrained by the timeline for the verification. Specifically, one project that was selected for an onsite inspection was not able to be completed, due to customer schedule constraints. Additionally, the timeframe did not allow for any metering, data collection via EMS trends, or other data collection methodologies that would have increased the potential accuracy of the verification. Expanding the timeline for the verification would greatly improve the ability to perform the verification to a high level.

- ***Continue to Utilize and Expand the use of Templates—***Several of the projects reviewed utilized templates or standardized calculations. The use of templates or standard calculations can greatly improve the accuracy and consistency of the program through several means. Therefore, we would encourage the expanded use of templates or standardized calculations.

- ***Collect Additional Information for Steam Leak Projects—***The largest project verified this year was a steam leak project. The analysis methodology was reasonable and appropriate; however, the accuracy of the savings estimates was limited by the information collected, which was insufficient to justify the savings estimate. It is recommended that whenever possible additional information be collected for projects of this type and/or magnitude.

- ***Verify Calculated Usage to Billed Data When Possible—***Two projects that involved the installation of efficient water heating systems has savings levels reduced significantly due to the original analysis basing savings on water usages that exceeded levels determined during the verification. For both of these projects a comparison of the energy usage for the facility during the summer months would have indicated that the usages in the analysis was likely excessive.

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1. Introduction

Union Gas delivers Demand Side Management (DSM) to their Ontario commercial, industrial, and low-income market customers through a Custom Rebate program. Incentives are based on energy savings relative to current actual use for retrofit projects, or relative to industry standard baselines in the case of new construction. Energy savings are calculated by trade allies, Union Gas staff, and/or Union Gas customers.

Michaels Energy was retained by Union Gas to perform technical project reviews for the custom rebate portion of their demand side management program. The main objectives of the review are:

3) Meet Ontario Energy Board requirements set forth in the "Demand Site Management Guidelines for Natural Gas Utilities" (EB-2008-0346) which indicates that evaluation "is a critical part of ensuring that programs are cost effective and generate the desired outcomes."
4) To provide an independent objective opinion on the reasonableness of the energy savings and equipment costs claimed by the custom projects through a review of a statistically representative sample of projects.

This is the final report for the review effort.

2. Verification Methodology

The scope of the verification was to include a paper review of the engineering algorithms and input assumptions to verify that the savings and costs were correctly calculated. The verification included a review of the project gas savings as well as associated electrical and water savings. In addition, a telephone interview was conducted to validate the installation of the equipment and confirm operating conditions and equipment costs for all projects.

This year, in addition to the desk reviews described above, for any project that it was deemed necessary to adequately characterize the operation and/or the savings, an on-site inspection was also completed. During the on-site visits, the installed equipment was visually verified to be installed, and its make and model, and any operating characteristics or settings were recorded. The customer was interviewed regarding the operation of the baseline and proposed systems, and any production records or trended data that was available was collected.

2.1. Verification Process

The verification process has up to three stages of review. The first stage is a technical review. The calculations and documentation of all 41 projects are reviewed in depth. The calculations are compared against information provided in the application and equipment data, as well as information collected during the customer or business partner interview for consistency, accuracy, and reasonableness of assumptions. If no calculations are provided, the savings are recalculated using any and all information available to the evaluator.

The second stage is the phone interview of the project customer and/or business partner. The customer and/or business partner is interviewed to verify information submitted on the application, as well as determine the operating conditions of the equipment installed.

The third stage, for many of the projects is an onsite inspection. Based on the recommendations of the Independent Auditor of the 2010 DSM verification, site visits were included in the verification process, starting with the 2011 verification. The projects were selected for on-sites based their total natural gas savings, TRC benefits, project complexity, and uncertainty in the *ex ante* analysis. The site visits for these five projects replaced the phone interview portion of the verification process. The information collected on-site was used to adjust the existing calculations or create new calculations to determine the verified savings.

2.2. Sample Overview

A total of twenty-nine projects were reviewed for the commercial and industrial program and twelve projects were reviewed for the low income program. According to the process outlined above, each project was reviewed to determine the expected level of complexity and uncertainty. Based on this review, coupled with the expected savings level and the potential for greater or more accurate data collection through an onsite inspection, the specific sites selected for onsite inspection and desk review were determined. Based on this review, a total of 26 commercial and industrial projects and 5 low income projects were selected for onsite inspection, while the remaining 3 commercial and industrial projects and 7 low income projects were verified by desk review. The breakdown of projects verified, including the savings and verification methodology, is given in Table 5 below.

Table 5 Costs, Savings, and Verification Methodology for Projects Reviewed

	Project	Technology	Natural Gas (m3)	Lifetime NG (m3)	Electrical (kWh)	Water (L)	Verification Method
Commercial & Industrial	IND-0216	EMS	1,200,528	11,044,858	1,448,820	-	Onsite
	COM-0102	Efficient Building	1,058,190	9,735,348	586,294	-	Onsite
	IND-0230	Building Rejuvination	2,018,082	18,566,354	5,885,639	7,610,052	Onsite
	IND-0176	Boiler	1,597,771	14,699,493	-	25,632,085	Onsite
	IND-0188	Boiler Repair	1,115,675	7,184,947	1,488,000	2,953,449	Onsite
	IN-0171	Burner Controls	1,667,381	15,339,905	-	-	Onsite
	IND-0156	Greenhouse curtain	1,920,653	4,417,502	-	-	Onsite
	IND-0220	Steam Traps	275,117	885,877	18,114	1,710,607	Onsite
	IND-0049	Heat Recovery	581,045	5,345,614	-	-	Onsite
	IND-0155	Steam Traps	428,837	1,380,855	-	550,366	Onsite
	IND-0079	[redacted] drying	318,377	2,929,068	-	43,049,034	Onsite
	COM-0020	Heat Recovery	415,905	3,826,326	-	-	Onsite
	IND-0225	[redacted] Dryer	296,704	2,729,677	152,500	-	Onsite
	COM-0057	Dock Doors	51,040	352,176	-	-	Onsite
	IND-0127	Heat Recovery	111,700	1,027,640	-	-	Onsite
	IND-0130	Plant Optimization	224,110	1,546,359	-	-	Onsite
	IND-0088	Greenhouse Glass	50,240	92,442	-	-	Onsite
	IND-0213	Linkageless controls	166,374	1,530,641	-	-	Onsite
	IND-0251	Temperature controls	712,243	6,552,636	-	-	Onsite
	IND-0532	Steam Leak Repair	5,242,292	24,114,543	-	64,851,144	Desk
	IND-0477	Process Improvements	1,811,219	16,663,215	-	-	Onsite
	IND-0187	Boiler	1,129,396	15,585,665	2,350	-	Onsite
	IND-0160	Temperature controls	691,732	6,363,932	-	-	Onsite
	IND-0524	Efficient Greenhouse	1,034,849	9,520,614	-	-	Onsite
	IND-0168	HVAC Controls	366,741	3,374,017	-	-	Desk
	COM-0092	[redacted] Dryer	255,454	2,350,177	24,000	-	Desk
	IND-0351	High-speed doors	383,978	3,532,598	-	-	Onsite
	IND-0107	High-speed doors	450,156	4,141,435	144,159	-	Onsite
	COM-0069	Heat Recovery	43,431	299,674	-	-	Onsite
Low Income	COM-0033	Roof Insulation	887	16,853	56,060	-	Desk
	COM-0034	Boiler	23,277	486,489	-	-	Onsite
	COM-0103	Windows	12,871	244,549	-	-	Desk
	COM-0278	Heat Recovery	39,703	565,768	-	-	Onsite
	COM-0277	Windows	5,608	106,552	-	-	Desk
	COM-0287	Water Heater	2,167	41,173	-	-	Onsite
	COM-0120	Water Heater	17,075	324,425	-	-	Onsite
	COM-0274	Windows and doors	13,754	261,326	-	-	Desk
	COM-0286	Roof Insulation	2,729	51,851	-	-	Desk
	COM-0159	Weatherizing	4,865	92,435	-	-	Desk
	COM-0157	Make-Up Air Unit	9,052	128,991	-	-	Onsite
	COM-0116	Windows	7,655	159,990	738	-	Desk

It should be noted that project IND-0477 was selected for onsite, as indicated in the table above, however, due to customer time constraints, no onsite visit was able to be performed for the verification.

2.3. Verification Guidelines

The following guidelines were used during the course of the verification process.

1. The original energy savings calculations incorporate the estimated equipment operation at the time of implementation. Therefore, the verification is also based on equipment operation at

the time of implementation. Adjustments are made if the system or equipment was not operating as described or portrayed in the original calculations at the time of implementation.

2. The verification includes assessment of savings claimed, as well as savings not claimed. Therefore, measures will be examined in depth to verify the existence or non-existence of electrical or water savings that are not claimed.

3. The verification includes assessment of the calculations and procedures used to determine the verified savings after an onsite visit (when applicable) had been conducted. For these projects, the presented savings include any adjustments made by the onsite evaluator and/or Michaels Energy.

4. The verification includes assessment of costs associated with the projects. Cost will be reviewed for reasonableness. In addition, the baseline and efficient system costs will be reviewed to ensure they are consistent with the equipment used to determine the savings.

2.4. Savings Adjustment Categories

Each calculation adjustment has been categorized into one of the following types.

Inappropriate Assumptions:	These are adjustments made because the assumptions used in the savings calculations resulted in unrealistically high or overly conservative energy savings. Unrealistic assumptions result in an incorrect energy use estimate before or after project implementation. Calculations resulting in incorrect savings from using the wrong baseline are included in this group.
Tracking Error:	These are adjustments made because the savings in the calculations do not match the savings ultimately used to determine the rebate for the project.
Calculation or Engineering Error:	These are adjustments made because of errors in applying engineering principles or general calculation errors not attributable to operation or installation.
Operated or Installed Differently:	These are adjustments made because based on the description of operation from the interview of the customer and/or business partner, the equipment was installed differently or is operated differently than what was assumed in the savings calculations.
Unknown:	The cause of these adjustments could not be determined. Often this is due to incomplete calculations or project descriptions being provided in the project file.

3. Project Verification Results

A total of twenty-nine projects were reviewed for the commercial and industrial program and twelve projects were reviewed for the low income program. The projects were reviewed for both technical accuracy and consistency with operational characteristics, as determined from the project documentation, customer interviews, and onsite inspection. For each project, a realization rate is calculated to show the impacts of any adjustments made to the savings during the technical reviews. The realization rate is calculated by dividing the adjusted savings by the original savings estimate. A project with no adjustments has a realization rate of 1.00.

3.1. Commercial and Industrial Project Realization Rates

Based on the results of the desk review and onsite inspection, the annual and lifetime natural gas savings for each project was adjusted. As shown in Table 6 below, a total of 16 projects had the savings levels adjusted downwards, with the remaining 13 projects being adjusted upwards. Eleven projects were adjusted by less than 10%. Individual projects had gas savings realization rates ranging from 35.0% to 149.4% for annual savings and 35.0% to 209.3% for lifetime savings.

Table 6: Natural Gas Realization Rates per Project

	Technology	Natural Gas (m3)			Lifetime NG (m3)		
		Ex Ante	Verified	RR	Ex Ante	Verified	RR
IND-0216	EMS	1,200,528	1,301,912	108.4%	11,044,858	7,186,553	65.1%
COM-0102	Efficient Building	1,058,190	896,997	84.8%	9,735,348	8,252,372	84.8%
IND-0230	Building Rejuvination	2,018,082	1,824,140	90.4%	18,566,354	16,782,085	90.4%
IND-0176	Boiler	1,597,771	1,351,320	84.6%	14,699,493	15,540,177	105.7%
IND-0188	Boiler Repair	1,115,675	1,254,586	112.5%	7,184,947	4,039,766	56.2%
IND-0171	Burner Controls	1,667,381	1,649,101	98.9%	15,339,905	9,103,036	59.3%
IND-0156	Greenhouse curtain	1,920,653	2,010,051	104.7%	4,417,502	9,246,237	209.3%
IND-0220	Steam Traps	275,117	268,112	97.5%	885,877	863,320	97.5%
IND-0049	Heat Recovery	581,045	694,171	119.5%	5,345,614	6,386,375	119.5%
IND-0155	Steam Traps	428,837	467,718	109.1%	1,380,855	1,506,051	109.1%
IND-0079	[redacted] drying	318,377	377,436	118.5%	2,929,068	3,472,408	118.5%
COM-0020	Heat Recovery	415,905	350,685	84.3%	3,826,326	3,226,301	84.3%
IND-0225	[redacted] Dryer	296,704	222,316	74.9%	2,729,677	2,045,310	74.9%
COM-0057	Dock Doors	51,040	13,497	26.4%	352,176	93,132	26.4%
IND-0127	Heat Recovery	111,700	115,793	103.7%	1,027,640	1,065,294	103.7%
IND-0130	Plant Optimization	224,110	234,322	104.6%	1,546,359	1,616,819	104.6%
IND-0088	Greenhouse Glass	50,240	43,577	86.7%	92,442	100,227	108.4%
IND-0213	Linkageless controls	166,374	239,635	144.0%	1,530,641	2,204,644	144.0%
IND-0251	Temperature controls	712,243	249,505	35.0%	6,552,636	2,295,448	35.0%
IND-0532	Steam Leak Repair	5,242,292	4,805,708	91.7%	24,114,543	22,106,255	91.7%
IND-0477	Process Improvements	1,811,219	1,534,337	84.7%	16,663,215	14,115,898	84.7%
IND-0187	Boiler	1,129,396	868,643	76.9%	15,585,665	9,989,396	64.1%
IND-0160	Temperature controls	691,732	699,078	101.1%	6,363,932	6,431,514	101.1%
IND-0524	Efficient Greenhouse	1,034,849	1,030,323	99.6%	9,520,614	9,478,973	99.6%
IND-0168	HVAC Controls	366,741	520,680	142.0%	3,374,017	2,874,152	85.2%
COM-0092	[redacted] Dryer	255,454	381,623	149.4%	2,350,177	3,510,932	149.4%
IND-0351	High-speed doors	383,978	339,819	88.5%	3,532,598	3,126,333	88.5%
IND-0107	High-speed doors	450,156	586,487	130.3%	4,141,435	5,395,676	130.3%
COM-0069	Heat Recovery	43,431	43,045	99.1%	299,674	297,012	99.1%

Similar to the natural gas savings, the electric and natural gas savings for each project were also adjusted. As shown in Table 7, a total of nine projects claimed electric savings, two of which had the savings set to zero in the evaluation. Additionally, seven projects claimed water savings. Only one water project had the savings set to zero in the evaluation. Additionally, one project did not claim water savings, but was found to have water savings in the verification.

Table 7 Electric and Water Savings Results

	Technology	Electrical (kWh)			Water (L)		
		Ex Ante	Verified	RR	Ex Ante	Verified	RR
IND-0216	EMS	1,448,820	1,448,820	100.0%	-	-	N/A
COM-0102	Efficient Building	586,294	586,293	100.0%	-	-	N/A
IND-0230	Building Rejuvination	5,885,639	5,177,945	88.0%	7,610,052	2,262,088	29.7%
IND-0176	Boiler	-	-	N/A	25,632,085	-	0.0%
IND-0188	Boiler Repair	1,488,000	-	0.0%	2,953,449	18,175,073	615.4%
IND-0171	Burner Controls	-	-	N/A	-	-	N/A
IND-0156	Greenhouse curtain	-	-	N/A	-	-	N/A
IND-0220	Steam Traps	18,114	10,967	60.5%	1,710,607	3,377,506	197.4%
IND-0049	Heat Recovery	-	-	N/A	-	-	N/A
IND-0155	Steam Traps	-	-	N/A	550,366	5,457,002	991.5%
IND-0079	[redacted] drying	-	-	N/A	43,049,034	43,049,034	100.0%
COM-0020	Heat Recovery	-	-	N/A	-	-	N/A
IND-0225	[redacted] Dryer	152,500	24,000	15.7%	-	-	N/A
COM-0057	Dock Doors	-	-	N/A	-	-	N/A
IND-0127	Heat Recovery	-	-	N/A	-	-	N/A
IND-0130	Plant Optimization	-	-	N/A	-	-	N/A
IND-0088	Greenhouse Glass	-	-	N/A	-	-	N/A
IND-0213	Linkageless controls	-	-	N/A	-	-	N/A
IND-0251	Temperature controls	-	-	N/A	-	-	N/A
IND-0532	Steam Leak Repair	-	-	N/A	64,851,144	61,855,200	95.4%
IND-0477	Process Improvements	-	-	N/A	-	-	N/A
IND-0187	Boiler	2,350	192,465	8190.0%	-	1,459,320	N/A
IND-0160	Temperature controls	-	-	N/A	-	-	N/A
IND-0524	Efficient Greenhouse	-	-	N/A	-	-	N/A
IND-0168	HVAC Controls	-	-	N/A	-	-	N/A
COM-0092	[redacted] Dryer	24,000	25,056	104.4%	-	-	N/A
IND-0351	High-speed doors	-	-	N/A	-	-	N/A
IND-0107	High-speed doors	144,159	-	0.0%	-	-	N/A
COM-0069	Heat Recovery	-	-	N/A	-	-	N/A

The incremental cost for each project was verified using the supplied invoice information, as well as information obtained during the customer interview. Project IND-0176 had the incremental cost decreased. The incremental costs used in the original analysis for project was the full project cost to install the new boiler. However, based on the customer interview, the existing boiler was in a state of disrepair, with plugged tubes and inability to adequately control the burner. For the purposes of the evaluation, the incremental cost was determine to be the cost differential between installing the new boiler and repairing the existing boiler. Project IND-0079 had the incremental cost increased significantly. The original project used a projected cost for the installed equipment. The evaluation included the cost for the installed equipment, as well as the cost to demolish and remove the existing equipment. Project IND-0532 had the cost increased, based on the supplied vendor invoices. The results of the incremental cost evaluation can be found in Table 8.

Table 8: Incremental Cost Results

	Technology	Incremental Cost		
		Ex Ante	Verified	RR
IND-0216	EMS	$ 11,311	$ 11,311	100.0%
COM-0102	Efficient Building	$ 4,820,000	$ 4,820,000	100.0%
IND-0230	Building Rejuvination	$ 2,500,000	$ 2,500,000	100.0%
IND-0176	Boiler	$ 435,562	$ 85,562	19.6%
IND-0188	Boiler Repair	$ 527,969	$ 527,969	100.0%
IND-0171	Burner Controls	$ 38,091	$ 38,091	100.0%
IND-0156	Greenhouse curtain	$ 938,060	$ 938,060	100.0%
IND-0220	Steam Traps	$ 18,252	$ 18,252	100.0%
IND-0049	Heat Recovery	$ 362,567	$ 362,567	100.0%
IND-0155	Steam Traps	$ 7,803	$ 7,803	100.0%
IND-0079	[redacted] drying	$ 420,000	$ 949,620	226.1%
COM-0020	Heat Recovery	$ 10,755	$ 10,755	100.0%
IND-0225	[redacted] Dryer	$ 640,000	$ 640,000	100.0%
COM-0057	Dock Doors	$ 14,549	$ 14,549	100.0%
IND-0127	Heat Recovery	$ 69,999	$ 69,999	100.0%
IND-0130	Plant Optimization	$ 118,000	$ 118,000	100.0%
IND-0088	Greenhouse Glass	$ 9,849	$ 9,849	100.0%
IND-0213	Linkageless controls	$ 51,304	$ 51,304	100.0%
IND-0251	Temperature controls	$ 8,225	$ 8,225	100.0%
IND-0532	Steam Leak Repair	$ 28,435	$ 32,132	113.0%
IND-0477	Process Improvements	$ 80,400	$ 80,400	100.0%
IND-0187	Boiler	$ 285,000	$ 285,000	100.0%
IND-0160	Temperature controls	$ 607,200	$ 607,200	100.0%
IND-0524	Efficient Greenhouse	$ 1,056,453	$ 1,056,453	100.0%
IND-0168	HVAC Controls	$ 24,066	$ 24,066	100.0%
COM-0092	[redacted] Dryer	$ 290,000	$ 290,000	100.0%
IND-0351	High-speed doors	$ 27,800	$ 27,800	100.0%
IND-0107	High-speed doors	$ 64,500	$ 64,500	100.0%
COM-0069	Heat Recovery	$ 8,900	$ 8,900	100.0%

The expected useful life (EUL) of each project was verified using documentation found from programs in other jurisdictions, research literature currently available, and the customer interview. A total of eight projects had their EUL adjusted. The original and verified EUL for each project is given in Table 9.

Three of these projects involved HVAC controls. Project IND-0216 involved the modification of an existing HVAC EMS system by the addition of an algorithm to improve control. Because this measure included only the modification of a program on an existing EMS system, not the installation of a new EMS system (including hardware), the originally claimed life of 15 years was reduced t o12 years. Projects IND-0168 and IND-0171 similarly involved the modification of existing control programs, however, for these project, the modification involved the changing of parameters associated with production-related equipment. Both projects have relatively new EMS systems, with a relatively high expected persistence. Therefore, the EUL of these measures was set at 12 years, higher than the 5-10 years typically seen for EMS change or RCx style projects, but less than the 20 years originally claimed.

Table 9 Project EUL Results

	Technology	EUL	
		Ex Ante	Verified
IND-0216	EMS	20.0	12.0
COM-0102	Efficient Building	20.0	20.0
IND-0230	Building Rejuvination	20.0	20.0
IND-0176	Boiler	20.0	25.0
IND-0188	Boiler Repair	14.0	7.0
IND-0171	Burner Controls	20.0	12.0
IND-0156	Greenhouse curtain	5.0	10.0
IND-0220	Steam Traps	7.0	7.0
IND-0049	Heat Recovery	20.0	20.0
IND-0155	Steam Traps	7.0	7.0
IND-0079	[redacted] drying	20.0	20.0
COM-0020	Heat Recovery	20.0	20.0
IND-0225	[redacted] Dryer	20.0	20.0
COM-0057	Dock Doors	15.0	15.0
IND-0127	Heat Recovery	20.0	20.0
IND-0130	Plant Optimization	15.0	15.0
IND-0088	Greenhouse Glass	4.0	5.0
IND-0213	Linkageless controls	20.0	20.0
IND-0251	Temperature controls	20.0	20.0
IND-0532	Steam Leak Repair	10.0	10.0
IND-0477	Process Improvements	20.0	20.0
IND-0187	Boiler	30.0	25.0
IND-0160	Temperature controls	20.0	20.0
IND-0524	Efficient Greenhouse	20.0	20.0
IND-0168	HVAC Controls	20.0	12.0
COM-0092	[redacted] Dryer	20.0	20.0
IND-0351	High-speed doors	20.0	20.0
IND-0107	High-speed doors	20.0	20.0
COM-0069	Heat Recovery	15.0	15.0

The EUL of project IND-0187 was also reduced from 30 years to 25 years and project IND-0176 had the EUL increased from 20 years to 25 years. Both of these projects involved the installation of a boiler. This verification EUL was based on EUL values from multiple sources including ASHRAE (22 years), DEER (20 years-capped), NYSERDA (25 years), and Efficiency Vermont (25 years).

Project IND-0188 involved the repair of a boiler system. The original project claimed an expected live of 14 years. Although the claimed 14 years was consistent with the time between the last time the customer rebuilt the backpressure turbine and this time, the use of the backpressure turbine had increased for the facility. Therefore, the customer indicated that they would be more likely to rebuild the turbine closer to the manufacturer's recommended 5 year interval, but probably not every 5 years exactly. Based on that customer interview, the evaluation selected an EUL of seven years.

Project IND-0156 involved the installation of greenhouse energy curtains. The original project claimed an expected life of 5 years, which was based on the manufacturer's warranty. However, based on the customer interview, and other sources reviewed, the life of these curtains is expected to be 10 years.

Project IND-0088 involved the installation of greenhouse glass. The original project claimed an expected life of 4 years, which is consistent with the age of the replaced equipment. However, based on discussions with the vendor, the replacement at that time was atypical, and was due to damage from hail. Based on that interview, as well as information from University of Wisconsin, the life of this equipment is expected to be 5 years.

3.2. Low Income Project Realization Rates

Similar to the commercial and industrial project, based on the results of the desk review and onsite inspection, the annual and lifetime natural gas savings for each low income project was adjusted. As shown in Table 10 below, a total of seven projects had the savings levels adjusted downwards, with three projects being adjusted upwards. Two projects were not adjusted. Six projects were adjusted by less than 10%. Individual projects had gas savings realization rates ranging from 60% to 158.9% for both annual and lifetime savings.

Table 10: Natural Gas Realization Rates per Project

	Technology	Natural Gas (m3)			Lifetime NG (m3)		
		Ex Ante	Verified	RR	Ex Ante	Verified	RR
COM-0033	Roof Insulation	887	899	101.3%	16,853	17,076	101.3%
COM-0034	Boiler	23,277	23,884	102.6%	486,489	567,252	116.6%
COM-0103	Windows	12,871	11,100	86.2%	244,549	231,982	94.9%
COM-0278	Heat Recovery	39,703	36,434	91.8%	565,768	519,180	91.8%
COM-0277	Windows	5,608	4,154	74.1%	106,552	86,810	81.5%
COM-0287	Water Heater	2,167	1,300	60.0%	41,173	24,700	60.0%
COM-0120	Water Heater	17,075	14,150	82.9%	324,425	268,859	82.9%
COM-0274	Windows and doors	13,754	13,119	95.4%	261,326	274,188	104.9%
COM-0286	Roof Insulation	2,729	2,729	100.0%	51,851	51,849	100.0%
COM-0159	Weatherizing	4,865	4,865	100.0%	92,435	92,442	100.0%
COM-0157	Make-Up Air Unit	9,052	7,388	81.6%	128,991	105,277	81.6%
COM-0116	Windows	7,655	12,164	158.9%	159,990	254,228	158.9%

Only two projects included any electric savings. Project COM-0033 has 56,060 kWh of savings claimed. However, this value could not be located in the supplied project documentation. The verified savings for this project were reduced to 22,516, based on the supplied calculations. Project COM-0116 included 738 kWh of savings in the ex ante calculations, however, the verified electric savings for this project were set to zero. None of the low income projects included water savings. The electric and water results by project are presented in Table 11 below.

Table 11: Electric and Water Savings Results

	Technology	Electrical (kWh)			Water (L)		
		Ex Ante	Verified	RR	Ex Ante	Verified	RR
COM-0033	Roof Insulation	56,060	22,516	40.2%	-	-	N/A
COM-0034	Boiler	-	-	N/A	-	-	N/A
COM-0103	Windows	-	-	N/A	-	-	N/A
COM-0278	Heat Recovery	-	-	N/A	-	-	N/A
COM-0277	Windows	-	-	N/A	-	-	N/A
COM-0287	Water Heater	-	-	N/A	-	-	N/A
COM-0120	Water Heater	-	-	N/A	-	-	N/A
COM-0274	Windows and doors	-	-	N/A	-	-	N/A
COM-0286	Roof Insulation	-	-	N/A	-	-	N/A
COM-0159	Weatherizing	-	-	N/A	-	-	N/A
COM-0157	Make-Up Air Unit	-	-	N/A	-	-	N/A
COM-0116	Windows	738	-	0.0%	-	-	N/A

The incremental cost for each project was verified using the supplied invoice information, as well as information obtained during the customer interview. Project COM-0157 had the incremental cost decreased. This was due to the savings being based on the installation of an efficient make-up air unit compared to an alternate less efficient baseline make-up air unit. The original analysis included the full installed cost, while the verified incremental cost is the difference between the two options. The results of the incremental cost evaluation can be found in Table 12 below.

Table 12: Incremental Cost Results

	Technology	Incremental Cost		
		Ex Ante	Verified	RR
COM-0033	Roof Insulation	$ 18,800	$ 18,800	100.0%
COM-0034	Boiler	$ 262,500	$ 262,500	100.0%
COM-0103	Windows	$ 167,718	$ 167,718	100.0%
COM-0278	Heat Recovery	$ 233,626	$ 233,626	100.0%
COM-0277	Windows	$ 58,500	$ 58,500	100.0%
COM-0287	Water Heater	$ 68,637	$ 68,637	100.0%
COM-0120	Water Heater	$ 161,000	$ 161,000	100.0%
COM-0274	Windows and doors	$ 353,315	$ 353,315	100.0%
COM-0286	Roof Insulation	$ 69,700	$ 69,700	100.0%
COM-0159	Weatherizing	$ 44,400	$ 44,400	100.0%
COM-0157	Make-Up Air Unit	$ 52,300	$ 13,000	24.9%
COM-0116	Windows	$ 174,720	$ 174,720	100.0%

The expected useful life (EUL) of each project was verified using documentation found from programs in other jurisdictions, research literature currently available, and the customer interview. A total of four projects had their EUL adjusted. Three of the projects were involved the installation of energy-saving windows. These projects claimed an expected useful life for windows of 20 years. Although not unreasonable, the literature reviewed indicated an expected life of between 20 and 25 years. The verification increased the EUL to 22 years. This is also consistent with the claimed EUL for the fourth window project in the sample. The original and verified EUL for each project is presented in Table 13 below.

Additionally, one project (COM-0034) involved in the installation of a boiler. Similar to the C&I program, the evaluation increased the life of this project from 22 years to 25 years.

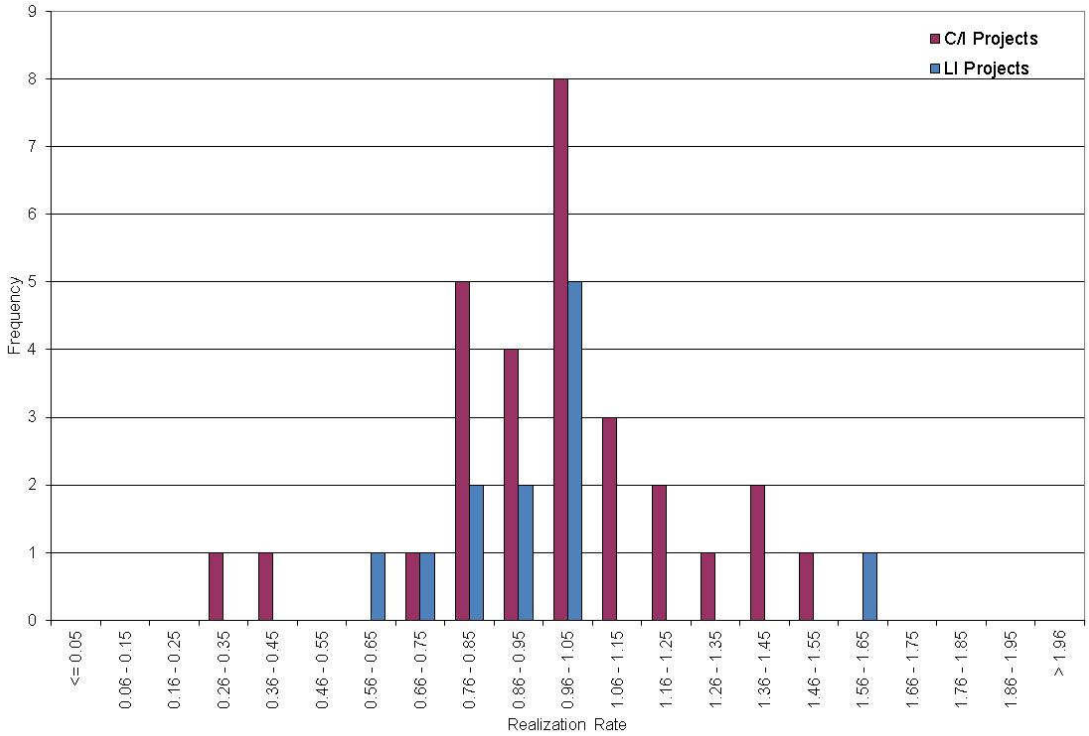
Table 13 Project EUL Results

	Technology	EUL	
		Ex Ante	Verified
COM-0033	Roof Insulation	20.0	20.0
COM-0034	Boiler	22.0	25.0
COM-0103	Windows	20.0	22.0
COM-0278	Heat Recovery	15.0	15.0
COM-0277	Windows	20.0	22.0
COM-0287	Water Heater	20.0	20.0
COM-0120	Water Heater	20.0	20.0
COM-0274	Windows and doors	20.0	22.0
COM-0286	Roof Insulation	20.0	20.0
COM-0159	Weatherizing	20.0	20.0
COM-0157	Make-Up Air Unit	15.0	15.0
COM-0116	Windows	22.0	22.0

3.3. Natural Gas Savings Realization Rate Distribution

To illustrate the variation in individual projects, the frequency of individual project realization rates after the technical review were plotted. The realization rates were broken into 10% bins and these bins were plotted against their frequency. These results are presented in Figure 1 below. Examination of shows that out of the 41 projects reviewed, 22 projects had realization rates that were within 15% of 1.0. The most common group was the 96% to 105% bin which consisted of eight commercial and industrial project and five low income projects.

Figure 1: Realization Rate Distribution



The overall project summaries are located in Appendix A. These summaries describe the project, the original analysis, and the claimed savings and verified savings. These reports also describe the evaluation approach taken and the any changes made to the analysis that affected the verified savings levels.

In order to better understand the factors that contributed to the distribution of realization rates, the reason for adjustment for each project was also examined. It should be noted that for many project there may be multiple reasons for adjusting the savings estimate for a project, but for clarity, only the primary reason was recorded. The primary reason is defined as the reason the reviewer determined had the greatest effect on the change in savings. Table 14 includes the frequency of occurrence for each adjustment reason and the magnitude of adjustments. It should be noted that the absolute value of adjustments is presented in the table below. The sum of these absolute values will be greater than the net adjustments reflected in the realization rate, because it does not account for any "offsetting" adjustments due to some adjustments increasing savings and other adjustments decreasing savings. However, this allows a more clear comparison of the magnitude of adjustments, and the relative deviation in the accuracy.

Table 14: Reasons for Adjusting Gas Savings

Gas Savings				
Primary Reason for Adjustment	Frequency	Percentage of Occurance	Absolute Value of Adjustments	Percent of Total Adjustments
Inappropriate Assumptions	8	21%	668,243	20%
Tracking Error	0	0%	0	0%
Calculation or Engineering Error	9	23%	740,377	22%
Operated or Installed Differently	22	56%	1,957,917	58%
Unknown	0	0%	0	0%
Total Adjustments	39	100%	3,366,536	100%

All of the project adjustments were due to either "Inappropriate Assumptions," "Calculation or Engineering Error," or Operated or Installed Differently." The "Operated or Installed Differently" accounted for both the most frequent adjustment factor as well as the greatest absolute of adjustment.

It should be noted that "Operated or Installed Differently" are often adjustments that are least under the control of the utility due to the operation and installation of the equipment is determined by the customer. Calculation errors, inappropriate assumptions, and tracking errors are errors that are much more controllable by the utility through training and other means.

3.4. Observations on Specific Projects

In addition to the adjustment categories presented above, project with significant adjustments, either by magnitude or percent, were reviewed individually. There were three gas projects that had their predicted savings adjusted by 50% or more in either direction. These projects are shown in Table 15.

Table 15: Projects with Gas Realization Rates of <50% or >150%

Project	Project Realization Rate	Natural Gas Adjustment (m^3)	Specific Reason For Adjustments
COM-0057	26.4%	(37,543)	The original savings calculation was completed in a vendor calculation. Although the exact cause of the discrepancy could not be difinitively defined, it appeared that the vendor anlaysis neglected to account for the orientation of the doors and assumed the wind direction was always directly into the door.
IND-0251	35.0%	(462,738)	The original analysis was based on the theoretical reduction in heating energy for make-up air. This reduction was not realized, based on a billed data analysis. It is possible that the original anlaysis did not fully account for internal gains and/or equipment scheduling.
COM-0116	158.9%	4,509	The original analysis was completed in RetScreen. The window specification input into the RetScreen analysis were inconsistent with the supplied window specifications. Additionally, the analysis incorrectly claimed the heat load reduction as savings, rather than the gas usage reduction. This error neglected the effect of boiler efficiency.

These projects are described in greater detail in the project overviews, found in Appendix A.

In addition to looking at projects that were adjusted by 50% or more, projects that had large savings adjustments were also examined. A total of 5 projects were found to have adjustments greater than 200,000 m3 for the Commercial and Industrial program. Four of these projects had savings levels reduced, while only one project had savings levels increased by the verification. These projects accounted for 50% of the absolute value of the adjustments. These projects are shown in Table 16 below.

Table 16: Commercial and Industrial Projects with Large Savings Adjustments

Project	Project Realization Rate	Natural Gas Adjustment (m^3)	Specific Reason For Adjustments
IND-0176	84.6%	(246,451)	The original analysis was based on a specific gas uage per heating degree day (m3/HDD) before and after the completion of the project, based on the billed data. This approach was reasonable, however, the balance point of the facility was low, resulting in the linear extrapolation of the gas usage overpredicted the savings.
IND-0251	35.0%	(462,738)	The original analysis was based on the theoretical reduction in heating energy for make-up air. This reduction was not realized, based on a billed data analysis. It is possible that the original anlaysis did not fully account for internal gains and/or equipment scheduling.
IND-0532	91.7%	(436,584)	The original analysis assumed that all of the reduced steam usage would result in a reduction in gas usage, however, the facility has combustors that produce steam from waste product. Therefore, not all of the steam reduction results in a steam reduction from the gas boilers.
IND-0477	84.7%	(276,882)	The original analysis was based on a specific gas uage per part produced (m3/unit) before and after the completion of the project, based on the billed data. This approach was reasonable, however, the original analysis failed to account for an "fixed" or non-proporational gas usage. Therefore, extrapolation results in overpredicting gas usage.
IND-0187	76.9%	(260,753)	The original analysis accounted for the required input of energy that must be met to produce the steam used by the customer. However, the water is pre-heated in a dearator, which partially offsets heat required by the boiler.

Similar to commercial and industrial projects, projects that had large savings adjustments were also examined for the low income project. A total of three projects were found to have adjustments greater than 2,000 m3 for the Low Income program. These three projects accounted for 60% of the absolute value of the adjustments. These projects are shown in Table 17 below.

Table 17: Low Income Projects with Large Savings Adjustments

Project	Project Realization Rate	Natural Gas Adjustment (m^3)	Specific Reason For Adjustments
COM-0278	91.8%	(3,269)	The original analysis used hard-coded values for the heat exchangere effectiveness. This resulted in a small error. Additionally, the percent of air bypassed by the heat exchanger to maintain discharge air temperture was incorrectly calculated.
COM-0120	82.9%	(2,925)	The original analysis calculated an assumed hot water usage based on facility characteristics. However, the assumed hot water usage was found to be inconsistent with the billed data, which suggested significantly lower usages.
COM-0116	158.9%	4,509	The original analysis was completed in RetScreen. The window specification input into the RetScreen analysis were inconsistent with the supplied window specifications. Additionally, the analysis incorrectly claimed the heat load reduction as savings, rather than the gas usage reduction. This error neglected the effect of boiler efficiency.

4. Observations and Recommendations

4.1. Review of Past Recommendations

Based on the 2010and 2011evaluations, Union Gas was given several recommendations to improve their documentation levels and calculation processes. After conducting a review of the 2012 projects, the progress made in several key areas should be identified.

4.1.1. Continue Improving the Documentation Levels

There were several noticeable improvements in the documentation levels including the *Energy Savings Calc* spreadsheet, and the *Equipment Installation Checklist*. These will continue to ensure all types of necessary documentation are obtained. However, the level of detail contained in the documentation should continue to be improved.

4.1.2. Continue Improving the Secondary Benefits Claims

There were a total of 15 projects that included secondary resource benefits in the 2012 sample. Of these projects, seven electric project had savings reduced by more than 35% and all but one water project had savings adjusted by more than 70%. Of these projects, Three electric projects and one water project had the savings set to zero. Additionally, one project (IND-0187) was found where no water savings were claimed, but water savings were found by the verification.

The evaluation team understands that claiming secondary resource benefits is not the primary purpose of the program. However, for some projects (such as IND-0216, IND-0230, IND-0079, and IND-01877) the secondary resource benefits are a major contributor to the overall resource benefits of the project. When secondary resources are significant, such as greater than 100,000 kWh or 1,000,000 L, the detail and level of rigor used to determine those benefits should be increased.

4.1.3. Use Current Production Levels for Process Projects

There were a total of two [redacted] dryer projects examined during the 2012 evaluation. Both of these projects based savings on production levels, which were assumed to [redacted] for the next fifteen years. Production [redacted] are extremely variable and often do not follow projections. Standard evaluation practice does not award additional savings for future production [redacted] unless; the current year in which the rebate was processed is significantly abnormal, the production [redacted] can be proven based on previous year over year [redacted] or there are contracts in place guaranteeing the growth. However, in any of these cases, the [redacted] in production can only be accounted for up to one year in the future.

4.2. New Recommendations

Based on the 2012 verification, several new recommendations were developed.

4.2.1. Consider Expanding the Timeframe for Verification

This year the work performed for the verification was greatly constrained by the timeline for the verification. Specifically, one project that was selected for an onsite inspection was not able to be completed, due to customer schedule constraints. Additionally, the timeframe did not allow for any metering, data collection via EMS trends, or other data collection methodologies that would have increased the potential accuracy of the verification. Expanding the timeline for the verification would greatly improve the ability to perform the verification to a high level.

4.2.2. Continue to Utilize and Expand the use of Templates

This year several of the projects reviewed utilized templates or standardized calculations. The use of templates or standard calculations improves the accuracy and consistency of the program through several means. First, the use of standardized calculations allows analysts to become familiar with technologies and calculations, which results in better and more consistent data collection to perform the calculations. Second, the number of calculation errors is reduced, since formulae are already input and reviewed. Third, the review of the project, either by an internal reviewer or the verifier is made easier, which again allows calculation errors to be identified quickly.

We would encourage the expanded use of templates or standardized calculations. As part of the verification, a review of the standardized calculations provided was performed, which led to the following recommendations:

4.2.2.1. Update Window Template to Include Solar Heat Gains

There were a total of four verified projects that included the installation of Energy Star windows. Two of these projects were calculated using a template. The reviewed template calculated the energy savings due to convection and conduction reasonably and appropriately, however, the effect of solar heat gain was neglected. It is recommended that this effect be added to the template.

4.2.2.2. Update Window Template to Eliminate Iterative Process

There were a total of four verified projects that included the installation of Energy Star windows. The current window template requires the user to perform an iterative analysis inputting loads for various conditions. Automating this process would eliminate potential errors associated with the manual iterative process.

4.2.2.3. Update the Quick Closing Door Template to Account for Door Open Times

Two projects verified included the installation of quick close doors. As part of the verification, it was determined that the current template assumes that the door is fully open from the time that the door starts to open to the time that the door is fully closed. This overestimates the savings. Specifically, during the time that the door is actively opening or closing, the door averages only one half open.

Additionally, the current template assumes that the time that the door is fully open (after fully opening but before starting to close) is constant in the existing and proposed cases. This may not always be the case. Specifically, for one project verified, the customer kept the door open in the base case for longer periods of time by bypassing the door controller, to eliminate the time that forklift drivers needed to wait for the doors to open. In these cases, the existing template underestimates savings.

4.2.3. Collect Additional Information for Steam Leak Projects

The larges project verified this year was a steam leak project. The analysis methodology was reasonable and appropriate; however, the accuracy of the savings estimates was limited by the information collected. Based on discussions with the Union Gas account manager, the vendor indicated the leak was a "6 of 10." The customer also indicated that the leak was about the same size as one last year.

Based on the size of the project, the information collected was insufficient to justify the savings estimate. It is recommended that whenever possible additional information be collected for these types of projects. The additional information could include steam production data, natural gas usage data, measurements of leakage area, pictures of leakage to indicate plume lengths, or any other information which could be used to justify leakage rates.

4.2.4. Verify Calculated Usage to Billed Data When Possible

Two projects that involved the installation of efficient water heating systems has savings levels reduced significantly due to the original analysis basing savings on water usages that exceeded levels determined during the verification.

For both of these projects a comparison of the energy usage for the facility during the summer months would have indicated that the usages in the analysis was likely excessive.

Appendix A: Site Specific Reports

Project Verification Report

Project ID:	IND-0216				Date Completed:	7/15/2011
Project Savings:	1,200,528	m3	1,448,820	kWh	0	L
Project Cost:	$11,311					
Project Description:	Controls-BAS-New Sequence of Control					

Verification Report

Measure Description:

The project consisted of the implementation of a new sequence of controls to the existing BAS to control 36 air-handling units (AHUs) serving production areas of the plant. The new sequence of controls ensure that the burners/heating coils/cooling coils do not operate when space/zone temperature setpoints are satisfied to avoid overheating and overcooling during the shoulder months. Additionally, the controls will add free cooling capability and will reduce the outdoor ventilation levels during non-economizer periods.

Summary of the ex ante Calculations:

The ex-ante savings were calculated using multiple 8760-hour spreadsheet-based engineering calculations. For each hour of the year, the energy consumption of the airhandling units was calculated using the expected outdoor air ventilation levels, as well as a heat load for the space, which was determined based on linear interpolation between a design load at the design point and a balance point, where not heating or cooling is expected.

In order to determine the savings for the ventilation reduction, the heat load in the pre- and post-implementation cases was calculated using the equation Q (BTU/hr) = 1.08 x CFM x (Tbalance-Toutdoor) where temperature was in degrees Fahrenheit. The outdoor air level was reduced throughout the year, with additional reductions occurring during periods of "low energy operation" which are periods of scheduled downtime where not production is expected to occur.

In order to determine the savings for the elimination of simultaneous heating and cooling, the savings were calculated by assuming that the load at the design point did not change, but the balance point was adjusted by 5°F to produce lower loads at each temperature and a "dead band" in the moderate temperatures.

Comments on the ex ante Calculations:

The approach to calculating gas usage is reasonable, although many of the assumptions used in the analysis are not justified by any supplied information. For example, no indication of the method used to determine the design heat load was supplied. However, for each unit, the calculated values are reasonable, when compared to typical HVAC loading factors.

The adjustment of the balance point to reflect the elimination of simultaneous heating and cooling may not reflect the actual operating conditions, however, it is not clear.

Ex Post Site Description:

A site visit was performed and the customer was interviewed on the operation of the HVAC system and the changed implemented due to the modification of the BAS. Based on the customer interview, the facility was over ventilated, which resulted in excess energy consumption. The customer representative indicated that the ventilation levels in the pre-case were consistent with the levels indicated in the project file. Due to the installation of this measure, the ventilation levels were reduced, first as indicated in the project file, however, the site representative has further reduced ventilation levels since the completion of this project.

Based on the customer description in the pre-case the HVAC system has significant simultaneous heating and cooling, however, no information was available to quantify the level of simultaneous heating and cooling. The simultaneous heating and cooling occurred due to two factors. First, the time delay on the HVAC system, coupled with the fact that the heating and cooling setpoint was very similar, would result in the system overshooting the setpoint for heating and cooling. Because of this, the system would oscillate between heating and cooling. When system would switch to heating , for example, it would ramp to 100% heat output, then back down to the appropriate level after the preset minimum time. However, by the time the minimum time period had elapsed, the zone temperature would have overshot the setpoint and the system would then switch to cooling. Many times, the temperature swings would be 10°F or more.

Additionally, because each H VAC unit was independently controlled, but most discharged to a common production space, many times one unit would be in heating, with the adjacent unit operating in cooling mode.

The controls implemented eliminate both causes of simultaneous heating and cooling.

Summary of ex post Calculations:

The ex post savings were calculated using a billed data approach. Based on the customer description, the production level has remained [redacted] with the exception of July and December, which have [redacted].

Based on information provided by Union Gas, the customer has completed multiple energy efficiency projects during the period affected by the billed data analysis. Specifically, the following projects were completed:

--EMS project (this project), completed July 15, 2011, expected savings of 1,200,528 m2
--Bldg Envelope - Zip Doors for Vestibule - Assembly, completed January 31, 2011, expected savings of 24,123 m3
--Ventilation Improvements - Audit Building, completed March 1, 2011, expected savings of 69,770 m3
--Ventilation Improvement - [redacted], completed March 1, 2011, expected savings of 40,000 m3
--Dock Door Sealing - [redacted], completed March 15, 2011, expected savings of 206,928 m3
--Boiler Blowdown Heat Recovery, completed March 28, 2011, expected savings of 29,022 m3
--Ventilation Improvement - [redacted], completed April 20, 2011, expected savings of 24,860 m3
--Ventilation Improvement - [redacted], completed June 16, 2011, expected savings of 17,760 m3
--Controls-PLD-New Sequence of [redacted], completed September 30, 2011, expected savings of 119,088 m3
--Controls--Pressure--[redacted] Load Optimization, completed October 21, 2011, expected savings of 354,700 m3.

