London Hydro

System Planning Report SP04-05

Towards a Sustainable Energy Future: Master Plan of Strategies and Approaches for Energy Conservation and Demand-Side Management Investments

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Credits

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Part 1 – Our energy conservation and demand-side management programs at a glance…

Executive Summary

In response to the blackout in the summer of 2003, Ontario's *Electricity Conservation and Supply Task Force* called for the creation of a culture of conservation as a means to save energy, money and the environment. "Last year's blackout affected 50 million people in North America and reinforced the need to address the looming electricity supply challenge Ontario faces," said Energy Minister Dwight Duncan. "We all need to work together to develop more aggressive measures to both conserve electricity and to generate cleaner sources of alternative power." The Minister further noted, "Local Distribution Companies (LDCs) are extremely well placed to encourage conservation and energy efficiency in the communities they serve, and we will need all their expertise, ingenuity and leadership to help build that conservation culture in Ontario." To that end, the Minister of Energy authorized electricity distributors to apply to the OEB for the recovery of the third (3rd) instalment of the market adjusted revenue requirement (MARR), on the condition that a one year equivalent amount of incremental revenue is invested by those distributors in conservation and demand management activities.

London Hydro is pleased to submit this plan of proposed energy conservation / demand-side management initiatives. This plan not only fulfills the regulatory requirement, but also in a significant manner contributes towards building the conservation culture in London and surrounding areas.

London Hydro has a rich history of very successful energy conservation, demand-side management, and energy marketing programs. London Hydro in the past has launched our flagship SAVE$™ electric storage water heater control program in 1992, followed in 1994 by SAVE$-Plus™ thermal energy storage heater program coupled with innovative time-of-use rate structure. Conversion of roadway lighting systems to high-pressure sodium fixtures in late 1991 / early 1992 reduced energy costs by 22 percent. These savings continue to this day. The portfolio of initiatives within this Plan clearly demonstrates that London Hydro has retained both the know-how and passion to succeed. London Hydro's approach to the current energy conservation / demand-side management initiative will be no less aggressive and successful.

This plan puts forward a diversified portfolio of conservation / demand-side management initiatives and is intended both to permit all customers (including low income and other hard to reach consumers) to participate in at least one conservation / DSM program, and to minimize cross-subsidization.

Wherever possible, our proposed initiatives have been leveraged by dovetailing with a number of federal, provincial, and municipal programs. The overall value of the energy conservation and demand-side management programs will be greater than London Hydro's $2.8M contribution, since additional funding streams are expected to be available from federal, provincial and municipal government-sponsored programs.

While some of the programs are initially targeted to the London market, we believe that in time they can be expanded to regional or provincial activities. With this prospect in mind, London Hydro has been exchanging ideas with other LDCs and endeavouring to share project development, advertising, and other common program costs. As the Ontario Power Authority (OPA) and its Conservation Bureau are established in the future, London Hydro will provide all the assistance as well as our plans to OPA to ensure the long-term continuity of some or all of these activities.

London Hydro is committed to doing its part (and then some) towards the overall Provincial goal of fostering a conservation culture. To monitor the effectiveness of the program, London Hydro will track energy savings at the project level.

London Hydro has developed the attached plan in accordance with the Ministry of Energy's letter of May 31, 2004 and the ensuing procedural order issued by the OEB. The attached plan is broken into two main sections. The first section is made up of Project Data Sheets that describe the program, major highlights of the program, targeted market (i.e. customer class), benefits of the program, and the cost of the program. The second section is a detailed report on all projects including a description of the methodology, prioritization methodology, review of technology adopted for the program, structure of the program, estimated energy savings, and cost benefit analysis. In total there are 14 programs targeted at all customer classes; the benefits of our CDM program are fairly distributed to all customer classes – 47% residential class and 53% to commercial/industrial class.

London Hydro Inc. hereby requests the Board's approval and final order authorizing its CDM plan, a summary of which is given in the table below, as being appropriate and effective in discharging its CDM investment obligation.

	Program Target Sector Budget		2004		2005		2006	
		Total	Capital	Operating	Capital	Operating	Capital	Operating
1	Traffic & Pedestrian Signals Upgrade	$ 808,500				$ 808,500		
2	Residential PowerCost Monitor	50,000				50,000		
3	Residential Appliance Recycling Program	842,500				441,250		401,250
4	Program to Increase Commercial Sector Energy Efficiency	304,000			25,000	74,000	25,000	180,000
5	Distribution Shunt Capacitor Program	125,000					125,000	
6	Combined Heat & Power (CHP) Opportunities	30,000		-		25,000		5,000
7	Energy Awareness in the Classroom Program	100,000				60,000		40,000
8	LCBO Warehouse Makeover Project	100,000				90,000		10,000
9	Residential Summer Comfort Program	25,000						25,000
10	Demand Response Enabling Technologies Program	69,000		5,500	57,000	5,000	1,500	
11	THAW Plus Program	50,000				25,000		25,000
12	Putting Our Own House in Order Program	33,000			33,000			
13	Community One-Tonne Challenge Plus Program	225,000			125,000	50,000		50,000
14	Public Education Campaign	75,000		2,000		32,000		41,000
		$ 2,837,000	$ -	$ 7,500	$ 240,000	$ 1,660,750	$151,500	$777,250

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LONDON HYDRO CONSERVATION & DEMAND-SIDE MANAGEMENT INVESTMENTS

Program Data Sheet

Program No. 1

Program Name:

Municipal Traffic & Pedestrian Signals Upgrade Project

Description:

London Hydro in conjunction the Corporation of the City of London have identified a significant opportunity to conserve a substantial amount of energy and reduce overall peak demand. This project undertakes the replacement of standard incandescent traffic and pedestrian signals with new Light Emitting Diode module.

Other Agencies:

None

Target Market:

Commercial (Municipal)

Benefits:

- Complete conversion of the traffic signals throughout the city to LED modules would result in a coincident demand reduction of 260 kW and an annual energy savings of 2,268,962 kWh.
- Complete conversion of the pedestrian signals throughout the city to LED modules would result in a coincident demand reduction of 210 kW and an annual energy savings of 1,840,353 kWh.

Budget:

	Program Target Sector Budget	2004			2005		2006	
		Total	Capital	Operating	Capital	Operating	Capital	Operating
1	Traffic & Pedestrian Signals Upgrade	$ 808,500				$ 808,500		

Methodology for Validating Efficiency Gains:

An independent auditor who will be provided with the information listed below will validate efficiency gains:

- a copy of this report which defines the scope of the project and anticipated savings;
- a copy of the invoice made out to the City of London that identifies the quantities and models of LED retrofit modules used to carry out the described retrofit project; and
- a signed statement by a staff Registered Professional Engineer at the City of London attesting to substantial completion of the work.

LONDON HYDRO CONSERVATION & DEMAND-SIDE MANAGEMENT INVESTMENTS

Program Data Sheet

Program No. 2

Program Name:

Residential PowerCost Monitor

Description:

London Hydro will install 70 PowerCost Monitors. The hypothesis being tested is that immediate and specific electricity end-use feedback will result in conservation behaviour. The pilot will determine the extent to which consumer behaviour is changed and electricity usage reduced by the availability of direct "real-time" feedback information of electricity consumption.

Other Agencies:

Hydro One Networks

Target Market:

Residential

Benefits:

It is estimated that energy savings would be 10% of the average residential consumption per customer. Given the average residential energy consumption the average energy savings will be 786 kW·h/month x 10% x 12 months/year ≈ 940 kW·h/yr per program participant.

Budget:

	Program Target Sector Budget	2004			2005		2006	
		Total	Capital	Operating	Capital	Operating	Capital	Operating
2	Residential PowerCost Monitor	50,000				50,000		

Methodology for Validating Efficiency Gains:

The methodology used for validating efficiency gains is mathematically quite complex but is described in the literature. In simple terms:

- for the participants and the control groups, the electrical loads for the year preceding the study period and the duration of the study period were adjusted to account for changes in weather patterns (i.e. if the summer season within the study period was unseasonably cool, then it would be necessary to attribute the greatly diminished air conditioning load to weather influences and not to conservation efforts), changes in appliances, and changes in household composition.
- after making these adjustments energy consumption levels will be compared before and after using the PowerCost Monitor.

As part of the project, attempts will be made to determine whether some groups of participants are more likely to show savings relative to others; and a statistical reliability (e.g., 95% confidence bands) will be calculated regarding estimated savings.

LONDON HYDRO CONSERVATION & DEMAND-SIDE MANAGEMENT INVESTMENTS

Program Data Sheet

Program No. 3

Program Name:

Residential Appliance Recycling Program

Description:

The residential appliance recycling program is designed to reduce energy usage by enticing eligible customers to upgrade to more energy efficient appliances (specifically those that meet the EnergyStar criteria) and to dispose of their operable, inefficient primary and secondary refrigerators, freezers and air conditioners in an environmentally safe manner and to ensure that the appliance being replaced does not enter the secondary market.

Other Agencies:

City of London's Air Policy Dept.
Clean Air Foundation
NRCan Office of Energy Efficiency
London Property Management Association
Ontario Ministry of Environment/Energy

Target Market:

Residential; multi-unit residential and assisted housing

Benefits:

Expected results would be an efficiency improvement > 50%, plus environmental benefits.

Budget:

	Program Target Sector Budget	2004			2005		2006	
		Total	Capital	Operating	Capital	Operating	Capital	Operating
3	Residential Appliance Recycling Program	842,500				441,250		401,250

Methodology for Validating Efficiency Gains:

For bulk-metered multi-tenant (apartment) buildings, actual revenue metering data will be used to validate the efficiency gains. The building's electrical load profile throughout the year prior to the refrigerator exchange will be compared with the post-exchange electrical profile (with adjustments made for changes in weather patterns, etc.).

For all other exchange or right-sizing projects, data from records systems will be available indicating the unit that was removed from service and its replacement. From this information, the gains in energy efficiency can be determined.

LONDON HYDRO CONSERVATION & DEMAND-SIDE MANAGEMENT INVESTMENTS

Program Data Sheet

Program No. 4

Program Name:

Program to Increase Commercial Sector Energy Efficiency

Description:

London Hydro will concentrate on a number of initiatives to increase energy efficiency in the commercial sector via a number of sub-programs. These sub-programs will be targeted at certain identified sectors and the number of sub-programs will increase through the duration of the Conservation Initiative. Current programs identified are the replacement of "Exit" signs and the installation of a device to reduce energy consumption in vending machines as these programs can be executed across the broad variety of the commercial entities. London Hydro will also participate in the "Cool Shops" program for small businesses which typically are overlooked in conservation programs

Other Agencies:

NRCan

Target Market:

Commercial, Industrial & Institutional

Benefits:

- The annual energy savings associated with the EnergyMI$ER control will depend largely on the pedestrian traffic level in the vicinity of the vending machine. The annual energy savings should range from 36% to 56%, assuming an average refrigerated vending machine consumes 3500 kWh/yr, the energy savings per unit will amount to about 1260 kWh/yr; and for customers in London the energy savings will translate into annual bill savings ranging from $90 to $150.
- LED Exit Sign Program – savings are expected to exceed 85%

Budget:

	Program Target Sector Budget	2004			2005		2006	
		Total	Capital	Operating	Capital	Operating	Capital	Operating
4	Program to Increase Commercial Sector Energy Efficiency	304,000			25,000	74,000	25,000	180,000

Methodology for Validating Efficiency Gains:

- For vending machines, a sample lot of machines will be monitored to validate savings.
- For the LED retrofit, the savings can be directly calculated.

LONDON HYDRO CONSERVATION & DEMAND-SIDE MANAGEMENT INVESTMENTS

Program Data Sheet

Program No. 5

Program Name:

Distribution Shunt Capacitor Program

Description:

This project entails installing capacitor banks on three distribution feeders for the purposes of reducing line losses.

Other Agencies:

None

Target Market:

LDC

Benefits:

Reduce line losses – changes in feeder configuration and loading since the original planning studies were carried out means that it would be prudent to update the load-flow analysis before quantifying specific demand and energy loss reductions.

Budget:

	Program Target Sector Budget	2004			2005		2006	
		Total	Capital	Operating	Capital	Operating	Capital	Operating
5	Distribution Shunt Capacitor Program	125,000					125,000	

Methodology for Validating Efficiency Gains:

Validation of the efficiency gains obtained via the installation of the capacitors will be validated by an unbalanced load-flow analysis using the Dromey DESS analysis software. The distribution system model will be calibrated to the existing loads on the respective feeders, and then two simulations will be done, one without the capacitors, and one with the capacitors. The difference in distribution line losses would be the benefit attributable to the capacitor banks.

LONDON HYDRO CONSERVATION & DEMAND-SIDE MANAGEMENT INVESTMENTS

Program Data Sheet

Program No. 6

Program Name:

Combined Heat & Power (CHP) Opportunities

Description:

This project involves identifying a diverse sample of small- to medium-size commercial customers that presently use natural gas to heat appreciable volumes of water for their processes. The primary focus of the project is not the generation of electricity. Rather firstly to meet the heating (and cooling needs) of the facility. Surplus thermal energy will be used to generate electricity to offset some of the customer's plant electrical load and increase the thermal efficiency from 35% to about 65%.

Other Agencies:

Possibly NRCan's CANMET

Target Market:

Commercial

Benefits:

The expected energy savings and cost of saved energy (CSE) will be determined as an integral part of the various feasibility studies.

Budget:

	Program Target Sector Budget	2004			2005		2006	
		Total	Capital	Operating	Capital	Operating	Capital	Operating
6	Combined Heat & Power (CHP) Opportunities	30,000		-		25,000		5,000

Methodology for Validating Efficiency Gains:

For a CHP project, the efficiency gain will be in the area of fuel combustion (natural gas) – the excess heat is used to generate electricity that will offset a portion of the customer's overall electric load.

Customers that are candidates for CHP projects likely already have an interval-style revenue meter installed. Efficiency gains can be validated by comparing the customer's electrical load profile prior to connection of a dispersed generator with the post-connection electrical profile and adjusting for changes in weather patterns, etc.

LONDON HYDRO CONSERVATION & DEMAND-SIDE MANAGEMENT INVESTMENTS

Program Data Sheet

Program No. 7

Program Name:

Energy Awareness in the Classroom Program

Description:

Building upon the success of the "The Power of Electricity" program, London Hydro plans to develop a complete conservation lesson program for the local school Boards. This program will develop a conservation mindset amongst the students and the Boards and assist in education our youth and encourage energy use reduction at the School Boards.

Other Agencies:

Thames Valley District School Board

London District Catholic School Board

Target Market:

Residential

Benefits:

As an education and awareness program, the benefits (in terms of energy savings) will be indirect, may not occur for several years, and even then will be difficult to quantify.

Budget:

	Program Target Sector Budget	2004			2005		2006	
		Total	Capital	Operating	Capital	Operating	Capital	Operating
7	Energy Awareness in the Classroom Program	100,000				60,000		40,000

Methodology for Validating Efficiency Gains:

Societal benefits of increased awareness on energy related matters are difficult to measure in a quantifiable manner.

LONDON HYDRO CONSERVATION & DEMAND-SIDE MANAGEMENT INVESTMENTS

Program Data Sheet

Program No. 8

Program Name:

LCBO Warehouse Makeover Project

Description:

The LCBO Warehouse is a very large warehouse office and facility that currently uses a mixture of outdated lighting and control technologies. London Hydro will assist the LCBO in updating the lighting and control technology. Also provided will be general assistance in energy use monitoring and planning. A case study will be developed to showcase the results of active energy management at a Key Account Seminar.

Other Agencies:

NRCan

Target Market:

Commercial / Industrial

Benefits:

The combination of modern technology and behaviour changes can cost-effectively reduce the energy consumption by more than 30%.

Budget:

	Program Target Sector Budget		2004		2005		2006	
		Total	Capital	Operating	Capital	Operating	Capital	Operating
8	LCBO Warehouse Makeover Project	100,000				90,000		10,000

Methodology for Validating Efficiency Gains:

The efficiency gains can collectively be measured directly via the interval meter that is presently installed for this customer.

LONDON HYDRO CONSERVATION & DEMAND-SIDE MANAGEMENT INVESTMENTS

Program Data Sheet

Program No. 9

Program Name:

Residential Summer Comfort Program

Description:

In recent years, summer peak electricity loads are almost entirely caused by residential and commercial air conditioning load. London Hydro will promote a program that will consist of three areas in which air conditioning load can be reduced via management of the building envelope, behaviour modification and the air conditioner itself. The program is scheduled for 2006 and details of activity are not complete at this time

Other Agencies:

CMHC and NRCan

Target Market:

Residential

Benefits:

A reduction in air conditioning load diminishes the need for peaking power plants, lowers power system infrastructure costs, and results in customer savings (as electricity is always most expensive during a heat wave).

Budget:

	Program Target Sector Budget		2004		2005		2006	
		Total	Capital	Operating	Capital	Operating	Capital	Operating
9	Residential Summer Comfort Program	25,000						25,000

Methodology for Validating Efficiency Gains:

The methodology for validating efficiency gains will be a part of the program design.

LONDON HYDRO CONSERVATION & DEMAND-SIDE MANAGEMENT INVESTMENTS

Program Data Sheet

Program No. 10

Program Name:

Demand Response Enabling Technologies Program

Description:

There are three distinct demand response techniques, direct load response, indirect load response and distributed generation technology. London Hydro will develop and provide the basic infrastructure necessary for the customers to be able to respond to the market conditions. These basic items will include interval metering and the availability of the interval data to the customer. Further processes such as the development of infrastructure to broadcast market prices and/or a demand response signal and feedback mechanisms to the LDC via the internet, IVR and web presentment. Customers will be able to choose their threshold for information detail and pricing constraints.

Other Agencies:

None

Target Market:

Commercial

Benefits:

This program is all about automatically providing customers with market pricing signals so that they may voluntarily undertake energy actions.

Budget:

	Program Target Sector Budget		2004		2005		2006	
		Total	Capital	Operating	Capital	Operating	Capital	Operating
10	Demand Response Enabling Technologies Program	69,000		5,500	57,000	5,000	1,500	

Methodology for Validating Efficiency Gains:

Since the customers that participate in this program will have an interval-style revenue meter installed, it will be fairly straightforward to list the program subscribers that set a price threshold at say 20 ¢/kW·h or greater, and review their respective revenue metering records after-the-fact to determine what, if any, load curtailment activities were undertaken.

LONDON HYDRO CONSERVATION & DEMAND-SIDE MANAGEMENT INVESTMENTS

Program Data Sheet

Program No. 11

Program Name:

THAW Plus Program

Description:

This program is meant to assist the lower income customers in managing their energy needs and improving efficiencies within their home without the penalizing them at a time when they are in a crisis situation. The THAW-Plus program will assist eligible customers in reducing their electricity consumption and providing the tools to help them use energy wisely and improve the efficiencies within their home.

Other Agencies:

United Way of London & Middlesex

Target Market:

Residential

Benefits:

Energy efficiency improvements will reduce expenditures on energy for those members of society least able to afford it.

Budget:

	Program Target Sector Budget	2004			2005		2006	
		Total	Capital	Operating	Capital	Operating	Capital	Operating
11	THAW Plus Program	50,000				25,000		25,000

Methodology for Validating Efficiency Gains:

Due to the anonymity of clients, there is no easy mechanism available for validating energy improvements.

LONDON HYDRO CONSERVATION & DEMAND-SIDE MANAGEMENT INVESTMENTS

Program Data Sheet

Program No. 12

Program Name:

Putting Our Own House in Order Program

Description:

If London Hydro is to be successful motivating others to take energy conservation measures, it is important that the organization "practices what we preach". London Hydro will perform an extensive review of energy usage with particular attention directed toward the HVAC system, light and building controls. It is expected that an update of technology is warranted and that this be a case study available to our customers as a demonstrable project.

Other Agencies:

None

Target Market:

Commercial

Benefits:

Once the range of alternative lighting designs for the Lower Stores building, the Stores yard, and other building spaces is established, the information would be entered into the appropriate spreadsheet, examples of which have been included within Appendix G for other projects. Based on the determined energy savings, an appropriate incentive amount would be automatically calculated, as is the case for all other projects. Similar analysis will be carried out for other initiatives.

Budget:

	Program Target Sector Budget	2004			2005		2006	
		Total	Capital	Operating	Capital	Operating	Capital	Operating
12	Putting Our Own House in Order Program	33,000			33,000			

Methodology for Validating Efficiency Gains:

London Hydro's head office complex is serviced via a number of supply points, each with an interval meter installed. The easiest method of validating efficiency gains is via actual metering data. The building's electrical profile throughout the year prior to the conservation measure will be compared with the post-measure electrical profile (with adjustments made for changes in weather patterns, etc.).

LONDON HYDRO CONSERVATION & DEMAND-SIDE MANAGEMENT INVESTMENTS

Program Data Sheet

Program No. 13

Program Name:

Community One-Tonne Challenge Plus Program

Description:

London's One-Tonne Challenge (OTC) Community Demonstration Project has been developed as in conjunction with the City of London and the Thames Regional Ecological Association as part of 41 community wide projects throughout Canada. London participation will include enhanced study of electrical usage reduction through information programs as well as the addition of interval meters enhanced with a second generation Power Cost monitor that will provide the customer with real time data and the capability to take advantage of the regulated price schema to be introduced in the near future.

Other Agencies:

University of Western Ontario, Electrical Engineering Faculty

Target Market:

All customers

Benefits:

Increased customer awareness regarding energy conservation would assist in self energy conservation activities.

Budget:

	Program Target Sector Budget		2004		2005		2006	
		Total	Capital	Operating	Capital	Operating	Capital	Operating
13	Community One-Tonne Challenge Plus Program	225,000			125,000	50,000		50,000

Methodology for Validating Efficiency Gains:

The effect of this project can be representatively measured under Program No. 2, Residential PowerCost Monitor Project.

LONDON HYDRO CONSERVATION & DEMAND-SIDE MANAGEMENT INVESTMENTS

Program Data Sheet

Program No. 14

Program Name:

Public Education Campaign

Description:

London Hydro's "public education campaign" involves leveraging the available information from government agencies with the range of strategies that will have a greater likelihood for motivating energy efficiency in the home and business. People are not all motivated in the same way, and hence a fusion of a multitude of strategies will be undertaken. London Hydro will be more visible in the community and actively participate in community initiatives and traditional sources of information gathering by the public such as home-shows.

Other Agencies:

Ontario Clean Air

University of Western Ontario, Faculty of Information and Media Studies

Target Market:

All Customers

Benefits:

General consumer awareness and education to promote a conservation culture in Ontario.

Budget:

	Program Target Sector Budget	2004		2005		2006	
		Total	Capital	Operating	Capital	Operating	Capital	Operating
14	Public Education Campaign	75,000		2,000		32,000		41,000

Methodology for Validating Efficiency Gains:

No quantifiable methods exist; however, the increased awareness and education will help increase the participation in other projects, as well as enhance the conservation culture in Ontario.

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Part 2 – Detailed descriptions of our energy conservation and demand-side management programs…

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1 INTRODUCTION

1.1 BACKGROUND

For more than 75 years, the electricity supply industry (generation, transmission and distribution) in Ontario was essentially a monopoly. Under this monopoly, the driving principle was to provide power to consumers at cost. However, by the mid-1990s, the cost of producing this power was rising sharply, and the debts incurred by the province's previous power generator, Ontario Hydro were reaching alarming heights.

In reviewing methods of reducing the debt, the Ontario government opted to deregulate the electricity market, in much the same way as the natural gas and long distance telephone industries had earlier been deregulated. As a result, Bill 35, *The Energy Competition Act, 1998* set out the framework for deregulation of the electric power industry in Ontario and the introduction of competition, where practical, into the system.

On May 1st, 2002 the Ontario electricity market opened to customer choice and competition. Unfortunately the combination of a prolonged heat wave and key generation facilities offline led to wild price fluctuations — as customers began to feel the financial strain, support for the Government initiative quickly waned, and there was growing pressure for Government intervention. For a variety of reasons (e.g. the Government-owned Ontario Power Generation was a predominant market-supplier and was seen as influencing market prices, the lack of large load-serving entities, missing market components such as a futures market to manage risk and price volatility, etc.), the new electricity market was unable to attract new investment and generation. To compound matters, Government intervention sent conflicting messages to suppliers and investors, further amplifying their concerns about market risk and instability.

Further, throughout the province, many energy conservation and demand-management programs were either discontinued or scaled back due to regulatory requirements. Local distribution companies (LDC), such as London Hydro, were permitted to operate only in areas that relate exclusively to wires distribution activities. As such, London Hydro no longer had the ability to fund and deliver energy management programs. In addition, whereas these activities could have continued under a retail affiliate company, London Hydro's shareholder (the City of London) elected not to set up a retail affiliate company to conduct competitive activities.

As a first step in overcoming the regulatory barriers against energy conservation and demand-management initiatives, Bill 210, *Electricity Pricing, Conservation and Supply Act, 2002* provided new powers for the Minister under the *Electricity Act, 1998* and the *Ontario Energy Board Act, 1998*. Specifically, it provided authority for the Minister to issue directives to the OEB that require the OEB to take steps to promote energy conservation, energy efficiency, load management and the use of cleaner energy sources, including alternative and renewable energy sources.

On August 14, 2003, large portions of the Midwest and Northeast United States and Ontario, Canada, experienced an electric power blackout. The outage affected an area with an estimated 50 million people and 61,800 megawatts (MW) of electric load in the states of Ohio, Michigan, Pennsylvania, New York, Vermont, Massachusetts, Connecticut, New Jersey and the Canadian province of Ontario. The blackout began a few minutes after 4:00 pm Eastern Daylight Time (16:00 EDT), and power was not restored for 4 days in some parts of the United States. Parts of Ontario suffered rolling blackouts for more than a week before full power was restored. Estimates of total costs in the United States range between $4 billion and $10 billion (U.S. dollars). In Canada, gross domestic product was down 0.7% in August, there was a net loss of 18.9 million work hours, and manufacturing shipments in Ontario were down $2.3 billion (Canadian dollars).[1] This single incident was the catalyst to focus attention and public policy debate on the issues and challenges faced by the Ontario electricity sector.

Just two months earlier, on June 27th, 2003, Energy Minister John Baird had announced the creation of *The Electricity Conservation and Supply Task Force* to provide recommendations on increasing the province's supply of electricity, improving the reliability of Ontario's electricity grid, and enhancing conservation and demand management programs. In January 2004, when the task force released their findings[2], included amongst the list of recommended reforms was:

- *Creating a "conservation culture" in Ontario: Making conservation, demand management and demand response strategies a cornerstone of Ontario's long-term energy future.*

Conservation, energy efficiency and demand management are crucial components of a provincial energy plan. They are the actions that control one whole side, the need side, of the energy supply and demand equation. How, when and for what purpose we use energy are just as important as the production of reliable, affordable and environmentally sound energy.

[1] *Final Report on the August 14, 2003 Blackout in the United States and Canada: Causes and Recommendations*; prepared by U.S.-Canada Power System Outage Task Force; April 5, 2004; pg 1 (available on NERC website: http://www.nerc.com/~filez/blackout.html).

[2] *Tough Choices: Addressing Ontario's Power Needs; Final Report to the Minister*; prepared by Electricity Conservation & Supply Task Force; January 2004 (available on Ontario Minister of Energy website: http://www.energy.gov.on.ca/index.cfm?fuseaction=electricity.taskforce)

With the legislated removal of many regulatory barriers to Ontario's LDC's instituting energy conservation, energy efficiency and demand management initiatives, there remained a program funding issue. Since the distribution tariffs are volumetric in nature, LDCs have no incentive (and, in fact, a large disincentive) to develop aggressive or cost-effective energy conservation programs.

On November 25th, 2003, the Ontario government introduced new legislation entitled the *Ontario Energy Board Amendment Act, 2003* to "… send a clear and powerful conservation message to Ontarians". Among other provisions, the legislation permits LDC's to achieve their full commercial return (that the previous government had put on hold) conditional upon the LDC's reinvesting the equivalent of one year of the monies in conservation and demand management initiatives.

Note: In his May 31st, 2004 letter to distributors, the Minister indicated that without limiting the range of innovative proposals that may be brought forward, he believes that "reasonable new expenditures on the planning, delivery and evaluation of the following specific measures should be supported by the Board:

- energy efficiency;
- behavioural and operational changes, including the application of benchmarking to "smart" control systems;
- load management measures which facilitate interruptible and dispatchable loads, dual fuel applications, thermal storage, and demand response;
- measures to encourage fuel switching which reduces the total system energy for a given end-use;
- programs and initiatives targeted to low income and other hard to reach consumers; and
- distributed energy options behind a customer's meter such as tri-generation, co-generation, ground source heat pumps, wind, and biomass systems."

On January 16th, 2004 the Minister of Energy announced the formation of a Conservation Action Team that will promote the government's conservation initiatives and work to remove barriers to conservation in existing government policies and programs to incorporate conservation principles. The Action Team will engage stakeholders across the province.

The enactment of Bill 100, *An Act to amend the Electricity Act, 1998 and the Ontario Energy Board Act, 1998 and to make consequential amendments to other Acts*, grants Ontario's electric utilities the authority to promote energy conservation, energy efficiency and load management. Also it will create the Ontario Power Authority (OPA), which will contract for new electricity supply and will promote energy conservation.

1.2 SCOPE

London Hydro's *Energy Conservation and Demand-Side Management* plan has been created to outline the programs that we believe will change the way Londoners think about and use energy. Our aim is to improve energy choices by raising general energy efficiency awareness and by providing businesses and individuals with the tools to make changes.

The portfolio of conservation programs described herein is intended to offer real value to the energy market and our customers. Often working in partnership with other organisations, in our program mix, we have attempted to meet the needs for all customer classes (defined both from a tariff and social perspective).

Some of the programs described herein are fully developed and ready for implementation, whilst others require additional development effort mainly to establish effective program delivery mechanisms.

Finally, London Hydro's *Energy Conservation and Demand-Side Management* plan is intended to be a model for similar efforts in other parts of southwestern Ontario, and that eventually these efforts will contribute positively towards a connected network of energy conservation programs throughout the Province that will be adequate to sustain our energy future.

1.3 PURPOSE

This document is intended to serve three distinct (but inter-related) purposes, namely:

- As a program outline and spending plan to support London Hydro's submission to the Ontario Energy Board (on January 17th, 2005) in support of its formal request for a *final approval* of its Market-Adjusted Revenue Requirement (MARR) increase to the distribution tariff;
- As a reference document for the 2005, 2006 and possibly 2007 capital budget; and
- As a reference document to record the insights of the staff members that developed this portfolio of initiatives in the event that other staff or agencies will be charged with running and managing the various programs.

It also serves as a reference document for neighbouring LDC's that elect to participate in some of the programs, for government agencies that will be requested to participate and jointly fund some programs, and for programs that may extend into the future under a funding mechanism different than MARR.

1.4 DEFINITIONS

1.4.1 Energy Efficiency, Conservation and Demand Management

Conservation, energy efficiency and demand management are crucial components of a provincial energy plan. They are the actions that control one whole side, the need side, of the energy supply and demand equation. How, when and for what purpose we use energy are just as important as the production of reliable, affordable and environmentally sound energy. Although often used interchangeably, there are distinct differences in the terms as described below:

Energy efficiency is the ability to use less energy to produce the same amount of useful work or services. It allows us to maintain equivalent or even better service in our homes, offices, factories, and automobiles. It is almost a *free lunch* in that it does not expect us to do less, or without, and may even allow us to do more with the same amount of energy. Efficiency implies new, advanced technology; efficiency improvements can include replacing equipment, such as lights, motors, appliances, and air conditioners with more efficient electrical equipment

Conservation is simply using less energy and is generally realized through changes in behaviour, such as turning off or dimming lights, and raising air conditioning thermostats (or lowering heating thermostats) in unused spaces. It conjures images of doing without, of wearing sweaters in dark and colder homes, and of sweating uncomfortably in front of a fan instead of using an air conditioner. But it need not be so if what we do in our conservation efforts is stop the wasteful use of energy for activities we know are unnecessary, like leaving the light on in a closed closet, or the refrigerator door open. Of course, what is wasteful can be a matter of personal judgment and differs from person to person.

Demand management is a newcomer on the scene and is the ability to adjust energy loads to reflect immediate supply conditions. Although efficiency and conservation are about how and for what purposes customers use energy, demand management is about when customers choose to use it. It is exerting control in telling electricity providers how much customers are willing to pay or not pay for electricity. A common form of energy demand management is air conditioner or water heater use curtailment. In this option the customer allows the utility to use radio transmitters to cut off the air conditioner or water heater momentarily when electricity prices are high. In that way customers signal that they are not willing to pay any price for electricity and would rather sometimes pass instead of buy. Spread over many customers, the ability to adjust demand on an as needed basis can be an important source of energy reserves for others, resulting in lower energy bills for participating customers.

1.4.2 Program Effectiveness Measurement Terms

Free Driver means customers who take actions without participating in a program, but who have been influenced by the program, and customers who, after participating in a utility program, take additional actions that they would not have taken otherwise. For example, a residential customer retrofits three lighting fixtures (the maximum allowed in the program) with high-efficiency lighting equipment due to a utility incentive program. The customer then retrofits two additional fixtures that are not eligible for an incentive. During an interview, the customer states that the high satisfaction he had with the initial retrofit motivated him to take the additional actions on his own.

Free Ridership means the phenomenon of customers' participating in programs and obtaining incentives for actions they claim that they would have taken without the incentive. Two types of free riders can be estimated:

- *Type 1* free riders are those customers who learned about the incentive offer after purchasing the equipment. It is assumed that the incentive did not influence these customers' decisions to purchase more efficient equipment. These customers are identified by a survey question, such as "When did you first learn about the incentive offer? (1) Before the purchase; (2) During the purchase; or (3) After the purchase".
- *Type 2* free riders are those customers who indicate that they would have purchased the identical high-efficiency equipment without the incentive. This behaviour can be measured through both a blunt and subtle fashion. A "blunt" approach asks, "If the incentive had not been available at the time you were making a purchasing decision, would you have (1) purchased the identical high-efficiency item; (2) purchased a less efficient item; or (3) not purchased the item at all?" A "subtle" approach asks, "How much did the incentive influence your decision to purchase high-efficiency items instead of purchasing less efficient items or not purchasing the items at all? (1) Strong influence; (2) Some influence; or (3) No influence."

Interpretation of these different approaches could be as follows: Items for which the customer would have "purchased the identical high-efficiency item" and where the incentive provided "some influence" or "no influence" are categorized as "Type 2" free riders. If the customer would have "purchased less efficient items" or "not purchased the items at all" and the incentive had "strong influence" or "some influence," the items are NOT categorized as free riders.

Persistence means the percentage of equipment that "persists" to be in place after its installation. Both short term (less than one year) and long term (greater than one year) persistence can be estimated. An example for the lack of short-term persistence would be a customer who was dissatisfied with the equipment and removed it. An example for the lack of long-term persistence would be a compact fluorescent lamp removed at the end of its useful life and replaced by an incandescent bulb.

Spillover Effect means reductions in energy consumption in a utility's service area caused by the presence of the DSM program whereby a utility customer is influenced by a program to take action, without actually ever participating. For example, a utility has a residential compact fluorescent lighting program that offers rebates to its customers. A customer learns about the program, purchases some of the lamps, but never applies for the rebate. The savings attributable to this customer is termed *spillover*.

Effective Useful Life means an estimate of the median number of years that the measures installed under the program are still in place and operable.

Engineering Useful Life means an engineering estimate of the number of years that a piece of equipment will operate if properly maintained.

1.4.3 Other Terms

Interactive voice response (IVR) is a telephony technology in which someone uses a touch-tone telephone to interact with a database to acquire information from or enter data into the database. IVR technology does not require human interaction over the telephone as the user's interaction with the database is predetermined by what the IVR system will allow the user access to. For example, banks and credit card companies use IVR systems so that their customers can receive up-to-date account information instantly and easily without having to speak directly to a person. IVR technology is also used to gather information, as in the case of telephone surveys in which the user is prompted to answer questions by pushing the numbers on a touch-tone telephone.

1.5 CHARACTERISTICS OF LONDON HYDRO'S DISTRIBUTION SYSTEM

1.5.1 Variations in Daily and Weekly Loads

The electrical load of any network does not remain constant and will vary during the day. To illustrate this, Figure 1-1 and Figure 1-2 below show the typical variation in load for the London Hydro distribution network.[3]

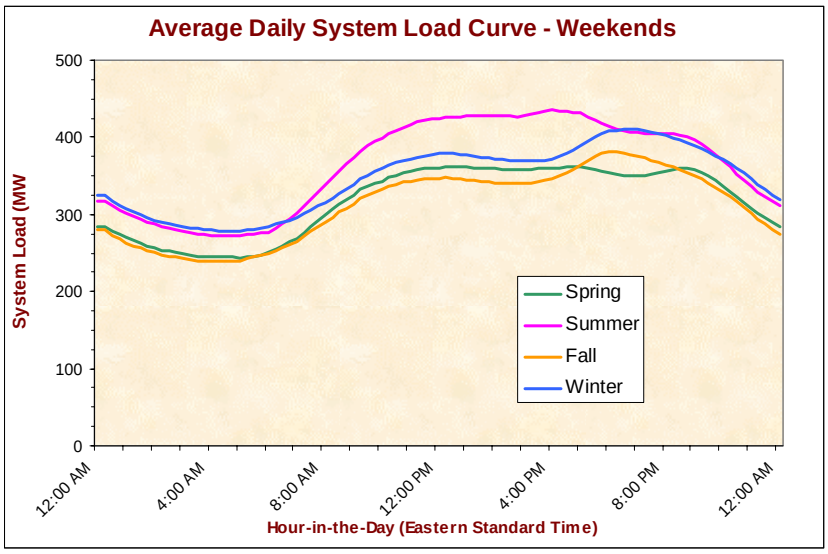

Figure 1-1, Average Daily System Load Curve (2001 Weekends)

The load is at a low level during the early hours of the morning and reaches a first peak in winter during the early to mid morning as meals are prepared, industry starts coming on line and the air-conditioning plants/heaters in office buildings are switched on.

[3] London Hydro System Planning Report: *Electricity Outlook - January 2000 to December 2001*; November 1999.

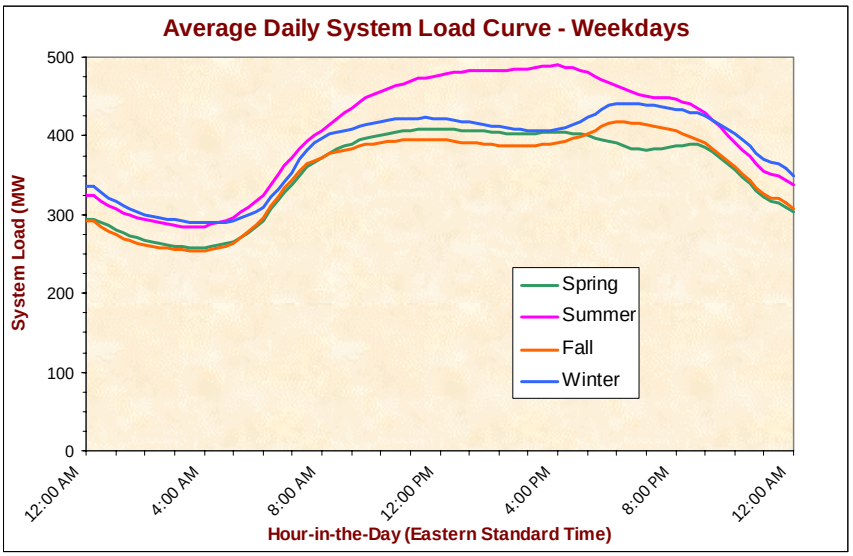

Figure 1-2, Average Daily System Load Curve (2001 Weekdays)

During winter, a slight downturn in load occurs during the middle of the day as industry starts to ease, building heating loads decrease and domestic heaters are switched off. During summer, the additional air-conditioning load results in an increase in total load during mid-afternoon.