Combined, these projects are expected to save 2,086,779 m3.

The gas usage for the pre- and post-implementation was correlated to heating degree days. In both cases, the gas usage was found to relate very closely to heating degree days, with the pre-and post-implementation cases both having R-squared values of over 0.99.
Based on the supplied data, the expected gas savings of the combined projects is 2,263,006 m3 of gas per year, approximately 8% greater than the expected savings. Because the affect of each project could not be isolated, the savings were divided proportionally, based on the ex ante savings value.

Comments on ex ante Costs and EUL:

The costs presented in the application were consistent with the invoices provided by the customer. The 20 year EUL is reasonable for BAS installation projects. However, this project involves only the modification of an existing EMS system, with no hardware installed. Based on a literature review, this appears excessive.

The verified EUL for this measure was determined to be 12 year. This was based on a preponderance of

evidence approach utilizing multiple sources. Specifically, a review was completed of DEER and TRMs from multiple jurisdictions, including Illinois and Connecticut. Most sources reviewed, did not include a measure that was directly applicable, however, the measure completed most closely aligned with RCx measures, which typically had EULs of 5-10 years, depending on the source and the measure completed. The Connecticut PSD specifically, described setpoint changes for both commercial and industrial equipment. This source listed an EUL of 6 years. Again however, a measure exactly aligning with this project could not be found. Based on the reviewed data, an EUL of 7 years was determined to be reasonable.

However, due to site specific conditions, the EUL was increased from the seven years. Specifically, the EUL of control point changes is limited to the RUL of the installed EMS or BAS system. The EMS system at this facility was installed approximately 5-6 years ago and has a long RUL expected. Additionally, the customer has staff dedicated to energy efficiency and has been an active participant in the program. Based on this information, the EUL of this measure was increased to 12 years, from the seven suggested above. However, this is still less than the 20 years originally claimed. It should be noted that the EUL for this project relies heavily on site specific conditions and should not be applied to other projects without careful analysis.

Reasons for Adjustments

- ☐ Inappropriate Assumptions
- ☐ Calculation/Engineering Error
- ☐ Tracking Error
- ☑ Operated or Installed Diff

Results

	Ex-Ante:	Ex-Ante Adjusted:	Ex-Ante Realization Rate:
kWh Savings (kWh):	1,448,820	1,448,820	100%
Gas Savings (m3):	1,200,528	1,301,912	108%
Water Savings (L):	0	0	0%
Incremental Cost:	$11,311	$11,311	100%
EUL (Yrs):	20	12	60%

Project Verification Report

Project ID:	COM-0102			Date Completed:	3/30/2011
Project Savings:	1,058,190	m3	586,294 kWh	0	L
Project Cost:	$4,820,000				
Project Description:	[redacted]High Eff Building				

Verification Report

Measure Description:

This is a new facility that incorporated many energy efficient technolgies to reduce energy usage, including 209 solar thermal collectors, high performance envelope, heat recovery ventilators, BAS, and ground-source heat pumps (GSHPs).

Summary of the ex ante Calculations:

The ex ante calculations use a detailed building simulation to establish reference, or baseline, performance based on applicable building and energy codes. A simulation for the proposed building was also performed and accounted for efficiency measures associated with the building envelope, lighting, ventilation, heating, and domestic hot water. In addition, the proposed building includes hot water solar collectors and solar ventilation air preheating. The efficiency contributions of all of the measures and renewable energy were taken directly from the reference vs. proposed simulations.

Comments on the ex ante Calculations:

Ex Post Site Description:

The customer representative was interviewed on November 12, 2012, and provided a tour of the mechanical rooms associated with this project. Monthly operating data that was provided included heating and cooling loads for the building and the heating source, e.g. gas boiler or GSHP. The values were based on customer metered data.

The gas boilers, chillers, and GSHPs that provide heating and cooling water for the facility are located in a separate, existing building that is adjacent to, but separate from the new building. The boilers, chillers, and GSHP's are part of common heating hot water and chilled water loops that serve both the existing building in which they are located and the new building. In the future, this equipment will serve other buildings as they are added to this [redacted]

The solar panels associated with this project are all installed on the new building. The heat collected by the solar panels is primarily used in the new building for heating and domestic hot water. Solar heat in excess of the new buildings needs is available for use by the existing building through the hot water service loop.

The solar heating is supplemented by the boilers and GSHPs as needed. Heating outputs for the boilers and GSHPs and cooling output of the chillers and GSHPs are metered. Heating and cooling supplied to each building is also metered separately. Metered data for heating and cooling was collected from the site representative.

Summary of ex post Calculations:

The ex ante baseline energy usage simulation for the building was assumed to be reasonable. The proposed energy usage was adjusted to match actual heating gas usage, as determined by customer data.

The savings due to the GSHPs qualified under the program guidelines.

Project Verification Report

The ex post savings are lowered because the facility gets a greater portion of its heating energy from gas than predicted by the ex ante simulation.

Comments on ex ante Costs and EUL:

The application appropriately based calculations on incremental cost.

The EUL of 20 years is considered reasonable for this project. While the savings are a result of numerous, different measures and measure types, the predominant savings are due to measures affecting ventilation and controls. The EUL for these measures is typically in the 15 to 20 year range, e.g. energy recovery ventilation at 15 years. The EUL for boilers and building shell measures may be in the 25 to 30 year range, but their contribution to overall savings is relatively small compared to the other measures. Considering a weighted average of all measures will not increase the EUL.

Reasons for Adjustments

- [x] Inappropriate Assumptions
- [ ] Calculation/Engineering Error
- [ ] Tracking Error
- [ ] Operated or Installed Diff

Results

	Ex-Ante:	Ex-Ante Adjusted:	Ex-Ante Realization Rate:
kWh Savings (kWh):	586,294	586,293	100%
Gas Savings (m3):	1,058,190	896,997	85%
Water Savings (L):	0	0	0%
Incremental Cost:	$4,820,000	$4,820,000	100%
EUL (Yrs):	20	20	100%

Project Verification Report

Project ID:	IND-0230				Date Completed:	10/2/2012	
Project Savings:	2,018,082	m3	5,885,639	kWh	7,610,052	L	
Project Cost:	$2,500,000						
Project Description:	HVAC-Building Rejuvenation						

Verification Report

Measure Description:

The project consisted of significant modifications and repairs to HVAC equipment serving the body in white area of the facility in order to improve system air balance, air quality, and efficiency.

Specific actions implemented included the decommissioning of 16 of 49 [redacted] rehabilitate the remaining 33 [redacted] Lock return air dampers in a known, fixed position and remove actuators; Add ductwork to improve air distribution; decommission 46 of 105 building exhaust fans; rehabilitate the remaining 59 exhaust fans; install controls to allow central control of exhaust fans; install 4 new exhaust fans to facilitate air balance at south end of building.

Summary of the ex ante Calculations:

The ex-ante savings were calculated using spreadsheet-based engineering calculations. Baseline operation was assumed to be existing units all operating continuously during production and non-production hours. Post retrofit operation assumed that the central controls would shut off units during non-production hours, resulting in an overall reduction in outside air. Energy savings were primarily due to the reduced ventilation of the proposed system operation.

Calculations used temperature bin data, with non production hours separated from production hours. Baseline conditions assumed constant outside air supply of approximately [redacted] cfm, with space temperature of 68F at all times. Supply air discharge temperatures were assumed to be 68oF and 72oF for summer and winter operation, respectively. The winter building balance temperature was 60oF, with no heating required when outdoor temperatures were higher. Air conditioning was assumed to be required at outdoor temperatures greater than 70oF.
Post retrofit operation assumed space temperatures of 76oF summer and 68oF winter with supply air discharge temperatures of 72F and 68F. Outside air provided during production hours was [redacted] cfm and [redacted] cfm during non production hours.

Some of the [redacted] have self-contained gas heaters and direct-expansion cooling systems. The other units have a water coil for which chilled water or hot water is provided, depending on the season. Ex ante calculations assumed boiler and gas heater efficiency of 80% for all units.

Comments on the ex ante Calculations:

The approach to calculating gas usage is reasonable, although the balance temperature for heating appears high for a facility of this type.
The source and details of the nominal fan motor powers were not included in the application. It appears that the calculations were based on the total sum of nominal horsepower and were assumed to operate at an average 85% load, which seems high for this type of application. Using the cfm presented in the application to estimate fan power results in significantly lower total fan power values.

Water savings appeared to assume that no steam condensate would be returned and would therefore be equal

to the pounds of steam saved. A more realistic approach would be to assume that a large portion of the condensate would be returned to the boiler, which would result in lower water savings.

Ex Post Site Description:

The facility engineer and a representative from the engineering firm that implemented the measures were interviewed on January 30, 2013 and provided a tour of the facility and this measure. The site representative reported that the plant currently operates 3 shifts per day, 5 days per week. [redacted] are expected in the foreseeable future.

A representative sample of the [redacted] was inspected and operation of the central control system was demonstrated. The customer reported that 3 of the units that had been targeted for shutdown were left in service due to air movement considerations. Because the fresh air supply is based on sf of floor area, this is not expected to have a significant effect on project savings.

It was also noted that a significant portion of the area affected by this project had been vacant for about 3 years prior to the implementation of these measures. There are currently no plans to occupy this space. The customer reported that re-occupying the space may require the rehabilitation and operation of some of the units that were shut down, but the effect on energy usage is not possible to predict at this time.
The central controls are programmed to shut off all but [redacted] of the [redacted] during times of non-production. While most of the hours of non production occur on weekends, the program allows a partial shutdown of equipment whenever production is interrupted for more than 30 minutes. The central controls display total fresh air supplied and exhausted; the totals are calculated based on the total number of supply and exhaust fans running and not based on actual air flow measurements. At the time of the site inspection, the fresh air supply [redacted] cfm and the exhaust volume [redacted] cfm, compared to the proposed [redacted] cfm of fresh air as presented in the application. However, the indicated air flows values were the result of BAS calculations based on the number of fans running, so the proposed value was considered reasonable.

Summary of ex post Calculations:

The ex post calculations closely followed the approach of the ex ante calculations with one notable difference. While the ex ante calculations assumed that all incoming air would be heated to a temperature of 72o F in the pre retrofit condition, the ex post calculations assumed that the temperature rise would be to 68F to match the space temperature. This was done because the heating output of the MUA units is controlled by space temperature.

Comments on ex ante Costs and EUL:

The costs presented in the application were consistent with the invoices provided by the customer. The 20 year EUL appears reasonable.

Reasons for Adjustments

- ☐ Inappropriate Assumptions
- ☐ Calculation/Engineering Error
- ☐ Tracking Error
- ☑ Operated or Installed Diff

Results

Project Verification Report

	Ex-Ante:	Ex-Ante Adjusted:	Ex-Ante Realization Rate:
kWh Savings (kWh):	5,885,639	5,177,945	88%
Gas Savings (m3):	2,018,082	1,824,140	90%
Water Savings (L):	7,610,052	2,262,088	30%
Incremental Cost:	$2,500,000	$2,500,000	100%
EUL (Yrs):	20	20	100%

Project Verification Report

Project ID:	IND-0176			Date Completed:	6/2/2011
Project Savings:	1,597,771	m3	0 kWh	25,632,085	L
Project Cost:	$435,562				
Project Description:	Low Volume Steam Boiler				

Verification Report

Measure Description:

The customer installed a new [redacted] BHP steam boiler with economizer and linkageless controls.

Summary of the ex ante Calculations:

The savings were done using a billed data analysis. The gas usage for approximatley 9 months from 2010 and 2011 was used to determine the baseline usage, with approximately 9 months from 2011 to 2012 being used to determine the usage after the efficiency upgrade. In each case, the gas usage for the time period was divided by the heating degree days over the same time period to determine a specific gas usage per heating degree day. This was then multiplied by the expected annual heating degree days for a typical meteorlogical year to determine the baseine usage, the efficient case usage, and the resulting savings.

Comments on the ex ante Calculations:

The analysis used is reasonable and appropriate for cases where the load is expected to be proportional to heating degree days. However, based on a review of the gas usage, the majority of the gas usage in each case (pre and post) is "fixed" load that does not appear to be related to temperature. Specifically, this is expected to be process load.

Therefore, a more appropriate approach would be to calculate the expected gas usage using the formula: Gas Usage = M x HDD + B, where the M is the coefficient of the temperature dependant load and B is the fixed load, as determined from the billed data.

To determine the "adjusted ex ante" (corrected ex ante) savings, the savings were recalculated using the approach described above. Using this approach the expected savings was increased to approximately 2.3 million cubic meters of natural gas.

Ex Post Site Description:

The installed boiler was found to be a steam boiler with economizer, operating at [redacted] psig, slightly lower pressure than described in the original project documentation. The boiler served a water treatment load and is expected to operate throughout the year.

The existing case boiler was a 1922 Trane boiler with a nominal capacity of [redacted] lbs/hr. The existing boiler was found to be in a state of disprepair and was currently tagged as illegal to operate. However, based on discussions with Union Gas, the customer stated that they had chosen to have the boiler tagged out in order to eliminate boiler operator postions. If needed, the boiler could be recomissioned and operated, after repairs.

Summary of ex post Calculations:

The evaluation savings were calculated based on the existing boiler being repaired, therefore, the billed data was not able to be used to directly calculate savings, but was used to determine the loading on the boiler.

In both the pre- and post- cases, the load of the boiler was divided into "shell" losses and "usage and other losses." Boiler shell losses are expected to be minimally load dependant (constant), while all other loads

(steam, stack, etc.) are expected to vary with boiler loading. The boiler shell loss in the baseline condition was assumed to be [redacted] nominal capacity, based on typical losses for older boilers as determined from Weil McLein data and historical data, adjusted for the observed relatively poor condition of the insulation, which was assumed to not be repaired. The new boiler shell losses was assumed to be [redacted] nominal capacity.

The post case gas usage was used to develop a relationship between HDD and monthly gas usage. This profile was then applied to typical meteorological year data to determine the expected annual gas usage. The shell portion of that usage was then removed from each month's usage with the remaining gas usage was attribued to the "loads" on the boiler. The existing case boiler was assumed to have a combustion efficiency of 80%, with the new boiler combustion efficiency being 87% (83% for the boiler + 4% increase due to the installed economizer).

The resulting savings are approximately 15% lower than the claimed savings. However, it is important to note that they are 42% lower than the corrected ex ante savings.

Comments on ex ante Costs and EUL:

Based on a review of the project documentation, the EUL appears reasonable.

The original anlaysis used the full project cost as the incremental cost. However, based on the customer interview, it was determined that the boiler was in poor condition (plugged tubes, leaking, and inadequate burner controls). Therefore, the evaluation uses the baseline of the existing boiler, but in a repaired state. Based on the provided documentation, the cost to repair the boiler was assumed to be a minimum of $350,000. The incremental cost is then the difference between this cost and the new boiler cost.

Reasons for Adjustments

- [x] Inappropriate Assumptions
- [x] Calculation/Engineering Error
- [ ] Tracking Error
- [ ] Operated or Installed Diff

Results

	Ex-Ante:	Ex-Ante Adjusted:	Ex-Ante Realization Rate:
kWh Savings (kWh):	0	0	0%
Gas Savings (m3):	1,597,771	1,351,320	85%
Water Savings (L):	25,632,085	0	0%
Incremental Cost:	$435,562	$85,562	20%
EUL (Yrs):	20	25	125%

Project Verification Report

Project ID:	IND-0188			Date Completed:	12/19/2011
Project Savings:	1,115,675	m3	1,488,000 kWh	2,953,449	L
Project Cost:	$527,969				
Project Description:	[redacted] Overhaul				

Verification Report

Measure Description:

The customer rebuilt a backpressure steam turbine that was leaking excessive amounts of steam to the atmosphere. The rebuild reduced the steam loss by [redacted] lbs of steam per year.

Summary of the ex ante Calculations:

No calculations were provided with the analysis, however, a report from the customer was provided that listed the claimed savings. In the provided files however, a description is given that sates that system runs on gas 65% of the time. Addiitonally, the stam enthalpy was [redacted] BTU/lb with [redacted] BTU/lb incoming make-up water.

Comments on the ex ante Calculations:

Although the calculations were not provided, the approach described appears reasonable.

Ex Post Site Description:

The back pressure turbine was found to be installed and operating as expected. The customer was interviewed, and it was determined that the backpressure turbine operates throughout the year. However, for [redacted] the year, the steam system is operated from waste material, rather than natural gas. For these hours, no savings are claimed.

Additionally, the steam conditions (temperature and pressure) were verified and found to be consistent with the provided documentation. Additionally, the customer provided a report that validated the steam savings values claimed.

Summary of ex post Calculations:

The savings were calculated based on the difference in the in the steam loss (lbs/hr) before and after the rebuild. This was then multipled by the difference in the steam enthalpy and the incoming make-up water enthalpy. A boiler efficiency of 75% was used, based on the customer interview.

The electric savings were set to zero. The original analysis claimed both the gas reduction and the additional electric generation due to the steam no longer lost. The ex post analysis calculates the reduction in steam, which results in no electrical generation or savings.

The water savings were increased. The original analysis multipled the lost steam by the percent condensate returned. However, the steam lost through leaks is all lost and none of it is returned as condensate. Therefore, a reduction in leakage will directly save water.

Comments on ex ante Costs and EUL:

The costs were found to be reasonable based on all supplied documentation.

The EUL used in the original analysis was 14 year, which was the time since the previous rebuild. However, based on the customer interview, it was determined that the operation of the turbine had changed. Due to the greater operation, the customer indicated that it would likely be rebuilt more frequently, so an EUL of seven

years was used for the ex post analysis.

Reasons for Adjustments

☐ Inappropriate Assumptions ☐ Calculation/Engineering Error
☐ Tracking Error ☐ Operated or Installed Diff

Results

	Ex-Ante:	Ex-Ante Adjusted:	Ex-Ante Realization Rate:
kWh Savings (kWh):	1,488,000	0	0%
Gas Savings (m3):	1,115,675	1,254,586	112%
Water Savings (L):	2,953,449	18,175,073	615%
Incremental Cost:	$527,969	$527,969	100%
EUL (Yrs):	14	7	50%

Project Verification Report

Project ID:	IND-0171	Date Completed:	1/20/2012
Project Savings:	1,667,381 m3	0 kWh	0 L
Project Cost:	$38,091		
Project Description:	CON-Burner [redacted] Air Heating Improvements		

Verification Report

Measure Description:

The customer modified their EMS control strategy for the burners for a [redacted] heating system.

Summary of the ex ante Calculations:

The savings were done using a billed data analysis. The gas usage 2010 was used to determine the baseline usage, with 2011 being used to determine the usage after the efficiency upgrade. In each case, the gas usage for the time period was divided by the heating degree days over the same time period to determine a specific gas usage per heating degree day. This was then multiplied by the expected annual heating degree days for a typical meteorlogical year to determine the baseine usage, the efficient case usage, and the resulting savings.

Comments on the ex ante Calculations:

The approach uses a modified heating degree value, which appears to be based on the balance point, as observed for the system. Therefore, the approach appears reasonable.

Ex Post Site Description:

The heating system changes were found to be revised as expected. The system controls the burners to blow heated air to condition [redacted] shafts, to prevent freezing.

Summary of ex post Calculations:

The saivngs were calculated in a manner similar to the original analysis. In order to increase the accuracy of the model, the relationship was increased to a cubic relationship, which captured the "flattening" at high and low temperatures more accurately and increased the R^2. The change only resulted in a small (approximately 1%) change in the savings.

Comments on ex ante Costs and EUL:

The project involved the changing of setpoints in an existing EMS system with no equipment modification. The evaluation decreased the EUL of the project, from 20 years to 12 years. The assumption of a 20 year life is reasonable and appropriate for projects that involve the installation of an EMS or BAS system, however, projects that involve only the changes of parameters to existing systems typically are assumed to have a shorter lifespan. For example, the current version of DEER lists the EUL for a retrocommissioning project as 10 years. However, specific measures may have differing measure lives. Based on a paper that reviewed the RCx programs in California (Bing Tso, et. Al--How much does Retrocommissioning Really Save?), the measure life for program schedule chages to existing EMS is only 3 years. For program logic changes to an existing EMS, the expected life is longer, at 5 years.

However, this equipment is production related, and the EMS system is relatively new. Therefore, for this specific projet, the EUL was increased to 12 years. However, this increased value is based on customer specific conditions and should not be applied to other projects.

Reasons for Adjustments

Project Verification Report

- ☐ Inappropriate Assumptions
- ☑ Calculation/Engineering Error
- ☐ Tracking Error
- ☐ Operated or Installed Diff

Results

	Ex-Ante:	Ex-Ante Adjusted:	Ex-Ante Realization Rate:
kWh Savings (kWh):	0	0	0%
Gas Savings (m3):	1,667,381	1,649,101	99%
Water Savings (L):	0	0	0%
Incremental Cost:	$38,091	$38,091	100%
EUL (Yrs):	20	12	60%

Project Verification Report

Project ID:	IND-0156	Date Completed:	12/1/2011
Project Savings:	1,920,653 m3	0 kWh	0 L
Project Cost:	$938,060		
Project Description:	Greenhouse Energy Curtain		

Verification Report

Measure Description:

The customer installed an energy curtain in a [redacted] acre greenhouse to minimize heat loss through the roof during nighttime hours.

Summary of the ex ante Calculations:

The ex ante calculations use energy usage of a similar facility to estimate energy usage for this new greenhouse. The specific energy usage was assumed to be equal for both facilities. The normal monthly usage for the [redacted] acre site was considered to be the average gas usage for the three years from 2007-2009. The [redacted] acre site had a similar curtain, so the usage per acre was adjusted to estimate gas usage with no curtains.

Comments on the ex ante Calculations:

The ex-ante calculation methodology is reasonable. The final estimated savings were calculated at an overall heating system efficiency of 75%, which appears to be somewhat lower than would be expected for a new facility.

Ex Post Site Description:

The installation of the energy curtain was physically verified and found to match the description provided in the application.

Summary of ex post Calculations:

The ex post calculations use a similar methodology as the ex ante calculations, but actual billed usage was used to establish monthly consumption for the efficient, as-built condition. The customer/vendor reported that the curtains were only used for the October to April heating seasons and no savings were expected for the remaining summer months. Ex post calculations used typical sunrise/sunset data for hours of use, which resulted in more hours of curtain use than for in the ex ante condition. Because billed data was used to establish savings, the boiler efficiency is accounted for in the monthly gas consumption.

In addition, a portion of the nighttime heat losses are due to factors that are not affected by the curtains, e.g. heat loss through walls, gutter area, and infiltration below the curtain. It was assumed that approximately 25% of the nighttime heat losses with curtains in place would be due to these other factors.

Comments on ex ante Costs and EUL:

The application costs are consistent with the invoice amounts. Based on conversations with the curtain vendor and other sources, a more appropriate EUL for this measure is 10 years.

Reasons for Adjustments

- ☐ Inappropriate Assumptions
- ☑ Calculation/Engineering Error
- ☐ Tracking Error
- ☑ Operated or Installed Diff

Project Verification Report

Results

	Ex-Ante:	Ex-Ante Adjusted:	Ex-Ante Realization Rate:
kWh Savings (kWh):	0	0	0%
Gas Savings (m3):	1,920,653	2,010,051	105%
Water Savings (L):	0	0	0%
Incremental Cost:	$938,060	$938,060	100%
EUL (Yrs):	5	10	200%

Project Verification Report

Project ID:	IND-0220			Date Completed:	8/8/2012
Project Savings:	275,117	m3	18,114 kWh	1,710,607	L
Project Cost:	$18,252				
Project Description:	SHW-Traps				

Verification Report

Measure Description:

The customer repaired 25 steam traps throughout the facility.

Summary of the ex ante Calculations:

Steam savings lbs/hour were estimated by the vendor and converted to btu savings. Gas savings were then calculated assuming average boiler efficiency of 83.9%.

Comments on the ex ante Calculations:

Total annual lbs/hour is slightly overestimated because it was assumed that the the steam loss for each trap occurred [redacted] hours per year, while 3 of the traps operated only [redacted] hours per year. Electrical savings were estimated assuming the feedwater pump and boiler ID fan both operated at 100% load. Water savings calculations appear to have used the 50% condensate return factor twice.

Ex Post Site Description:

The installation of the new traps was verified by inspecting a sample of 12 traps, and all appeared to be recently replaced. It should be noted that it was not possible to verify the actual leakage of the old traps.

It should be noted that the savings per trap for this project are somewhat higher than the per trap savings for a similar project, IND-0220, verified with this evaluation. The primary cause of this is the significantly higher system pressure associated with this facility than for the other facility.

Summary of ex post Calculations:

The ex-post calculation used the list of traps and estimated leak rates before repair as provided by the trap replacement vendor. Ex post calculations were similar to the ex ante approach. Hours of operation for the three steam traps associated with space heating were reduced from [redacted] hours per year to [redacted] hours per year. Differences in gas savings are due to a slight adjustment to total lbs of steam saved and minor differences in calculation assumptions, e.g. use of steam and condensate enthalpy.

Feedwater pump kW savings was calculated using typical hp required for the required flow and pressure. Fan savings assumed a load factor of 80%. These factors reduced the electrical savings. Water savings are greated because of a correction in the calculations that did not duplicate the 50% return factor.

Comments on ex ante Costs and EUL:

Reported costs were consistent with invoiced costs. The 7 year EUL is reasonable.

Reasons for Adjustments

- [x] Inappropriate Assumptions
- [ ] Calculation/Engineering Error
- [ ] Tracking Error
- [ ] Operated or Installed Diff

Project Verification Report

Results

	Ex-Ante:	Ex-Ante Adjusted:	Ex-Ante Realization Rate:
kWh Savings (kWh):	18,114	10,967	61%
Gas Savings (m3):	275,117	268,112	97%
Water Savings (L):	1,710,607	3,377,506	197%
Incremental Cost:	$18,252	$18,252	100%
EUL (Yrs):	7	7	100%

Project Verification Report

Project ID:	IND-0049	Date Completed:	1/1/2012
Project Savings:	581,045 m3	0 kWh	0 L
Project Cost:	$362,567		
Project Description:	[redacted]		

Verification Report

Measure Description:

The customer installed a gas-fired generator set to provide electrical power for greenhouse lighting that was installed with equipment to recover waste heat from the generator engine coolant, oil, and exhaust. The recovered energy is used to heat water used in the greenhouse operation.

Summary of the ex ante Calculations:

The ex-ante calculation methodology is reasonable. Data provided by the generator manufacturer was used to establish the amount of heat available to be recovered from the engine exhaust, cooling water, after coolers, and oil cooler. It was assumed that the generator would operate at full capacity for [redacted] hours per year.

Comments on the ex ante Calculations:

The ex ante approach appears to be reasonable and appropriate.

Ex Post Site Description:

The installation of the heat recovery equipment was physically verified and found to match the description provided in the installation.
The customer reported that the generator was expected to operate for [redacted] hours per year. The primary purpose of the generator is to reduce facility demand kW during those times when artificial lighting is required. Lighting is required during part of the nighttime hours in order to extend the equivalent hours of daylight. While more artificial lighting will be required during the winter months, artificial lighting and generator use will occur throughout the year.

The generator is controlled to operate during times when lighting is required and is expected to operate at 100% capacity when running. The heat recovery system also operates at 100% capacity whenever the generator is running. The greenhouse requires heated water at all times of the year and has significant hot water storage capacity so that all of the recovered heat can be effectively used. The annual hours of operation claimed appear to be reasonable.

Summary of ex post Calculations:

The ex post calculations used the manufacturer data for heat rejection to establish rate of heat recovery. The generator set was assumed to operate at 100% capacity for [redacted] hours per year at a heat recovery rate of [redacted] kW. The heat recovery was considered to replace the heating that would have otherwise be provided by a hot water boiler operating at 84% efficiency.

Comments on ex ante Costs and EUL:

The costs presented in the application were consistent with the invoices provided by the customer. The 20 year EUL is reasonable.

Reasons for Adjustments

☐ Inappropriate Assumptions ☑ Calculation/Engineering Error

Project Verification Report

☐ Tracking Error ☐ Operated or Installed Diff

Results

	Ex-Ante:	Ex-Ante Adjusted:	Ex-Ante Realization Rate:
kWh Savings (kWh):	0	0	0%
Gas Savings (m3):	581,045	694,171	119%
Water Savings (L):	0	0	0%
Incremental Cost:	$362,567	$362,567	100%
EUL (Yrs):	20	20	100%

Project Verification Report

Project ID:	IND-0155			Date Completed:	3/30/2012
Project Savings:	428,837 m3		0 kWh		550,366 L
Project Cost:	$7,803				
Project Description:	SHW-Traps-Repairs 2012				

Verification Report

Measure Description:

The customer repaired 13 steam traps throughout the facility.

Summary of the ex ante Calculations:

Steam savings lbs/hour were estimated by the vendor. These pound per hour values were then multipled by [redacted] hours per year of operation and an assumed 28.3 m^3 of gas heat output per 1000 lbs of steam. This was then divided by an 80% boiler efficiency to determine the gas savings.

Comments on the ex ante Calculations:

The savings approach found is reasonable. No information was available to justify the 28.3 m^3 per 1000 lbs of steam. However, it should be noted that the water savings were calculated incorrectly. The water savings were reduced to account for the percent of the steam usage that is made up with make-up water. However, all steam trap leakage is lost and therefore must be made up by make-up water.

Ex Post Site Description:

The traps were found to be replaced as indicated. The upstream pressure was found to be 180 psig, slightly lower than the 185 psig indicated in the original anaysis. Additionally, based on the combustion tests provided, the boiler efficiency was increased from 80% to 80.7%.

Summary of ex post Calculations:

The savings for the evaluation were calculated using the difference between the enthalpy of the lost steam and the make-up water. The pounds per hour for each trap was found to be reasonable and retained from the ex ante anlaysis.

It should be noted that the savings per trap for this project are somewhat higher than the per trap savings for a similar project, IND-0155, verified with this evaluation. The primary cause of this is the significantly higher system pressure associated with this facility than for the other facility.

It was assumed that all leaked steam was lost to the atmosphere and would require 100% makeup water. Ths system does not have a pressurized return so it is expected that only a small amount of lost steam will condense before being returned to the boiler room.

Comments on ex ante Costs and EUL:

The cost, incremental cost, ane EUL were found to be reasonable.

Reasons for Adjustments

- ☐ Inappropriate Assumptions
- ☑ Calculation/Engineering Error
- ☐ Tracking Error
- ☐ Operated or Installed Diff

Project Verification Report

Results

	Ex-Ante:	Ex-Ante Adjusted:	Ex-Ante Realization Rate:
kWh Savings (kWh):	0	0	0%
Gas Savings (m3):	428,837	467,718	109%
Water Savings (L):	550,366	5,457,002	992%
Incremental Cost:	$7,803	$7,803	100%
EUL (Yrs):	7	7	100%

Project Verification Report

Project ID:	IND-0079	Date Completed:	1/1/2011
Project Savings:	318,377 m3	0 kWh	43,049,034 L
Project Cost:	$420,000		
Project Description:	[redacted]Other-[redacted] Machine to Reduce Drying		

Verification Report

Measure Description:

The customer installed an [redacted] system to locate debris in [redacted] product. The system allows the debris to be removed via air jets and other means rather than by washing and drying the entire incoming [redacted] stream.

Summary of the ex ante Calculations:

The claimed savings is the average of three savings values. The first value used is the value claimed by the customer. No description or calculations for this value is presented. The second value is used based on energy intensity. The third value is a billed data (CUSUM) analysis. The gas usage was coorelated to heating degree days. The savings was the difference between the actual usage and the projected usage based on the historical usage for 2011.

Comments on the ex ante Calculations:

The savings methods appear reasonable.

Ex Post Site Description:

The [redacted] system was found to be installed as expected. The system removed debris from the [redacted] stream. Prior the the installation, the entire [redacted] stream was washed to remove rocks. The washed [redacted] then required extra energy to dry in the baking oven. Additionally, due to the completion of this project, the waste for the facility was reduced. Prior to the completion of this project a portion of the production [redacted] would not meet specification for moisture content after backing and would need to be thrown away.

Summary of ex post Calculations:

The savings were caluclated using a billed data approach similar to one of the original savings methods. However, the billed data was used to determine the energy associated with the production equipment (the fixed loads). Due to the [redacted] in production, the baseline energy usage was multiplied by 1.01.

Comments on ex ante Costs and EUL:

The EUL for this measure was determined to be reasonable, and no changes were made.

The cost for this project was increased significantly. The original cost was basecd on the expected cost for the installed equipment. The verified costs included the complete costs for the project, which included the installed equipment, installation, and demolition of the existing equipment.

Reasons for Adjustments

- ☐ Inappropriate Assumptions
- ☐ Calculation/Engineering Error
- ☐ Tracking Error
- ☑ Operated or Installed Diff

Results

Project Verification Report

	Ex-Ante:	Ex-Ante Adjusted:	Ex-Ante Realization Rate:
kWh Savings (kWh):	0	0	0%
Gas Savings (m3):	318,377	377,436	119%
Water Savings (L):	43,049,034	43,049,034	100%
Incremental Cost:	$420,000	$949,620	226%
EUL (Yrs):	20	20	100%

Project Verification Report

Project ID:	COM-0020	Date Completed:	11/30/2011
Project Savings:	415,905 m3	0 kWh	0 L
Project Cost:	$10,755		
Project Description:	HR-Compressor Air Recovery		

Verification Report

Measure Description:

Use heat rejected by two [redacted] Hp plus one [redacted] Hp air compressors to offset heat otherwise provided by gas-fired space heating equipment.

Summary of the ex ante Calculations:

The ex ante hours of heat recovery are [redacted] per year. The total recoverable heat was calculated using compressor vendor data for fan cfm and air temperature rise and assumed to all be used to offset heating provided by gas heating equipment in the facility at outdoor air temperatures lower than 15C. It was assumed that the offset heating would have been provided by unit heaters operating at 80% efficiency.

Comments on the ex ante Calculations:

The ex-ante analysis did not take into account the fact that a small number of those hours likely occurred during times when the plant heating system may not have been operating, e.g. much of May and October. It is not clear if the ex ante analysis used average temperature data or data from 2010. The ex ante calculations assumed a heating system efficiency of 82.5%.

Ex Post Site Description:

The as-found condition matched the application description.
Heating for the facility is provided by power-vented indirect makeup air units. The standard efficiency was assumed to be 80%, which is typical for commercially available standard MUA units.

Summary of ex post Calculations:

Heat rejected by the compressors was provided in the manufacturer literature and those values were used instead of calculating heat recovery based on fan cfm and an estimated temperature rise. According to the customer, the manual dampers are set to provide supplemental heating from mid October through early to mid May. The primary cause of the reduced realization rate is because the ex post hours of heat recovery are only [redacted] per year.

This is one of two similar projects evaluated, IND-0127 and IND-0020. IND-0020 has verified savings that are approximately 3 times greater than those for IND-0127 even though the total available compressor power is similar, [redacted] HP and [redacted] HP respectively. However, the compressors at the IND-0020 facility are typically operating at, or close to, full load for an average load of [redacted].5 HP. One of 3 compressors associated with IND-0127 operates in standby mode and the two main compressors normally operate at about 67% load for an average total load of [redacted] HP. This is the primary cause for the large difference between the two projects.

Comments on ex ante Costs and EUL:

Project costs were consistent with provided invoices. An EUL of 20 years is reasonable.

Reasons for Adjustments

☐ Inappropriate Assumptions ☐ Calculation/Engineering Error

Project Verification Report

☐ Tracking Error ☑ Operated or Installed Diff

Results

	Ex-Ante:	Ex-Ante Adjusted:	Ex-Ante Realization Rate:
kWh Savings (kWh):	0	0	0%
Gas Savings (m3):	415,905	350,685	84%
Water Savings (L):	0	0	0%
Incremental Cost:	$10,755	$10,755	100%
EUL (Yrs):	20	20	100%

Project Verification Report

Project ID:	IND-0225			Date Completed:	11/30/2011
Project Savings:	296,704 m3		152,500 kWh		0 L
Project Cost:	$640,000				
Project Description:	HR-Heat Transfer Improvement				

Verification Report

Measure Description:

The customer installed a high efficiency [redacted] dryer.

Summary of the ex ante Calculations:

The savings were calculated using a [redacted] dryer calculation reviewed in prior years. The moisture removed was calculated based on the expected throughput and points dried for each [redacted] This is then multiplied by a BTU/lb of moisture for each dryer.

Comments on the ex ante Calculations:

The savings approach appears reasonable based on the supplied information, with one exception. In the original analysis, the [redacted] each year.

Additionally, the electric savings value could not be duplicated. Based on the provided documentation, the appropriate savings is 24,000 kWh.

Ex Post Site Description:

The [redacted] dryer was installed as expected. However, due to the date of installation and other factors, the throughput for the dryer was lower than anticipated. However, next year it is expected to be [redacted] production.

Summary of ex post Calculations:

The savings were recalculated using the workbook used to determine the ex ante savings. However, the ex post savings are based on the expected production for next year (the fist full year of production). No production [redacted] is included.

Comments on ex ante Costs and EUL:

The cost, incremental cost, and EUL appears reasonable.

Reasons for Adjustments

- [x] Inappropriate Assumptions
- [ ] Calculation/Engineering Error
- [ ] Tracking Error
- [x] Operated or Installed Diff

Results

Project Verification Report

	Ex-Ante:	Ex-Ante Adjusted:	Ex-Ante Realization Rate:
kWh Savings (kWh):	152,500	24,000	16%
Gas Savings (m3):	296,704	222,316	75%
Water Savings (L):	0	0	0%
Incremental Cost:	$640,000	$640,000	100%
EUL (Yrs):	20	20	100%

Project Verification Report

Project ID:	COM-0057	Date Completed:	1/12/2012
Project Savings:	51,040 m3	0 kWh	0 L
Project Cost:	$14,549		
Project Description:	IV-Dock Door Seals		

Verification Report

Measure Description:

The customer replaced (11) damaged and aged dock door seals with new seals.

Summary of the ex ante Calculations:

The ex-ante savings were calculated using a vendor calculator template. It was assumed that the indoor set temperature was 20 deg C, with 7,890 HDD. The average heating season wind speed is 20.1 kw/hr. The doors are each 8' wide by 10' high, for a total calculated pre retrofit free area of 12.27 sq ft per door. The doors were expected to each be open for 2 hours per work day.

Comments on the ex ante Calculations:

It was not possible to evaluate the formulas used to establish energy savings. It was not clear whether the orientation of the doors is accounted for. The actual condition of the old door seals was not presented in detail, but the pre retrofit free area seems reasonable.

Ex Post Site Description:

The installation of 11 new door seals was physically verified and found to match the specifications presented in the application. Heating for the facility is provided by gas-fired infra-red heaters, with an estimated operating efficiency of 80%.

Summary of ex post Calculations:

The ex-post calculation uses TMY3 data with a spreadsheet calculation to determine the expected change in infiltration through the dock doors for the pre and post retrfoit conditions. The infiltration is primarily due to wind-caused differential pressure on the doors and is accounted for. The calculations use the TMY3 data to determine wind pressure on the doors based on average wind speed and direction. The infiltration is estimated using the assumed free area. Additional heating due to door infiltration is based on indoor/outdoor temperature differential for each hour and converted to gas savings using heating system efficiency of 80%.

The primary reason for the low realization rate is that the vendor template appears to significantly overestimate savings for this location.

Comments on ex ante Costs and EUL:

The costs presented in the application were consistent with the invoices provided by the customer. The 15 year EUL appears reasonable.

Reasons for Adjustments

- ☐ Inappropriate Assumptions
- ☑ Calculation/Engineering Error
- ☐ Tracking Error
- ☑ Operated or Installed Diff

Results

Project Verification Report

	Ex-Ante:	Ex-Ante Adjusted:	Ex-Ante Realization Rate:
kWh Savings (kWh):	0	0	0%
Gas Savings (m3):	51,040	13,497	26%
Water Savings (L):	0	0	0%
Incremental Cost:	$14,549	$14,549	100%
EUL (Yrs):	15	15	100%

Project Verification Report

Project ID:	IND-0127	Date Completed:	12/29/2011
Project Savings:	111,700 m3	0 kWh	0 L
Project Cost:	$69,999		
Project Description:	HR-Compressor Air Recovery		

Verification Report

Measure Description:

Use heat rejected by three [redacted] Hp air compressors to offset heat that would otherwise provided by gas-fired space heating equipment.

Summary of the ex ante Calculations:

The ex-ante calculation methodology is reasonable. The ex ante analysis calculated compressor heat rejection using cooling fan cfm and an assumed temperature rise and heat recovery efficiency. Heat recovery was assumed to occur whenever the outdoor temperature is lower than the building heating balance point temperature of 13 degrees C.

Comments on the ex ante Calculations:

The ex-ante analysis did not account for hours during times when the plant heating system may not have been operating.

Ex Post Site Description:

The installation of the heat recovery ductwork was physically verified and found to match the description provided in the application.

Summary of ex post Calculations:

The ex-post calculation uses a simplified bin analysis to calculate the hours of use and savings for each temperature range. Useful heat is recovered during all hours from November through April plus 1/2 of the hours during May and October during which the outdoor air temperatures are below 13 deg C. According to the customer, the efficiency of the boiler providing steam to the heating system in this part of the building is 82.5%, based on the most-recent boiler inspection and test report. The ex post analysis used the manufacturer's data for compressor cooler heat rejection.
This is one of two similar projects evaluated, IND-0127 and IND-0020. IND-0020 has verified savings that are approximately 3 times greater than those for IND-0127 even though the total available compressor power is similar, [redacted]5 HP and [redacted] HP respectively. However, the compressors at the IND-0020 facility are typically operating at, or close to, full load for an average load of [redacted].5 HP. One of 3 compressors associated with IND-0127 operates in standby mode and the two main compressors normally operate at about 67% load for an average total load of [redacted] HP. This is the primary cause for the large difference between the two projects.

Comments on ex ante Costs and EUL:

The project costs were consistent with invoice amounts. The 20 year EUL appears to be reasonable.

Reasons for Adjustments

- ☐ Inappropriate Assumptions
- ☐ Calculation/Engineering Error
- ☐ Tracking Error
- ☑ Operated or Installed Diff

Project Verification Report

Results

	Ex-Ante:	Ex-Ante Adjusted:	Ex-Ante Realization Rate:
kWh Savings (kWh):	0	0	0%
Gas Savings (m3):	111,700	115,793	104%
Water Savings (L):	0	0	0%
Incremental Cost:	$69,999	$69,999	100%
EUL (Yrs):	20	20	100%

Project Verification Report

Project ID:	IND-0130	Date Completed:	5/20/2010
Project Savings:	224,110 m3	0 kWh	0 L
Project Cost:	$118,000		
Project Description:	[redacted] Plant Optimization		

Verification Report

Measure Description:

The customer installed new [redacted] equipment with a high-efficiency burner and a VFD on the baghouse. In addition, the burner on the [redacted] was tuned and adjusted to improve efficiency.

Summary of the ex ante Calculations:

The ex ante calculations used the CuSum regression analysis to compare gas use efficiency, in m3 of gas per ton of product, of the new [redacted] system with the old [redacted] system. Daily [redacted] production and facility gas usage was provided by the customer.

Comments on the ex ante Calculations:

The ex ante calculations used a reaonable approach to establish measure savings.

Ex Post Site Description:

The installation of the VFD and burner was physically verified and found to match the desciptions provided in the application. The customer provided production and gas usage data at the plant for the 2012 year, so data was available for the 3-year period from 2010 through 2012.

Summary of ex post Calculations:

The ex post calculations use production and gas usage record for the three years from 2010-2012 and calculate savings based on estimated efficency increase of the new equipment. Information provided by the vendor reported that the burner and VFD would result in an efficiency improvement of approximately 20%. No literature was available to verify this claim, so the efficiency of the new equipment was compared to the efficiency of the old equipment. A regression analysis on the post replacement was conducted to establish a correlation between production and gas usage for the new equipment. The result was used to estimate gas usage at pre replacement production levels. The efficiency improvement was only 14.1% between the old and new equipment, so this value was used to estimate total measure efficiency of the new mixer. The regression result was also used to estimate total gas usage of the boiler, which was assumed to be relatively constant at the same level on days for which there was no production. It was estimated that the burner tune up would result in an improvement in boiler efficiency of approximately [redacted]. Boiler savings were less than 1% of overall project savings.

Comments on ex ante Costs and EUL:

Total project costs were not included with the application documentation. The incremental costs were consistent with the costs provided by the customer. The EUL of 15 years appears to be reasonable for this type of project.

Reasons for Adjustments

- ☐ Inappropriate Assumptions
- ☐ Calculation/Engineering Error
- ☐ Tracking Error
- ☑ Operated or Installed Diff

Results

	Ex-Ante:	Ex-Ante Adjusted:	Ex-Ante Realization Rate:
kWh Savings (kWh):	0	0	0%
Gas Savings (m3):	224,110	234,322	105%
Water Savings (L):	0	0	0%
Incremental Cost:	$118,000	$118,000	100%
EUL (Yrs):	15	15	100%

Project Verification Report

Project ID:	IND-0088	Date Completed:	9/1/2011
Project Savings:	50,240 m3	0 kWh	0 L
Project Cost:	$9,849		
Project Description:	GH-IR Poly		

Verification Report

Measure Description:

This project is for the replacement of poly film roofing of a greenhouse. The baseline condition is assumed to be standard double poly film with an air gap between the layers. The efficient case is also duoble wall, but the poly film includes infra red (IR) additive, which is expected to reduce heat loss through the roof.

Summary of the ex ante Calculations:

The ex ante calculations are based on data collected for a number of greenhouse installations and the average baseline and efficient gas usage volumes per acre of covered area are used to estimate usage for individual projects.

Comments on the ex ante Calculations:

The methodolgy used to establish measure savings may, on average, yield reasonable overall results, but it does not account for differences in setpoint temperatures, total hours of operation, or heating system efficiencies for individual projects.

Ex Post Site Description:

The installation of the poly roof was verified and found to match the description provided in the application.

Summary of ex post Calculations:

The ex post calculations use premise gas usage, normalized for HDD, to establish the baseline gas usage for the greenhouses with double-wall poly film but no IR component. Data from 2010 was adjusted for average HDD for the area. In addition, it was assumed that the all film on the premises had similar insulating properties as the new film and baseline usage was adjusted to simulate usage with standard double wall poly film.

Historical application results for UG greenhouse customers who completed similar measures from 2010 to early 2011 were used to determine average per cent savings expected for IR film. The results were based on data collected for a range of greenhouse sizes and is assumed to be a representative sample of the greenhouse industry in Union Gas Ltd. territory. Based on the provided Union Gas data, the average savings for similar projects is expected to be approximately [redacted] baseline usage. This figure was deemed reasonable based on published literature, e.g. University of Wisconsin Madison presentation on Greenhouse Efficiency, S Sanford, 2005.

Comments on ex ante Costs and EUL:

The overall costs of the measure are consistent with documentation provided. Based on EULs used for similar measures in other areas, a review of related literature, and conversations with vendors, the 4 year EUL appears to be conservative. An EUL of 5 years is used on the ex post analysis.

Reasons for Adjustments

☐ Inappropriate Assumptions ☐ Calculation/Engineering Error

Project Verification Report

☐ Tracking Error ☐ Operated or Installed Diff

Results

	Ex-Ante:	Ex-Ante Adjusted:	Ex-Ante Realization Rate:
kWh Savings (kWh):	0	0	0%
Gas Savings (m3):	50,240	43,577	87%
Water Savings (L):	0	0	0%
Incremental Cost:	$9,849	$9,849	100%
EUL (Yrs):	4	5	125%

Project Verification Report

Project ID:	IND-0213	Date Completed:	8/15/2012
Project Savings:	166,374 m3	0 kWh	0 L
Project Cost:	$51,304		
Project Description:	CON-Linkageless Controls [redacted] Boilers		

Verification Report

Measure Description:

Install linkage-less controls and draft fan VFD on two steam boilers to improve operation efficiency. One boiler is rated at [redacted] BHP and the other at [redacted] BHP.

Summary of the ex ante Calculations:

The ex-ante savings are taken from the vendor's test results for pre and post installation of the linkageless burner controls. The vendor metered operation of the 2 boilers for a period of 4 weeks. The metered period included both pre and post retrofit operation. The steam production for the metered period was assumed to be representative of standard annual operation and the test results were extrapolated to annual operation without adjustment.

Comments on the ex ante Calculations:

Because the savings were based on metered data collected by the vendor, the results are expected to be accurate.

Ex Post Site Description:

The installation of the linkageless controls, including VFDs on the forced draft fans, was physically verified and found to match the description provided in the application. The customer provided records of monthly softened water supplied to the boilers as determined by their own meters. The data confirmed the increase in production claimed.

Summary of ex post Calculations:

Because the metered ex ante data was expected to accurately represent the savings due to improvement in boiler efficiency, the ex post calculations used those results, adjusted to represent current operating conditions, to establish measure savings. The softened water records were used to establish actual current operation of the boilers.

Comments on ex ante Costs and EUL:

The project costs are consistent with documentation provided with the application. The EUL of 20 years is reasonable for this type of measure.

Reasons for Adjustments

- ☐ Inappropriate Assumptions
- ☐ Calculation/Engineering Error
- ☐ Tracking Error
- ☑ Operated or Installed Diff

Results

Project Verification Report

	Ex-Ante:	Ex-Ante Adjusted:	Ex-Ante Realization Rate:
kWh Savings (kWh):	0	0	0%
Gas Savings (m3):	166,374	239,635	144%
Water Savings (L):	0	0	0%
Incremental Cost:	$51,304	$51,304	100%
EUL (Yrs):	20	20	100%

Project Verification Report

Project ID:	IND-0251	Date Completed:	3/3/2011
Project Savings:	712,243 m3	0 kWh	0 L
Project Cost:	$8,225		
Project Description:	HVAC-Setbacks		

Verification Report

Measure Description:

The customer installed programmable thermostats to control unit heaters, which are the primary source of heat to the facility. The thermostats were relocated to a position about 15 feet above the floor to eliminate tampering. The thermostats are programmed at 72 deg F during the week and 68F on weekends. The old thermostats were reported to be set at 74F at all times.

Summary of the ex ante Calculations:

The ex-ante savings used the in-house CUSUM spreadsheet to establish savings. Only a screenshot of the CUSUM results were included in the application information packet that was examined. A functioning CuSum analysis was subsequently provided during the evaluation process. It appears that the analysis uses the period from January 2011 through November 2011 to establish a linear relationship between HDD and billed gas usage. The result has a high correlation with an R2 value of 0.992. This period was considered to represent baseline operation.

The CuSum results were checked using the theoretical effect of the reduced temperature settings on makeup air. It was assumed that [redacted],000 cfm of makeup air would be provided to the space and the savings would be a result of reduced temperature settings using the relationship:

Btu/hour savings = 1.08 x (Old Temperature F - New Temperature F) x [redacted],000 cfm

This was done for weekday and weekend conditions and the total converted to gas usage without considering heating system efficiency. The result was 785,855 m3 of gas savings, compared to the ex ante result of 712,243 m3.

Comments on the ex ante Calculations:

The use of CUSUM to establish a correlation between building gas usage and HDD is reasonable if a significant correlation can be established.
The ex ante calculations appear to have been carried out assuming that the period from January through November of 2011 represented baseline conditions. However, the installation of this measure was in progress during the month of January and was fully implemented in early March, so gas usage during 2011 does not represent pre-retrofit operation of the heating system.

In addition, the savings period considered appears to include the period from December 2011 through August of 2012. During that period, another energy efficiency project was implemented with program incentive. Three high speed zip doors replaced existing doors, with one door being installed in each month of January, February, and March.

It is also noted that much of the savings were due to a normal temperature reduction from 74° F to 72° F. It may have been possible to implement this portion of the project without capital cost by merely reducing set temperature, although a prime motive for re-locating the thermostats was to eliminate tampering with set

points. The ex ante savings represented approximately [redacted] of the entire billed usage of the facility and about [redacted] of the gas use expected for heating only. A theoretical analysis using the pre retrofit and post retrofit temperatures predicts heating savings of about [redacted].

Ex Post Site Description:

Two on-site managers were interviewed on February 20th, 2013 and provided a tour of the facility and associated measures. The pre retrofit and post retrofit operation of the unit heaters was discussed and set point temperatures collected. Heating is provided by unit heaters installed around the perimeter of the building.

The customer confirmed that, prior to the completion of this measure, manual thermostats were wall-mounted at accessible levels. The old temperature set point was 74 F and no effort was made to set back temperatures on weekends. The new thermostats are programmed with a weekday set point of 72 F and a weekend temperature of 68 F on weekends.

This project was completed during January and February of 2011. The final commissioning was on March 3, 2011. Since the completion of this project, 2 additional gas savings measures were implemented through the program. A project to replace 3 overhead doors with zip doors was completed during the January to March 2012 and a boiler tuneup was completed during 2012.

The customer reported that production levels at the plant had [redacted] from 2010 to 2011. 2012 production is about [redacted] than for 2011. The amount of process heating used depends on product mix, customer orders, and other factors. There does not appear to be a quantifiable correlation between production and process heating use, e.g. average use for the summer of 2012, when no HDD dependence is expected, is lower than for summer of 2010 in spite of [redacted] in production.

Summary of ex post Calculations:

The ex-post calculations assume that the savings are proportional to the reduction in space temperature set points. The average space temperature was calculated for the pre retrofit and post retrofit conditions. The average winter temperature was calculated from bin temperatures for the period from October 1 through May 31. The results were used to calculate the potential per cent savings due to the temperature reductions.

Billed usage data was analyzed to estimate the portion of gas dedicated to space heating. A regression analysis of pre retrofit usage vs. HDD was completed, resulting in a linear correlation with R2 value of 0.99. Outlier months were not used in the analysis, e.g. July and December data was not included because the plant observes a one-week shutdown during those months.

A similar regression analysis was completed with 2011 data. The 2011 analysis uses data from March through November, with July not used due to the one-week shutdown. January and February were not included because the project was being installed during this time. When the regression results are used to compare 2010 and 2011 gas usage, the analysis of HDD dependent gas use demonstrates significant negative savings.

Because the effects of changes in production are difficult to predict, for instance the average monthly summer usage from 2010 to 2011 [redacted] but the summer usage in 2012 was [redacted] than 2011 or 2012. It is expected that the differences in summer usage are primarily due to production and would have no HDD dependence. Therfore, savings calculated using the regression analysis were considered to be unreliable and a theoretical approach to determining savings was used. The results of the regression analysis were used to estimate the HDD dependent usage for the facility. The ex post savings are the product of the calculated per cent savings and HDD dependent usage.

It should be noted that a regression analysis demonstrated significant savings from 2011 to 2012, but two other efficiency projects were completed in the first half of 2012.

Project Verification Report

The ex ante calculations used 2011 data because it was believed that, because of production [redacted], 2010 would not adequately represent baseline production. However, much of the production [redacted] was reported to have occurred during the fall of 2010, prior to the implementation of this project. The effect of the production [redacted] would likely be seen in process related use, some [redacted] may be seen in heating gas consumption due to [redacted] door traffic.

Comments on ex ante Costs and EUL:

The costs presented in the application were consistent with the invoices provided by the customer. The 20 year EUL is reasonable for this measure.

Reasons for Adjustments

- ☐ Inappropriate Assumptions
- ☑ Calculation/Engineering Error
- ☐ Tracking Error
- ☑ Operated or Installed Diff

Results

	Ex-Ante:	Ex-Ante Adjusted:	Ex-Ante Realization Rate:
kWh Savings (kWh):	0	0	0%
Gas Savings (m3):	712,243	249,505	35%
Water Savings (L):	0	0	0%
Incremental Cost:	$8,225	$8,225	100%
EUL (Yrs):	20	20	100%

Project Verification Report

Project ID:	IND-0532			Date Completed:	5/1/2012
Project Savings:	5,242,292 m3		0 kWh		64,851,144 L
Project Cost:	$28,435				
Project Description:	SHW-Leaks-Steam Leaks Repairs 2012				

Verification Report

Measure Description:

The project consisted of the repair of three steam leaks at an industrial facility. Two of the steam leaks were very large, with one being small. The total steam loss was estimated to be [redacted] lbs/hr of [redacted] psig steam for [redacted] hours per year.

Summary of the ex ante Calculations:

The steam leak rate was estimated for each leak using the Darcy equation. The Darcy equation calculates the expected leak rate of steam through an orifice by assuming that the hole is small in relation to the steam pipe or reservoir. The steam loss will be governed by the area of the orifice and the sonic velocity of the steam at the conditions in the orifice.

The first steam leak was the smallest, and occurred at a ½" valve bonnet. The leak area was estimated to be 0.0625 sq. in, which per the supplied notes was a 1/16" groove in the packing. This area results in an estimate of [redacted] lbs/hr of steam loss. At [redacted] hours per year, the repair of this leak saves [redacted] m3 per year. No boiler efficiency was considered in these savings.

The second steam leak was significantly larger, and occurred at a flange in a 12" pipe. The leak area was estimated to be 0.93 sq. in. Based on the notes, this area is based on a 0.05" gap, which was the compressed thickness of the installed 1/16" gasket. This area results in an estimate of [redacted] lbs/hr of steam loss. At [redacted] hours per year, the repair of this leak saves [redacted] m3 per year. Again, no boiler efficiency was considered in these savings.

The third steam leak was the largest, and occurred at a flange in a 16" pipe. The leak area was estimated to be 1.406 sq. in. Based on the notes, this area is based on a 0.09" gap, which was the compressed thickness of the installed 1/8" gasket. This area results in an estimate of [redacted] lbs/hr of steam loss. At [redacted] hours per year, the repair of this leak saves [redacted] m3 per year. Again, no boiler efficiency was considered in these savings.

Comments on the ex ante Calculations:

The Darcy approach is a reasonable and appropriate way to estimate steam loss in many circumstances and is supported when compared to steam loss tables, based on area. However, no indication of how steam leakage area was determined was included. Based on discussions with the Union Gas account manager who calculated the leaks, the leak area was based on the description from the vendor that the leaks were rated a 6 of 10.

It should be notd that the projected gas savings are approximately [redacted] of the customer usage. This customer also completed a second steam leak project included in this sample and one in last year's program. These three projects combined are expected tol savings nearly [redacted] of the customer gas usage.

Ex Post Site Description:

The savings for this measure were verified through a desk review. Attempts were made to interview both the customer representative and the vendor, however, the customer representative no longer is employed at the

facility and no other site contact could provide any information on the project. Additionally, despite multiple attempts, the vendor was not able to be interviewed.

However, the customer contact has been interviewed and the affected steam system inspected as part of the verification of project IND-0188. Based on that interview, it was determined that the steam system does operate at [redacted] psig, but that the facility uses other fuels to produce the majority of the steam.

Therefore, the savings were adjusted only based on calculation errors or methodological adjustments. Parameters that could not be verified were retained from the

Summary of ex post Calculations:

The evaluation uses a similar approach as the ex ante, however, several changes were made. The approach taken, is similar to the approach used in the verification last year of a similar leak at the same customer (Project 2011-IND-0335), completed by Diamond Engineering.

First, the original analysis uses the Darcy formula to calculate the steam leakage, based on pressure and leak area. This approach assumes that the steam will be leaking at a sonic velocity. The verification uses the Napier equation:

msteam = 51.43 x Oriface Area x Steam Pressure x Coriface x Cgeometery

When 0.6 is used for Coriface*Cgeometery, high correlation has been found for leaks through sharp edged orifices, like expected for this project. This change produces relatively small changes to the steam leak rate.

The leak area was also adjusted. First, the original analysis incorrectly calculated the reduction in leak area due to the bolts, due to an error in the formula. The verification corrected this formula.

Third, bolt size and bolt diameter values were corrected to be consistent with ANSI B16.5 Class 300 flange specifications.
The original analysis assumed a 1/16" gasket for the 12" pipe flange and a 1/8" gasket for the 16" flange. Based on information collected for last year's verification, the thickness of the gasket for the 16" flange was 1/16". However, after discussions with the engineer that completed last year's verification, the accuracy of that thickness could not be verified. Therefore, it was determined that thre was insufficient information to adjust the thickenss.

Finally, the vast majority of the steam produced at this facility is produced by combustors which do not burn natural gas. Only approximately 10% of the steam is produced from the natural gas boilers. However, the natural gas boilers are essentially the "lag" boilers and modulate based on the load conditions.

Based on the changes described above, the steam leakage rate was determined to be approximately [redacted] lbs/hr. However, not all of this steam reduction results in a reduction in steam produced by the natural gas boilers. In order to determine the natural gas reduction, the steam production of the natural gas boilers was reviewed. Based on a review of the data, it appears that both boilers are fired continuously, and that the minimum operating point of the boilers is approximately [redacted] lbs/hr per boiler ([redacted] lbs/hr combined). Therefore, the maximum reduction in steam usage from gas that can be achieved at any point in time is the minimum of either the steam leak rate, or the difference in the steam from gas and the minimum of [redacted] lbs/hr. Based on a review of the daily data, starting with January 1, 2011, approximately 82% of the steam leak reduction will result in a reduction in gas usage.

Based on all the above changes, the savings were reduced to 4,805,708 m3 per year. It should be noted that as a secondary check, the customer billed data was reviewed. No distinguishable difference or reduction in gas usage could be identified during the dates associated with this project.

Project Verification Report

Comments on ex ante Costs and EUL:

The costs presented in the application were consistent with the invoices provided by the customer. The 10 year EUL is reasonable for steam leak repairs for this customer.

Reasons for Adjustments

- [x] Inappropriate Assumptions
- [x] Calculation/Engineering Error
- [ ] Tracking Error
- [x] Operated or Installed Diff

Results

	Ex-Ante:	Ex-Ante Adjusted:	Ex-Ante Realization Rate:
kWh Savings (kWh):	0	0	0%
Gas Savings (m3):	5,242,292	4,805,708	92%
Water Savings (L):	64,851,144	61,855,200	95%
Incremental Cost:	$28,435	$32,132	113%
EUL (Yrs):	10	10	100%

Project Verification Report

Project ID:	IND-0477	Date Completed:	7/12/2012
Project Savings:	1,811,219 m3	0 kWh	0 L
Project Cost:	$80,400		
Project Description:	PI-[redacted] Process		

Verification Report

Measure Description:

The customer has implemented a number of measures that increased the efficiency of their [redacted] process. The measures include:
1. Recalibration of the furnaces belt speeds
2. Part load pattern analysis and adjustments
3. [redacted]
6. A preventative maintenance program

Summary of the ex ante Calculations:

Savings were established by calculating the m3 of gas required to produce a pound of finished product. The baseline year of production was assumed to be 2008 and the post retrofit year was 2012.

Comments on the ex ante Calculations:

Using the billed m3 per pound of finished product is a reasonable approach if production represents the major end use of natural gas provided. Production represents the major demand on gas usage for this facility, with space heating representing most of the balance of gas demand. However, the ex ante calculations did not attempt to separate miscellaneous gas usage from production uses. Using a simple m3 per pound of product metric for computing savings does not account for non-production gas usage, which may remain constant regardless of production levels.

Ex Post Site Description:

Due to time constraints on the part of the customer, no tour of the facility was conducted.

The plant manager and production manager were interviewed on February 20th, 2013. The project and its various measures were discussed. It appears that the modifications to the furnaces to improve throughput had the most significant effect on savings.

The site representatives reported that production has [redacted] recently and is expected to continue at [redacted] for the foreseeable future. While the modifications completed as part of this project also increased the throughput capacity of the furnaces, they have standby furnaces that could have been used to meet added demand.

Summary of ex post Calculations:

A regression analysis uses bill and production data was conducted for pre and post retrofit conditions. A linear correlation was established for each condition and used to predict baseline and efficient usage at current levels of production.

The ex post savings are 1,534,337 m3, compared to ex ante savings of 1,811,219 m3, for a realization rate of 84.7%. The lower calculated savings are due to the calculation approach, which accounts for the non-

production gas usage.

It soudl be noted that the

Comments on ex ante Costs and EUL:

The costs presented in the documentation provided match those used in the application. It is noted that most of the costs were internal costs of the customer.

The 20 year EUL is reasonable for this project.

Reasons for Adjustments

- ☐ Inappropriate Assumptions
- ☑ Calculation/Engineering Error
- ☐ Tracking Error
- ☑ Operated or Installed Diff

Results

	Ex-Ante:	Ex-Ante Adjusted:	Ex-Ante Realization Rate:
kWh Savings (kWh):	0	0	0%
Gas Savings (m3):	1,811,219	1,534,337	85%
Water Savings (L):	0	0	0%
Incremental Cost:	$80,400	$80,400	100%
EUL (Yrs):	20	20	100%

Project Verification Report

Project ID:	IND-0187			Date Completed:	3/31/2011
Project Savings:	1,129,396	m3	2,350 kWh	0	L
Project Cost:	$285,000				
Project Description:	SHW-Boiler				

Verification Report

Measure Description:

The customer installed a new steam boiler for space heating that included the following efficient options: Feedwater economizer, automated blowdown, VFD on [redacted] HP [redacted] fan, and high turndown burner -minimum 10:1.

Summary of the ex ante Calculations:

Savings for the economizer and automated blowdown gas usage were calculated separately. Electrical savings for the VFD were also considered separately. No savings were claimed for the high turndown burner.

Savings due to the feedwater economizer were calculated by analyzing the energy required to raise the temperature of the makeup water plus the condensate return separately. The feedwater was assumed to consist of 10% makeup water and 90% condensate return. Savings for each were established by calculating the energy saved by the temperature rise through the economizer and dividing by boiler efficiency of 83%. Energy usage for boiler blowdown with the automated controls was determined assuming that the rate of blowdown would be [redacted] total steam production. It was assumed that the baseline blowdown rate would have been [redacted] steam production. As with the economizer savings, the makeup water and condensate return were treated separately. The savings are due to reduced volume of feedwater required, and therefore less energy required to heat the feedwater up to boiler operating temperature. It was also assumed that the boiler efficiency was 83%.

VFD electrical savings for the draft fan were calculated assuming that baseline operation of the fan would be with inlet vane control. The operation at various loads was calculated for baseline and efficient conditions and the electrical usage summed for one year of operation.

Comments on the ex ante Calculations:

The ex ante approach was reasonable for the measures considered in this project. Estimating the relative contribution of makeup water vs. condensate return may result in inaccuracies if the per cent of condensate return is misrepresented.

The calculations do not consider the possible interactive effects of the economizer and automated blowdown. The economizer has the effect of increasing the effective efficiency of the boiler, which in turn will decrease the overall savings of the automated blowdown. However, this is expected to have a minimal effect on project savings.

The VFD calculations do not correctly match the duty of the baseline and VFD operation. The duty of the two cases should closely match, within the limitations of the baseline turndown. For example, the baseline duty is assumed to be [redacted]% flow for [redacted]% of the time while it was [redacted]% flow for [redacted]% of the time with the VFD. The full flow kW of the draft fan does not consider motor efficiency or full flow motor loading. Typical fan motors are sized such that the motor is operating at about 80% of rated power. In addition, the curve used to estimate % power vs. % flow indicates that the power at 100% flow with the VFD is 98% of total power. Operating with a

VFD at 100% flow, or 60 Hz, is greater than 100% because the electrical inefficiency of the VFD results in energy loss. The calculations are based on 8760 hours of operation per year, while the boiler gas savings are based on [redacted] hours per year to account for one-week of shutdown.

It appears that there was a tracking error in the system for claimed electrical savings for this project. The claimed savings shown are 2,350 kWh, but during subsequent conversations with Union Gas, it was learned that the annual savings should have been 235.000 kWh.

Ex Post Site Description:

The [redacted] director and the facility energy were interviewed on January 31st, 2013 and provided a tour of the facility and associated measures. The operation of the new boiler in particular, and the steam system in general were discussed.

The new boiler was installed to replace two old boilers with a capacity of [redacted],000 pounds per hour each. The old boilers were approximately 60 years old, so the ex ante approach using a new boiler as baseline was appropriate.

The installation of the boiler and associated options was physically verified and found to match the description presented in the application.
The [redacted] provides steam year round for space heating, including reheat, and domestic hot water. The new boiler provides sufficient capacity to satisfy total [redacted] demand during most times of the year, but rarely operates above 60% of full output. During cold weather, another boiler is fired and the new boiler becomes the swing boiler. During summer operation, the new boiler will operate alone because of its low-fire capability.

Condensate return and makeup water are treated in a de-aerator to remove non-condensable gasses by heating with 8 psig steam to a temperature of [redacted]F before going through the economizer. The site representative confirmed that steam throughput provided for the application was representative of standard operation for the boiler. While the boiler steam temperature is slightly lower during times of reduced loading in the summer, it is relatively constant during the heating season when most steam is produced.

The customer reported that the automatic condensate blowdown provides much better control of condensate quality in addition to reducing wasted condensate. The system is equipped with blowdown heat recovery which, in addition to extending the life of the control sensors, provides heat to the makeup water.

Summary of ex post Calculations:

The ex-post approach used spreadsheet calculations to establish project savings. Heat recovered by the stack economizer was determined from the temperature gain of the feed water to the boiler and average monthly pounds/hour of steam produced. The temperature gain and throughput were provided by the customer. It was assumed that the inlet temperature to the economizer would average 235F.

Calculation due to automatic blowdown used an approach similar to the ex ante's. It was assumed that the baseline would blow down at a rate of 3% while the new condition would blow down at a rate of 2%. Because the blowdown rate would primarily affect makeup water but not condensate return, savings were calculated for the temperature difference between raw makeup water and dearator temperature instead of the weighted average used in the ex ante calculations. This resulted in increased ex post savings.

Because the blowdown system included heat recovery, additional savings were credited for those components. These were not included in the ex ante calculations.

The ex post savings are 868,643 m3, compared to ex ante savings of 1,129,396 m3, for a realization rate of 76.9%.

Project Verification Report

Water savings were due to the reduction in blow down, which reduces the amount of makeup water needed by an equal amount. The total annual reduction is 3,217,800 pounds, or 1,459,320 liters of water saved.

Electrical savings were due to using a VFD to control draft fan flow. The duty cycle of the blower, which is the per cent of time for which the VFD operates at various speed ranges, e.g. the VFD operates between 70% and 80% speed for 10% of the time, was estimated using steam flows. The [redacted] VLT Energy Box program was used to model the blower operation using inlet vane control as the baseline and VFD operation as the efficient case.

It should be noted that the ex post savings are lower due to considering only the temperature rise of the feedwater from the deaerator outlet temperature through the economizer. The ex ante calculations included the temperature rise of the condensate makeup water, but that water is preheated in the deaerator. Steam output needed for the deaerator is included in the total boiler steam output and is therefore accounted for in the overall calculations.

Comments on ex ante Costs and EUL:

Reasons for Adjustments

- [x] Inappropriate Assumptions
- [ ] Calculation/Engineering Error
- [ ] Tracking Error
- [x] Operated or Installed Diff

Results

	Ex-Ante:	Ex-Ante Adjusted:	Ex-Ante Realization Rate:
kWh Savings (kWh):	2,350	192,465	8190%
Gas Savings (m3):	1,129,396	868,643	77%
Water Savings (L):	0	1,459,320	0%
Incremental Cost:	$285,000	$285,000	100%
EUL (Yrs):	30	25	83%

Project Verification Report

Project ID:	IND-0160	Date Completed:	11/30/3011
Project Savings:	691,732 m3	0 kWh	0 L
Project Cost:	$607,200		
Project Description:	Controls-BAS Greenhouse		

Verification Report

Measure Description:

The customer installed a Building Automation System for climate control in a greenhouse.

Summary of the ex ante Calculations:

The ex-ante savings were determined through the use of a proprietary vendor calculator template. It was assumed that the use of the BAS will allow a reduction of 1oC in average space temperatures, but it was reported that savings were calculated at any overall average reduction of 0.5 C to be conservative.

Comments on the ex ante Calculations:

The calculations provided with the application did not include the equations or algorithms used to establish baseline and proposed energy usage, so the validity of the approach could not be determined.

The ex ante calculations appear to be conducted on prior building phases for this same customer, but the application states that this measure applies only to Phase 6. The greenhouse area listed in the calculations is approximately [redacted] acres, while the greenhouse area of phase 6 is [redacted] acres. It was assumed that the savings per acre would be the same as for the existing greenhouses and the savings were factored by a simple ratio of the 2 areas.

The results of the spreadsheet simulation show several months during which negative usage was expected by the greenhouse. There was no explanation for this apparent anomaly. In addition, the simulation assumes 12 months of similar operation, and significant usage was attributed to December operation. The actual typical growing season of the greenhouse is from January through November, while work in December normally consists of greenhouse cleanup, sterilization, and preparation for planting the following January. Finally, the resulting annual usage of the spreadsheet model was lower than actual usage for 2012, a year that was significantly warmer than normal.

Ex Post Site Description:

The head grower of the facility and the implementing contractor were interviewed on January 31st, 2013 and provided a demonstration of this measure. The contractor representative reported that the average set temperature of the greenhouse can be reduced by 1C as a result of the improved control of the heating system. In addition, the contractor stated that the BAS reduces ventilation and infiltration loads by about 10%. The BAS is expected to reduce greenhouse ventilation through roof vents by optimizing settings based on indoor humidity and outdoor conditions. The BAS also uses local real time weather data to anticipate the effect of expected outdoor conditions for the very near future and adjusts ventilation and heating set points accordingly.

The installation of the [redacted] BAS system was verified and its capabilities and operation were demonstrated by the customer. This is a stand-alone greenhouse operation with [redacted] acres of greenhouse area plus approximately [redacted] acres of service area.

Project Verification Report

This is a new facility that was commissioned in January of 2012 and has been in operation for one full growing season. The BAS was installed as part of the new construction.

Summary of ex post Calculations:

The ex-post savings used the Virtual Grower 3 software calculator to establish energy use baseline and efficient greenhouse operation. Inputs included location, structure type, heating system efficiency, hours of operation, and set point temperatures.

The baseline and efficient conditions assumed no changes to the structure or system heating efficiency. The temperature set point of the baseline condition was 1oC higher and the infiltration rate was 10% higher than for the efficient system. Heating system efficiency was estimated based on the type of system used at the greenhouse. The normal production season was set to January 1 through December 3.

The ex post savings are 699,078 m3, compared to ex ante savings of 691,732 m3, for a realization rate of 101.1%.

Comments on ex ante Costs and EUL:

The total costs presented in the invoices provided with the application show a total installed cost of [redacted], compared to the application high efficiency option cost of $619,200. The baseline cost was reported to be $12,000.

It should be noted that the BAS monitors and controls irrigation, hydroponic nutrients and other water conditions, humidity control, curtain operation, ventilation, and other functions, in addition to control of the heating system. However, there was insufficient documentation to establish the appropriate costs associated only with factors affecting gas usage.

The 20 year EUL is consistent with other EMS/BAS systems.

Reasons for Adjustments

- ☐ Inappropriate Assumptions
- ☐ Calculation/Engineering Error
- ☐ Tracking Error
- ☑ Operated or Installed Diff

Results

	Ex-Ante:	Ex-Ante Adjusted:	Ex-Ante Realization Rate:
kWh Savings (kWh):	0	0	0%
Gas Savings (m3):	691,732	699,078	101%
Water Savings (L):	0	0	0%
Incremental Cost:	$607,200	$607,200	100%
EUL (Yrs):	20	20	100%

Project Verification Report

Project ID:	IND-0524	Date Completed:	11/1/2011
Project Savings:	1,034,849 m3	0 kWh	0 L
Project Cost:	$1,056,453		
Project Description:	[redacted]New Greenhouse		

Verification Report

Measure Description:

Project Description:
The customer built a new greenhouse with several energy efficient features, including
--Efficient hot water boiler
--CO2 stack heat recovery condenser
--Hot water storage tank
--BAS system
--Poly film with IR components

Summary of the ex ante Calculations:

The application documentation included the ex-ante savings results established with a vendor's spreadsheet calculator. A document describing the approach was subsequently provided for evaluation.

The ex ante approach begins with calculations that establish the baseline heating load of the facility. Hourly average temperatures for each month were estimated from a sinusoidal model of daily temperature swings based on historical average monthly high and low temperatures. The hourly temperature results were used to develop heating loads for temperature sensitive factors affecting the greenhouse. The factors included conductive heat loss through walls, roof, and floor areas; controlled ventilation; and infiltration. Solar irradiation was considered, as was a small amount of heating energy required for summertime humidity control.

The savings calculations progress by first considering the effect of the CO2 condenser. The CO2 condenser is a boiler stack economizer that recovers a significant amount of heat because it condenses water vapor out of the exhaust stream. In addition to recovering stack heat, the CO2 condenser reduces the exhaust temperature enough to allow the greenhouse operator to use the exhaust as a source of CO2 for the growing operation. It was assumed that the condenser would provide useful heat from the condenser, which cools boiler stack exhaust and condenses water vapor out of it. The condenser was expected to provide useful heat whenever CO2 was required by the facility. It was assumed that the condenser would recover [redacted] of the usable gas energy input of the boiler when heating was also needed.

The calculations follow with the effect of the hot water storage tank. It was assumed that the tank would store energy whenever the greenhouse required CO2 but did not require heating. It was further assumed that in the absence of the tank, the boiler would run to provide CO2 as needed and any heat that could not be put to useful benefit would be wasted.

Additional savings, i.e. load reduction, were included for the effect of the BAS system. The algorithms used in the calculations were not provided, but the overall savings were about [redacted] of total usage.

The previous calculations resulted in a theoretical greenhouse load before boiler efficiency was considered. The load was divided by the advertised boiler efficiency of 85.1% to establish theoretical greenhouse gas usage in

the efficient condition.

Comments on the ex ante Calculations:

The general approach to savings is reasonable. A greenhouse represents a fairly complex facility to operate and analyze, and the ex ante approach appears to be a reasonable approximation of actual conditions.

It appears that savings attributed to the hot water storage tank are a result of inconsistent baseline conditions. The energy report describing the calculations states "In the standard case natural gas boilers are fired during the day to meet the required CO2 demand and any excess heat beyond daytime needs is wasted". However, the baseline case for this project is a standard boiler with no CO2 condenser and therefore the boiler would not be running if there was no heat needed in the greenhouse. That is not to say that there are no savings attributed to the hot water storage, but the effect of the storage tank and CO2 condenser must be considered as a unit.

The application states that the new greenhouse also included and IR component in the poly film covering, but it appears that no credit was taken for expected savings due the installation of this feature.

The actual gas usage of the facility was not available at the time when the ex ante calculations were completed. Based on gas usage for the year after the addition, it appears that the theoretical usage was overestimated by about 10%.

Ex Post Site Description:

A grower of the facility and the implementing contractor were interviewed on January 31st, 2013 and provided a tour of the facility and associated measures. The general operation of the greenhouse and the measures associated with this project were discussed.
The installation of the boiler, CO2 condenser/stack economizer, storage tank, computer system, and greenhouse cladding were verified. The greenhouse associated with this project is an [redacted]-acre addition to an existing greenhouse that consisted of about [redacted] acres plus approximately [redacted] acre of service area. The new greenhouse area operates independently from the existing portion, which has its own boilers and support equipment. The existing greenhouse had a BAS system in place and the BAS for the new greenhouse was added to it.
The old greenhouse grows the same produce as the new addition, but heat is provided by steam boilers instead of hot water boilers.

Summary of ex post Calculations:

The savings were established using the results of the ex ante calculations for building loads. The savings were then calculated in sequence to establish estimated gas usage of the new facility.

The baseline gas usage was established by dividing the baseline facility load by the efficiency of the baseline boiler at 80%.

The effect of the high-efficiency boiler was calculated using the ratio of the standard efficiency to actual efficiency to establish gas usage with no other measures considered.

Gas usage with HE boiler = Baseline gas usage x standard efficiency/actual efficiency

It was assumed that the primary effect of the stack economizer on gas usage would be to increase the overall efficiency of the boiler. The vendor stated that the boiler with economizer would have an overall effective efficiency of 95%. The effect of the condenser was also assumed to produce usable heat, with the aid of the hot water storage tank, whenever the boiler was running. The effect of the hot water storage tank was included with the effect of the economizer.

The gross savings effect of the BAS was taken from the ex ante calculations. The values were not adjusted and were considered before the effects of the other measures were considered.

The effect of the IR component in the poly film covering was assumed to result in an overall 11% reduction in heat load, a figure that was used in the evaluation for IND-0088. The IR savings were considered as the final step to establish total facility gas usage with all measures installed.
In order to check the results against actual usage, the gas usage was estimated based on facility gas usage. A regression analysis of gas usage and HDD data for 2010, which included only the old part of the facility was conducted and resulted in a linear correlation with an R2 value of 0.9681. The result was used to estimate the portions of 2012 usage that could be allocated to the old and new portions of the greenhouse. The result for the new portion of the greenhouse was normalized using 20-year average HDD. This result was compared to the theoretical analysis and the actual use was found to be lower. The building load established by the model was to calibrate the theoretical gas usage with the normalized gas usage.

The results of the regression analyses were also used as a reality check of the savings claimed for the new greenhouse. Using the regression analysis, it is estimated that the savings of the new portion of the greenhouse compared to the old portion would be about 688,000 m3. The old portion operated with a steam boiler without CO2 condenser and no storage, but it did have a BAS in place. If the effects of the BAS and IR film were removed from this projects savings, the savings would have been approximately 600,000 m3.

The ex post savings are 1,030,323 m3, compared to ex ante savings of 1,034,849 m3, for a realization rate of 99.6%.

The ex post and ex ante savings are nearly the same in spite of two significant, off-setting adjustments. Savings were reduced by the considering the net effect of the CO2 condenser and hot water storage tank working together. The ex ante claim for savings for the two measures was 628,205 m3, while the ex post savings for the condenser working with the storage tank are about 298,000 m3.
The reduction was offset by ex post savings of 281,578 m3 for the IR poly greenhouse covering.

Comments on ex ante Costs and EUL:

A cost summary provided with the application shows a total incremental installed cost of [redacted]. It is not clear from the data provided if the costs are full costs or actual incremental costs. For several of the measures, the CO2 condenser at [redacted] and the hot water storage tank, at [redacted], it appears that the full cost was used appropriately.

A weighted average EUL was calculated using EULs of the major components of this project. Using an EUL of 5 years for the poly roof, 25 years for the boiler, CO2 condenser, and storage tank, plus 20 years for the BAS results in an average weighted EUL of 18 years.

Reasons for Adjustments

- ☐ Inappropriate Assumptions
- ☑ Calculation/Engineering Error
- ☐ Tracking Error
- ☐ Operated or Installed Diff

Results

Project Verification Report

	Ex-Ante:	Ex-Ante Adjusted:	Ex-Ante Realization Rate:
kWh Savings (kWh):	0	0	0%
Gas Savings (m3):	1,034,849	1,030,323	100%
Water Savings (L):	0	0	0%
Incremental Cost:	$1,056,453	$1,056,453	100%
EUL (Yrs):	20	20	100%

Project Verification Report

Project ID:	IND-0168			Date Completed:	5/16/2012
Project Savings:	366,741 m3		0 kWh		0 L
Project Cost:	$24,066				
Project Description:	[redacted]-Burner-[redacted] [redacted] Heaters Optimization				

Verification Report

Measure Description:

The project consisted of the modification of setpoints and HVAC operation in an EMS system to reduce overheating of air used to warm [redacted] The program consisted of two parts. First, the controls implemented tighter controls on the discharge air temperature to avoid overheating air during normal operation. Second, the controls were set to minimize both the time and the temperature of the discharge air during maintenance mode, during which the temperature is heated to a greater setpoint to provide comfort for workers in the [redacted]

Summary of the ex ante Calculations:

The savings were calculated using a billed data analysis. For both the pre and the post cases, an m3 of natural gas was calculated per heating degree day. This difference in heating degree days was then multiplied by the typical annual heating degree days to determine the expected energy savings.

Comments on the ex ante Calculations:

The use of a specific gas usage value (m3 per HDD) is reasonable and appropriate in many cases, especially in cases where the balance point of the facility is expected to be the same as the reference point for the development of the HDD values. However, in this case, the [redacted] is only heated to approximately [redacted]°C, much lower than the [redacted]°C reference that is commonly used as the reference for heating degree days. Due to this discrepancy, the gas usage is expected to be related to HDD, but not be proportional to HDD. A more appropriate method to determine gas usage in this case is to develop a profile or relationship between gas usage and HDD, which would typically take the form: Gas Usage = M x HDD + B.

Ex Post Site Description:

The savings for this measure were verified through a desk review. However, a similar project (IND-0171) for the same customer at a different [redacted] was verified through onsite inspection. Additionally, the site representative and site engineer were interviewed to verify the operation of the systems involved in this project.

As part of the original project documentation a six sigma report was provided. This six sigma report was reviewed with the customer.
Based on the supplied information, the sepoint for the discharge air for the [redacted] heating system is [redacted]C. However, due to poor temperature control, prior to the project completion, the air was often overheated, resulting in excess gas usage, or underheated, resulting in issues with production equipment. Based on the approximately 210 days of data metered for the six sigma pre-implementation period, during standard operation, the discharge air temperature averaged [redacted]°C, or approximately 2°C above the sepoint. During maintenance mode, the average discharge air temperature averaged [redacted]°C, or [redacted]C above the [redacted]°C septoint. Maintenance mode comprised approximately 3% of the operation.

After the completion of the project, an approximately 16 day comparison period was also metered. During this period, the normal operation discharge air temperature was [redacted]°C. No maintenance operation was metered

in the post period.

Based on the supplied information, the six sigma report suggested savings of approximately 265,000 m3 per year of natural gas.

Summary of ex post Calculations:

The ex post analysis used the provided monthly bill histories for the customer from Union Gas. For both the pre-implementation and the post-implementation cases a linear relationship was developed to relate gas usage to heating degree days. Based on a review of the data, it was determined that during the operation of this [redacted] heating system is expected to be limited to approximately seven months of operation, with the summer months not being affected by this project. This is also consistent with the customer description of operation, which they stated was that they heat to keep the [redacted] from [redacted] If the air temperature is warm, they do not heat. Therefore, they only need to run the heater system from approximately October to May.

Therefore, the linear relationship developed only accounted for "cold" months, which had greater than [redacted] HDD per day, that occurred from mid October to mid May. Using these criteria, the resulting relationships very closely modeled the actual gas usage, having R-squared values of 0.981 for the pre-implementation case and 0.989 for the post-implementation case.

The resulting savings are 520,680 m3 per year.

The ex post savings value of 520,680 m3 is higher than originally claimed. It should be noted that this is consistent with the original estimate of 15% savings provided by the customer, however, the baseline usage assumed by the customer to determine savings was inconsistent with the annual gas usage suggested by a review of the Union Gas billed history.

Comments on ex ante Costs and EUL:

The costs presented in the application were consistent with the invoices provided by the customer. The EUL for this project was assumed to be 15 years. This value is reasonable for the life of an EMS system. However, this project involved only the setting of parameters. This is typically assumed to have a much shorter life, often around 7 years. However, because the EMS system for this facility is new (long remaining useful life) and the equipment being controlled is industrial equipment rather than HVAC for comfort heating or cooling, it is likely that the EUL for this measure would be longer than the typical case. Therefore, the EUL of this measure was set to 12 years.

Reasons for Adjustments

- ☐ Inappropriate Assumptions
- ☐ Calculation/Engineering Error
- ☐ Tracking Error
- ☑ Operated or Installed Diff

Results

Project Verification Report

	Ex-Ante:	Ex-Ante Adjusted:	Ex-Ante Realization Rate:
kWh Savings (kWh):	0	0	0%
Gas Savings (m3):	366,741	520,680	142%
Water Savings (L):	0	0	0%
Incremental Cost:	$24,066	$24,066	100%
EUL (Yrs):	20	12	60%

Project Verification Report

Project ID:	COM-0092			Date Completed:	5/31/2012
Project Savings:	255,454 m3		24,000 kWh		0 L
Project Cost:	$290,000				
Project Description:	HR-Heat Transfer Improvement to High Eff Dryer				

Verification Report

Measure Description:

The customer converted an existing modular [redacted] dryer into a [redacted] upgrade unit. The current modular [redacted] dryer has a drying capacity of [redacted]00 [redacted] per hour operating presently at a thermal efficiency of [redacted]50 Btu/lbs of water removed. The converted [redacted] dryer will have an increased capacity of [redacted]00 [redacted] per hour and operate at a thermal efficiency of [redacted]00 Btu/lbs of water removed.

Summary of the ex ante Calculations:

The ex-ante savings are established using spreadsheet calculations that are based on moisture removal efficiency for the pre retrofit and post retrofit conditions. Average annual production, in [redacted] per year, of [redacted] along with average pre-drying moisture levels were provided by the customer.

The total energy needed to dry the [redacted] to [redacted] moisture levels was calculated and the difference between the pre and post conditions represented the gas savings.

A small amount of electrical savings were claimed due to expected reduction in fan power needed as a result of the conversion. This was assumed to be the reduction from [redacted]60 hours of drying time to [redacted]00 hours operation of [redacted]0 HP of electrical motors. The results, but not the actual calculations, were only included in the vendor summary. It appears that the vendor did not convert motor HP to kW in the calculations used to establish electrical savings. However, the vendor also claims in a separate document that the modifications will decrease motor HP needed, but that was not considered in the calculations.

Comments on the ex ante Calculations:

The ex ante approach was reasonable and the calculations considered the important factors affecting the [redacted] drying. The average annual volume of [redacted] processed was projected 30 years into the future and the savings were based on the average of future and current production. The source of and rationale for the projection was not clear, but the projection assumed constant future production of about [redacted] million [redacted] while production during 2012 was about [redacted] million [redacted] The reason for the expected [redacted] in production was not provided.

Ex Post Site Description:

No on-site inspection was conducted for this project. The customer was interviewed over the phone to discuss the project installation and the operation of the dryer.

The ex post savings were established be desk review and customer phone interview. The customer provided production volume and moisture levels for [redacted] processed during the 2012 [redacted] season. Overall [redacted] production for the 2012 season was significantly [redacted] than for previous seasons at [redacted] compared to an expected [redacted] Total [redacted] production were [redacted] compared to the projection of [redacted]

Summary of ex post Calculations:

The ex-post calculations use the same template as was used for the ex ante calculations, with updated

production volume figures.

The ex post electrical baseline energy use is calculated using the reported motor HP operating at an 80% load factor and [redacted] hours of operation. Proposed electrical energy use assumed that the load factor would be reduced by 20% as claimed in the vendor project description and the blowers would operate for [redacted]00 hours. Ex post electrical savings are 25,056 kWh, compared to ex ante savings of 24,000 kWh.

The ex post savings are 381,623 m3, compared to ex ante savings of 255,454 m3, for a realization rate of 149.4%.

Comments on ex ante Costs and EUL:

The costs and EUL are reasonable.

Reasons for Adjustments

- ☐ Inappropriate Assumptions
- ☐ Calculation/Engineering Error
- ☐ Tracking Error
- ☑ Operated or Installed Diff

Results

	Ex-Ante:	Ex-Ante Adjusted:	Ex-Ante Realization Rate:
kWh Savings (kWh):	24,000	25,056	104%
Gas Savings (m3):	255,454	381,623	149%
Water Savings (L):	0	0	0%
Incremental Cost:	$290,000	$290,000	100%
EUL (Yrs):	20	20	100%

Project Verification Report

Project ID:	IND-0351	Date Completed:	2/2/2012
Project Savings:	383,978 m3	0 kWh	0 L
Project Cost:	$27,800		
Project Description:	IV-Infilatration-Automatic Zip Door		

Verification Report

Measure Description:

The customer replaced a standard exterior roll-up door with a high-speed roll-up door. The new door is the same size as the old door and there is no indication that door operation has changed.

Summary of the ex ante Calculations:

The ex-ante savings used engineering calculations on an in-house spreadsheet template. The template follows ASHRAE guidelines and equations to establish infiltration rates, or air exchange between interior and exterior spaces, through an open door. The factors considered include door orientation plus wind speed and orientation, indoor space temperatures, typical outdoor temperatures for the area, door dimensions, and air properties.

Door opening speeds were used to determine the time required to open, and close, the door in the old and new conditions. The total operating time required to open and close the door for each cycle was multiplied by the daily door pass-throughs to determine the total time open for the pre and post retrofit conditions. The total time was used to establish infiltration through the door. The difference in infiltration was used to establish energy savings.

Comments on the ex ante Calculations:

The ex ante approach was reasonable and the calculations considered the important factors affecting door infiltration. The meteorological values used were overall seasonal averages, which greatly simplifies the calculations while maintaining reasonable accuracy.

The ex ante calculations assumed that the infiltration would occur at a rate consistent with a completely open door and that the time to open the door would be equivalent to the time of a completely open door. However, during the opening/closing times, the door will be only partially open during these periods. Since the door will be, on average ½ open during opening and closing, it may be more appropriate to assume that the open time of a complete open/close cycle is equivalent to the time of either opening or closing.

Ex Post Site Description:

A representative of the facility was interviewed on February 25th, 2013 and provided a tour of the facility and associated measure. The installation of the high-speed door was verified and its operation was discussed. Production at the facility has [redacted] since the time this project was implemented. While the expected frequency of use did not change, the total days of operation have increased to a normal of 7 days per week. The current hours of operation are expected to remain the same for the foreseeable future.

The operation of the old and new door was discussed with the customer, along with the age and condition of the old door. The customer reported that the old door was about 5 years old and in good condition-various parts were salvaged for use in other areas of the plant.
The customer reported that the number of door openings provided in the application was based on production and fork truck loads and estimated that the door is operated 600 times per day. The customer also reported

that the old doors were frequently propped open or the controls were over-ridden to reduce waiting times for forklift traffic.

Space heating is provided by direct-fired makeup air units, with a space temperature of about 68F to 70F. There is no air conditioning provided for the production area.

The customer also reported that one of the reasons for installing the new door was to reduce infiltration in the immediate area of the door. Due to [redacted], the area adjacent to the door was converted from storage and new equipment was installed in its place. The equipment uses steam to operate and is sensitive to low temperatures. Installing the zip door was intended to mitigate the effect of having it so close to production equipment-it appears that it was a reasonably effective remedy.

Summary of ex post Calculations:

The ex-post calculation used the same approach and calculations as the ex ante calculations. To account for the doors not being completely open during the opening and closing operations, it was assumed that a complete open/close cycle would be the equivalent of the door being completely open for the amount of time required to open or close.

The heating season was considered to run from October through the end of April. It was assumed that the facility operated 7 days per week. This resulted in 212 days of use, compared to the 160 days assumed in the ex ante calculations.

It was assumed that there were no behavioral changes that would affect the amount of time each door was open, i.e. the time for pass-through would remain consistent for both pre retrofit and post retrofit conditions. However, it was considered that the new doors would negate the temptation to prop the doors open and it was assumed that the old doors would be open an additional 10 minutes per hour because of this factor.

Savings were calculated assuming a heating efficiency of 92%, which is typical for a direct-fired makeup air unit.

The ex post savings are 339,819 m3, compared to ex ante savings of 383,978 m3, for a realization rate of 88.5%.

Comments on ex ante Costs and EUL:

Using total costs was appropriate and reported costs are consistent with the invoices provided in the application.

The 20 year EUL is reasonable for this measure.

Reasons for Adjustments

- [x] Inappropriate Assumptions
- [ ] Calculation/Engineering Error
- [ ] Tracking Error
- [x] Operated or Installed Diff

Results

Project Verification Report

	Ex-Ante:	Ex-Ante Adjusted:	Ex-Ante Realization Rate:
kWh Savings (kWh):	0	0	0%
Gas Savings (m3):	383,978	339,819	88%
Water Savings (L):	0	0	0%
Incremental Cost:	$27,800	$27,800	100%
EUL (Yrs):	20	20	100%

Project Verification Report

Project ID:	IND-0107			Date Completed:	2/15/2012
Project Savings:	450,156 m3		144,159 kWh		0 L
Project Cost:	$64,500				
Project Description:	IV-Automatic Zip Doors				

Verification Report

Measure Description:

The customer replaced 3 standard exterior roll-up doors with high-speed roll-up doors. The new doors are the same size as the old doors and door function and use has not changed.