A second peak in the winter load occurs during the early evening as meals are prepared and domestic heaters are switched on. This evening peak is usually the highest peak of a winter day. In contrast, the summer early evening load is often less than the mid-afternoon load.

The magnitude of the peaks and the shape of the load curve are greatly affected by the weather, the day of the week and the time of year. In recent times the summer period has produced higher peak loads than the winter period.

During holiday periods, such as Easter and Christmas, the loads are usually lower than at any other period.

1.5.2 Load Sensitivity to Weather

One key determinant of day-to-day variance in electricity demand is the weather. Temperature, wind speeds, insolation, and humidity all play important roles in determining utility loads, primarily through their impact on demand for space conditioning in the residential and commercial sectors. Figure 1-3 below shows the relationship between daily peak load and average daily ambient temperature.

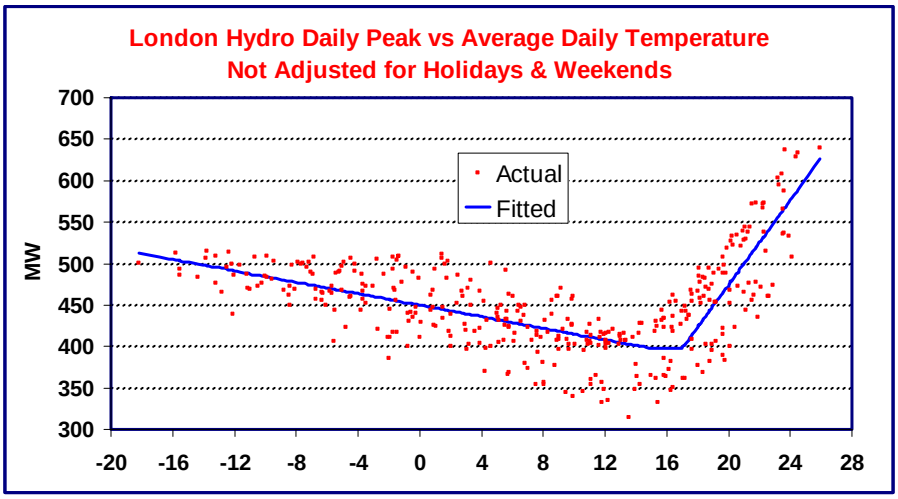

Figure 1-3, Relationship Between Peak Load and Ambient Temperature

It will be observed that for ambient temperatures greater than about 17°C, the relationship between system load and ambient temperature is about 25 MW/°C. Similarly for ambient temperatures low than about 15°C, the relationship between system load and ambient temperature is 3⅛ MW/°C. This phenomenon will be similarly observed in other utilities throughout southwestern Ontario and is reflective of the increased penetration of air conditioning load over the past few decades — something that was once a luxury has now become commonplace.

1.5.3 Duration of Peak Loads

The so-called load duration curve is intended to show the cumulative time duration that the system demand exceeds a particular level, where the number of hours is shown on the x-axis and demand level (in kW) on the y-axis. As illustrated in Figure 1-4, Figure 1-5, Figure 1-6 and Figure 1-7, loads tend to have substantial short-duration peaks.

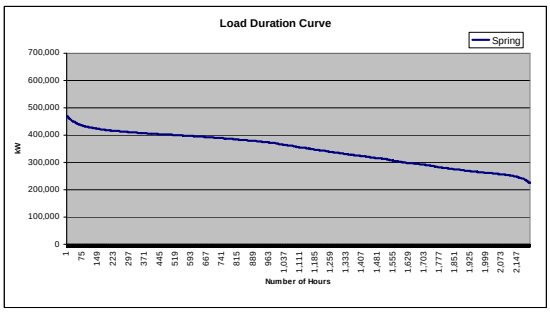

Figure 1-4, Spring 2003 Load Duration Curve

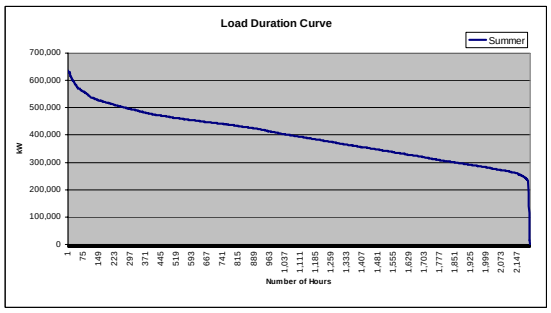

Figure 1-5, Summer 2003 Load Duration Curve

For example, Figure 1-5 shows that in the summer of 2003, the system load exceeded 600 MW for a total of 22 hours. The generation required to supply this short-duration peaking demand is the most expensive.

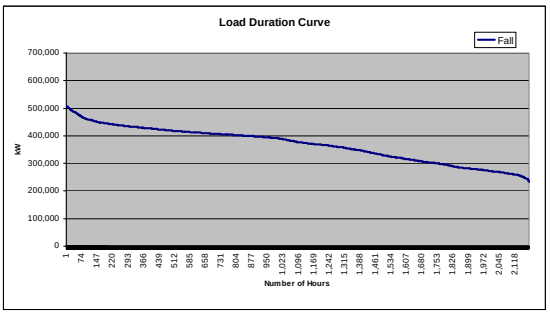

Figure 1-6, Fall 2003 Load Duration Curve

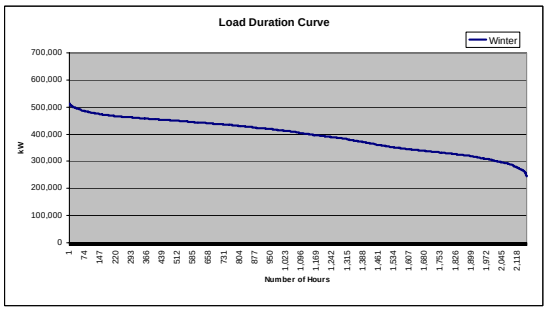

Figure 1-7, Winter 2003 Load Duration Curve

Such load duration curves are useful for determining the potential (and overall operating hours) for opportunity-specific consumer-owned generation and load management systems.

1.5.4 Historic and Forecast Load Growth

London Hydro's load growth over the past six decades and a forecast of system peak demand ten years from now are illustrated in Figure 1-8 below.

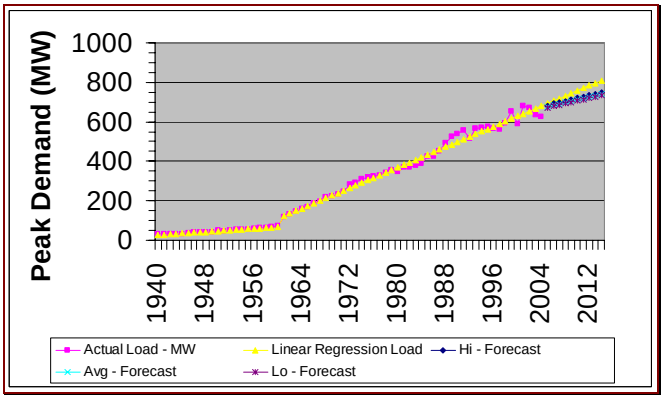

Figure 1-8, Historic Peak Load and 10-Year Forecast

As one might expect, there is a direct correlation between the increasing load and the combination of historical population increases, increases to London Hydro's franchise service territory, and the saturation of energy consuming products (e.g. air conditioners, computers, etc.).

1.5.5 Commodity Pricing and Tariffs

For the two-year period extending from the official opening date of the energy marketplace on May 1st, 2002 until April 20th, 2004, the observed market price for energy (in kilowatt-hours, and before any so-called Market Power Mitigation Adjustments) has been tabulated below.

Table 1-1, Historic Time-Differentiated Market Energy Prices

Average Price \ Season	Spring	Summer	Fall	Winter
Average On-Peak Price	5.5 ¢/kW·h	7.6 ¢/kW·h	6.3 ¢/kW·h	8.0 ¢/kW·h
Average Off-Peak Price	3.3 ¢/kW·h	4.4 ¢/kW·h	4.1 ¢/kW·h	5.6 ¢/kW·h

Note: The defined on-peak period is defined as 07:00 to 23:00 hours (local time) Monday to Friday inclusive, except for New Year's Day, Good Friday, Victoria Day, Canada Day, Civic Holiday, Labour Day, Thanksgiving Day, Christmas Day and Boxing Day.

Note: The price of electricity was frozen by the Provincial Ministry of Energy in May 2002 at 4.3¢/kW·h. In April 2004, the tiered price structure was introduced with the price to residential and small businesses adjusted to 4.7¢/kW·h for the first 750 kW·h of consumption and 5.5¢/kW·h for the balance. It is expected that in May, 2005 the Government's Regulated Price Plan will be unveiled, but at this time any suggestion of a tariff structure would be pure speculation.

Based on the commodity prices shown in Table 1-1, the time-weighted average market price of energy has been 5.6¢/kW·h. The Market Power Mitigation Adjustment would reduce the average market price by a cent to 4.6¢/kW·h. The latter is the price that will be used for determining whether an energy conservation measure is cost effective (i.e. is it cheaper than the cost of generation).

The tariffs (that apply to the commodity) for assessment of distribution charges, transmission charges and debt recovery are itemized below:

- Distribution tariff: .....$0.01 per kW·h
- Transmission tariff: .....$0.0104 per kW·h
- Wholesale market services:.....$0.0062 per kW·h
- Debt recovery:.....$0.007 per kW·h

Note: For unmetered scattered loads, such as roadway lighting, traffic signals, Bell and CATV amplifiers, etc. the distribution tariff is $0.0082 per kW·h.

1.6 HISTORICAL PERSPECTIVE FOR UTILITY CONSERVATION AND DSM ACTIVITIES

1.6.1 Pre-market Opening Conservation / DSM Programs

London Hydro's energy conservation / demand-side management activities in the decade or so preceding market opening can be broadly classified into six areas, namely:

[1] Rates and Charges –

In the late 1980's London Hydro began to offer a variety of time-of-use retail volumetric rates to various end-use customer classes. Specifically:

- Residential Time-of-Use
- General Service < 50 kW Time-of-Use
- General Service > 50 kW Time-of-Use
- Large User > 5000 kW Time-of-Use
- Real Time Pricing (RTP-II)
- Street Lighting Time-of-Use

These time-of-use rates were designed both to encourage customers to shift their usage from peak to the off-peak hours (between 11:00 p.m. and 7:00 a.m.) and to make investments in products (e.g. energy efficient lighting and motors) or procedures (e.g. energy management systems) that would manage their usage more efficiently.

London Hydro worked extensively with customers, especially the key account customers with greater than 1 MW of average monthly peak demand, to ensure that they would get the maximum benefit of these rate structures. Although small in number (approx. 50) the key account customer class represented approximately 30% of energy sales. Customers were provided technical and energy management advice through in-house visits, supplementary process metering, key account seminars, bill inserts and brochures. This was one of the most successful programs, as the customers saved money and the distribution system utilization was enhanced extensively, as reflected in London Hydro's high load factor (approx. 70% load factor before implementation to over 80% for this customer class after implementation) for these customer classes.

[2] Agent in Ontario Hydro Conservation / DSM –

In the early 1990's Ontario Hydro was very active in DSM initiatives to manage demand pressures on the system. Through these initiatives Ontario Hydro offered considerable financial incentives (e.g. $500/kW) for customers to become energy efficient and reduce their demand. London Hydro was a very active participant in this program and acted as a liaison with our customers to bring Ontario Hydro incentives, products and "wise use" information to them.

The main focus of these incentive programs related to the following initiatives:

- Energy efficient lighting; retrofits from incandescent lighting to energy efficient (lower wattage) incandescent, halogen or fluorescent fixtures (Compact, T8 and T10), installation of lighting reflectors to fluorescent fixtures, mercury vapour fixture retrofits to metal halide or high pressure sodium and street light conversions;
- Motor efficiency; incentives to procure and install approved energy efficient motors (e.g. variable speed drives);
- Heat pump installation; incentives to install energy efficient heat pumps for heating and cooling;
- Timers and controllers; incentives to install timers and controllers and other energy management devices (e.g. automatic thermostat setback) to shift load to the off-peak periods;
- Thermal heating and cooling; incentives to install thermal heating and cooling to store heat or cooling during off-peak periods for use during on-peak periods;

- Insulation and thermal envelope; incentives to retrofit existing facilities to reduce heat or cooling loss in existing facilities;
- Energy efficient appliances; incentive programs to purchase energy efficient appliances or to buy back older less efficient appliances (e.g. refrigerator buy back program);
- Water efficient fixtures (low flow shower heads and faucet aerators); incentives to install fixtures that would reduce water consumption and water heat energy; and
- Any project proposed by industrial or commercial customers that would reduce energy use or shift use to off peak periods was eligible to apply for incentives.

The programs also offered free energy audits of existing facilities to help customers identify areas where energy efficiency would provide the greatest return and the possible incentives for achieving these returns.

[3] SAVE$™ Electric Storage Water Heater Control Program –

In the early 1990's London Hydro developed and offered to customers a SAVE$ electric storage water heater control program. Under the program, storage tanks were outfitted with insulating blankets, showers were retrofitted with low-flow heads, and the storage tanks were outfitted with timers to shift electric consumption for water heating to off-peak hours. In the late 1990's, the program was expanded to include central electric boiler systems within four apartment buildings operated by London & Middlesex Housing Authority.

London Hydro's gross margin on energy sales to customers increased when customers switched to off-peak hours, and these savings were passed along to customers in the form of a free monthly rental charge.

More than 11,000 residential and general service customers participated in this program and, on average, shifted 26 MW of electric demand off the system during the peak times of the weekday.

[4] SAVE$-Plus™ Thermal Energy Storage Space Heating Program –

In 1995, London Hydro launched its SAVE$-Plus program for customers with thermal electrical storage (TES) space heating units and the SAVE$ water heater timer program outlined above. TES units use off-peak electrical energy to charge an internal heat-storage media, and the heat is then released during on-peak periods for space heating.

The thermal heat storage units were sold to about 200 residential customers as a substitute for their existing electric baseboard heaters that were used for space heating. As part of the initiative, the traditional revenue meter was replaced with a special time-of-use revenue meter. The TES unit together with the time-of-use rates offered customers a more economical heating system and the distribution system benefited from shifting demand to off-peak periods.

Figure 1-9, Typical Thermal Energy Storage Space Heater

Customers enjoyed approximately $350/year in savings under the TOU tariff.

[5] Information Campaigns –

In the past, London Hydro was extensively involved in information campaigns related to both water and energy conservation. In alliance with Ontario Hydro "wise use" information would be disseminated through the media (co-operative advertisements; newspaper and radio), bill inserts, Website, home show booth's, in-house visits and through the call center (high billing enquiries). London Hydro's website had an appliance calculator to help customers identify their usage and offered conservation information to help them use these appliances wisely.

[6] Municipal Roadway Lighting Conversion Program –

In the early 1990's the City of London participated in Ontario Hydro's "Municipal Streetlight Incentive Program". Through this program all roadway lightning luminaires using mercury vapour lamps were converted to the more energy-efficient high-pressure sodium lamps, resulting in a 22% reduction[4] in annual streetlight operating cost.

1.6.2 The Changing Roles Associated With Market Opening

Prior to market opening, the vision upon which the Market Rules were created was one whereby local distribution companies (LDC's) would restricted to non-competitive distribution wires activities (i.e. the *transportation pipeline* between the provincial high-voltage electricity grid and the low-voltage consumer), and retailers (or retail affiliates of the LDC) would come to the marketplace to contract with end user customers for the supply of the electricity commodity and also to provide a range of energy conservation / demand-side management activities.

[4] Letter to Darcy Dutton, P.Eng. of City of London from Ken Walsh, P.Eng. of London PUC; re: *City of London Street Lighting Conversion Program* (File: SL-1027-15); dated September 27, 1990.

However the City of London (as London Hydro's sole shareholder) elected not to establish a retail affiliate company to conduct competitive activities (where energy conservation / demand-side management activities could have continued). As a consequence:

- London Hydro's SAVE$™ electric storage water heater program was sold (with the load-shifting control timers now out-of-service);
- The time-of-use revenue meters associated with London Hydro SAVE$-Plus™ thermal energy storage heating units were replaced with traditional energy meters;

The distribution tariff didn't provide a funding mechanism to even recover costs for continued education campaigns on the subject of energy conservation.

As a result of wild price fluctuations throughout the late summer and early Fall of 2002, the Provincial government intervened in December 2002 with Bill 210 that fixed the price of energy at 4.3¢/kW·h for residential and small business customers. This was followed in April 2004 with Bill 4 that adjusted the fixed price to 4.7¢/kW·h for the first 750 kW·h of consumption and 5.5¢/kW·h for the balance. While these actions brought price stability, it also brought to a standstill retailer activities (including potential conservation / DSM) amongst the residential and small business customer sector.

1.6.3 Post-Market Opening Conservation / DSM Programs

Since market opening, London Hydro has necessarily restricted its energy conservation / DSM activities to the two areas outlined following:

- Responding on an "ad hoc" basis to customer requests for information regarding conservation, DSM and energy efficiency matters; and
- Expanding the population of interval-style revenue meters on the system, via lowering the threshold for mandatory interval meters (since Market opening, London Hydro has progressively reduced the threshold from 500 kW to its present level of 200 kW), and pilot testing various AMR systems. Part of this project includes developing ways to make electrical consumption information more accessible to customers so that they can better manage their energy usage.

1.7 PROGRAM FUNDING CONSTRAINT

The program funding available for London Hydro's initiatives is $2,836,791.^{00}, and this amount has to be spent prior to September 30th, 2007.

Note: This amount originates from the Ontario Energy Board's Decision with Reasons and Order #RP-2000-0061/EB-2000-0519 issued on May 18th, 2001 in which the Board approved London Hydro' first MARR adjustment of $2,836,792.^{00}, which was stated to be "one third of the amount required to achieve the target return on equity, exclusive of payment in lieu of taxes." On March 7th, 2002 the Board issued its Decision and Order #RP-2002-0093/EB-2002-0102 whereby London Hydro's second tranche of MARR in the amount of $2,836,791 was approved. Therefore, the remaining one-third tranche of MARR required to be spent on Energy Conservation / Demand-Side management projects is $2,836,791.^{00}.

The overall value of the energy conservation and demand-side management programs will be greater than London Hydro's requested budget, since additional funding streams are expected to be available from other programs sponsored by the Federal, Provincial and Municipal governments.

♦ - ♦ - ♦

2 METHODOLOGY DEVELOPED FOR PROGRAM SELECTION

2.1 OVERALL GOALS

2.1.1 Primary Goals

The primary goal of this project was to provide a list of potential energy conservation and demand-side management measures that could provide electricity savings for London Hydro consumers.

We adopted a published methodology for generally evaluating the cost-effectiveness of individual measures and packages of measures based on levelized cost of saved energy. The results will enable London Hydro to compare widely different program options and conservation strategies against a single yardstick, and to anticipate the potential cost and savings impacts of utilizing various measures in specific applications.

In developing the final list of recommended measures, our goal was to provide a means for comparing widely disparate energy efficiency options along with guidelines for understanding the size of the potential market for which each option is applicable.

While this project was not intended to provide program design, we have where possible attempted to identify and provide quantitative estimates of electricity use and measures of activity (such as number of apartment buildings) in the target markets.

2.1.2 Secondary Goals

Participation by All Customer Classes - Ideally the portfolio of energy conservation / demand-side management initiatives should provide for conservation opportunities to all customer sectors. Figure 2-1 below shows the customer classes and their approximate contribution to London Hydro's distribution revenues.

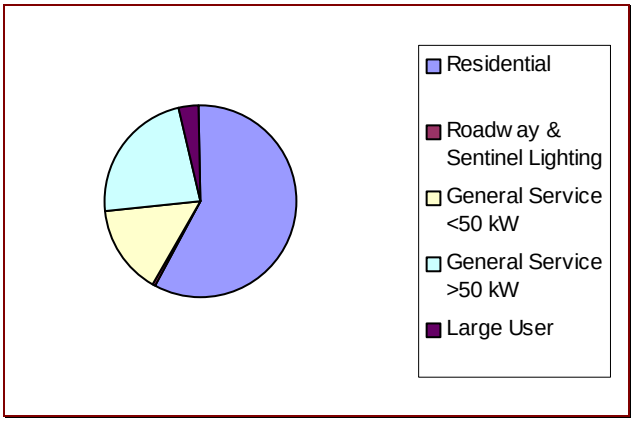

Figure 2-1, Conservation Program Spending Objective by Customer Segment

London Hydro's conservation plan will include conservation offerings for every customer class except roadway lighting as this opportunity has already been exploited (refer to Section 1.6.1 herein).

Minimize Program Start-up & Administration Costs - The literature[5] will show that in the past there has been legitimate criticism of subsidized utility-driven energy conservation programs. Two of the criticisms that need to be circumvented in London Hydro's energy conservation programs are replicated below for convenience of reference – to quote the Hispanic-American philosopher George Santayana: *Those who cannot remember the past are condemned to repeat it*.[6]

> **Problem #4: Conservation planners routinely over-estimate savings by ignoring the incentive such programs give to consumers to increase their consumption**. Consider a program to insulate homes: after the insulation is installed, homeowners may not keep their thermostats as low as before because their heating cost has dropped. Or a program to subsidize the purchase of efficient refrigerators: the consumer may decide to keep the old refrigerator in the basement, and operate two. Efficient lights save energy while they are displacing less efficient lights, but they also reduce people's incentive to turn lights off. Subsidized or even free air conditioners may replace far less consumptive fans.
>
> In each case, conservation efforts encourage behavioural changes that increase consumption. In some cases, the amount of electricity consumed after the program may even rebound far enough to exceed the original rate of consumption. …
>
> **Problem #6: Centrally planned conservation encourages the development of massive bureaucracies**. Because electricity can be saved by literally millions of consumers each using electricity in a great variety of ways, programs able to influence all electricity-using activities are impractical, even with greatly expanded bureaucracies. But even when programs focus on a very small sub-set of the ways in which people use electricity a large bureaucratic overhead is required.

[5] Energy Probe paper EP-350: *Seven Problems with Subsidized, Utility-Driven Conservation Programs – A Brief on Demand Management Issues at the Ontario Hydro Demand / Supply Plan Environmental Assessment*; Thomas Adams, Energy Probe; August 21, 1991.

[6] George Santayana, *The Life of Reason*, Volume 1, 1905.

In 1990, Ontario Hydro budgeted $112.5 million for its conservation programs. …

Secondary goals will therefore be to select programs that are immune from the *consumption rebound* phenomena and to minimize the start-up and administrative overhead costs (to say below 5%).

Note: In this plan, only *incremental* labour costs incurred by London Hydro will be borne by the conservation programs.

2.2 CHARACTERISTICS OF PREFERRED PROJECTS

To maximize the effectiveness of investments from the perspective of timeliness and magnitude of results, it was considered prudent at the outset of the project to define the characteristics of *preferred* projects as well as the characteristics of *non-preferred* projects.

Amongst the overall list of possible projects, those that will be considered as being the most desirable to undertake (i.e. preferred projects) will have characteristics or attributes as listed following:

- Kick Starts – The project should require only the initial input of London Hydro resources (e.g. expertise, financing, incentives, etc.), and should be self-sustaining thereafter.
- Leverageable – seek partner resources to leverage inputs; Use customer/other resources to strategically partner to get "buy in" from partners/customers
- Tangible efforts – Hard goods or strategies; Do things to actually reduce load, not just predict load reduction efforts i.e. Actually performing reduction versus feasibility studies only
- Technically Proven – The project may use existing technology creatively but there should be no large commitments to the development of new technology.
- Directly Measurable/Calculable results – Swap $ for kW's; Must be able to calculate savings in kW, $, etc. i.e. bang for buck
- Visible – Must be demonstrable; Must be able to share results with public to encourage self action by other customers via measured results
- It must meet the requirements of the Minister of Energy's letter of May 31st, 2004 to all distributors that outlined the reasonable new expenditures on planning, delivery and evaluation of specific measures that should be supported by the Board. For convenience of reference, these are listed below:
  - energy efficiency
  - behavioural and operational changes, including the application of benchmarking to "smart control systems"
  - load management measures which facilitate interruptible and dispatchable loads, dual fuel applications, thermal storage, and demand response

- measures to encourage fuel switching which reduces the total system energy for a given end-use
- programs and initiatives targeted to low income and other hard to reach consumers
- distributed energy options behind a customer's meter such as tri-generation, co-generation, ground source heat pumps, wind, and biomass systems

Undesirable projects will have one or more of the following traits:

- Non-calculable returns; Can't manage/gauge what is not measured
- Long term commitment of London Hydro staff and $$$; Short term directive, therefore short term commitments. However projects should endure through long term without input.
- Long lead time for Engineering and implementation; Vicious implementation of strategy, planned executed timely

As a final note, we have consciously steered clear of the so-called *gold plating*, a phenomena that has been defined in one US regulatory hearing as: "A lot of money is spent for consultants, administrative matters and on programs that don't tangibly conserve energy. Those ineffective efforts have the effect of raising bills for hard-pressed urban consumers while not helping the cause of conservation."

2.3 PROGRAM RANKING

2.3.1 Initial List of Conservation Measures

One of the initial steps in this project was to identify potential electric efficiency measures that could be applicable in the London area. To do this, internal resources were used in addition to an extensive literature review to identify measures in various sectors that were potentially cost-effective, and for which cost and performance information was sufficiently well developed to serve as the basis for evaluation and potential program design. The subject of energy efficiency is not new, so we tried to draw upon the published success stories from the interest groups listed below:

- Consortium for Energy Efficiency (CEE) – (URL: http://www.cee1.org)
- American Council for an Energy-Efficient Economy (ACE^3) – (URL: http://aceee.org/)
- U.S. Department of Energy's *Office of Energy Efficiency and Renewable Energy* (EERE) – (URL: http://www.eere.energy.gov/)
- Alliance to Save Energy – (URL: http://www.ase.org/)
- Oak Ridge National Laboratory's *Energy Efficiency & Renewable Energy Program* – (URL: http://www.ornl.gov/sci/eere/)

- U.S. Department of Housing and Urban Development (HUD) - documents, publications, and information related to resource conservation in public housing (URL: http://www.hud.gov/offices/pih/programs/ph/phecc/resources.cfm)
- The Conservation Council of Ontario - (URL: http://www.greenontario.org/solutions/energy.html)
- Natural Resources Canada's *Office of Energy Efficiency* (OEE) – (URL: http://oee.nrcan.gc.ca/english/index.cfm)

Appendix A provides a complete list of the measures initially considered for review.

2.3.2 Prioritization Methodology

To compare and prioritize measures, we adopted[7] a *levelized cost of saved energy* (CSE) for each measure or package of measures. The CSE calculation starts with the incremental capital cost of a given measure or package of measures over and above the cost of standard technologies. This cost is amortized over an estimated measure lifetime using an average discount rate, and added to any net annual operating and maintenance cost (or benefit) to estimate an annual net "levelized" cost for the measure. This annual net measure is then divided by the annual net energy savings (in kWh) from measure application (again relative to standard technology) to produce the CSE estimate in dollars per kWh saved, as illustrated below:

$$\text{CSE} = \frac{\text{Net Annual Cost (\$)}}{\text{Net Annual Savings (kWh)}}$$

Illustrative Example:

To greatly simplify the example, the time value of money (i.e. interest and inflation) will be ignored. If we assume that there is lighting retrofit action that a customer can implement that will yield 500 kWh per year in energy savings, the lifetime of the special bulbs is 3 years, and the utility provides an incentive in the amount of $60 toward this project, then the cost of saved energy (to the utility) is calculated as:

$$\text{CSE} = \frac{\$60.00}{500\,\text{kWh} + 500\,\text{kWh} + 500\,\text{kWh}} = \$0.04/\text{kWh}$$

At 4 ¢/kWh, the cost to society of this energy action is slightly below the average market price for generated electricity. As such, the incentive monies are being invested in the lowest cost option to society (i.e. conservation measures versus new generation).

The CSE is a figure that can be compared with the full cost of delivering power from electricity generation options. The CSE approach was chosen as the most practical and useful method of comparing measures of various types and applications.

[7] *Energy Efficiency and Conservation Measure Resource Assessment for the Residential, Commercial, Industrial and Agricultural Sectors*; A report prepared for the Energy Trust of Oregon Inc by Ecotope Inc, The American Council for Energy Efficient Economy (ACEEE) and Tellus Institute Inc; January 2003.

2.3.3 Prioritized List of Conservation Measures

The cost of saved energy (CSE) evaluations assessments are included within the individual program descriptions. All included programs that are measurable will have a CSE of 4.1 ¢/kWh or less (so from that perspective are equal at this time). Many of the illustrative examples show the results of differing design scenarios, and as such, the final CSE won't be established until the customer's consultant undertakes a detailed design.

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3 MUNICIPAL TRAFFIC & PEDESTRIAN SIGNALS UPGRADE PROJECT

3.1 GENERAL

3.1.1 Background

Traffic signals may not seem like big energy consumers. But across the province tens of thousands operate 24 hours a day, so a typical city or county can incur sizable costs to keep traffic flowing smoothly.

Figure 3-1, Signals Installed on One Corner of Typical Intersection

Figure 3-2, Typical Traffic Control Signal Head

Figure 3-3, Typical Pedestrian Signal Head

For more than 70 years, the main light source used in traffic signal heads (as depicted in Figure 3-2) and pedestrian signal heads (as depicted in Figure 3-3) has been the conventional incandescent lamp, with a coloured plastic or glass lens to project the red, green, or yellow colours through to oncoming viewers.

Because incandescent signals produce white light and must filter all colours other than the red, green or yellow desired, incandescent light is an inherently inefficient source of light for traffic signal applications. Additionally, incandescent bulbs produce considerable light outside the visible spectrum, which is emitted in the signal head as heat.

Within the traffic signal head, the red module uses a 135 W bulb, and the yellow and green modules each use 60 W bulbs. Both modules within the pedestrian signal head are outfitted with 90 W bulbs. A typical signalized four-way intersection will be populated with eight (8) traffic signals and eight (8) pedestrian signals.

Annual energy consumption billed to the City of London simply for traffic and pedestrian signals is 3,831,023 kWh[8], which represents an annual cost of $398K (based on the 2004 tariff).

3.1.2 Overview of Project

The traffic signal market in developed countries is currently undergoing a shift from incandescent to high-brightness light emitting diode (LED) -based products. LED's are energy efficient, durable and emit coloured light, eliminating the need for coloured lenses. The LEDs rated 10 to 20 watts are replacing the old-style incandescent bulbs rated at between 50 and 150 watts.

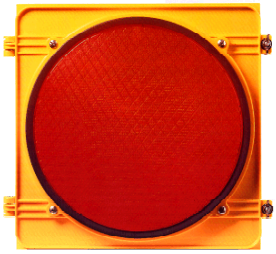

Figure 3-4, Typical Red LED Signal Module

The new traffic lights are made out of arrays of light emitting diodes (LEDs). These are tiny, purely electronic lights that are extremely energy efficient and have a very long life. Each LED is about the size of a pencil eraser, so hundreds of them are used together in an array.

LED traffic signal manufacturers also assemble packages of LED's into traffic signal retrofit kits. The LED's are arranged in arrays that are fitted into a fixture, typically with a reflector, and connected to a power supply that transforms and rectifies alternating current to the direct current required by the LED signals. These retrofit kits are designed to easily fit into the housing for incandescent signals.

In the long-term, the widespread use of LED traffic lights brings significant economic and ecological advantages, which are already being exploited in other countries such as Japan, Taiwan, UK, Sweden, France, Switzerland and Belgium. Recently, many cities in the US have or are in the process of replacing their incandescent traffic lights with LED units as a result of the energy supply difficulties they are currently experiencing. In all cases, the cited advantages include:

- LEDs are brighter. The LED arrays fill the entire "hole" and have equal brightness across the entire surface, making them brighter overall.
- LEDs do not heat up and typically last for five to seven years[9], whereas the incandescent bulbs will generally only last twelve to fifteen months[10]. This means

[8] This energy consumption value has been uplifted to include the prevailing distribution loss factor.

that maintenance and service cost - which are a heavy burden on municipal budgets - are significantly diminished.

- LED bulbs save a lot of energy.

One of the historic barriers to greater penetration of this technology has been the high initial cost of LED signals[11], but as the marketplace matures, the combination of lowered product prices and increasing energy costs are favouring LED retrofit projects.

3.1.3 Project Scope

As of August 2004, there are 330 intersections and 28 crosswalks in London equipped with traffic signals and pedestrian signals.

3.2 ANALYSIS OF TECHNOLOGY AND ENERGY SAVINGS

3.2.1 Review of Maturity of LED Technology

The maturity of LED-based technology for traffic signal and pedestrian signal applications is assessed using several parameters, namely:

- the existence of product standards (covering performance, interchangeability, design, etc.) by recognized standards-writing groups such as ANSI, CSA, ITE, IEEE, etc.
- the number of manufacturers offering compliant products.
- the population of in-service installations of the technology (and published reports of its success).

The Institute of Traffic Engineers (ITE) is one of five standards development organizations designated by the U.S. Department of Transportation (U.S. DOT) to develop standards under a cooperative agreement with the U.S. DOT. The governing standards covering LED-based traffic and pedestrian signal devices are listed below:

- ITE Purchasing Specification, *Vehicle Traffic Control Signal Heads - Part 2: Light Emitting Diode (LED) Vehicle Traffic Signal Modules*.
- ITE Performance Specification, *Pedestrian Traffic Control Signal Indications - Part 2: Light Emitting Diode (LED) Pedestrian Traffic Signal Modules*.

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[9] Consortium for Energy Efficiency (CEE) Fact Sheet*: Energy-Efficient Traffic Signals* (URL: http://www.cee1.org/resrc/facts/led-fx.php3).

[10] *Light-Emitting Diode (LED) Traffic Light Replacement Program*; DOE Regional Office and ICF Consultants; January 25, 2001; (URL: http://www.westgov.org/wieb/led-lite3.htm).

[11] *Increasing Market Penetration of LED Traffic Signals in New York State: Review of Articles and Information of LED Traffic Signals*; Lighting Research Centre of Rensselaer Polytechnic Institute; July 20, 2000; (URL: http://www.lrc.rpi.edu/programs/lightingTransformation/led/pdf/review.pdf).

With respect to manufacturers, the leaders in the Canadian marketplace (in alphabetical order) are probably:

- Cooper Lighting, Peachtree City, Georgia (http://www.fortrantraffic.com or http://www.cooperlighting.com) -
- Dialight Corporation, Farmingdale, New Jersey (www.dialight.com) - Dialight introduced its first LED-based traffic signal in 1994.
- GELcore LLC (a joint venture of GE Lighting and EMCORE Corporation; formerly Ecolux Inc of Lachine, Quebec), (http://www.gelcore.com/markets/traffic/signals/) -
- Tacel Ltd, Toronto, Ontario (http://www.tacel.ca) -

Appendix B includes a number of testimonials from various municipalities that have undertaken traffic signal retrofit projects using high-efficiency LED technology.

A review of the literature[12] will reveal some degradation problems associated with impurities or defects in the crystalline structure of the gallium arsenide (used for red signals), aluminum gallium arsenide (used for super red signals) or gallium nitride compounds (used for green signals) that were used in the first generation of LED products. The present day aluminum indium gallium phosphide and indium gallium nitride compounds are less sensitive to crystalline defects and as such provide much improved longevity.

One can conclude from the foregoing that the proposed LED technology for retrofitting traffic and pedestrian signals is sufficiently well developed and field proven that no risks (of a technical nature) are envisioned with the proposed project.

3.2.2 Assumptions

Certain assumptions need to be made about the numbers, types, ratings, and operation of the existing population of traffic signals in order to quantify the potential savings associated with retrofitting existing traffic and pedestrian signals with energy-efficient LED units. Specifically:

- duty cycle for traffic signals – For the purposes of the analysis at hand, it is assumed that red signals operate approximately 55 percent of the time, whereas green signals operate 42 percent of the time and yellow signals operate the remaining 3 percent[13].
- existing population and ratings of traffic signals – There are 330 signalized intersections and 28 signalized crosswalks in the city of London with a distribution of signal lights as tabulated below[14]:

[12] *LEDs Give Traffic Signals a Green Light for Efficiency*; Taylor Moore; EPRI Journal Online, November 2003; (URL: http://www.epri.com/journal/details.asp?doctype=features&id=213).

[13] *A Market Transformation Opportunity Assessment for LED Traffic Signals*; April 1998; Margaret Suozzo, American Council for an Energy-Efficient Economy.

Table 3-1, Existing Traffic Signal Population and Make-Up (August 2004)

Traffic Signal Module	Number of Incandescent Signals	Number of LED Signals	Notes
Red (12")	2,753	125	Installed as pilot years ago.
Red (8")	107	--	
Amber (12")	83	--	
Amber (8")	2,900	--	
Green (12")	83	--	
Green (8")	2,900	--	
Other (Arrow)	483	--	

Most of the green coloured modules are 8-inch modules; however some units along Fanshawe Park Road, Airport Road and Exeter Road are 12-inch modules (to comply with provincial highways legislation when the signals were originally installed).

- existing population and ratings of pedestrian signals –

  The number of twin-housing pedestrian signals (consisting of a "walking man" compartment and a "orange hand" compartment is 2,516.

- ratings of retrofit LED units – The technical design requirements for LED traffic signal modules are stipulated in ITE Purchasing Specification, *Vehicle Traffic Control Signal Heads - Part 2: Light Emitting Diode (LED) Vehicle Traffic Signal Modules*. The following tabulation indicates the energy-efficiency performance requirements to qualify the module for the International *ENERGY STAR®* label. It also provides anticipated energy performance data as per manufacturer literature for units using state-of-the-art materials (refer to Section 3.2.1 on page 25 herein).

Table 3-2, Energy Ratings for Retrofit Traffic Signal LED Modules

Traffic Signal Module	Nominal Wattage Rating (at 25°C)	Maximum Wattage Rating (at 74°C)	Manufacturer's Wattage Rating
Red (12")	11	17	10½, 10, 13
Red (8")	8	13	--
Amber (12")	not specified	not specified	--
Amber (8")	not specified	not specified	13, 13, 15
Green (12")	15	15	15, 12, 16
Green (8")	12	12	12, 6, 10

The technical design requirements for LED traffic signal modules are stipulated in ITE Performance Specification, *Pedestrian Traffic Control Signal Indications - Part*

[14] E-mails to Gary Rains from Shane Maguire; dated September 10, November 2, and November 3, 2004; re: LED Program (copies included within Appendix B).