Summary of the ex ante Calculations:

The ex-ante savings used engineering calculations on an in-house spreadsheet template. The template follows ASHRAE guidelines and equations to establish infiltration rates, or air exchange between interior and exterior spaces, through an open door. The factors considered include door orientation plus wind speed and orientation, indoor space temperatures, typical outdoor temperatures for the area, door dimensions, and air properties.

Door opening speeds were used to determine the time required to open, and close, the doors in the old and new conditions. The total operating times were used to establish per and post retrofit infiltration through the doors. The difference in times was used to establish energy savings.

There was no consideration for changes in behavior as a result of the new doors, e.g. propping old doors open to avoid waiting for the door to open.

Comments on the ex ante Calculations:

The ex ante approach was reasonable and the calculations considered the important factors affecting door infiltration. The meteorological values used were overall seasonal averages, which greatly simplifies the calculations while maintaining reasonable accuracy.

The ex ante calculations assumed that the infiltration would occur at a rate consistent with a completely open door and that the time to open the door would be equivalent to the time of a completely open door. However, during the opening/closing times, the door will be only partially open during this period. Since the door will be, on average ½ open during opening and closing, it may be more appropriate to assume that the open time of a complete open/close cycle is equivalent to the time of either opening or closing. As an alternative, it may be appropriate to consider that the door is partially open during movement while using the complete time to open and close for each cycle.

Ex Post Site Description:

Two on-site managers were interviewed on February 20th, 2013 and provided a tour of the facility and associated measures. The pre retrofit and post retrofit operation of the doors was discussed. Heating is provided by unit heaters installed around the perimeter of the building plus makeup air units.

The customer confirmed that prior to the completion of this measure, the operating speed of the old doors was about 1 foot per second, which is consistent with the value of 10 inches per second as reported in the application. Two of the doors are in north-facing walls and the other door faces east.

Project Verification Report

The customer reported that they had installed counters on the doors for the original application. The counters indicated that two of the doors were cycled 425 times per shift and the other was cycled 350 times per shift. The new doors include counters and the count was recorded at the time of the site visit. The customer reported the counts after 72 hours of operation. The counts for two of the doors were slightly lower than the pre retrofit count, but sufficiently close to validate them. The count for the third door was much lower, but the customer stated that use of the door was temporarily curtailed due to the installation of new equipment in its vicinity.

This project was completed during January, February, and March of 2012 with (1) door being replaced each month. Since the completion of this project, a boiler tuneup was completed during 2012.

The customer reported that production levels at the plant had [redacted] from 2010 to 2011. 2012 production is about [redacted] than for 2011. The amount of process heating used depends on product mix, customer orders, and other factors.

Summary of ex post Calculations:

The ex-post calculation uses a regression analysis of pre retrofit and post retrofit conditions to establish savings. The period from March through November of 2011 was selected for the pre retrofit analysis. December and July 2011 were not used because the plant normally has a one-week shutdown that makes those months outliers. March was selected as the beginning of the period because IND-0107 was completed on the 3rd of that month. A linear correlation was established with an R2 value of 0.9963. The post retrofit period included March through November of 2012. July and December data were not used for the reasons stated for 2011. A linear correlation was established with an R2 value of 0.9905.

The correlations were used with normal HDD to establish the HDD dependent usage for the pre retrofit and post retrofit conditions. The results of the analysis show a total savings from 2011 to 2012 of 1,455,395 m3. However, about [redacted] m3 of that amount could be attributed to non-HDD dependent uses, e.g. [redacted] in process loads or savings from another efficiency project affecting process use. A total of [redacted] m3 was allocated to HDD dependent factors and credited to this project.

It is noted that there is a significant reduction in gas usage from 2010 to 2012, but it was not clear that the reductions could be entirely attributed to the two project in this evaluation. The analysis of billed usage demonstrates that a significant portion of the savings come as a result of non-HDD dependent gas usage. For example, the June through August gas usage is [redacted] 3 for 2010, 2011, and 2012, respectively. Since the summer gas usage cannot be driven by HDD, it can be surmised that the plant would likely would have used less gas in 2012 even in the absence of these two projects.

Electrical savings were set to 0.0 kWh. The ex ante analysis included savings for reduced cooling loads, but the plant is not air conditioned and therefore there are no cooling savings.

Comments on ex ante Costs and EUL:

Full project costs are consistent with the invoices provided with the application.

The 20 year EUL is reasonable for this measure.

Reasons for Adjustments

- ☐ Inappropriate Assumptions
- ☑ Calculation/Engineering Error
- ☐ Tracking Error
- ☑ Operated or Installed Diff

Results

Project Verification Report

	Ex-Ante:	Ex-Ante Adjusted:	Ex-Ante Realization Rate:
kWh Savings (kWh):	144,159	0	0%
Gas Savings (m3):	450,156	586,487	130%
Water Savings (L):	0	0	0%
Incremental Cost:	$64,500	$64,500	100%
EUL (Yrs):	20	20	100%

Project Verification Report

Project ID:	COM-0069	Date Completed:	3/31/2011
Project Savings:	43,431 m3	0 kWh	0 L
Project Cost:	$8,900		
Project Description:	HR-Refrigeration System		

Verification Report

Measure Description:

The customer recently acquired a number of [redacted] stores. After engineering review, the customer determined that many of the stores had refrigeration heat recovery systems that were in various states of disrepair and not functioning as intended for various reasons. The customer recommissioned these units to capture waste heat and off set building heating.

Summary of the ex ante Calculations:

Limited calculations were provided for this project. The provided documentation included a list of compressors installed at the facility and a "heat rejection available" for each compressor. A note in the files states that the gas savings are calculated as: Heat recovery available x degree days x 24 / (efficiency of the heater x temperature difference x 35494). It is not clear if this is used to calculate the savings or what values were used, as the provided savings are hard-coded values

Comments on the ex ante Calculations:

As the calculations were not provided, minimal comments can be made.

Ex Post Site Description:

The savings for this measure were verified through an onsite inspection and customer interview. Based on the information provided, the refrigeration system has a secondary condenser system that is located [redacted] The [redacted] has [redacted] refrigeration racks, and each rack has a dedicated condenser in the airstream, which can be staged on and off to provide heat as needed. Excess heat not needed by the airstream to meet sepoint temperature setpoints is rejected by an outdoor condenser.

At the time of the site visit, the outdoor air temperature was approximately 35°F. Per the customer description, below this temperature, the refrigeration system is fully rejecting heat to the space. This was also consistent with the observed operation. During the site visit, all four condensers were rejecting heat to the airstream. Periodically the gas heat system would turn on to provide supplemental heat when the refrigeration heat rejection was insufficient to meet setpoints.

The HVAC system is a [redacted],000 cfm unit that operates at approximately 10% outside air. The system operates to maintain a 75°F space temperature.

Summary of ex post Calculations:

The savings were verified using a billed data approach. The claimed savings is expected to be [redacted]2% of the annual gas usage. Additionally, the gas consumption is expected to be highly correlated to temperature.

Based on the supplied pre- and post-implementation billed data, linear relationships of gas usage were developed to monthly heating degree days. The usage was found to be highly correlated, with R-squared values of 0.97 for both the pre- and post-implementation cases. The resulting calculated savings are 43,045 m3.

The ex post savings are almost identical to the claimed savings. As an additional check, the savings were also

Project Verification Report

verified using the expected operation of the AHU. The unit is [redacted],000 cfm and operates at 10% outside air. Using an estimated temperature rise of 35°F for the outdoor air and 5°F for the return air, based on [redacted] hours per year of operation, the expected savings are again within a few percent of the ex post savings estimate. The [redacted] hour estimate would be considered high for most facility types, but many [redacted] [redacted] require some heat for most of the year to overcome the cooling provided by the refrigerated cases. Based on an examination of the billed gas usage, [redacted] hours appeared reasonable.

Comments on ex ante Costs and EUL:

The costs presented in the application were consistent with the invoices provided by the customer. The EUL is reasonable.

Reasons for Adjustments

- ☐ Inappropriate Assumptions
- ☐ Calculation/Engineering Error
- ☐ Tracking Error
- ☑ Operated or Installed Diff

Results

	Ex-Ante:	Ex-Ante Adjusted:	Ex-Ante Realization Rate:
kWh Savings (kWh):	0	0	0%
Gas Savings (m3):	43,431	43,045	99%
Water Savings (L):	0	0	0%
Incremental Cost:	$8,900	$8,900	100%
EUL (Yrs):	15	15	100%

Project Verification Report

Project ID:	COM-0033			Date Completed:	1/5/2012
Project Savings:	887	m3	56,060	kWh	0 L
Project Cost:	$18,800				
Project Description:	IN-Roof				

Verification Report

Measure Description:

The customer installed insulation at their multifamily residenital building. The common spaces (assumed to be 25%) are heated by 80% efficient gas furnaces. The residential spaces (assumed to be 75%) are heated by electric baseboards.

Summary of the ex ante Calculations:

The savings are calculated using an ASHRAE simplified bin analysis method. The heat load is determiend at each temperature in, based on the R-value in the pre and post cases and the difference in the temperature between the indoor spaces and the outdoor air temperature.

Comments on the ex ante Calculations:

The approach listed appears reasonable and appropriate.

Ex Post Site Description:

N/A

Summary of ex post Calculations:

The ex post anlaysis uses the same approach as the ex ante analysis. However, small changes were made. First, the ex ante analysis had a mismatch in the heat load calculation and the bin analysis. The design heat load was calculated based on a design temperature of -0.9F, however, this design heat load was then applied to the -5F temperature bin in the ASHRAE bin analysis. These values were set to the same temperature in the ex post analysis.

Also, the electrical savings claimed in the ex ante analysis could not be located in the calculation workbook. The ex post analysis uses the same bin analysis to calculate the electric and gas savings.

Comments on ex ante Costs and EUL:

No changes were made to the cost, incremental cost or EUL.

Reasons for Adjustments

- ☐ Inappropriate Assumptions
- ☑ Calculation/Engineering Error
- ☐ Tracking Error
- ☐ Operated or Installed Diff

Results

Project Verification Report

	Ex-Ante:	Ex-Ante Adjusted:	Ex-Ante Realization Rate:
kWh Savings (kWh):	56,060	22,516	40%
Gas Savings (m3):	887	899	101%
Water Savings (L):	0	0	0%
Incremental Cost:	$18,800	$18,800	100%
EUL (Yrs):	20	20	100%

Project Verification Report

Project ID:	COM-0034	Date Completed:	2/29/2012
Project Savings:	23,277 m3	0 kWh	0 L
Project Cost:	$262,500		
Project Description:	SHW-Boiler		

Verification Report

Measure Description:

The customer replaced 175 boilers in a housing complex with 91% High Efficiency [redacted] Boilers.

Summary of the ex ante Calculations:

The ex-ante calculation methodology using HDD to normalize for typical gas usage volume is reasonable. It was assumed that 70% of the total usage for each housing unit was used for space heating and the remaining usage would have been used for hot water heating. The estimated heating gas usage was normalized for typical HDD. The ex ante calculations also assumed that the old boiler had been operating at an average efficiency of 70%, which is a reasonable estimate considering that the replaced boilers were at least 25 years old. The baseline boiler efficiency was assumed to be 83%, which is the efficiency of the standard boiler that could have been provided by the same vendor that installed the new boilers. The new boiler efficiency of 93% was taken from manufacturer literature.

Comments on the ex ante Calculations:

The methodology and assumptions used to establish savings were reasonable. The ex ante calculations considered the baseline condition to be new boilers with standard efficiency. This was appropriate because the age of the old boilers indicated that they were at the end of their useful lives.

Ex Post Site Description:

Access to boilers at the site was limited because most of the units are currently occupied. Boilers at several units were inspected and found to match the specifications provided in the application documents. The installation of other units was confirmed by the installation of PVC intake and exhaust piping, which would not have been required by the old boilers.

Summary of ex post Calculations:

The ex-post calculation used a similar approach to calculating savings as for the ex ante calculations. The ex ante calculations adjusted variance in 2010 usage using normal HDD instead of 2010 data, i.e. variance % = (HDD normal - HDD 2010)/HDD normal) instead of (HDD normal - HDD 2010)/HDD 2010) as used in the ex post calculatation to normalize usage. The slight difference in the mathematical approach of the variance between typical and actual HDD in the ex post calculations result in a realization rate that is slightly higher than 100%.

Comments on ex ante Costs and EUL:

The incremental costs were consistent with information provided with the application. The EUL of the new boilers was increased to 25 years to be consistent with the Union Gas prescriptive program.

Reasons for Adjustments

- ☐ Inappropriate Assumptions
- ☐ Calculation/Engineering Error
- ☐ Tracking Error
- ☑ Operated or Installed Diff

Project Verification Report

Results

	Ex-Ante:	Ex-Ante Adjusted:	Ex-Ante Realization Rate:
kWh Savings (kWh):	0	0	0%
Gas Savings (m3):	23,277	23,884	103%
Water Savings (L):	0		0%
Incremental Cost:	$262,500	$262,500	100%
EUL (Yrs):	22	25	114%

Project Verification Report

Project ID:	COM-0103	Date Completed:	5/19/2012
Project Savings:	12,871 m3	0 kWh	0 L
Project Cost:	$167,718		
Project Description:	IV-Non-Profit Housing Windows		

Verification Report

Measure Description:

The customer replaced 305 existing windows with energy star windows in a townhouse complex. The windows are installed in a total of 36 townhouse units.

Summary of the ex ante Calculations:

The savings were calculated using a DOE window modeling program. The window areas and propoerties were input into the program, which then calculates the baseline and proposed energy consumptions for heating and cooling.

Comments on the ex ante Calculations:

The methodology and assumptions used to establish savings were reasonable. However, the projected gas usage from the program was not consistent with the gas usage of the facilities. The cause of the discrepancy could not be identified.

Ex Post Site Description:

The savings were evaluated using a desk review.

Summary of ex post Calculations:

The savings were calculated using a DOE window modeling program. The window areas and propoerties were input into the program, which then calculates the baseline and proposed energy consumptions for heating and cooling.

The second approach utilized a modified version of the window template supplied by Union Gas. The Union Gas template accountes for changes to window U-value and infiltration. However, the Union Gas template does not account for changes to solar heat gain coefficient. Therefore, this was added into the analysis. Incident solar radiation was taken from NREL. The installed efficient windows were modeled with a solar heat gain coefficient of 0.5, compared to a baseline solar heat gain coefficient of 0.76, typical for single pane glass.

To verify the savings, the savings were modeled using two different approaches. First, the input parameters from the analysis were reviewed and adjusted to better match the equipment specifications supplied in the anlaysis. This was then used to determine a percent reduction in heating load, as output from the ResFen file. This percent savings was applied to the heating portion of the normalized gas usage for each building. Incident solar ratiaion data was taken from the NREL Solar Radiation Data Manual for Buildings.

Both approaches produced similar results (within 10%), which were lower than the original savings estimates.

Comments on ex ante Costs and EUL:

No changes were made to the cost, incremental cost or EUL.

Reasons for Adjustments

Project Verification Report

- [x] Inappropriate Assumptions
- [x] Calculation/Engineering Error
- [ ] Tracking Error
- [ ] Operated or Installed Diff

Results

	Ex-Ante:	Ex-Ante Adjusted:	Ex-Ante Realization Rate:
kWh Savings (kWh):	0	0	0%
Gas Savings (m3):	12,871	11,100	86%
Water Savings (L):	0	0	0%
Incremental Cost:	$167,718	$167,718	100%
EUL (Yrs):	20	22	110%

Project Verification Report

Project ID:	COM-0278	Date Completed:	2/8/2012
Project Savings:	39,703 m3	0 kWh	L
Project Cost:	$233,626		
Project Description:	HVAC-MAU		

Verification Report

Measure Description:

The customer installed a new [redacted],000 cfm make up air unit. The installed make up air unit has a heating efficiency of 80% and a heat pipe heat recovery unit in order to recover heat from the exhausted air to preheat the incoming outdoor air.

Summary of the ex ante Calculations:

The energy savings are calculated using an ASHRAE simplified bin analysis approach. For each bin, the expected heating load is calculated, based on the heat required to bring the outdoor air temperature to 70°F. In the baseline case, that energy was all met by the 80% efficient indirect fired heating system. In the baseline case, the heat load was reduced due to the heat exchanger. For each bin, the heat exchanger effectiveness was calculated, based on a profile given by ASHRAE for heat pipe systems based on temperature differential between the airstreams. This effectiveness then is used to determine the percent of the heat load that is met by the heat exchanger, and the percent that must be met by the indirect fired heating system. In both cases, the make up air unit operates [redacted] hours per year.

In order to ensure the exhaust air is maintained above freezing, the AHU has the ability to bypass a portion of the air from the heat recovery section. The exhaust temperature is maintained above 34°F.

Comments on the ex ante Calculations:

The ex ante approach is reasonable. However, it appears that the effectiveness values calculated do not exactly reflect the supplied ASHRAE profile, however, the differences are small and could be due to rounding or curve-fitting. Additionally, a bypass cfm is assumed for each bin. It is not clear how the bypass cfm was determined as the values are hard-coded. The savings assume a value of 1.1 BTU/cfm-F-hr to calculate the heat load. This is slightly higher than the 1.08 typically assumed, but not excessively so.

Ex Post Site Description:

The installation of the measure was verified through onsite inspection. The installed equipment was inspected and the site representative was interviewed to verify operation. Based on the customer interview, the make-up air unit runs [redacted] hours per year. During the winter months, the system runs to maintain temperature in the hallway spaces, which are kept at approximately 65-70°F. At the time of the site visit, the space was cooler, at around 65°F, but per the site representative, the space is sometimes warmer.

Summary of ex post Calculations:

The ex-post calculation used the same approach as the ex ante calculations, but the temperature of the return air was decreased to 68°F. Additionally, the 1.1 value used in the original analysis was corrected to 1.08, and a curve fit was developed to better match the expected performance, based on the temperature difference between the airstreams. Finally, the temperature of the discharge air was calculated for each bin. For low temperature operation, the cfm level was bypassed so the total combined cfm would not drop below 34°F.

The combined changes reduce the savings to 36,434 m3, approximately 92% of the ex ante value.

Project Verification Report

Comments on ex ante Costs and EUL:

Measure costs presented in the application are consistent with customer-provided invoices.

The EUL is reasonable for this type of measure.

Reasons for Adjustments

- ☐ Inappropriate Assumptions
- ☐ Calculation/Engineering Error
- ☐ Tracking Error
- ☑ Operated or Installed Diff

Results

	Ex-Ante:	Ex-Ante Adjusted:	Ex-Ante Realization Rate:
kWh Savings (kWh):	0	0	0%
Gas Savings (m3):	39,703	36,434	92%
Water Savings (L):			
Incremental Cost:	$18,800	$18,800	100%
EUL (Yrs):	15	15	100%

Project Verification Report

Project ID:	COM-0277	Date Completed:	10/15/2012
Project Savings:	5,608 m3	0 kWh	L
Project Cost:	$58,500		
Project Description:	IV-Energy Star Window Replacement		

Verification Report

Measure Description:

The customer replaced 150 existing windows with energy star windows in a townhouse complex. The windows are installed in a total of 30 townhouse units.

Summary of the ex ante Calculations:

The energy savings are calculated using a template developed for Union Gas. The template calculates the expected energy savings for both increased R-value for the new window (conduction losses) as well as reduced infiltration due to the installation of the new windows.

In order to determine the savings for the conduction losses, a design conduction load was determined for the baseline windows and the efficient windows by multiplying the U-value of the window by the area and the temperature difference between the design point and the assumed indoor air temperature of 72°F. This design load was then input into an ASHRAE simplified bin analysis, which proportioned the load based on outdoor air temperature, with no load occurring at 72°F and the design load occurring at -0.9°F.

To determine the infiltration savings, the windows were separated by orientation. For each orientation, the infiltration level was calculated. The area of each window was multiplied by an infiltration level per square foot for the baseline and proposed windows. The baseline windows were assumed to have an infiltration level of 0.9 cfm/sf, at the design condition of 0.3 in. wc. This equates to a wind speed of approximately 25 mph. Based on the location, the average wind speed is only 12. Therefore, the wind pressure is reduced to 0.07 in. wc. Therefore, the infiltration level at the average operating wind speed is calculated as the infiltration at 0.3 in. wc. X 0.07 / 0.03. The proposed windows infiltration level was calculated similarly, with the nominal infiltration (at 0.3 in wc) being 0.1 cfm/sf.

The infiltration level is then the area of each window multiplied by the infiltration cfm/sf level multiplied by the percent of time the wind direction is from the same orientation as the window.

Comments on the ex ante Calculations:

The supplied analysis is reasonable and appropriate for the calculation of losses due to conduction and infiltration. However, radiation can play a significant role in the energy savings for windows, and must be accounted for.

Ex Post Site Description:

The savings were verified through a desk review.

Summary of ex post Calculations:

The original analysis was retained for the ex post analysis, except for the addition of radiation effects. The installed windows have a lower solar heat gain coefficient. This will allow less solar energy to enter the house, which will reduce the cooling load but will result in increased heating load.

Incident solar radiation data was taken from the NREL Solar Radiation Data Manual for Buildings. The solar

radiation data is taken by orientation, for minimally shaded windows, as based on the review of the facility from Google Earth, few trees or other factors impede the light path to the windows.

The solar radiation data is presented in a BTU/sf value per day. This value is then multiplied by the solar heat gain coefficient in order to determine the transmitted solar gains. Based on the supplied documentation, the old windows were single pane glass, and were assumed to have a solar heat gain coefficient of 0.76. The installed windows had a solar heat gain of 0.5.
The combined changes reduce the savings to 4,154 m3, approximately 74% of the ex ante value.

Comments on ex ante Costs and EUL:

The incremental cost for this measure was found to be reasonable. The ex ante EUL for this measure was 20 years. This was increased to 22 years, based on the Union Gas measure life table provided, which is reasonable when compared to other sources.

Reasons for Adjustments

- [x] Inappropriate Assumptions
- [x] Calculation/Engineering Error
- [ ] Tracking Error
- [ ] Operated or Installed Diff

Results

	Ex-Ante:	Ex-Ante Adjusted:	Ex-Ante Realization Rate:
kWh Savings (kWh):	0	0	0%
Gas Savings (m3):	5,608	4,154	74%
Water Savings (L):			
Incremental Cost:	$262,500	$262,500	100%
EUL (Yrs):	20	22	110%

Project Verification Report

Project ID:	COM-0287	Date Completed:	5/22/2012
Project Savings:	2,167 m3	0 kWh	L
Project Cost:	$68,637		
Project Description:	SHW-Boilers-Domestic Hot Water		

Verification Report

Measure Description:

The customer installed hot water storage tanks in order to use heating boilers to provide domestic hot water to an apartment building. Existing gas-fired, tank type domestic hot water heaters were removed.

Summary of the ex ante Calculations:

The ex-ante savings used engineering calculations and a spreadsheet template to estimate baseline and efficient gas usage. Total hot water usage was estimated and used to establish usage based on pre retrofit and post retrofit efficiencies. Calculations included tank and piping losses from the old and new tanks. Circulating pump electrical usage was assumed to be unchanged.

Comments on the ex ante Calculations:

The ex ante approach is reasonable if accurate water usage can be collected. If actual hot water usage cannot be determined, the results should be reviewed to assure alignment with actual billing data. The application states that summer gas use is primarily for domestic hot water. Using that information suggests that total baseline gas usage dedicated to domestic hot water is on the order of [redacted],000 m3 per year, compared to application estimated baseline usage of [redacted],829 m3 per year.

Ex Post Site Description:

The housing maintenance manager was interviewed on February 26th, 2013 and provided a tour of the facility and associated measure. The installation and operation of the new boiler and domestic hot water system was discussed.

The installation of the boiler and associated equipment was physically verified and its operation was observed. The site representative reported that the old domestic hot water heaters were commercial AO Smith Model BTR-120 units.

In addition to the domestic hot water heaters, the project included the installation of a new makeup air unit with hot water coil. The MUA unit replaced a direct-fired gas unit with lower cfm capacity. The MUA unit was not included in this measure and its effect on facility gas usage was not considered.

Domestic hot water in the storage tanks is maintained at an average temperature of about 139o F and tempered to 120 o F before distribution to the facility.

Summary of ex post Calculations:

The ex-post calculation used the same approach as the ex ante calculations, but the temperatures and water usage were adjusted to align with observed site conditions and utility bill data.

Comments on ex ante Costs and EUL:

Measure costs presented in the application are consistent with customer-provided invoices.

The 20 year EUL is reasonable for this type of measure.

Project Verification Report

Reasons for Adjustments

- ☐ Inappropriate Assumptions
- ☐ Calculation/Engineering Error
- ☐ Tracking Error
- ☑ Operated or Installed Diff

Results

	Ex-Ante:	Ex-Ante Adjusted:	Ex-Ante Realization Rate:
kWh Savings (kWh):	0	0	0%
Gas Savings (m3):	2,167	1,300	60%
Water Savings (L):			
Incremental Cost:	$167,718	$167,718	100%
EUL (Yrs):	20	20	100%

Project Verification Report

Project ID:	COM-0120			Date Completed:	7/12/2012
Project Savings:	17,075	m3	0	kWh	L
Project Cost:	$161,000				
Project Description:	SHW-Boiler				

Verification Report

Measure Description:

The customer installed new gas-fired boilers with indirect domestic water heating and storage tanks. The system replaced existing electric, tank type hot water heaters.

Summary of the ex ante Calculations:

The ex-ante savings used engineering calculations and a spreadsheet template to estimate baseline and efficient gas usage. Total hot water usage was estimated and used to establish usage based on pre retrofit and post retrofit efficiencies. Calculations included tank and piping losses from the baseline and new tanks.

The baseline water heaters selected for this project were typical commercial gas-fired boilers.

Comments on the ex ante Calculations:

The ex ante approach is reasonable if accurate water usage can be collected, but if possible results should be compared to actual billing data. It appears that the water usage was selected to align with facility gas usage.

The ex ante calculations assumed an energy factor (EF) of 0.60 for the baseline water heater. The baseline water heater listed as baseline has a thermal efficiency of 0.80, so an EF of 0.60 is lower than would be expected. In addition, the dimensions of the new storage tanks correspond to a volume of 23 gallons and it was assumed that only one was installed, which underestimates the standby losses for the new storage tanks.

Ex Post Site Description:

The housing maintenance manager was interviewed on February 21st, 2013 and provided a tour of the facility and associated measure. The installation and operation of the new boiler and domestic hot water system was discussed. The installation of the boiler and associated equipment was physically verified and its operation was observed.

Domestic hot water in the storage tanks is maintained at an average temperature of about 130o F and tempered to 120 o F before distribution to the facility.

Summary of ex post Calculations:

The ex-post calculation used the same approach as the ex ante calculations, with the baseline EF was adjust to 0.67 and heat loss from the new storage tank was calculated to match actual tank dimensions. The results were compared to billed gas usage to assure that the domestic hot water volume was comparable.

Comments on ex ante Costs and EUL:

Measure costs presented in the application are consistent with customer-provided invoices.

The 20 year EUL is reasonable for this type of measure.

Reasons for Adjustments

Project Verification Report

- [x] Inappropriate Assumptions
- [ ] Calculation/Engineering Error
- [ ] Tracking Error
- [ ] Operated or Installed Diff

Results

	Ex-Ante:	Ex-Ante Adjusted:	Ex-Ante Realization Rate:
kWh Savings (kWh):	0	0	0%
Gas Savings (m3):	17,075	14,150	83%
Water Savings (L):			
Incremental Cost:	$233,626	$233,626	100%
EUL (Yrs):	20	20	100%

Project Verification Report

Project ID:	COM-0274	Date Completed:	3/28/2012
Project Savings:	13,754 m3	0 kWh	L
Project Cost:	$353,315		
Project Description:	IV-Energy Star Window & Door Replacements		

Verification Report

Measure Description:

The customer replaced 402 existing windows and 106 existing doors (with glass) with energy star windows in a townhouse complex. The windows are installed in a total of 51 townhouse units.

Summary of the ex ante Calculations:

The energy savings are calculated using a template developed for Union Gas. The template calculates the expected energy savings for both increased R-value for the new window (conduction losses) as well as reduced infiltration due to the installation of the new windows.

In order to determine the savings for the conduction losses, a design conduction load was determined for the baseline windows and the efficient windows by multiplying the U-value of the window by the area and the temperature difference between the design point and the assumed indoor air temperature of 72°F. This design load was then input into an ASHRAE simplified bin analysis, which proportioned the load based on outdoor air temperature, with no load occurring at 72°F and the design load occurring at -0.9°F.

To determine the infiltration savings, the windows were separated by orientation. For each orientation, the infiltration level was calculated. The area of each window was multiplied by an infiltration level per square foot for the baseline and proposed windows. The baseline windows were assumed to have an infiltration level of 0.9 cfm/sf, at the design condition of 0.3 in. wc. This equates to a wind speed of approximately to a 25 mph. Based on the location, the average wind speed is only 12. Therefore, the wind pressure is reduced to 0.07 in. wc. Therefore, the infiltration level at the average operating wind speed is calculated as the infiltration at 0.3 in. wc. X 0.07 / 0.03. The proposed windows infiltration level was calculated similarly, with the nominal infiltration (at 0.3 in wc) being 0.1 cfm/sf.

The infiltration level is then the area of each window multiplied by the infiltration cfm/sf level multiplied by the percent of time the wind direction is from the same orientation as the window.

Comments on the ex ante Calculations:

The supplied analysis is reasonable and appropriate for the calculation of losses due to conduction and infiltration. However, radiation can play a significant role in the energy savings for windows, and must be accounted for.

Additionally, due to the operation of the template, the user is required to input parameters on certain tabs, and then take the resulting heat load values and copy them into the final analysis tab. For this project, it appears that the heat load values for conduction were not properly transferred, as the design conduction heat load was calculated to be 214,289 BTU/hr for the windows (excluding doors and patio doors) for the baseline case and 132,860 BTU/hr for the efficient case. However, in the final analysis tab these design heat load values are input as 755,130 BTU/hr and 95,994 BTU/hr, respectively. Therefore, the calculated savings are based on a heat load value that is approximately 3.5 times the heat load determined for the windows.

Project Verification Report

Ex Post Site Description:

The savings for this measure were verified through desk review.

Summary of ex post Calculations:

The original analysis was retained for the ex post analysis, with the exception of the addition lf radiation. The installed windows have a lower solar heat gain coefficient. This will allow less solar energy to enter the house, which will reduce the cooling load, however, will result in increased heating load.

Incident solar radiation data was taken from the NREL Solar Radiation Data Manual for Buildings. The solar radiation data is taken by orientation, for minimally shaded windows, as based on the review of the facility from Google Earth, few trees or other factors impede the light path to the windows.

The solar radiation data is presented in a BTU/sf value per day. This value is then multiplied by the solar heat gain coefficient in order to determine the transmitted solar gains. Based on the supplied documentation, the old windows were single pane glass, and were assumed to have a solar heat gain coefficient of 0.76. The installed windows had a solar heat gain of 0.59.

Similarly, savings were calculated for the doors and the patio doors, however, for these cases, the solar gains were reduced based on the percent of the door that was glass. For the case of the entrance doors, the door was approximately 33% glass. For the patio doors, the door was approximately 75% glass.

The combined changes reduce the savings to 13,119 m3, approximately 95% of the ex ante value.

Comments on ex ante Costs and EUL:

Measure costs presented in the application are consistent with customer-provided invoices. The ex ante EUL for this measure is 20 years. The verified EUL is 22 years.

Reasons for Adjustments

- [x] Inappropriate Assumptions
- [x] Calculation/Engineering Error
- [ ] Tracking Error
- [ ] Operated or Installed Diff

Results

	Ex-Ante:	Ex-Ante Adjusted:	Ex-Ante Realization Rate:
kWh Savings (kWh):	0	0	0%
Gas Savings (m3):	13,754	13,119	95%
Water Savings (L):			
Incremental Cost:	$58,500	$58,500	100%
EUL (Yrs):	20	22	110%

Project Verification Report

Project ID:	COM-0286	Date Completed:	11/15/2012
Project Savings:	2,729 m3	0 kWh	L
Project Cost:	$69,700		
Project Description:	IN-Roof		

Verification Report

Measure Description:

The customer replaced the roof and insulation in a senior social housing apartment. The building insulation level is being increased from 2 inches to 4 inches of extruded polystyrene insulation. The insulation level is increasing from an R-value of 10 to an R-value of 20.

Summary of the ex ante Calculations:

The energy savings are calculated using a template developed for Union Gas. The template calculates the expected energy savings due to the increased R-value associated with the new roof (conduction losses).

In order to determine the savings for the conduction losses, a design conduction load was determined for the baseline and upgraded roof by multiplying the U-value of the roof by the area and the temperature difference between the design point and the assumed indoor air temperature of 72°F. This design load was then input into an ASHRAE simplified bin analysis, which proportioned the load based on outdoor air temperature, with no load occurring at 72°F and the design load occurring at -0.9°F. In both the pre- and the post cases, the U-values calculated include factors for the U-value of the insulation, as well as the roof materials and air film.

Comments on the ex ante Calculations:

The supplied analysis is reasonable and appropriate for the calculation of heat losses due to conduction.

Ex Post Site Description:

The savings for this measure were verified through desk review.

Summary of ex post Calculations:

No changes were made to the analysis.

Comments on ex ante Costs and EUL:

Measure costs presented in the application are consistent with customer-provided invoices. The EUL is reasonable for this type of measure.

Reasons for Adjustments

- ☐ Inappropriate Assumptions
- ☐ Calculation/Engineering Error
- ☐ Tracking Error
- ☐ Operated or Installed Diff

Results

Project Verification Report

	Ex-Ante:	Ex-Ante Adjusted:	Ex-Ante Realization Rate:
kWh Savings (kWh):	0	0	0%
Gas Savings (m3):	2,729	2,729	100%
Water Savings (L):			
Incremental Cost:	$68,637	$68,637	100%
EUL (Yrs):	20	20	100%

Project Verification Report

Project ID:	COM-0159	Date Completed:	9/30/2011
Project Savings:	4,865 m3	0 kWh	L
Project Cost:	$44,400		
Project Description:	IV-Weatherstripping-Caulking Windows		

Verification Report

Measure Description:

The customer installed 6,157 lineal feet of weather stripping (caulking) around 94 windows.

Summary of the ex ante Calculations:

The energy savings are calculated using a window template developed for Union Gas. The template calculates the expected energy savings for both increased R-value for the new window (conduction losses) as well as reduced infiltration due to the installation of the new windows. For this analysis, the conduction losses were set to zero.

To determine the infiltration savings, the windows were separated by orientation. The linear feet of crack each window was multiplied by an infiltration level per lineal foot for the baseline and proposed windows. The baseline windows were assumed to have an infiltration level of 0.6 cfm/ft at the design condition of 0.3 in. wc, which equates to a wind speed of approximately 25 mph. The post retrofit windows were assumed to have an infiltration level of 0.1 cfm/ft at 0.3 in. wc.Based on the location, the average wind speed is only 12 mph, so the average wind pressure is 0.07 in. wc. Therefore, the total infiltration levels at the average operating wind speed were calculated as"

Baseline infiltration = 0.6 cfm/foot* 0.07 / 0.03 *6,157 feet= 862 cfm
Post retrofit infiltration = 0.1 cfm/foot* 0.07 / 0.03 *6,157 feet= 142 cfm

The design loads were calculated assuming an interior space temperature of 72o F and design day temperature of -0.9o F. A bin analysis using local temperatures was completed to estimate total annual energy use in the pre and post retrofit cases. Those results were further adjusted to account for local wind direction frequency.

Comments on the ex ante Calculations:

The supplied analysis is a reasonable approach and no issues were discovered during the review process.

Ex Post Site Description:

The savings for this measure were verified through desk review.

Summary of ex post Calculations:

No changes were made to the analysis.

Comments on ex ante Costs and EUL:

Measure costs presented in the application are consistent with customer-provided invoices. The EUL of 20 years is reasonable for this type of measure.

Reasons for Adjustments

☐ Inappropriate Assumptions ☐ Calculation/Engineering Error

Project Verification Report

☐ Tracking Error ☐ Operated or Installed Diff

Results

	Ex-Ante:	Ex-Ante Adjusted:	Ex-Ante Realization Rate:
kWh Savings (kWh):	0	0	0%
Gas Savings (m3):	4,865	4,865	100%
Water Savings (L):			
Incremental Cost:	$161,000	$161,000	100%
EUL (Yrs):	20	20	100%

Project Verification Report

Project ID:	COM-0157	Date Completed:	11/25/2011
Project Savings:	9,052 m3	0 kWh	L
Project Cost:	$52,300		
Project Description:	HVAC-MAU		

Verification Report

Measure Description:

The customer installed a new [redacted] cfm, 80% efficient make up air unit. The installed make up air unit has a VFD to control ventilation levels and has a controller that allows the scheduling of discharge air temperature settings. These two features minimize the expected gas usage of the make up air unit.

Summary of the ex ante Calculations:

The energy savings are calculated using a hybrid approach. In order to assess the expected baseline gas usage, a bin analysis method was performed, assuming the make-up air unit would operate at full speed continuously throughout the year. For each bin, the heat load was calculated using the formula: Heat load (BTU/hr = 1.08 x CFM x (Tdischarge –Tout). This heat load was then multiplied by the hours in each bin and divided by the expected efficiency of 80% to determine the annual gas use.

The baseline gas usage was then compared to the consumption of the building during a ten month period. Based on the supplied analysis, the building consumed [redacted] m3 during that period. The domestic hot water usage (assumed to be [redacted] m3) was removed, leaving [redacted] m3. This was multiplied by the ratio of heating degree days during that period to typical annual heating degree days to determine the expected annual use in the efficient case.

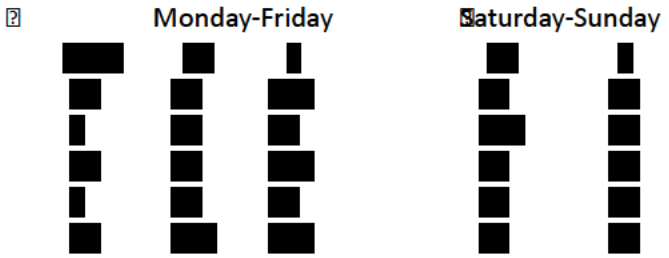
The difference between these two values was the savings. The savings were expected to be 9,052 m3, or approximately [redacted] the baseline gas usage or [redacted] the efficient case gas usage.

Comments on the ex ante Calculations:

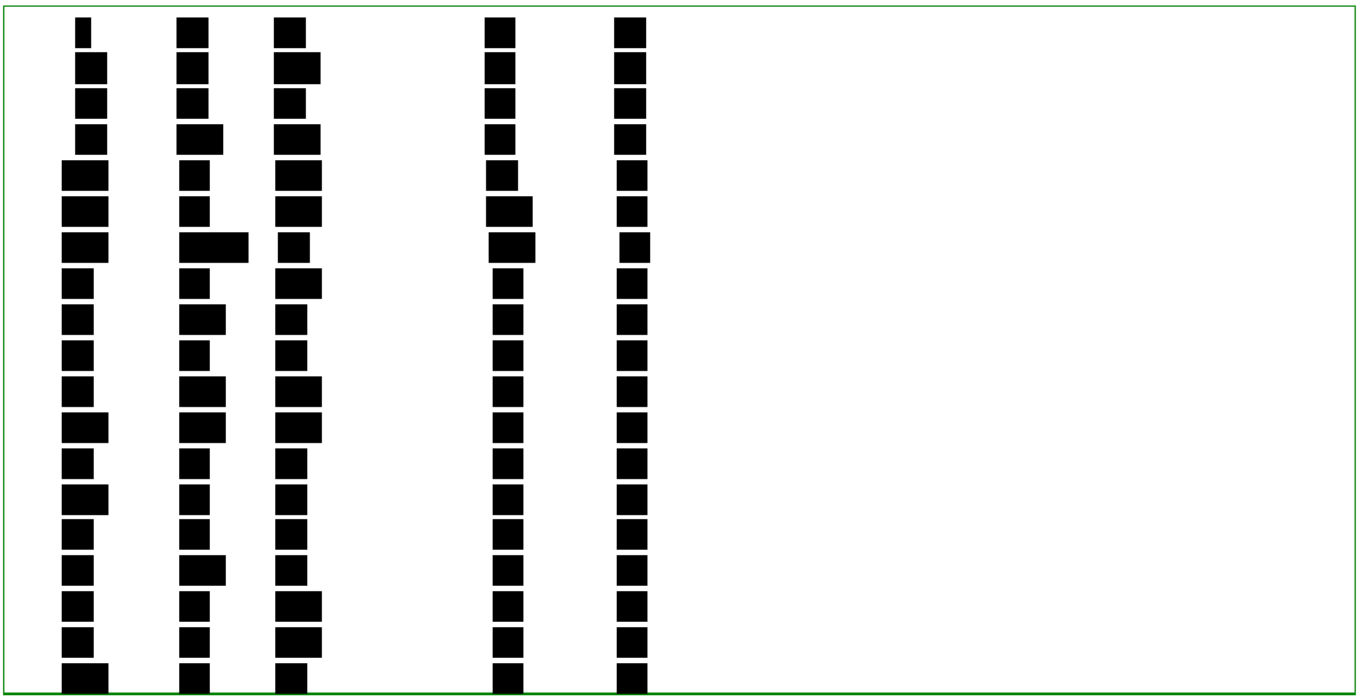
Although not necessarily incorrect, the method taken to determine the savings can be complex. It is not clear what factors affect the gas usage in the metered period or how those affects would change the savings estimates.

Ex Post Site Description:

The installation of the measure was verified through onsite inspection. The installed equipment was inspected and the site representative was interviewed to verify operation. Based on the customer interview, the make-up air unit runs [redacted] hours per year. During the winter months, the system runs to maintain temperature for the discharge air, with both the speed of the VFD and temperature changing, depending on time of day and day of the week. The operational schedule for the unit is:



Project Verification Report



Summary of ex post Calculations:

The ex-post calculation used an ASHRAE simplified bin analysis method. For each bin, air temeprature and cfm (as indicated by Hz) was developed, based on the information collected from the onsite. The expected gas usage was then calculated for each bin, using an approach similar to the approach used to calculated the baseline system usage in the ex ante calculations. Specifically, the energy required to heat the air was calculated as

BTU/HR = 1.08 X CFM X (Tdischarge - Toutdoor)

For the baseline condition, the unit was assumed to operate at 60Hz, with a discharge air temperature of 72°F.

The combined changes reduce the savings to 7,388 m3, approximately 81% of the ex ante value.

The calculated savings for this project are approximately [redacted] of the baseline gas usage. This reduction is reasonable when compared to the speed levels indicated in the program. Based on the observed schedule, the unit averages approximately 37 Hz, or 60% speed. Therefore, the reduction would be expected to be about 40%. As an additional check, the billed gas usage was correlated to heating degree days. Based on that correlation, the gas usage of the installed efficient equipment was extrapolated to a typical meteorological year. This gas usage value was similar (within 5%) to the gas usage projected in the bin analysis calculations for the efficient system operation.

Comments on ex ante Costs and EUL:

Measure costs presented in the application are consistent with customer-provided invoices. However, the incremental cost given in the project was the full cost of the make up air unit. The baseline used in the analysis was a new baseline unit. Therefore, the baseline cost should also reflect the installation of a new baseline unit. The evaluation assumed a baseline cost of approximately [redacted] the efficient equipment cost.

The EUL is reasonable for this type of measure.

Reasons for Adjustments

Project Verification Report

- ☐ Inappropriate Assumptions
- ☐ Calculation/Engineering Error
- ☐ Tracking Error
- ☑ Operated or Installed Diff

Results

	Ex-Ante:	Ex-Ante Adjusted:	Ex-Ante Realization Rate:
kWh Savings (kWh):	0	0	0%
Gas Savings (m3):	9,052	7,388	82%
Water Savings (L):			
Incremental Cost:	$52,300	$13,000	25%
EUL (Yrs):	15	15	100%

Project Verification Report

Project ID:	COM-0116			Date Completed:	3/2/2012
Project Savings:	7,655	m3	738	kWh	L
Project Cost:	$174,720				
Project Description:	IV-Windows				

Verification Report

Measure Description:

The customer replaced 206 existing windows with energy star windows in a high-rise apartment building with a total of 80 units.

Summary of the ex ante Calculations:

The energy savings are calculated using a RetScreen model. Minimal information was input for the model, however, the window area and specifications were input. A heating efficiency of 70% was used.

Comments on the ex ante Calculations:

The supplied analysis is reasonable and appropriate. The assumption of 70% boiler efficiency is low, but possible. Additionally, it should be noted that the heat load value was incorrectly claimed as the savings. This neglects the effect of the boiler efficiency.

Ex Post Site Description:

The savings for this measure were verified through desk review.

Summary of ex post Calculations:

The original analysis was retained for the ex post analysis. Boiler efficiency was increased to 80%. Second, the window specifications were adjusted to be consistent with the supplied manufacturer information, which indicated U-values of 1.73 W/m^2-C to 1.82 W/m^2-C, depending on the window. Finally, the ex post analysis savings use the difference in the modeled pre- and post-installation gas usage, rather than the heat load value.

The combined changes increase the savings to 12,164 m3, approximately 158% of the ex ante value.

Comments on ex ante Costs and EUL:

Measure costs presented in the application are consistent with customer-provided invoices. The EUL is reasonable for this type of measure.

Reasons for Adjustments

- [x] Inappropriate Assumptions
- [x] Calculation/Engineering Error
- [ ] Tracking Error
- [ ] Operated or Installed Diff

Results

Project Verification Report

	Ex-Ante:	Ex-Ante Adjusted:	Ex-Ante Realization Rate:
kWh Savings (kWh):	738	0	0%
Gas Savings (m3):	7,655	12,164	159%
Water Savings (L):			
Incremental Cost:	$174,720	$174,720	100%
EUL (Yrs):	22	22	100%

2012 Evaluation of Distribution Contract Custom Projects

For

Union Gas

50 Keil Drive North
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Chatham, Ontario, Canada
N7M 5M1

April 10, 2013

Performed By

Diamond Engineering Company
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This report is confidential and contains sensitive information about the operations of Union's customers. It is intended for use only by Union Gas and the reviewer of the program.

Table of Contents

Introduction

Union Gas has been undertaking Demand Side Management initiatives to encourage the efficient use of natural gas. In the industrial markets, custom projects represent a significant portion of the DSM savings. A sampling plan randomly selects an appropriate number of sites that are to be audited by an independent third party. The primary objectives of the report on this audit are:

- To review the original customer application and supporting documentation with respect to savings estimates.
- To conduct site visits and verify the system was installed and operational. To verify equipment costs with the customers.
- To discuss the project with service representatives and customers, and determine operating practices.
- To collect operating data and design information.
- To review the information and make an estimate of the rate of annual gas volume savings, and where appropriate, make an estimate of the rate of water and electrical savings. Savings estimates are Diamond Engineering's best attempt to determine, with the information provided, what the actual savings rate is, without any factors of safety.
- Project Costs are solely the representations of the customers interviewed. This review does not constitute a financial audit.

Summary

Seventeen projects were reviewed. Customers invested $ 15,937,806 in these projects. These projects resulted in an annual natural gas savings of between 69,203,500 and 73,655,500 m^3. Using a 0.00188 metric ton CO_2 / m^3 gas consumed conversion factor, CO_2 emission reduction from these seventeen projects was between 129,800 and 138,100 metric tons per year.

While this audit process consists of both a Boolean and numeric analysis of project applications and results, there are other factors that, when considered with the supporting information and data, either add to or detract from the auditor's confidence in the conclusions presented. It must be reported that during every site visit, the customers welcomed the auditor and willingly took the time necessary to explain the project and its results. In two instances, a customer was not initially able to provide sufficient information to verify critical savings elements but provided the information at a later date.

This year, the lower than verified savings calculations for natural gas on the project applications indicate Union Gas personnel and their customers were conservative when estimating savings. This pattern is typical because while it is a common practice to apply factors of safety when performing engineering calculations, no such factors are applied by Diamond Engineering in the preparation of this report.

Union Gas Representatives and Project Managers were always welcomed by the customers, viewed as partners and considered valuable resources.

It would be desirable to encourage all Customers to provide internal verification procedures to estimate the exact savings achieved from their projects, however, it is important to note most end users perform only enough analysis to justify a course of action. In other words, if the companies required payback period is one year, the investment of additional resources to accurately calculate whether the project pays back in six or three months is a an academic exercise and has no commercial value to the customer.

As with any such body of work, the quality of the supporting material for each project varies significantly. Diamond Engineering personnel have used what is in their judgment the best available information to arrive at the savings estimates.

Summary (continued)

Other Considerations

Energy Intensity – Whenever possible, this analysis will describe energy efficiency improvement(s) in light of *Energy Intensity* reductions. If no such conclusion is provided, in general, there was insufficient data provided or the it required analysis falls outside the describe scope of the analysis. For the purposes of this analysis, Energy Intensity is defined as *Gross Energy Consumed* per consistent unit produced or processed.

Gross Energy Consumed – Unless otherwise noted, *Gross Energy Consumed* is assumed to be the energy value at the facilities boundary. Generation and Distribution losses are not accounted for in the analysis.

HHV – Unless otherwise noted, All values are expressed in terms of the *Higher Heating Value* of any given fuel. The quantity of fuel saved is expressed in terms of a volume under standard pressure and temperature. The Higher Heating Value (HHV) for a cubic meter of natural gas is assumed to be 35,315 British Thermal Units (BTU).

Period of Savings – Unless otherwise stated, When describing the impact of a project or action on energy consumption, it is assumed the benefit has accrued from a one year period.

Rational Process Operator – Unless evidence is uncovered to the contrary, it is assume the person / people responsible for various decisions as to the operation, maintenance, and investment in the process or apparatus follow sound business principles. Unless otherwise noted, this analysis does not seek to understand why decision(s) are made, only the decision(s) impact on energy consumption.

Honest Process Operator – Unless evidence is uncovered to the contrary, it is assume the person / people disclosing information do so without any intentional misrepresentation, however, it is not assumed the information is accurate.

While the execution of each project was verified, this was not a financial audit – project costs are as represented by the customers interviewed.

Summary (continued)

Natural Gas Savings	Estimated Annual Natural Gas Consumption (Normal Cubic Meters) from Application	Estimated Annual Natural Gas Consumption (Normal Cubic Meters) Auditor's Calculations (Maximum)	Estimated Annual Natural Gas Consumption (Normal Cubic Meters) Auditor's Calculations (Minimum)
1. Project # 2012-IND-0057	5,473,070	5,474,000	5,474,000
2. Project # 2012-IND-0030	9,655,436	11,230,000	9,700,000
3. Project # 2012-IND-0027	2,818,056	2,973,000	2,433,000
4. Project # 2012-IND-0152	2,321,976	2,268,000	2,041,000
5. Project # 2012-IND-0024	5,902,120	6,404,000	5,240,000
6. Project # 2012-IND-0241	1,240,811	1,525,000	1,017,000
7. Project # 2012-IND-0153	1,705,572	1,706,000	1,706,000
8. Project # 2012-IND-0068	1,039,637	1,040,000	1,040,000
9. Project # 2012-IND-0157	408,208	593,500	593,500
10. Project # 2012-IND-0151	2,414,798	4,834,000	4,351,000
11. Project # 2012-IND-0443	4,593,133	4,593,000	4,593,000
12. Project # 2012-IND-0543	3,068,457	3,401,000	3,401,000
13. Project # 2012-IND-0290	6,956,258	6,017,000	6,017,000
14. Project # 2012-IND-0486	10,055,761	12,280,000	12,280,000
15. Project # 2012-IND-0430	3,631,134	3,508,000	3,508,000
16. Project # 2012-IND-0282	3,347,642	4,208,000	4,208,000
17. Project # 2012-IND-0431	1,600,756	1,601,000	1,601,000
Totals	**66,232,825**	**73,655,500**	**69,203,500**

Electrical Savings	Estimated Annual Electrical (kWh) from Application	Estimated Annual Electrical (kWh) Auditor's Calculations (Maximum)	Estimated Annual Electrical (kWh) Auditor's Calculations (Minimum)
2. Project # 2012-IND-0030	1,205,222	1,253,000	1,082,000
3. Project # 2012-IND-0027	229,734	276,100	225,900
5. Project # 2012-IND-0024	575,712	594,800	486,700
6. Project # 2012-IND-0241	37,916	214,400	143,000
8. Project # 2012-IND-0068	122,552	128,520	128,520
Totals	**2,171,136**	**2,466,820**	**2,066,120**

Summary (continued)

Water Savings	Estimated Annual Water (liters) from Application	Estimated Annual Water (liters) Auditor's Calculations (Maximum)	Estimated Annual Water (liters) Auditor's Calculations (Minimum)
2. Project # 2012-IND-0030	113,189,749	117,800,000	101,700,000
3. Project # 2012-IND-0027	21,575,736	23,740,000	19,420,000
5. Project # 2012-IND-0024	54,068,630	59,420,000	48,620,000
6. Project # 2012-IND-0241	2,865,918	14,990,000	9,992,000
Totals	**191,700,033**	**215,950,000**	**179,732,000**

Project Costs	Estimated Project Costs from Application	Estimated Project Costs confirmed during site visits
1. Project # 2012-IND-0057	$ 561,030	$ 561,030
2. Project # 2012-IND-0030	1,988,519	1,988,519
3. Project # 2012-IND-0027	65,400	65,400
4. Project # 2012-IND-0152	924,897	924,897
5. Project # 2012-IND-0024	184,700	184,700
6. Project # 2012-IND-0241	318,733	318,733
7. Project # 2012-IND-0153	140,000	140,000
8. Project # 2012-IND-0068	46,631	46,631
9. Project # 2012-IND-0157	1,428,800	1,625,000
10. Project # 2012-IND-0151	181,000	181,000
11. Project # 2012-IND-0443	541,791	541,791
12. Project # 2012-IND-0543	125,710	125,710
13. Project # 2012-IND-0290	3,954,386	3,954,386
14. Project # 2012-IND-0486	4,226,575	4,226,575
15. Project # 2012-IND-0430	709,680	709,680
16. Project # 2012-IND-0282	188,475	188,475
17. Project # 2012-IND-0431	155,279	155,279
Totals	**$ 15,741,606**	**$ 15,937,806**

Summary (continued)

Equipment Life	Estimated Project Life in Years from Application	Estimated Project Life in Years confirmed during site visits
1. Project # 2012-IND-0057	2	1.65
2. Project # 2012-IND-0030	20	30
3. Project # 2012-IND-0027	7	7
4. Project # 2012-IND-0152	4	4
5. Project # 2012-IND-0024	7	7
6. Project # 2012-IND-0241	20	30
7. Project # 2012-IND-0153	4	4
8. Project # 2012-IND-0068	7	7
9. Project # 2012-IND-0157	20	20
10. Project # 2012-IND-0151	2	2
11. Project # 2012-IND-0443	20	20
12. Project # 2012-IND-0543	20	20
13. Project # 2012-IND-0290	30	30
14. Project # 2012-IND-0486	20	20
15. Project # 2012-IND-0430	20	20
16. Project # 2012-IND-0282	20	20
17. Project # 2012-IND-0431	20	20

Summary (continued)

The results of this review can also be reported in terms of CO_2 emission avoided. For a conversion, the US Department of Energy's Energy Information Agency has calculated an average value of 117.08 Pounds of CO_2 emitted per mmBTU of natural gas consumed. Using this factor, the accounts examined in the review process saved the following:

CO2 Emissions Avoided	Annual Estimated metric tons of CO2 emissions avoided per Application values	Annual Estimated metric tons of CO2 emissions avoided per Auditor's Calculations (Maximum)	Annual Estimated metric tons of CO2 emissions avoided per Auditor's Calculations (Minimum)
1. Project # 2012-IND-0057	10,265	10,266	10,266
2. Project # 2012-IND-0030	18,108	21,061	18,192
3. Project # 2012-IND-0027	5,285	5,576	4,563
4. Project # 2012-IND-0152	4,355	4,254	3,828
5. Project # 2012-IND-0024	11,069	12,010	9,827
6. Project # 2012-IND-0241	2,327	2,860	1,907
7. Project # 2012-IND-0153	3,199	3,200	3,200
8. Project # 2012-IND-0068	1,950	1,950	1,950
9. Project # 2012-IND-0157	766	1,113	1,113
10. Project # 2012-IND-0151	4,529	9,066	8,160
11. Project # 2012-IND-0443	8,614	8,614	8,614
12. Project # 2012-IND-0543	5,755	6,378	6,378
13. Project # 2012-IND-0290	13,046	11,285	11,285
14. Project # 2012-IND-0486	18,859	23,031	23,031
15. Project # 2012-IND-0430	6,810	6,579	6,579
16. Project # 2012-IND-0282	6,278	7,892	7,892
17. Project # 2012-IND-0431	3,002	3,003	3,003
Totals	**124,217**	**138,100***	**129,800***

*rounded to 4 significant digits

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Independent Audit of 2012 DSM Program Results

Final Report

Report Number 1447

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Executive Summary

EnerNOC was engaged to conduct an independent, third-party audit of Union's Draft DSM 2012 Annual Report, in accordance with the Ontario Energy Board guidelines. To conduct the audit, the Audit team reviewed Union's 2012 savings estimates and the calculations, assumptions, background material, and other documents supporting the result presented in the Draft DSM 2012 Annual Report.

This audit identified cases where calculations and result presented in the Draft DSM 2012 Annual could be improved. All recommendations are discussed in detail in the report. In summary, the Audit Team recommends the following changes to the Draft DSM 2012 Annual Report:

- As recommended in the last audit, when survey respondents do not know whether they have a natural gas water heater, Union should assume they do not until the TEC is able to address this issue.
- Include all formulas in the Audit Tool if they cannot be directly verified in the verification report.
- For Residential Home Retrofit savings, Union should collect information on age and efficiency of furnaces replaced to help assess the validity of using a 20 year EUL for all participating homes.
- Union should include a description in the annual report about the adjustment for the second showerhead in the Free Showerhead Installation program.
- Union and Enbridge should revisit the incremental costs for High Efficiency Boilers.
- In future, CPSV verification consultants should use zero decimal places in annual gas savings to match original values in future studies.
- Change the EUL for the Industrial Control Programming measure from 20 years to 15 years to match the value used for Commercial Controls Systems.
- Change the baseline efficiency for a repaired boiler to 75% to reflect the age of the boiler.
- Correct the change in temperature for one control measure used to reflect the weighted/blended value for the ex-post savings.
- Reduce the rating of the steam leak for the largest C/I project to reflect the appropriate severity of the leak.
- Reduce the savings for heat exchangers in Large Industrial Rate T1/100 by 50% to account for the uncertainty around baselines.

The following are more general recommendations for custom projects.

- Develop better UELs for Control settings.
- Develop guidelines about how to differentiate issues related to baselines, EUL, and free riders.
- Require specific information to be collected for custom projects of the same type.
- Do not use vendor's energy savings calculations for rebates unless independently verified.
- Require more details on baselines for custom project of a certain savings level.
- Clarify CPSV roles for verification consultants and auditors.
- Better define the roles for the auditor review of CPSV results.

Table 1 shows the impact of the audit findings on the Scorecard metrics and DSM incentives and Table 2 shows the impact on changes on just the DSM Incentive and LRAM values.

Table 1 Impact of Audit Adjustments on Scorecard Metrics and DSM Incentives

Scorecard & Metrics	Draft Report	Audit Result	Change
Resource Acquisition			
Cumulative Natural Gas Savings (10^3 m^3)	900.44	893.86	- 6.58
Deep Savings - C/I (% savings)	10.4%	9.45%	-0.95%
DSM Incentives ($000,000s)	$3.87	$3.61	-$0.26
Large Industrial Rate R1/100			
Cumulative Natural Gas Savings (10^3 m^3)	1,456.25	1,392.93	-63.32
DSM Incentives ($000,000s)	$1.81	$1.81	-$0.00
Market Transformation			
Top 10 Builders Participating	4	3	-1
Top 50 Builders Participating	7	8	+1
DSM Incentives ($000,000s)	$0.20	$0.18	-$0.02

Table 2 Impact of Audit Changes on DSM Incentives and LRAM ($000,000)

Scorecard	Draft Annual Report	Final Audit Report	Difference
Resource Acquisition	3.868	3.609	-0.259
Low-Income	2.725	2.725	0.000
Large Industrial	1.807	1.807	-0.000
Market Transformation	0.198	0.182	-0.016
Total DSM Incentive	**$ 8.598**	**$ 8.322**	**- $ 0.276**
LRAM	**$ 1.017**	**$ 0.966**	**- $ 0.051**

Table of Contents

List of Tables

1.0 Introduction

Union Gas Ltd. and the AC engaged EnerNOC Utility Solutions to conduct an audit of their 2012 DSM Annual Report. The primary objective of the audit is to provide an independent opinion to DSM stakeholders (i.e. the OEB, Intervener consultative members, and the utility), that serves to determine if the DSMVA, LRAM and utility DSM Shareholder Incentive calculations are appropriate.

We have audited the Annual Report, DSM Shareholder Incentive, Lost Revenue Adjustment Mechanism (LRAM) and Demand Side Management Variance Account (DSMVA) of Union Gas Ltd for the calendar year ended December 31, 2012. The Annual Report and the calculations of DSM Shareholder Incentive, LRAM, and DSMVA are the responsibility of the company's management. Our responsibility is to express an opinion on these amounts based on our audit.

We conducted our audit in accordance with the rules and principles set down by the Ontario Energy Board in the DSM Guidelines for Natural Gas Utilities (EB-2008-0346) and in accordance to the contents of the Union Gas Settlement Agreement (EB-2011-0327). Details of the steps taken in this audit process are set forth in the Audit Report that follows, and this opinion is subject to the details and explanations therein described.

In our opinion, and subject to the qualifications set forth above, the following figures are calculated correctly using reasonable assumptions, based on data that has been gathered and recorded using reasonable methods and accurate in all material respects, and following the rules and principles set down by the Ontario Energy Board that are applicable to the 2012 DSM programs of Union Gas Ltd:

DSM Shareholder Incentive Amount Recoverable - $8,322,458
LRAM Amount Recoverable - $966,386
DSMVA Amount Recoverable - $368,119

1.1 Audit Approach

Most of the cumulative natural gas m^3 savings reported in the draft annual DSM report were from custom projects (89%). The custom project savings were a key consideration in the audit, but all savings from programs were also audited. Cumulative natural gas savings were mainly from the Large Industrial Rate T1/R100 (61%) followed by Commercial and Industrial (C/I) custom projects (28%), C/I Prescriptive and Quasi-Prescriptive Measures (8%), Low Income (2%), and Residential (1%)[1].

Union's 2012 DSM portfolio included programs under each of four scorecards as shown in the following table along with the DSM incentive amounts from the draft DSM report[2]:

[1] Source: Union Gas Draft 2012 DSM Annual Report and Amended Table 4.7 from the report
[2] Source: Union Gas Draft 2012 DSM Annual Report.

Table 3 Union Gas Programs by Scorecard

Scorecard	DSM Incentive	Program(s)
Resource Acquisition	$3,868,403	Residential • Energy Savings Kit (ESK) Offering • Home Retrofit Offering Commercial/Industrial • Prescriptive & Quasi-Prescriptive Measures • Custom Offering

Low Income	$2,725,227	• Helping Homes Conserve Offering
		• Affordable Housing Conservation Offering
		  • Free Showerhead Initiative
		  • Custom Offering

Large Industrial Rate T1/R100	$1,806,595	• Custom Offering
Market Transformation	$198,255	• Optimum Home Program

EnerNOC's approach to the audit was based on the following principles.

ETHICAL CONDUCT – foundation of professionalism, which flows from the trust, integrity, confidentiality, and discretion of the auditor

FAIR PRESENTATION – report truthfully and accurately the audit findings, audit conclusions and audit reports; correctly report significant obstacles encountered during the audit and unresolved or diverging opinions between the audit team and utility and/or stakeholders

DUE PROFESSIONAL CARE – application of diligence and judgment while auditing

PROCESS INDEPENDENCE – auditors must be independent of the activity being audited, and be free from bias and conflict of interest. Auditors must maintain an objective state of mind throughout the audit process, to ensure that the findings and conclusions will be based only on evidence.

EVIDENCE – the rational basis for reaching reliable and reproducible audit conclusions. Audit evidence must be verifiable. It must be based on the sample of information available. Samples should therefore be appropriately representative, since confidence that can be placed in the audit conclusions is closely related to the samples.

QUALITY AUDIT – a "*systematic, independent and documented process for obtaining audit evidence and evaluating its objectivity, to determine the extent to which audit criteria are fulfilled*." Audit should be planned and carried out in accordance with defined and documented procedures, using a checklist and complete with formal reports and records.

AUDIT EVIDENCE – "*records, statements of facts or other information which is relevant to the audit criteria and is verifiable*." It is based on an unbiased observation; it is not as a result of personal prejudice, and personally seen by the auditor. It can be quantitative or qualitative.

1.2 Checklist of Audit Tasks

Table 4 below shows the checklist of tasks for the audit of Union's Draft 2012 DSM Report.

Table 4 Checklist of Audit Tasks

Audit Task	Status
Audit the Draft 2012 DSM Annual Report to identify if there are claims made that have not been substantiated.	√
Address issues raised by the AC during the audit process.	√
Review Union's procedures to track program participants and determine whether they lead to accurate counts.	√
Review Union's tracking system procedures and review a sample of tracking system inputs.	√
Review substantiation sheets and supporting research and documents for Prescriptive and Quasi-Prescriptive Measures to algorithms and assumptions are reasonable.	√
Review third party verification studies of installation and retention of measures in the ESK and HWC programs and ensure they are properly applied to savings.	√
Review third party verification studies of samples of custom projects for Large Industrial, Commercial/Industrial, and Low Income. Review the calculation of the population realisation rate and the associated precision to ensure it meets OEB requirements.	√
Review the data and calculations for deep savings to ensure they are accurate and conform to Settlement agreement.	√
Review the Scorecard calculations to ensure they are accurate and conform to the Settlement agreement.	√
Review and verify calculations of the Market Transformation claim and comment on metrics.	√
Review and provide an opinion of the DSMVA account.	√
Verify that the claimed savings for LRAM are accurate, consistent with the Settlement agreement, and are based on the best available information at the time of the audit.	√

Appendix A provides a list of the documents reviewed by the Audit Team and Appendix B provides information on the key meetings for the audit process, meeting purpose, and attendees.

2.0 Review Tracking System and CPSV Reports

This section describes the audit of data tracking procedures and the review of the CPSV reports in terms of quality of reporting, adherence to terms of reference, and incorporation of auditor comments.

2.1 Tracking System and Data Review

The Audit Team examined Union's 2012 program tracking procedures to:

- Review and determine whether procedures for tracking program participants lead to accurate counts, particularly for programs that do not provide customer rebates
- Assess whether values that go into estimation of program energy savings and other metrics are adequately documented in the program records

- Document strengths of the current program tracking practices
- Recommend improvement of program tracking procedures and documentation practices, where needed

Union provided an Excel Spreadsheet, called the Audit Tool to help the auditor:

- Compile and organize relevant data from the tracking database (DSMt),
- Review application of adjustments such as realisation rates and installation and retention rates of measures
- Review Scorecard calculations for Resource Acquisition, Low Income, Large Industrial Rate T1/R100, and Market Transformation,
- Trace the calculation of Deep Savings for Residential and C/I,
- Review LRAM calculations.

The Audit Team had full access to the Audit Tool and was able to operate the model and check calculations on our own. The team reviewed the Audit Tool in several ways:

- Reviewed the Audit Tool fields in the worksheet with the extract from the database to ensure appropriate data is tracked for programs.
- Reviewed the results in the Audit Tool to ensure that they match values reported in the Draft DSM 2012 Annual Report.
- Reviewed the data and calculations in the Audit Tool to ensure there are no mechanical errors in how different values are computed.
- Reviewed the data and calculations in the Audit Tool to ensure they are consistent with OEB-approved methods.
- Reviewed the input data referenced in the Audit Tool to ensure that they are consistent with values presented in the Draft DSM 2012 Annual Report,
- Reviewed Settlement agreement and input assumptions document to ensure they are consistent with the audit tool, and,
- Evaluated other data-related concerns raised by the AC.

The Audit Team requested and reviewed data tracking procedures provided by Union and requested and reviewed either a sample of data for each program or reviewed all results as shown below.

Residential Programs

- Reviewed a list of participants installing programmable thermostats in 2012 (provided by Union) to ensure the total participants were correct in the Audit Tool
- Reviewed the Audit Tool to ensure algorithms were correctly implemented for prescriptive measures.
- Reviewed the savings output and input variables from HOT2000 files for Home Retrofit participants

Commercial/Industrial Programs

- Reviewed audit tool to ensure algorithms correctly implemented for HWC.
- Reviewed sample of quasi-prescriptive measures to ensure algorithms correctly implemented.
- Reviewed information for a sample of 5 custom projects to ensure the Audit Tool correctly captured results from the verification study report.

Low Income Programs

- Reviewed audit tool to ensure algorithms correctly implemented for HHC and AFC prescriptive measures.
- Review Audit tool to ensure all savings from low income custom projects properly captured.

Large Industrial Rate T1/100

- Reviewed information for a sample of 5 custom projects to ensure the Audit Tool correctly captured results from the verification study report.

Optimum Home Program

- Reviewed data and contracts for all builders signing contracts in 2012

Overall Findings

The following are overall findings.

- The tracking systems can and do capture program-critical information.
- Procedures for tracking program participants lead to accurate counts.
- Values that go into estimating program energy savings and other metrics are adequately documented in program records.
- Reported values for participation are appropriate for calculation of LRAM and DSM incentives.
- There were no incorrect counts of measures installed or omission of information needed to calculate prescriptive savings.
- Some custom projects were completed before 2012 but these projects had not been previously claimed and Union wanted to wait until they had more data on post-installation in order to increase the accuracy of the savings results.

Union's Gas's tracking system and procedures adhere to best practices.

The new Audit Tool is very helpful in increasing the transparency of calculations and results. The Audit Team has the following suggestions to improve the Audit Tool.

- Include the spreadsheet data from HOT2000 files for Home Retrofit participants in the Audit Tool.
- Use lookup formulae for repetitive inputted assumptions. This will help protect the integrity of the data and enable easier, faster verification and editing. If this method

increases the file size to the point that calculations process very slowly, we recommend splitting in into separate workbooks or files.

- Include descriptions of how various calculations are done if they are not clear. This includes calculations for a second showerhead and deep savings for C/I.

The Audit Team compared Union's program tracking procedures to "best practices" identified in the National Action Plan for Energy Efficiency[3] and determined that Union implemented all the procedures identified. The Audit Team found the same results from a similar comparison to best practices identified for a robust tracking and measurement system[4].

Appendix C provides details about the review processes, questions, and findings.

2.3 Custom Projects Savings Verification (CPSV)

During the Custom Projects Saving Verification (CPSV) process, third party engineering firms hired by Union verify the claimed savings (natural gas, electricity, and water) for a statistically representative sample of custom projects. The projects fall into three categories: 1) Large Industrial (T1/R100 rate class); 2) Commercial & Industrial (C&I), and 3) Low Income. The CPSV process involves two "waves" of project reviews, designed to facilitate completing these reviews within the regulatory timeframe required to file Union Gas' annual DSM report.

For 2012 CPSV results, "the AC has made provision for the Auditor to work with the selected firm(s) to enable the review of both the draft and final reports and an opportunity to discuss individual projects, any findings and adjustment factors recommended throughout the firm's review." (RFP page 6). Working with engineering firms before reports are finalized is aimed to:

- Ensure correct calculation of realization rates and precision at the 90 % confidence level.
- Save time in the audit by allowing modification of results before the report is completed and reviewing results earlier in the audit process.
- Increase the auditor's confidence in the results of the CPSV project reviews.
- Identify any significant issues with these results early in the audit.

As auditor, EnerNOC conducted the following activities to complete this task:

- Coordinated with Union and the engineering firms to set up audit process
- Reviewed Phase 1 findings and identified areas for clarification
- Reviewed audit findings for Phase 1 with Union and the engineering firms and worked with them to resolve issues
- Reviewed Phase 2 findings with Union and the engineering firms in the same manner

[3] National Action Plan for Energy Efficiency, July 2006.
[4] Prindle, Wm., *From Shop Floor to Top Floor: Best Business Practices in Energy Efficiency*, April 2010.

- Provided an opinion about the quality of the CPSV report and the engineering firm's adherence to the Terms of Reference for the CPSV
- Provided further opinions about issues outstanding after the verification reports were completed and recommended changes to the results for the C&I/Low Income category
- Discussed findings with Union and the AC and addressed the AC's concerns with the CPSV process and findings

2.2.1 Adherence to Terms of Reference

This section describes how each of the verification consultants—Diamond Engineering ("Diamond") for Large Industrial and Michaels Engineering ("Michaels") for C&I and Low Income—followed the terms of reference provided by Union Gas and the AC.[5]

Overall, Diamond met the scope of work detailed in the Terms of Reference. The "Large Industrial" column in Table 5 illustrates Diamond's compliance with each Term of Reference related to project deliverables. Michaels fell short of meeting the scope of work detailed in the Terms of Reference. The "C&I and Low Income" column in Table 5 illustrates Michaels' compliance with each Term of Reference related to project deliverables.

[5] ToR Industrial Project Savings Verification Sept 6 2012; ToR Commercial Custom Project Savings Verification - Sept 6

Table 5 Adherence to Terms of Reference

Terms of Reference Related to Project Deliverables	Large Industrial (Diamond)	C&I and Low Income (Michaels)	Notes
Draft Report presenting results for the samples separately to be simultaneously sent to Auditor and Utility to review	√	√	
Report showing findings for each project review undertaken	√	√	
Date of interview and names of individual(s) interviewed	See Note	See Note	Individuals not named to protect privacy
Description of project including approach used to measure gas savings	√	√	
Detailed review of methodology used by applicant to calculate gas savings and upon which utility's incentive is based	√	See Note	Cursory review
Date of installation of equipment	See Note	See Note	Not always included in report
Type of building, building segment or process	√	√	
Description of base case scenario used in the application and associated savings calculations, if applicable	√	√	
Reasonableness of designation of advancement or replacement of claimed base case used in the savings calculation	√	√	
Commentary on reasonableness of measure life applied to the specific project	√	√	
Where appropriate, comment on future changes to OEB approved measure lives for custom projects	See Note	See Note	Comments pertain to adjusting EULs for unique circumstances
Discussion of any base case adjustments applied, if applicable	√	√	
Discussion of reasonableness of the results (i.e. gas m3/yr)	√	√	
Any unclaimed gas savings	√	√	
Discussion of difference between claimed savings and evaluated calculations and methodology, including references for each input value used in the evaluated savings calculation	√	See Note	Not always included in written description
Printouts or other information from any proprietary models used by the consultant to replicate the savings calculation	See Note	See Note	Not included in reports

Terms of Reference Related to Project Deliverables	Large Industrial (Diamond)	C&I and Low Income (Michaels)	Notes
Complete documentation of reviewer's calculations where they differ from calculations in original application	√	See Note	Not always included in written description
Any additional data or information collected through the verification process	See Note	See Note	Auditor does not know extent of additional data collected
Report on any discrepancies between equipment as described in savings estimates and equipment as installed	√	√	
Discussion of changes in size or use of building or process that alter the baseline model and assumptions that were made to account for these changes	√	√	
Total claimed and evaluated gas savings, and incremental costs	√	√	
Recommendations on steps which could be taken to provide higher level of accuracy/confidence for future reviews	No	No	Not included in reports
Recommendations on what could have been done earlier in the process to improve the confidence and accuracy of verification results	No	No	Not included in reports
To the extent that any measurement were taken on-site, list what was actually measured	√	√	
Identify areas of greatest confidence and areas with the greatest level of uncertainty	See Note	No	Diamond did this by error bounds
Report includes a section commenting on calculation methodologies employed and recommending any refinements for future savings calculations for custom projects.	See Note	No	Diamond had minimal discussion in report summary
For privacy issues, names and addresses of customers and any identifying information is not published in reports	√	√	
Consultant involved in subsequent discussions with an auditor regarding the report	√	√	

2.2.3 Population Realization Rate and Precision

In this section we summarize the Audit Team's comments on the sample design and analysis for the CPSV sample verifications. We present a comparison of the results from our calculations with the results presented in the May 8, 2013 memo with subject line "Sample Design and Evaluation Results for Union Gas 2012 Custom Projects", and discuss concerns, issues, and recommendations in Appendix D.

Using the program and stratum level population information in Figure 5 of the memo, combined with the individual sample customer results in Figures 9 and 10, we estimated the population verified savings and the associated one-sided 90% confidence intervals by stratum and for the whole program. There are no differences between the Navigant estimates and the EnerNOC estimates of realisation rates, in the two decimal places reported in the memo. Any differences (a decrease of 33 m^3 for C/I savings and an increase of 687 m^3 for Large Industrial savings) are miniscule compared to the magnitude of the savings estimates, representing less than one ten-thousandth of a percent, and so are of no concern.

Table 6 and Table 7 show the relative precision from the Navigant memo and EnerNOC's confidence intervals, based on a separate ratio estimate, using the same approach that we believe Navigant used. We were not able to match the relative errors as closely as we matched the verified savings estimates for each stratum. However, we did match the overall program relative errors much more closely, though still not exact, using the approach we believe Navigant used.

The precision of the realisation rates for each of the C&I and Large Industrial populations are at least 10% precise at the one-sided 90% confidence level

Table 6 Navigant and EnerNOC C&I Relative Error Values.

Stratum	Sample Size	Navigant Relative Error	EnerNOC Relative Error, Navigant Method
Large	12	6%	5.5%
Medium	9	17%	15.7%
Small	7	19%	17.2%
Very Small	1	-	0%
TOTAL	**29**	**8.5%**	**8.2%**

Table 7 Navigant and EnerNOC R1/T100 relative errors.

Stratum	Sample Size	Navigant Relative Error	EnerNOC Relative Error, Navigant Method
Large	7	14%	12.6%
Medium	6	17%	15.2%
Small	4	45%	35.4%
Very Small	0	-	0%
TOTAL	**17**	**10.0%**	**9.6%**

Union Gas had Navigant update the population realization rates based on the final audit findings for the custom projects samples for C/I and Large Industrial participants.

3.0 Resource Acquisition

The Resource Acquisition scorecard metrics include cumulative natural gas savings from specific programs and deep savings achieved from the Residential Home Retrofit Program and the C/I custom offering program Table 8 shows what Union programs are included in the Resource Acquisition Scorecard metric in 2012.

Table 8 Programs Included in Resource Acquisition Scorecard

Resource Acquisition Metrics	Residential	Commercial/Industrial
Cumulative natural gas savings (m3)	Residential • Energy Savings Kit (ESK) Offering • Home Retrofit Offering	• Prescriptive & Quasi-Prescriptive Measures • Custom Offering
Deep Savings	# of Home Retrofit participants achieving deep savings	Percentage of savings achieved by participants implementing custom projects compared to the 2011 weather-adjusted energy use.

3.1 Residential Programs

The Audit Team reviewed results for the ESK offerings and the Home Retrofit program which includes incentives for achieving deep savings.

3.1.1 Energy Savings Kits (ESK)

The Audit Team reviewed the verification studies completed for the ESK program and reviewed the results in the Audit Tool to ensure the calculations conformed to the substantiation sheets. The verification studies were incorrectly titled as audits. The Audit Team reviewed the following studies conducted by Beslin Research.

- An Audit of the Union Gas ESK – Residential-Push Initiative [Mar 15, 2013]
- An Audit of the Union Gas ESK – Residential-Pull Initiative [Mar 15, 2013]
- An Audit of the Union Gas ESK – Residential Replacement Initiative [Mar 15, 2013]

- An Audit of the Union Gas ESK – Residential Program Door-to-Door Drop-off Initiative [Mar 15, 2013]
- An Audit of the Union Gas ESK – Residential Program Install Initiative [Mar 15, 2013]

Audit Recommendation: Future report titles should be labeled Verification Study of the Union Gas [Program].

Treatment of Respondents Who Don't Know if Water Heater is Natural Gas)

As part of its verification of Union's ESK Residential measures surveys were administered to develop adjustment factors used in the Audit Tool and the Draft DSM annual report. The survey administrator, Beslin, asked respondents a variety of questions that affected the adjustment factors, including if they did or did not have a natural gas water heater, and how often they used the low flow showerhead. Some respondents did not know the answer to these questions. In applying the survey results, Union adopted the industry's standard approach and dropped these "Don't Know" responses from the sample and used the remaining results to calculate the adjustment factors. By dropping the "Don't Know" responses, Union implicitly distributed those responses among the possible responses in proportion to the known respondents. While this is a standard industry practice in market research, Union has the "burden of proof" and as a result should not use an approach that potentially inflates savings without verified evidence of actual savings. This is consistent with the conclusion from last year's audit that it is not possible to determine how many of these "Don't Know" respondents have or do not have natural gas hot water heaters, or how much of these "Don't Know" respondents use their showerhead. For 2011 results, Union adjusted "Don't Know" responses to no for water heaters and to 0% for low flow showerhead use. Showerhead usage was adjusted to 0% for "Don't Know" responses in 2012 as well. Union referred the issue to the Technical Evaluation Committee (TEC), but is has not yet been addressed.

The Audit Team recommends using this approach until the TEC reviews the approach and change the "Don't Know" responses get reclassified as "No" for water heaters. This will reduce the percentage of respondents with natural gas water heaters from 90.12% to 86.90% for ESK Pull and 87.04% to 84.43% for ESK Push.

This recommendation decreases LRAM by $2,206, DSM incentives by $9,873, and net annual natural gas savings by 67,570,000 m^3 as reported in the Draft DSM 2012 Annual Report.

ESK Adjustment Factors (Audit Tool does not match verification reports)

The total ESK adjustment factor is a product of three adjustment factors: Received and Installed, Gas Savings and Gas Water Heater. The adjustment factors in the reports are different from what is used in the audit tool. The Audit Tool calculation is correctly based off the numbers in the verification report but provides only the final adjustment factor and the calculation formula is not included.

The Audit Team recommends that all formulas be included in the Audit Tool if they cannot be directly verified in the verification report.

3.1.2 Home Retrofit Program

The Audit Team reviewed the data on savings from the program extracted from the HOT2000 models by the delivery agent. Union provided a spreadsheet for each homes showing savings per measure and savings for the overall homes taking interactive effects into account and a spreadsheet of input data for the homes with deep savings. There were 73 homes with "deep measures" and 23 homes that did not meet this criterion. The Audit Team reviewed both spreadsheets but did not run HOT2000 models.

One measure included in this program—furnace replacement—is different from other measures because the code for furnace efficiency levels is a minimum of 90% AFUE. In the Settlement agreement it was agreed that Union would use the HOT2000 in EnerGuide mode; however, with this method the AFUE of the existing furnace is used as the baseline rather than the code requirement.

The Audit Team assessed whether the EUL for the Home Retrofit Program (which was not stipulated in the agreement) can be used to address this issue. We used the 2012 savings by measure to determine the proportion of savings from each measure and a NYSERDA source for EULs for these measures. We calculated weighted average EUL for furnace replacements using these assumptions:

- 50% of participants who installed new furnaces had efficiency levels below code[6]
- These furnaces would have been replaced within 5 years (advancement)
- Average AFUE for existing furnaces which were advancement was 80% and furnaces would have been replaced at an efficiency level of 90%
- Advanced furnaces would get savings from the difference between existing efficiency and 90% for 5 years
- All furnaces would get savings from the difference between 90% and 95%
- % of savings = (average existing efficiency – new efficiency)/average existing efficiency

The following table shows the weighted average life of furnaces relative to the baseline efficiency of the existing equipment is 7 years.

[6] Data on the efficiency of existing and new furnaces provided to Union was not useful as the fields for existing and new AFUE were identical.

Table 9 Weighted Average Life of Furnaces Installed in 2012

	Avg base AFUE from2012 Participants	New AFUE	% savings	Equipment Life	% of participants	Weighted lifetime savings
Advancement	80%	90%	12.5%	5	50%	31%
All Furnaces	90%	95%	4.9%	20	100%	97%
			17.4%			128%
Weighted EUL relative to old replaced equipment baseline = 128%/17.4%						**7.4**

The Audit Team used this EUL as shown in Table 10 to calculate a weighted average EUL for all 2012 participating homes. The Audit Team found that Union's EUL of 20 years is reasonable and savings are not overstated because of the use of existing furnace efficiencies as baseline.

Table 10 Weighted Average EUL for Home Retrofit Adjusted for Furnace Advancement

Measure	2012 Savings (m3) [7]	% of Savings by Measure	EUL [8]	Years
Furnace	43,544	37.3%	20	7
Insulation	57,167	48.9%	30	30
Air sealing	13,993	12.0%	15	15
Water heater	329	0.3%	13	13
Windows	1,774	1.5%	20	20
TOTAL [9]	116,807	100.0%		
Weighted average EUL			***20 Years***	

Audit Recommendations: For 2012 the Audit Team recommends accepting Union's results as the method used to calculate annual savings was approved as part of the settlement agreement and a 20 year EUL takes the impact of the furnace baseline issue into account. In future Union should collect data on efficiency levels of existing and replaced furnaces and age of existing furnaces to help assess whether the 20 year EUL is appropriate.

[7] Source; Extract from HOT2000 files showing savings by measure.
[8] NY Home Performance with ENERGY STAR® Effective Useful Life of Energy Efficient Measures, Revised August 2012. http://credit.csgrp.com/webapps/nyserda/InstructionManuals/7.8%20Effective%20Useful%20Life%20of%20Measures.pdf
[9] Claimed savings from HOT2000 are 119,958 m^3 from taking interactions into account.

3.2 Deep Savings – Residential

The criteria for savings from Home Retrofit participants to be considered "deep" are:

- At least two major measures installed
- At least 11,000 m^3 lifetime natural gas savings
- At least 25% average savings across all participants with "deep" savings

Union provided data on all homes in the Home Retrofit program from the HOT2000 software. This included estimated annual savings for each measure installed and the modeled annual savings for the home which include interactive effects.

The auditor reviewed the results and determined that each of the 73 participants with "deep" savings had at least two major measures installed and achieved lifetime gas savings of at least 11,000 m^3. Also the average savings across all participants was 32.5% so all criteria for "deep" savings were met.

3.3 Commercial/industrial Programs

This section describes the audit and findings for C/I programs including Hot Water Conservation measures in both multi-family and other homes as well as incentive-based savings for C/I prescriptive and non-prescriptive measures.

3.3.1 Hot Water Conservation

The Audit Team reviewed the following verification studies conducted in 2012 and found all adjustments from the reports were properly applied in the draft DSM report.

- Verification Results: 2012 Commercial Hot Water Conservation Initiative (Multi-family) [Apr 19, 2013]
- Verification Results: 2012 Commercial Hot Water Conservation Initiative (Non Multi-family) [Apr 19, 2013]

However, In the Verification Results 2012 Commercial Hot Water Conservation Initiative (Multi-Family) Final Report, the installation rate for showerheads is listed as 82.6%. But in the audit tool the installation rate for showerhead MURB is listed as 81.00%. Discussion with Union determined that the difference was due to the need to adjust that factor needs by the use of showers in second bathrooms (Section 4.4 of the HWC report).

The Audit Team recommends that Union include a description in the annual report about the adjustment for the second showerhead.

3.3.2 Quasi-Prescriptive Offerings

Potential energy savings for some technologies are considered 'quasi-prescriptive' not prescriptive. This means that most saving inputs will be prescriptive; however, there will be one or possibly a few that are customized for each installation to determine energy savings. Examples of inputs customized for each installation/claim are: where equipment is installed (new or existing building), type of business (e.g. Foodservice or Healthcare), and size of equipment (e.g. CFM or BTU). For the Quasi-Prescriptive measures, the Audit Team reviewed

the savings calculations and results, including major assumptions. This included reviewing the new and updated C&I prescriptive measures from the approved Application for New and Updated DSM Measures [Dec 19, 2012].

The Audit Team also reviewed documents provided by Union for the Laundry Ozone measure and supporting documents for boiler measures and compared the calculations to the results in the Audit tool for a selection of projects. The list of documents reviewed is shown below:

- Ozone Laundry Substantiation Document
- Commercial Hydronic Boiler System Baseline Study [Sep 16, 2011]
- Natural Gas Technologies Centre DSM Opportunities Associated with Ozone Laundry Treatment (for Hospitality and Health Care Facilities) , Nov 25, 2009
- Final Report DSM Ozone Laundry_calculator – Redacted (xlsx)
- Final 2012 Input Assumption Table (xlsx)
- Seeline Group, Union Gas Boiler Base Case Efficiency Study, Final Report, Jan 30, 2009.
- Enbridge Gas Distribution: Prescriptive Commercial Boiler Program Prescriptive Savings Analysis (Base Case Boiler Update) [Nov 8, 2012]

Enbridge Gas Distribution: Prescriptive Small Commercial Boiler Program Prescriptive Savings Analysis (Condensing Boilers Under 300 MBH), Oct 19, 2012

The measures reviewed in depth and the audit findings are shown in Table 11

Table 11 Quasi-Prescriptive Measure Review and Findings

Measure	Audit Finding & Recommendations
Infrared Heaters (replacing a regular unit heater)	No issues identified
Condensing Make up Air Unit (replacing a conventional MUA with constant speed fan)	No issues identified
Laundry Ozone	Initially the Audit Team had no backup document and had to guess at the assumptions and had trouble getting to the levels Union has computed. Union provided a copy of the supporting documents. The Audit Team reviewed these documents and was able to replicate the savings.
High Efficiency Boilers for space heating (replacing 80% space heating boiler)	The Audit Team reviewed the existing documentation and noted that base case boiler efficiency was reduced from 81 % to 80.5 % without an explanation. Once the Audit Team reviewed the ICF Marbek report and was satisfied with the changed baseline.

Measure	Audit Finding & Recommendations
Condensing Boilers under 300,000 Btu/hour (replacing non-condensing boilers at 82% efficiency)	The Audit Team reviewed the existing documentation and noted that baseline was higher than that for high efficiency boilers. Once the Audit Team reviewed the ICF Marbek report and was satisfied with the baseline value.
High Efficiency Boilers under 300 MBH (replacing non condensing boilers at 82 % efficiency)	The Audit Team reviewed the existing documentation and noted that base case boiler efficiency was reduced from 81 % to 80.5 % without an explanation. Once the Audit Team reviewed the ICF Marbek report and was satisfied with the changed baseline. The Audit Team noted that incremental costs for 200-300 size range decreases for both existing and new construction which seems counterintuitive. The Audit Team recommends lowering existing construction value to $ 1,883 and new construction value to $ 1,313.
High Efficiency Boilers – Domestic Hot Water	The Audit Team reviewed the existing documentation and noted that base case boiler efficiency was reduced from 81 % to 80.5 % without an explanation. Once the Audit Team reviewed the ICF Marbek report and was satisfied with the changed baseline. Incremental cost for 1500 MBH boiler decreases compared to 1,000 MBH boiler which does not seem correct. The incremental cost anomaly is from an Agiro report from September 10, 2008 (Prescriptive Commercial Boiler Program). The Audit Team recommends using the following incremental costs: 83-84%: $ 5,850; 85-88 % $ 6,700.
Non-Condensing Boilers	Questions have been raised as to the efficacy of incentivizing any non-condensing boilers, regardless of efficiency due to the wide variability in efficiencies between models. While there is a wide range in efficiencies among the various makes and models of these boilers, most fall between 78 and 82 percent efficient. Given the baseline efficiency is in the range of 81 percent, the decision to keep incentives for efficient non-condensing boilers is appropriate. However, the incentive is small and the market for non-condensing boilers is likely to continue to shrink. The Audit team recommends this issue be carefully revisited in future. At some point, likely within 2 to 5 years, it will no longer make sense to incentivize any non-condensing boiler.

The two changes in incremental costs will not impact cumulative natural gas savings and although the changes would impact TRC values, the changes are too small to impact whether the programs screen for cost effectiveness under TRC.

Audit Recommendations: The Audit Team accepts the cumulative natural gas savings for 2012 but recommends that Union revisit the incremental costs for High Efficiency Boilers. The Audit Team also recommends that the value of providing incentives for non-condensing boilers be reviewed for the next program cycle.

3.3.3 Commercial/Industrial Custom Offering

Union Gas engaged Michaels to conduct the CPSV for C&I and Low Income Projects. Across the Wave 1 and Wave 2 review periods, Michaels evaluated a sample of 29 C&I projects.

Michaels' technical evaluation of the projects was based on rigorous and defensible approaches. The engineers carefully analyzed ex ante methodologies and in many cases used improved approaches to calculate the ex post estimates. The assumptions and calculations were based on sound judgment and reflected a solid understanding of the measures.

Technical comments posed by the Audit Team during Wave 1 and 2 audit meetings include:

- For each project, provide a detailed calculation section that describes the approaches, algorithms, and assumption used to estimate savings
- For several projects, provide additional clarification about the project details
- Review the EUL for select projects to reflect special circumstances
- Confirm the efficiency for select equipment
- Ensure consistency in approaches followed for similar projects
- Review the baseline for select projects

The parties were unable to come to resolution on all issues during the meetings, so the Audit Team requested additional project documentation to become better informed about the projects in question. Findings and recommendations for the projects are included below.

Steam Leak Project (IND 0532)

- **Initial Issue and Actions:** Michaels' original verified savings estimates for the project were far below the estimates in the project application. Because of the large variance, the Audit Team reviewed the project documentation, scrutinized calculations and assumptions, and discussed the approach with EnerNOC steam experts and Michaels.
- **Diamond's Role:** Union also suggested asking Diamond in to conduct an independent estimate of the savings for IND-0532 because of Diamond's general experience with steam leak measures and specific experience with past steam leaks on the same steam line at the same facility. Union originally expressed interest in having Diamond's analysis replace Michael's analysis because Union felt Michaels was making inappropriate assumptions and not completely using provided data. Union asked for the Audit Team's opinion. The Audit Team told Union that we would be open to reviewing Diamond's additional analysis in conjunction with Michaels' analysis, but that it would be inappropriate to disregard Michaels' findings. With all of the uncertainty around this project, the Audit Team welcomed additional perspectives but by no means was ready to ignore Michaels' work. The Audit Team reviewed Diamond's savings estimates and discussed the approach with Diamond.
- **Initial Resolution:** Union was able to provide additional customer documentation on the type and size of the failed gaskets. The gasket type identified by the customer is consistent with gaskets used in these types of steam systems. In the original analysis, Michaels had

assumed the gaskets were thinner and of the same type as identified during a different project analyzed by Diamond for the same customer in a previous program year; this was a reasonable assumption barring the additional information on the gasket type provided by the customer. Michaels revised some of the assumptions based on the new data and came up with new savings estimates. The Audit team approved the modified gasket assumption and the resulting ex post savings; these modified values were then included in Michaels' CPSV report and incorporated in Union's DSM Annual Report. It is important to mention that the Audit Team was not comfortable with the baseline assumption that leaks of this size had been present for a sustained period of time and would continue to exist unrepaired for a long period of time in the absence of the program. However, the Audit Team initially accepted the savings because of Union's significant free rider adjustment.

- **Subsequent Issue and Actions:** The AC questioned one of Michaels' comments in the CPSV report: "No distinguishable difference or reduction in gas usage could be identified during the dates associated with this project, due to variability in production." The question led to a detailed discussion of the project and reasonableness of the savings estimates. The Audit Team further reviewed the data and discussed the characteristics of the facility and circumstances around the leak repair with Michaels.
- **Subsequent Findings:** The Audit Team learned two important pieces of information during the subsequent project review: 1) The steam leaks were located within the facility (as opposed to a remote exterior location that could more easily be ignored); and 2) the customer contacted specially-trained technicians from an outside firm who fixed the leaks in a matter of days, with all indications being that a significant event occurred to precipitate the repair. The first finding makes the sustained presence of large leaks (rated 6 by the repair technician) improbable since they would be impossible to ignore. The second finding suggests the leaks reached a severe size and were dealt with right away.
- **Audit Recommendation:** The Audit Team recommends that the effective rating of the two large leaks in question be reduced from a rating of 6 to 3 (out of 10). A leak with a rating of 3 is more likely to sustain for a long period of time in absence of the program. It is quite conceivable that the leaks had been small prior to the "events" that occurred and that they may have continued to be ignored had the gaskets not further failed.