2: Light Emitting Diode (LED) Pedestrian Traffic Signal Modules. The following tabulation indicates the energy-efficiency performance requirements to qualify the module for the International *ENERGY STAR®* label. It also provides anticipated energy performance data as per manufacturer literature for units using state-of-the-art materials.

Table 3-3, Energy Ratings for Retrofit Pedestrian Signal LED Modules

Pedestrian Signal Module	Nominal Wattage Rating (at 25°C)	Maximum Wattage Rating (at 74°C)	Manufacturer's Wattage Rating
Walking Man	9	12	6.6, 5
Orange Hand	13	16	8.1, 6
Combination Man/Hand	13	16	7/8, 5/7, 15/15

A sensitivity analysis would normally be carried out as part of any calculations and depending upon on the influence of each parameter to the end result, efforts may be made to obtain more precise data.

3.2.3 Expected Energy Savings Associated with Traffic Signal Retrofits

Complete conversion of the traffic signals throughout the city to LED modules would result in a coincident demand reduction of 260 kW and an annual energy savings of 2,268,962 kWh. Figure 3-5 below shows the potential energy savings by signal colour. For example, 73½% of the overall savings (i.e. 1,671,538 kWh) are attributable to retrofitting of the red modules, and 24% of the overall savings (i.e. 548,789 kWh) are attributable to retrofitting the green modules.

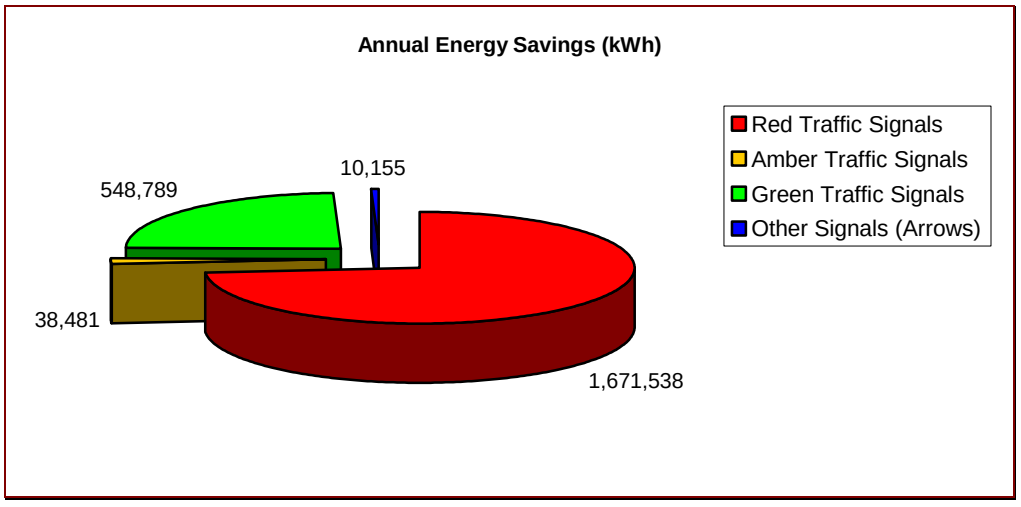

Figure 3-5, Predicted Annual Energy Savings for Traffic Signal Retrofits

The energy savings associated with amber signals and advanced arrows is fairly small mostly on account of the short ON times.

3.2.4 Expected Energy Savings Associated with Pedestrian Signal Retrofits

Complete conversion of the pedestrian signals throughout the city to LED modules would result in a coincident demand reduction of 210 kW and an annual energy savings of 1,840,353 kWh.

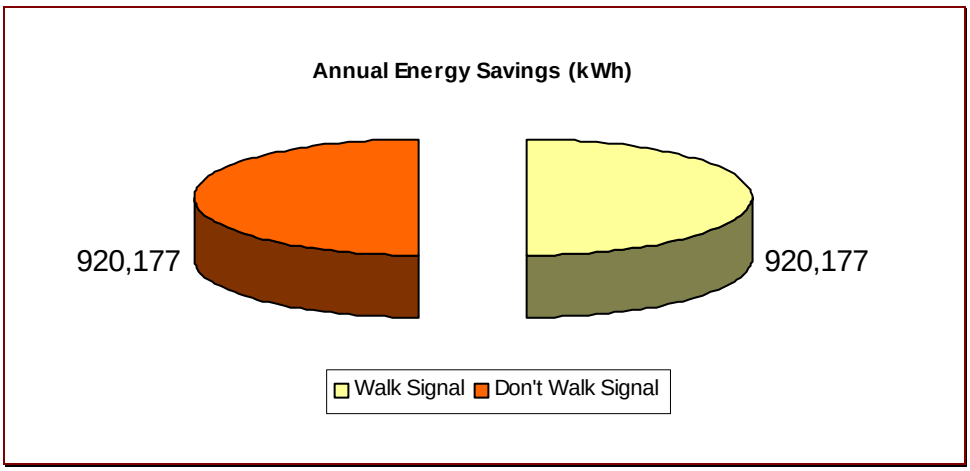

Figure 3-6, Predicted Annual Energy Savings for Pedestrian Signal Retrofits

For some manufacturers' LED modules, the wattage rating for the *walking man* and *orange hand* are identical (which is the assumption used in creating Figure 3-6), whereas for others there is a difference.

3.2.5 Expected Energy Savings Associated with Other Signal Retrofits

There are a small number of traffic signals with continuously flashing amber or red signals. Three such installations are depicted below in Figure 3-7.

Figure 3-7, Examples of Continuously Flashing Signals

The savings associated with retrofitting these signals to LED modules would be quite comparable to the savings achievable with the standard traffic signal heads as previously outlined in Section 3.2.3. It is the identical module; the only difference would be that the

analysis is based on a 50% duty cycle as opposed to the 55% and 42% duty cycles assumed for the standard red and green signals.

3.3 PROGRAM EXECUTION METHODOLOGY AND COSTS

3.3.1 Assumptions

The City of London has had a *group re-lamping* maintenance program (in contrast to a *spot re-lamping* program whereby only failed lamps are replaced) for traffic signals and pedestrian signals for many years now. Basically, the incandescent bulbs within the red and green traffic modules and all the pedestrian modules are replaced on an annual basis, while the incandescent bulbs within the amber and flashing arrow modules are replaced every second year.

Note: When a lighting system is installed it is designed to produce a specific light level and even distribution of light. All lamps lose output over time due to lumen depreciation and dirt accumulation on the lamp and fixture. Group re-lamping is a maintenance strategy in which a crew is equipped and dispatched to replace all the lamps (as well as wash and clean the reflective surfaces and lenses, and replace defective parts in the fixtures such as sockets and ballasts) in a system at once, saving the time of gathering equipment on an irregular but, as the lamps age, frequent basis. It is generally done at 70% of the rated life of the lamps under the prevailing operating conditions.

With respect to the retrofitting of incandescent signals with LED signal modules, the following assumptions are made:

- The list price for the incandescent lamps presently used for traffic and pedestrian signals is given in Table 3-4 below. Also tabulated are the list prices for replacement LED modules[15].

Table 3-4, List Prices for Retrofit LED Modules

Signal Module	Unit List Price of Incandescent	Price of Retrofit LED Module	Notes
Red (12”)	$4.^{00}$	$215.^{00}$	
Red (8”)	$2.^{50}$	$166.^{00}$	
Amber (12”)	$4.^{00}$	$268.^{00}$	
Amber (8”)	$2.^{50}$	$161.^{00}$	
Green (12”)	$4.^{00}$	$418.^{00}$	
Green (8”)	$2.^{50}$	$236.^{00}$	
Hand / Man (12”)	$2.^{75}$ + $2.^{75}$	$362.^{00}$	

Prices listed do not include federal and provincial taxes or any volume discounts that may apply.

[15] Fortran Traffic Systems Limited website; signal products price list page (http://www.fortrantraffic.com/signals/Pricelist/Pricelist.htm#LED810).

- incremental retrofit labour cost – the incremental labour cost associated with the retrofit was based on the assumption that the contractor (two trades staff and a vehicle) would be traveling to and setting up at a given intersection anyway as part of an annual group re-lamping / lens cleaning work assignment. A rate of $35 per hour has been used for each tradesperson, $25 per hour for the vehicle, and an incremental retrofit time of 20 minutes per signal module.

The cost of red, green, and yellow LED retrofit kits varies considerably as a function of the number of suppliers, market demand for the signal colour, and intensity requirements.

3.3.2 Program Execution Methodology

Retrofitting the existing traffic and pedestrian signal population with LED modules will be carried out by the City of London in accordance with their established policies and practices, i.e. the City would pre-qualify product suppliers and installation contractors, tender, and administer the retrofit project.

London Hydro's role would be limited to defining supplementary technical requirements (e.g. performance rating on LED module) for inclusion in the tender, defining necessary submissions (certified test results, invoices, certificate of substantial completion), and finally providing incentive monies.

3.3.3 Other Implementation Costs

Historically, traffic signal loads (like roadway lightning systems) has been an unmetered loads, i.e. there is no physical revenue meter to measure energy consumption. Instead, pursuant to the provisions of the Ontario Energy Board's *Retail Settlement Code*, the customer is billed based on an approved *deemed* load profile. It will therefore be necessary as part of this project undertaking to develop a new load profile for the traffic and pedestrian signals. With the reduced lamp load per se, the heaters and fans within the traffic control cabinets become a dominant load.

Another potential cost to the end user is disposition of any inventory of incandescent bulbs.

3.4 OVERALL COST BENEFIT ANALYSIS

It would have been desirable to carry out a Total Resource Cost (TRC) analysis for the project in general accordance with Chapter 4, *Total Resource Cost Test*, of California Standard Practice Manual: *Economic Analysis of Demand-Side Programs and Projects* (October 2001 edition), with the analysis parameters listed following:

- Free-riders rate: not applicable
- Life expectancy of measure: 6 years – refer to discussion in Section 3.1.2 herein.

However, at this time, certain key parameters (e.g. upstream transmission and generation costs) are not available.

Three criteria were adopted for establishing an incentive level for this project, namely:

- The incentive level should be sufficient that the customer achieves a return on investment from predicted energy savings within three years[16], based on a discount rate (difference between interest and inflation) of 5% per annum; however
- The levelized cost of saved energy (over the lifetime of the measure) should not exceed 90% of the cost of new generation, using the historic commodity prices given in Section 1.5.5 (see page 10 herein); and
- The incentive level should not exceed 25% of the project cost.

A spreadsheet was developed for determining the incentive level that fulfills the above criteria. The results of this analysis are tabulated in Table 3-5 below.

Table 3-5, Incentives to Upgrade Traffic & Pedestrian Signals

Measure Description	Unit Retrofit Investment Cost	London Hydro Unit Incentive	Levelized Cost of Saved Energy	Notes
Red (12")	$230.43	$100.27	$0.03 / kW·h	Based on 3-year payback.
Red (8')	185.13	54.13	0.041 / kW·h	Limited by CSE analysis.
Amber (12")	279.43	6.93	"	Limited by CSE analysis.
Amber (8")	180.51	2.67	"	Limited by CSE analysis.
Green (12")	366.33	95.38	"	Limited by CSE analysis.
Green (8")	418.10	38.15	"	Limited by CSE analysis.
Arrows	291.45	4.54	"	Limited by CSE analysis.
Pedestrian	366.33	158.02	"	Limited by CSE analysis.

The spreadsheet, which provides greater detail, is included within Appendix G. If the population counts for traffic and pedestrian signals change when the City completes their field audits, the quantity adjustments can be readily made to the spreadsheet and the overall project incentive amount adjusted accordingly.

3.5 METHODOLOGY FOR VALIDATING EFFICIENCY GAINS

An independent auditor who will be provided with the information listed below will validate efficiency gains:

- a copy of this report which defines the scope of the project and anticipated savings;

[16] US DOE Energy Information Administration report: *U.S. Electric Utility Demand-Side Management: Trends and Analysis*; April 10, 1997; page 9 (http://www.eia.doe.gov/cneaf/pubs_html/feat_dsm/contents.html)

- a copy of the invoice made out to the City of London that identifies the quantities and models of LED retrofit modules used to carry out the described retrofit project; and
- a signed statement by a staff Registered Professional Engineer at the City of London attesting to substantial completion of the work.

Furthermore, one of the elements of this project is the installation of AMR-style revenue meters on the supply to the traffic signals controller at selected intersections that could serve as a proxy for other similar intersections.

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4 RESIDENTIAL POWER COST MONITOR - PILOT PROJECT

4.1 GENERAL

4.1.1 Background

Several independent studies[17] [18] [19] on the effects of real-time feedback on energy conservation indicate that real-time knowledge of energy consumption is the single most important form of feedback necessary to modify a user's electricity consumption behaviour. The studies suggest potential energy savings on the order of ten percent.

The research concluded that, because of human psychology, a homeowner's energy bill at the end of the month does not reinforce long-term positive changes in his or her energy use habits. The message about *energy saving and the environment* is familiar to consumers, but few actually link the importance of energy saving to their own personal behaviour. The largest behavioural impacts occur when end users immediately correlate their daily energy consumption with a monetary cost. Consumers then take control of consumption to achieve savings.

For residential customers, their revenue meter is located either outside the home or in the basement, neither location being particularly amenable to giving the consumer real-time feedback. Furthermore, the four or five rotating dials (resembling miniature clocks) on the front face that register the accumulated energy consumption aren't easily interpreted by the majority of consumers.

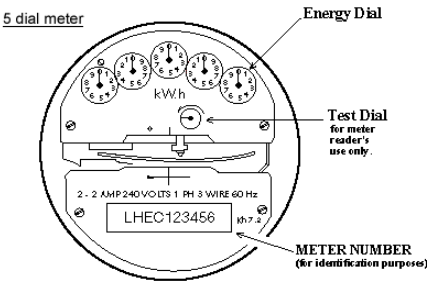

Figure 4-1, Typical 5-Dial Residential Revenue Meter

[17] *The Effect of Goal-Setting and Daily Electronic Feedback on In-home Energy Use*; Jeannet H van Houwelingen and W Fred van Raaij; Journal of Consumer Research: An Interdisciplinary Quarterly, 1989, vol. 16, issue 1, pages 98-105.

[18] Darby, Sarah; *Making it obvious: Designing feedback into energy consumption*; A paper presented at the Second International Conference on Energy Efficiency in Household Appliances and Lighting, Naples, September, 2000.

[19] Dobson, John K., and J.D. Anthony Griffin, Ontario Hydro; *Conservation Effect of Immediate Electricity Cost Feedback on Residential Consumption Behavior*; Paper read at ACEEE 1992 Summer Study on Energy Efficiency in Buildings.

There has been an expressed market interest in a robust low-cost feedback device that will provide customers with real-time information on their energy consumption level and the market price for electricity.

The literature will also show that feedback is a necessary but not always a sufficient condition for savings and awareness. It should not be treated in isolation. There are other important factors such as "… the condition of housing, personal contact with a trustworthy advisor when needed, and the support from utilities and government that can provide the technical, training and social infrastructure to make learning and change possible".

4.1.2 Overview of Project

London Hydro is a participant in a larger pilot project that was initiated by Hydro One Networks. The Hydro One Networks' *Real-Time Feedback Pilot* project with Blue Line Innovations (http://www.bluelineinnovations.com) involves the installation of Blue Line's *PowerCost Monitors*™ in the homes of 500 Hydro One customers in the Peterborough, Timmins, Lincoln and Brampton areas for a period of 12 months. Within London Hydro's service territory, 70 residential homes will be outfitted with identical PowerCost Monitor devices. The PowerCost Monitor concept is depicted in Figure 4-2 below.

Figure 4-2, PowerCost Monitor

The hypothesis being tested is that immediate and specific electricity end-use feedback will result in conservation behaviour. The pilot will determine the extent to which consumer behaviour is changed and electricity usage reduced by the availability of direct "real-time" feedback information of electricity consumption.

Note: The pilot project will be designed to determine a likely consumer participation model (i.e. what combination of household income, educational background, dwelling characteristics, demographic and other characteristics, etc. are typical of individuals or families that value such feedback devices) and to gauge the effectiveness (simplicity, clarity, etc.) of information presentation on the display component of the PowerCost Monitor product.

To conduct the portion of the overall research project that will be conducted within London Hydro's service territory, 1050 households were qualified from a random sample drawn from a population of approximately 113,000 houses within London Hydro's service territory. These homes were randomly assigned to one of two groups:

- the PowerCost Monitor group, who received the PowerCost Monitor; and
- the control group, who were aware that their electricity consumption was being studied but did not get the PowerCost Monitor.

Note: Within each group, the customers are stratified into six subgroups based on consumption, the first sub-group having an annual consumption less than 4,500 kW·h and the sixth group having an annual consumption greater than 22,500 kW·h.

Note: From the overall population of households, certain customers were initially excluded from the overall population. The exclusions include customers with revenue meters for which the Government seal will expiry during study period; revenue meters for which the internal K_h factor is other than 7.2 W·h per disc revolution; customers with revenue meters that haven't been proven to interoperate with the PowerCost Monitor device; customers with less than 12 months consumption history at their present location; and sites where the wireless communications channel between detector and display components is too far for reliable communications (e.g. some townhouse complexes where all the meters are arranged on an exterior wall of the end unit).

Customers in the first two groups will then be contacted to enlist their participation. This process will continue until the requisite numbers of participants for each group have been obtained.

4.1.3 Project Scope

London Hydro will be responsible for procuring and installing the seventy (70) Blue Line *PowerCost Monitor* devices on the selected homes, educating the customer on the use of the device, surveying the customers (regarding lifestyle, family size, educational background, composite household income level, appliance penetration, etc.), providing ongoing customer support for the duration of the project, and providing revenue metering information (covering periods prior to and during the study period) for analysis.

The initial selection of participants and control groups will be determined by Dr Dean Mountain, of Mountain Economic Consulting and Associates Inc.

Hydro One Networks staff will do the analysis of load data for both the participants and control group.

Finally, Dr Dean Mountain will write the final report for the entire project, i.e. London Hydro's participation will be treated as a chapter within an overall composite report of the entire project.

4.2 ANALYSIS OF TECHNOLOGY AND ENERGY SAVINGS

4.2.1 Review of Maturity of Power Cost Monitor Technology

There are two discrete functional components of the PowerCost Monitor product, the *detection unit* as depicted below in Figure 4-4, and the *display unit* as depicted in Figure 4-3.

Figure 4-3, Display Unit for PowerCost Monitor

Figure 4-4, Detection Unit Installed on Electromechanical Revenue Meter

The detection unit, which is affixed to an existing single-phase electromechanical revenue meter with a simple ring clamp, tracks the energy consumed by counting revolutions of the meter's internal induction disk. In London Hydro's assessment, the design of the detection unit is insufficiently robust to withstand vandalism, unintended dislodging by wind, driving rain, etc. that conceivably affect the ability of the unit to accurately track revolutions of the meter's internal induction disk.

The display unit, which is located inside the home, receives a wireless signal from the detection unit, computes the approximate power use, energy cost and greenhouse gas generation and displays this information on an LCD screen in real time for the consumer. Consumers can input a specific electricity tariff rate and greenhouse gas conversion factor. This unit appears to be consumer grade quality and is of adequate construction for the application. However the perceived issues with this unit are:

- there is no mechanism to receive real-time commodity pricing – rather the user programs the monitor with the average cost of power;
- the presentation of information on the display is far too complex for most end users. Human-factors design principles would suggest a far simpler and more intuitive default display panel, with access to other panels available for the more sophisticated or curious users.

In its present state the PowerCost Monitor isn't suitable for mass deployment. However, it is both a low-cost and available non-intrusive technology that is appropriate for a limited scope pilot project. Presumably, however, if the pilot project is successful, it will spawn both alternate suppliers and development of a second generation of consumer feedback devices that overcome the limitations of the present product.

Note: The only other known and comparable product is the Australian Cent-a-Meter™ wireless monitor (http://www.centameter.com.au/).

4.2.2 Assumptions

Within London Hydro's franchise service territory, in 2002 the average residential customer consumed 786 kW·h of electricity per month[20].

4.2.3 Expected Energy Savings Associated with PowerCost Monitors

The cited literature indicates average energy savings of 10% can be anticipated with an appropriate feedback device. This would be consistent with the energy savings (e.g. 8 to 20 percent through conservation) reported for pre-payment meters in North American applications. Although pre-payment meters are different in design, they are equipped with an in-home display unit that enables the customer to monitor their energy usage and thereby become more energy-aware.

It is speculated at the outset of the project that the PowerCost Monitor will, at best, provide the 10% average energy savings. While the literature notes the importance of immediacy and accessibility of feedback data on overall savings results, it also underscores the need for the importance of clear information that is specific to the household in question. As outlined previously in Section 4.2.1, there are some shortfalls (from a human factors perspective) in the presentation of information on the display.

Given the average residential energy consumption (see Section 4.2.2), the average energy savings will be 786 kW·h/month x 10% x 12 months/year ≈ 940 kW·h/yr per program participant.

4.3 PROGRAM EXECUTION METHODOLOGY AND COSTS

4.3.1 Assumptions

The 2004 unit price for the Blue Line PowerCost Monitor device is $250.^{00}. The design premise is that, in future, the customer would install the unit.

[20] London Hydro's *Distribution Rate Application for Regulatory Assets*; January 23, 2004 (Ontario Energy Board filing reference: RP-2004-0064).

Table 4-1, Cost Estimates for Real-Time Feedback Devices

Item	Quantity	Purpose of Procurement	Unit Price	Total Cost
1	70	PowerCost Monitors for participation in joint Hydro One project.	$250	$17,500

It is assumed that the second generation of this device would address identified design shortcomings but maintain the current price. It is only with the third generation of the unit (when volumes will increase and competing products will undoubtedly be introduced into the marketplace) that the prices will be expected to decrease.

Note: It isn't yet clear whether the PowerCost Monitor will even interface with the new revenue meters that will be installed in future under the Provincial Smart-Metering initiative.

4.3.2 Other Implementation Costs

Most pilot projects involve some significant one-time up-front costs that aren't present with the deployment of mature technology. This project is no different with anticipated initial project costs as follows:

Table 4-2, Non-Recurring Pilot Project Cost Estimates

Project Activity	Estimate
• Consultant to select customers eligible to be program participants and control groups, to develop survey questionnaires, and to carry out the assessment of the program results.	$15,000
• Call centre services to follow-up on mail-out soliciting program participants.	$5,000
• Contract installation of 70 PowerCost Monitors, including instructing user on operation of unit.	$3,200
• Consultant to analyze surveys and revenue metering data from both project participants and control groups.	$5,000
Total:	**$28,200**

There will undoubtedly be additional costs incurred by London Hydro staff associated with extraction of revenue metering and other information from corporate computer systems, providing ongoing technical and non-technical support to program participants, and reporting on project progress both internally and externally.

4.3.3 Overall Cost Benefit Analysis

It would have been desirable to carry out a Total Resource Cost (TRC) analysis for the project in general accordance with Chapter 4, *Total Resource Cost Test*, of California Standard Practice Manual: *Economic Analysis of Demand-Side Programs and Projects* (October 2001 edition), with the analysis parameters listed following:

- Free-riders rate: 0

- Life expectancy of measure: 5 years

However, at this time, certain key parameters (e.g. upstream transmission and generation costs) are not available.

A *cost of saved energy* analysis was carried out for the two scenarios described following:

- The existing PowerCost Monitor achieving an average customer energy savings of 10% - see Section 4.2.3 herein; and
- A PowerCost Monitor with expanded functionality and an improved user interface that can achieve greater resultant annual energy savings (i.e. 1300 kWh).

The results are tabulated below.

Table 4-3, Cost of Saved Energy Analysis for Residential PowerCost Monitor

Description	Initial Investment Cost	Annual Unit Energy Savings (kWh)	Annual Unit Bill Savings ($)	Levelized Cost of Saved Energy ($/kWh)
(Col 1)	(Col 2)	(Col 3)	(Col 4)	(Col 5)
Case 1 – Existing Unit	$250	940	$75	$0.06
Case 2 – Improved Interface	"	1300	$104	$0.04

It can be seen or inferred from Table 4-3 that to be an effective utility investment, the residential PowerCost Monitor will have to provide average annual energy savings of at least 1300 kWh to each customer, the unit price will have drop below the $150 price point, or the measure lifetime will have to be greater than 8 years.

Nonetheless, it has been selected as a pilot project only to validate the hypothesis that real-time feedback helps consumers save energy (and money). The validation of the thesis would greatly assist in designing future such programs under the Smart-Metering initiative.

4.4 METHODOLOGY FOR VALIDATING EFFICIENCY GAINS

The methodology used for validating efficiency gains is mathematically quite complex but is described in the literature[21]. In simple terms:

- for the participants and the control groups, the electrical loads for the year preceding the study period and the duration of the study period were adjusted to account for changes in weather patterns (i.e. if the summer season within the study period was unseasonably cool, then it would be necessary to attribute the greatly diminished air

[21] *Estimating End-Use Specific Energy Savings for a Community Based Energy Efficiency Program: A Bayesian Integration of End-Uses and Billing Data*; D.C. Mountain, R.B. Robinson and F. Eaton; 2001.

conditioning load to weather influences and not to conservation efforts), changes in appliances, and changes in household composition.

- after making these adjustments energy consumption levels will be compared before and after using the PowerCost Monitor.

As part of the project, attempts will be made to determine whether some groups of participants are more likely to show savings relative to others; and a statistical reliability (e.g., 95% confidence bands) will be calculated regarding estimated savings.

♦ - ♦ - ♦

5 RESIDENTIAL APPLIANCE RECYCLING PROGRAM

5.1 GENERAL

5.1.1 Background

The refrigerator-freezer is an indispensable electric appliance for modern society, but consumes a significant fraction of household energy. According to Natural Resources Canada's *Office of Energy Efficiency* (http://oee.nrcan.gc.ca/english), a standard refrigerator accounts for 11% of a home's total energy requirements.

Energy efficiency of household refrigerators, combination refrigerator-freezers, freezers (chest and upright), and room air conditioners has been dramatically improved over the past two decades mainly on account of the federal EnerGuide program[22] which was established in 1978 to provide Canadians with accurate information on the energy consumption of appliances.

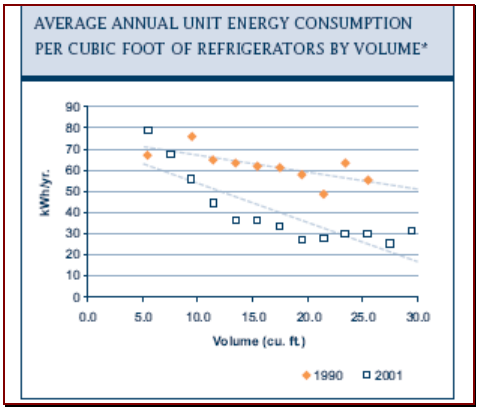

Figure 5-1, Refrigerator Energy Performance Improvements Over 20 Years

The figure to the left is excerpted from a recent Natural Resources Canada publication[23] and shows that the energy performance of refrigerators improved remarkably between 1990 and 2001.

Note: Interpretation of Figure 5-1 is not entirely intuitive because of its *normalized* presentation. For example, for a 25 cu ft unit, the figure shows that its normalized energy efficiency has increased by about 25 kWh/yr. This translates into a real-world energy improvement of (25 kWh/yr/ft³ x 25 ft³ =) 625 kWh.

[22] Regulations of the *Energy Efficiency Act*, passed in 1992, specify minimum energy- efficiency standards for a number of energy-using equipment, including household appliances.

[23] Natural Resources Canada publication: *Energy Consumption of Major Household Appliances Shipped in Canada - Trends for 1990–2001*; December 2003.

In 1990, refrigerators larger than 16.4 cu. ft. consumed on average more than 1000 kWh of electricity per year. By 2001, refrigerators that size consumed only half as much energy.

It is well established that the energy performance of a refrigeration device deteriorates over its in-service lifetime due to degradation of the insulation foam, dirt accumulation on the condenser coils, over- or under-charged refrigerant level, and damage to the door seals. With an average 14-year in-service lifetime, a refrigerator-freezer is one of the longest life-span household appliances. However, one recently published report[24] suggests that historical and forecast technology improvements (i.e. the more technology improves, the more energy consumption decreases) coupled with the reality of in-service deterioration of initial performance, means that the optimal replacement interval (to minimize total primary energy consumption) is on average 7 to 8 years.

Many consumers keep old, second refrigerators in their garages and basements – the main uses of second refrigerators are to store beverages (especially beer) and seasonal items and as additional storage space for special occasions. A market research study[25] carried out by BC Hydro found that 60% of these second refrigerators are full-sized, and that 55% of them are more than 12-years old.

Significant and highly cost-effective energy efficiency savings have already been realized through programs that target the retirement and recycling of older refrigerators, freezers and room air conditioners in other jurisdictions.

5.1.2 Overview of Project

The residential appliance recycling program is designed to reduce energy usage by enticing eligible customers to upgrade to more energy efficient appliances (specifically those that meet the EnergyStar® criteria) and to dispose of their operable, inefficient primary and secondary refrigerators, freezers and air conditioners in an environmentally safe manner.

The program will have to be carefully designed to ensure that anticipated energy savings are in fact achieved. In other jurisdictions, where the utility has sponsored a simple rebate program to encourage customers to replace their existing refrigerator with a new energy-efficient unit, the underlying program assumption was that the consumer would replace their refrigerator with a unit of identical size and type. However, in a real world setting, the savings may be limited if the program allows too much customer choice. The

[24] *Life Cycle Optimization of Household Refrigerator-Freezer Replacement*; Yuhta A Horie; Centre for Sustainable Systems Report No. CSS04-13; University of Michigan; August 14, 2004.

[25] British Columbia Hydro Power Smart Refrigerator Buy-Back Pilot; Profile #10; 1992; page 6. (http://www.bpa.gov/Energy/N/Reports/Results_Center/ProfileInfo.cfm?ID=10)

pitfalls associated with customer choice as described in the literature[26] are summarized below:

- Participants may opt for a larger refrigerator (e.g. replacing a medium-capacity model with a large-capacity model), which may use more electricity.
- Participants may choose a less efficient refrigerator configuration (e.g. replacing a combination refrigerator-freezer with a top-mounted freezer configuration with a unit having a side-by-side configuration).
- Participants may select features (e.g. through-the-door ice service and water dispensers) that increase energy use.

There are many possible elements and phases to the overall program as outlined below:

- New refrigerator rebate program - to encourage replacement of existing primary refrigerators with refrigerators that meet or exceed the EnergyStar® criteria. In the initial phases, the program will target replacements in apartment buildings and rental townhousing complexes (with special attention to subsidized buildings housing the most impoverished) outfitted with vintage refrigerators. This approach can achieve initial high volumes, and overcome the issues associated with consumer choice.
- Beer fridge bounty program – to encourage the replacement of full-size secondary refrigerators in basements and garages with small capacity refrigerators that meet or exceed the EnergyStar® criteria.
- New freezer right-sizing and rebate program – to encourage replacement of existing freezers with freezers that meet or exceed the EnergyStar® criteria. This program should initially be targeted to the so-called *empty-nester* couples. Without dependent children in the household, the existing freezer is likely too large and a much smaller capacity unit would be a better fit with the couple's needs.
- Room air conditioner right-sizing and rebate program - to encourage replacement of existing room air conditioners with units that meet or exceed the EnergyStar® criteria. It is well established that many existing room air conditioners are oversized for the space where they are presently installed. Somehow the program would need to disseminate right-sizing information such as those issued by the EnergyStar program itself.

A common but logical and essential component to the delivery mechanisms of all the programs described above is its logistics, i.e. the provision of an environmentally-sound means of collecting and disposing of old appliances (i.e. sorting the units by refrigerant, removing and recovering the refrigerants, and then dismantling and recycling the

[26] *Refrigerator Replacement in Florida: A Case Study*; Home Energy Magazine Online, January/February 1993 issue; 7 pages. (http://hem.dis.anl.gov/eehem/93/930110.html).

remains) thereby alleviating restricted landfill capacity and the uncontrolled release of chlorofluorocarbons into the atmosphere.

Note: In the foregoing descriptions, although the terms "rebate" and "bounty" have been used, they needn't necessarily refer to cash. Rather, rebate could refer to other forms of incentives such as innovative financing and billing. Similarly bounty could refer to other forms of customer reward, such as the offering of say $50 worth of compact fluorescent lamps to the customer.

The success of this undertaking will require leveraging the skill-sets of several external organizations, all having an interest in energy efficiency or environmental protection. The program participants and their anticipated roles are outlined below:

- City of London's Air Policy Department - to provide in-kind support for a coordinator (hired by the Clean Air Foundation) to manage all aspects of the appliance-recycling program.
- London Waste Haulers - local waste haulers and recyclers in London (in conjunction with Clean Air Foundation) will identify the most cost-effective and efficient appliance collection and recycling process.

  Note: Where the program is being rolled-out in apartment buildings and townhouse complexes, there will also need to be a mechanism to pickup and recycle the significant quantities of cardboard appliance shipping containers.
- NRCan's Office of Energy Efficiency – to provide baseline energy efficiency information for various vintages and types of in-service appliances; to provide resource information (expected savings) for public education and advertising campaigns and to landlords and customers of the end-use appliances.
- Clean Air Foundation – this national not-for-profit organization will manage all aspects of the appliance recycling program; this includes developing strategy, marketing and communication, partnership development, coordinating back-end recycling of collected appliances, monitoring and evaluation.
- Ontario Ministry of Environment / Energy - to provide funding for marketing/communication (currently providing funding for air conditioner recycling program), raise awareness of the programs in London; to provide strategic direction that coordinates efforts with larger provincial efforts (including other exchange programs and WDO legislation).
- London Hydro – funding for rebates and bounties; advertising; special in-bill advertising; strategic direction and partnership coordination with the Clean Air Foundation.
- Manufacturers/Retailers - to provide in-sync marketing to promote ENERGY STAR qualified products and to provide linkages to appliance recycling programs; to provide association support (e.g. CAMA).
- London Property Management Association (LPMA) - to promote the benefits of the programs to property managers in London.

With respect to home energy, market transformation is an attempt to change the market for particular appliances and equipment so that efficient practices become the norm. The literature[27] indicates that higher participation rates can be achieved if the program recognizes that "*Householders consider a broad range of factors in their energy decisions – not just energy efficiency. … Programs should emphasize a suite of benefits that the technology or strategy will provide the householder with.*" As such, London Hydro's program will be coupled with the federal government's *One-Tonne Challenge*, an initiative to reduce individual greenhouse gas (GHG) emissions (see website: http://www.climatechange.gc.ca for additional information on this federal program).

Another element of the program is to increase the saturation of Energy Star household appliances sold throughout London. Consumers can be easily be confused by present appliance labelling requirements as described below:

- Major electrical household appliances and room air conditioners sold in Canada must meet minimum energy efficiency standards and are required to display an EnerGuide label as shown in Figure 5-2 below. The EnerGuide label shows the consumer how much electricity (in kilowatt-hours) is used by an appliance in one year under a standard set of conditions — the lower the number, the less energy the appliance will use. The horizontal bar shows the range of energy consumption for similar appliance types. The arrow below the kWh shows where this appliance falls on the efficiency scale.
- The international ENERGY STAR® symbol, as shown in Figure 5-3 below, complements Canada's EnerGuide program. Energy Star goes one step further and identifies specific models that meet or exceed premium levels of energy efficiency. For example, refrigerators and refrigerator-freezers are eligible for Energy Star labelling only if they are at least 15% more efficient than prescribed by Canada's energy efficiency regulations. The ENERGY STAR symbol may even appear on an EnerGuide label.

[27] *Motivating Home Energy Action – A Handbook of What Works*; prepared by Michelle Shipworth for the Australian Greenhouse Office, April 2000; chapter *Market Transformation*; page 11.

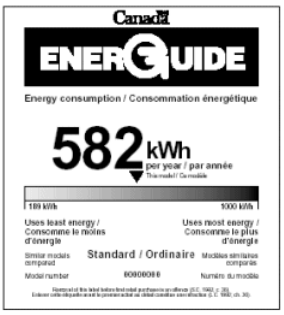

Figure 5-2, Example EnerGuide Appliance Label

Figure 5-3, Example Energy Star Appliance Label

A promotional program is needed to familiarize customers with the Energy Star label and the money-savings and environmental benefits of selecting Energy Star appliances. The objective of this program is two-fold:

- for consumers that actively participated in the recycling program, there can be visibility and recognition by their visitors and neighbours, and hence positive peer attitudes toward the participants; and
- to motivate consumers to instinctively choose Energy Star appliances when purchasing appliances that aren't a part of the recycling program at this time (e.g. dishwashers, clothes washers, audio electronics, etc.).

5.1.3 Project Scope

Within London Hydro's franchise service territory there are 690 apartment buildings (with greater than 10 tenant units) for a total of 44,750 apartment units. The number of buildings in which the rental units are outfitted with refrigerators of a vintage ten years or older is presently still being compiled (with the cooperation of London Property Management Association). When available, the energy savings opportunity in this sector will be summarized in the tabulation format below:

Table 5-1, Potential Savings Opportunities with Apartment Refrigerator Retrofit Program

Existing Refrigerator Capacity	Number of Apartment Units	Likely EER of Existing Units	Rating of EnergyStar Unit	Overall Savings Potential
Small (<14 ft³)			439 kWh/yr	
Medium (15 – 18 ft³)	Complete information not available at this time...		460 - 472	
Large (>19 ft³)			467 - 490	

Lacking data specific to the London area, if we accept national *residential appliance details* information from NRCan's Office of Energy Efficiency website, then the average number of refrigerators per household in 2002 was 1.24. Some portion of the secondary

refrigerators would certainly be small bar fridges. But it would be reasonable to infer that the number of households with so-called *old clunker beer fridges* in the basement or garage to be in the 15% range.

The first phase of project will be launched in early 2005, and will focus on the following activities:

- refrigerator replacement program in low income housing complexes and apartment buildings (especially those occupied by senior citizens and limited income people),
- right-sizing beer fridges elsewhere; and
- educating customers about the Energy Star label.

This approach can generate some immediate results while the mechanics for rolling out other phases of the project are developed.

With the popularity of the program unknown at this point, it will have to be run on a first-come, first-served basis until allocated funds are spent.

5.2 ANALYSIS OF TECHNOLOGY AND ENERGY SAVINGS

5.2.1 Review of Maturity of EnergyStar Qualified Appliances

Residential refrigerators are a very mature technology, with ENERGY STAR® simply being a labelling mechanism for identifying the most energy efficient units.

Note: In 1992 the US Environmental Protection Agency (EPA) introduced ENERGY STAR® as a voluntary labelling program designed to identify and promote energy-efficient products to reduce greenhouse gas emissions. The Energy Star label is now on major appliances, office equipment, lighting, home electronics, and more. In 2001, Natural Resources Canada (NRCan) signed an agreement on high energy-efficiency with the U.S. Environmental Protection Agency and the U.S. Department of Energy. This agreement allows these agencies to work together to promote the development of technical specifications and the Energy Star symbol as the international mark of energy efficiency.