  This reduced cumulative natural gas savings value by 12,446,255 m^3 for this sample point.
- **Recommendation for future:** More detailed project documentation should be required for claiming savings to avoid having to make assumptions about unverifiable parameters that have substantial effects on the savings estimates (in this case, gasket type, thickness, and extent and duration of rupture). Photographs and physical evidence would be extremely valuable. It is also important to account for the fact that severe gasket failures of this magnitude are highly likely to be repaired immediately. Therefore, the assumption that the savings benefit associated with a severe failure accrues for the entire year represents a limitation in program rules for these types of projects unless an effective leak rating is determined to downgrade the leak to a size more likely to be ignored.

Impact of Production Increases on Baseline (IND-0251)

This project involved reprogramming and relocating thermostats. The original estimate used a CUSUM analysis with post-installation data as the baseline in an effort to account for production increases. Michaels' verified savings estimates were based on the temperature setting data supplied by the project documentation and confirmed by the customer and a correlation of gas usage with heating degree days (HDDs). The gas savings were then calculated by multiplying the percent reduction in temperature difference (delta T) due to adjusted thermostat settings by the portion of annual gas usage associated with HDDs. The correlation of gas usage with HDDs was based on pre-installation data to remove the influence of other HDD-dependent measures conducted during the same timeframe of this project (including project IND-0107). Michaels estimated that production increases (much of which occurred just prior to the project) would not have a notable influence on HDD-related gas usage.

The Audit Team reviewed the project documentation and calculations and agreed with Michaels' approach and found it is more appropriate than the ex ante approach. It isolates the HDD dependent gas usage and reasonably compares post-installation and pre-installation conditions to assess the impacts of the measure and other measures conducted during the same However, there was an error in Michaels' analysis: the delta T for the post case should use the weighted/blended value for the set temperature to account for both weekday and weekend settings (71° F) instead of 72° F, which is the weekday setting. Changing to the correct delta T will increase the annual savings to 392,080 m^3 compared to 249,505 m^3. Since the savings for this project are based on thermostat set point reductions of only a couple of degrees, a 1 degree error has a large impact, increasing annual savings by 57% in the audited vs. verified values.

The Audit Team also recommends that the EUL be changed from 20 years to 15 years because this measure involves reprogramming and relocating thermostats. Even though the thermostats have been moved out of reach to avoid tampering, the measure is essentially a "comfort heating" one, so the EUL should not exceed the EUL of commercial building controls, which, according to Union's Custom Offering EUL and Base Case Assumptions document, is 15 years.

The effects of each of these two changes are as follows:

- Impact of calculation correction <u>only</u>:
    - Annual savings: 392,080 m^3 (audited) vs. 249,505 m^3 (verified) vs. 712,243 m^3 (reported)
    - EUL = 20 years (verified and reported)
    - Cumulative savings: 3,607,136 m^3 (audited) vs. 2,295,448 m^3 (verified) vs. 6,552,636 m^3 (reported)
    - <u>Increase</u> in audited cumulative value relative to verified: 1,311,688 m^3
- Additional impact of EUL adjustment to corrected annual savings:
    - Annual savings: 392,080 m^3 (audited) vs. 249,505 m^3 (verified) vs. 712,243 m^3 (reported)
    - EUL: 15 years (audited) vs. 20 years (verified and reported)
    - Incremental <u>decrease</u> in audited cumulative value relative to verified: 901,784 m^3

- Net Impacts of both adjustments
  - Net increase in audited cumulative value relative to verified: 409,904 m^3
  - Net decrease in audited cumulative value relative to reported: 3,847,284 m^3

- **Audit Recommendation:** The Audit Team recommends the savings be changed to 392,080 m^3 and the EUL to 15 years. This increases the cumulative natural gas savings by 409,904 m^3 for this sample point.

Baseline Question (IND-0107)

This project consisted of replacing three exterior roll-up doors with high-speed roll-up doors in the same facility as project IND-0251. The Audit Team reviewed the project documentation and investigated calculations. The two projects were conducted a year apart from each other. IND-0251 (thermostats) was implemented in Jan-Feb 2011 and IND-0107 was implemented in Jan-Mar 2012. The verifier used a billing analysis approach that isolated the impacts from the two projects and removed "other" non-HDD dependent gas impacts to prevent over-counting of the savings. Specifically, in the regression analysis for IND-0107 the verifier used a baseline period of Mar-Dec 1011, which is after implementation of the thermostats (IND-0251) and before implementation of the zip doors (IND-0107). Therefore, the baseline for the zip doors includes the presence of thermostats and savings are not double-counted.

The post period for the zip doors project was Mar 2012 through Dec 2012. Since the doors were installed Jan-Mar 2012, the Audit Team found the pre- and post- installation period to be appropriate. In addition, the Audit Team found Michaels' billing analysis approach reasonable considering the availability of pre- and post-billing data. However, the team would have liked to see a comparison of the billing analysis results with estimates calculated in a manner consistent with the other zip door projects in the sample as a cross-check (e.g., the verified savings for IND-0351 were based on an ASHRAE engineering algorithm/calculator approach).

- **Audit Recommendation:** The Audit Team accepts Michaels' verified savings for this project.

Baseline for Boiler (IND 0176)

The original baseline was a tagged boiler that was in disrepair; Michaels used a well-functioning repaired boiler as the baseline. The Audit Team reviewed project documentation and investigated calculations. The Audit Team agreed with Michaels' approach. However, the efficiency used for the baseline boiler was too high for a boiler of that type (80%). A baseline boiler efficiency of 75% is more appropriate given the type of the boiler. The EUL of 25 years is reasonable for a boiler project and consistent with the treatment of similar projects.

- **Audit Recommendation:** The Audit Team recommends that the sample savings for this project be adjusted to 1,585,343 annual m^3 to reflect a baseline boiler efficiency of 75%. This increases the cumulative natural gas savings by 2,691,268 m^3 for this sample point.

EUL for Controls Programming Measure (IND-0216, IND-0168, IND-0171)

There were three projects in the sample with controls programming. The Audit Team reviewed the project documentation and studied Union's Custom Offering EUL and Base Case Assumptions document. The Audit Team recommends the maximum EUL for this type of controls programming measure be 15 years. The EUL should not exceed that for commercial building control systems, which, according to Union's Custom Offering EUL and Base Case Assumptions document, is 15 years.

- **Audit Recommendation:** Since the building automation system for IND-0216 was already five years old, the Audit Team discounted the EUL by 5 years to yield a 10 year EUL. This decreases the cumulative savings by 1,197,757 m^3 for this sample point.
- **Audit Recommendation:** The EUL for IND-0168 and IND-0171should be 15 years. This increases the cumulative savings by 2,994,297 m^3 for these sample points.

Discrepancy between Audited Calculations and Verification Report (IND-0188)

This project involved the repair of a backpressure steam turbine that was leaking excessive amounts of steam. According to Michaels' CPSV report: "No calculations were provided with the [reported savings] analysis, however, a report from the customer was provided that listed the claimed savings. In the provided files however, a description is given that [states] that system runs on gas 65% of the time." In the verifier's preliminary Wave 1 report, the savings were calculated with this assumption of 65%. Not knowing this project was related to the IND-0532, the Audit team approved of the annual gas savings of 1,087,308 m^3 based on the 65% estimate.

In the final CPSV report, Michaels' description of the project including the assumption that they system runs on gas 65% of the time was the same, but the calculated savings provided as final verified savings were higher than what was agreed upon during the audit process. There was no explanation for the change. The Audit Team subsequently reviewed the final calculation file delivered with the final report and found a note that indicated the steam turbine system was located in the same facility as project IND-0532. IND-0188 was completed in Dec 2011, while IND-0532 was completed in May 2012. In the modified calculations, Michaels had increased the percentage from 65% to 80%. The 80% value is consistent with the detailed data provided for IND-0532.

Specifically, during the verification of IND-0532 (steam leak repairs), the verifier used daily steam production data to calculate the share of steam savings that would result in gas savings. This analysis yielded the value of 80%. This value arises because the gas boilers are used as "lag" boilers and modulate based on the load conditions. So, steam savings would first reduce steam generated in gas boilers and then would reduce steam produced in waste boilers. Therefore, if the steam savings exceed the amount produced by gas boilers, some of the savings would be realized by the waste boilers. The analysis of daily steam production data showed that 80% of steam savings from leak corrections would impact the gas boilers, while the other 20% would impact the waste boilers. This value of 80% was used to correct the 65% assumption originally used for IND-0188.

- **Audit Recommendation:** The Audit Team accepts the modifications to the verified savings.

Discrepancy between Audit and Verification Calculations (Decimal Points)

When calculating the annual gas savings Michaels used 3 significant decimal points whereas the reported savings were rounded to zero decimal points. This approach resulted in different cumulative gas savings when reported and verified annual savings appeared identical. The impact of using this approach was a 0.5% increase in cumulative savings.

- **Audit Recommendation:** The Audit Team accepts the verified savings for these project but recommends using zero decimal places in annual gas savings to match original values in future studies.

The overall impact of these changes on the cumulative natural gas savings for the sample is a decrease of 7,548,543 m^3. The Audit Team will determine the impact on the Resource Acquisition cumulative natural gas savings and DSM incentives and on LRAM of all these changes once Union has Navigant determine the population realisation rate based on updated sample estimates.

Appendix E shows the annual and cumulative savings and EUL by project for reported, verified and audited.

3.3.4 Deep Savings – Commercial/Industrial

The Audit Team reviewed how Union calculated C/I deep savings from the database of projects. The following steps were taken to calculate these savings.

- Review all eligible C/I custom projects in 2012
- Include prescriptive project savings where appropriate
- Weather normalize 2012 savings from commercial projects
- Compare to 2011 consumption (weather normalized for commercial projects)
- Calculate 2012 normalized annual gas savings
- Calculate percentage of 2012 annual gas savings compared to 2011 consumption

The auditor used the Audit Tool, with assistance from Union staff to follow the flow from the original dataset to the C/I Deep Savings worksheet, and reviewed the weather adjustments and calculation of percentage savings. The metric does not include results from new construction custom projects since there is no consumption history. As the audit tool did not identify whether custom projects were new construction, Union provided a list of the new construction custom projects and associated savings to enable checking the calculations for the metric.

The auditor was able to replicate the deep savings percentage based on the verified results.

4.0 Low Income

In 2012, Union's Low-Income single family offerings consisted of a standalone basic measure offering and a building envelope offering (Helping Homes Conserve). In Q2 2012 Union introduced a social and assisted housing offering (Affordable Housing Conservation) for the multi-family market which provides municipalities and social and assisted housing owners with enhanced incentives on all multi-family prescriptive and custom measures currently offered in the Commercial/Industrial Program.

The Audit Team reviewed three verification studies conducted by Union.

- Beslin Communications Group Inc. telephone verification for the HHC offering (An Audit of the Union Gas ESK – Helping Homes Conserve – HHC – Program Low-income Initiative [Mar 15, 2013])
- SeeLine Group Ltd. conducted an on-site verification of the Free Showerhead Installation initiative; Verification Results: 2012 Low Income Free Showerhead Installation Initiative (Multi-family) [Apr 19, 2013])
- Michaels conducted the custom project savings verification for all 12 projects completed in 2012. Union Gas 2012 Commercial and Industrial and Low Income Project Verification Final Report [May 2013]

4.1 Helping Homes Conserve

The Audit Team found that the adjustment factors from the Beslin verification report were correctly applied in the Draft DSM Report.

4.2 Free Showerhead Installation

The Audit Team found that the adjustment factors from the Seeline verification report were correctly applied in the Draft DSM Report.

4.3 Custom Projects Savings Verification

The verification study made a slight adjustment to the low income projects (less than 1% difference), however, verified annual gas savings were calculated to 3 significant decimal points whereas the reported savings were rounded to zero decimal points. This approach resulted in different cumulative gas savings when reported and verified annual savings appeared identical. The auditor calculated savings using zero decimal points which increased savings by only 14 m^3 with no change in the realization rate.

- **Audit Recommendation:** Accept verification findings for low income for 2012 and recommend that future verification studies use the same rounding factor for verified and reported results.

EUL for Window and Door Replacement (COM-0103, COM-0116, COM-0274, COM-0277)

Michaels increased the EUL from 20 to 22 years for four projects. One of Michaels' explanations for the increase was a literature review that "indicated an expected life of between 20 and 25

years" (p. 10), but Michaels did not cite the literature review findings or provide an explanation in the project description. Another explanation for the increase was to be consistent with a "Union Gas measure life table provided." However, the only table we could find related to this type of measure was in a 2009 Navigant report and it lists an EUL of 20 years.

The Audit Team studied Michaels' project documentation and researched a few other sources for approved EUL values, including reviewing the EULs recently approved for energy efficient windows by the Regional Technical Forum (RTF). (The Audit Team's research did not constitute an exhaustive literature review because that would have been beyond the scope of work.)

The Audit Team found the RTF has approved (July 18, 2013) a EUL of 25 years for energy efficient windows applied to manufactured homes and 45 years for single family homes, so the range of 20-25 years is not unreasonable.

- **Audit Recommendation:** The Audit Team accepts the EUL of 22 years and suggests further study of EULs for new windows.

Appendix F provides a table with original savings, verified savings, and audit savings for each custom low income project completed in 2012.

5.0 Large Industrial Rate T1/100

Union Gas engaged Diamond to conduct the CPSV for Large Industrial (Distribution Contract) Projects. A total of 17 projects were evaluated across the Wave 1 and Wave 2 review periods. This sample of projects represents roughly 70 million m^3 of annual natural gas savings, with EULs ranging from 1.65 years for heat exchanger cleaning to 30 years for a steam leak repair.

Diamond did a good job conducting analysis of the Large Industrial projects in a technically sound manner. In cases where data were lacking, they made reasonable assumptions that were clearly indicated in analysis procedures. They also presented the results with error bounds, reflecting the inherent uncertainty associated with these types of estimates. Reports were thorough and easy to follow. The calculations were clearly presented in tabular form and include the formulae and assumptions used. Overall documentation was clear, concise and professional.

Many of the projects reviewed were similar in nature and Diamond generally followed the approach used in the initial application to estimate ex post results. Given consistency with ex ante approaches, they developed realization rates very close to 100 percent for most projects.

The Audit Team requested only minor clarifications and modifications during the Wave 1 and Wave 2 CPSV reviews of the Large Industrial projects. In general, the approaches followed were clearly presented in the report, with only a few projects requiring additional clarification. Examples of technical comments posed during Wave 1 and 2 audit meetings include:

- Provide consistency between calculation approaches used in separate, but similar, projects (e.g., heat exchanger projects)

- Provide site specific data to support EUL adjustments
- Revise the base case to include a degradation factor (one project)
- Explain the approach for estimating electrical savings
- Use common engineering terminology for project descriptions, rather than terminology used by personnel at the site
- Review the actual steam trap leakage rates in original application documents and update the verified savings calculation (one project)

Diamond satisfactorily incorporated the Audit Team's comments in the final CPSV report for Large Industrial projects. However, they provided a high and low estimate for annual gas savings for six of the 17 projects reviewed. The average of the range was used to calculate cumulative gas savings. As some ranges were asymmetrical, some estimates of cumulative gas savings were not based on the estimate that the verifier reported. These numbers were provided to Navigant to calculate population savings. The Audit Team reviewed the impact of using the point estimate on the sample realisation rate and cumulative natural gas savings. The result was to decrease the realisation rate by less than 0.01% and cumulative savings by 0.4%. It is not likely that this change would have any material impact on the population realisation rate.

- **Audit Recommendation:** Accept the verification findings but in future use the point value calculated by the verification consultant to determine population-level impacts

One important limitation in Diamond's approach relates to how the engineers handled certain assumptions. Specifically, in a couple of cases (e.g., steam leaks and heat exchanger cleaning projects) they used disclaimers to indicate that the baseline assumptions may yield overstated savings. In the cases in question, the assumptions were carried over from the reported savings estimates. Instead, the Audit Team recommends in the future that the verifier attempt to gather as much additional baseline information from the customer as possible during the verification visit to enable better definition of these types of baseline assumptions. Along these lines, two topics associated with Firm 1's verified savings require additional explanation:

Approach for Analyzing Measures with Performance Degradation

- **Catalyst replacement (IND-0152):** The project involved replacing a catalyst. Catalysts degrade over time to a point where they stop working. At that point, the baseline can be considered to be essentially fixed, whereby the reactor requires a higher process temperature to function as required. When the catalyst is replaced the efficiency of the process improves; however, this improvement degrades over time as the catalyst loses effectiveness until it reaches the point where it must again be replaced. If degradation is assumed to occur at a linear rate, the savings over the EUL of the project can be estimated as 50% of the savings immediately upon catalyst replacement. Diamond originally estimated the savings assuming they would not degrade over the EUL. The Audit Team recommended the savings be adjusted to account for degradation. Diamond agreed and modified the savings for inclusion in their final CPSV report.

- **Heat exchanger cleaning (IND-0057, IND-0151, IND-0153):** These projects involved cleaning heat exchanger surfaces. Over time, heat exchangers lose heat transfer effectiveness as material deposits on their surfaces (known as fouling). Left un-cleaned, the material continues to deposit and the performance continues to degrade. Thus, the baseline condition is an un-cleaned heat exchanger with constantly decreasing effectiveness. Once the heat exchanger surfaces are cleaned, the effectiveness of the heat exchanger is reset to some maximum value. However, prior to the next cleaning period, the effectiveness of the cleaned heat exchanger (the efficient case) also degrades over time. Therefore, the baseline is a relatively more fouled heat exchanger, with decreasing efficiency, within a range of accepted tolerance. The efficiency case is a relatively cleaner heat exchanger, with decreasing efficiency, within an accepted tolerance range. The range of tolerance for fouling and the cleaning cycle period can be considered smaller for the efficient case than for the baseline case. Thus, the efficient case saves energy relative to the baseline for the life of the efficient case's cleaning cycle (which is the EUL). The time between cleanings is determined by the customer and is a function of factors such as production and tolerance for reduced performance and higher energy costs. For these projects, the program can be viewed as influencing the time between cleanings and, thus, shortening this time because incentives make the cleaning more cost-effective and program information brings this measure to the customer's attention.

  The challenge with heat exchanger cleaning projects is defining the baseline condition. The net savings for the project due to the program should only reflect the additional savings achieved by encouraging the customer to clean the heat exchangers sooner rather is standard practice. The savings should not be the total savings achieved from cleaning an overly fouled surface, since a portion of those savings would have been realized in absence of the program when the customer eventually got around to cleaning the surfaces.

  For the projects in the CPSV sample, the baseline condition was not clearly defined. From what the Audit Team could determine, no data was collected by Union or the verifier to estimate the degree of fouling that would have been tolerated in the absence of the program. During a conversation the Audit Team had with the verifier, the verifier stated that Union told him the baseline was a heat exchanger that would not be cleaned. Therefore, he calculated the maximum savings for the measure in each facility. This would be the best case scenario; the worst case scenario would be that the incentive did not change the cleaning schedule and no savings were achieved. The Audit Team thinks a more reasonable approach would be to take the average of the two scenarios and reduce the savings estimates by 50%.

- **Audit Recommendation:** The Audit Team recommends reducing the annual savings by 50% for IND-0057, IND-0151, and IND-0153. This reduces the cumulative natural gas savings (m^3) for each sampled project by 2,518,040, 2,112,550, and 1,569,520 respectively. The Audit Team also recommends that Union require detailed documentation of the baseline condition, i.e. the customers practice for cleaning heat exchangers, for future heat exchanger cleaning projects.

IND-0030 involved 342 steam leak repairs and IND-0241 involved 119 steam leak repairs. The applications for both projects estimated the EUL to be 20 years. Diamond updated the EULs to 30 years to reflect the specific conditions at the sites. The rationale was that the customers each have thousands of pipe connections in their facilities and if every pipe connection were to leak every 20 years, it would be necessary for each customer to repair over 10 thousand leaks per year, as opposed to the hundreds of leaks included in the project applications. The verifier's point about the vast number of pipe connections is to illustrate how it is unlikely these repairs would only last 20 years in these two types of facilities. If the repairs were needed every 20 years, conceivably they would be asking for incentives to repair even more leaks. Based on this logic, the increase to 30 years is conservative, since the facilities would still require thousands of repairs each year if the repairs only lasted 30 years. Moreover, the customers consistently correct misalignments and other causes of leaks in a workmanlike manner, thereby increasing the expected EUL of leak repairs. The Audit Team agreed with Diamond's EUL increase based on the types of facilities (well-maintained refineries) and Diamond's rationale.

- **Audit Recommendation:** Accept the verifier's EUL increase to 30 years.

In terms of the baseline for these projects, the verifier states: "All estimated savings figures as given are a rate, not a quantity. All calculations are based on the hourly savings rate multiplied by the appropriate working hours per year. In other words, even if the Base Case condition occurred for less than a year, the savings resulting from the Project as presented in the Higher Efficient Option will always be viewed as having occurred for one full year." The Audit Team determined that this approach has been the standard procedure in past program years.

Some factors influencing the duration of a leak could include the following:

- *Location:* Steam leaks in exterior locations at facilities spanning large areas are more likely to go undetected and/or unrepaired for longer periods of time than leaks in interior locations. Further, some leaks can be located in difficult positions making repair a significant challenge, such as in elevated pipe racks where scaffolding has to be erected to fix the leak.
- *Severity*: Smaller leaks are more likely to go undetected and/or unrepaired for longer periods of time than larger leaks.
- *Maintenance culture*: Leaks at facilities with less rigorous maintenance protocols are more likely to go undetected and/or unrepaired for longer periods of time than at facilities conducting regular inspections and maintenance. Many facilities have reduced or eliminated routine inspections because given historical gas prices in the past twenty years, the labor costs exceed any energy savings.

- **Audit Recommendations:** Additional information on baseline conditions should be collected in the future to help assess the program's influence on steam leak repairs. The Audit Team also recommends the baseline approach be reviewed with the Technical Evaluation Committee to determine if and when extrapolation to an annual baseline is a reasonable assumption for steam leaks.

Appendix F shows the original project results, the verification findings, and the audit findings for all custom projects in the sample.

6.0 Market Transformation

The only program involved in Market Transformation is the Optimum Home Program (formerly New Home Efficiency. The program is designed to accelerate residential home builder's energy efficiency practices such that they are ready and capable of building homes that meet an increased minimum efficiency standard expected in the next release of the Ontario Building Code (OBC) in 2017. The program engages builders in a three year consulting process to build homes to a higher level of energy efficiency. This program targets the top fifty builders in Union's franchise area (based on 2011 housing starts). The "top builders" is based on the number of housing starts in Union's franchise area in the prior calendar year. The metric results represent the number of home builders that participated in the Optimum Home Program by signing a Participation Contract within the program year.

The Audit Team reviewed the work Union has completed to show progress on its Market Transformation Program. We reviewed the program logic model and the metrics used to measure program performance. In 2012 Union relied on two metrics to measure performance: (1) the number of participating builders as tracked by the program in the top 10, and (2) the number of participating builders as tracked by the program in the top 50.

6.1 Review of Logic Model

The logic model and the metrics focus solely on builders. While the Audit Team agrees that builders should be the top priority, the goal of the program is to transform the entire market. We recommend conducting additional marketing and outreach directed at homeowners. Examples of marketing/outreach could include consumer brochures describing the benefits of the New Home Efficiency Program, detailed fact sheets about the typical features found in qualified homes, public service announcements publicizing the program and its partners, and local consumer outreach featuring participating builders. Increasing homeowners' awareness of the program could be an additional metric to track. This would involve a baseline survey followed by annual surveys measuring any increase in homeowner awareness.

6.2 Review of Top Builder List

The Audit Team reviewed the Top Builder List to verify the information provided on the Market Transformation Scorecard. The Top Builder's List is compiled from Union's CARS (Construction Administration Records System) database. The system coordinates Union's construction activities and associated record keeping, including gas service details, contact information and construction information. Separate software called "Discoverer" is then used to query the CARS database to obtain the required information for the Top Builder List.

The Top Builder List is an Excel workbook containing a spreadsheet of builders ranked by number of total services. There are additional spreadsheets, one for each builder, which provides data on each new construction project. A single family home is counted as one

service, and multifamily homes are counted as multiple services -- one service per address. The number of services and each builder's rank was audited and no errors were found.

6.3 Review of Builder Contracts

Contracts were provided for 11 builders. They were all signed and the dated in 2012 – the program year. Three of the contracted builders were in the top 10, and 8 were in the top 50. This differs from the Draft DSM Report because Union updated the number of services with actual data. The draft report noted 4 builders in the top 10, 7 in the top 50.

The Audit Team recommends changing the number of builders in the top 10 to 3 and the number in the top 50 to 8. This reduces the DSM incentive in the Market Transformation Scorecard by $16,521.

7.0 Financial Calculations

The Audit Team reviewed the results of Scorecard, LRAM, and DSMVA calculations as presented in the Draft DSM 2012 Annual Report.

7.1 Scorecards

The auditor confirmed that all the calculations were correct and that the approved approaches were applied.

7.2 LRAM

As per the Settlement Agreement (p. 34), Union calculated LRAM on a monthly basis using the volumetric impact of the measures implemented in that month. This approach ensures that LRAM amounts closely reflect the actual timing of the implementation of the DSM measures. The auditor confirmed the LRAM calculations were done correctly.

7.3 DSMVA

The DSMVA is calculated by subtracting DSM spending from the allocated DSM budget. Union may recover excess spending, up to 15 percent of the OEB-approved budget (Settlement Agreement, p. 35). In addition the following transfers can be made across budget items:

(1) Budget remaining from the DWHR Program must be credited to the DSMVA (p. 11)

(2) Budget remaining from Evaluation must be credited to the DSMVA (p. 11)

(3) Up to $300,000 can be transferred to C/I Program Incentive, Promotion, and Admin without impacting the targets (pp. 19-20)

(4) Budgets can be transferred across rate classes (p. 22)

As part of the discussion of the draft report Union provided more details on the DSMVA calculations. The original table in the draft annual DSM report was not clear about budget overspent and under-spent amounts. Union updated the table to provide a clear summary of the calculations. The Audit team reviewed and accepted the final table. Table 12 summarizes Union's DSM-related budget and spending for 2012 and transfers across budget items based on the four categories above. As shown in the final row, the DSMVA for 2012 is $368,119.

Table 12 Review of Budget and Spending and DSMVA Results

	2012 Budget	2012 Spending	Difference	Transferred Across Budget Items	Total DSMVA
Resource Acquisition Scorecard					
Residential program Incentive, Promotion & Admin (4)	$3,232,791	$3,022,503	($210,288)	($210,288)	$0
Residential Evaluation (2)	$20,000	$31,190	$11,190	$0	$11,190
Commercial/Industrial Program Incentive, Promotion & Admin (4)	$10,509,385	$11,054,473	$545,088	$388,573	$156,515
Commercial/Industrial Evaluation (2)	$60,000	$81,363	$21,363	$0	$21,363
IEMS (3)	$600,000	$178,458	($421,542)	($300,000)	($121,542)
Large Industrial Rate T1/Rate 100 Scorecard					
Large Industrial Rate T1/Rate 100 Incentive, Promotion and Admin	$4,622,475	$5,005,746	$383,271	$0	$383,271
Large Industrial Rate T1/Rate 100 Evaluation	$40,000	$37,549	($2,451)	$0	($2,451)
Low-Income Scorecard					
Low-Income Incentive, Promotion & Admin	$6,993,874	$7,513,842	$519,968	$0	$519,968
Low-Income Evaluation	$40,000	$188,205	$148,205	$0	$148,205
Market Transformation Scorecard					
High Efficiency Residential New Build Incentive, Promotion & Admin (4)	$852,974	$434,823	($418,151)	($255,000)	($163,151)
PROGRAMS SUBTOTAL	**$26,971,499**	**$27,548,152**	**$576,654**	**($376,714)**	**$953,368**
DWHR Sunset[10] (1)	$550,000	$477,142	($72,858)	$0	($72,858)
Research	$788,194	$770,057	($18,137)	($18,137)	$0
Evaluation (2)	$969,000	$489,102	($479,898)	$0	($479,898)
Administration	$1,675,405	$2,037,763	$362,358	$394,851	($32,493)
PORTFOLIO SUBTOTAL	**$3,982,599**	**$3,774,064**	**($208,535)**	**$376,714**	**($585,249)**
TOTAL	**$30,954,098**	**$31,322,216**	**$368,119**	**($0)**	**$368,119**

[10] Union discontinued the Drain Water Heat Recovery (DWHR) program in 2012.

8.0 Audit Recommendations

This section present a summary of audit recommendations, general recommendations related to the CPSV review, and a summary of key issues and resolutions.

8.1 Summary of Recommended Changes

- As recommended in the last audit, when survey respondents do not know whether they have a natural gas water heater, Union should assume they do not until the TEC is able to address this issue.
- Include all formulas in the Audit Tool if they cannot be directly verified in the verification report.
- For Residential Home Retrofit savings, Union should collect information on age and efficiency of furnaces replaced to help assess the validity of using a 20 year EUL for all participating homes.
- Union should include a description in the annual report about the adjustment for the second showerhead in the Free Showerhead Installation program.
- Union and Enbridge should revisit the incremental costs for High Efficiency Boilers.
- In future, CPSV verification consultants should use zero decimal places in annual gas savings to match original values in future studies.
- Change the EUL for the Industrial Control Programming measure from 20 years to 15 years to match the value used for Commercial Controls Systems.
- Change the baseline efficiency for a repaired boiler to 75% to reflect the age of the boiler.
- Correct the change in temperature for one control measure used to reflect the weighted/blended value for the ex-post savings.
- Reduce the rating of the steam leak for the largest C/I project to reflect the appropriate severity of the leak.
- Reduce the savings for heat exchangers in Large Industrial Rate T1/100 by 50% to account for the uncertainty around baselines.

8.2 General CSPV Recommendations

This section provides general recommendations to help improve the savings estimates for custom projects and improve the process.

Develop better EULs for controls settings. Union should continue to investigate how best to handle EULs for controls settings in commercial and industrial settings and provide clear and consistent guidelines. Two useful sources for information are:

- Glossary of Terms and Acronyms Version 2.1 developed for the Regional EM&V Forum, Northeast Energy Efficiency Partnerships[11]; and,
- Chapter 13: Assessing Persistence and Other Evaluation Issues Cross-Cutting Protocols, Uniform Methods Project: Methods for Determining Energy Efficiency Savings for Specific Measures, National Renewable Energy Laboratory.

Require specific information to be collected for projects of the same type. Since many custom projects are similar, including insulation repair, steam leak repair, and steam trap repair, Union should require specific information be collected before repairs are started. This could be easily incorporated into any scope of work associated with these projects and make estimating energy savings simpler and more accurate. Specific "before" measurements could include:

- For all pipe insulation projects, have a before/after analysis conducted. Before should be based on measured temperature at the outer surface of the insulation, or a thermographic image of the insulation.
- For all steam leak projects, require customers to estimate individual leaks by recording plume size and ambient temperature during plume measurement. Alternatives are thermographic imaging or ultrasonic measurement.
- Steam trap surveys could include infrared pictures or analysis with an ultrasonic meter. More details on baseline conditions should also be collected for operation and maintenance measures, such as steam leak repairs and heat exchanger cleaning, to enable more accurate estimation of the portion of savings attributable to the program.

The Union Gas calculators are acceptable tools, but vendors' energy savings calculators should not be used as the basis for rebates unless independently verified. Union Gas developed eight calculators for use in assessing savings. The Audit Team briefly reviewed the calculators by following the code and found that the calculations are transparent in those tools. The Audit Team also found instances where vendor calculators were used to develop savings. Vendor calculators include spreadsheets or other packaged calculators that take a few inputs and output expected savings. The source code and calculation methods are often not

[11] **Measure Life** - The length of time that a measure is expected to be functional. Measure Life is a function of equipment life and measure persistence (not savings persistence): 1) Equipment Life means the number of years that a measure is installed and will operate until failure; 2) Measure Persistence takes into account business turnover, early retirement of installed equipment, and other reasons measures might be removed or discontinued. Measure Life is sometimes referred to as expected useful life (EUL). **Equipment Life** - The number of years that a measure is installed and operates until failure. **Measure Persistence** - The duration of an energy consuming measure, taking into account business turnover, early retirement of installed equipment, and other reasons measures might be removed or discontinued. **Savings Persistence Rate** - Percentage of first year energy or demand savings expected to persist over the life of the installed energy efficiency equipment; developed by conducting surveys of installed equipment several years after installation to determine presence and operational capability of the equipment.

transparent; their purpose is to sell a particular product, not to accurately determine energy savings and thus they are often wildly optimistic.

Clarify CPSV Roles for the Verification Consultants and Auditors. The CPSV has changed considerably since the OEB directive to verify five projects a year. The focus moved from desk review to more on-sites, sampling became complex, the sample increased, and consultants verify projects in two waves to help timeliness of reporting. For 2012 a new approach to CPSV was introduced along with new sampling methodology for the new framework. The auditor now reviews draft findings from each wave with verification consultants before CSPV reports are finalized, and CPSV reports are shared with the AC Team. There is confusion about roles of CPSV verification consultants and the auditor[12]; some verification consultants refer to their work as audits. Verification is generally done at two levels: project-level Measurement and Verification (M&V); and program-level Evaluation, Measurement and Verification (EM&V). Project-level M&V is often done as part of program implementation for quality assurance. EM&V (or evaluation), which includes stringent independent M&V at the project level all the way up to the program level, is done at the end of the program year or cycle and often takes six months or longer. There is not enough time between end of program year and the CPSV report deadline to conduct a complete evaluation, yet there is a need for some evaluation, given the impact of the savings on the DSM incentive. The Audit Team sees the most practical CPSV role as balancing simple verification with limited measurement (project-level M&V) for less complex projects with more comprehensive M&V (project-level evaluation) for complex projects.

- **Simpler verification for projects conducted in the program year.** Verify installation and operating conditions and update assumptions with better data and limited measurement.
- **More comprehensive evaluation for projects carried over from the previous program year to allow more time to evaluate[13].** Include a greater degree of billing analysis and independent estimation approaches.
- **Require more details on baselines for projects of a certain savings level.** Union should require the customer to provide more detailed information on the base case for custom projects of a certain absolute savings size (e.g. 1 million m^3) to better quantify conditions before and after the measure's implementation. Union could involve an evaluator at pre-implementation stage for these projects to review savings calculations and assumptions, determine baseline, and set up an M&V plan for data collection.

[12] Auditor in particular has multiple definitions, for example: visits home, office, or plant to assess potential savings; inspects whether equipment is installed and operating; and reviews financial calculations and records.
[13] Union has been moving in this direction by carrying some complex projects into the following year.

8.3 Summary of Issues

The table below outlines the key issues where there were differences of opinion during the audit process and how these were resolved.

Table 13 Issues Raised During the Audit and How Addressed

Issue	Resolution
Degradation	Audit recommendation is to accept Diamond's treatment of degradation for catalyst replacement and heat exchanger cleaning. A detailed explanation is provided in Section 5.0.
Heat exchangers	Audit recommendation is to decrease the verified savings for heat exchanger cleaning projects. A detailed explanation is provided in Section 5.0.
Steam leak	Audit recommendation is to reduce the effective rating of the two large steam leaks, thereby decreasing the gas and water savings. A detailed explanation is provided in Section 3.2.2.
Baseline for residential furnaces	Estimated EUL of furnaces accounting for baseline efficiency and advancement. Audit recommendation is to collect data on age and efficiency level of replaced furnaces to improve the estimate of EUL for Home Retrofit savings.
Non-Condensing Boilers	Obtained and reviewed studies done for Enbridge to support savings estimates for these measures. Audit recommendation is to review incremental costs and the value of providing incentives in future program cycles.
Role of the auditor in the CPSV review	Assess the reasonableness of the Verification Consultant's analysis and reporting. Only review original project files when parties are unable to come to resolution during the Wave meetings.
ESK door-to-door approach	Refer the issue to the Technical Evaluation Committee.

Appendix A– List of Documents Reviewed

Topic Area	Document
Verification Studies	An Audit of the Union Gas ESK – Residential-Push Initiative [Mar 15, 2013]
	An Audit of the Union Gas ESK – Residential-Pull Initiative [Mar 15, 2013]
	An Audit of the Union Gas ESK – Residential Replacement Initiative [Mar 15, 2013]
	An Audit of the Union Gas ESK – Residential Program Door-to-Door Drop-off Initiative [Mar 15, 2013]
	An Audit of the Union Gas ESK – Helping Homes Conserve – HHC – Program Low-income Initiative [Mar 15, 2013]
	An Audit of the Union Gas ESK – Residential Program Install Initiative [Mar 15, 2013]
	Verification Results: 2012 Low Income Free Showerhead Installation Initiative (Multi-family) [Apr 19, 2013]
	Verification Results: 2012 Commercial Hot Water Conservation Initiative (Multi-family) [Apr 19, 2013]
	Verification Results: 2012 Commercial Hot Water Conservation Initiative (Non Multi-family) [Apr 19, 2013]
	2012 Evaluation of Distribution Contract Custom for Union Gas [Mar 28, 2013]
	Union Gas 2012 Commercial and Industrial and Low Income Project Verification Final Report [May 2013]
	Terms of Reference: 2012 Industrial and Large Industrial Custom Project Savings Verification [Sep 6, 2012]
	Terms of Reference: 2012 Commercial Sector Custom Project Savings Verification [Sep 6, 2012]
CPSV Sampling	A Sampling Methodology for Custom C&I Programs [Nov 12, 2012]
	Evaluation Findings for 2012 Union Custom Projects [May 8, 2013]
Previous DSM Reports	Demand Side Management – 2011 Annual Report [Jun 29, 2012]
	Demand Side Management – 2011 Annual Report [Jun 29, 2011]
Draft 2012 DSM Report	Demand Side Management – 2012 Annual Report (Draft) [May 10, 2013]
	Demand Side Management – 2012 Annual Report Appendices (Draft) [May 10, 2013]
Background	EB-2011-0327 Union Gas Ltd. Settlement Agreement [Jan 31, 2012]
	Demand Side Management Guidelines For Natural Gas Utilities EB-2008-0326 [Jun 30, 2011]

Topic Area	Document
	Decision on Interim Approval of Union Gas' 2012-2014 Demand Side Management Plan [Nov 16, 2011]
Spreadsheets	Audit Tool 2012 for Auditor
	Spreadsheet of calculations of verification adjustments for MURB showerheads in second bathrooms.
	Spreadsheet of 2012 New Construction Custom Projects
	Dataset of Major Measures Installed through Home Retrofit 2012
Measure Assumptions	Application for New and Updated DSM Measures [Dec 19, 2012]
	2011 Demand Side Management Plan – New Measures for the 2011 Program Year [Feb 8, 2012]
	2010 Demand Side Management Plan – Revised 2010 DSM Measure – Post the Audit of Union's 2009 DSM Annual Report [Mar 14, 2011]
	Measures and Assumptions Demand Side Management (DSM) Planning. Appendix C: Substantiation Sheets [Apr 16, 2009]
	Ozone Laundry Substantiation Document
	Commercial Hydronic Boiler System Baseline Study [Sep 16, 2011]
	Natural Gas Technologies Centre DSM Opportunities Associated with Ozone Laundry Treatment (for Hospitality and Health Care Facilities) , Nov 25, 2009
	Final Report DSM Ozone Laundry_calculator – Redacted (xlsx)
	Final 2012 Input Assumption Table (xlsx)
	Seeline Group, Union Gas Boiler Base Case Efficiency Study, Final Report, Jan 30, 2009.
	Enbridge Gas Distribution: Prescriptive Commercial Boiler Program Prescriptive Savings Analysis (Base Case Boiler Update) [Nov 8, 2012]
	Enbridge Gas Distribution: Prescriptive Small Commercial Boiler Program Prescriptive Savings Analysis (Condensing Boilers Under 300 MBH), Final Report 2012 Update, Oct 19, 2012
	NY Home Performance with ENERGY STAR® Effective Useful Life of Energy Efficient Measures, Revised August 2012. http://credit.csgrp.com/webapps/nyserda/InstructionManuals/7.8%20Effective%20Useful%20Life%20of%20Measures.pdf
Other Union Documents	Amended Table 4.7 (C/I Program Results)
	2012 Spend and Budget Summary Table
	Logic Model – NHEP – 110930 (ppt)
	Union Tracking System Processes and Procedures, Tracking Forms, and Application Forms

Appendix B– Key Meetings

Date	Purpose	Union Gas	AC Members	EnerNOC	Verification Firm
5-Feb	CPSV Review (Wave 1)	L. Kulperger		J. Murphy	J. Clarke, Diamond Engineering
		T. Nicholson		K. Parmenter	
		P. Koepfgen		G. Cook	
12-Mar	CPSV Review (Wave 1)	L. Kulperger		J. Murphy	R. Kroll, Michaels Energy
		T. Nicholson		K. Parmenter	C. Hanson, Michaels Energy
		P. Koepfgen			
		E. Dibaji			
22-Mar	CPSV Review (Wave 2)	L. Kulperger		J. Murphy	J. Clarke, Diamond Engineering
		T. Nicholson			
23-Apr	CPSV Review (Wave 2)	L. Kulperger		J. Murphy	R. Kroll, Michaels Energy
		T. Nicholson		K. Parmenter	
		P. Koepfgen			
		T. Marentette			
26-Feb	Kickoff Meeting	L. Kulperger	J. Girvan	G. Cook	
		T. Nicholson	K. Millyard	C. Williamson	
			J. Shepherd		
12-Jun	Audit Discussion	L. Kulperger	J. Girvan	G. Cook	
		T. Nicholson	K. Millyard	K. Parmenter	
		E. Buan	J. Shepherd	J. Murphy	
20-Jun	Audit Discussion	L. Kulperger	J. Girvan	G. Cook	
		T. Nicholson	K. Millyard		
			J. Shepherd		
3-Jul	Audit Discussion	L. Kulperger	J. Girvan	G. Cook	
		T. Nicholson	K. Millyard	C. Williamson	

Date	Purpose	Union Gas	AC Members	EnerNOC	Verification Firm
		T. Marentette	J. Shepherd	K. Parmenter	
				J. Murphy	
9-Jul	Audit Discussion	L. Kulperger	J. Girvan	G. Cook	
		T. Nicholson	K. Millyard		
15-Jul	Audit Discussion	L. Kulperger	J. Girvan	G. Cook	
		T. Nicholson	K. Millyard		
			J. Shepherd		
22-Jul	Audit Discussion	L. Kulperger	J. Girvan	G. Cook	
		T. Nicholson	K. Millyard		
			J. Shepherd		
7-Aug	Audit Discussion	L. Kulperger	J. Girvan	G. Cook	
		T. Nicholson	K. Millyard		
		E. Buan	J. Shepherd		
		E. Dibagi			
16-Aug	Audit Discussion	L. Kulperger	J. Girvan	G. Cook	
		T. Nicholson	K. Millyard	K. Parmenter	
			J. Shepherd	J. Murphy	

Appendix C: Review of Tracking & Reporting Procedures

This appendix documents findings from the Audit Team's review of tracking system procedures for Union's different types of programs. The task involved examining Union's 2012 program tracking procedures and requesting and reviewing samples of data maintained on each program.

Union provided an Excel Spreadsheet, called the Audit Tool, to help the auditor:

- Compile and organize relevant data from the tracking database (DSMt),
- Review application of adjustments such as realisation rates and installation and retention rates of measures
- Review Scorecard calculations for Resource Acquisition, Low Income, Large Industrial Rate T1/R100, and Market Transformation,
- Trace the calculation of Deep Savings for Residential and C/I,
- Review LRAM calculations.
- Review Settlement agreement and input assumptions document to ensure they are consistent with the audit tool, and,
- Evaluate other data-related concerns raised by the AC.

The Audit Team also requested and reviewed data tracking procedures provided by Union Gas and requested and reviewed either a sample of data for each program or reviewed all results.

Overview of Tracking System

Union Gas uses two 2003 Windows web-based proprietary applications, DSMt and AIMS; both interact with Banner and use Crystal Reports to pull data from the applications. The following describes these components, their respective functions and how they are connected.

- *Banner* is Union's (CIS) customer information and billing system that is used to store current customer information including rate class and historical consumption.
- *DSMt* is a custom 2003 Windows web-based database run using Oracle 10G. DSMt stores all information required to track customer-specific applications and produce DSM reporting requirements specific to the current DSM Framework. DSMt also receives automated uploads from Banner to ensure that customer information remains up-to-date. Uploads are constant and every time an account is accessed, the most current Banner rate class info is provided. DSMt content includes:
    - Customer information including name, address, rate class, sector, measures installed, installation date
    - Measure details or input assumptions for each DSM measure including number of units, measure life, resource savings, incremental cost, project description, basecase, and net-to-gross adjustment factors
    - Customer incentive details

- *Account Information Management System* (AIMS) is a custom 2003 Windows web-based application run using Oracle 10G. AIMS houses Customer and Service provider information including mailing addresses and customer contact information for customer and service providers that participate in custom DSM programs. Custom project details, including all attachments associated with the custom project submission, are housed in AIMS.
- *Crystal Reports* is used to extract data and generate reports from the information contained in DSMt. There are several pre-defined monthly reports produced in DSMt that contain information such as cumulative m^3 savings, LRAM amounts, TRC values and incentive dollars paid by rate class. A General Extraction Report of most data fields tracked in DSMt is also generated monthly and used for additional reporting. The general extraction of data is referred to as the End User Measure (EUM) report. This report is generated automatically from DSMt and is exported directly into Excel. The EUM report is found as the DSMt Results tab in the 2012 Audit Tool.

Audit Approach and Findings

Table 13 shows the audit activity and questions by scorecard and program and findings.

Table 14 Review of Tracking Procedures and Data by Scorecard and Program

Scorecard/Program	Activity	Question	Result
Resource Acquisition			
Energy savings kits, programmable thermostats (Residential)	Compared the tracking form total of participants installing thermostats to the Summary worksheet in the Audit Tool.	Did total installations match what was in the Audit Tool?	Yes
	Reviewed substantiation sheets for ESK measures and P-Stats algorithms and audited calculations in the DSMt worksheet in the Audit tool.	Are algorithms correctly implemented in the tracking system?	Yes
Home Retrofit (Residential)	Compared HOT200 spreadsheet values for each 2012 participant to savings input to DSMt spreadsheet.	Are the savings correctly input in the database?	Yes
Hot Water Conservation (C/I)	Reviewed measure algorithms and compared the measure savings in the database correctly reflect the algorithms.	Are the algorithms for the HWC measures (e.g. aerators, showerheads) correctly applied to the measures installed?	Yes
Quasi-Prescriptive (C/I)	Reviewed calculations for a sample of entries for quasi-prescriptive measures (e.g. laundry ozone, boilers).	Was supporting data available to do the calculations (e.g. square feet)?	Yes
	Compared calculations to the substantiation documents.	Do the database results for each measure correctly reflect the algorithms?	Yes

Scorecard/Program	Activity	Question	Result
Custom Offering (C/I)	Reviewed information for a sample of 5 custom projects reviewed by the verification consultant.	Does the database correctly capture results from the verification study report?	Yes
Large Industrial Rate T1/100	Reviewed information for a sample of 5 custom projects reviewed by the verification consultant.	Does the database correctly capture results from the verification study report?	Yes
Low Income			
Helping Homes Conserve (Residential) **Free Showerhead Installation (Multi-Family)**	Reviewed audit tool to ensure algorithms correctly implemented for prescriptive measures.	Are the algorithms correctly applied in the database?	Yes
Custom Offering (Multi-Family)	Reviewed information for all custom low income projects and compared to the database.	Does the database correctly capture all of the low income results?	Yes
Market Transformation			
Optimum Home Program	Reviewed data on builder projects in 2012 and contracts for all builders.	Were the builders correctly classified as in the top 10 or top 50 builders?	Yes
		Are there signed contracts for all builders?	Yes

Overall Findings

The following are overall findings.

- The tracking systems can and do capture program-critical information.
- Procedures for tracking program participants lead to accurate counts.
- Values that go into estimating program energy savings and other metrics are adequately documented in program records.
- Reported values for participation are appropriate for calculation of LRAM and DSM incentives.
- There were no incorrect counts of measures installed or omission of information needed to calculate prescriptive savings.
- Some custom projects were completed before 2012 but these projects had not been previously claimed and Union wanted to wait until they had more data on post-installation in order to increase the accuracy of the savings results.

Strengths of Program Tracking Procedures

The Audit Team compared Union's program tracking procedures to "best practices" identified in the National Action Plan for Energy Efficiency[14]. Union implemented all the procedures identified:

- Applications and other forms should be clear and require the minimum information (equipment and customer) to confirm eligibility and track participation by customer for measurement and verification (M&V) purposes.
- *Participating customer information.* At a minimum, create an unique customer identifier that can be linked to the utility's Customer Information System (CIS). Other customer or site specific information might be valuable.
- *Measure specific information.* Record equipment type, equipment size or quantity, efficiency level and estimated savings.
- *Program tracking information.* Track rebates or other program services provided (for each participant) and key program dates.
- *All program cost information.* Include internal staffing and marketing costs, subcontractor and vendor costs, and program incentives.

The Audit Team also compared Union's procedures to "best practices" identified in a paper by Wm Prindle of ICF International[15]. Union has implemented all the best practices identified by the paper for a robust tracking and measurement system.

- The system collects data regularly from all business units.
- The data is normalized and base-lined.
- Data collection and reporting is as granular as possible.
- The system tracks performance against goals in a regular reporting cycle.
- Performance data is visible to senior management in a form they can understand and act upon.
- Energy performance data is shared internally and externally.
- The system is linked to a commitment to continuous improvement.

Recommendations for Improvement

Union's Gas's tracking system and procedures adhere to best practices. The new Audit Tool is very helpful in increasing the transparency of calculations and results. The Audit Team has the following suggestions to improve the Audit Tool.

- Include the spreadsheet data from HOT2000 files for Home Retrofit participants in the Audit Tool.

[14] National Action Plan for Energy Efficiency, July 2006.
[15] Prindle, Wm., *From Shop Floor to Top Floor: Best Business Practices in Energy Efficiency*, April 2010.

- Use lookup formulae for repetitive inputted assumptions. This will help protect the integrity of the data and enable easier, faster verification and editing. If this method increases the file size to the point that calculations process very slowly, we recommend splitting in into separate workbooks or files.
- Include descriptions of how various calculations are done if they are not clear. This includes calculations for a second showerhead and deep savings for C/I.

Appendix D - Comments on CPSV Sample Methodology

There were several potential issues with Navigant's sample estimation and the reporting thereof. Some of these issues are simply a lack of clarity – the results may be perfectly valid, but the Audit team was unable to verify the steps that Navigant took, or determine why there are small differences between our results and theirs. In addition, the way the "Very Small" strata for both programs were handled was not completely consistent, and the associated calculations should have accounted for the difference in how these strata were handled, but apparently were not. However, in all these cases, the magnitude of the differences was so small that the savings estimates and the realisation rates were not substantively affected. The possible exception is our last concern, which is unverifiable from the report, but if true, could put the statistical validity of the estimates into doubt.

The following are issues we identified, discussed in more detail:

Fundamentally, a sample should represent the entire population. The samples used here were selected to represent only the "Small," "Medium," and "Large" strata, and excluded the "Very Small" stratum in each of the programs. We understand that this was done to make more efficient use of evaluation resources and budget, which is understandable. However, if the "Very Small" customers are not evaluated, it may not be appropriate to claim savings from them, depending on how strictly the evaluation requirements are interpreted. That said, the "Very Small" stratum represents so small a percentage of the total savings that excluding them would not change the results substantively. And the proxy that Navigant used to estimate the realisation rate and the savings was reasonable, given the lack of sample. A more conservative approach would have been to assume a realisation rate of 1.0 (no change to the reported savings), instead of the 1.08 and the 1.15, based on the rest of the sample, but again, this would not have changed the realisation rate to the number of decimal places reported or changed the verified savings estimate substantively.

- **Recommendation:** union should talk to Enbridge Gas Distribution about changing the sampling methodology. The change would be to assign a realisation rate of 1.0 (no change to the reported savings) for projects that are not included in the sample frame.

Navigant said that for the C&I sample, like the T1/R100 sample, they initially did not select any "Very Small" customers. However, during the sampling or analysis, there was one "Small" sample point reclassified as "Very Small." It is not clear how this misclassification was discovered, and more importantly, it is not clear whether the remaining population projects that were not included in the sample were subject to the same level of scrutiny about which stratum they were included in. If the remainder of the population was not checked for stratum assignment, then the shifting of the sample point is inappropriate, and it should have been left in the "Small" stratum, even though the reported savings turned out to be incorrect. Sampling

theory tells us that if a sample point was misclassified, then it is likely that at least some of the population projects were also misclassified. Leaving this sample point in the "Small" stratum would have been the safer choice. However, the effect of this reclassification is tiny, and the results would not be substantively affected.

- **Recommendation**: Union's sampling consultant should either not retroactively reclassify sample points to other strata or if so explain the rationale for this reclassification.

As mentioned above, we were unable to exactly match the relative precision numbers, but our results were close to Navigant's results, and consistent in the relationship between strata. It would have been helpful for Navigant to more clearly define the 90% one-sided confidence interval. We are fairly certain our interpretation is the same as what Navigant meant, but it is impossible to verify based on the memo. It also would have been helpful if Navigant included some detail around their calculations, at a minimum showing the absolute error (the plus/minus amount in kWh of the 90% confidence interval). Given the rounding of the relative precision numbers, we can't verify how those differed from our calculated numbers. Showing more details of calculations would better allow for audit review and assessment of the effects of rounding error. If numbers were rounded at intermediate points, Navigant should have specified that. We are not assuming that they did round, but that might explain the small differences.

- **Recommendation:** In future audits, the sampling consultant should provide more details about their definition of the 90% one-sided confidence interval and more details about calculations, such as showing the absolute errors.

Navigant uses a separate ratio estimate, which is consistent with the Sampling Methodology Report done prior to the evaluation. When using a ratio estimate, there are two choices, a separate ratio estimate and a combined ratio estimate. Both are valid methods, but there are advantages and disadvantages to each. Navigant references Lahr's "Sampling: Design and Analysis" in using the separate ratio estimate. We believe that the combined ratio estimate would have been a better choice here, as there are two weaknesses to the separate ratio estimate relative to the combined ratio estimate in this case. First, there is a mathematical bias in any ratio estimate. However, the bias is introduced with the calculation of the ratio, so the bias in the separate ratio estimate is potentially larger than the bias in the combined ratio estimate. In addition, Cochran's "Sampling Techniques"[16] recommends the combined ratio estimate when there is "only a small sample in each stratum," which is the case here. For these two reasons, we believe the combined ratio estimate would be a better choice.

[16] Cochran, Wm. G. Sampling Techniques, 3rd Edition, John Wiley & Sons, 1977.

- ***Recommendation:*** Since both methods can be appropriate, and because the separate ratio estimate is specified in the Sampling Methodology Report, we recommend acceptance of the results as calculated by Navigant.

When looking at the average reported savings across the strata, we were surprised to see that all seven of the stratum samples have a higher average reported savings than the true population average in the stratum from which they were selected. While this is not impossible as a random outcome, we are concerned that smaller sites within strata may have been omitted from the sample selection process in an effort to make the on-site work appear more cost-effective. While Navigant did this with the "Very Small" stratum, and reported that they did this, it would be inappropriate to sample within each stratum non-randomly. If some of the cases within a stratum are systematically excluded from being selected, then the results are biased and the confidence intervals are not valid. For instance, if smaller projects tend to have lower (or higher) realisation rates, then biasing the selection would result in incorrectly lower (or higher) overall estimates of realisation rates. However, there is no evidence that Navigant biased the selection in this way – there is only the unlikely result that all the stratum sample averages are greater than the stratum population averages.

- **Recommendation:** Union should review this issue with its sampling consultant to ensure that the sample within each stratum is truly randomly selected with equal probability of selection and without bias.

None of these except the last would substantively affect the results of the analysis. We have no way of determining the randomness of the sample, so we can't say whether anything inappropriate was done.

- **Recommendation**: Because of the magnitude of the differences and based on Navigant's description of their sampling as random, we recommend acceptance of Navigant's sample expansion to the population

There may be some concern or confusion because so many of the sample points have realisation rates less than one, but the overall realisation rate is greater than one, particularly with the C&I sample. It is important to remember that this is a stratified sample, with some of the strata sampled at a higher frequency than others. The population verified savings are estimated for each stratum, and then stratum results are summed to get total population results. So for the C&I projects, while 16 of the 29 projects in the sample, more than half, have a realisation rate less than one, most of those are in the sample for the "Large" group, which has a much higher sampling frequency and only 20 of the 467 total projects. The result is that the realisation rate for the "Large" group is less than one, but when the results are all combined, the higher realisation rates for the other strata push the overall realisation rate to above one.

This may be clearer if you look at the magnitude of the difference between the reported savings and the estimated population verified savings for each stratum, as shown in Figures 11 and 12 in the Navigant report. For the C&I sample, the large stratum verified savings are about 48 million lower, but the medium is 43 million higher, the small about 17 million higher, and the very small about half a million higher. The net effect, when summed, is that the total verified savings is about 12.5 million higher, resulting in an over realisation rate greater than 1.0.

Union Gas applied the sample realisation rates for water and electricity to the population to calculate population savings. Although this is not the appropriate approach to assessing population savings based on a sample, since these results are not used in financial calculations, there is no impact on LRAM or performance incentives.

- ***Recommendation*:** Include a note in the report that these estimates are based on sample realization rates.

Appendix E - Audit Recommendations for CPSV Sample Projects (C&I)[17]

Project Identification No.	Population Stratum	Reported Annual Gas Savings (m^3)	Reported Measure Life (yrs)	Reported Cumulative Gas Savings (m^3)	Verified Annual Gas Savings (m^3)	Verified Measure Life (yrs)	Verified Cumulative Gas Savings (m^3)	Project Realization Rate	Audited Annual Gas Savings (m^3)	Audited Measure Life (yrs)	Audited Cumulative Gas Savings (m^3)	Audited Project Realization Rate	Audit Recommendations
2012-COM-0020	Medium	415,905	20	3,826,326	350,685	20	3,226,301	0.84	350,685	20	3,226,301	0.84	Accept the verification findings.
2012-COM-0057	Small	51,040	15	352,176	13,497	15	93,132	0.26	13,497	15	93,132	0.26	Accept the verification findings.
2012-COM-0069	Small	43,431	15	299,674	43,045	15	297,012	0.99	43,045	15	297,012	0.99	Accept the verification findings.
2012-COM-0092	Medium	255,454	20	2,350,177	381,623	20	3,510,932	1.49	381,623	20	3,510,932	1.49	Accept the verification findings.
2012-COM-0102	Large	1,058,190	20	9,735,348	896,997	20	8,252,372	0.85	896,997	20	8,252,372	0.85	Accept the verification findings.
2012-IND-0049	Medium	581,045	20	5,345,614	694,171	20	6,386,375	1.19	694,171	20	6,386,375	1.19	Accept the verification findings.
2012-IND-0079	Medium	318,377	20	2,929,068	377,436	20	3,472,408	1.19	377,436	20	3,472,408	1.19	Accept the verification findings.
2012-IND-0088	Very Small	50,240	4	92,442	43,577	5	100,227	1.08	43,577	5	100,227	1.08	Accept the verification findings.
2012-IND-0107	Medium	450,156	20	4,141,435	586,487	20	5,395,676	1.3	586,487	20	5,395,676	1.08	Accept the verification findings.
2012-IND-0127	Small	111,700	20	1,027,640	115,793	20	1,065,294	1.04	115,793	20	1,065,294	1.04	Accept the verification findings.
2012-IND-0130	Small	224,110	15	1,546,359	234,322	15	1,616,819	1.05	234,322	15	1,616,819	1.05	Accept the verification findings.
2012-IND-0155	Small	428,837	7	1,380,855	467,718	7	1,506,051	1.09	467,718	7	1,506,051	1.09	Accept the verification findings.
2012-IND-0156	Medium	1,920,653	5	4,417,502	2,010,051	10	9,246,237	2.09	2,010,051	10	9,246,237	2.09	Accept the verification findings.
2012-IND-0160	Large	691,732	20	6,363,934	699,078	20	6,431,514	1.01	699,078	20	6,431,514	1.01	Accept the verification findings.
2012-IND-0168	Medium	366,741	20	3,374,017	520,680	12	2,874,152	0.85	520,680	15	3,592,691	1.06	Change EUL to 15 years.
2012-IND-0171	Large	1,667,381	20	15,339,905	1,649,101	12	9,103,036	0.59	1,649,101	15	11,378,794	0.74	Change EUL to 15 years.
2012-IND-0176	Large	1,597,771	20	14,699,493	1,351,320	25	15,540,177	1.06	1,585,343	25	18,231,445	1.24	Correct the baseline value.
2012-IND-0187	Large	1,129,396	30	15,585,665	868,643	25	9,989,396	0.64	868,643	25	9,989,396	0.64	Accept the verification findings.
2012-IND-0188	Large	1,115,675	14	7,184,947	1,254,586	7	4,039,766	0.56	1,254,586	7	4,039,766	0.56	Accept the verification findings.
2012-IND-0213	Small	166,374	20	1,530,641	239,635	20	2,204,644	1.44	239,635	20	2,204,644	1.44	Accept the verification findings.
2012-IND-0216	Large	1,200,528	20	11,044,858	1,301,912	12	7,186,553	0.65	1,301,912	10	5,988,795	0.54	Change EUL to 10 years.
2012-IND-0220	Small	275,117	7	885,877	268,112	7	863,320	0.97	268,112	7	863,320	0.97	Accept the verification findings.
2012-IND-0225	Medium	296,704	20	2,729,677	222,316	20	2,045,310	0.75	222,316	20	2,045,310	0.75	Accept the verification findings.
2012-IND-0230	Large	2,018,082	20	18,566,354	1,824,140	20	16,782,085	0.9	1,824,140	20	16,782,085	0.9	Accept the verification findings.
2012-IND-0251	Large	712,243	20	6,552,636	249,505	20	2,295,448	0.35	392,080	15	2,705,352	0.41	Change annual savings and change EUL to 15 ye
2012-IND-0351	Medium	383,978	20	3,532,598	339,819	20	3,126,333	0.88	339,819	20	3,126,333	0.88	Accept the verification findings.
2012-IND-0477	Large	1,811,219	20	16,663,215	1,534,337	20	14,115,898	0.85	1,534,337	20	14,115,898	0.85	Accept the verification findings.
2012-IND-0524	Large	1,034,849	20	9,520,611	1,030,323	20	9,478,973	1	1,030,323	20	9,478,973	1	Accept the verification findings.
2012-IND-0532	Large	5,242,292	10	24,114,543	4,805,708	10	22,106,255	0.92	2,100,000	10	9,660,000	0.40	Change annual savings based on audit findings

[17] Cumulative savings = annual savings * measure life * (1-free rider rate). Free rider rate = 0.54.

Appendix F - Audit Recommendations for CPSV Sample Projects (Low Income)[18]

Project Identification No.	Reported Annual Gas Savings (m^3)	Reported Measure Life (yrs)	Reported Cumulative Gas Savings (m^3)	Verified Annual Gas Savings (m^3)	Verified Measure Life (yrs)	Verified Cumulative Gas Savings (m^3)	Project Realization Rate	Audited Annual Gas Savings (m^3)	Audited Measure Life (yrs)	Audited Cumulative Gas Savings (m^3)	Audited Project Realization Rate	Audit Recommendations
2012-COM-0033	887	20	16,853	899	20	17,081	1.014	899	20	17,081	1.014	Accept verification findings
2012-COM-0034	23,277	22	486,489	23,884	25	567,245	1.166	23,884	25	567,245	1.166	Accept verification findings
2012-COM-0103	12,871	20	244,549	11,100	22	231,990	0.949	11,100	22	231,990	0.949	Accept verification findings
2012-COM-0116	7,655	22	159,990	12,164	22	254,228	1.589	12,164	22	254,228	1.589	Accept verification findings
2012-COM-0120	17,075	20	324,425	14,150	20	268,850	0.829	14,150	20	268,850	0.829	Accept verification findings
2012-COM-0157	9,052	15	128,991	7,388	15	105,279	0.816	7,388	15	105,279	0.816	Accept verification findings
2012-COM-0159	4,865	20	92,435	4,865	20	92,435	1.000	4,865	20	92,435	1.000	Accept verification findings
2012-COM-0274	13,754	20	261,326	13,119	22	274,187	1.049	13,119	22	274,187	1.049	Accept verification findings
2012-COM-0277	5,608	20	106,552	4,154	22	86,819	0.815	4,154	22	86,819	0.815	Accept verification findings
2012-COM-0278	39,703	15	565,768	36,434	15	519,185	0.918	36,434	15	519,185	0.918	Accept verification findings
2012-COM-0286	2,729	20	51,851	2,729	20	51,851	1.000	2,729	20	51,851	1.000	Accept verification findings
2012-COM-0287	2,167	20	41,173	1,300	20	24,700	0.600	1,300	20	24,700	0.600	Accept verification findings

[18] Cumulative savings = annual savings * measure life * (1-free rider rate). Free rider rate = 0.05.

Appendix G – Audit Recommendations for CPSV Sample Projects (Large Industrial) [19]

Project Identification No.	Population Stratum	Reported Annual Gas Savings (m^3)	Reported Measure Life (yrs)	Reported Cumulative Gas Savings (m^3)	Verified Annual Gas Savings (m^3)	Verified Measure Life (yrs)	Verified Cumulative Gas Savings (m^3)	Verified Project Realization Rate	Audited Annual Gas Savings (m^3)	Audited Measure Life (yrs)	Audited Cumulative Gas Savings (m^3)	Audited Project Realization Rate	Audit Recommendation
2012-IND-0024	Medium	5,902,120	7	19,004,826	5,822,000	7	18,746,840	0.99	5,822,000	7	18,746,840	0.99	Accept verification findings.
2012-IND-0027	Medium	2,818,056	7	9,074,140	2,703,000	7	8,703,660	0.96	2,703,000	7	8,703,660	0.96	Accept verification findings.
2012-IND-0030	Large	9,655,436	20	88,830,011	10,465,000	30	144,417,000	1.63	10,465,000	30	144,417,000	1.63	Accept verification findings.
2012-IND-0057	Medium	5,473,070	2	5,035,224	5,474,000	2	5,036,080	0.83	2,737,000	2	2,518,040	0.50	Reduce annual savings by 50%.
2012-IND-0068	Small	1,039,637	7	3,347,631	1,040,000	7	3,348,800	1.00	1,040,000	7	3,348,800	1.00	Accept verification findings.
2012-IND-0151	Small	2,414,818	2	2,221,633	4,592,500	2	4,225,100	1.9	2,296,250	2	2,112,550	0.95	Reduce annual savings by 50%.
2012-IND-0152	Medium	2,321,976	4	4,272,436	2,154,500	4	3,964,280	0.93	2,154,500	4	3,964,280	0.93	Accept verification findings.
2012-IND-0153	Small	1,705,572	4	3,138,252	1,706,000	4	3,139,040	1.00	853,000	4	1,569,520	0.50	Reduce annual savings by 50%.
2012-IND-0157	Small	408,208	20	3,755,514	593,500	20	5,460,200	1.45	593,500	20	5,460,200	1.45	Accept verification findings.
2012-IND-0241	Medium	1,240,811	20	11,415,461	1,271,000	30	17,539,800	1.54	1,271,000	30	17,539,800	1.54	Accept verification findings.
2012-IND-0282	Large	3,347,642	20	30,798,306	4,208,000	20	38,713,600	1.26	4,208,000	20	38,713,600	1.26	Accept verification findings.
2012-IND-0290	Large	6,956,258	30	95,996,360	6,017,000	30	83,034,600	0.86	6,017,000	30	83,034,600	0.86	Accept verification findings.
2012-IND-0430	Large	3,631,134	20	33,406,433	3,508,000	20	32,273,600	0.97	3,508,000	20	32,273,600	0.97	Accept verification findings.
2012-IND-0431	Medium	1,600,756	20	14,726,955	1,601,000	20	14,729,200	1.00	1,601,000	20	14,729,200	1.00	Accept verification findings.
2012-IND-0443	Large	4,593,133	20	42,256,824	4,593,000	20	42,255,600	1.00	4,593,000	20	42,255,600	1.00	Accept verification findings.
2012-IND-0486	Large	10,055,761	20	92,513,001	12,280,000	20	112,976,000	1.22	12,280,000	20	112,976,000	1.22	Accept verification findings.
2012-IND-0543	Large	3,068,457	20	28,229,804	3,401,000	20	31,289,200	1.11	3,401,000	20	31,289,200	1.11	Accept verification findings.

[19] Cumulative savings are calculated as annual savings * measure life * (1 – free rider rate). Free rider rate = 0.54.

Appendix H : Resumes for Key Audit Team Members

Craig Williamson

Craig Williamson
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Professional History

- *Senior Manager – Program Evaluation & Load Analysis,* EnerNOC, Utility Solutions Consulting
- *Senior Associate I* Global Energy Partners, LLC, Walnut Creek, California
- *Practice Director, Energy Consumer & End Use Research,* Energy Insights, Framingham, Massachusetts
- *Program Director/Research Director, Energy End Use Research,* Energy Insights, Framingham, Massachusetts
- *Honorarium Instructor,* University of Colorado at Denver and Denver University, Denver, Colorado
- *Unit Manager, Load Research & Evaluation,* New Century Energies/Public Service Company of Colorado, Denver, Colorado

Education

M.A., Applied Math (Statistics), University of Colorado, Boulder, Colorado

B.A., Mathematics and Theatre, University of Colorado, Boulder, Colorado

Professional Associations

- Association of Energy Services Professionals
- Western Load Research Association

Craig Williamson is the Senior Manager of Program Evaluation and Load Analysis at EnerNOC Utility Services. He manages consulting activities related to load research, load forecasting, and both EE and DR program evaluation, and created and leads EnerNOC's Load Analysis Membership Service (LAMS). He formerly headed the Energy Consumer and End Use Research area at Energy Insights (and EPRI Solutions and Primen before that). He has served as co-chair of the Western Load Research Association three times and teaches sample design and data analysis for the AEIC Load Research Fundamentals Course. He now has more than a quarter century of experience in the electricity and natural gas industry.

Key Project Experience

- PG&E SmartMeter Program Evaluation, 2011-2013. Mr. Williamson directed this impact evaluation of PG&E's Energy Alert and Web Presentment programs.
- Oklahoma Gas & Electric EE Evaluation, 2010-2012. OG&E contracted with Global (now EnerNOC Utility Solutions) to complete their EE Evaluation for 9 programs across three program years.
- Connecticut Energy Efficiency Board evaluation of Energy Conscious Blueprint, 2010-2011. Mr. Williamson led impact analysis, including sample design, data collection, and data analysis.
- Xcel Energy Smart Grid City Pricing and In-Home Smart Device Pilot Impact Evaluation, 2010-2013. Global is analyzing participant and control group customer energy use and survey data to estimate the impact on energy use and load shapes for these two pilot programs for the 2010-2013.
- OG&E Smart Grid Project, 2009-2013. Mr. Williamson designed the randomized statistical experiment for the first two years of this pilot, then coordinated the estimation of load impacts across eight rate/technology combination. Based on these results, OG&E is rolling out the program to all customers, and EnerNOC is evaluating the full roll-out as well.

Other Recent Projects

- JEA Load Research Sample Design, 2009-2010. Mr. Williamson worked with JEA in Jacksonville, FL to design new samples for residential and commercial rate classes, including analysis of billing data, stratification, and estimation of required sample sizes.
- PNM Load Research Workshop, 2009. Mr. Williamson, in collaboration with PNM, prepared the day long load research workshop for all parties, presented the information and facilitated discussion at the workshop itself, and attended several subsequent workshops.
- PNM load shape development for TNMP rate case, 2010-2011. Mr. Williamson developed class load shapes, coincident and non-coincident demands, load factors, and coincidence factors for non-IDR classes for the subsidiary and provided testimony support and interrogatory responses.
- OG&E Pay-as-You-Go program evaluation, 2011-2012. EnerNOC set up the participant and control groups for this prepaid electricity pilot, and is evaluating the load impacts and impacts on payments and bad debt for OG&E.

Publications and Presentations

How to Hit Several Targets at Once – Impact Evaluation Sample Design for Multiple Variables (Electric and Gas), Williamson, Craig, and Kasman, Robert (PG&E), published and presented at the 2012 ACEEE Summer Study, and presented at the 2012 AESP Implementation and Evaluation conference

(bin) Size Matters - The effect of empty bins in Delanius-Hodges minimum variance stratification, Williamson, Craig, presented at WLRA Spring 2012 conference

Efficient Sample Design with Multiple Measures per Site, Williamson, Craig, presented at WLRA Fall 2010 conference

Demand Response – It's a Resource, So Treat It Like One! Williamson, Craig, and Marrin, Kelly, Dec 2009

DSM Needs and Gets a Makeover, Williamson, Craig, Ryan, Barb, and Marrin, Kelly, April 2009

Peak Time Rebate's Dirty Little Secret, Williamson, Craig, and Marrin, Kelly, Mar 2009

Energy Efficiency Provisions in the American Recovery and Reinvestment Act of 2009, Williamson, Craig, Ryan, Barb, and Marrin, Kelly, Feb 2009

To Call or Not To Call? When to Call DR Event Days, Williamson, Craig, and Marrin, Kelly, June 2008

Residential Energy Market Profiles Update, Williamson, Craig, and Kester, Bridget, June 2008

Who Has What? Predictive Modeling Using Customer Billing Data, Williamson, Craig, and McNulty, Shawn, August 2007

Energy Efficiency and Demand Response: Separate Efforts or Two Ends of a Continuum?, Rohmund, Ingrid, Williamson, Craig, and Borstein, Jan, April 2007

Managing AMI Data, Kester, Bridget, and Williamson, Craig, January 2007

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Professional History

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- *Director – Program Design and Evaluation,* Global Energy Partners, Walnut Creek, California
- *Principal Associate/Senior Advisor,* Global Energy Partners, Walnut Creek, California
- *President*, Pacific Consulting Services, Berkeley, California
- ***Associate,*** Cambridge Systematics, Inc., Cambridge, Massachusetts
- ***Economist,*** Data Resources, Inc., Lexington, Massachusetts

Education

M.S., University of California, Berkeley, College of Civil Engineering, 1982
University of Arizona, graduate studies, 1977
B.A., University of Arizona, 1976

Professional Associations

- Association of Energy Services Professionals

Patrice Ignelzi, is Senior Consultant in the Program Evaluation and Load Analysis practice at EnerNOC Utility Solutions. She directs projects that incorporate impact, process, and/or market evaluation of energy efficiency programs. She conducted some of the first impact evaluations in the industry and has trained utility staff and evaluation practitioners in methods appropriate for estimating impacts. Outside of debating the finer points of program evaluation, she enjoys traveling (mostly to Italy, it seems).

Key Project Experience

- For Columbia Gas under subcontract to Johnson Consulting, directing impact evaluation of the Home Savings program, which promotes building envelope and HVAC improvements. The evaluation employs statistical bill analysis methodology to estimate savings achieved by 2010-2012 participants (ongoing 2012)
- For California Energy Commission under subcontract to KEMA, directed evaluation of ARRA-funded Energy Smart Jobs, a program that promoted refrigeration and lighting improvements in convenience and grocery stores.
- For Oklahoma Gas & Electric, serving as technical advisor for evaluation of OG&E's 2010-2012 portfolio of energy efficiency programs in Arkansas.
- For Oklahoma Gas & Electric, developed strategy for and overseeing evaluation of OG&E's 2010-2012 portfolio of energy efficiency programs in Oklahoma. These programs offer incentives, services, and education to customers and trade allies who serve them, in all sectors. (2010-present)
- For the Connecticut Energy Efficiency Board, directed a comprehensive process and impact evaluation of the Energy Conscious Blueprint program aimed at capturing opportunities in new construction and planned equipment replacement projects in commercial and industrial facilities.

Other Relevant Projects

- For the City of Alameda, led evaluation of the city's CFL promotional activities, including understanding residents' awareness of and participation in the events and incentives, and estimation of the energy savings achieved by customers who installed CFLs. (2010)
- For PECO, helped design a portfolio of residential and nonresidential energy efficiency programs to meet aggressive energy consumption and peak load reduction goals the company faces—almost 400 million kWh and 355 MW by 2011. Programs range from lighting promotion and low-income in-home assistance to renewables and traffic signal improvements. (2009)
- For California utilities, directed Global's work in the evaluation of the California Alternative Rate for Energy (CARE) program by designing and fielding a survey to assess understanding and satisfaction of community-based and low-income assistance organizations that participated in the program, and developing results that included identification of opportunities to improve the program. (2003)
- For the California Measurement Advisory Council (CALMAC), directed an assessment of the effects of energy efficiency programs administered by California utilities, municipalities, and state and local entities in 2001. (2002-2003)

Also at Global, Ms. Ignelzi directed projects related to energy efficiency products and programs, including identification of emerging technologies and development of programs to promote energy efficiency. Examples of these include:

- For Southern California Edison, designed and participated in the implementation of the Ag Efficiency Plus program that reduced annual electricity use among food producers and processors by 30 million kWh and reduced peak load by 5 MW. (2005-2008)
- For Bonneville Power Administration, directed two studies to determine the peak load reduction potential of energy efficiency and demand response initiatives suitable for the Olympic Peninsula and the rapidly growing Southern Oregon Coast. (2004-2005)
- For the Tennessee Valley Authority, directed a study to design appropriate and effective market transformation commercial lighting and residential appliance programs. (2003)
- For Wisconsin Public Service, directed a study that identified best program practices and lighting technologies for small business customers and identified the most promising emerging energy efficiency technologies to help residential, commercial, and industrial customer use electricity more effectively. (2002)

Publications and Presentations

"Are Free-Riders Actually a Good Thing? Revisiting What Free-Riders Are Actually Telling Us," Author and presenter at International Energy Program Evaluation Conference (IEPEC), Rome, June 2012.

"Free-ridership in Energy Efficiency Programs: Where Are We Now?" Panelist for AESP Brown-Bag teleconference, June 7, 2012.

"Doing More With Less—Getting What's Needed Most From Evaluations," Co-author for at International Energy Program Evaluation Conference (IEPEC), Boston, June 2011.

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Professional History

- Project Manager – Program Evaluation, EnerNOC Utility Solutions
- Managing Consultant, Navigant Consulting, Inc.
- Senior Consultant, Summit Blue Consulting
- Senior Analyst, Ontario Hydro

Education

- Master of Science (Biostatistics), Faculty of Medicine, University of Toronto
- Bachelor of Arts (First Class Honours), Carleton University, Ottawa,, Ontario

Professional Associations

- Association of Energy Services Professionals

Gaynoll Cook is a Project Manager with the Consulting Group of EnerNOC Utility Solutions which is based in Walnut Creek California. Gaynoll has over 30 years' experience in the energy industry including over 20 years with Ontario Hydro and Ontario Power Generation. She has been a consultant for seven years involved in activities such as managing and conducting program evaluations for both gas and electricity, assessing savings estimates, conducting market research, and designing samples.

Key Project Experience

The following projects are most relevant to managing the audit of Union's DSM Evaluation Report.

- ✓ ***Union Gas-*** Managed the annual audit of Union Gas's DSM Evaluation Report for 2005 and 2006
- ✓ ***Oklahoma Gas and Electric*** – Evaluate DSM portfolios for Oklahoma (2010-2012) and Arkansas (2011-2013).
- ✓ ***Columbia Gas of Virginia*** - Impact Evaluation of 2010-2012 DSM Programs.
- ✓ ***Missouri Gas Energy*** - Billing Analysis of Water Heating Program.
- ✓ ***Union Gas/Enbridge Gas*** - Determine Savings for Selected Residential Measures.
- ✓ ***Union Gas/Enbridge Gas*** **-** Attribution Research for Selected Residential Measures.
- ✓ ***Union Gas/Enbridge Gas*** **-** Attribution Research for Custom Projects with C&I Customers.
- ✓ ***Union Gas*** **-** Audit Annual Evaluation Report (2005 & 2006).
- ✓ ***Union Gas/Enbridge Gas*** **-** Sample Design to Verify Savings for Large C&I Projects.
- ✓ **Union Gas -** Assessed the Precision of Realization Rates for Custom C&I Projects.

Other Relevant Projects

- ***Source Gas*** - Evaluate DSM portfolio delivered by four natural gas utilities in Colorado.
- ***PECO*** – Evaluated Low Income Energy Efficiency Program.
- ***AEP Ohio - Evaluate Low Income Energy Efficiency Program.***
- ***Ontario Power Authority*** - Evaluate the Cross-Cutting Commercial and Institutional Retrofit Incentive Programs.
- ***BC Hydro*** **-** Review Power Smart DSM Plan for integrated resource planning process.
- ***Northwest Energy Efficiency Alliance*** **-** Long-term follow-up studies of market transformation programs.
- **EmPower MD - Assessed the Precision of Program Realization Rates**
- **NW Natural Gas – Benchmark study of gas** utilities providing DSM programs in Washington.
- **BC Hydro - Regulatory Process Review.** Helped BC Hydro develop an approach to providing appropriate information to regulators on DSM program plans and results,
- ***Natural Resources Canada Office of Energy Efficiency*** – Determine attribution of savings from multiple fuels using discrete choice and enhanced self-report methods.

Publications and Presentations

Advantages of a Team Approach to Evaluation and Implementation, presented at the Association of Energy Services Professionals (AESP) conference in Long Beach, CA, October 16, 2012.

Beyond HERS: Measuring Savings for Homes Built to Exceed Energy Star Standards, presented at the AESP summer conference in Toronto, Ontario, July 31, 2012.

"Attribution Methodology Wars: Self-Report Methods Versus Statistical Number Crunching—Which Should Win?" G. Cook, Summit Blue Canada, presented at the ACEEE Summer Conference on Buildings, August 22, 2008.

"Evaluating Annual Gas Savings from Custom Projects: A Balancing Act," presented at the 18th National Energy Services Conference in Clearwater Florida in January 30 2008.

"Quick-Hit Dr Programs: A Case Study of California's 20 -20 Program." D. Violette & G. Cook, Summit Blue Canada, October 3, 2005.

"DSM in North America: 2005 Results." Presented at the ENERCom 2007 Conference at the Royal York Fairmont Hotel in Toronto, Ontario, March 6, 2007.

Barb Ryan

Barb Ryan
Project Manager – Program Evaluation

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Barb Ryan is a Project Manager at EnerNOC Utility Solutions. She has almost 20 years of experience working in the energy industry. Barb has established expertise in energy program design and evaluation, customer segmentation, market assessment, and market research related to customer decision making processes.

Professional History

- Project Manager – Program Evaluation, EnerNOC Utility Solutions
- Research Manager -.Energy Insights
- Senior Consultant, Hagler Bailly Consulting

Education

- Bachelor of Science), University of Wisconsin La Crosse, WI

Professional Associations

- Association of Energy Services Professionals

Key Project Experience

The following projects are most relevant to managing the audit of Union's Annual DSM Evaluation Report.

- ✓ ***Oklahoma Gas and Electric*** – Evaluate C&I Standard Offer Program for Oklahoma (2010-2012), designed participant survey for the C&I lighting program and conduct process evaluation for the Arkansas portfolio (2011-2013).
- ✓ ***State of California***– Evaluate market transformation effects of the Energy Smart Jobs Program.
- ✓ ***City of Alameda***– Evaluate the impacts of the residential CFL program.
- ✓ ***Connecticut Energy Efficiency Board***– Evaluation of the Energy Conscious Blueprint Program.
- ✓ ***Idaho Power Company***– Review processes for the residential program portfolio.
- ✓ ***Los Angeles Department of Water and Power***– Review processes for three programs facing staffing issues.
- ✓ ***City of Burbank***– Identify opportunities for the city to use smart grid capabilities to enhance their energy efficiency program portfolio.

Other Relevant Projects

- ***Energy Trust of Oregon***– Directed a benchmarking project that compared the metrics of ETO's energy efficiency programs to those in other states
- ***EPRI*** - Evaluated the market for horizontal axis washing machines.
- ***Energy Center of Wisconsin-*** Evaluated how effectively the Wisconsin KEEP Program approach ultimately affects learning, attitudes, and behavior among students and their families.
- ***Michigan Public Service Commission-*** Conducted a study to determine the efficiency of forced air furnaces and boilers sold in Michigan compared to Wisconsin.

Publications and Presentations

Advantages of a Team Approach to Evaluation and Implementation, presented at the Association of Energy Services Professionals (AESP) conference in Long Beach, CA, October 16, 2012.

Doing More with Less—Getting What's Needed Most From Evaluations, presented at the IEPEC summer conference in Boston, MA, 2011.

Project Porchlight: A Sophisticated, Grassroots Approach to Energy Savings, Ryan, Barb. March 2009, prepared for the Energy Insights Customer Strategies Research Service.

Small Business Customers Respond to Time-Based Rates, Ryan, Barb co-authored with Williamson, Craig and Marrin, Kelly. January 2009, prepared for the Energy Insights Customer Strategies Research Service.

Beyond the Bill: In-Home Displays Deliver Energy Savings, Ryan, Barb co-authored with Marrin, Kelly. December 2008, prepared for the Energy Insights Customer Strategies Research Service.

Lessons Learned in Low-Income Energy Efficiency Programs, Ryan, Barb. September 2008, prepared for the Energy Insights Customer Strategies Research Service.

Savings Inside the White Room. Virtualization Slashes Data Center's Energy Use, Ryan, Barb, June 2008, prepared for the Energy Insights Customer Strategies Research Service.

Residential Energy Efficient Programs, Are Consumer Rebates Necessary? Ryan, Barb co-authored with Rohmund, Ingrid. December 2006, prepared for the Energy Insights Customer Strategies Research Service.

Lessons Learned in Small Business Energy Efficiency Programs, Ryan, Barb co-authored with George, Karen. June 2005, prepared for the Energy Insights Customer Strategies Research Service.

Business Customers Need Solutions to Their Energy Problems: Can Energy Providers Devise Strategies That Work? Ryan, Barb, December 2001, prepared for the Energy Insights Customer Strategies Research Service.

Kelly E. Parmenter, Ph.D.

Kelly E. Parmenter, Ph.D.
Principal Project Manager – Program Evaluation & Load Analysis

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USA
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Professional History

- Senior Project Manager – Program Evaluation & Load Analysis, Utility Solutions Consulting, EnerNOC
- Manager – Consulting Engineering Support, Utility Solutions Consulting, EnerNOC
- Senior Associate – Technology Applications, Global Energy Partners
- Research Associate – Energy Services, DMJM (AECOM)
- Research Engineer – Departments of Mechanical Engineering and Materials, University of California, Santa Barbara (UCSB)

Education

- Doctorate (Thermal Sciences, Mechanical Engineering), UCSB
- Master of Science (Mechanical Engineering), UCSB
- Bachelor of Science (Mechanical Engineering), UCSB

Qualifications

- Over eighteen years' experience in the energy sector
- Twelve years' experience in the academic sector
- Over 25 peer-reviewed technical papers and more than 50 energy-related reports
- Areas of expertise:
  - Project and team management
  - Research and reporting
  - Energy analysis
  - End-use energy efficiency
  - Emerging technology applications
  - Technical writing

Dr. Parmenter recently joined EnerNOC's Program Evaluation and Load Analysis practice area as a Senior Project Manager. Prior to joining the Program Evaluation and Load Analysis team, she worked closely with the team over the course of three years. Specifically, in her previous role as Manager of Consulting Engineering Support, she and her team of nine engineers provided engineering expertise to impact analysis work on several program evaluation projects. In addition, she was the Project Manager for a large impact and process evaluation project carried out in 2010/2011.

In June 2012, her Consulting Engineering Support team was selected as a Vendor of Record by Ontario Power Authority to provide Technical and CDM Program Support Services.

Key Project Experience

Recent program evaluation projects include the following:

✓ ***Oklahoma Gas & Electric: Oklahoma, 2010-present; Arkansas, 2012-present*** – Dr. Parmenter is currently supervising engineering analysis tasks for the evaluation of the utility's DSM portfolios in Oklahoma and Arkansas.

✓ ***California Energy Commission (subcontract to KEMA), 2011-2012*** – Dr. Parmenter supervised the engineering team conducting on-site M&V for a sample of 75 projects associated with a refrigeration, lighting and controls program aimed at customers across the state of California.

✓ ***Connecticut Energy Efficiency Board, 2010-2011*** – Dr. Parmenter was project manager for the impact and process evaluation of a commercial and industrial (C&I) energy efficiency program, coordinating all aspects of the work along with the project director.

Her responsibilities included overseeing a subcontractor in the data monitoring of hundreds of energy efficiency projects at a sample of 100 C&I facilities statewide; managing the building simulation and spreadsheet energy analysis process to determine the realized energy savings impacts for the program; coordinating with other team members in the process evaluation tasks; and preparing interim deliverables and the final report.

Other Relevant Work Experience

For the last two years, Dr. Parmenter led EnerNOC's Consulting Engineering Support service area. She and her group carried out facility energy and water/wastewater assessments as well as provided engineering expertise to assessment and demonstration of emerging energy technologies and solutions, utility program planning, utility program implementation, measure characterization and review, retro-commissioning, EM&V, and Strategic Energy Management. Dr. Parmenter provided project direction for the work executed by her team and was responsible for oversight of two energy technology application membership programs for utilities. For the decade between 2000 and 2010, Dr. Parmenter conducted research, provided engineering support, and managed projects for Global Energy Partners' Technology Applications (Tech Aps) group. Her work included numerous technology and market assessments of advanced technologies for residential, commercial, and industrial applications for EPRI and a wide variety of utility clients. She is experienced working with utilities, research organizations, public agencies, and directly with commercial and industrial facilities. Examples of recent projects include the following:

- ***Electric Power Research Institute –*** Research report on electricity use and management in the water supply and wastewater industries (Sep 2012-present)
- ***California Energy Commission (CEC) –*** Demonstration of ozone technology to treat process water in a fresh cut vegetable facility (2011-present)
- ***Pacific Gas and Electric (PG&E) –*** Third-party engineering review of energy efficiency project analyses (on-going since 2011)
- ***Energy Trust of Oregon –*** Allied Technical Assistance Contractor providing comprehensive system assessments for industrial customers (on-going since 2011)
- ***Snohomish PUD –*** Engineering review of energy efficiency project analyses, includes verifying the appropriateness and accuracy of calculation methodologies and results (on-going since 2011)
- ***Southern California Edison –*** Technical service provider for ammonia refrigeration RCx pilot project (on-going since 2011)
- ***Commonwealth Edison –*** Technical Assistance Provider for several of ComEd's Smart Ideas for Your Business programs (on-going since 2011)

Publications and Presentations

She has published over 25 peer-reviewed technical papers and more than 50 reports, including:

"Demand-Side Management," Gellings, C.W., and K.E. Parmenter, in *Handbook of Energy Efficiency and Renewable Energy*, edited by F. Kreith and D.Y. Goswami, CRC Press, New York, NY: 2007.
"Electrical Energy Management in Buildings," Smith, C.B., and K.E. Parmenter, in *Handbook of Energy Efficiency and Renewable Energy*, edited by F. Kreith and D.Y. Goswami, CRC Press, New York, NY: 2007.
Efficient Use and Conservation of Energy in the Industrial Sector, Gellings, C., K. E. Parmenter, and P. Hurtado, 2002, in "Efficient Use and Conservation of Energy," edited by C. Gellings, in *Encyclopedia of Life Support Systems (EOLSS)*, EOLSS Publishers, Oxford, UK, http://www.eolss.net.
Energy Efficiency Planning Guidebook: Energy Efficiency Initiative, EPRI, Palo Alto, CA: 2008. 1016273. (One of the lead authors).

John K. Murphy, P.E., CEM

John K. Murphy, P.E., CEM
Senior Energy Engineer

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Professional History

- Senior Energy Engineer, EnerNOC
- Sr. Project Engineer - Technology Applications, Global Energy Partners
- Sr. Project Engineer – EPRI Community Environmental Center, St. Louis, MO
- Project Engineer – Murphy Mechanical Company, St. Louis, MO
- Water Resources Engineer – Black & Veatch, Kansas City, MO
- Environmental Process Engineer – Black & Veatch, Kansas City, MO

Education

- Master of Science in Civil/Environmental Engineering, University of Missouri - Columbia
- Bachelor of Science in Chemical Engineering, University of Missouri – Columbia

Qualifications

- Over twenty years' experience in the energy & environmental sectors
- Nearly 15 years' experience in short course development & presentations
- Extensive experience in the preparation & delivery of technical documents and consultation on energy & environmental issues for industrial customers
- Areas of expertise:
  - Project management
  - End-use energy efficiency
  - Environmental impacts assessments
  - Water & wastewater process improvements
  - Energy efficiency for cold storage facilities and food processors
  - Applied emerging technologies

Mr. Murphy serves EnerNOC through his appointment as a Research Associate at Washington University in St. Louis. As a Senior Energy Engineer with EnerNOC, Mr. Murphy performs a variety of tasks on technical issues for electric utilities, energy agencies and related parties. Typical tasks include supporting impact evaluation work for commercial and industrial (C&I) customers, conducting energy efficiency audits, developing energy use profiles for C&I customers, developing and delivering technical seminars and short courses, and supervising technical work conducted by junior-level engineers and analysts.

Key Project Experience

Recent projects include the following:

- ✓ ***Ameren Illinois: 2011-2012*** – Mr. Murphy was on project team that collected 100 energy profiles for Ameren Illinois' largest industrial users throughout central and southern Illinois. The profiles were used to develop estimates for the potential savings possible through the development of specific energy efficiency programs.
- ✓ ***Commonwealth Edison: 2012 - present*** – Mr. Murphy is currently leading a team of engineers in conducting compressed air assessments and process cooling and refrigeration audits for select industrial customers throughout Commonwealth Edison's service territory. ComEd has developed an aggressive program to reduce energy throughout their service territory through targeted programs in refrigeration, cooling and compressed air, along with process heating for large energy users. Mr. Murphy is leading EnerNOC's technical efforts in these programs to deliver energy savings to ComEd's industrial customers.
- ✓ ***Connecticut Energy Efficiency Board, 2010-2011*** – Mr. Murphy was an analyst on an impact and process evaluation of a C&I energy efficiency program. His responsibilities included assisting a subcontractor in the data monitoring of hundreds of energy efficiency projects at a sample of 100 C&I facilities statewide and using the collected data to develop spreadsheet energy analysis programs to determine the realized energy savings from the program. Energy savings measures included lighting improvements, new energy efficient motors and transformers, compressed air system improvements, and CO2 controlled exhaust fans for a parking garage.

Other Relevant Work Experience

Over the past four years, Mr. Murphy has been the technical lead for a variety of facility energy and water/wastewater assessments as well as provided engineering expertise to assessment and demonstration of emerging energy technologies and solutions, utility program planning, utility program implementation, measure characterization and review, retro-commissioning, EM&V, and Strategic Energy Management. Prior to this recent work with EnerNOC, Mr. Murphy was an energy engineer with Murphy Company, a mechanical contractor located in St. Louis, MO. While with Murphy Company, Mr. Murphy was part of a team of engineers responsible for the development of an energy services division within the company. That division identified, developed and delivered on energy savings projects for a variety of commercial and industrial customers in the St. Louis region. Mr. Murphy also has extensive experience with the assessment and development of emerging technologies for energy and environmental applications through his work at the EPRI Community Environmental Center. This employment followed eight years of practical experience in the development of environmental solutions to drinking water, wastewater and stormwater problems for municipalities across the U.S. while working for Black & Veatch, an international engineering firm headquartered in Kansas City, MO. He is experienced working for utilities, research organizations, public agencies, and directly with commercial and industrial customers of many sizes. Examples of recent projects include the following:

- ***Southern California Edison –*** Technical service provider for ammonia refrigeration RCx pilot project (on-going since 2011)
- ***Commonwealth Edison –*** Technical Assistance Provider for several of ComEd's Smart Ideas for Your Business programs (on-going since 2011)
- ***Electric Power Research Institute –*** Research report on electricity use and management in the water supply and wastewater industries (Sep 2012-present)
- ***California Energy Commission (CEC) –*** Demonstration of ozone technology to treat process water in a fresh cut vegetable facility (2011-present)
- ***Energy Trust of Oregon –*** Allied Technical Assistance Contractor providing comprehensive system assessments for industrial customers (on-going since 2011)
- ***Vectren –*** Developed energy use profiles for thirty commercial and industrial customers within service territory through on-site interviews and independent research (Autumn, 2012)
- ***Confidential Customer , Alabama–*** Developed and implemented electrical sampling plan to determine load on customer's four primary transformers to assess need for additional electrical infrastructure (Summer, 2012)

Publications and Presentations

He has published several technical papers and numerous technical reports, such as:

> *"Energy Requirements for Technologies to Inactivate Cryptosporidium"* in Proceedings of the 2000 American Water Works Association Conference and Exposition, Denver, Colorado, June 13, 2000. Carns, K.E., Perkins, D.L. and Murphy, J.K.
>
> *"Energy Use Assessment and Management"*, Chapter 10 in Management Strategy Manual for Water Treatment Infrastructure Assessment, American Water Works Association Research Foundation, publishers, Denver Colorado, 1999. Murphy, J.K. and Burton, F.