The exchange of a consumer's refrigerator, freezer or room air conditioner for a more energy efficient unit is but one step in the overall and desired goal of market transformation effort wherein efficient practices become the norm. The literature covering effective strategies for market transformation (with respect to energy conservation) notes:

> *Rejected energy efficient technologies and strategies will taint future technologies and strategies with the air of unacceptability. If someone has an unpleasant experience with a new energy efficient technology or energy action strategy, they are likely to form negative attitudes about the technology or strategy. Attitudes formed through direct experience inspire future action. In other words, previous experience*

> *with unacceptable energy efficient technologies and strategies can lead to people not adopting future technologies and strategies.*[28]

As such, any product that the customer directly associates with London Hydro should necessarily be of a *better than average* quality as well as being energy efficient.

5.2.2 Assumptions

With respect to the estimated energy use of existing appliances:

- A database of estimated annual energy use of most refrigerators manufactured between 1979 and 1992, published by the California Energy Commission (CEC), and entitled: *Directory of Certified Refrigerators, Freezers, and Refrigerator Freezers*, is publicly available from several sources;[29]
- This database also includes performance information for various types of chest and upright freezers.

The energy consumption of new appliances is readily available from Natural Resources Canada in their publications: *EnerGuide Appliance Directory – 2004*, and *EnerGuide Room Air Conditioner Directory – 2004*.

The CEC historical database gives the annual energy usage of older refrigerators when they were new. To account for performance degradation due to age, the accepted approach is to inflate the performance data on a sliding scale based on refrigerator age as shown in Table 5-2 below:[30]

Table 5-2, Adjustments to Energy Data for Refrigerator Age

Refrigerator Age	Energy Data is Inflated by:
Less than 5 years old	0%
5 to 10 years old	10%
10 to 15 years old	20%
More than 15 years old	30%

On the matter of free-ridership in new homes and apartments (i.e. is a builder likely to populate the dwelling with EnergyStar-qualified appliances, the evidence of survey research indicates that Canadian builders and building owners select appliances on the

[28] *Motivating Home Energy Action – A Handbook of What Works*; prepared by Michelle Shipworth for the Australian Greenhouse Office, April 2000; chapter *Market Transformation*; page 10.

[29] Weatherization Assistance Program (WAP) Technical Assistance Center's website: http://www.waptac.org/sp.asp

[30] *Incorporating Refrigerator Replacement Into the Weatherization Assistance Program*; a report prepared for the U.S. Department of Energy by Alex Moore, D&R International Ltd; November 19, 2001; pg 7.

basis of price. Comparison of energy efficiency of alternative models is rarely used as a selection criterion.[31]

5.2.3 Expected Energy Savings Associated with Refrigerator Exchange

For the refrigerator exchange program, it will be assumed that the average primary refrigerator in an apartment building (that is eligible for the program) is on average 13 - 15 years old. From the Natural Resources Canada publication entitled: *Energy Consumption of Major Household Appliances Shipped in Canada, Trends for 1990 – 2001* (dated December 2003), it can be seen from Table 1.2, *Distribution of Refrigerators by Type*, that at 86.3% the predominant refrigerator sold in 1991 was a *Type 3* unit (i.e. refrigerator-freezers with automatic defrost, with top-mounted freezer and without through-the-door service, as well as all refrigerators without freezers but with automatic defrost). Table 1.3, *Distribution of Refrigerators by Volume*, of this same publication shows that at 47.9%, refrigerators in the volume range of 16.5 – 18.4 cu ft dominated the marketplace. Table C.1, *Average Annual Unit Energy Consumption of Refrigerators by Volume*, indicates that the average 1991-vintage refrigerator with a volume of 16.5 – 18.4 cu ft would have an annual consumption of 1018 kWh/yr when new.

Application of the age de-rating factors shown in Table 5-2 means that average expected energy performance of secondary refrigerators is (1018 x 1.2 =) 1222 kWh/yr.

For the purposes of an illustrative example, the energy performance of two (2) EnergyStar rated refrigerators that are of comparable volume and type are tabulated below:

Table 5-3, Predicted Annual Energy Savings for Primary Fridges

Volume	Manuf'r	Model	Description	Annual Usage	Resulting Savings
18.0 cu ft	GE	GTH18JB	Automatic defrost; top-mounted freezer compartment	411 kWh	811 kWh
18.3 cu ft	Kenmore	970-6889	Automatic defrost; top-mounted freezer compartment	407 kWh	815 kWh

It is therefore predicted that for each primary refrigerator that was replaced, average energy savings of 813 kWh per year would occur. To the end use customer, this represents a savings of about $65 per year.

Note: The apartment building phase of the refrigerator exchange program will be carried out on a building-by-building basis, with the existing stock of refrigerators catalogued and compared

[31] *Motivating Home Energy Action – A Handbook of What Works*; prepared by Michelle Shipworth for the Australian Greenhouse Office, April 2000; chapter *Market Transformation*; pg 7.

against the performance of new EnergyStar-qualified units. Interestingly, for the example project that includes 150 refrigerators in three apartment buildings (see Appendix G.3), the calculated energy savings amount to more than 1,900 kWh per exchanged refrigerator; a fairly substantial amount. Once the refrigerator populations in other candidate buildings have been catalogued, it will be possible to determine whether this is simply an outlier or typical of the refrigerator stock in apartment buildings.

5.2.4 Expected Energy Savings Associated with Beer Fridge Bounty

For the Beer Fridge Bounty program, is will be assumed that the average secondary refrigerator is about 12 years old (based on BC Hydro experience described in Section 5.1.1). From the Natural Resources Canada publication entitled: *Energy Consumption of Major Household Appliances Shipped in Canada, Trends for 1990 – 2001* (dated December 2003), it can be seen from Table 1.2, *Distribution of Refrigerators by Type*, that at 86.1% the predominant refrigerator sold in 1992 was a *Type 3* unit (i.e. refrigerator-freezers with automatic defrost, with top-mounted freezer and without through-the-door service, as well as all refrigerators without freezers but with automatic defrost). Table 1.3, *Distribution of Refrigerators by Volume*, of this same publication shows that at 42%, refrigerators in the volume range of 16.5 – 18.4 cu ft dominated the marketplace. Table C.1, *Average Annual Unit Energy Consumption of Refrigerators by Volume*, indicates that the average 1992-vintage refrigerator with a volume of 16.5 – 18.4 cu ft would have an annual consumption of 940 kWh/yr when new.

Application of the age de-rating factors shown in Table 5-2 means that average expected energy performance of secondary refrigerators is (940 x 1.2 =) 1128 kWh/yr.

If the beer fridge bounty program is set up to limit customer choice to just one or two EnergyStar qualified models (in the same fashion that a sale in a department store is limited to selected merchandise), it would be possible to simplify the program and explicitly quantify the expected energy savings.

For the purposes of an illustrative example, the energy performance of two (2) EnergyStar rated refrigerators that would be suitable candidates for the beer fridge program are tabulated below:

Table 5-4, Predicted Annual Energy Savings for Beer Fridges

Volume	Manuf'r	Model	Description	Annual Usage	Resulting Savings
4.9 cu ft	Sanyo	SR-4910	Automatic defrost; refrigerator only	316 kWh	812 kWh
10.3 cu ft	Sanyo	SR-1030	Automatic defrost; top-mounted freezer compartment	331 kWh	797 kWh

It is therefore predicted that for each secondary refrigerator (or beer fridge) that was right-sized, average energy savings of 800 kWh per year would occur. To the end use customer, this represents a savings of about $64 per year.

5.2.5 Expected Energy Savings Associated with Freezer Exchange

For the Freezer Exchange program, is will be assumed that the average freezer is more than 15 years old (based on the presumption that the target interest group would be so-called *empty nesters*). From the Natural Resources Canada publication entitled: *Energy Consumption of Major Household Appliances Shipped in Canada, Trends for 1990 – 2001* (dated December 2003), it can be seen from Table 2.1, *Distribution of Freezers by Type*, that at 83.2% the predominant freezer sold in 1990 was a *Type 10* unit (i.e. chest freezer). Table C.4, *Average Annual Unit Energy Consumption of Freezers by Model Year*, indicates that the average 1990-vintage freezer would have an annual consumption of 657.7 kWh/yr when new.

Application of the age de-rating factors shown in Table 5-2 means that average expected energy performance of vintage chest freezers is (657.7 x 1.2 =) 789 kWh/yr.

If the freezer exchange program is set up to limit customer choice to just one or two EnergyStar qualified models (in the same fashion that a sale in a department store is limited to selected merchandise), it would be possible to simplify the program and explicitly quantify the expected energy savings.

For the purposes of an illustrative example, the energy performance of two (2) EnergyStar rated freezers that would be suitable candidates for the freezer right-sizing program are tabulated below:

Table 5-5, Predicted Annual Energy Savings for Freezer Exchange Program

Volume	Manufacturer	Model	Type	Annual Usage	Resulting Savings
10.0 cu ft	Woods	C10NAE	Chest	282 kWh	507 kWh
9.0 cu ft	Woods	C09NAD	Chest	251 kWh	538 kWh

It is therefore predicted that for each freezer that was right-sized, average energy savings just more than 500 kWh per year would occur. To the end use customer, this represents a savings of about $40 per year.

5.2.6 Expected Energy Savings Associated with Room Air Conditioner Exchange

Based on the Clean Air Foundation's *Keep Cool* program (which ran in various locations in Ontario over the past 3 years), estimates of the impact on the electricity load of exchanging old air conditioning units can be made.

The following is a "snapshot" of Clean Air Foundation's findings of an average old air conditioner:

- Uses 7,557 BTUs/hr
- Average wattage of 1159 watts
- Average Energy Efficiency Ratio (EER) of 6.5

With the knowledge that the average EER of the units collected was 6.5, the average and total kilowatt-hours used by the collected RACs can be readily calculated using the formula:

$$\text{Energy Consumption} = \frac{(\text{BTU x hours of operation})/(\text{EER x DF})}{1000}$$

Some assumptions are now used:

- Hours of Operation – the Heating Refrigeration and Air Conditioning Institute (HRAI) estimates that the average Southern Ontario and Southern Quebec household uses their room air conditioner (RAC) an average of 750 hours per year.
- Degradation Factor (DF) – for the collected RACs, the Clean Air Foundation assumed that the units were operating at less than 100% efficiency, and therefore added a degradation factor (DF) of 10% into the equation. This is in line with the NYSERDA analysis in New York State and the two previous Keep Cool campaigns.

Therefore, from the calculations and assumptions, retiring each RAC results in the following kWh savings:

$$\text{Energy Consumption} = \frac{(7557 \text{ BTU/hr x } 750 \text{ hr}) / [6.5 \text{ W/BTU x } 0.9]}{1000 \text{ W/kW}} \approx 969 \text{ kWh}$$

According to NRCan's publication *EnerGuide Room Air Conditioner Directory – 2004*, a representative 8000 BTU/hr unit that is EnergyStar-qualified (GE model AJCS08ACBM1, 120 V rated) would have an EER ratio of 9.5. The same calculation method can be used to assess the annual energy consumption for an EnergyStar-qualified RAC as:

$$\text{Energy Consumption} = \frac{(8000 \text{ BTU/hr x } 750 \text{ hr}) / [9.5 \text{ W/BTU x } 1.0]}{1000 \text{ W/kW}} \approx 632 \text{ kWh}$$

Therefore, one would expect annual energy savings on the order of (969 – 632 =) 337 kWh. To the end use customer, this represents a savings of about $27 per year in operating cost.

5.3 PROGRAMS EXECUTION METHODOLOGY AND COSTS

5.3.1 Assumptions

One of the paradoxes of the psychology of environmentalism is that citizens generally hold pro-preservation attitudes but routinely engage in environmentally unfriendly actions … *people who cite conservation as the single most important strategy for improving our energy future are no more likely than others to engage in energy-conserving behaviours*.[32] For a program such as this, the literature suggests two techniques for success:

- Use community groups to run energy action programs.[33] Their greater success seems to be due to a combination of their high credibility in the eyes of the householders; their intensive, but low cost, marketing efforts; and their concern to cut energy costs for households.
- Emphasize a suite of benefits.[34] Programs should emphasize a suite of benefits that the technology or strategy will provide the householder with.

London Hydro has engaged the Clean Air Foundation to develop the marketing and environmental elements of the plan, and to manage program implementation. It is believed that this organization provides program credibility, and will be able to call attention to both the environmental and energy conservation aspects of the project.

Note: Although the appliance recycling program is being developed for initial rollout in London, once the minor glitches (that occur in the start-up phase of virtually every project) are ironed out, it is expected that the program can be expanded to other LDC's within south-western Ontario. As such some portion of the monies paid to Clean Air Foundation to develop a plan will be recoverable at a later date.

For appliance exchange programs within apartment buildings (and similar multi-tenant rental complexes) one of the anticipated barriers to program participation is related to the arrangement of the revenue metering system. At the time of building construction, there are two revenue-metering options available to the owner: installation of a single bulk meter (also known as a master meter) or installation of individual rental unit meters.

- For bulk-metered buildings (wherein the cost of utilities is embedded in the tenant's rental cost), if the owner invests in more energy efficient appliances, the owner will derive the benefits of lower energy consumption, thereby offsetting the investment in new appliances.

[32] *Motivating Home Energy Action – A Handbook of What Works*; prepared by Michelle Shipworth for the Australian Greenhouse Office, April 2000; chapter *Attitudes Sometimes Motivate*; pg 1.

[33] *Motivating Home Energy Action – A Handbook of What Works*; prepared by Michelle Shipworth for the Australian Greenhouse Office, April 2000; chapter *People Need People*; pg 8.

[34] Ibid; pg 11.

- However for buildings with individual rental unit meters (wherein tenants are responsible for utilities in addition to rent), if the owner invests in more energy-efficient appliance, the benefits will flow directly to the tenants in the form of lower monthly utility bills.

The latter case (wherein the owner and tenant have different motivations) is clearly a barrier to program participation that the promotion campaign will certainly have to address at the outset. One technique suggested in the literature[35] is to make landlords feel that their existing or future rate of return is under threat (especially if a scheme could be developed to assign energy star ratings to rental units).

It is difficult to predict the success of a project like this with any degree of certainty. Nonetheless, the assumed annual appliance recycling volumes are tabulated below:

Table 5-6, Assumed Appliance Volumes for Recycling Program

Initiative Description	2004	2005	2006
Refrigerator Exchange (Apartments)	--	1,500	1,500
Refrigerator Exchange (Homeowners)	--	900	900
Beer Fridge Bounty (Disposal Only)	--	200	200
Beer Fridge Bounty (Right-Sizing)	--	500	500
Freezer (Right-Sizing)	--	150	150
Room Air-Conditioner (Apartments)	--	100	100
Room Air-Conditioner (Homeowner)	--	100	100
Total Volumes:		3,550	3,550

If the recycling program proves to be more successful than envisioned, it will be expanded with monies transferred from energy conservation / demand-side management projects with a higher associated cost of saved energy. Conversely, if the program under-performs, surplus monies will be transferred to projects with a comparable or better cost of saved energy.

5.3.2 Execution Methodology for Refrigerator Exchange Program

The initial phases of the refrigerator exchange program will be targeted to apartment buildings and subsidized townhouse developments. High volumes of plain apartment-style refrigerators can be pursued (thereby circumventing any customer choice issues) with minimal administrative overhead (i.e. it is more efficient to negotiate the exchange of 130 refrigerators with a single building owner than with 130 individual homeowners).

[35] *Motivating Home Energy Action – A Handbook of What Works*; prepared by Michelle Shipworth for the Australian Greenhouse Office, April 2000; chapter *Money Sometimes Motivates*; pages 11-12.

The remainder of this section does not lay out the program in minute detail, but instead provides sufficient information to describe the program's basic intent and structure.

Phase 1: Bulk-metered apartment buildings and subsidized public housing –

- A number of owners of older bulk-metered apartment buildings and the London Middlesex Housing Authority (LHMA) will be contacted to obtain information about the size and vintage of the existing refrigerators, and to solicit their interest in being an early adopter in the exchange program.
- For each project, London Hydro will prepare an analysis of the savings opportunities by exchanging the subject refrigerators with Energy Star qualified units. Also included will be an assessment of the subsidy level that London Hydro will apply to the project.
- Upon agreement by the owner, project execution will commence with the active participation of the following parties: retailers and recyclers and supporting groups.

  Note: Program execution elements also include the Energy Star Awareness Program (as described in Section 16.2.4 herein), the refrigerator magnets (as described in Section 5.3.6) and the Appliance Sticker Program (as described in Section 16.2.3).

- To foster greater program participation, one or two of the early adopters will be encouraged to present their case study at a regular meeting of London Property Management Association.

  Note: Bland summaries of potential kilowatt-hour savings or dollar savings do not influence decision makers. Case histories do influence decision-makers even though they may be less representative than the summaries.[36]

  Note: This element of the project is part of the *Energy Conservation Workshops Program* described in Section 16.2.5 herein.

- The apartment building owners that participated in the exchange program will be each issued personal recognition of achievement letters (acknowledging their contributions towards both improving energy efficiency and reducing greenhouse gas emissions), and jointly signed by the provincial Ministers of Energy and the Environment (with copies issued to the apartment owners association, and mayor's office). The letters should be issued about a month after the exchange has occurred.
- The refrigerator exchange program will also be used as a mechanism for leveraging other energy improvements. Participants will be issued an invitation for further participation in other programs (e.g. exit, audit, room air conditioner exchange, etc.).
- One year following completion of the exchange, the building owners will be provided with feedback (based on revenue metering data) as to the energy savings actually realized (considering weather factors, etc.).

[36] *Motivating Home Energy Action – A Handbook of What Works*; prepared by Michelle Shipworth for the Australian Greenhouse Office, April 2000; chapter *Information Sometimes Motivates*; pg 5.

Phase 2: Individually-metered apartment buildings –

The elements of this phase would be identical to those in Phase 1. However, with individually metered apartment units, the split motivation problem (previously described in Section 5.3.1) exists, so a couple of presentations at regular LPMA meetings may be required (to convey the potential threat that their future livelihood might be jeopardized if they don't participate).

Phase 3: Individual homeowners –

The Clean Air Foundation is actively designing this phase of the program. In all likelihood, this phase will be based on staging a series of conservation / environment weeks during the summer (or autumn) during which homeowners could phone a central number and book a pick-up. Alternatively, it could somehow dovetail with activities presently carried out by retailers.

5.3.3 Execution Methodology for Beer Fridge Bounty Program

The beer fridge bounty program is targeted to homeowners with a secondary refrigerator in the basement. It is believed that homeowners with a beer fridge in the basement can be classified into one of two groups, namely:

- One group that, with knowledge of the money they are *throwing away* with their existing secondary refrigerator coupled with an effortless means of disposal, could be encouraged to turn in their secondary refrigerator.
- A second group that genuinely needs a secondary refrigerator and that could be encouraged to replace their existing secondary refrigerator with a right-sized energy efficient unit if the process for doing so was seen as virtually effortless.

The remainder of this section does not lay out the program in minute detail, but instead provides sufficient information to describe the program's basic intent and structure.

- For both groups, an infrastructure system needs to be established by which a customer can arrange for the pick-up and recycling (i.e. extraction of freons, and recycling of plastics, metal, etc. all in a environmentally friendly manner) of their secondary refrigerator. To that end, London Hydro is working with the City, Clean Air Foundation, Ministry of Environment, and others to set up a program for the effective coordination and management of such an infrastructure.
- Participants in the first group will receive a package of compact fluorescent lamps (6 x 15W CFLs and 2 x 23W CFLs; having approximate overall value of $50) at the time of pickup. Within a couple of weeks, participants will each be issued personal recognition of achievement letters from London Hydro (acknowledging their contributions towards both improving energy efficiency and reducing greenhouse gas emissions).

- Participants in the second group will receive a beer fridge (including the magnet and temperature label) at a discounted price as well as the package of compact fluorescent lamps at the time of refrigerator exchange. Customers will have the option of paying for the replacement beer fridge outright, or financing the outstanding balance. Again, within a couple of weeks, participants will each be issued personal recognition of achievement letters (acknowledging their contributions towards both improving energy efficiency and reducing greenhouse gas emissions), and signed by London Hydro's Director of Public Relations.

Figure 5-4, Right-Sized Secondary Refrigerator

Note: An integral part of the program is the selection of a right-sized secondary refrigerator (i.e. *compact* size classification) and branding the unit. In London, Labatts is a local brewery and natural fit for a co-branding initiative.

- The refrigerator exchange program will also be used as a mechanism for leveraging other energy improvements. Participants will be issued an invitation for further participation in other programs (e.g. exit, audit, room air conditioner exchange, etc.).

5.3.4 Execution Methodology for Freezer Right-Sizing Program

The mechanics of the freezer right-sizing program are identical to the Beer Fridge Bounty program described in Section 5.3.3 above.

5.3.5 Execution Methodology for Room Air-Conditioner Program

The mechanics of the room air-conditioner exchange program are identical to the refrigerator exchange program described in Section 5.3.2 above.

5.3.6 Other Implementation Costs

Consumer Education -

The overall success of the program will require two levels of consumer education, namely:

- educating customers about the Energy Star label; and
- educating participants in the program on the proper operation of their replacement appliance to maximize energy savings.

In some of their pioneering work with refrigerator replacement programs in apartments operated by the New York City Housing Authority (NYCHA), the New York Power Authority (NYPA) discovered that the new refrigerators weren't performing as well as anticipated (from an energy consumption perspective). It was discovered that the poor performance was primarily because the factory control settings (midpoint, 5 on a scale of

9) kept the refrigerator substantially colder than necessary. As a consequence, NYPA began changing controls to a setting of 2 at installation and NYCHA began an education campaign to keep them there.[37]

To be successful, an education campaign should focus people's attention on those actions that offer the greatest return for their efforts rather than overloading residents with too many tips.

A simple refrigerator magnet has been used successfully in other jurisdictions. It is suggested that NRCan's Office for Energy Efficiency develop the specific wording, but the example included as Figure 5-5 illustrates the concept.

Note: Although not shown on the example, it would be appropriate to also include the logo for the Ontario Clean Air Alliance on the magnet.

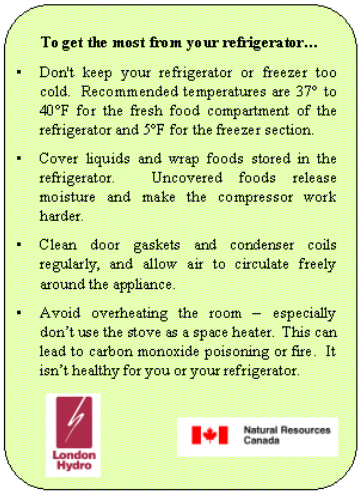

Figure 5-5, Example Refrigerator Magnet

For the average consumer, relating a dial setting within the refrigerator to a desired temperature isn't entirely intuitive, so perhaps a circular-shaped secondary sticker or magnet that could be installed within the refrigerator to indicate the suggested setting may be effective.

It is presumed that there will be no direct cost for NRCan's Office of Energy Efficiency to develop appropriate wording for the refrigerator magnet, nor any licensing fees to use their logo on the magnet. The production cost of the magnets is assumed to be $2.[50].

Similar fact sheets or tip magnets would also have to be prepared for the freezer and room air conditioner exchange programs.

Recycling Program Development -

Presently in the province, there are no examples of functional appliance recycling programs. The expectation is that with the cooperation of municipal and provincial governments and the local recycling firms, a program can be developed and piloted in London. In time, it is expected that the value of the extracted freons, recyclable metals and plastics will offset the operating costs of the recycling program. However there may be some upfront development costs that can be co-funded by London Hydro and various governments.

[37] *Refrigerator Replacement in the Weatherization Program: Putting a Chill on Energy Waste*, a special report for the Weatherization Assistance Program; Larry Kinney and Rana Belshe; September 2001; pg 10.

5.3.7 Overall Cost Benefit Analysis

It would have been desirable to carry out a Total Resource Cost (TRC) analysis for the project in general accordance with Chapter 4, *Total Resource Cost Test*, of California Standard Practice Manual: *Economic Analysis of Demand-Side Programs and Projects* (October 2001 edition), with the analysis parameters listed following:

- Free-riders rate: 0 for the apartment buildings projects; to be defined for the homeowner
- Life expectancy of measure:

However, at this time, certain key parameters (e.g. upstream transmission and generation costs) are not available.

Therefore, we have employed three criteria for establishing an incentive level for this project, namely:

- The incentive level should be sufficient that the customer achieves a return on investment from predicted energy savings within three years, based on a discount rate (difference between interest and inflation) of 5% per annum; however
- The levelized cost of saved energy (over the lifetime of the measure) should not exceed 90% of the cost of new generation, using the historic commodity prices given in Section 1.5.5 (see page 10 herein); and
- The incentive level should not exceed 25% of the project cost.

A series of spreadsheets was developed for determining the incentive level that fulfills the above criteria. These have been included in Appendix G. The incentives for the apartment refrigerator exchange are evaluated on a project-by-project basis. For the illustrative case involving 450 apartment units (included in Appendix G) it can be seen that an incentive of $126.[19] per refrigerator is sufficient to provide the owner with a three-year return on investment from energy savings, and to provide society with a cost of saved energy of about 1 ¢/kWh; significantly below the cost of constructing new generation facilities.

The budget for the residential appliance-recycling program depends entirely upon its success (which directly translates into appliance volumes). The project budget is shown below as Table 5-7.

Table 5-7, Budget for Residential Appliance Recycling Program

Activity	2004	2005	2006
Program development (Clean Air Foundation)	--	$30,000	--
Apt fridge exchange incentives (1500/yr @ $130/unit)	--	195,000	$195,000
Home fridge exchange incentives (900/yr @ $130/unit)	--	117,000	117,000
Beer fridge bounty (200/yr @ $35 in CFL's)	--	7,000	7,000
Beer fridge right-sizing (500/yr @ $100 in total)	--	50,000	50,000
Freezer right-sizing (150/yr @ $100 incentive + $35 CFL's)	--	20,250	20,250
Apt RAC exchange incentives (100/yr @ $35 incentive)	--	3,500	3,500
Home RAC exchange incentives (100/yr @ $35 incentive)	--	3,500	3,500
Other magnet, sticker, and pamphlet costs	--	5,000	5,000
Potential co-funding recycling development (contingency)	--	10,000	--
Program Cost:	--	$441,250	$401,250

The budget is based on the volumes previously given in Table 5-6, a first-order estimation of the incentives that London Hydro would make available to customers, and an expectation that all parties will work cooperatively to develop a pickup and recycling process that is timely, cost effective and transparent to the customer.

Note: The incentive amounts shown in the tabulation should be considered as estimates only. Specific amounts will be developed when more information is available and as part of the marketing plan for this project.

5.4 METHODOLOGY FOR VALIDATING EFFICIENCY GAINS

For bulk-metered multi-tenant (apartment) buildings, actual revenue metering data will be used to validate the efficiency gains. The building's electrical load profile throughout the year prior to the refrigerator exchange will be compared with the post-exchange electrical profile (with adjustments made for changes in weather patterns, etc.).

For all other exchange or right-sizing projects, records systems will be available indicating the unit that was removed from service and its replacement. From this information, the gains in energy efficiency can be determined.

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6 PROGRAM TO INCREASE COMMERCIAL SECTOR ENERGY EFFICIENCY

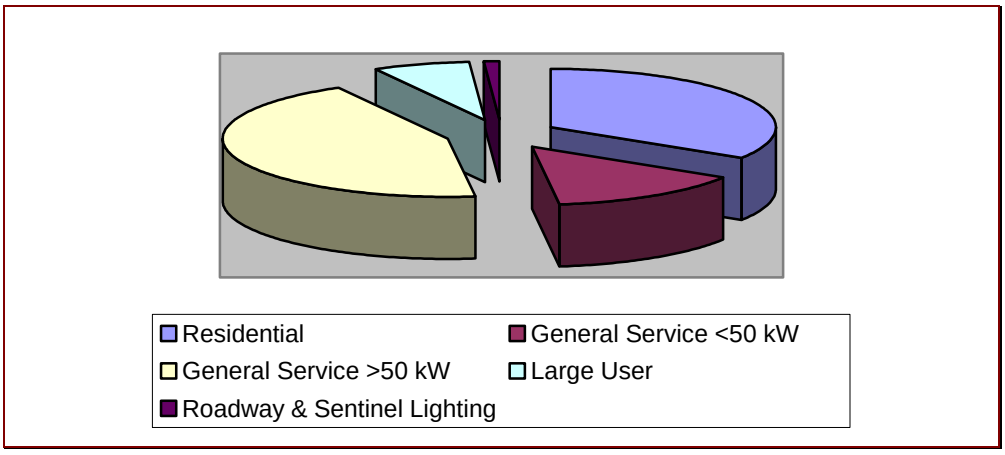
6.1 GENERAL

6.1.1 Background

For the purposes of this initiative, the term *commercial sector* refers to an assortment of small and medium-size businesses and institutional facilities, examples of which are listed below:

- Restaurants
- Retail stores
- Convenience stores
- Arenas
- Medical offices & labs
- Business offices
- Warehouses
- Hotels & motels
- Banks
- Schools
- Supermarkets
- Theatres

Within London Hydro's franchise service territory, there are more than 12,000 commercial customers that together account for almost 60% of overall energy consumption.



For this sector, the sheer varieties of appliances, machines, computers, and other equipment within the buildings and facilities means that any initiative can at best be targeted to a subgroup of the population (e.g. occupancy sensors that yield energy savings in hotels and motels may be of no practical value in a supermarket).

Furthermore, at this point in time, the penetration of energy-efficient devices and sophistication amongst end-use customers will be highly variable. Some franchise retail operations and institutions (e.g. schools, libraries) will likely have ongoing or had previous dealings with so-called energy services providers to reduce their energy operating costs via measures that improve their energy efficiency.

For the other commercial customers, the barriers to their participation include one or more of the following factors:

- Low awareness and understanding of energy efficiency products and services;
- Higher initial cost to purchase energy efficiency products and services;
- Lack of infrastructure of qualified energy efficiency service professionals;
- Lack of credible information on the savings that can accrue from energy efficiency products and services; and
- Reluctance to try new technologies.

Note: Another potential barrier can potentially arise in leased / rented buildings. The landlord isn't paying utility costs and hence may not be particularly interested in implementing measures that benefit the tenant. Conversely the tenant may not be interested in investing in more permanent measures that provide long term benefits to the landlord.

It is entirely likely that there are many as yet untapped opportunities for making significant energy efficiency gains. However success will depend on a program design with the following elements:

- Increased awareness by the customer of their pattern of electrical consumption;
- The provision of facility energy assessments by credible organizations to identify energy efficiency opportunities;
- Targeted incentive offerings, based on annual kWh savings, to assist business customers install energy efficient equipment, including lighting, HVAC, occupancy sensors, electric hot water measures, controls for walk-in coolers, programmable thermostats, energy efficient motors, variable frequency drives (VFDs), energy management systems, or other custom measures; and finally
- The establishment of long-term relationships with participants and networks of trade allies in order to support sustained changes in markets and consumer behaviour.

With awareness and realization of some initial cost savings, it is naturally expected that the customer will be interested in expanding their cost savings opportunities via the implementation of other efficiency measures.

6.1.2 Outline of Initiatives within Program Portfolio

The overall program is subdivided into two phases; in the first year a limited number of initiatives (as described below) will be available and promoted. However, in the second year, the portfolio will be expanded to encompass a range of other initiatives.

First Year Initiatives:

In the first year of the program, the primary focus will be with three distinct initiatives, as listed below:

- Vending machine energy efficiency program, described in greater detail in Section 6.1.3;
- Illuminated exit sign program, described in greater detail in Section 6.1.4; and
- Fluorescent lighting retrofit program (including occupancy and similar lighting system controls), described in greater detail in Section 6.1.5.

In concert with these initiatives, London Hydro will outfit the customer with an interval-style revenue meter, and provide a hands-on demonstration of the MW-Web Internet-based program so that customers will have a better feedback mechanism regarding their consumption patterns.

In this first year, we will also make commercial, industrial and institutional customers aware of NRCan's *Industrial Energy Audit Incentive* and commercial *Energy Innovators Initiative* programs so the background work can be completed, incentives determined, and proper project budgets formulated in advance of the second year initiatives.

Second Year Expanded Initiatives:

In the second year of the program, the focus will expand to encompass additional initiatives, as listed below:

- Solar control window films program, to reduce the building's air conditioning load in the summer and heating load in the winter;
- Premium efficiency motors program;
- Commercial HVAC program, designed to promote energy-efficient heating, ventilating and air conditioning systems in commercial buildings.
- Climate and lighting controls program;
- Power factor compensation program, to promote the installation of low-voltage power factor correction capacitors.

More detailed descriptions of the expanded initiatives will be provided at a later date, likely in the form of an addendum to this report.

6.1.3 Overview of Vending Machine Energy Efficiency Program

Within London Hydro's service territory there are certainly thousands of coin-operated refrigerated vending machines of the type illustrated in Figure 6-1, Figure 6-2, and Figure 6-3. They will be found in most hotels and motels, hospitals, Fanshawe College, University of Western Ontario, high school cafeterias, arenas and similar recreational facilities, some larger supermarkets, and in the cafeterias of some of the larger industrial and commercial customers. A cold beverage vending machine reportedly consumes on average 400 W, or 3500 kWh per year, which in London (at 8¢ per kWh) represents about $280 in annual energy costs to the store, hotel, or facility owner.

Figure 6-1, Typical Cold Beverage Vending Machine

Figure 6-2, Typical Snack Vending Machine

Figure 6-3, Typical Food Vending Machine

While EnergyStar-qualified refrigerated vending machines that use around one-third less energy than standard machines are becoming available in the marketplace, these machines cost several thousand dollars and the energy savings by themselves (i.e. about $90/year) wouldn't entice many owners to replace their present machines with an EnergyStar-qualified unit.

There is however another option that London Hydro will be promoting in this plan. USA Technologies manufacturers a line of occupancy-based energy control products, called the VendingMI$ER™, that reduces energy consumption by an average of 46%, while maintaining the temperature of the product.

The VendingMI$ER, depicted in Figure 6-4, uses three different technologies to intelligently manage the power to a vending machine. Specifically:

- Utilizing an infrared sensor accessory to determine whether there is anyone within 20-30 feet of the machine, it waits for 15 minutes of vacancy and then completely powers off the vending machine. If the compressor is running, power down is delayed until the

Figure 6-4, VendingMI$ER Control and Occupancy Sensor

current cycle is completed.

- Once powered off, it will monitor the room's temperature, and based on this measurement will automatically re-power the vending machine in 1½ to 3 hours - the controller uses *fuzzy logic* to learn from the habits of the building occupants, and modifies the time-out period accordingly. It allows the vending machine to run a complete cooling cycle and then powers it off again.
- The product will never power down a vending machine while the compressor is running, avoiding high head-pressure starts. In addition, when the vending machine is powered up, the cooling cycle is allowed to run to completion before again powering down.

Additionally, VendingMiser can also control other cooled product vending machines, such as refrigerated candy machines. Non-cooled product machines can be controlled by companion product, SnackMI$ER™.

Note: These products are not designed for application on vending machines containing perishable product such as milk. Furthermore, for locations that are open and occupied 24 hours per day, seven days a week (perhaps like a train station), the unit would not produce meaningful savings.

Over 800,000 of these devices have already been deployed in the United States[38]. The product has also been included in a recent NRCan Energy Innovators Case Study.[39]

6.1.4 Overview of Illuminated Exit Sign Program

Illuminated exit signs are an important and legally required safety feature in many buildings. In the case of an emergency such as a fire, their operation is critical in protecting the well being of the building occupants. By design, exit signs operate 24 hours per day, and although they may not seem like big energy consumers across the province hundreds of thousands operate 24 hours a day.

Figure 6-5, LED Exit Signs

Many exit signs in today's buildings use older, incandescent and fluorescent/compact fluorescent lighting (CFL) technology.

Nowadays, the state-of-the-art exit signs as depicted in Figure 6-5 are based on light-emitting diode (LED) technology which is even more energy efficient than units housing compact fluorescent lamps.

[38] US DOE, Office of Energy Efficiency and Renewable Energy; Rebuild America - Weatherization & Intergovernmental Program; website: www.rebuild.org/partnerships/bp_companyview.asp?OrganizationID=2895.

[39] NRCan publication: *Energy Innovators Case Study: CHIP Hospitality – Welcoming Energy Efficiency*; March 2004. website: http://oee.nrcan.gc.ca/Publications/infosource/Pub/ici/eii/pdf/M144-37-2004E.pdf

The scope of the project includes retrofitting illuminated exit signs in the following facilities:

- high-rise apartment buildings
- educational institutes (e.g. schools, colleges, university)
- medical institutions (hospitals, long-term health care facilities, etc.)
- accommodation facilities (hotels, motels, conference centres)

During the first year of the program the focus will be directed to London & Middlesex Housing Authority, which is understood to have significant population of incandescent-based exit signs. In subsequent years the program will be expanded to other buildings on a first-come, first-served basis until funding is exhausted.

6.1.5 Overview of Fluorescent Lighting Upgrade Program

Over the past decade, there have been significant gains in the energy efficiency of fluorescent lighting systems. Today's fluorescent tubes and electronic ballasts have greater light output and less energy input than those of yesteryear. Coupled with the improvements in the reflector component of a fixture, it is now commonplace to provide better lighting to a building area using less electrical energy to do so. And for conditioned spaces, a more energy efficient lighting system can reduce the air conditioning load, thereby providing greater savings to the customer.

With the notable exception of a large-scale project described in Section 10, most lighting system upgrades will be in the small retail operations via the Cool Shops program. In subsequent years the program will be expanded to other buildings on a first-come, first-served basis until funding is exhausted.

6.1.6 Project Scope

Specific projects will be considered on a first-come first-served basis until funding is exhausted.

6.2 ANALYSIS OF TECHNOLOGY AND ENERGY SAVINGS

6.2.1 Review of Maturity of VendingMI$ER Product

The VendingMI$ER™ and companion products were initially developed by Bayview Technology Group in California. In 2003, USA Technologies acquired this company. It isn't clear when the VendingMiser controls were first introduced into the marketplace, but the market penetration in the US indicates that the product has clearly been a success.

An engineering evaluation of the product, prepared by Foster-Miller Inc (a company that carries out diagnostic testing of electrical apparatus amongst among other client services) entitled: Vending Machine Energy Efficiency Device – Engineering Evaluation and Test

Report (dated: June 1, 2000) gives the VendingMI$ER a favourable review. This report is in the public domain and can be downloaded from the vendors website.

The two news releases (*Long Island Power Joins 20 Power Authorities …*, and *CHIP Hospitality Achieves Energy Savings …*) included in Appendix D are testament to the apparent success of the product.

6.2.2 Review of Maturity of LED-Based Illuminated Exit Signs

The maturity of light-emitting diode (LED) technology was earlier described in Section 3.2.1, *Review of Maturity of LED Technology* (see page 25 herein).

6.2.3 Review of Maturity of T8 Fluorescent Lighting Systems

The so-called T8 (and T5) fluorescent tubes and associated electronic ballasts have become the standard for all new construction in North America.

6.2.4 Expected Energy Savings Associated with Vending Machine Program

The annual energy savings associated with the EnergyMI$ER control will depend largely on the pedestrian traffic level in the vicinity of the vending machine. As depicted in Figure 6-6 below, the annual energy savings should range from 36% to 56%, and for customers in London is energy savings will translate into annual bill savings ranging from $90 to $150.