About EnerNOC Utility Solutions

EnerNOC Utilities Solutions™ is a comprehensive suite of demand-side management (DSM) program implementation and consulting services, technology platforms, and applications designed to address the evolving needs of utilities and grid operators worldwide. Hundreds of utilities have leveraged our technology, our people, and our proven processes to make their energy efficiency (EE) and demand response (DR) initiatives a success. Utilities trust EnerNOC to work with them at every stage of the DSM program lifecycle – assessing market potential, designing effective programs, supporting program implementation, and measuring program results.

The EnerNOC Utility Solutions consulting team has decades of combined experience in the utility DSM industry. We provide expertise, insight and analysis to support a broad range of utility DSM activities, including: potential assessments; end-use forecasts; integrated resource planning; EE, DR, and smart grid pilot and program design and administration; load research; technology assessments and demonstrations; EE project reviews; EE and DR program evaluation; and regulatory support.

Our consulting engagements are managed and delivered by a seasoned, interdisciplinary team comprised of professional electrical, mechanical, chemical, civil, industrial, and environmental engineers as well as economists, business planners, project managers, market researchers, load research professionals, and statisticians. Utilities view EnerNOC's experts as trusted advisors, and we work together collaboratively to make any DSM initiative a success.

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Audit Committee
Summary Results and Responses to the Audit of Union's 2012 DSM Annual Report

October 22, 2013

The purpose of this document is to outline the process followed for the Audit of the 2012 DSM Annual Report, summarize the Audit Committee (AC) resolutions to Audit recommendations, and recalculate the corresponding impacts to the 2012 DSM savings claims. In addition, this report documents additional audit issues and/or recommendations brought forward by the AC and resolution of those items.

Selection of AC members

The AC was comprised of three Consultative representatives and two Union Gas representatives (Leslie Kulperger and Tina Nicholson).

The Consultative elected three AC members at the Consultative Meeting on August 15, 2012, to represent the group through the Audit process. These representatives are:

- Kai Millyard – Green Energy Coalition
- Julie Girvan – Consumers Council of Canada
- Jay Shepherd – School Energy Coalition

Selection of Auditor and Terms of Reference

As part of the Stakeholder Engagement Terms of Reference (ToR), the audit process included the issuance and maintenance of an ongoing Request for Qualifications (RFQ) by Union to qualify audit firms to a preapproved bidders list. Union's AC reached consensus on a pre-approved bidders list from the RFQ of nine audit firms.

As outlined in the ToR, Union issued a Request for Proposal (RFP) to the pre-approved list for the purpose of conducting the Annual DSM Audit. Both the RFQ and RFP were developed in conjunction with Union and Enbridge's ACs to standardize the audit process between the two utilities. The standardized RFP scope of work was extended to include a provision that allowed the Auditor to work with the Custom Project Savings Verification firm to enable the review of both the draft and final verification reports and an opportunity to discuss individual projects, any findings and adjustment factors recommended throughout the firm's review. While the AC strives for consensus, the ToR also appointed the intervenor members of the AC to ultimately select the successful proponent in the absence of consensus.

Eight responses to the Audit RFP were reviewed by the AC. The intervenor representatives of the AC selected EnerNOC Inc. as the Auditor of the 2012 Annual Report. EnerNOC was commissioned to undertake the Audit. The Request for Proposal is attached as Appendix A.

Information Exchange

The Consultative, including the members of the AC and EnerNOC, reviewed the Draft 2012 DSM Annual Report circulated by Union Gas on May 10, 2013.

Other than comments from members of the AC, no additional comments were received from members of the Consultative.

EnerNOC presented the AC with the 2012 Final Draft Audit report on September 13, 2013 for review. Nine joint meetings with the AC, EnerNOC, and Union were held between February 26, 2013 and August 16, 2013 to initiate the audit process, review the Draft 2012 Annual DSM Report, the Draft Audit Report, and the Draft Final Audit Report.

Following these discussions, the 2012 Audit of Union's DSM Annual Report was completed by EnerNOC on September 13, 2013.

Audit Recommendations

Recommendations as outlined in the Audit Report, in addition to those brought forward by the AC during the Audit process, are documented below with corresponding resolutions. Recommendations are discussed within this report in two sections – recommendations that impact specific scorecards, followed by recommendations brought forward by the Auditor and the AC that reflect other issues.

The Audit recommendations that affect the cumulative m3 savings and the recalculation of DSM incentives and LRAM for 2012 include:

- Regarding the current use of natural gas hot water heaters, change all "Don't Know" responses collected through surveys supporting the Energy Savings Kits (ESKs) verification study to "No" responses, and change the adjustment factors for the ESK Residential Push/Pull measures accordingly. Auditor recommends using this approach until the Technical Evaluation Committee (TEC) is able to address this issue. (Recommendation #1)
- Reducing the rating of the steam leak for the largest C/I project to reflect the appropriate severity of the leak. (Recommendation #7)
- Changing the Effective Useful Life (EUL) for the Industrial Control Programming measure from 20 years to 15 years to match the value used for Commercial Controls Systems. (Recommendation #8)
- Correcting the change in temperature for one control measure used to reflect the weighted/blended value for the ex-post savings. (Recommendation #9)
- Changing the baseline efficiency for a repaired boiler to 75% to reflect the age of the boiler. (Recommendation #10)
- Decreasing the EUL for one specific Industrial Control Programming measure from 15 to 10 years to account for a building automation system that is already five years old. (Recommendation #11)
- Increasing the EUL for two specific Industrial Control Programming measure from 12 years to 15 years to match the value used for Commercial Controls Systems. (Recommendation #12)
- Reducing the savings for heat exchangers in Large Industrial Rate T1/100 by 50% to account for the uncertainty around baselines and the degradation of savings over time. (Recommendation #19)
- Moving one builder from the Top 10 Builder metric to the Top 50 Builder metric within the Market Transformation scorecard. (Recommendation #20)

The Audit recommendations that affect program-specific elements but do not impact 2012 results include:

- Labeling future Energy Savings Kit (ESK) reports to reflect work conducted. (Recommendation #2)
- Upholding a 20 year measure life for the Home Retrofit program and collecting more furnace data in the future to assess whether the 20 year measure life remains appropriate, as recommended by the auditor, or adopting a 15 year measure life for homes undergoing a furnace replacement and a 25 year measure life for homes not replacing a furnace, as recommended by the AC. (Recommendation #3)
- Providing a description in the Annual Report about the adjustment for the second showerhead in the Commercial Hot Water Conservation Showerhead Installation offering. (Recommendation #4)
- Revisiting the incremental costs for non-condensing boilers. (Recommendation #5)
- Revisiting the value of providing incentives for non-condensing boilers during the next program cycle. (Recommendation #6)
- Considering further study of appropriate EUL for energy efficient windows. (Recommendation #17)
- Using the point value calculated by the Verification Consultant (not the midpoint value) to determine population-level impacts in future studies. (Recommendation #18)

The Audit recommendations that affect future evaluation issues include:

- Union's sampling consultant should either not retroactively reclassify sample points to other strata or if so explain the rationale for this reclassification. (Recommendation #13)
- In future audits, the sampling consultant should provide more details about their definition of the 90% one-sided confidence interval and more details about calculations, such as showing the absolute errors. (Recommendation #14)
- Union should confirm with the sampling consultant that the sample within each stratum is truly randomly selected with equal probability of selection and without bias. (Recommendation #15)
- Union should include a note in the annual report that adjustments to water and electricity savings are based on sample realization rates. (Recommendation #16)
- Having Custom Project Savings Verification (CPSV) Consultants use zero decimal places in annual gas savings to match original values in future studies. (Recommendation #21)
- Documentation improvement for Custom Programs (Recommendation #22)
- Require specific information to be collected for custom projects of the same type. (Recommendation #23)
- Require more details on baselines for custom project of a certain savings level. (Recommendation #24)
- Developing better EULs for control settings. (Recommendation #25)
- Clarify CPSV roles for Verification Consultants and Auditors; better define the roles for the Auditor review of CPSV results. (Recommendation #26)
- Include all formulas in the Audit Tool if so that they directly correlate to the verification report. (Recommendation #27)
- Develop guidelines about how to differentiate issues related to baselines, EUL, and free riders. (Recommendation #28)

- Do not use vendor's energy savings calculations for rebates unless independently verified. (Recommendation #29)
- The Auditor recommends conducting additional marketing and outreach directed at homeowners as part of the Optimum Home program. (Recommendation #30)
- "The Auditor noted as follows: "Some custom projects were completed before 2012, but these projects had not been previously claimed and Union wanted to wait until they had more data on post-installation in order to increase the accuracy of the savings results". The intervenor members of the AC expressed a concern that this may not be consistent with the assumptions underlying the DSM Framework. (Recommendation #31)

Auditor's Recommended Changes to Cumulative Gas Savings, Utility DSM Incentive and LRAM Claim

EnerNOC conducted the audit in accordance with the rules and principles set down by the Ontario Energy Board in the DSM Guidelines for Natural Gas Utilities (EB-2008-0346) and in accordance to the contents of the 2012-2014 Union Gas Settlement Agreement (EB-2011-0327). The Auditor's Final Report presents their opinion subject to the qualifications set forth above, that "the following figures are calculated correctly using reasonable assumptions, based on data that has been gathered and recorded using reasonable methods and accurate in all material respects, and following the rules and principles set down by the Ontario Energy Board that are applicable to the 2012 DSM programs of Union Gas Ltd:

DSM Shareholder Incentive Amount Recoverable: $8,210,417

LRAM Amount Recoverable: $948,326

DSMVA Amount Recoverable: $368,119

Audit recommendations that impact cumulative m3, DSM Utility incentive and LRAM amounts led to a decrease of 76 million m3, $0.388M in DSM Utility incentive and $0.069M in LRAM claim from what was reported in Union's pre-Audit Annual Report.

Resource Acquisition Scorecard: Residential Program Recommendations

Recommendation #1

Regarding the current use of natural gas hot water heaters, change all "Don't Know" responses collected through surveys supporting the Energy Savings Kits (ESKs) verification study to "No" responses, and change the adjustment factors for the ESK Residential Push/Pull measures accordingly. The Auditor recommends using this approach until the Technical Evaluation Committee (TEC) is able to address this issue.

Resolution:

The AC accepts the Auditor's recommendation. This results in a net annual natural gas decrease of 675,703 m3, a decrease of $2,206 in LRAM; and a decrease of $9,873 to the

Resource Acquisition Scorecard DSM incentive. Additionally, Union will treat the Auditor's recommendation on how to deal with "Don't Know" responses as best available information until the TEC has the opportunity to review and standardize the appropriate method of interpreting "Don't Know" responses.

Recommendation #2

Future residential ESK verification reports should be properly labeled to reflect work conducted. Reports should be labeled as "Verification Study of Union Gas ESKs," not as an audit of ESKs.

Resolution:

The AC accepts the Auditor's recommendation in principle but will title these studies "Impact Evaluations" instead of "Verification Studies" on a going-forward basis.

Recommendation #3

In the Home Retrofit program Union attributed a 20 year measure life for calculating lifetime savings. An issue was raised about whether an average measure life of 20 years was appropriate given that roughly one-third of the savings were associated with furnace replacements for which savings were calculated relative to the efficiency of the old unit being replaced. For the portion of those furnace replacements that were early retirements, the lifetime of the full estimated savings was probably more like 5 years (with smaller additional savings relative to new 90% AFUE furnace being applicable for the remaining 15 year furnace life that would bump up the savings weighted measure life by several years). For the portion of the furnace replacements that were not early retirements, the savings would have been much smaller (measured relative to a 90% AFUE for a new standard furnace – again, making the savings weighted life considerably less than 20 years for this group). Put simply, the estimated furnace savings are overstated at 20 years. Indeed, the Auditor estimated that it was reasonable to assume that the effective lifetime of program's estimate of furnace savings in 2012 was 7 years when the proper baseline is taken into account. On the other hand, the life of some other measures installed through the program was longer than 20 years (e.g. insulation measures should have a life of 30 years). The auditor concluded that the combined effects of these measure life assumptions for 2012 was a weighted average of 20 years – i.e. the same as assumed by Union. On this basis the Auditor recommends accepting Union's claim for 2012 but suggests collecting more furnace data in the future to assess whether the 20 year life remains appropriate.

Resolution:

The AC accepts the 20 year lifetime for 2012 and 2013 savings. For 2014, the AC accepts a 15 year measure life for homes undergoing furnace replacements and a 25 year measure life for homes not replacing a furnace as part of the Home Retrofit program. The 20 year assumption only ended up being acceptable because of the portion of savings attributable to furnaces relative to other measures. If a larger portion of the savings were to come from furnaces in future years, the assumption of 20 years for all savings would be too high (and vice versa). Given the significant difference between the measure lives of furnaces and other measures,

the AC believes continuing to use a single weighted average assumption is problematic in that it could provide an incentive to pursue more furnace savings and provides no incentive to pursue more insulation savings. Two options have been presented for how to ensure furnace savings are appropriate in the future. The auditor's method would adjust the average effective measure life for whole retrofits after collecting additional information about furnace replacements in all projects. The method accepted by the AC for 2014 savings would fix a longer measure life of 25 years for retrofits without furnace replacements, and a shorter measure life of 15 years for those with furnace replacements.

Resource Acquisition Scorecard: Commercial Prescriptive Program Recommendations

Recommendation #4

Union should provide greater detail in how the use of showers in secondary bathrooms is accounted for in the calculation of adjustment factors for the Hot Water Conservation Multi-family sector initiative.

Resolution:

The AC accepts the Auditor's recommendation and Union will update the Final DSM Annual Report accordingly.

Recommendation #5

The incremental cost for space heating and domestic hot water non-condensing boilers between 200 and 300 MBH should be lowered to maintain a consistent trend of increasing incremental cost with increasing boiler size:

- Existing Construction incremental cost should be lowered from $2,114 to $1,883
- New Construction incremental cost should be lowered from $1,544 to $1,313

The incremental cost for domestic hot water non-condensing boilers between 1,000 and 1,500 MBH should be lowered for the same reason:

- Efficiency 83-84% incremental cost should be lowered from $7,400 to $5,850
- Efficiency 85-88% incremental cost should be lowered from $10,300 to $6,700

Resolution:

The AC accepts the Auditor's recommendation and Union will forward this recommendation with the TEC for consideration for the purpose of the Technical Reference Manual (TRM).

Recommendation #6

Within 2 to 5 years non-condensing boiler technology should be revisited as it will no longer make sense to provide incentives. However, since the baseline efficiency of 81% for non-condensing boilers is within the range of efficiencies for most non-condensing makes and models (78-82%), it is appropriate to keep incentives at this time.

Resolution:

The AC accepts this recommendation for 2012 results. Based on the Seeline and Marbek

studies, the AC continues to have concerns regarding the uncertainty in efficiency measurement standards for large boilers, the accuracy of the market baseline estimate, and therefore the savings estimates. All AC members agree to refer the issues to the TEC for review.

Resource Acquisition Scorecard: Commercial/Industrial Custom Program Recommendations

Recommendation #7

The Auditor recommended reducing the rating of the steam leak for the largest C/I project to reflect the appropriate severity of the leak. The Auditor recommends that the effective rating of the two large leaks in question be reduced from a rating of 6 to 3 (out of 10). A leak with a rating of 3 is more likely to sustain for a long period of time in absence of the program. It is quite conceivable that the leaks had been small prior to the "events" that occurred and that they may have continued to be ignored had the gaskets not further failed.

Resolution:

The AC is concerned that the information available on this project is insufficient to reach a fully supportable conclusion. The Auditor's recommendation proposes that, for the purpose of calculating savings for this steam leak, an assumption be made that something different happened than what in fact happened. The AC disagrees in principle with basing savings on an assumption that is known to be factually incorrect, and agrees that going forward auditors will be instructed to base all recommendations on verifiable facts.

For this project, for 2012, the AC will accept the net result the Auditor proposes, without accepting the basis on which that result was reached. The Audit recommendation decreased the cumulative natural gas savings for one audited project by a total of 12,446,255 m3 from the verified savings value.

Recommendation #8

The Auditor recommended decreasing the EUL for Industrial Control Programming measures from 20 years to 15 years to match the value used for Commercial Controls Systems. This measure involves reprogramming and relocating thermostats. Even though the thermostats have been moved out of reach to avoid tampering, the measure is essentially a "comfort heating" one, so the EUL should not exceed the EUL of commercial building controls, which, according to Union's Custom Offering EUL and Base Case Assumptions document, is 15 years.

Resolution:

The AC accepts this recommendation for the purpose of the 2012 audit. Union will consider investigating and/or tabling appropriate industrial control EULs for consideration by the TEC. This recommendation decreased the cumulative natural gas savings for one audited project by a total of 901,784 m3 from the verified savings value.

Recommendation #9

The Auditor recommended correcting the change in temperature for one control measure used to reflect the weighted/blended value for the ex-post savings. The delta T for the post case

should use the weighted/blended value for the set temperature to account for both weekday and weekend settings (71° F) instead of 72° F, which is the weekday setting.

Resolution:

The AC accepts the Auditor's recommendation. **This recommendation increased project-level cumulative natural gas savings for one audited project by a total of 1,311,688 m3 from the verified savings value.**

Recommendation #10

The Auditor recommended changing the baseline efficiency for a repaired boiler to 75% to reflect the age of the boiler. The efficiency used for the baseline boiler was too high for a boiler of that type (80%). A baseline boiler efficiency of 75% is more appropriate given the type of the boiler.

Resolution:

The AC does not agree with the Auditor's resolution. The AC agrees with the CPSV contractor that the most reasonable baseline is replacement of the red-tagged boiler with a standard efficiency boiler. Therefore, the verified savings should be reduced by the amount of the Auditor's increase (2,691,268 m3). **New realization rates were calculated based on a stratification of this finding and were applied to the entire custom project C/I portfolio.**

Recommendation #11

The Auditor recommended decreasing the EUL for one specific Industrial Control Programming measure from 15 to 10 years. The EUL for an Industrial Control Programming measure should not exceed the EUL of commercial building controls, which, according to Union's Custom Offering EUL and Base Case Assumptions document, is 15 years. Since the building automation system this project was already five years old, the Auditor discounted the EUL by 5 years to yield a 10 year EUL.

Resolution:

The AC accepts the Auditor's recommendation for the purpose of the 2012 audit. Union will consider investigating the appropriate EUL associated with industrial controls in comparison to commercial building controls. **This recommendation decreased project-level cumulative natural gas savings for one audited project by a total of 1,197,757m3 from the verified savings value**.

Recommendation #12

The Auditor recommended increasing the EUL for two specific Industrial Control Programming measures from 12 years to 15 years to match the value used for Commercial Controls Systems. The EUL for an Industrial Control Programming measure should be consistent with the EUL of commercial building controls, which, according to Union's Custom Offering EUL and Base Case Assumptions document, is 15 years.

Resolution:

The AC accepts the Auditor's recommendation for the purpose of the 2012 audit. Union will consider investigating the appropriate EUL associated with industrial controls in comparison to commercial building controls. This recommendation increased project-level cumulative natural gas savings for two audited projects by a total of 2,944,297m3 from the verified savings value.

Recommendation # 13

Union's sampling consultant should either not retroactively reclassify sample points to other strata or if so explain the rationale for this reclassification.

Resolution:

The AC will refer Auditor's recommendation to the TEC for inclusion in future sampling methodology. It should also be made clear in future Auditor RFPs that the Auditor accept the sampling methodology as presented to them but that qualitative discussion on the issue can be included in the Audit report.

Recommendation # 14

In future audits, the sampling consultant should provide more details about their definition of the 90% one-sided confidence interval and more details about calculations, such as showing the absolute errors.

Resolution:

The AC will refer Auditor's recommendation to the TEC for inclusion in future sampling methodology. It should also be made clear in future Auditor RFPs that the Auditor accept the sampling methodology as presented to them but that qualitative discussion on the issue can be included in the Audit report.

Recommendation # 15

Union should confirm with the sampling consultant that the sample within each stratum is truly randomly selected with equal probability of selection and without bias. The Auditor was concerned that smaller sites within strata may have been omitted from the sample selection process. While the sampling consultant did this with the "Very Small" stratum, and reported that they did this, it would be inappropriate to sample within each stratum non-randomly. However, there is no evidence that the sampling consultant biased the selection in this way apart from the "Very Small" stratum.

Resolution:

The AC will refer the Auditor's recommendation to the TEC for inclusion in future sampling methodology. It should also be made clear in future Auditor RFPs that the Auditor accept the sampling methodology as presented to them but that qualitative discussion on the issue can be included in the Audit report.

Recommendation #16

Union should include a note in the annual report that adjustments to water and electricity are based on sample realization rates, which were designed to be statistically significant for natural gas. Union Gas applied the sample realization rates for water and electricity to the population to calculate population savings. Although this is not the appropriate approach to assessing population savings based on a sample, since these results are not used in financial calculations, there is no impact on LRAM or performance incentives.

Resolution:

The AC will refer the Auditor's recommendation to the TEC for inclusion in future sampling methodology. It should also be made clear in future Auditor RFPs that the Auditor accept the sampling methodology as presented to them but that qualitative discussion on the issue can be included in the Audit report.

Low-Income Scorecard: Custom Program Recommendation

Recommendation #17

Union should consider further study of appropriate EUL for energy efficient windows. The Auditor studied sources for approved EUL values, including reviewing the EULs recently approved for energy efficient windows by the Regional Technical Forum (RTF). The Auditor found the RTF has approved an EUL of 25 years for energy efficient windows applied to manufactured homes and 45 years for single family homes. The Auditor found the range of 20-25 years as being not unreasonable.

Resolution:

The AC accepts this recommendation.

Large Industrial Rate T1 and Rate 100 Scorecard: Custom Program Recommendations

Recommendation #18

Moving forward, Union should use the point value calculated by the Verification Consultant to determine population-level impacts instead of the sample mid-point. The Verification Consultant provided a high and low estimate for annual gas savings for 6 of 17 verified Large Industrial projects. The average of the range was used to calculate gas savings. As some ranges are asymmetrical, some estimates of cumulative gas were not based on the estimate that the Verification Consultant reported. These numbers were provided to the Sampling Consultant to calculate population savings. Upon review, the impact of using the point estimate on the

sample realization rate and cumulative natural gas savings resulted in a decrease of less than 0.01% and 0.4% respectively. This will likely not have any material impact on the population realization rate. The Auditor accepts the findings but in the future Union should use the point value calculated by the Verification Consultant to determine population-level impacts.

Resolution:

The AC accepts the Auditor's recommendation for the purposes of 2012. With respect to future CPSV RFPs, Union will request that the verifier provide a point estimate to be used for the purposes of the audit.

Recommendation #19

Union should reduce the savings for heat exchangers in custom Large Industrial Rate T1/Rate 100 projects by 50% to account for the uncertainty around baselines and the degradation of savings over time.

Resolution:

The AC accepts the Auditor's recommendation for the purpose of the 2012 audit. New realization rates were calculated based on a stratification of these audit findings and were applied to the entire Large Industrial Rate T1/Rate 100 portfolio. This results in a decrease of 63,315,091 cumulative m3 to the Large Industrial scorecard. However, the corresponding affect on DSM incentive is above the $1.807M cap and, as such does not alter the DSM incentive earned for this scorecard in 2012.

All members agree that savings cannot be calculated without the collection of adequate baseline information. In custom projects, savings will not be recognized in the future without collecting baseline information that can support savings estimates.

For projects that involve savings degradation, Union will instruct all relevant staff and evaluators that degradation must be taken into account in savings calculations.

Where the conservation measure is of a behavioural or maintenance nature, the information about the customer's current practises (prior to participation in the program) must be collected. For example for steam leak repairs the rules being used by the customer or their schedule for repairing steam leaks, and at what pace steam leaks are being repaired before Union's involvement must be established.

Market Transformation (Optimum Home) Scorecard Recommendation

Recommendation #20

Union should shift one Optimum Home builder from the Top 10 Builder metric to the Top 50 Builder metric within the Market Transformation scorecard. This decreases the number of builders in the Top 10 to 3 and increases the number of builders in the Top 50 to 8.

Resolution:

The AC accepts this recommendation. Union proactively indentified this change after an additional review of the information used to calculate the number of home built per builder

revealed that proxies had been used in lieu of the actual number of 2011 builder multi-attachments, which became available during the audit. The shift reduces the DSM incentive for the Market Transformation Scorecard by $16,521.

Recommendations Brought Forward by the Auditor and the AC That Reflect Audit Process Issues

Recommendations presented below were either put forward by the Auditor or were made by the intervenor members of the AC. Recommendations in this section of the report are more process and evaluative in nature and do not impact the DSM natural gas savings claim, DSM utility incentive, or LRAM.

Recommendation #21

In future studies, Union should request that Verification Consultants use zero decimal places when reporting verified gas savings in order to match number of decimal places used in original claim. One Verification Consultant used 3 significant decimal points whereas the reported savings values were rounded to zero decimal points. This approach resulted in different cumulative gas savings when reported and verified annual savings appeared identical. The impact of using this approach was a 0.5% increase in cumulative savings. The Auditor accepts the verified savings for these projects but recommends using zero decimal places in annual gas savings to match original values in future studies.

Resolution:

The AC accepts the Auditor's recommendation and will share it with the TEC to enable standardization.

Recommendation #22

More detailed project documentation should be required for claiming savings to avoid having to make assumptions about unverifiable parameters that have substantial effects on the savings estimates (e.g. gasket type, thickness and extent and duration of rupture for steam leaks, etc.). Photographs and physical evidence would be extremely valuable.

Resolution:

The AC accepts the Auditor's recommendation. Union will use its best efforts to continue to improve its project data collection.

Recommendation #23

Require Union to collect specific information for custom projects of the same type. Since many custom projects are similar, including insulation repair, steam leak repair, and steam trap repair, Union should require specific information be collected before repairs are started. This could be easily incorporated into any scope of work associated with these projects and make estimating energy savings simpler and more accurate.

Resolution:

The AC accepts the Auditor's recommendation. Union will use its best efforts to continue to improve its project data collection.

Recommendation #24

Union should require the customer to provide more detailed information on the base case for custom projects of a certain absolute savings size (e.g. 1 million m3) to better quantify conditions before and after the measure's implementation. Union could involve an evaluator at pre-implementation stage for these projects to review savings calculations and assumptions, determine baseline, and set up an M&V plan for data collection.

Resolution:

The AC accepts the Auditor's recommendation. Union will use its best efforts to continue to improve its project data collection.

Recommendation #25

Union should develop better EULs for control settings. Union should continue to investigate how best to handle EULs for controls settings in commercial and industrial settings and provide clear and consistent guidelines.

Resolution:

The AC will bring this recommendation forward to the TEC.

Recommendation #26

Union should clarify CPSV roles for Verification Consultants and Auditors. The role of the Auditor includes reviewing draft findings with Verification Consultants before CSPV reports are finalized and shared with the AC Team. There is confusion about roles of CPSV Verification Consultants and the Auditor and some Verification Consultants refer to their work as audits. The Auditor sees the most practical CPSV role as balancing:

- Simpler verification for projects conducted in the program year. Verify installation and operating conditions and update assumptions with better data and limited measurement.
- More comprehensive evaluation for projects carried over from the previous program year to allow more time to evaluate. Include a greater degree of billing analysis and independent estimation approaches.
- Require more details on baselines for projects of a certain savings level (e.g. 1 million m3). Union could involve an evaluator at pre-implementation stage for these projects to review savings calculations and assumptions, determine baseline, and set up an M&V plan for data collection.

Resolution:

While the AC doesn't necessarily agree with all solutions, Union is working with the TEC to review these recommendations to refine and standardize the process.

Recommendation #27

Include all formulas in the Audit Tool if they cannot be directly verified in the verification report. For ESK adjustment factors, the factors found within the audit tool were not linked back to its source data; confirming appropriate calculation of adjustment factors required review of data not provided within the audit tool.

Resolution:

The AC accepts the Auditor's recommendation. Union will ensure that future audit tools maintain a clear link between all source data (survey results, verification results, program results, etc.) and calculated values.

Recommendation #28

Develop guidelines about how to differentiate issues related to baselines, EUL, and free riders.

Resolution:

The AC accepts the Auditor's recommendation. Union will provide the Auditor's recommendation to the TEC for consideration in establishing a harmonized process for both gas utilities.

Recommendation #29

Union should not use vendor's energy savings calculations for rebates unless independently verified. Vendor calculators include spreadsheets or other packaged calculators that take a few inputs and output expected savings. The source code and calculation methods are often not transparent; their purpose is to sell a particular product, not to accurately determine energy savings and thus they are often wildly optimistic.

Union Gas developed eight custom calculators for use in assessing savings. The Auditor briefly reviewed the calculators by following the code and found that the calculators are acceptable tools.

Resolution:

The AC accepts the Auditor's recommendation. Union will continue to use its custom savings calculators and limit vendor tools. In instances where Union's calculators are not able to provide savings calculations, Union will rely upon 'best available information' to calculate savings provided that this information is independently corroborated.

Recommendation #30

The Auditor recommends conducting additional marketing and outreach directed at homeowners as part of the Optimum Home program. Increasing homeowners' awareness of the program could be an additional metric to track. This would involve a baseline survey followed by annual surveys measuring any increase in homeowner awareness. While the Auditor agrees that builders should be the top priority, the goal of the program is to transform the entire market.

Resolution:

The AC collectively disagrees with the Auditor on this recommendation. The existing program elements are detailed in the settlement agreement and the focus on builders was intentional. The AC considers this recommendation to be a program design issue not an Audit issue.

Recommendation #31

The Auditor noted as follows: "Some custom projects were completed before 2012, but these projects had not been previously claimed and Union wanted to wait until they had more data on post-installation in order to increase the accuracy of the savings results". The intervenor members of the AC expressed a concern that this may not be consistent with the assumptions underlying the DSM Framework.

Resolution:

Projects are implemented and/or commissioned in advance of tracking the claim, particularly in cases where additional supporting data is considered necessary to support the project savings claim. Union has confirmed to the AC that incentives are paid to the customer after the project is included in the DSM tracking system. It is at that time that the savings are included in Union's claim. This means that in some cases, project completed in a previous year are claimed in the current calendar year in limited circumstances where additional information is required.

On the basis of this practice, the AC has accepted the inclusion of 278.5 Mm3 of savings from projects in-service in 2011 in the 2012 Resource Acquisition scorecard, 450.1 Mm3 of savings from projects in-service in 2011 in the 2012 Large Industrial Rate T1 Rate 100 scorecard, and 0.2 Mm3 of savings from projects in-service in 2011 in the 2012 Low Income scorecard. For 2012, the impact of the inclusion of pre-2012 projects is to increase the 2012 Resource Acquisition shareholder incentive by $3.1M, and the 2012 Large Industrial Rate T1 and Rate 100 shareholder incentive by $1.2M. The 2012 Low Income shareholder incentive remains above the cap.

The AC agrees that this practice can continue in the current manner for 2013 and 2014, but that an express protocol with respect to timing of recognition of projects should be included in the next DSM Framework."

Impacts of Audit Recommendations

Claimed Cumulative m3 savings

Recommendations that adjusted cumulative m3 savings had the following impact to values claimed in Union's pre-audit Annual Report.

Table 1 – Impact of Audit Recommendations on 2012 Cumulative Gas Savings (m3)

	Union pre-Audit Annual Report	Audit Findings	Difference
Resource Acquisition	900,443,984	887,302,617	-13,141,367
Large Industrial Rate T1 and Rate 100	1,456,247,081	1,392,931,990	-63,315,091
Low Income	56,104,622	56,116,031	11,409
Market Transformation	NA	NA	NA
Total	2,412,795,687	2,336,350,638	-76,445,049

Claimed DSM Incentive Amounts

Recommendations that resulted in adjustments to cumulative m3 savings had the following impact on the Utility DSM incentive values claimed in Union's pre-audit Annual Report.

Table 2– Impact of Audit Recommendations on 2012 DSM Utility Incentives

	Union pre-Audit Annual Report	Audit Findings	Difference
Resource Acquisition	$3,868,403	$3,496,862	-$371,541
Large Industrial Rate T1 and Rate 100	$1,806,595	$1,806,595	$0
Low Income	$2,725,227	$2,725,227	$0
Market Transformation	$198,255	$181,734	-$16,521
Total	$8,598,480	$8,210,417	-$388,063

Claimed LRAM Amounts

Recommendations that adjusted cumulative m3 savings had the following impact on the Utility LRAM values claimed in Union's pre-audit Annual Report.

Table 3 – Impact of Audit Recommendations on 2012 LRAM Claim

	Union pre-Audit Annual Report	Audit Findings	Difference
South			
M1 Residential	$85,858	$84,494	-$1,364
M1 Commercial	$99,183	$96,524	-$2,659
M1 Industrial	$1,708	$1,657	-$51
M2 Commercial	$171,709	$163,108	-$8,601
M2 Industrial	$86,156	$78,664	-$7,492
M4 Industrial	$59,831	$53,751	-$6,080
M5 Industrial	$154,170	$138,394	-$15,776
M7 Industrial	$1,566	$1,405	-$161
T1 Industrial	$61,366	$51,328	-$10,038
South total	**$721,547**	**$669,325**	**-$52,222**
01 Residential	$42,969	$42,127	-$842
01 Commercial	$60,146	$59,724	-$422
10 Commercial	$100,200	$95,441	-$4,759
10 Industrial	$57,943	$52,166	-$5,777
20 Industrial	$14,569	$13,079	-$1,490
100 Industrial	$19,685	$16,464	-$3,221
North total	**$295,513**	**$279,001**	**-$16,512**
Total	**$1,017,060**	**$948,326**	**-$68,734**

Appendix A: 2012 Audit of DSM Annual Report RFP

REQUEST FOR PROPOSAL

Independent Audit of 2012 DSM Annual Report

December 3, 2012

BACKGROUND

Union Gas Ltd (Union) has been delivering Demand Side Management (DSM) initiatives since 1997 to its broad customer base. DSM activities include planning, developing, implementing and evaluating energy efficiency initiatives for residential, commercial, industrial and low income markets. Union's DSM activities are regulated by the Ontario Energy Board (OEB/Board) and adhere to the requirements as laid out in the newly implemented EB-2008-0346 DSM Guidelines for Natural Gas Utilities.[1]

In the new Guidelines, the DSM Shareholder Incentive is no longer based on TRC, but on scorecards with a focus on lifetime cumulative cubic meters of natural gas savings.

The OEB DSM Guidelines include two financial mechanisms: the Demand Side Management Variance Account (DSMVA) and the Lost Revenue Adjustment Mechanism (LRAM), with a provision for a DSM Shareholder Incentive.

The Guidelines establish an annual cap for the 2012 DSM Shareholder Incentive at $9.45M to be escalated for inflation in subsequent years. This cap was later increased by the Board to $10.45M to reflect the increased budget for the utilities' Low Income programs.

Program results are presented in a detailed Annual Report which is then subject to a third party audit. The 2012 DSM Annual Report contains a review of DSM program results and will be provided to the auditor.

As part of the new framework, the utilities worked with intervenor (active participants before the OEB) stakeholder groups to develop a "Joint Terms of Reference on Stakeholder Engagement for DSM Activities by Enbridge Gas Distribution Inc and Union Gas Limited" (hereto referred to as ToR) for the 2012-2014 Plan period.[2]

In accordance with the ToR, each utility will have an Audit Committee (AC). Comprised of three intervenor representatives and a utility representative, the goal of the AC is to ensure that there is, each year, an effective and thorough audit of the utility's DSM results.

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[1] http://www.ontarioenergyboard.ca/OEB/_Documents/Regulatory/DSM_Guidelines_for_Natural_Gas_Utilities.pdf

[2] http://www.ontarioenergyboard.ca/OEB/_Documents/Documents/UNION_SettlementP_20120131.pdf, Attachment A

OBJECTIVE

The primary objective of the audit is to provide an independent opinion to DSM stakeholders (i.e. the OEB, Intervenor consultative members, and the utility), that serves to determine if the DSMVA , LRAM and utility DSM Shareholder Incentive calculations are appropriate.

The auditor should include in their final report or subsequent memo an independent professional opinion in the following form, with or without qualifications:

We have audited the Annual Report, DSM Shareholder Incentive, Lost Revenue Adjustment Mechanism (LRAM) and Demand Side Management Variance Account (DSMVA) of Union Gas Ltd for the calendar year ended December 31, 2012. The Annual Report and the calculations of DSM Shareholder Incentive, LRAM, and DSMVA are the responsibility of the company's management. Our responsibility is to express an opinion on these amounts based on our audit.

We conducted our audit in accordance with the rules and principles set down by the Ontario Energy Board in the DSM Guidelines for Natural Gas Utilities (EB-2008-0346). Details of the steps taken in this audit process are set forth in the Audit Report that follows, and this opinion is subject to the details and explanations therein described.

In our opinion, and subject to the qualifications set forth above, the following figures are calculated correctly using reasonable assumptions, based on data that has been gathered and recorded using reasonable methods and accurate in all material respects, and following the rules and principles set down by the Ontario Energy Board that are applicable to the 2012 DSM programs of Union Gas Ltd:

DSM Shareholder Incentive Amount Recoverable	-	*$x,xxx,xxx*
LRAM Amount Recoverable	-	*$x,xxx,xxx*
DSMVA Amount Recoverable	-	*$ xxx,xxx*

REPORTING STRUCTURE

Although Union is technically a member of the AC, for the purpose of this RFP, the “AC” will be considered intervenor consultative representatives only and will not include Union Gas. 2012 Union AC members are: Julie Girvan representing Consumers Council of Canada, Kai Millyard representing Green Energy Coalition, and Jay Sheppard representing School Energy Coalition.

The AC members, together with the utility representative, endeavor to reach consensus on both a bidders list for the auditor RFP and selection of the winning bid. In the event consensus is not possible, the utility has responsibility for final selection of the firms on the bidders list and the non-utility AC members make the final decision on the selection of the auditor from among those submitting bids. In practice, consensus on both has been the norm.

The following excerpts from the ToR outline the primary function of the AC with respect to the Audit itself:

- "The auditor will receive guidance and direction from the AC (e.g., on the scope of work, draft work plans, and draft work products). However, the Auditor's report and effort will be independent of utility or intervenor control or influence."[3]
- The AC will make recommendations based on the Audit Report regarding the utility's claims regarding DSM results and DSMVA, LRAM, utility DSM Shareholder incentives and any target adjustments through the AC Report submitted to the Board."[4]

The AC will also help to ensure that the process enables the utility to file the Final Auditor's Report and recommended DSMVA, LRAM and DSM Shareholder Incentive claims by June 30th as required by the Board's Directive and in keeping with the Guidelines.

While the AC will provide guidance and direction throughout the audit process, "The utility will administer the audit contract and hold the auditor accountable to the terms of the contract."[5]

The initial start-up meeting with the Auditor will be held with all members of the AC to ensure a consistent understanding among all parties of the scope and expectations of the independent audit. Additional meetings between all Committee members and the Auditor will be arranged for group discussion and progress reporting. Meetings will be held at Company offices or through conference calls as appropriate.

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[3] http://www.ontarioenergyboard.ca/OEB/_Documents/Documents/UNION_SettlementP_20120131.pdf, Attachment A, page 15 of 21.

[4] ibid, page 13 of 21.

[5] Ibid, page 15 of 21.

SCOPE AND REQUIREMENTS

"The Auditor shall, at a minimum:

- provide an audit opinion on the DSMVA, LRAM and DSM Shareholder Incentive amounts proposed by the natural gas utility and any amendment thereto;
- confirm any target adjustments have been correctly calculated and applied;
- identify any input assumptions that either warrant further research or that should be updated with new best available information;
- review the reasonableness of any verification work that has been undertaken to inform utility results; and
- recommend any forward-looking evaluation work to be considered."[6]

The Auditor selected for this task will be expected to exercise his/her expert judgment to determine the elements of the audit, and to set the approach and process that will be followed in the audit in order to meet the regulatory requirements as stated above.

The deliverable will be a written report outlining the principles of the audit, the methodology followed, and the findings and recommendations of the audit, including an opinion in the form set forth above.

The following list outlines activities that are expected to be carried out for the purpose of this audit. The Auditor is encouraged to propose other tasks that they believe would be helpful in reaching the study objective.

Audit Activities

1. Consider and respond to stakeholder comments on Union's Annual DSM

[6] Ibid, page 17 of 21.

Report for 2012, including those of the AC.

2. Review Union's 2012 procedures for tracking program participants and determine whether they lead to accurate counts, particularly for programs that do not provide customer rebates.
3. Determine whether Union's reported values for participation, measure lives and gas savings are appropriate for calculation of LRAM and DSM Shareholder Incentive. This shall include assessing: (1) whether values are adequately documented by program records, evaluation studies and other relevant data; (2) where applicable, whether assumptions regarding measure lives and gas savings are in line with Board/TEC (Technical Evaluation Committee) approved values for calculation of the DSM Shareholder Incentive; and (3) the reasonableness of measure lives and savings for the calculation of LRAM and DSM Shareholder Incentive. As a general rule, the Auditor should follow TEC-adopted prescriptive measure assumptions. The Auditor will apply prescriptive assumption changes for the audit year only for exceptional items that are material, where the justification for the change is clear and when failure to make changes would otherwise prevent the Auditor from giving an opinion as to the reasonableness of the utility's savings claims.
4. Review measures that are considered advancements rather than replacements to ensure measure lives and gas savings are treated appropriately. As part of such consideration of advancement measures the Auditor shall assess both whether gas savings and measures lives are estimated in line with models developed in the last 2 years and whether such models are reasonable.
5. Review and verify the accuracy of all calculations leading up to the proposed DSMVA, LRAM, and DSM Shareholder Incentive amounts and verify that the calculations are consistent with the Board-approved prescribed methodology.
6. In accordance with OEB direction, Union, in consultation with their AC have retained independent third party engineering consultants to undertake a detailed review of the savings estimates for Custom Project Savings Verification (CPSV) for custom projects. To ensure that the auditor may rely on the reports of the third party engineering firms in giving the auditor's opinion on the reasonableness of the utility's claims re: DSMVA, LRAM and DSM Shareholder Incentive, the AC has made provision for the Auditor to work with the selected firm to enable the review of both the draft and final reports and an opportunity to discuss individual projects, any findings and adjustment factors recommended throughout the firm's review. The Auditor will be expected to ultimately provide an opinion as to the quality of the CPSV report and the consultant's adherence to the ToR and the reliability and reasonableness of the error ratio (and/or realization rate) when applied to a larger population of custom projects. Any recommendations to change realization rates from those recommended by the CPSV will be explained and

substantiated by relevant research/documentation.

7. The auditor will also review all verification studies conducted in support of the DSM Annual Report and ensure the conclusions are sound and that the results have been appropriately incorporated into the calculation of the DSM Shareholder Incentive.
8. Identify any assumptions underlying Union's DSM program design that should be modified prospectively, based on the auditor's experience, the results of the audit, and knowledge of other studies or data.
9. Identify future evaluation research opportunities to enhance the assumptions used to calculate the DSM Shareholder Incentive and LRAM.
10. The Auditor shall also provide an opinion as to the usefulness of Union's market transformation metrics as indicators of success in market transformation and, where applicable, propose alternatives that may be better indicators to use in the future.
11. Work with the AC and Union to resolve any relevant issues prior to completion of the audit.
12. Identify any other matters considered by the Auditor to be relevant to an assessment of Union's DSMVA, LRAM and DSM Shareholder Incentive claims.

Audit Resources

To assist the Auditor in conducting the audit, all relevant Union documentation will be made available to the Auditor for review. Union is committed to providing the necessary data and tools the Auditor deems reasonably necessary in order to meet the ultimate goal of the audit.

SCHEDULE

Following the Board Directive of December 2004, the independent audit of DSM results is to be completed and a recommendation filed with the Board by the last day of the sixth month after the financial year end.

Due to the importance to meet these Board imposed deadlines, the Auditor will be contractually bound to meet the deadlines outlined in their proposal. If due to the Auditor's negligence, the Auditor has not provided the AC with the deliverables, 10% of the amount payable to the Auditor may be deducted for each week beyond the deliverable dates specified herein that the Auditor has not provided the AC with the deliverables.

Audit Schedule	
Activity	**Due**
RFP Dissemination	December 4, 2012
Questions of Clarification	December 11, 2012
Proposals Due	January 7, 2012 – 4:00 PM E.S.T.
Contract Awarded	January 21, 2013
Launch Meeting & Audit Work Plan	Week of January 28, 2013
1st Phase CPSV Draft Report Review	Week of January 28, 2013
2nd Phase CPSV Draft Report Review	Week of March 11, 2013
DSM Annual Report sent to Auditor	April 1, 2013
AC & Consultative Comments on Annual Report	On or before April 10, 2013
Draft Audit Report	On or before May 17, 2013
Response from Union and AC	On or before May 31, 2013
Final Draft Audit Report	On or before June 3, 2013
Final Audit Report	June 10, 2013

SELECTION CRITERIA

Proposals will be evaluated on the following criteria listed in approximate order of importance:

Qualifications & Experience of Project Team

- Qualification and experience of key project personnel in evaluation of natural gas utility DSM programs
- Relevant engineering (preference for a Professional Engineer), particularly in understanding Commercial and Industrial Custom Projects
- Allocation of work and years of relevant experience of key personnel
- Experience in Ontario and knowledge of the DSM regulatory framework for natural gas utilities
- Experience to include both market transformation and resource acquisition programs for all market sectors (residential, commercial, industrial, and low-income)
- Demonstrated ability to work with (and be viewed as credible and objective by) a variety of different types of stakeholders, including utilities, environmental groups, consumer groups and industry

Approach

- Logical presentation of a clear and comprehensive approach & method, including description of quantitative and qualitative assessments that will be used
- Outline of the audit principles that will guide the work
- Provide supporting rationale for described approach
- Quality, depth and clarity of writing in the proposal and work plan

Cost and Administration

- Reasonableness of cost proposal including allocation of dollars per task and team member
- Ability to work in Eastern Standard Time (E.S.T.) regular business hours

MANDATORY PROPOSAL REQUIREMENTS

The proposal must include the following elements:

- A clear disclosure of any potential conflict of interest,
- A description of the methodology and approach to be used in the audit,
- A list of proposed tasks,
- Suitable information for the AC to determine the qualifications of individuals and their roles in the project:
    - Breadth of expertise in impact evaluations of gas DSM
    - Experience in developing deemed savings and/or review of year end savings calculations
    - Identify exact nature of historic experience with DSM in Ontario
    - Identify and describe technical expertise that the firm would bring to the role for the review of the CPSV
    - Focus on examples of experience in the past 5 years
- Confirmation that the proponent will be able to meet the “Utility” contractor insurance and WSIB requirements as described in the attachment, and,
- Confirmation of ability to meet timelines or specific reasons why a deviation from the schedule is required.

The cost proposal must include:

- Breakout of costs by task and roles,
- Assumptions regarding the number of meetings at the ”Utility” offices and the associated costs, and
- Hourly rates for additional related work such as appearing as an expert witness at the OEB.

Proposals are due no later than 4:00pm EST December 17, 2012. Proposals must be submitted in electronic format via email.

Questions of clarification should be directed to utility representative at the coordinates indicated below. Responses to questions of clarification will be circulated to all respondents.

Proposals should be sent to the attention of the full AC as listed in Appendix A.

Appendix A – Audit Contacts

Utility Representatives - Union Gas

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