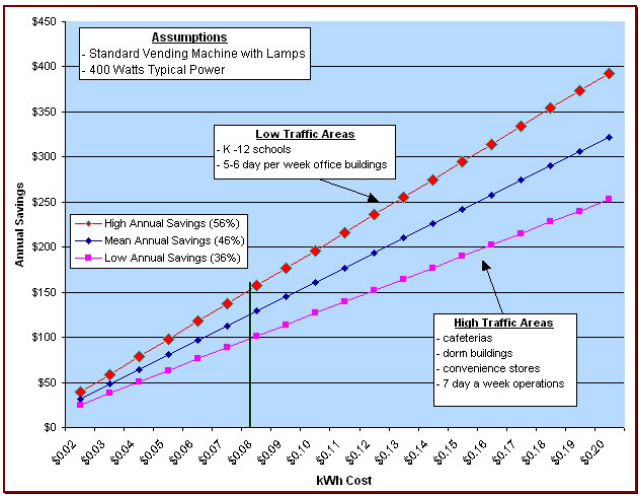


Figure 6-6, Range of Savings with VendingMI$ER Control

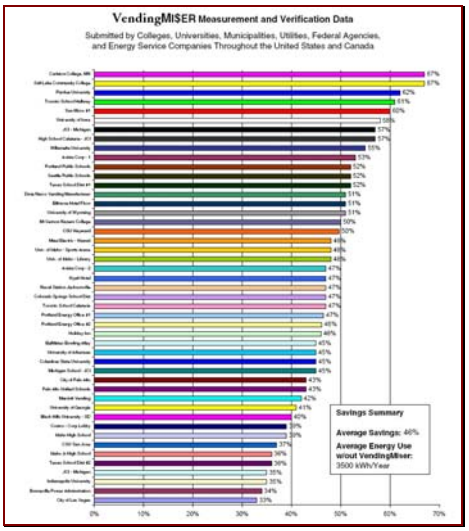


Figure 6-7, Reported Saving Experience with VendingMI$ER Control

If one takes a pessimistic view that each installed VendingMI$ER will yield only 36% energy savings for the average refrigerated vending machine that consumes 3500 kWh/year, then the per device savings will amount to 1260 kWh/year.

If London Hydro is successful in installing these devices on 1000 vending machines, the overall energy savings will be at least (1,000 machines x 1,260 kWh/yr =) 1,260,000 kWh/yr.

6.2.5 Expected Energy Savings Associated with LED Exit Sign Program

The energy savings attributable to an LED exit sign retrofit program are highly dependent upon what the customer is starting with. For example, with reference to Figure 6-9, if the conversion is from a 2-bulb incandescent fixture to LED retrofit lamps, then the per-fixture fixture savings will be (40W – 5W = 35 W, or 306 kWh/yr.

Figure 6-8, LED Conversion Kit

Lighting Type	Average Wattage
Incandescent 1 bulb fixture	20
Incandescent 2 bulb fixture	40
Compact fluorescent 1 bulb fixture	7
Compact fluorescent 2 bulb fixture	14
LED 1 bulb fixture	2.5
LED 2 bulb fixture	5

Figure 6-9, Typical Bulb Sizes for Exit Signs

To the customer, this represents slightly more than $24/year in energy savings.

6.2.6 Expected Energy Savings Associated with T8 Retrofit Program

Simply retrofitting an existing twin-tube fluorescent fixture housing F34T12 fluorescent tubes and a magnetic ballast with a pair of pin-compatible high-efficiency F28T8 fluorescent tubes and an electronic ballast reduces the per fixture electrical load from 74 W to 49 W. The opportunity to use improved fixtures (meaning less fluorescent tubes) coupled with occupancy controls, can yield even greater energy savings to the customer.

Note: The foregoing was an illustrative example based on GE Lighting fluorescent tubes and UltraMax electronic ballasts. Product combinations from other manufacturers may produce savings that are slightly more or slightly less than this example.

6.3 PROGRAM EXECUTION METHODOLOGY AND COSTS

6.3.1 Assumptions

With respect to the VendingMI$ER suite of products, the following assumptions are made:

- the unit cost of the (VM-170 easy-install c/w sensor) device is CAN$230
- the average installation cost will be less than $25 per unit (in a multi-machine facility)
- the current penetration of energymisers in the London area is less than 5%
- achievable targets are 500 installations in 2005 and 500 installations in 2006

Note: If funding streams were available from NRCan's *Energy Innovators Initiative* or via the federal *One-Tonne Challenge* initiative, then this additional funding stream would be used to expand the program to additional vending machines.

With respect to the Cool Shops program, incentive monies are already included in the program cost – refer to draft budget submission included within Appendix D.

6.3.2 Execution Methodology for Vending Machine Efficiency Program

Probably the most straightforward and cost-effective manner for implementing this program is as outlined following:

- Obtain permission to distribute the VendingMI$ER™ information leaflet prepared by Dakota Electric Association and included within Appendix D. The only information that may need to be included (or that needs to be available) is the regulatory approval designation for application in Ontario.
- Based on knowledge of locations where a large percentage of the refrigerated vending machines are located, take an inventory of the numbers, types and locations of machines that each customer has on their respective premises.
- Given that the VendingMI$ER units aren't commodities available in local hardware or electrical supply outlets, London Hydro would bulk purchase the requisite number of units, and arrange for the units to be delivered and installed within participating customer premises.
- The customer would be invoiced for the cost of the units plus a nominal installation fee, less London Hydro's incentive monies, out of realized savings. For example, (ignoring carrying charges) if the anticipated annual savings was $120, then the customer would be invoiced an additional $10/month until their portion of the investment was fully paid for.

6.3.3 Execution Methodology for Illuminated Exit Light Program

Retrofitting illuminated exit signs with LED lamps will normally be carried out by the building owner's trade staff or contract electricians. London Hydro's role would be limited to providing incentive funding.

6.3.4 Execution Methodology for Small Businesses

The Clean Air Foundation has an existing program called *Cool Shops* that is targeted to small business, and specifically small restaurants, Laundromats, dry cleaners, and small supermarkets. This program can, and will be, tailored to the London community – refer to program workshop information included in Appendix D.

Note: The Clean Air Foundation is a not-for-profit organization dedicated to developing, implementing and managing public engagement programs and strategic initiatives that lead to a measurable improvement in air quality. Their approach is based on forming successful partnerships, and forging relationships with companies and governments, to create programs that produce measurable results.

The Cool Shops program conducts an initial energy audit and then provides small retail businesses with energy efficient solutions, including recommendations on how they can save money in the short-, medium- and long-term. Through working with its delivery agents, the Cool Shops program also provides immediate installation of quick initiatives and direct access to implementation partners who can provide the tools and incentives to encourage a shift to more energy efficient buildings. All official "Cool Shops" receive a window sticker to promote their store as energy efficient and to let the community know they are taking a positive step towards clean air.

Figure 6-10, COOL SHOPS Program Logo

The method of engaging participants is to make an introductory presentation at regular meetings of various local Business Improvement Areas (BIAs) and Business Associations (BAs), followed by the implementation of outreach strategies developed specifically to the city of London and it's diverse communities. In addition, these associations will identify and engage model business leaders in their communities who will be early adopters of the program as pilots. The following are known business associations and improvement areas in London who are key partners of the program:

- Hyde Park Business Association
- Old East Village Business Improvement Area
- London Downtown Business Association

In addition to these associations, other key players in the implementation of the program are the City of London, Union Gas, Ontario Ministry of the Environment, Natural Resources Canada, and London Hydro. London Hydro's contribution to the program lies in its ability to provide rebates, incentives, and/or funds associated with participants' adoption of in-store energy efficient measures. One example is encouraging small retailers to replace existing T12 fluorescent lighting, with more energy efficient T8 alternatives. Also, London Hydro could support the implementation of the program by providing funds for staffing, off-setting the costs for audits, and for keystone projects.

The Clean Air Foundation will provide a detailed business plan for the implementation of Cool Shops tailored to the City of London and carry out significant marketing and advertising of the retail participants within the local communities. In addition to providing the framework and structure of the Cool Shops program, the Clean Air Foundation will provide earned media and public relations opportunities, including launch events, awards, and media coverage of the program in London.

6.3.5 Overall Cost Benefit Analysis

Three criteria were adopted for establishing an incentive level for this project, namely:

- The incentive level should be sufficient that the customer achieves a return on investment from predicted energy savings within three years, based on a discount rate (difference between interest and inflation) of 5% per annum; however
- The levelized cost of saved energy (over the lifetime of the measure) should not exceed 90% of the cost of new generation, using the historic commodity prices given in Section 1.5.5 (see page 10 herein); and
- The incentive level should not exceed 25% of the project cost.

Spreadsheets have been developed for determining the incentive level that fulfills the above criteria, and the resulting cost of saved energy. Examples have been included in Appendix G.

The budget for the vending machines program is given in Table 6-1 below.

Table 6-1, Budget for Vending Machine Energy Efficiency Project

Activity	2004	2005	2006
Incentives for VendingMI$ER units (500/yr @ $50)	--	$25,000	$25,000
Installation contractor (500/yr @ $25/unit)	--	12,500	12,500
Other pamphlet costs	--	1,500	--
Program Cost:	--	$39,000	$37,500

The budget for the illuminated exit sign retrofit program is given in Table 6-2 below.

Table 6-2, Budget for Illuminated Exit Sign Program

Activity	2004	2005	2006
LHMA (250 dual incandescent signs)	--	$5,000	--
Other opportunities	--	--	$10,000
Program Cost:	--	$5,000	$10,000

The budget for the Cool Shops program (that will predominantly undertake lighting upgrade projects in small businesses) is given in Table 6-3 below.

Table 6-3, Budget for T8 Fluorescent Light Retrofit Program

Activity	2004	2005	2006
Cool Shops Small Business Program (all inclusive)	--	$30,000	$30,000
Program Cost:	--	$30,000	$30,000

The budget for Phase II initiatives is given in Table 6-4 below.

Table 6-4, Budget for T8 Fluorescent Light Retrofit Program

Activity	2004	2005	2006
Phase 2 initiatives (undefined at this time)	--	--	$152,500
Program Cost:	--	--	$152,500

Note: There may be additional phase 2 programs funding available should the *LCBO Warehouse Makeover Project* turn out to be over-funded.

6.4 METHODOLOGY FOR VALIDATING EFFICIENCY GAINS

If the energy action is significant in comparison to the customer's normal load, then it will be possible to validate the efficiency gain via the revenue meter.

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7 DISTRIBUTION SHUNT CAPACITOR PROGRAM

7.1 GENERAL

7.1.1 Background

A distribution system's operating power is composed of two parts: active (working) power and reactive (non-working magnetizing) power. The *active* power performs the useful work, the *reactive* power does not - its only function is to develop magnetic fields required by inductive devices, such as motors.

Power factor is the relationship between working (active) power and total power consumed (apparent power). Essentially, power factor is a measurement of how effectively electrical power is being used.

Low power factor means poor electrical efficiency. The lower the power factor, the higher the apparent power drawn from the distribution network.

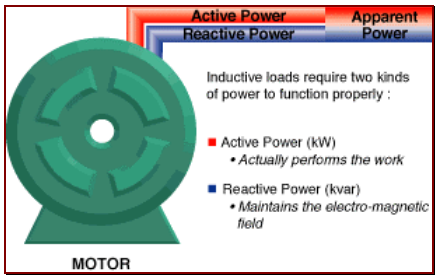

Figure 7-1, Active Versus Apparent Power for Motor Load

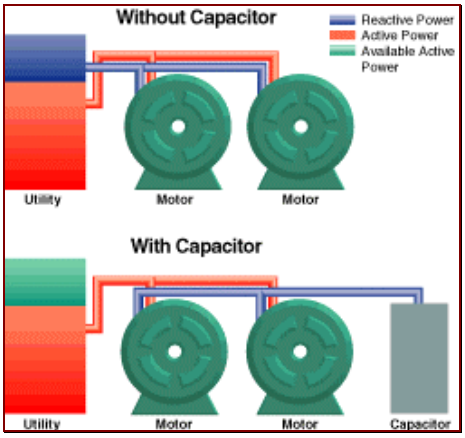

Figure 7-2, Illustration of Power Factor Compensation

Low power factor can be overcome by adding power factor correction capacitors to the electrical network. As illustrated in Figure 7-2, power factor correction capacitors work as reactive current generators, providing needed reactive power (kVAr) to the power supply. By supplying their own source of reactive power, the customers free the utility from having to supply it; therefore, the total amount of apparent power (kVA) supplied by the utility will be less.

Power factor correction capacitors reduce the total current drawn from the distribution system and subsequently decrease line losses.

As a general principle, the ideal location for placement of power factor correction capacitors is within the customer's plant as close as possible to the load. Being downstream of the revenue meter, the customer benefits with a reduced demand charge, and the utility benefits with reduced distribution system losses.

Sometime, it is not possible to convince the customer to install capacitors within their plant (for reasons of practicality, the complexity of the subject matter, or the harmonic nature of the customers load) thereby making it desirable for the utility to install capacitors on the primary distribution system to reduce line losses, provide voltage support, and release system capacity.

7.1.2 Overview of Project

London Hydro's system planning group regularly reviews the performance of its distribution system and prepares a report on its findings. The following paragraph has been replicated from System Planning Report SP03-01, *Annual Energy Delivery Efficiency Performance for Year 2002*, for convenience of reference:

It was observed from the electrical model of London Hydro that on 27.6 kV feeders, savings of up to 15% of the line losses on a main feeder are attainable when compensating for 60% of the reactive power demand at peak hour. In terms of savings, a reduction of 120 kW at system peak (equivalent to ¼ of the savings obtained from the system optimization) is achievable from compensating for the reactive power of three (3) distribution feeders with high losses for a total amount of 14.5 MVAr at a bulk price of $125K. Savings from this type of compensation would add up to over $25K annually.

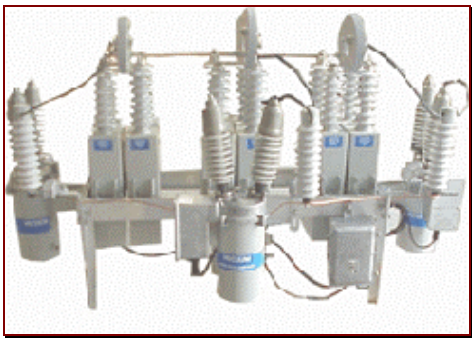

Figure 7-3, Typical Pole-Mounted Capacitor Assembly

The analysis model was updated with present customer load data and the distribution circuit configuration information to ensure that there have been no significant changes that would impact the validity of the referenced System Planning report.

7.1.3 Scope of Project

This project will see the installation of capacitors on three distribution circuits that show the greatest cost-benefit performance.

7.2 ANALYSIS OF TECHNOLOGY AND ENERGY SAVINGS

Distribution shunt capacitors are an everyday piece of distribution equipment that has been used throughout the world certainly for more than 50 years. The only real technology advances are the use of improved internal dielectric materials that provide

improved loss performance and smaller size, and the availability of synchronous switches that are suitable for application at the 16/27.6Y kV distribution levels used by London Hydro.

7.3 PROGRAM EXECUTION METHODOLOGY AND COSTS

7.3.1 Program Execution Methodology

For this program, the capacitors will be specified, procured, and installed by London Hydro's forces in the same fashion that any other capital program (e.g. transformer bank installation) would be carried out.

7.3.2 Overall Cost Benefit Analysis

With changes in distribution system loadings and configurations, the initial cost benefit study that was done a few years ago is outdated. An updated engineering load-flow analysis will be carried out and a Cost of Saved Energy (CSE) analysis will be done as a routine System Planning activity in 2005.

The program budget is given in Table 7-1 below.

Table 7-1, Budget for Distribution Shunt Capacitor Program

Activity	2004	2005	2006
Design, Procure & Install Capacitor Banks.	--	--	$125,000
Program Cost:	--	--	$125,000

As the capacitor assets will become an integral part of London Hydro's electric distribution system, this initiative is classified as capital program.

London Hydro has another capital program entitled *Putting Our Own House In Order Program* (described in Section 14 herein) that will start in 2005 and that is likely under-funded considering the number and magnitude of the opportunities. It is proposed that, should the Cost of Saved Energy (CSE) analysis show that there would be significantly greater benefit in investing in energy actions within London Hydro's head office building (as compared to distribution capacitor banks), there be some mechanism for transferring funding from this program to the other program.

7.4 METHODOLOGY FOR VALIDATING EFFICIENCY GAINS

Validation of the efficiency gains obtained via the installation of the capacitors will be validated by an unbalanced load-flow analysis using the Dromey DESS analysis software. The distribution system model will be calibrated to the existing loads on the

respective feeders, and then two simulations will be done, one without the capacitors, and one with the capacitors. The difference in distribution line losses would be the benefit attributable to the capacitor banks.

It should be noted that a four-season load-flow simulation is based on nominal weather patterns. If the summers are hotter and the winters are colder than the nominal weather pattern, then greater savings (in loss reductions) will be achieved with the capacitors; and conversely if the summers are unseasonably cool and the winters warm, then the line loss reduction will be less than predicted.

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8 COMBINED HEAT & POWER (CHP) OPPORTUNITIES FOR DISPERSED GENERATORS

8.1 GENERAL

8.1.1 Background

Distributed generation is the application of small generators, typically ranging in capacity from 15 to 10,000 kW, scattered throughout a power system, to provide the electric power needed by electrical consumers. *Dispersed generation*, a subset of distributed generation, refers to generation that is located at customer facilities or off the utility system. Usually dispersed generation is also understood to include only very small generation units, of the sized needed to serve individual households or small businesses, in the capacity range of 10 to 250 kW.[40]

Gas turbine powered distributed generators are broadly categorized as utility-, mini-, or micro-turbine. Each type has distinctively different output capacity, designs and operating characteristics. The smallest category, and the one that has attracted much attention in recent years, is the microturbine generator.

Figure 8-1, Typical Size of Microturbine Unit

Figure 8-2, Typical Microturbine Installation

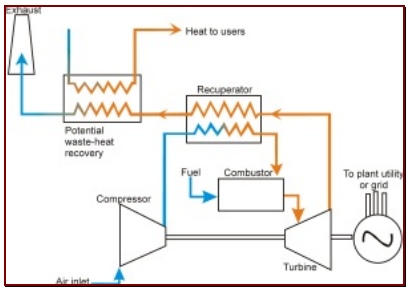

Figure 8-3, Microturbine Functional Diagram

Microturbines are small combustion turbines approximately the size of a refrigerator with outputs of 25 kW to 500 kW. They evolved from automotive and truck turbochargers,

[40] *Distributed Power Generation – Planning and Evaluation*; H. Lee Willis and Walter G. Scott; Marcel Dekker Inc, New York; 2000; pg 1.

auxiliary power units for airplanes, and small jet engines and are comprised of a compressor, combustor, turbine, alternator, recuperator, and generator.

A gas turbine generator uses a turbine spun by the rapid gases of combustion to rotate an electric generator. A micro-turbine's air compressor, turbine and generator are mounted on a single shaft and all spin at the same rate. One unique feature of the microturbine is that its rotating speeds are extremely high, in the range of 45,000 to 100,000 revolutions per minute. And the speed can vary when running - whenever more power is required, the turbine is revved to a higher RPM. Microturbines use DC generators with power electronics to invert to the required three-phase 60 Hz power frequency.

Micro-turbines can't compete with large central power plants for the production of electricity. However, there has been recent interest in micro-turbines for specific niche applications[41] such as:

- harnessing waste gas – microturbines are able to operate on the traditional fuels such as natural gas, diesel fuel and propane, but they can also run on waste gas fuel from landfills and from digesters using agricultural waste.
- integrated combined heat & power applications - Typically, about two thirds of the fuel energy used to generate electricity in central power stations is discarded as waste heat, and then further losses are incurred in power transmission and distribution. However, the fuel efficiency can be approximately doubled if the waste heat is harnessed for heating and cooling purposes. Customers with a need to heat large volumes of water (e.g. food processing plants, linen and uniform laundry facilities, and indoor swimming pools) are likely locations for a cogeneration application of a microturbine.

However, it should be recognized that there are three specific barriers to adoption of micro-turbines by the target small businesses, specifically:

- There hasn't been a sufficient in-service track record to validate manufacturers claims of durability and low maintenance — the *fit it and forget it* trait is a key success factor for small business markets;[42]
- At this time there probably isn't the knowledge base amongst local plumbing and electrical contractors to effectively maintain micro-turbines, and a contractual arrangement with factory-trained service technicians would be required; and

[41] *Microturbines: Lessons Learned from Early Adopters – An E Source Multi-Client Study*; David Van Holde PE, Gary Cler, Christine Hurley, Jon Slowe; a paper presented at the Third Annual Workshop on Microturbine Applications, January 21, 22 and 23, 2003 in Calgary, Alberta (web: http://www.nrcan.gc.ca/es/etb/cetc/cetc01/downloads/presentation_2003_pdfs/15_d_van_holde.pdf)

[42] *Distributed Power Generation – Planning and Evaluation*; H. Lee Willis and Walter G. Scott; Marcel Dekker Inc, New York; 2000; pg 200.

- Today's business leaders strongly encourage businesses to focus on their core competencies, and the cogeneration of electrical power isn't likely within the capabilities of the target market.

8.1.2 Overview of Project

This project involves identifying a diverse sample of small- to medium-size commercial customers that presently use natural gas to heat appreciable volumes of water for their processes. Ideally, the thermal requirements of these customers will be comparable to the capabilities of commercially available micro-turbines, and the customer's existing heating equipment will be almost or fully depreciated.

The primary focus of the project is not the generation of electricity. Rather the microturbine is to be arranged in a Combined Heat & Power (CHP) co-generation mode or Combined Cooling Heat & Power (CCHP) tri-generation mode and used firstly to meet the heating (and cooling needs) of the facility. Surplus thermal energy will be used to generate electricity to offset some of the customer's plant electrical load. With CHP or CCHP, one could increase the thermal efficiency from 35% to about 65%.

Electric load profiles for a diverse group of customers with loads in the 50 to 1500 kW range who presently use significant quantities of gas-heated water are illustrated below in Figure 8-4 through to Figure 8-6:

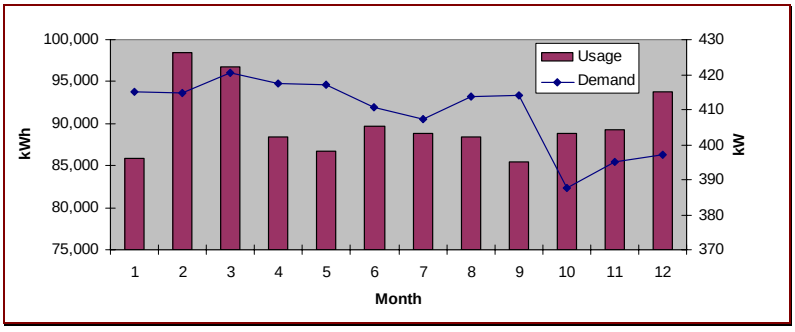

Figure 8-4, Load Profile for Uniform & Linen Laundry

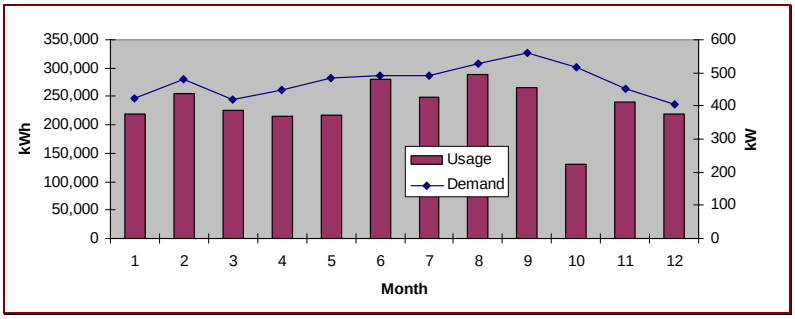

Figure 8-5, Load Profile for Hotel & Conference Centre

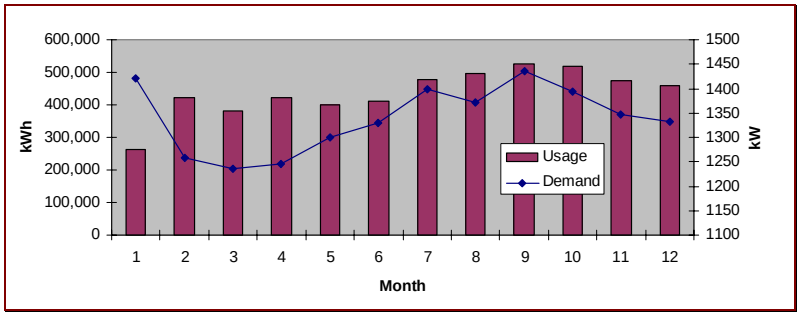

Figure 8-6, Load Profile for Food Processing Plant

Note: Natural gas consumption patterns for these same customers are not available for inclusion in this report, but will be required to conduct a feasibility study.

Customers in the core area of the city (i.e. within Core Energy's service territory) have been excluded as candidates for this program. These customers already have the option of interconnecting with Core Energy's steam or coolant pipelines, which are both produced via an existing tri-generation system.

8.1.3 Scope of Project

Whilst micro-turbines can be for a number of different types of applications, it is clearly a niche market where micro-turbines will be economically viable. Natural Resources Canada (as well as the US Department of Energy) are interested in advancing such applications as a means of reducing the generation of greenhouse gases.

This project will assist in the development of a local market for this technology by:

- Raising customer awareness of CHP opportunities – by engaging Kinectrics Inc[43] to carry out feasibility studies for 4 or 5 customers (at no cost to the customer) with very different processes, and presenting findings to customers in a workshop setting.
- Developing solutions for customer barriers to adoption – by identifying the opportunities for all-inclusive service contracts and other measures to minimize customer risk; and by identifying funding availability from NRCan's CANMET Energy Technology Centre - Emerging Technologies Program.[44]
- Identifying and eliminating regulatory and institutional barriers – this activity will include a literature search of the experiences from other installations, a review of London Hydro's interconnection requirements to ensure microturbines aren't unnecessarily encumbered, and a workshop to familiarize other regulatory agencies

[43] Kinectrics Inc is a well-renowned R&D company in Ontario and has the requisite expertise and wherewithal to undertake this task. As such, they have been pre-qualified for this assignment.

[44] See web site: http://www.nrcan.gc.ca/es/etb/cetc/cetc01/htmldocs/funding_programs_etp_e.html

(e.g. Electrical Safety Authority, zoning and permitting groups, fire departments, etc.) with microturbine technology.

The project may be expanded if one of the candidate customers elects to pursue a microturbine-based CHP system.

8.2 ANALYSIS OF TECHNOLOGY AND ENERGY SAVINGS

8.2.1 Review of Maturity of Microturbine Technology

Distributed energy — onsite power generation — is not new. It has been done for decades, but mainly in large industrial facilities such as paper mills and steel mills. Since those facilities use massive amounts of electricity and heat, it made sense for them to generate power onsite. But what is new is the application of distributed energy to smaller energy-using sites — office and apartment buildings, schools and colleges, hotels and motels, supermarkets. And the dawn of the microturbine — including its inexpensive means of interconnecting with the utility grid — is a major reason for this trend toward distributed energy at smaller sites.[45]

The U.S. Department of Energy's *Office of Energy Efficiency and Renewable Energy* (web: http://www.eere.energy.gov/) is at the mid-point in their *Advanced Microturbine Program*. This program is described as a six-year program for FY 2000-2006 with a Government investment of over $60 Million. End-use applications for the program are open and include stationary power applications in industrial, commercial, and institutional sectors. The five manufacturers involved in the program are:

- Capstone Turbine Corporation, California (web: http://www.microturbine.com/)
- GE Global Research (in concert with the GE Power Systems and GE Industrial Systems divisions (web: web: http://www.crd.ge.com/01_coretech/energy.shtml)
- Ingersoll-Rand Company Ltd, North Carolina (web: http://www.irpowerworks.com/products_microturbines.htm)
- Solar Turbines (web: http://esolar.cat.com)
- UTC Power (A United Technologies Company), Connecticut (web: http://www.utcpower.com/html/home.html)

There is also active interest and expertise in Canada. Much information can be found on Natural Resources Canada's *CANMET Energy Technology Centre* website (http://www.nrcan.gc.ca/es/etb/index_e.html) and Kinectrics Inc's (formerly Ontario

[45] Gene Dallaire; article: *Microturbines: Power to the People*; Distributed Energy magazine, published by Forester Communications Inc.; November / December 2004 Edition (web: http://www.forester.net/de_0411_microturbines.html)

Hydro Research) website describes their involvement in some recent and ongoing projects (see http://www.kinectrics.com/en/solutions/microturbinedemo.html).

Certainly on earlier lists of barriers to adoption of micro-turbines was the grid interconnection issue – the interconnection rules and regulations vary between utilities, and the cautious approach to new technologies meant that the costs associated with interconnecting generating to the grid were quite high. However, some recent standards publications as listed below should simplify the interconnection issue for future projects:

- The California Energy Commission (CEC) has worked with all major utilities there to develop a state-wide set of rules and regulations (known as Rule 21) concerning distributed-generation interconnection.
- IEEE Standard 1547-2003, *IEEE Standard for Interconnecting Distributed Resources with Electric Power Systems,* provides a uniform standard for interconnection of distributed resources with electric power systems. It provides requirements relevant to the performance, operation, testing, safety considerations, and maintenance of the interconnection.
- UL Standard 1741, *Standard for Inverters, Converters and Controllers for Use in Independent Power Systems*.

8.2.2 Assumptions

The customer's initial capital investment and ongoing operating and maintenance costs for a micro-turbine will depend on the output rating of the dispersed generator, the type and cost of fuel (e.g. natural gas versus landfill flare gas), and the application requirements (standby electric generator versus base-load thermal-following CHP co-generator).

For lack of site-specific information, it is assumed that information contained within two papers referenced below is a reasonable proxy of project costs:

- *CHP Field Trial – Cummins / Capstone 60 (Including: Copeland Fuel Gas Booster and & Unifin HR Unit)*; Bryan Halliday, Eng., CANMET Energy Technology Centre – Ottawa; a paper presented at the DOE/CETC/CANDRA *Workshop on Microturbine Applications*, January 21 – 23, 2003, Calgary, Alberta.
- *Microturbine Installation & Operational Experiences in the South Coast Air Quality Management District*; Vincent G McDonell, UCI Advanced Power & Energy Program, University of California; a paper presented at the DOE/CETC/CANDRA *Workshop on Microturbine Applications*, January 21 – 23, 2003, Calgary, Alberta.

8.2.3 Expected Energy Savings Associated with Microturbine

The expected energy savings and cost of saved energy (CSE) will be determined as an integral part of the various feasibility studies.

8.3 PROGRAM EXECUTION METHODOLOGY AND COSTS

Consulting firms with experience in this subject matter will carry out most of the work elements for this project. The program budget is given in Table 8-1 below.

Table 8-1, Budget for CHP Opportunities for Dispersed Generators Program

Activity	2004	2005	2006
Feasibility Studies (5 @ $4K)	--	$20,000	--
Workshops (2 @ $2½K)	--	5,000	--
Co-fund development of RFP	--	--	$5,000
Program Cost:	--	$25,000	$5,000

With respect to workshops, London Hydro will use internal resources to host these events – the cost elements indicated are for the costs of bringing external experts to a local forum.

8.4 METHODOLOGY FOR VALIDATING EFFICIENCY GAINS

For a CHP project, the efficiency gain will be in the area of fuel combustion (natural gas) – the excess heat is used to generate electricity that will offset a portion of the customer's overall electric load.

Customers that are candidates for CHP projects likely already have an interval-style revenue meter installed. Efficiency gains can be validated by comparing the customer's electrical load profile prior to connection of a dispersed generator with the post-connection electrical profile and adjusting for changes in weather patterns, etc.

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9 ENERGY AWARENESS IN THE CLASSROOM PROGRAM

9.1 GENERAL

9.1.1 Background

In the April 19th, 2004 news release[46] from the Premier's office in regard to the emerging energy challenge in the province, it is noted that: "… *The McGuinty government is committed to working with Ontarians to create an energy conservation culture throughout the province. A variety of new measures will help individuals, families, institutions, government, businesses and communities play a role*."

In various speeches, Minister of Energy Dwight Duncan reinforced the conservation culture message (e.g. "*We believe that LDCs can and should be agents of change at the local level to promote conservation. LDCs are extremely well placed to encourage conservation and energy efficiency in the communities they serve, and we will need all their expertise, ingenuity and leadership to help build that conservation culture in Ontario*.").

According to Webster's New Collegiate Dictionary, culture is *the integrated pattern of human behaviour that includes thought, speech, action, and artifacts and depends on man's capacity for learning and transmitting knowledge to succeeding generations*. In other words, people learn culture.

Since elementary schools are the established institutions where succeeding generations do much of their learning, it seems like a logical place to introduce the energy conservation creed.

This program, which is targeted to younger students in elementary schools, is intended to increase their awareness of energy resource issues and provide them with some basic information so that they can monitor the energy use within their home and school building.

[46] Premier of Ontario – Dalton McGuinty website; April 19th, 2004 posting: *Background Information – Meeting Ontario's Energy Challenge*. (http://www.premier.gov.on.ca/english/news/Energy041904_bd1.asp)

9.1.2 Overview of Project

London Hydro previously developed a teaching resource kit entitled "*The Power of Electricity*" that has been designed to address most of the learning expectations for the Grade 6 curriculum unit on the subject of electricity. The kit consists of a binder of teaching materials and two videos – see Figure 9-1.

Building upon the success of the "The Power of Electricity", London Hydro plans to develop a turnkey conservation awareness program.

Figure 9-1, Power of Electricity Resource Kit

This new resource material will be structured so that it may be used in concert with *The Power of Electricity* material, or as a stand-alone teaching package, thereby giving the teacher / Board greater flexibility and increasing the likelihood of Province-wide interest.

If done correctly, the program is certain to plant the energy conservation seed in the minds of the students. One need only look as far as the Blue Box as an example of how schools can influence social behaviour. Use of the blue bins at schools is an entrenched action, and most children naturally look for the bin when discarding materials outside the school yard. There is every reason to believe that the same outcome (i.e. positive cultural shift) is possible with energy conservation.

The prerequisites and vision for a successful and effective Energy Awareness program are outlined below:

[1] It has to be easy to teach, and the teachers need to be comfortable with the subject matter -

The vision by which this program objective would be addressed is outlined following:

- Develop a turnkey energy conservation lesson plan – The workload of today's teachers is great and any material that they may obtain for teaching (e.g. lesson plans) is welcome. London Hydro will contribute towards the development of such a product by Board staff with expertise in this area.
- Train all Grade 5 teachers in the material – This ensures that all materials and objectives in the lesson plan are fully communicated to the teachers. A London Hydro representative will be present to answer questions in regards to the energy issues within the plan.

[2] It has to be fun for the students, age specific, and include elements that are Internet-based (students that age recognize they live in the Internet-based era – in fact they probably can't image life without the Internet – and we want energy conservation to be perceived as the way of the future, similar to the manner that the Internet is perceived) -

Certainly one of the best interactive internet-based products for fulfilling the stated vision is the "Energy Hog" product (http://www.energyhog.org/), of which some of the screens have been reproduced in Figure 9-2 below.

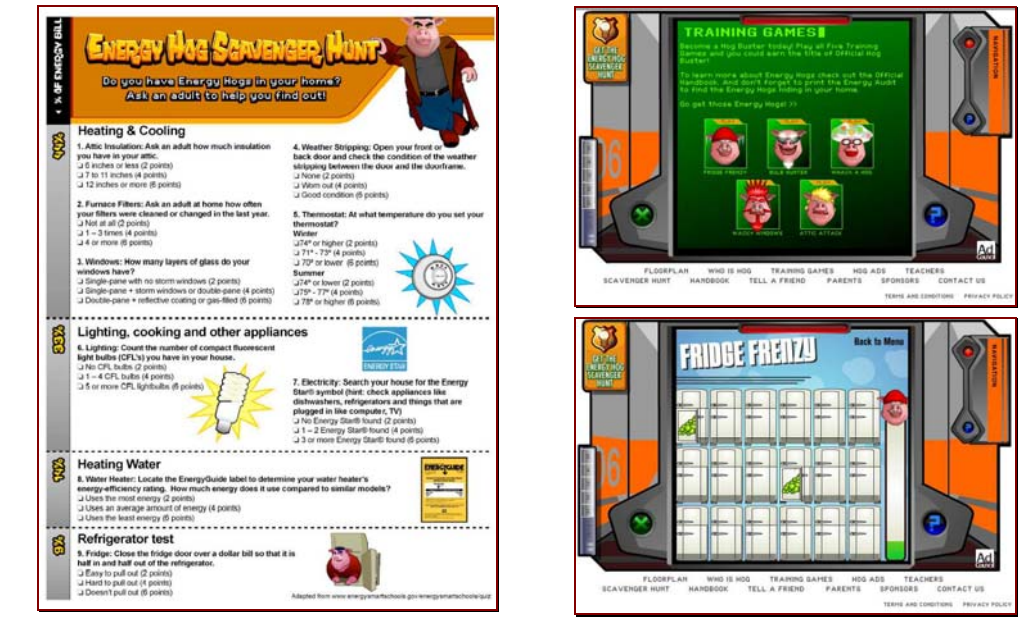

Figure 9-2, Images of Internet-Based Energy Hog Product

As part of the plan, London Hydro will try to license this product so that the students, both in the classroom and from their home, may use it.

Note: One of the enhancements that we will pursue is looking at the possibility of making the *Energy Hog Scavenger Hut* (the term used to describe the household energy audit) an online form that could be used as a mechanism for verifying student participation rates.

[3] There has to be actionable elements of the program – we want the program to be more than a classroom lesson – we want to make it very easy for the student implement a few energy actions immediately within their home -

London Hydro will develop a hands-on energy conservation kit for distribution to each student. It is envisioned that the kit would include the items listed following:

- 1 compact fluorescent light, complete with instructions as to where is should be installed for maximum effect (refer to Figure 16-3);
- 3 door-knob hanger Energy-saver artwork cut-outs (see Figure 9-3);
- Thermometer stickers for installation within the household refrigerator and freezer (see Figure 16-6);
- Energy saver stickers for fridge, washer, dryer, and dishwasher (see Figure 5-5, Figure 16-7 and Figure 16-8);
- Home energy audit test, for self and a family member (which may simply be instructions for logging into the Energy Hog website from home);
- Shower flow measuring bag (doubles as kit bag);
- Energy lesson plan materials (so that parents understand the nature of the program and can assist the child's participation); and
- EcoSchools material for school energy audit (age appropriate).

Figure 9-3, Illustrative Example of Door-Knob Hanger

[4] There has to be a positive reward system in place to encourage participation -

To further increase program participation, it is envisioned that each teacher that could demonstrate that 80% or more of his or her students undertook the at-home portions of the program (i.e. simple audit and installation of conservation kit items) would receive a gift certificate in a token amount for use in Scholars Choice, The Toy Shoppe, or other retail store that sells educational supplies.

A final objective of the program is to integrate this initiative with the Ontario EcoSchools initiative,[47] provided that this wouldn't delay or detract from London Hydro's program goals.

9.1.3 Scope of Project

The target rollout date for the *energy awareness in the classroom* program to grade 5 students in both the Thames Valley District School Board and the London District Catholic School Board is the Fall of 2005. Rollout to private schools (that are interested) will follow in the Fall of 2006.

[47] see website: http://www.yorku.ca/fes/envedu/EcoSchools_pdfs/EcoSchools_Brochure.pdf

The numbers of schools within each Board's jurisdiction that has grade 5 students, as well as the approximate numbers of grade 5 students for each Board is tabulated below.

Table 9-1, Target Audience for Energy Awareness in Classroom Program

School Board	Number of Schools	Number of Eligible Students
• Thames Valley District School Board	155	≈ 5,000
• London District Catholic School Board	37	≈ 1,500
• Private Schools	?	≈ 250

Note: It is assumed that 70% of the schools and students are within London Hydro's franchise service territory, and the others are in Dorchester, St Thomas, Tillsonburg, Woodstock, and other towns.

There is another dimension to the program whereby London Hydro intends to install interval-style revenue meters in all TVDSB and LDCSB schools within its franchise service territory. Once completed, London Hydro will develop a series of benchmarking metrics (energy use per floor area, energy use per student, energy use per hours of operation, etc.) for ranking the schools within each Board's jurisdiction in terms of energy performance, so that the under-performing buildings can be targeted for energy conservation actions.

9.2 Analysis of Technology and Energy Savings

As an education and awareness program, the benefits (in terms of energy savings) will be indirect, may not occur for several years, and even then will be difficult to quantify. This would be analogous to attributing the learning of fractions in grade school to future career successes.

With respect to the contents of the energy conservation kits, each item within the kit will be recognized as a tool for saving energy within the household, but these would be small measures and difficult to measure or determine with any degree of certainty.

As to the energy performance-benchmarking component (described in Section 9.1.3), it is premature to speculate as to which energy actions will be undertaken. But it is realistic to expect that the Boards will be interested in participating in one of the other programs described within this plan (e.g. *Program To Increase Commercial Sector Energy Efficiency*) at some future date.

9.3 Program Execution Methodology and Costs

9.3.1 Assumptions

One of the difficulties with this program is that the service areas for both the TVDSB and LDCSB extend well beyond London Hydro's franchise service territory, to include such neighbouring communities as St Thomas, Tillsonburg, Dorchester, Woodstock, Lucan and Strathroy to name a few.

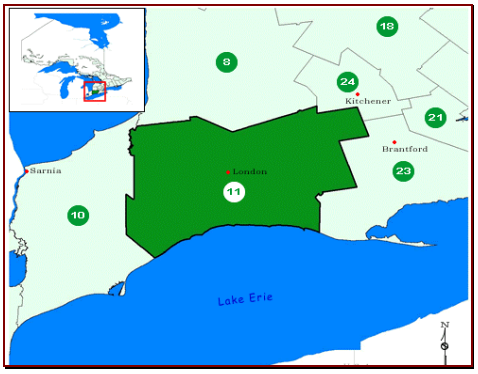

Figure 9-4, Thames Valley District School Board

Figure 9-5, London District Catholic School Board

The plan is based on the following set of assumptions:

- For each school board, 2/3 of the overall number of students attends schools that are located within London Hydro's service territory;
- London Hydro will provide seed funding for development of the conservation program that will be available for implementation throughout both school boards;
- It will be possible to teach the teachers within one of the professional development days. If not, London Hydro has included some funding to cover the cost of supply teachers.
- The Ministries of Education, Environment and Energy will see value in the conservation program and will make up any funding shortfalls for program development; and
- Neighbouring LDC's will see value in participating in this program. The budget amounts shown later are only sufficient to provide teaching materials and teacher training for the schools located in London; presumably other LDC's would contribute teaching materials and training for the students and schools within their respective service territories.
- The material would fit into the Fall curriculum within each Board; if not, it only means that the timing of program expenses given later in Table 9-2 will be incorrect.

9.3.2 Execution Methodology

London Hydro has no expertise in developing educational materials (e.g. lesson plans), and so will either provide seed monies for program development by school board staff with this expertise, or alternatively contract with an educational consultant.

Prior to program rollout, it is expected that a pilot project will be done with one volunteer grade 5 class simply to discover and remedy shortcomings before full rollout.

London Hydro will arrange for assembly of the give-away energy conservation kits, and licensing of the internet-based energy programs.

London Hydro staff will install interval-style revenue meters at all schools using monies from the Smart-Metering initiative. London Hydro will either use internal resources of a summer student to develop and populate the energy performance benchmarking spreadsheets.

9.3.3 Overall Cost Benefit Analysis

The budget for this program is given in Table 9-2 below.

Table 9-2, Budget for Awareness in the Classroom Project

Activity	2004	2005	2006
Program development (co-funding with Boards)	--	$5,000	--
Web site licensing fees		5,000	
Teacher training (half the teacher population)		10,000	--
Energy conservation kit giveaways (4450 students)	--	40,000	$40,000
Program Cost:	--	$60,000	$40,000

All elements of the energy awareness in the classroom program are described in the literature as *behaviour change* projects.[48] One measure of a behaviour change project is its *program cost per capita of the target community*. This measure has been used herein with results as tabulated below:

Table 9-3, Program Cost per Student

Program	Budget	Number of Students	Cost per Student
• Classroom Energy Awareness Program	$ 100,000	4,450 / yr	$ 11.[24]

It should be noted that there are some significant start-up costs associated with program development and teacher training. In future years, these costs will be negligible, and the resultant cost per student will decrease.

9.4 METHODOLOGY FOR VALIDATING EFFICIENCY GAINS

A literature search has not disclosed any sensible techniques that may be used to quantify the energy efficiency gains that are directly associated with the public education campaign.

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[48] *A Review of Strategies Promoting Energy Related Behaviour Change*; J. M. Rolls, Energy SA, Australia; a paper presented at the ISES 2001 Solar World Congress.

10 LCBO WAREHOUSE MAKEOVER PROJECT

10.1 GENERAL

10.1.1 Background

In his April 19th, 2004 statement to the Legislative Assembly in regard to *building a culture of conservation* in the province, Premier Dalton McGuinty had the following to say about the government's own actions:[49]

> *Together we will make real change in the way we use energy in this province.*
>
> *Our government's goal is ambitious: to reduce electricity use by five percent across the province by 2007.*
>
> *But our government will also do our part.*
>
> *In fact, we will hold ourselves to an even higher standard.*
>
> *We will cut electricity consumption in all government operations by 10 per cent over the same period.*
>
> *To help reach those targets …*

While the LCBO is not strictly a *government operation* (in spite of public perception to the contrary), the London warehouse operation has been selected to be a *showcase* site for several reasons including:

- local staff have expressed great interest, have monies to invest in efficiency measures, and have been very cooperative in working with London Hydro on ideas to significantly reduce their energy consumption;
- the energy consuming processes and appliances are fairly easy to understand; and
- the savings opportunities are fairly significant and for the most part will utilize a number of retrofit technologies that will be of direct interest to other commercial and industrial customers within London.

  Note: While this is a *showcase* project, all other commercial and industrial customers within London will be afforded the same opportunities and incentives under other programs described herein, such as the *Program To Increase Commercial Sector Energy Efficiency*.

[49] Dalton McGuinty, Premier of Ontario's web site: http://www.premier.gov.on.ca/english/news/default.asp; article: *McGuinty Government Building Culture Of Conservation: Working With Ontarians To Save Energy, Money And The Environment*; April 19, 2004.

10.1.2 Overview of Project

The LCBO Warehouse, located at 955 Wilton Grove Road, is one of five regional distribution centres that serve the province. LCBO warehouses work on a hub system with the center located at the LCBO's Durham facility. Smaller regional warehouses in Toronto, London, Ottawa and Thunder Bay serve the retail stores in their respective geographic areas.

Figure 10-1, LCBO Regional Warehouse

The original building was constructed in 1967 and consists of heated warehouse space, covered loading docks for transport trucks, and conditioned office space along the north side. In 2003, an expansion project almost doubled the warehouse space.

Figure 10-2, Aerial View of LCBO Warehouse

The customer's load profile over the past year is shown in Figure 10-3 and Figure 10-4 below.

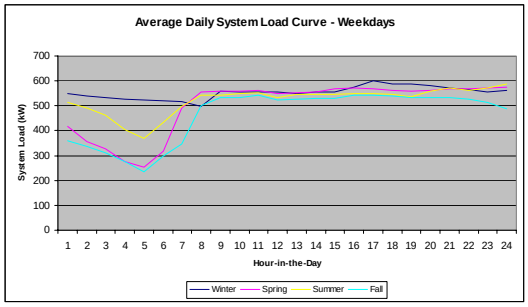

Figure 10-3, Average Daily Load Curve (Weekdays, March 2003 - 2004)

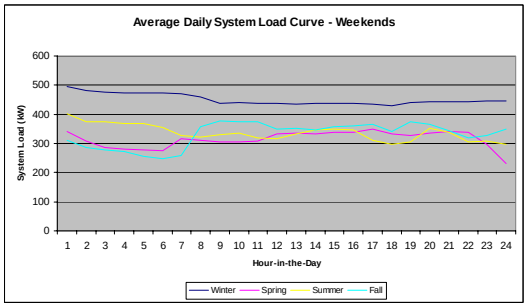

Figure 10-4, Average Daily Load Curve (Weekends, March 2003 - 2004)

A staff of 80 employees works in the warehouse area in two shifts; the first from 8:00 to 16:00 hours, and the second from 16:00 to 24:00 hours. Another 7 staff works in the office area from 8:00 to 16:00 hours.

10.1.3 Scope of Project

This project is comprised of the following elements:

- Conducting a detailed energy audit of the LCBO warehouse;
- Preparing a lighting design for the proposed retrofit activities;
- Preparing a list of recommended energy actions for the customer to undertake, and determining the incentives that will apply to each energy action;
- Making application to NRCan (on behalf of the customer) to co-fund part of this project under their Energy Retrofit Assistance program;
- Measuring gross improvements in energy performance (via the revenue meter) as individual energy actions are undertaken; and
- Preparing a case study for presentation (preferably by the customer) at one of London Hydro's energy conservation workshops (refer to Section 16.2.5 on page 139 herein).

10.2 ANALYSIS OF TECHNOLOGY AND ENERGY SAVINGS

10.2.1 Warehouse Lighting Systems

The original section of the warehouse is lit via 1400 2-lamp 8-foot long fluorescent fixtures, each outfitted with standard F95T12 fluorescent lamps (and a single common magnetic ballast) as depicted in Figure 10-5 and Figure 10-6 below.

Figure 10-5, Suspended Fluorescent Fixtures in Original Warehouse

Figure 10-6, Close-Up of Twin-Tube 8-Ft Fixture

One cost effective efficiency measure would be to replace the fluorescent lamps with energy efficient T8 fluorescent lamps (which share the same length and end-pin configuration) and replace the magnetic ballast with a (low-THD style) electronic ballast. This measure will reduce the average consumption per fixture (ballast losses included) from 227 W to 160 W.

The T-8 fluorescent fixtures and lamps have been in the marketplace for more than a decade, and are now in fact the standard for new construction.

The new section of the warehouse is lit via 230 metal halide fixtures as depicted in Figure 10-7. Each fixture has integral ballast and a standard 400 W bulb.

Figure 10-7, Metal-Halide Lighting in Expanded Warehouse

In the expanded section of the warehouse, two energy actions are suggested, namely:

- Replacing the existing 400 lamps with 360 W Philips Econ-o-watt® metal-halide lamps (or similar) having the same 36,000 initial lumen output characteristic and rated life as the original 400 W lamp); and
- Outfitting the fixtures with an occupancy-sensing dimming control, such as the Hubbell LightBAT-G2 unit depicted below in Figure 10-8. These controllers are designed so that full light output is provided directly over any activity, and the light output is reduced to 50% when the space is unoccupied. This scheme is illustrated in Figure 10-9 below.

Figure 10-8, Hubbell *LightBAT G2* Controller

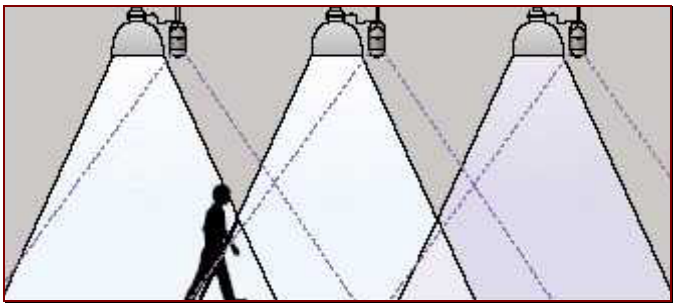

Figure 10-9, Illustration of Motion-Sensing Dimming Control

Note: One of the inherent drawbacks of high-intensity discharge lamps, such as metal halide, high-pressure sodium, and mercury vapour is their long start-up time. Start-up typically takes 3 to 5 minutes, and restarting after a shutdown or power interruption takes 10 to 20 minutes (or 5 to 7 minutes with a pulse-start system). It is for this reason that the described occupancy sensor is designed to dim the light, as opposed to turning it completely off.

Occupancy sensor technology is not new; what is unique about the product illustrated in Figure 10-9 is its packaging that provides a convenient low-cost retrofit strategy.

The lamp replacement measure will reduce the average consumption per fixture (ballast losses included) from 465 W to 415 W. The occupancy controls are expected to yield an

additional 40% energy savings (for this particular application, thereby reducing the effective per-fixture consumption to 250 W.

The foregoing discussion has been solely to describe in general terms one approach to retrofitting and the associated potential energy savings. It is not intended to supplant the need for a formal lighting design. Aside from energy efficiency, interior lighting systems need to provide appropriate illuminance levels for the nature of the task, and some degree of illuminance uniformity (see examples shown in Figure 10-10 and Figure 10-11 below).[50]

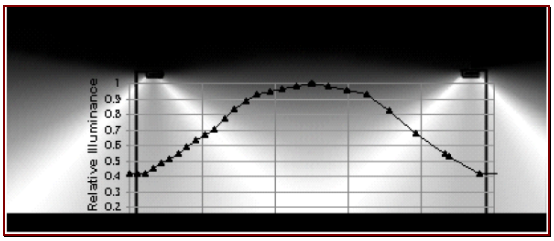

Figure 10-10, Poor Illuminance Uniformity

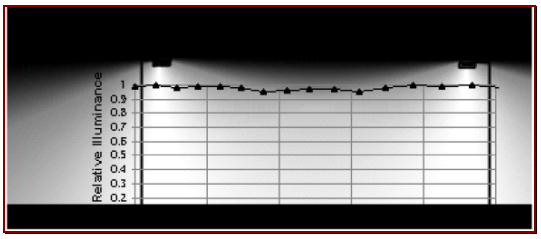

Figure 10-11, Good Illuminance Uniformity

Such parameters are set forth in Illuminating Engineering Society of North America (IESNA) publication DG-2-92, *Design Guide for Warehouse Lighting*; 02-Aug-1992.

As part of this project a formal design review will be carried out to ensure that the end system firstly conforms to the established requirements for task lighting, and secondly saves energy (when compared to the existing system).

10.2.2 Office Lighting Systems

The office area is lit via ceiling-recessed fluorescent fixtures as illustrated in Figure 10-12. Each fixture houses four (4) standard 48-inch F40T12 tubes and a magnetic ballast.

One cost effective efficiency measure would be to replace the four fluorescent lamps in each fixture with two energy-efficient high-output T8 fluorescent lamps (which share the same length and end-pin configuration) and replace the magnetic ballast with a (low-THD style) electronic ballast. This measure will reduce the average consumption per fixture (ballast losses included) from 227 W to 160 W.

Figure 10-12, Existing 4-Lamp Fixtures in Office Area

[50] Source: PIER Lighting Research Program report: *Design Criteria and Energy Savings Report Deliverable 5.3.1b and c*; A report prepared under California Energy Commission contract # 500-01-041; May 30, 2003

Note: Aside from the new lighting arrangement being more energy efficient, there will be a consequent reduction in air conditioning load in the summer for the office area.

Again, the foregoing discussion has been solely to describe in general terms one approach to retrofitting and the associated potential energy savings. It is not intended to supplant the need for a formal lighting design. Aside from energy efficiency, interior lighting systems need to provide appropriate illuminance levels for the nature of the task, and some degree of illuminance uniformity.

Such parameters are set forth in ANSI/IESNA Standard RP-1-04, *Standard Practice for Office Lighting*; 20-Feb-2004. As part of this project a formal design review will be carried out to ensure that the end system firstly conforms to the established requirements for task lighting, and secondly saves energy (when compared to the existing system).

10.2.3 Forklift Charging Systems

One significant load within the warehouse is the charging station used to recharge the batteries used for the fleet of 21 forklifts and 13 tow motors. The chargers are uniquely numbered from 1 to 32, as depicted in Figure 10-13 and Figure 10-14 below.

Figure 10-13, Battery Charging Station

Figure 10-14, Typical Battery Chargers

It is believed that the battery-charging regime is responsible large peak that occurs daily just following the shift change at 16:00 hours. This peak is clearly evident in Figure 10-15 and appears to be about 100 kW in magnitude.

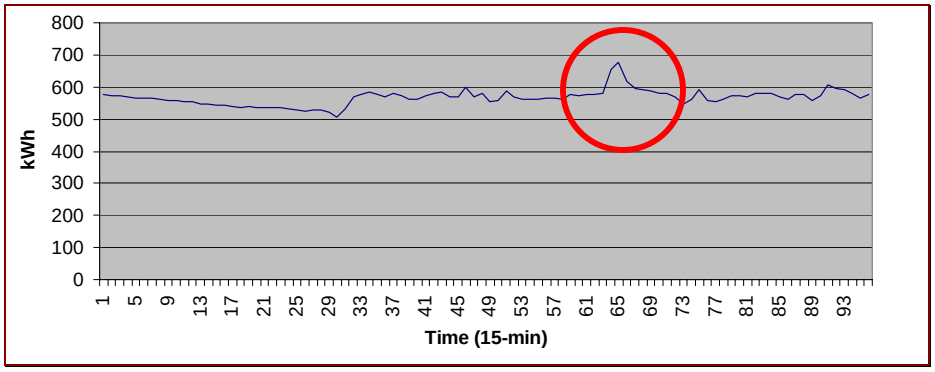

Figure 10-15, Example Daily Load Profile (Feb 25, 2004)

Battery charging is a load that can usually be shifted to the so-called off-peak periods for both demand and energy savings. To illustrate the potential demand savings, the overall monthly demand charge for *general service > 50 kW* customers is composed of the following elements:

- $2.3431/kW - transmission network charge (applies 7:00 am to 7:00 pm, local time)
- $2.1755/kW - transmission connection charge
- $1.6229/kW - distribution

  $6.1415/kW total demand tariff

If the 100 kW peak illustrated in Figure 10-15 is representative, then it is contributing $615 in demand charges on each monthly invoice. Delaying the battery charging until after 7:00 pm would avoid the transmission network charge component. Delaying the process until after midnight when the second shift has finished, and at least 100 kW of lighting or other load has been shut off for the night would be the optimal savings arrangement.

Figure 10-6 below shows the average hourly market price for electricity since Market opening. On average, when the batteries are being re-charged at or after 4:00 pm, the market energy price is about 6¼¢/kW·h.

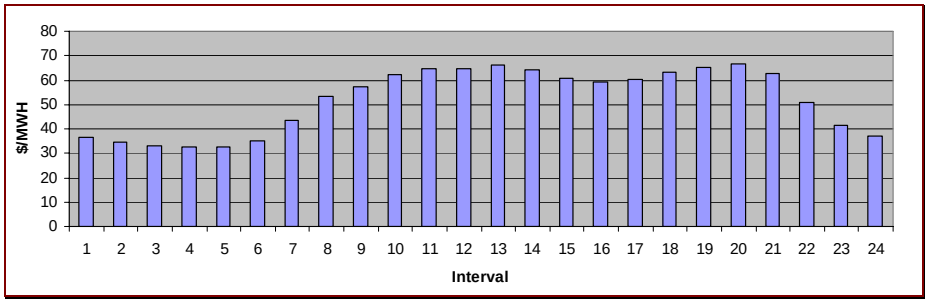

Figure 10-16, Average Hourly Market Energy Prices

However, if the charging activity is delayed until after midnight, the market energy price is about 3½¢/kW·h, which translates into further customer bill savings.

This load shift opportunity may require the purchase of additional batteries.

10.2.4 Other Opportunities

As part of the project, a more extensive energy audit will be conducted of the entire complex. Measures that will be examined will include, but not necessarily be limited to the following:

- installation of solar control films (e.g. *3M's Scotchtint™ Plus Low E*) on the windows to both reduce solar gain in the summer months, and cut heat loss in the winter months.
- review of the lighting and lighting controls used in the system of post-top luminaires for lighting the access roadways and parking areas, and for illuminated corporate signage.
- assessment of opportunities for energy-efficient motors for the ventilation fans and conveyor belts in the warehouse area.
- assessment of opportunities for energy-efficient office equipment (e.g. LCD computer monitors, fax machines, photocopiers, printers, etc.).
- assessment of opportunities for lighting controls in non-continuously occupied areas (e.g. washrooms, change rooms, meeting rooms, etc.). Also included will be opportunities for automatic "daylight dimming" ballasts/controls that dim the office lighting when daylight is adequate.
- assessment of opportunities for other energy saving products such as USA Technologies' VendingMISER® for cold beverage and snack vending machines (if any) in employee areas.

Note: There is no need for power factor correction capacitors at this location. Furthermore, all existing illuminated exit signs are presently based on LED technology.

10.3 PROGRAM EXECUTION METHODOLOGY AND COSTS

10.3.1 Assumptions

It is assumed that the audit and lighting design phases of this project will be eligible for partial funding from NRCan's *Energy Retrofit Assistance* program.

10.3.2 Execution Methodology

LCBO employees or their contractors will carry out all energy actions (e.g. lighting retrofits, installation of controls, etc.) within the LCBO warehouse in accordance with the LCBO's normal procurement policies and procedures. London Hydro role in any physical works is simply to provide incentive monies.

10.3.3 Overall Cost Benefit Analysis

The anticipated energy improvements are depicted graphically in Figure 10-17 below. Basically it seems that the combination of modern technology and behaviour changes can cost-effectively reduce the energy consumption by more than 30%.

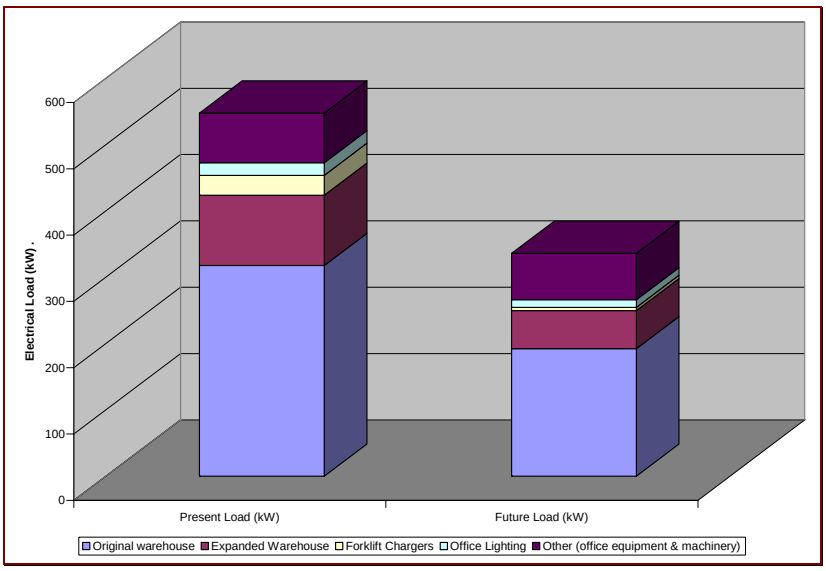

Figure 10-17, Summary of Anticipated Energy Improvements

Three criteria were adopted for establishing an incentive level for the different elements of this project, namely:

- The incentive level should be sufficient that the customer achieves a return on investment from predicted energy savings within three years, based on a discount rate (difference between interest and inflation) of 5% per annum; however
- The levelized cost of saved energy (over the lifetime of the measure) should not exceed 90% of the cost of new generation, using the historic commodity prices given in Section 1.5.5 (see page 10 herein); and
- The incentive level should not exceed 25% of the project cost.

A spreadsheet was developed for determining the incentive level that fulfills the above criteria. The results of this analysis are tabulated in Table 10-1 below for the lighting retrofit programs described earlier.

Table 10-1, Incentives to Upgrade LCBO Lighting Systems

Measure location & description	Retrofit Investment Cost	London Hydro Incentive (Illustrative)	Levelized Cost of Saved Energy	Notes
Original warehouse – retrofit with T5 fluorescent fixtures	$292K	≈ $70K	$0.03 / kWh	Option #2 – controls will produce greater savings opportunities.
Warehouse expansion – lamp replacement & occupancy controls	$50K	≈ $10K	$0.015 / kWh	Option #3
Office area – T8 retrofit	$19½K	≈ $5K	$0.015 / kWh	

Note: The information included in Table 10-1 is intended only to illustrate the existence of alternative solutions, the potential investment costs by the customer, the levels of incentives that have been budgeted for this project, and the resulting CSE. Once an engineering design (complete with cost estimates) has been completed, the referenced spreadsheets will be updated and the incentives re-calculated (again in accordance with the criteria previously given). If the incentive levels turn out to be less than indicated in Table 10-1, the surplus will be transferred to the *Program To Increase Commercial Sector Energy Efficiency*.

The spreadsheet, which provides greater detail, is included within Appendix G. Other program elements will be analyzed in the same fashion.

The budget for this program is given in Table 10-2 below.

Table 10-2, Budget for LCBO Warehouse Makeover Project

Activity	2004	2005	2006
Co-funding audit and retrofit lighting design	--	$5,000	--
Incentives for lighting retrofits	--	85,000	--
Incentives for other energy actions	--	--	$10,000
Program Cost:	--	$90,000	$10,000

Not being familiar with the LCBO's internal processes and timeframes for contracting, an assumption was made that most of the retrofit activities would occur in Q3 and Q4 of 2005, with some spillover into Q1 of 2006.

10.4 METHODOLOGY FOR VALIDATING EFFICIENCY GAINS

The efficiency gains can collectively be measured directly via the interval meter that is presently installed for this customer.

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11 RESIDENTIAL SUMMER COMFORT PROGRAM

11.1 GENERAL

11.1.1 Background

Appliance motors, the engines that drive air conditioners, refrigerators, washing machines, and other home appliances, account for about a quarter of all residential energy use. As illustrated in Figure 11-1, about 61% of residential motor energy is used in space conditioning.[51]

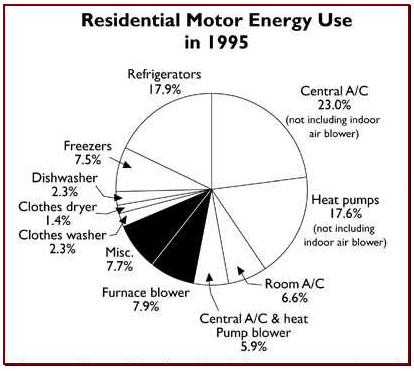

Figure 11-1, Typical Residential Motor Energy Use

In the summer months when the temperatures are soaring and the humidity levels are high, the demand for air conditioning climbs with every degree the temperature outside climbs.

Analogous to rush hour, which only occurs a few hours every week, but certainly strains the roads systems when it happens, on a hot summer day, the electrical load attributable to thousands of residential air conditioners can strain an electric power system. In recent years, summer peak electricity loads are almost entirely caused by residential and commercial air conditioning load.

In fact, Figure 1-3 (on page 9 herein) shows the relationship between peak electrical load and ambient temperature for London Hydro's distribution system. As more expensive forms of generation are brought online, the market price for electricity increases appreciably, as illustrated in Figure 11-2.

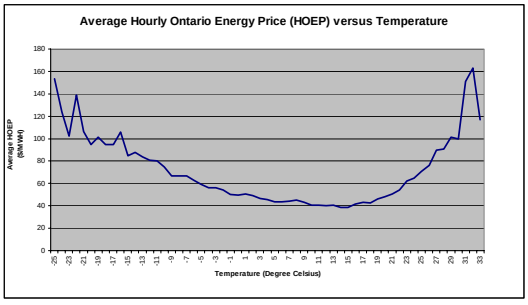

Figure 11-2, Observed Market Electricity

[51] Jeanne Byrne; *Motors Matter*; an article published in Home Energy Online, July / August 2000 edition; web: http://www.homeenergy.org/archives.html.

Prices Verses Temperature

All energy efficiency actions that are targeted to residential air conditioning load will provide benefits to society (by not having to run the peaking power generation plants), to transmission and distribution utilities (who have to provide electric infrastructure to supply the peak electrical demand), and to the end use customer (who will be using less electricity to provide the same level of comfort when commodity prices are soaring.

11.1.2 Overview of Project

There are a variety of techniques for improving the energy efficiency of air conditioning systems. Each measure can be classified into one of three general categories, as listed below:

- passive and behavioural changes –

  There are a number of passive techniques and behavioural changes that can be undertaken to make the air conditioning system run for efficiently.

  Most such measures are described in NRCan's publication "*Air Conditioning Your Home*". Often times, utilities include these consumer tips in billing inserts or on their web site.

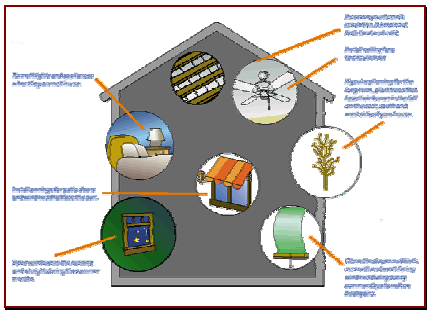

Figure 11-3, Passive Techniques for Keeping the House Cool

- changes to the thermal envelope of the house –

  There are traditional approaches to improve the home's insulation system, such as adding additional insulation and venting in the attic, replacing windows, etc. Most of these are well described in literature produced by NRCan and CMHC. And then there are a number of non-traditional techniques such as illustrated below:

Figure 11-4, Solar-Powered Roof & Gable Fans

Figure 11-5, Solar Control Window Films

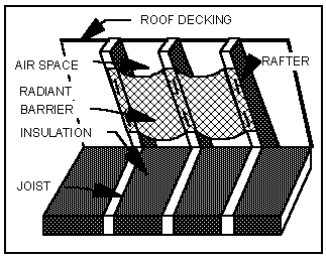

Figure 11-6, Attic Radiant Barrier

- improvements to the air conditioning system itself –

The final category of techniques is to promote improvements to the air conditioning system itself. This could be done via:

- promoting consumer adoption of air conditioners with higher energy efficiency ratings (EER) than they would otherwise have installed; or
- replacing the motors on air conditioning units and in furnace blowers with more energy-efficient motor designs (e.g. ECM's - Electronically Commutated Motors)

While London Hydro will continue to provide energy conservation tips in our billing inserts, the aim of this project is encourage other energy actions that will reduce the air conditioning load on the system.

11.1.3 Scope of Project

This program is still at the conceptual stage meaning it isn't clear which initiatives would be most effective and which would have the greatest consumer appeal. The project will include the elements listed below:

- obtain further information about the cost versus benefits for the various strategies from various government agencies such as NRCan, CMHC, etc.
- obtain further information from utilities in other parts of the country and the United States as to which measures have the greatest consumer appeal – the literature notes that customers are more apt to undertake energy actions that are visible than other alternatives that are more cost effective (e.g. a visible solar hot water system rather than some terrific insulation hidden behind a wall).
- develop an incentive program to be launched in advance of the 2006 cooling season.

11.2 ANALYSIS OF TECHNOLOGY AND ENERGY SAVINGS

An analysis of the range of alternatives will be carried out as part of the assessment and program design.

11.2.1 Expected Energy Savings with Electronically Commutated Motors

The capacity of an air conditioner's motor is usually based on the anticipated maximum cooling load of the house. But most of a home's operating hours occur under much milder conditions, thereby requiring only a fraction of the cooling capacity of the air conditioner. In a typical air conditioner with a single-speed compressor, the unit cycles on and off to maintain the conditioned space at a desired set temperature. Continuous operation modulated by a VSD would use the heat exchangers more efficiently, limit losses associated with on-off cycling, and reduce the indoor air-flow rate.

Using a continuously variable-speed compressor with an ECM indoor blower could improve an air conditioner's seasonal energy efficiency ratio. The effectiveness of this approach has been documented in two federal publications listed below:

- Canadian Centre of Housing Technology report NRCC-38443, *The Impact of ECM Furnace Motors on Natural Gas Use and Overall Energy Use During the Heating Season of CCHT Research Facility*; 2002.
- Canadian Centre of Housing Technology report NRCC-38443, *Final Report on the Effects of ECM Furnace Motors on Electricity and Gas Use: Results from the CCHT Research Facility and Projections*, 2003.

To summarize these reports, heating season testing was done over 29 days between February 15th and May 25th 2002, and clearly showed significant reductions in the use of electricity, and corresponding increases in natural gas use. Cooling season testing occurred over 41 days between August 1st and October 3rd 2002, and showed reductions in electricity use for both the furnace fan and the air conditioner compressor.

11.3 PROGRAM EXECUTION METHODOLOGY AND COSTS

Lacking a specific program design at this time, incentive monies have been set aside to promote a series of energy action items in 2006.

The budget for this program is given in Table 11-1 below.

Table 11-1, Budget for Residential Summer Comfort Project

Activity	2004	2005	2006
Incentives for AC energy actions	--	--	$25,000
Program Cost:	--	--	$25,000

11.4 OVERALL COST BENEFIT ANALYSIS

The cost benefit analysis will be conducted as part of the program design using the same cost of saved energy (CSE) criteria that have been adopted in other parts of this plan.

11.5 METHODOLOGY FOR VALIDATING EFFICIENCY GAINS

The methodology for validating efficiency gains will be a part of the program design.

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12 DEMAND RESPONSE ENABLING TECHNOLOGIES PROGRAM

12.1 GENERAL

12.1.1 Background

Like any other commodity, electricity is subject to the law of supply and demand. When demand increases, prices tend to go up. If supply cannot increase to meet the new level of demand, prices tend to be bid up even further.

Figure 12-1 below illustrates the difference between a normal market and a capacity-constrained market. In a normal market, as the system demand increases from D1 to D2 the clearing price of electricity will tend to increase slightly as more expensive peaking generators are brought on-line to supplement the outputs from the base-load generators. By contrast, in a capacity constrained electricity marketplace, there is a threshold (D1) beyond which reserve margins are greatly diminished (i.e. there is an imbalance between supply and demand) and the price escalates rapidly.

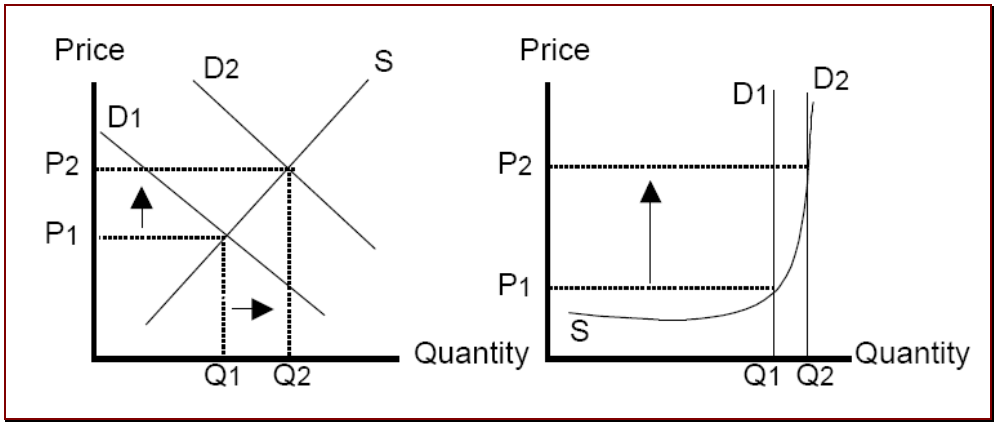

Figure 12-1, Supply & Demand Curves in Normal versus Capacity-Constrained Markets

In capacity constrained marketplaces, the combination of an unusual heat wave and scheduled and unscheduled outages at some generating plants can easily lead to several days of significant price spikes. In such marketplaces, demand response programs can be effective balancing mechanisms that serve to bring volatile prices into equilibrium.

The term demand response means many different things to many different people. For the purposes of this plan, there are three distinct types of demand response, namely:

- Direct load response, which includes direct load control of customer loads such as residential air conditioners; partial or curtailable load reductions; and complete load interruptions. Direct load response systems could include devices with local smart controllers or remotely controlled systems (e.g. building energy management systems).
- Indirect load response, that provides customers with pricing knowledge and giving them the choice of whether or not to curtail their demand when prices are high via technologies ranging from inexpensive programmable smart thermostats to energy management computer systems for large buildings.
- Distributed generating technologies such as cogeneration systems, microturbines, and fuel cells operated for demand response purposes.

Customers have widely varying needs, price responsiveness, options, and opportunity costs. Multiple program designs will be needed in order to maximize demand response in the Ontario market. These programs should reflect the fact that 1) customers want as much notice as possible, 2) minimum notification period varies by customer, 3) market value varies by notification period, 4) there are typically "shut-down" and "start-up" costs incurred by customers, and 5) many customers have minimum "down" times.[52]

One of the central issues in developing effective demand response programs and supporting infrastructure is that demand response is only required infrequently yet there are significant fixed costs needed to facilitate demand response.

The key products and services necessary for demand response include:[53]

- Interval meters to measure customer response every 15 minutes;
- Communication of metered consumption data to customer and LDC;
- Communication of market price and need for demand response signal to the customer;
- Ability of the customer to execute desired response to end-use equipment; and
- Feedback on actual response to customer and LDC (as provided by interval meter).

There are a wide variety of communications methods available for getting data from interval meters and/or providing signals to remote controls and other equipment at customer's facilities. These include: digital paging, telephone landline, cellular telephone, radio frequency, satellite, and power line carrier.

[52] *Blueprint for Demand Response in Ontario*, A Report Prepared for Independent Electricity Market Operator, by Navigant Consulting; April 2003; pg 8.

[53] Ibid; pg 18.

12.1.2 Overview of Project

Figure 12-2 below gives some idea of the price volatility that has existed in the Ontario energy marketplace over the two-year period from market opening in May 2002 to the end of April 2004.

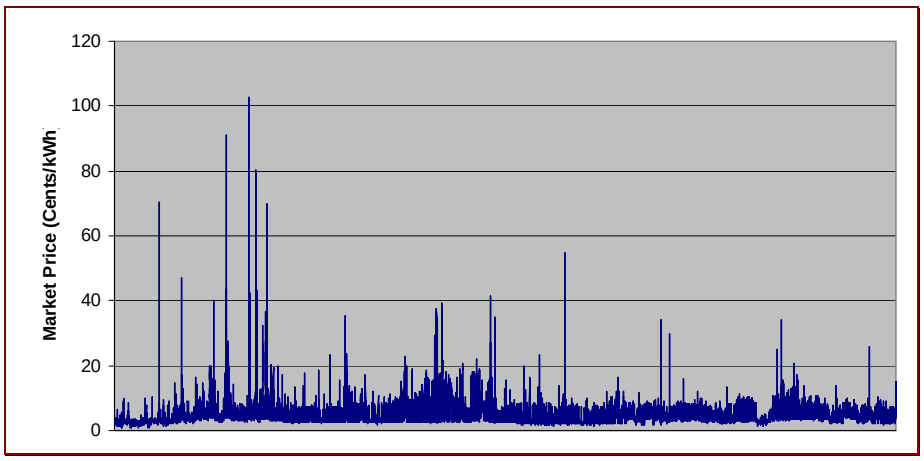

Figure 12-2, Market Prices for Energy (May 2002 - April 2004)

Figure 12-3 provides further insight into the magnitude, frequency and duration of spikes observed in the Ontario electricity marketplace over this same two-year period. For example, it can be seen in the period May 2003 to April 2004, there were two instances when the market price escalated to value in the range of 30 to 35 ¢/kW·h for an overall duration of 0.023% of the time.

May 2002 to April 2003			May 2003 to April 2004		
Year One	Minimum	Maximum	**Year Two**	Minimum	Maximum
Cents/kWh	0.78	102.84	Cents/kWh	1.15	54.85
Cents/kWh	Data Points	% of Total	Cents/kWh	Data Points	% of Total
> 0.0 < 5.0	4709	53.756%	> 0.0 < 5.0	5461	62.170%
> 5.0 < 10.0	3242	37.009%	> 5.0 < 10.0	3087	35.143%
> 10.0 < 15.0	510	5.822%	> 10.0 < 15.0	207	2.357%
> 15.0 < 20.0	193	2.203%	> 15.0 < 20.0	19	0.216%
> 20.0 < 25.0	42	0.479%	> 20.0 < 25.0	4	0.046%
> 25.0 < 30.0	19	0.217%	> 25.0 < 30.0	2	0.023%
> 30.0 < 35.0	11	0.126%	> 30.0 < 35.0	2	0.023%
> 35.0 < 40.0	17	0.194%	> 35.0 < 40.0	0	0.000%
> 40.0 < MAX	17	0.194%	> 40.0 < MAX	2	0.023%
Total	8760	100.000%	Total	8784	100.000%

Figure 12-3, Characteristics of Ontario Market Price Spikes

With respect to the source of the market pricing information that can be communicated to the customer, the IMO publishes (and continuously updates) both pre-dispatch and dispatch prices for the current day (as depicted below in Figure 12-4) as well as pre-dispatch prices for the day-ahead market (as depicted below in Figure 12-5).

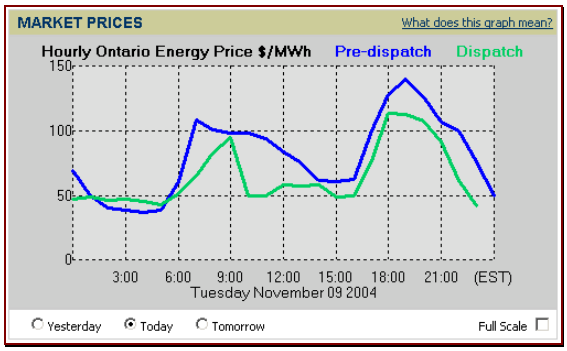

Figure 12-4, IMO Posted Hourly Energy Price (for current day)

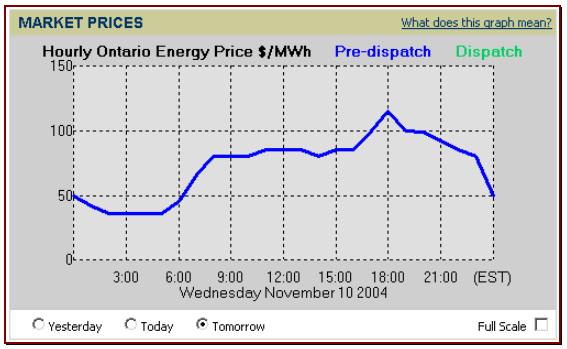

Figure 12-5, IMO Posted Hourly Energy Price (for tomorrow)

A schematic representation of the system that will fulfill the overall objective of this initiative is depicted in Figure 12-6 below.

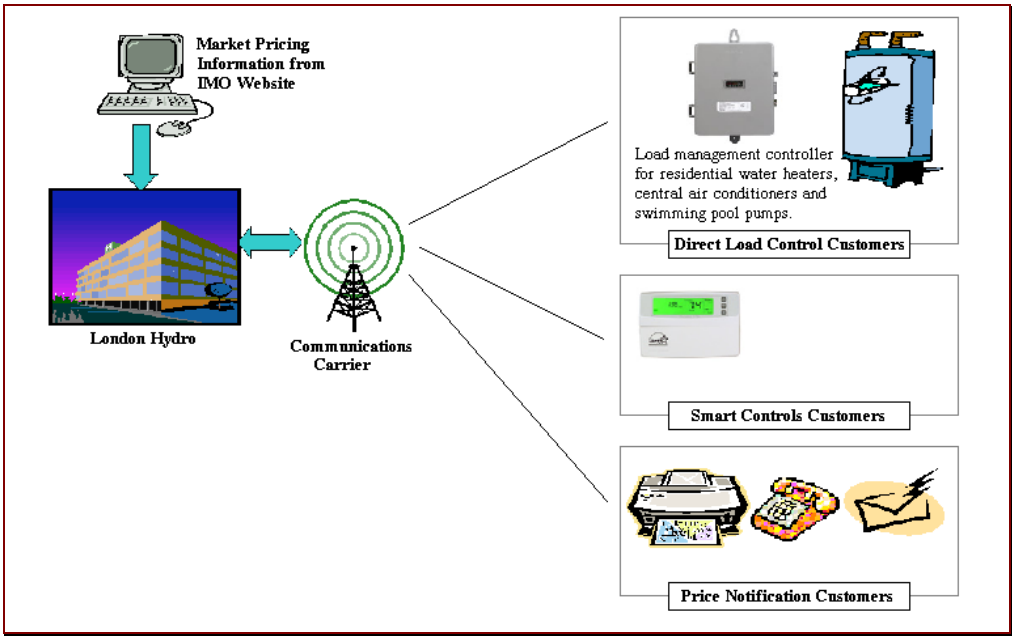

Figure 12-6, Conceptual Demand Response System

For the overall system illustrated above, there are three distinct demand response techniques, and associated end-use equipment and processes and interconnecting communications systems:

- The *direct load control customers* will be those customers (typically residential) with a load management controllers installed in conjunction with their hot water heater, central air conditioner, or swimming pool pump. The utility is authorized to cycle or shut-off the end-use appliances for a limited number of hours for a limited number of occasions. Control signals from the utility are typically transmitted via radio or paging signals.

  Note: The water heater load management system being revived at Festival Hydro (in Stratford) is an example of direct load control. However the control strategy there is based on levelizing the overall monthly system peak, as opposed to allowing the end-use customer to select a price threshold beyond which the load control is to be activated.

- The *smart controls customers* will be those customers (again typically residential) with intelligent thermostats and other controls in the household that require notification of pricing information for their proper operation. Pricing signals from the utility are typically transmitted via radio or paging signals.

- The *price notification customers* will be those commercial, institutional or industrial customers with interruptible load, and customers with existing emergency/backup generation systems (that can transfer some or all of their internal load to their generators in response to a constrained electric grid). Advance market pricing information from the utility is generally transmitted to the customer via facsimiles, electronic mail, or recorded messages to the customers telephone or cellular phone, according to the customer's stated preferences with respect to message media, lead time, and price threshold.

Note: There are some issues that limit more fully defining the project at this time. Specifically:

- With respect to the IMO's posted prices, the discrepancies between pre-dispatch and real-time pricing are well noted. The IMO is developing the attempting to address this matter via the Day Ahead Market (DAM) and its associated calculation engine, but it isn't entirely clear at this point in time when this new mechanism will be fully implemented. As an alternative, a utility could either device a better price-forecasting algorithm or could purchase better pricing. Such plans might be developed in the future generation of this program.
- The provincial government proposes to announce details of the new Regulated Price Plan in May 2005. If this pricing plan protects residential and small business customers from the price spikes in the electricity marketplace, there is little chance that customers would be interested in either direct control or smart controls.
- For customers signed up with retailers, London Hydro (as an LDC) will have no knowledge of the contracted pricing structure, so dispatching control signals to load management controllers or price signals to smart controllers based on the market signals may be incorrect.

It is presumed that by the third-quarter of 2005, there will be greater certainty as to how to proceed with an appropriate implementation.

12.1.3 Scope of Project

Due to some marketplace uncertainties that have previously been described, the overall project will have a phased implementation. For calendar year 2005, the implementation elements will be as outlined below:

- Expand London Hydro's existing Interactive Voice Response (IVR) telephony system to include outbound notification capability (so that the customer can be automatically notified via their choice of price threshold, notification period, and notification method), an internet-based customer self-choice interface, and a connection to the IMO website for pricing information.
- Installation of interval-style revenue meters for project participants that don't already have this style of revenue meter (i.e. customers with loads less than 500 kW).
- Engage consultants with recognized expertise in load management and tariffs to examine direct load controllers with the express purpose of assessing the cost benefit of offering direct control for various types of end-use devices (e.g. of water heaters, air conditioners, pool pumps, which offers the greatest overall benefit to both the customer and society), the control strategies (e.g. cyclic operation versus shutting down over the control period) that optimize the benefit to both the customer and society, and the types of customer incentives that would be appropriate for customers that subscribe to direct load control.

If possible (i.e. no market nor technological barriers), prudent, and permitted in the Regulations, the project will be expanded in 2006 and beyond.

12.2 ANALYSIS OF TECHNOLOGY AND ENERGY SAVINGS

12.2.1 Review of Maturity of Load Management Controllers

Load management controllers, especially units for controlling electric hot water storage heaters have been used by utilities for more than three decades. These are fairly simple and rugged devices; the only thing that has changed is the technology (from discrete components to microprocessor-based units) and the communications media (from ripple control to wireless or more advanced forms of power-line carrier). The predominant players in this marketplace now are:[54]

- Brayden Automation Corp.
- Cannon Technologies
- GoodCents Solutions

It is imperative to program success that the selected load management controller is equipped with a temporary override feature.

Note: The literature[55] shows a strong relationship between program acceptance and the consumer's choice and control. In one cited study … *residents were opposed to the installation of automatic day-night thermostats. The thermostat was redesigned such that residents could override it*

[54] Chartwell Inc. report: *Utility Load Management & Demand Response Programs*; September 2003.

[55] *Motivating Home Energy Action – A Handbook of What Works*; prepared by Michelle Shipworth for the Australian Greenhouse Office, April 2000; chapter *Understanding the Householder*; page 5.

temporarily. The re-designed automatic day-night thermostats were much more appealing to residents. It does not matter whether or not the residents ever used the override mechanism. They felt in control of the system and this contributed to the appeal of the system.

12.2.2 Review of Maturity of Smart Controllers

Presently smart controllers for residential applications seem to be limited to intelligent thermostats capable of receiving pricing signals via a paging signal from the utility. The three dominant products in the marketplace are described following:

Thermostat Model	Overview of Typical Application
 **Figure 12-7, Honeywell-Cannon ExpressStat Thermostat**	The ExpressStat Programmable Demand Response Thermostat provides a wireless communication link with the electric utility. Critical Peak Program participants may optionally program the thermostat's daily schedules and critical peak period reduction levels using an intuitive interface on the utility Web site. A Setpoint Cycle program allows the utility to restrict the runtime of compressors during peak periods.
 **Figure 12-8, Carrier ComfortChoice Thermostat**	Using a wireless communications network, Con Edison sends instructions to the customer's thermostat to reduce the number of minutes that the compressor operates. The thermostat then sends a message to Con Edison acknowledging that it received the instructions. The air-conditioning system, although not turned off, uses less power to operate the fan, which continues to circulate cool air. After the adjustment is made, a "curtailment" message appears on the thermostat. Power-curtailment events usually occur in the afternoon and typically last no longer than four hours. A customer can choose to override the curtailment instruction manually. When that happens, the thermostat will signal Con Edison that its instruction has been overridden.
 **Figure 12-9, Invensys GoodWatts RF Thermostat**	The Invensys EMST-100 Home Control GoodWatts Systems RF Communicating Thermostat works with the GoodWatts System Residential Gateway to provide monitoring, management and control of the HVAC system by both the utility and the homeowner.

Some utilities are offering such thermostats, including installation, to their customers free of charge. However, for the foreseeable future, residential customers will either deal with a retailer or be on the provincial regulated price plan; and as such immune from fluctuations in the market prices of electricity.

For commercial, industrial and institutional customers that are market participants, there may be merit.

12.2.3 Review of Maturity of IVR Systems

Interactive Voice Response (IVR) systems are used widely in various types of call centres, with financial services firms reporting the most mature IVR implementations, averaging 11 years. System maturity, combined with the appeal of self-service account inquiry, has led to high acceptance and adoption rates within the call centre industry, and many now augment or plan to augment their IVR systems with automated speech recognition (ASR) functionality.[56]

12.2.4 Assumptions

In determining customer energy cost savings, it is assumed that the fluctuations in the market prices for electricity as depicted in Figure 12-2 (on page 108) are a reasonable proxy of the future market behaviour, both in terms of frequency, magnitude and duration of the price excursions.

12.2.5 Expected Energy Savings Associated with Direct Load Control

Direct load control is not part of the first phase of this project. It is expected that cost saving information will be reported from the water heater control project at Festival Hydro (see Section 12.1.2 herein) and from the consultant's report (see Section 12.1.3 herein).

12.2.6 Expected Energy Savings Associated with Smart Controls

Smart controls are fairly new marketplace offerings, and while many case studies are reported in the literature[57], definitive quantitative information on the magnitude of energy savings is noticeably absent. This may be on account of a combination of the competitive nature of the sponsoring utilities and program infancy at the time the smart controls case studies were published.

12.2.7 Expected Energy Savings Associated with IVR Notification System

It is somewhat difficult to predict the customer savings that will be associated with the described enabling technologies. For the participating customers with curtailable load, standby generation, or both, the savings will be dependent upon a number of factors including whether or not the customer opts for price certainty via a contract with a retailer, and the number of times the market price exceeds the customer-defined threshold.

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[56] The Ascent Group, Inc. publication: *Is your IVR perceived as one of "those confounded machines that won't let you talk to a human"? The Customer Experience is It!*; 2003 (see website: http://www.speechtechmag.com/whitepapers/Ascent3.pdf)

[57] Chartwell Inc report: *Utility Load Management & Demand Response Programs*; September 2003.

The City of London is responsible for an interconnected system of water pumping stations and wastewater treatment plants throughout the city. Many of these are equipped with standby generators so that on loss-of-supply of the upstream electrical distribution system, the generators are started automatically and will carry the plant load until either the electrical supply is restored or the fuel supply is exhausted.

For the purposes of an illustrative example, a local engineering consulting firm was asked to quantify the potential savings that the city would realize if they opted to utilize the standby generators as demand response devices. This analysis, which is included in Appendix C, indicates that the annual customer savings is highly variable, ranging from $32½K to $70K depending upon volatility of the electricity marketplace. The attached spreadsheet also suggests that 20 ¢/kWh as being the approximate market price threshold by which it is more cost effective to run the generator and accrue savings.

It is assumed that the combination of load curtailments by the commercial, institutional and industrial sector customers will yield comparable cost savings.

12.3 PROGRAM EXECUTION METHODOLOGY AND COSTS

12.3.1 Assumptions

It is assumed that most target customers with curtailable load will have an interval-style revenue meter. Nonetheless, it is assumed that there will be some small number of general service customers that will require a AMR accessory (Tantalus or similar) so that they may participate. It is assumed that the AMR accessory will be about $150 and there will be ten required each year.

12.3.2 Overall Cost Benefit Analysis

The budget for this program is given in Table 12-1 below.

Table 12-1, Budget for Demand Response Enabling Technologies Program

Event	2004	2005	2006
Procurement of IVR System Enhancements	--	$55,500	--
Engineering Assessment of Dispersed Generation	$5,500	--	--
Installation of Interval-Meters	--	$1,500	$1,500
Engaging consultant (re: direct load control)	--	$5,000	--
Program Cost:	$5,500	$62,000	$1,500

Expansion of the program to include transmission of paging signals to smart controllers and the provision of load management controllers may occur in 2006 and beyond. Any costs associated with these program elements are not included in Table 12-1.

This program is all about automatically providing customers with market pricing signals so that they may voluntarily undertake energy actions. As it is uncertain which

customers may opt to participate in the program, and the amount of curtailable load each has, any cost-benefit analysis performed at this time would be highly speculative and of questionable value.

12.4 METHODOLOGY FOR VALIDATING EFFICIENCY GAINS

Since the customers that participate in this program will have an interval-style revenue meter installed, it will be fairly straightforward to list the program subscribers that set a price threshold at say 20 ¢/kW·h or greater, and review their respective revenue metering records after-the-fact to determine what, if any, load curtailment activities were undertaken.

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13 THE HEAT AND WARMTH (THAW) PLUS PROGRAM

13.1 GENERAL

13.1.1 Background

The London-based THAW program was established in response to the Mayor's Anti Poverty Action Group (MAPAG) report produced in August 1997. MAPAG's terms of reference were: "*to develop strategies to ensure that the basic needs of all Londoners are being met and to achieve this by moving immediately to mobilize community goodwill and by identifying and accessing all available resources*."

The program assists London families that due to financial hardship are having difficulty paying their electricity and gas bills and often times are subject to disconnection during the heating months. The program begins each year on January 2nd and runs through to March or until funds have been exhausted.

In the past, London Hydro's involvement had been strictly a supportive role that helped develop the eligibility criteria for customers seeking assistance and verified that the customer was indeed in an arrears situation and subject to disconnection for non-payment. The United Way performs the distribution of funds and the administrative duties, with assistance from their own staff and community volunteers.

Several years ago, the London Hydro Board of Directors honoured a request from the United Way to assist in the funding of the THAW program due to the significant growth in the number of customers requesting assistance. Subsequently, over the past 3 years the Board has approved a donation of $50,000 to keep the heat on for less fortunate families.

In 2004, total funding for the THAW program amounted to $353,499.99 of that $173,909.79 was disbursed to pay London Hydro 542 accounts at an average payment of $320.87.

Customers who qualify may receive assistance as determined by the THAW Manager after reviewing the application and providing the customer meets the following criteria:

- Families with children (when funding is above $50K this will be extended to include single people and couples with no dependants)
- Disabled

- Seniors
- Those who need arrears paid to maintain social housing
- Those with medical issues (need electricity in regards to medical problems, i.e. asthma compressors, pneumonia)
- Amount per utility – average bill of $380 per utility with discretion in exceptional circumstances to increase to a maximum of $500 where there are children under 16, seniors over 60, disabled, or a need to maintain social housing, or those with medical issues.
- Have received a final notice, notice of disconnection or notice of termination of service and the person named on the bill
- Minimum payment of $50.^{00} in previous four months. (Can pay $50 to the utility at time of application)
- Eligible once every two years

Applicants must also provide the following:

- Proper identification
- Proof or residence address
- Proof of utility account in applicant's name
- Proof of income and income source

The make-up of the qualifying customers for the 2004 program were fairly representative with 90% reported as being *tenants* and the remaining 10% being *homeowners*.

13.1.2 Overview of Project

This program is meant to assist the lower income customers in managing their energy needs and improving efficiencies within their home without the penalizing them at a time when they are in a crisis situation. Low-income households in Ontario might have a disproportionately high electricity bill due to the factors listed below:

- Low-income households often have the greatest need for improved energy efficiency, but the least ability to make capital investments; often they cannot take advantage of tax credits or rebates for purchasing energy efficient products. They will often change their lifestyles (e.g. reducing the temperature for home heating) while higher-income households will purchase energy efficient products.
- Statistic Canada's 2002 survey of household spending illustrates that … the lowest Canadian income quintile has a far greater proportion of households that:
  - are rented;
  - have electric space heating;
  - have principal heating equipment more than 10 years old; and

  - have electric water heating.[58]
- Aggravating this situation is the reality that low-income households tend to live in old homes that are not well insulated or weatherized, i.e. the homes that offer the most potential for energy savings, reducing fuel bills and increasing the comfort of their residents.

The THAW-Plus program will assist eligible customers in reducing their electricity consumption and providing the tools to help them use energy wisely and improve the efficiencies within their home. Some guidance in the program design was obtained from a publication[59] that is both recent and specific to low-income households within Ontario.

In general, two categories of energy conservation measures will be available to eligible customers that have an interest in participating. The two packages of measures are described following:

(i) Basic energy saving measures:

A home energy improvement kit is the most effective means of getting quick results. The kits will be delivered to the customer by appointment with a set of easy-to-follow instructions and literature on making their home more energy efficient and energy saving tips. A preferable arrangement, assuming the United Way can interest a local service group to participate in this program as a delivery agent, would be for the items in the kit to be installed by the service group. The items included in the basic kit will include:

- Weatherizing / draft proofing measures – installation of 3M window film, and weather-stripping around doors and windows.
- Replacement of most frequently used incandescent light bulbs with compact fluorescent lamps (likely 3 x 15 W + 1 x 23 W – refer to Figure 16-3 herein).
- Installation of low-flow showerheads and faucet aerators (if they don't already exist)
- Installation of insulating wrap on accessible hot water pipes.
- Replacement of gaskets on leaking faucets and flapper valves on leaking toilets.
- Replacement of furnace filters (for units with central furnaces).
- Installation of a programmable thermostat (for units with central furnaces).

[58] IndEco report A4253, *Low income energy conservation and assistance*; IndEco Strategic Consulting Inc; April 8, 2004; pp 5-6.

[59] IndEco report A4254, *Designing a low-income energy efficiency program: Recommendations for Toronto Hydro and other Ontario electricity local distribution companies*; a document prepared for the Low-Income Energy Network (LIEN) by IndEco Strategic Consulting Inc; November 30, 2004

- Miscellaneous appliance labels (as described in Section 16.2.3 herein)

The delivery agent would also take note of the type of space heating, storage water heater, and vintage of selected appliances

(ii) Extended energy saving measures:

At this time, the extended energy savings measures are limited to:

- appliance replacement – London Hydro would familiarize the landlord with the appliance recycling program and seek their participation.

13.1.3 Scope of Project

In the initial phase of the project, participation will be limited to those households that meet the qualification requirements for the London-based THAW program.

It is envisioned that at a later project phase, the eligibility requirements will be broadened to include any household with a family income considered to be below a generally accepted poverty line.

Note: The Canadian Council on Social Development and the National Council of Welfare have both adopted Statistics Canada's pre-tax, post-transfer, Low-income Cut Offs (LICOs) as poverty lines. This amount varies according to household size and the size of the community.

13.2 ANALYSIS OF TECHNOLOGY AND ENERGY SAVINGS

All measures use off-the-shelf technologies for which the energy savings are well documented in the literature.

13.3 PROGRAM EXECUTION METHODOLOGY AND COSTS

13.3.1 Assumptions

Of the 450 to 550 customers that will likely qualify for THAW assistance in each of 2005 and 2006, it is assumed that only 250 to 350 of these customers would exercise the option of the basic energy saving measures of the THAW-Plus program – participation will depend greatly on the conditions that the THAW Manager attaches to receiving financial assistance.

Given the purpose, it is assumed that London Hydro can solicit the participation of several local manufacturers (e.g. 3M, EMCO, Philips, etc.) to obtain materials at or below wholesale pricing levels. As such, it is assumed that the kit of basic energy saving measures can be assembled for about $70 with a $40 adder if a programmable thermostat is provided.

13.3.2 Other Implementation Costs

London Hydro will co-fund a local service group for installation of the energy conservation devices in the subject homes.

13.3.3 Overall Cost Benefit Analysis

All the elements in the described conservation kit are well-established energy conservation devices.

The budget estimate for this program is included below as Table 13-1.

Table 13-1, Budget for THAW-Plus Program

Event	2004	2005	2006
Basic energy savings measures (307 @ $70)	--	$21,500	$21,500
Adder thermostats (50 @ $40)	--	2,000	2,000
Program delivery	--	2,500	2,500
Level 2 measures (included in other programs)	--	--	--
Program Cost:	--	$25,000	$25,000

13.4 METHODOLOGY FOR VALIDATING EFFICIENCY GAINS

Normally the revenue metering data could be used to validate efficiency gains, but due to sensitive nature of all social assistance programs, the clients are anonymous in London Hydro's eyes.

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14 PUTTING OUR OWN HOUSE IN ORDER PROGRAM

14.1 GENERAL

14.1.1 Background

For consistency and credibility, any organization promoting energy conservation products or services must strive for an impeccable conservation record. If London Hydro is to be successful motivating others to take energy conservation measures, it is important that the organization "*practices what we preach*".

14.1.2 Overview of Project

The London Hydro's office premises are currently occupied by approximately 150 to 175 employees and contract staff. The facilities include a mixture of office, garage, workshops and warehouse facilities.

Figure 14-1, London Hydro's Head Office Building

Heating and cooling are mostly supplied by a central electric heating and cooling system and controlled via regular "dumb" thermostats by staff. There are approximately 70 thermostats used in the buildings currently.

Over the years, some positive conservation measures have been undertaken. Specifically all illuminated exit lights have been retrofitted with LED technology. And in the office areas, the fixtures that formerly lit F40T12 fluorescent tubes were retrofitted 34-watt fluorescent tubes.

There have been many internal renovations and light design layout for quality and quantity of light has not been addressed.

But there are also other opportunities that will potentially yield significant energy savings. Some of the more evident energy saving prospect are described below:

Figure 14-2, Existing Lighting Fixtures in Lower Stores

The lighting systems in the Lower Stores building, depicted in Figure 14-2, are high-bay mercury-vapour HID lamps. Significant improvements could be made by the combination of upgrading the fixtures and ballasts to accommodate the so-called economizer-style metal-halide bulbs and dimming controls.

Similar opportunities exist for the mercury-vapour HID lights used in the stores yard, as depicted in Figure 14-3.

Figure 14-3, Existing Lighting in Stores Yard

There are two penthouse HVAC utility rooms housing blowers as depicted in Figure 14-4 below. The motors are two-speed 25 HP rated units. Retrofitting these motors with variable speed drives could achieve energy savings on the order of 15% to 20%.

Figure 14-4, Cooling Tower Blowers

Finally, it is likely that a complete building automated building management system (that networks area thermostats, occupancy sensors and lighting controls) could achieve appreciable savings.

There are other prospective improvements of a lesser nature that won't be listed here.

14.1.3 Scope of Project

The project fundamentally consists of four elements:

- carry out an engineering assessment of alternative lighting, motor upgrade, and building automation schemes;
- determine the effectiveness of each conservation measure;
- make application to NRCan for co-funding under their Energy Innovators Initiative; and

- implement the measures to the extent that budgets and program funding permits.

14.2 Analysis of Technology and Energy Savings

Once the range of alternative lighting designs for the Lower Stores building, the Stores yard, and other building spaces is established, the information would be entered into the appropriate spreadsheet, examples of which have been included within Appendix G for other projects. Based on the determined energy savings, an appropriate incentive amount would be automatically calculated, as is the case for all other projects. Similar analysis will be carried out for other initiatives.

14.3 Program Execution Methodology and Costs

A well established lighting design company that is listed with NRCan's Energy Innovators Initiative will be invited to audit major lighting systems and prepare alternative design proposals for the Lower Stores building, stores yard, and some of the office areas. A determination of whether the retrofit work would be carried out by London Hydro's staff electricians or contracted out would depend on the scope and nature of the recommended lighting solution.

A similar approach will be used for other potential initiatives.

The budget for this program is given in Table 14-1 below.

Table 14-1, Budget for Putting Our Own House In Order Program

Event	2004	2005	2006
Lighting Design	--	$3,000	--
Project incentives		30,000	--
Program Cost:	--	$33,000	--

Since the incentives will fund assets (lighting, control systems, etc.) that are part of London Hydro's infrastructure, this project is classified entirely as *capital*.

Note: Additional incentive monies may be diverted from the *Distribution Shunt Capacitor Program* if the engineering analysis determines that monies spent on the initiatives described herein would provide greater energy savings per invested dollar. Refer to the notation in Section 7.3.2.

14.4 Methodology for Validating Efficiency Gains

London Hydro's head office complex is serviced via a number of supply points, each with an interval meter installed. The easiest method of validating efficiency gains is via actual metering data. The building's electrical profile throughout the year prior to the conservation measure will be compared with the post-measure electrical profile (with adjustments made for changes in weather patterns, etc.).

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15 COMMUNITY ONE-TONNE CHALLENGE PLUS PROGRAM

15.1 GENERAL

15.1.1 Background

London's One-Tonne Challenge (OTC) Community Demonstration Project has been developed as a result of funding from the Federal One-Tonne Challenge Program[60], which encourages individuals to reduce their energy consumption at home and on the road by one tonne over a one-year period.

Forty-one communities across Canada (ten in Ontario) are receiving funding to promote the OTC at the local level. The City of London and the Thames Region Ecological Association (TREA) are co-leaders for the Demonstration Project in London.

Figure 15-1, Federal Print-Ad for One-Tonne Challenge

Initiatives under development target individuals through households, businesses, schools and service groups.

The overall community project can be subdivided into four categories:

1. Enhancement of Selected Existing Programs -

   A portion of OTC funding may be used to enhance existing local programs, including the Active & Safe Routes to School Program and the Commuter Challenge. TREA already leads these projects and will receive increased support from the City of London and several community partners.

2. OTC-Related Initiatives -

[60] For further information, see website: http://www.climatechange.gc.ca/onetonne/english/everyone.asp#communities

There are a number of community initiatives that will support the One Tonne Challenge in London, but will not require the use of Federal OTC funds. Most of these initiatives are related to London Hydro's pending submission to the Ontario Energy Board for Energy Conservation and Demand-Side Management measures. Examples of these initiatives include the proposed "beer fridge", air conditioner, and freezer recycling programs, as well as programs targeted at property managers of multi-unit residential buildings. London Hydro will be working in partnership with the Clean Air Foundation, the City of London, and other partners on these initiatives.

3. New Community Challenges -

   A series of challenges for the community may be organized to encourage individual behaviour change and registration in the One Tonne Challenge. Actions may be encouraged in the areas of energy, waste, water use and transportation alternatives. The challenges may include information on anti-idling, driving less, and driving smarter for employees in workplaces to consider at home and on the road. TREA will lead these new community challenges with support from the City of London and several community partners.

4. Neighbourhood Challenge -

   The City of London will lead a neighbourhood challenge where one neighbourhood would be selected from each of the City's seven wards. TREA will support these initiatives. The seven neighbourhoods would receive OTC information and participate in environmental challenges. Each neighbourhood would have approximately 500 households for a total of approximately 3,500 households in the target areas.

The launch would include door-to-door drop offs, various levels of information sharing, etc. to ensure that all households receive the OTC diary and other important details. Neighbourhoods would partake in individual and group challenges throughout the year-long campaign depending on their level of interest and potential participation. Challenges would be tailored, by neighbourhood, to focus on a particular behaviour or behaviours.

Local service groups, community associations, etc. may play a role in offering households presentations and workshops. These groups may also assist in getting the neighbourhood involved in challenges throughout the year. Other opportunities will exist through a dedicated website, local discussion, etc. to solicit feedback.

All neighbourhoods would receive regular feedback (perhaps via a newsletter) that might include items such as measured waste and recycling amounts, average household electricity consumption, the number of *EnerGuide for Houses* audits conducted, etc. Measurement (quantitative) is key for several areas while qualitative measurement will be required for other areas.

The study will run for a twelve-month period, likely from April 1, 2005 to March 31, 2006.

15.1.2 Overview of Project

While the overall project encompasses many issues (energy, domestic water, waste and transportation alternatives), this report addresses solely the matter of specific interest to London Hydro's energy conservation program, i.e. electrical energy consumption.

This section does not lay out the program in minute detail, but instead provides sufficient information to describe the program's basic intent and structure.

- All project participants will receive an initial letter acknowledging their participation in the program, and advising them of the activities that will transpire in the weeks and months to follow.
- For a subset of the project participants (100 per ward), London Hydro will outfit the existing single-phase revenue meter with a pulse recorder device (e.g. Tantalus TUNet-1205, or similar) so that hourly consumption data is available from the revenue meter.
- For a subset of the project participants (50 per ward, i.e. half the interval metered customers), London Hydro will provide the homeowner or tenant with a modified residential PowerCost Monitor (refer to Section 4 herein) so that the homeowner (or tenant) will have real-time feedback regarding their energy consumption.
- Home visits to all project participants will be arranged by a call centre working in concert with a program delivery agent. At the time of the home visit:
  - Project participants will receive an energy conservation kit (with the delivery agent encouraging the homeowner to install the various CFL's, appliance labels, etc at the time); and
  - An inventory would be taken of the type of thermostat (electronic set-back verses manual), nameplate information from the customer's refrigerator (both primary and secondary), freezer, room air-conditioner, and the type of water storage heater (gas versus electric) and space heating would be noted.
- In the weeks following the home visit, letters would be issued to program participants giving each positive feedback about their participation in the program, and how their simple measure such as performing a CFL exchange has made a positive contribution towards achieving their environmental goal.
- As the program progresses, follow-up letters will be issued with energy conservation measures that are specific to the customer (e.g. if they have a secondary refrigerator or vintage freezer, specific information will be provided about the appliance recycling program – see Section 5).
- At the end of the initial twelve-month period, the McMaster Institute for Energy Studies will carry out a formal analysis of efficiency gains.

Note: London Hydro has a close working arrangement with UWO's Faculty of Electrical & Computer Engineering and generally provides thesis topics to fourth year students. It is envisioned that this would be a good project to involve two students in for their thesis topic and to expand the local knowledge base on energy conservation strategies.

- When the results of the analysis are known, project participants will be sent letters commending them on their participation and providing feedback on the results of the formal analysis.

15.1.3 Project Scope

The statistical study will ideally look at one neighbourhood within each of London's seven wards. Each neighbourhood study area would contain about 500 households, roughly that defined by a collection route used by a City of London household waste and recycling collection truck. Basing the study on the waste collection route allows the project leaders to measure the impact of the campaign on waste generation and recycling rates. Postal codes for the homes along the route can be used to collect the information on energy use.

15.2 Analysis of Technology and Energy Savings

The PowerCost Monitor technology is described in Section 4 of this report.

The energy conservation kits are described in Section 16 of this report.

15.3 Program Execution Methodology and Costs

In order to create an effective "Challenge Program" and meet the needs of the City of London's political objective of pitting one ward against the other, it is key that an effective sample be taken from the seven (7) different political wards.

A random sample of sufficient size will be determined for each of the seven wards by the Econometrist/Statistician. These potential customers would then receive a letter that would inform them that they might be asked to join the OTC and also be made aware of its goals. Utilizing an Outbound Call Centre, customers will be recruited to join the initiative and be asked to participate at certain levels for information sharing and behaviour modification. The "on the ground" delivery agent would visit the customers who accept the challenge. The agent would perform a variety of functions that would include a small home energy audit, information sharing and assistance with making some basic energy choices. The agent will also be versed in all aspects of the challenge including the non-electricity areas of the initiative. Full development of the expected study content will be developed in conjunction with all partners and the study consultant to ensure valid results.

The budget estimate for London Hydro's portion of the Community One-Tonne Challenge project is set forth in Table 15-1.

Table 15-1, Cost Estimates for One-Tonne Challenge (Electrical Portion)

Item	Quantity	Purpose of Procurement	Unit Price	Total Cost
1	700	Retrofitting revenue meters with AMR device (Tantalus TUNet-1205, or similar, pulse recorder) and re-sealing meter.	$150	$105,000
2	350	Supply of (modified) PowerCost Monitors	$150	52,500
3	700	Delivery agent for conducting basic home inventory and delivering conservation kits.	$10	7,000
4	700	Supply of energy conservation kits	$40	28,000
5	1,500	Letters to customer (minimum 3 per customer @ $0.71)	0.71	1,500
6	2800	Call centre	7.50	21,000
7	1	Analysis of electrical consumption data.		10,000
			Total Estimate:	$225,000

Note: The budget presumes that wireless-communications transmitter and central station equipment is carried under the corporate budget prepared for Smart-Metering (i.e. outside this conservation program).

15.4 METHODOLOGY FOR VALIDATING EFFICIENCY GAINS

The methodology for validating efficiency gains is identical to that used for the *Residential Power Cost Monitor - Pilot Project*. Refer to Section 4.4 on page 40 herein.

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16 PUBLIC EDUCATION CAMPAIGN

16.1 GENERAL

16.1.1 Background

One of the cornerstones in developing a *conservation culture* throughout the Province is public awareness. Awareness helps to change attitudes, thus encouraging consumers to seek out ways to save energy. Also, it changes behaviours, making sure that energy users take energy-saving actions and continue to use and maintain energy-saving equipment after it has been installed. That is, energy awareness helps to increase the *persistence* of energy-savings projects so that they continue to reap savings year after year.

The provincial government recognized the importance of public awareness by including the following element in their conservation plan:[61]

- *Launching a public education and outreach campaign, including town hall meetings, to encourage conservation.*

According to the literature, promoting energy conservation is easier said than done, as usually media campaigns are unsuccessful at encouraging people to take part in an energy action program. Specifically:

- Utility and government efforts to promote conservation have relied on traditional marketing techniques with generally poor results. Even though direct mailings and bill inserts have been used extensively, these techniques typically generate response rates of less than 5% for conservation programmes.[62]
- Public media campaigns have also been ineffective in generating clients for most conservation programmes. For instance, one early California Energy Extension Service (CEES) programme attempted to draw apartment owners and managers to two energy-efficiency workshops with 22,000 direct mail brochures, 12,000 inserts in trade magazines, display ads in seven local newspapers, multiple news releases and

[61] Premier of Ontario – Dalton McGuinty News Release: McGuinty Government Building Culture of Conservation – Working with Ontarians to Save Energy, Money and the Environment; April 19, 2004. (website: www.premier.gov.on.ca/english/news/Energy041904.asp)

[62] Coltrane, Scott, Archer, Dane & Aronson, Elliot 1986, *The social-psychological foundations of successful energy conservation programmes*, Energy Policy, Vol. 14, No. 2, April, pp. 136.

two half-hour public affairs radio shows. These combined efforts produced a disappointing 59 workshop participants out of 18,000 apartment owners in the area. Extensive and continuing programme evaluation enabled later CEES programmes to rely less on media campaigns and more on the use of existing social networks.[63]

Promoting energy conservation is not like promoting a brand of soap or toothpaste. Consumers don't need to invest much time or money to purchase more soap or change brands. On the other hand, consumers do need to invest much time and expense purchasing and installing most energy saving devices. They face many obstacles: they lack experience with the technology and may be anxious about installing and maintaining it, they don't know how efficient the device will be and they are inclined to postpone non-routine decisions.

To ensure that monies invested in public education campaigns is used effectively, London Hydro's strategies will rely heavily on documented successful approaches in other jurisdictions, and specifically the two publications listed below:

- *Motivating Home Energy Action - A Handbook of What Works*; prepared by Michelle Shipworth for the Australian Greenhouse Office, April 2000.[64]
- *Watt's Going On, California – Public Education & Promotions Tool Kit*; prepared by California State Association of Counties, League of California Cities, California Park and Recreation Society and Local Government Commission; 2001.[65]

16.1.2 Overview of Project

A number of government programs provide very good information (mostly in the form of pamphlets) on conservation measures for the home and small business. Such programs include those listed below:

- Canada Mortgage and Housing Corporation (www.cmhc-schl.gc.ca) - CMHC makes available a wealth of consumer information for the housing industry. This information encompasses technical building information and purchasing assistance for all levels of housing.
- NRCan's Office of Energy Efficiency (oee.nrcan.gc.ca/corporate/programs.cfm) – has an extensive range of programs covering buildings, equipment, government operations, housing, industry, transportation, and outreach.

[63] Coltrane, Scott, Archer, Dane & Aronson, Elliot 1986, *The social-psychological foundations of successful energy conservation programmes*, Energy Policy, Vol. 14, No. 2, April, pp 136-137.

[64] Publication available on Australian Government's website: http://www.greenhouse.gov.au/coolcommunities/publications/index.html

[65] Publication available on Local Government Commission's website: http://www.lgc.org/freepub/energy/campaign/FinalHandbook.pdf

- Government of Canada's climate change program (www.climatechange.gc.ca) and specifically the *One-Tonne Challenge* initiative.

However, research[66] indicates that pamphlets, videos and other information services result in very little savings – possibly in the region of 0-2%. Simply feeding information to home energy users usually has little impact on their action.

This broadly termed "public education campaign" involves leveraging the available information from the listed government agencies with the range of strategies outlined herein that will have a greater likelihood for motivating energy efficiency in the home and business. People are not all motivated in the same way, and hence a fusion of strategies will be undertaken.

16.1.3 Project Scope

Some awareness campaigns that are specific to a particular program are outlined and budgeted with the chapter that describes the program; other awareness campaigns are more general in nature or are common to several programs and are outlined and budgeted in this chapter.

There are many dimensions to the public education campaign as highlighted below:

- a *compact fluorescent for incandescent exchange* program that will be run at trade shows and conservation forums;
- an outreach program for non-English-speaking recent immigrants to the city;
- an energy conservation labelling program for selected appliances;
- an awareness program to familiarize consumers with the EnergyStar label;
- a diverse portfolio of workshops, each intended to encourage different customer groups to undertake their own energy actions;
- an internet-based resource centre to support do-it-yourself conservation activities by customers.

Each facet of the campaign is individually described and budgeted in a later section of this report. It is believed that employing different strategies will increase the effectiveness of the program.

It is expected that several of the program elements described below will be of interest to other utilities and opportunities of joint and cooperative programs will surface.

[66] *Motivating Home Energy Action – A Handbook of What Works*; prepared by Michelle Shipworth for the Australian Greenhouse Office, April 2000; chapter *Information Sometimes Motivates*; page 1.

16.2 PROGRAM EXECUTION METHODOLOGY AND COSTS

16.2.1 Execution Methodology for "CFL for Incandescent Exchange" Program

The compact fluorescent lamp (CFL) for incandescent bulb exchange program that allows customers to exchange a traditional incandescent bulb (which will typically have a 60 or 100 W rating) for an Energy Star qualified compact fluorescent lamp (with a 15 W consumption / 900 lumen light output rating).

To have the greatest chance of success, the literature[67] indicates that the program should be founded on the principles listed following:

- … once someone makes a small commitment in an area, they are more likely to make a larger commitment in the same area. Someone might commit to installing a shower flow restriction device – either by paying for it, or by making some other kind of commitment (e.g. at a social club). That person is then more likely to make a larger commitment, such as insulating a hot water unit. On the other hand, someone who does not make an energy saving commitment will rationalize his or her lack of effort.
- People often do not know where most of their energy is used. They tend to think that visible energy consuming technologies (such as lights) consume more energy than less visible technologies (such as a hot water service). They may also overestimate energy use related to socially significant events such as Christmas lights or Christmas dinner.
- People need guidance on which energy actions to take first – they need to know which actions will have the greatest impact. If they are simply given a list of energy action options, people will take the easiest energy action or the one that is most visible.

Simply stated, this CFL exchange program is a so-called "foot in the door" strategy that is both visible and easy to implement, and likely to lead to further energy actions.

The exchange program will be run at well-attended public venues such as the London Spring Home & Design Show, and at smaller forums with a conservation theme such as the Energy Conservation Forum. It will also be an element in other programs described herein such as the

Figure 16-1, Participation in Energy Conservation Forum at Central Library

[67] *Motivating Home Energy Action – A Handbook of What Works*; prepared by Michelle Shipworth for the Australian Greenhouse Office, April 2000; chapter *Information Sometimes Motivates*; pages 12, 18 and 21.

Energy Awareness in the Classroom Program, the *Community One-Tonne Challenge Plus Program*, and others.

Of the number of CFL's given away, it is not known how many will be installed in households outside London Hydro's service territory, how many consumers are free riders, or whether the CFL replaced a 40, 60 or 100 W incandescent lamp. Nonetheless, if one assumes that the free-ridership rate is 15%, 10% of the CFL's will be installed outside London Hydro's service territory, and the average cost of energy to the consumer is 8 ¢/kW·h, the expected annual bill savings to the customer will be a function of the average daily operating time of the CFL as depicted below in Figure 16-2.

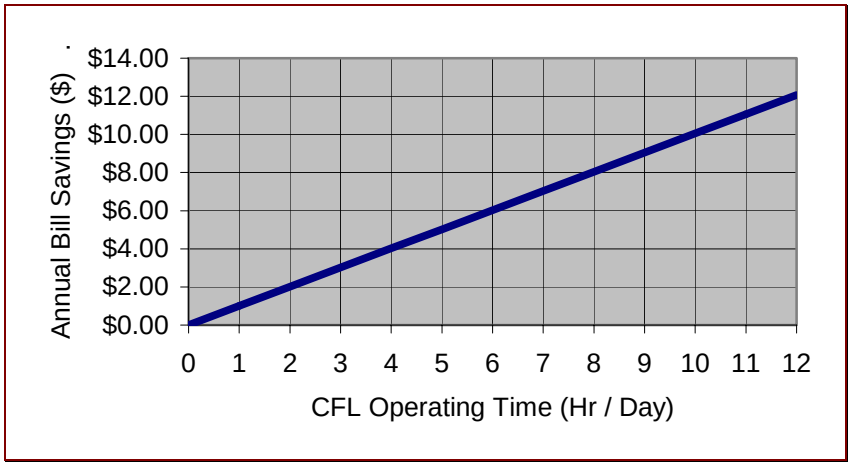

Figure 16-2, Estimated Annual Customer Savings with CFL's

The literature[68] provides some insight as to the average On-times for lights installed inside and outside a house. For convenience of reference, the findings from the referenced study have been replicated in Figure 16-3.

It is clear that the most effective locations for CFL's are exterior lighting, kitchens, and living rooms / family rooms.

Average On-time for Selected Locations

Location	Hours
Outdoor porches	4.7
Kitchens	3.9
Outdoor yard/driveway	3.4
Living rooms	3.1
Bathrooms	1.7
Bedrooms	1.3

Source: Tribwell and Lerman, 1996.

Figure 16-3, Average On-Times by Location for Household Lighting

The budget for this program is given in Table 16-1 below.

[68] Tribwell, Lyle S. and David I. Lerman. 1996. "Baseline Residential Lighting Energy Use Study." Proceedings of the 1996 ACEEE Summer Study on Energy Efficiency in Buildings, Vol 3, pg 153, American Council on a Energy Efficient Economy, Washington, DC.

Table 16-1, Budget for CFL for Incandescent Exchange Program

Event	2004	2005	2006
Energy Conservation Forum	400	--	--
London Spring Home & Garden Show		1,500	1,500
Other events		500	500
Total Number of CFLs:	400	2,000	2,000
Program Cost (@ $5.^{00} per CFL):	$2,000	$10,000	$10,000

An effective newspaper advertising campaign in advance of each event will typically cost $3K to $4K, although there are sometimes opportunities to reduce this cost via cross promotions and similar techniques.

16.2.2 Execution Methodology for Immigrant Outreach Program

One of the barriers to participating in a conservation program is certainly language. As indicated in Figure 16-4 below, almost 16% of London's population speak neither of the country's two official languages. As such, these customers would not be expected to effectively receive any messages about energy conservation or conservation programs from bill inserts, television or radio promotions, or other traditional mechanisms.

While the goal of the program is to ultimately encompass all significant populations of non-English speaking immigrants, in the first year, the program will be directed towards the Spanish-speaking community that have immigrated from Central and South America. This will serve as a model for other immigrant populations (and may have to be fine-tuned in later years to reflect our initial experiences).

By Mother Tongue (2001) London City

	Male	Female	Totals	%
English	169,795	180,235	350,030	82.6%
Polish	3,470	3,550	7,020	1.66%
Portuguese	3,305	3,345	6,645	1.57%
Arabic	3,065	2,730	5,800	1.37%
Dutch	2,515	2,790	5,300	1.25%
French	2,370	3,095	5,465	1.29%
Spanish	2,225	2,520	4,750	1.12%
German	2,090	2,745	4,835	1.14%
Italian	2,090	1,985	4,075	0.96%
Other				5.32%

Source: Statistics Canada Census 2001

Figure 16-4, London Population Characteristics (2001)

To have the greatest chance of success, the literature[69] indicates that the program should be founded on the principles listed following:

- Social networks act as models for action – they can demonstrate how to purchase, install and maintain energy saving technologies and how to behave in energy saving ways. The following anecdote amply illustrates this principle:

[69] *Motivating Home Energy Action – A Handbook of What Works*; prepared by Michelle Shipworth for the Australian Greenhouse Office, April 2000; chapter *Information Sometimes Motivates*; pg 23 - 25.

> *During the 1930's, the (US) federal government sought to facilitate the adoption of improved agricultural equipment and practices. An initial attempt to persuade farmers took the form of informational pamphlets. This approach produced few results. A later attempt took the form of a demonstration project. Government consultants worked side by side with farmers on selected farms. This program was a tremendous success. The government-trained farmers served as models for other farmers. When friends and colleagues saw the results of the new methods (an improved harvest), the techniques and equipment spread rapidly.*

- Information received from friends, family and colleagues is more likely to motivate action than information from impersonal sources. Peers can be more effective at training each other than specially trained experts. People are more likely to notice the information, evaluate it favourably, understand and remember it when they receive that information from people they know. Community groups spread information effectively, apparently because they are credible and use word-of-mouth.
- The importance of the social reference group increases when the issue is complicated and unclear.
- Almost any organization that has the trust of the intended target population can add credibility to energy conservation efforts … For residential programs, churches, civic groups, neighbourhood associations and senior citizen centres have been helpful reaching people who might not otherwise have attended energy workshops. Most programs find that combining energy conservation presentations with other regularly scheduled items works best, since by themselves energy conservation presentations tend to draw few people.

The remainder of this section does not lay out the program in minute detail, but instead provides sufficient information to describe the program's basic intent and structure.

The most suitable communication media is a local Spanish-language newspaper called Prensa Latina, which is published monthly, and is available in variety stores, restaurants, doctors offices, church and the offices of agencies that cater to the Spanish-speaking community.

Figure 16-5, Local Spanish-Language Newspaper

It is envisioned that London Hydro would pay for a series of articles to be included in Prensa Latina. The program phases (and corresponding newspaper articles that are envisioned) are outlined following:

- An inaugural article will introduce the author of this report and provide background information about the looming provincial energy crisis, the government's appeal to create a conservation culture, and the manner in which London Hydro is responding with a local Energy Conservation and Demand-Side Management Plan. The article

will lay the foundation for future articles, and finally will include a mail-in coupon to receive a free CFL (see mock-up article in Appendix E).

- Regular writers in Prensa Latina and other respected people within the Spanish-speaking community will be approached about participating in the program. London Hydro will outfit the revenue meter with a residential PowerCost Monitor (see Section 5 herein), arrange and pay for an energy audit in the person's home (by a Spanish-speaking auditor) and certain energy conservation measures in exchange for a testimonial article about the audit process and findings, the measures that were undertaken and the savings realized. Also included in the article will be a mail-in coupon to receive a free energy conservation measure (e.g. 3M window kit, faucet aerator, or an easy measure that came forth from the audit).

  Note: The companies that provide the conservation measures (e.g. 3M, Philips, etc) generally have an international presence. As such, arrangements can easily be made for the samples that are mailed out to be complete with Spanish-language instructions.

- Each person that received a give-away product will be provided with follow-up information (written in both English and Spanish) about additional energy saving opportunities.

- In concert with the activities described above, London Hydro will arrange for a Cool Shops program with a selected restaurant, variety or grocery store, and church that are frequented by the Spanish-speaking community. Again, London Hydro will pay the cost of the energy audit and certain energy conservation measures in exchange for a testimonial article about the audit process and findings, the measures that were undertaken, and the savings realized.

It is recognized that the owners of the businesses and homes that have agreed to participate in this initiative may not be comfortable or proficient at writing interesting newspaper articles. The University of Western Ontario's Faculty of Information and Media Studies has a journalism program (see: http://www.fims.uwo.ca/index.htm). Hopefully one of the journalism students is Spanish-speaking and is interested in some practical work experience.

The anticipated program costs are tabulated below:

Table 16-2, Budget for Immigrant Outreach Program

Event	2004	2005	2006
Series of newspaper articles (6)	--	$1,500	$1,500
NRCan home audits (3 residential)	--	2,000	2,000
Residential PowerCost Monitor & Improvements	--	2,000	--
CoolShops audits (2 small commercial)	--	200	300
Commercial Improvements – covered in Section 6	--	--	--
CFL & other product giveaways	--	200	200
Program Cost:	--	$5,900	$4,000

16.2.3 Appliance Sticker Program

This program would be disseminated via several channels, namely the Residential Appliance Recycling Program, the Energy Awareness in the Classroom Program, The Heat and Warmth (THAW) Plus Program, and at trade shows / conservation forums.

The refrigerator and freezer internal temperature labels would be used in conjunction with external refrigerator magnet depicted in Figure 5-5 (on page 59) and for the reasons earlier described in Section 5.3.6.

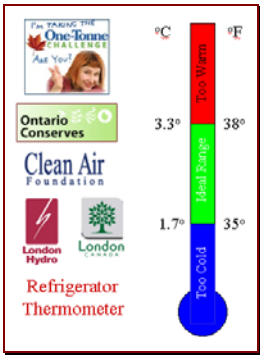

Figure 16-6, Concept Illustration of Refrigerator Temperature Label

It is envisioned that the refrigerator temperature label would be about the size of a credit card, would be based on Veritemp's reversible temperature indicating technology, and would be branded with the logos of the various project participants. The wax paper on the reverse side that covers the adhesive would be imprinted with installation instructions. The graphic artist will likely incorporate some character onto the front face that will appeal to children (e.g. snowman, penguin, polar bear, or perhaps shivering NRCat).

A similar label would be created for installation in freezers.

As a partner in the nationwide *switch to cold* campaign spearheaded by the Clean Air Foundation, London Hydro will include in its energy kits, various labels that may be affixed to washers and dryers. For the washing machine the label pictured as Figure 16-7 encourages the consumer both to use cold water and the use of machines after 8:00 pm.

Figure 16-7, Concept Illustration of Washing Machine Label

Figure 16-8, Concept Illustration of Dishwasher Label

Point-of-use labels, such as depicted in Figure 16-8, would also be supplied to be affixed to clothes dryers and dishwashers. With the proliferation of Smart Metering it is assumed that the customer may take advantage of off-peak hours of electricity supply thereby reducing on-peak demand.

Note: Conceptual artwork, courtesy of Carve | design + communications, of London.

The anticipated program costs are tabulated below.

Table 16-3, Budget for Appliance Sticker Program

Event	2004	2005	2006
Graphic Artist	--	--	--
Refrigerator Temperature Labels		3,000	3,000
Washing Machine Labels (Cool)		1,000	1,000
Washing Machine / Dishwasher Labels		1,000	1,000
Program Cost:	--	$5,000	$5,000

The budget amounts are based on the presumption of co-funding and co-branding by other agencies.

16.2.4 EnergyStar Awareness Program

Although NRCan has a variety of pamphlets and information cards that promote the Energy Star label, a simple poll of typical consumers will quickly reveal that the typical consumer draws no distinction between the terms *EnerGuide* and *EnergyStar*. Clearly the message isn't migrating effectively to its intended target; and the *EnergyStar* label is a cornerstone of many of London Hydro's conservation programs. An advertising program needs to be launched that will both give name recognition to the EnergyStar and assign a positive connotation to the label in the customer's mind.

Certainly one of the challenges of the EnergyStar awareness program will be to address the practical reality of what is termed in the literature[70] as *search minimization* – some consumers do not want to compare appliances - they do not want to compare prices or operating costs – if replacing an appliance, they will buy the same brand. We don't need the customer to change brands; only to derive satisfaction in picking out the model that bears the EnergyStar label.

The budget for this program is given in Table 16-5 below.

Table 16-4, Budget for EnergyStar Awareness Program

Event	2004	2005	2006
Television advertising	--	$2,500	$2,500
Newspaper advertising	--	2,500	2,500
Program Cost:	--	$5,000	$5,000

Note: The budget for the *EnergyStar Awareness program* is based on the premise that NRCan has or is prepared to develop television and print advertising (for provincial or national purposes), that the newspaper advertisements could be run in conjunction with retailers' promotions of EnergyStar-

[70] *Motivating Home Energy Action – A Handbook of What Works*; prepared by Michelle Shipworth for the Australian Greenhouse Office, April 2000; chapter *Understanding the Householder*; pg 7.

qualified appliances, and that neighbouring LDC's would have an active interest in participating in this program.

16.2.5 Energy Conservation Workshops Program

Various workshops are envisioned within this program, namely:

- Business Improvement Associations (BIA's) - As part of the *Cool Shops* programs, the Clean Air Foundation will present conservation program information and conservation case studies to local business improvement associations. The subject BIA's were previously identified in 6.3.4.
- London Property Management Association – London Hydro will arrange to make at least two presentations to the LPMA; the first to introduce the energy conservations opportunities available to members (e.g. refrigerator exchange, air conditioner exchange, LED illuminated exit sign program, etc.), and the second at a later date to have one of the early adopter members present a case history (probably in the form of a PowerPoint presentation) of their experiences to the other LPMA members.
- Key Account Seminar – London Hydro typically hosts a Key Account Seminar roughly on an annual basis to keep large volume commercial, industrial and institutional customers abreast of forthcoming changes in the marketplace. At one of these seminars, arrangements will be made for a representative from the LCBO Warehouse Makeover project present a case history (probably in the form of a PowerPoint presentation) of the project, its expectations and successes.
- Senior Citizens event – Work remains to be done to develop a forum that will be both appealing and entertaining to senior citizens, and that can also be used as a medium for familiarizing this segment of the population with both London Hydro's strategies for developing a conservation culture and some of the programs that may have direct appeal.
- Consulting Engineer / Architects Energy Conservation Workshop – this full day workshop would be held in London, and it would bring in energy professionals that are readily connected to premier buildings (as far as energy savings by design is concerned) to present case studies on techniques and experiences. It is imperative that the formal session opening and closing, and post-lunch speaker, be high-profile dignitaries associated with the energy sector (e.g. conservation secretariat, etc.), and that there be media coverage of what will be billed as a prestigious event.[71]

The budget for this program is given in Table 16-5 below.

[71] *Motivating Home Energy Action – A Handbook of What Works*; prepared by Michelle Shipworth for the Australian Greenhouse Office, April 2000; chapter *People Need People*; pg 5.

Table 16-5, Budget for Conservation Workshops Program

Event	2004	2005	2006
BIA Presentations (included in Cool Shops)	--	--	--
Presentation at LPMA meetings	--	$100	$100
LCBO presentation to Key Account Seminar	--	--	500
Senior citizens event	--	1,000	--
Consulting Engineers / Architects workshop	--	--	3,000
Program Cost:	--	$1,100	$3,600

Note: The budget for the *consulting engineer / architects energy conservation workshop* is based on the premise that there would be sources of government co-funding, the target audience take on projects not just in London but throughout southwestern Ontario so other LDC's would be interested in participating, and finally that there would be some nominal fee charged to invited participants that would offset the cost of lunch and beverages.

16.2.6 Energy Conservation Self-Help Program

The *energy conservation self-help* program is founded on two recent phenomena, namely:

- the dawn of the Internet-based era –

  The Internet is delivering vast knowledge and new choices to consumers – raising their expectations and, in many cases, handing them the controls. … Smart businesspeople understand this. "Changes in business processes will emphasize self-service," said Ray Lane, when he was president of Oracle. "Your costs as a business go down and the perceived service goes up because customers are conducting it themselves." [72]

- the continuing social fascination with *Do It Yourself (DIY)* activities -

  Home ownership is a huge incentive for one to take up DIY activities, and people tend to be most active in terms of DIY after purchasing a home. Social trends have also spurred the DIY market. Television programs (Trading Spaces, Facelift, Designing for the Sexes, Martha Stewart Living, Bob Villas' This Old House, etc) have fuelled the DIY demand in recent years, because people imitate the projects shown on TV. The aging population is expected to also contribute to the DIY market in the future; rather than move later in life, people often wish to remain in their homes, and as a result, choose home improvement.

The requisite elements of an all-embracing *energy conservation self-help* program are described below:

- an Internet-based tool for calculating energy use in residential buildings. There is a host of energy audit software in the marketplace, but many of these packages are

[72] Tom Peters; *Re-imagine! Business Excellence in a Disruptive Age*; Dorling Kindersley Limited, London, 2003; pp 66 – 67.

difficult to use from the end-user's perspective because they require a year or so of billing history (which the customer generally won't have readily available), and they require inputs based on terminology that the customer really doesn't understand. The *Home Energy Saver* product that is depicted in Figure 16-9 below is suggested as a good model to London Hydro to license or imitate.

Note: The Home Energy Saver was the first Internet-based tool for calculating energy use in residential buildings. The U.S. Department of Energy (DOE) and the U.S. Environmental Protection Agency (EPA), as part of the national ENERGY STAR Program for improving energy efficiency in homes, sponsored the project. There is a more complete product description on the website: http://hes.lbl.gov/hes/about.html.

- reliable sources of instructional information so that customers can confidently undertake the do-it-yourself projects (as suggested by the energy audit session) that will result in home energy improvements. This information may be in the form of a catalogue of online *how to* guides as depicted in Figure 16-10, a series of DIY videos that London Hydro provides to the public library system, or both.
- information regarding both sources of lesser known products (e.g. solar control films, etc.), and directions to credible sources of product performance information (e.g. Consumer Report articles, NRCan publications, etc.) when the customer can make a choice between alternative techniques (e.g. radiant barriers versus power-operated attic ventilators).

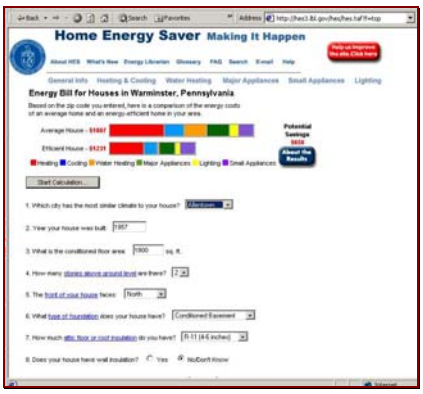

Figure 16-9, Example Interactive Home Energy Audit Session

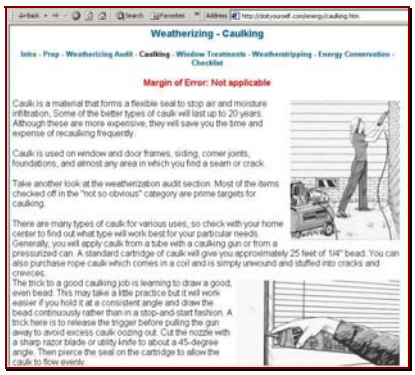

Figure 16-10, Example Online Do-It-Yourself Instructions

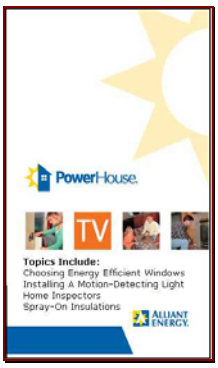

Figure 16-11, Example Do-It-Yourself Program Library

Note: The example caulking instruction shown in Figure 16-10 is from the Do It Yourself.com website (http://www.doityourself.com/energy/). The video illustrated in Figure 16-11 is from Alliant Energy's *PowerHouse* television series (see website: www.powerhousetv.com).

The budget for this program is given in Table 16-6 below.

Table 16-6, Budget for DIY Conservation Program

Event	2004	2005	2006
Licensing Home Energy Saver tool	--	--	$10,000
Licensing Online DIY instructions	--	--	1,000
Videos (50 episodes @ $20) * 2 copies	--	--	2,000
LHI web site development	--	$5,000	--
Other costs	--	--	400
Program Cost:	--	$5,000	$13,400

Most of the entries in Table 16-6 are simply guesses at this time. However, there is a possibility that this program (or variants thereof) will be of interest to other distributors, which in turn opens the possibility of cost sharing and even partial government funding.

16.2.7 Overall Cost Benefit Analysis

All elements of the public education campaign are described in the literature as *behaviour change* projects.[73] One measure of a behaviour change project is its *program cost per capita of the target community*. With the exception of the *CFL for incandescent exchange* program, this measure has been used with results as tabulated below:

Table 16-7, Program Cost Per Capita of Target Community

Public Education Program	Budget	Target Community	Program Cost Per Capita
Immigrant Outreach Program	$9,900	4,750	$2.08
Appliance Sticker Program	$10,000	≈ 3,000	$3.33
EnergyStar Awareness	$10,000	≈ 130,000	$0.08
Conservation Workshops	$4,700	≈ 300	$15.67
Self-Help Program	$18,400	unknown	

Note: The EnergyStar Awareness program appears to be the most cost effective by far; but this is deceiving. For this particular program, it is anticipated that most of the funding will come from the Federal government.

The costs versus benefits for the *CFL for Incandescent Exchange* program (outlined above in Section 16.2.1) can be quantified in terms of the Cost of Saved Energy (expressed in ¢/kW·h) as depicted in Figure 16-12 below:

[73] *A Review of Strategies Promoting Energy Related Behaviour Change*; J. M. Rolls, Energy SA, Australia; a paper presented at the ISES 2001 Solar World Congress.

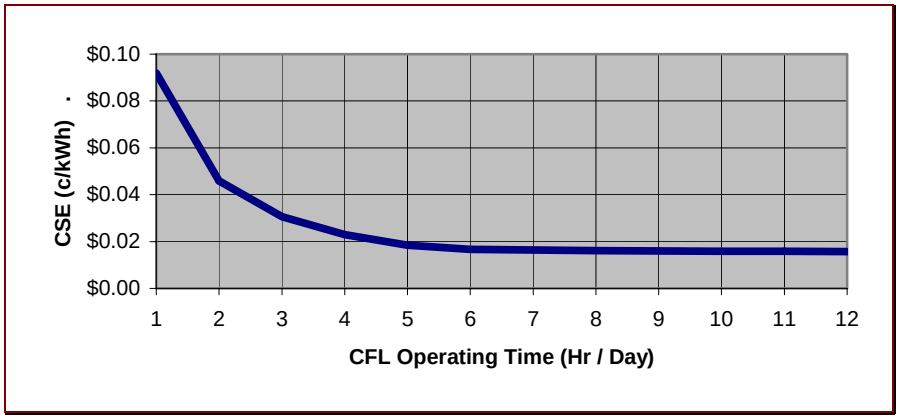

Figure 16-12, Predicted Cost of Saved Energy for CFL Exchange Program

For the assumptions made earlier regarding CFL cost, application, free-ridership, etc, it can be seen from Figure 16-12 that provided the average daily operating time of the CFL is greater than 2½ hours per day, the cost of saved energy will be less than the threshold 4.1 ¢/kW·h.

The summarized budget for the overall Public Education Campaign program is given in Table 16-6 below.

Table 16-8, Overall Budget for Public Education Campaign

Individual Program Budget	2004	2005	2006
Table 6-1, CFL for incandescent program	$2,000	$10,000	$10,000
Table 6-2, Immigrant outreach program	--	5,900	4,000
Table 6-3, Appliance sticker program	--	5,000	5,000
Table 6-4, EnergyStar awareness program		5,000	5,000
Table 6-5, Conservation workshops program	--	1,100	3,600
Table 6-6, DIY Conservation program	--	5,000	13,400
Program Cost:	$2,000	$32,000	$41,000

The program budget given in Table 16-8 is a ceiling amount – not to be exceeded. Any budget surpluses due to unanticipated external sources of co-funding will be re-directed to customer projects that turned out to be more successful than anticipated.

16.3 METHODOLOGY FOR VALIDATING EFFICIENCY GAINS

A literature search has not disclosed any sensible techniques that may be used to quantify the energy efficiency gains that are directly associated with the public education campaign.

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17 CONCLUSIONS AND RECOMMENDATIONS

17.1 PROGRAM AND BUDGET SUMMARY

Table 17-1 below presents a summary of London Hydro's energy conservation and demand-side management initiatives.

Table 17-1, London Hydro's Conservation / DSM Budget

No	Program		Target Sector	Budget
1	Traffic & Pedestrian Signals Upgrade		Municipal	$808½K
2	Residential PowerCost Monitor		Residential	$50K
3	Residential Appliance Recycling Program		Residential	$842½K
4	Program to Increase Commercial Sector Energy Efficiency	•	Commercial	$304K
5	Distribution Shunt Capacitor Program	•	Utility	$125K
6	Combined Heat & Power (CHP) Opportunities		Commercial	$30K
7	Energy Awareness in the Classroom Program		Students	$100K
8	LCBO Warehouse Makeover Project		Industrial	$100K
9	Residential Summer Comfort Program		Residential	$25K
10	Demand Response Enabling Technologies Program	•	All sectors	$69K
11	THAW Plus Program		Residential	$50K
12	Putting Our Own House in Order Program	•	Utility	$33K
13	Community One-Tonne Challenge Plus Program	•	Residential	$225K
14	Public Education Campaign		All sectors	$75K
	Total:			$2.837M

More than 85% of the program spending is operating in nature – meaning it is going to the customer in the form of project incentives or education. The programs denoted in Table 17-1 with a "•" symbol have both an operating and capital element.

Each program is detailed within the body of this report. The individual program budgets within the plan have been prepared based on a *good faith estimate* of each program's likely success. However going forward into the harsh real world, there will undoubtedly be some programs that exceed all expectations, others that under-perform, and a final group that performs about as predicted. We may even find a stellar program developed by another LDC that was completely overlooked by London Hydro. It is London

Hydro's understanding and expectation that there will be a streamlined approval process for transferring unspent monies from under-performing programs to a new or different program provided that the destination program has a comparable or better cost of saved energy (CSE) prediction.

Note: It should be noted that the names assigned to the various programs are simply for the purposes of this document. It is entirely likely that several programs will be renamed when the marketing plans are refined and the opportunities for joint programs with neighbouring LDC's are more fully explored.

The distribution of funding (at the budget level) amongst the various customer classes is illustrated in Figure 17-1 below.

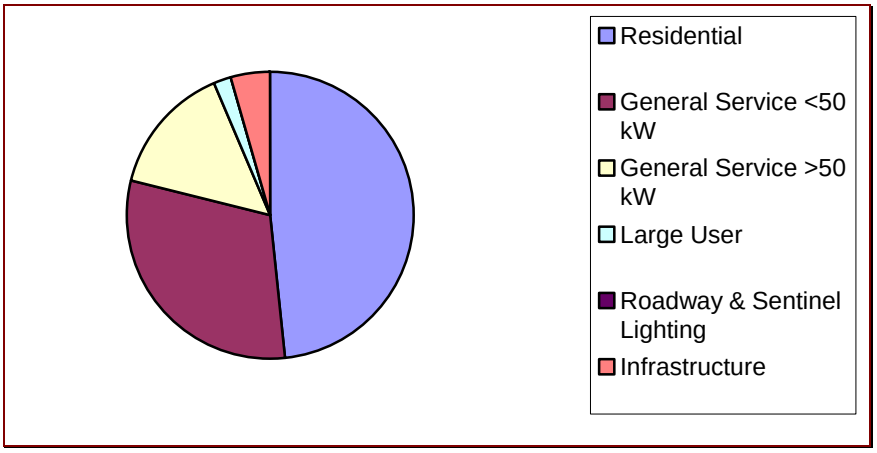

Figure 17-1, Conservation Program Budget by Customer Segment

The overall value of the energy conservation and demand-side management programs will be greater than London Hydro's requested budget, since additional funding streams are expected to be available from other programs sponsored by the Federal, Provincial and Municipal governments.

Table 17-2, Conservation/DSM Program Delivery Partners

Program	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Federal Participants														
• NRCan (OEE)		✓	✓	✓			✓	✓	✓			✓	✓	✓
• NRCan (CANMET)						✓								
• CMHC									✓		✓			
• Environment Canada							✓						✓	
• Climate Change							✓						✓	
Provincial Participants														
• Min of Environment			✓				✓							
• Min of Energy			✓				✓							
Municipal Participants														
• City of London	✓													
Other Participants														
• Clean Air Found'n				✓										✓
• Waste Div'n Ont.			✓	✓										
• TV Board of Ed				✓			✓							
• LC School Board				✓			✓							
• CEA / Hydro One		✓												

During the process of preparing this plan, formal and informal meetings were held with a number of neighbouring LDC's with respect to opportunities for joint or cooperative energy conservation / demand-side management programs. It was recognized that while there was some diversity in our respective portfolios of programs, and differing Plan submission approaches, joint and cooperative programs is a preferred execution methodology. These opportunities will certainly be pursued again once formal OEB approval of the various Plans has been attained.

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Appendices

Appendix A

Ideas List

A.1 List of Conservation / DSM Ideas

In the course of this project, a number of energy conservation / demand-side management ideas were brought forth. Some of the suggestions are listed below. The reason that the idea was dismissed could have been for a variety of reasons, including it didn't meet our criteria, it would require resources or expertise that we didn't possess, it was felt that the idea would be more appropriate for second phase offering, there wouldn't appear to be wide customer acceptance of the concept in this area, it wasn't cost-effective, etc.

Although ideas were raised throughout the project duration, the ones that come to mind are listed below:

- Projects that were considered
- Massive CFL deployment (citywide)
- Thermostat rebates for homes with A/C
- Thermostat programming by High School Students
- Gray water heat recovery unit installation (GFX)
- High Rise apartment window solar film installation
- Low flow toilet/ Leak stop hardware for high rise apartment/condo
- Energy star rebate for new/refit A/C installation for household and business
- Radio controlled water heating relays (22,000 in London possible)
- Air conditioner control program (residential)
- ECM furnace motor retrofit rebate
- Solar powered roof fan installation
- Roof fan installation rebate
- Light Controller rebate for office towers
- Weatherization program for older homes
- Infrared video/photo audit for homes/business (cheaper than blower door)
- Ceiling fan installation rebate
- Energy from waste (biofuel)
- Controllable Dual Fuel Water heater development (gas/electric) gas and 120 volt plug
- Power factor correction for small commercial accounts

Appendix B

Traffic and Pedestrian Signal Reference Information

B.1 Testimonial on LED Traffic Signals from Idaho

U.S. Department of Energy - Energy Efficiency and Renewable Energy
State Energy Program

LED Traffic Lights Save Energy in Idaho

State Energy Office Project Brief, Idaho, May-June 2004

Traffic signals may not seem like big energy consumers. But hundreds of thousands operate 24 hours a day, so a typical city or county can incur considerable costs to keep traffic flowing smoothly.

Idaho's largest county and two cities have taken steps to cut those costs. Ada County, Nampa, and Coeur d'Alene have fitted many of their traffic signals with lamps built on light-emitting diode (LED) technology. Like many others around the country, municipalities in Idaho have discovered the remarkable energy efficiency of LED-type lights.

A typical signalized four-way intersection may have three lanes per approach (two through lanes and a left turn lane), plus pedestrian crossings. Conventional incandescent lamps in a single four-way traffic light consume roughly 85 kWh of electricity per day and cost about $1,600 per year to operate. LED lights use just 10% of the electricity that incandescent lamps use, so the opportunity for savings is enormous.

The purchase cost of LED lamps is much higher than that of older incandescent lamps. But with their lower energy use, LED lamps can pay for themselves in as little as five years. Funding assistance can come from federal agencies, including DOE and the U.S. Department of Transportation, and from loans and grants administered by state energy offices such as Idaho's Department of Water Resources.

Ada County has installed LED lights in approximately 82 of its 349 signalized intersections. Coeur d'Alene now has LED lights at 19 intersections, and Nampa has 51 traffic signals with LEDs.

B.2 Testimonial on LED Traffic Signals from Syracuse

RELEASE: IMMEDIATE
CONTACT: Tom Collins
1-866-697-3732 (NYSERDA) ext. 3250 or **tgc@nyserda.org**

CITY INSTALLS NEW ENERGY-SAVING TRAFFIC LIGHTS AT 299 INTERSECTIONS

NEW LIGHTS SAID TO BE SAFER

Syracuse, NY- January 28, 2004 - The City of Syracuse has improved traffic signals at 299 intersections with energy-efficient Light-Emitting-Diode (LED) traffic lights. The new LED lamps, installed in 10,044 traffic lights, will aid in protecting both vehicular and pedestrian traffic while saving the City over $225,000 annually. The City partnered with the New York State Energy Research and Development Authority (NYSERDA) which contributed $537,240 to the project. Conservation Station, Inc. was the energy service company overseeing the project.

Incandescent lamps in traffic signals were replaced with LED lights, which have 10 times the life expectancy of the incandescent fixtures. Energy savings is also considerable as a red incandescent lamp requires 135 watts while a 12 inch red LED uses just 10 watts. In an LED fixture each colored light consists of over a hundred light emitting diodes. For example, if a red incandescent lamp fixture burns out on a traffic signal, the entire red light is non-functional and a portion of the intersection is without that particular traffic signal. With an LED fixture, if one LED that composes the red light burns out, the remainder continue to function and traffic flow through the intersection is not interrupted.

"In efforts to reduce electricity consumption, save money on utility bills, and protect our pedestrians and motorists, we invested in the new, improved traffic lamps," said Mayor Matthew J. Driscoll . "The new lamps significantly decrease maintenance costs and improve motorist visibility. The City expects to see a payback of our investment in less than 2 ½ years, and we thank NYSERDA for assisting us in financing this project. We also thank Conservation Station for providing the technical expertise needed to see this project to fruition."

"I applaud the City of Syracuse for making an investment that will save the City money, save energy, and improve safety at important intersections," said NYSERDA Acting President Peter R. Smith at a check presentation ceremony held at City Hall in Syracuse today. "Governor Pataki has stressed the importance of energy

B.2 Testimonial on LED Traffic Signals from Syracuse (continued)

and the City of Syracuse has stepped up to the plate in this effort. The LED project will assist in lowering electric usage, and equally as important it will improve safety at these intersections by providing a higher quality traffic light with increased reliability ."

Funding for this project comes from the **New York Energy $mart[SM]** Commercial/Industrial Program. All **New York Energy $mart[SM]** programs are funded by a System Benefits Charge (SBC) paid by electric distribution customers of Central Hudson, Con Edison, NYSEG, Niagara Mohawk, Orange and Rockland, and Rochester Gas and Electric. NYSERDA, a public benefit corporation established by law in 1975, administers SBC funds and programs under an agreement with the Public Service Commission.

New York Energy $mart[SM] programs are designed to lower electricity costs by encouraging energy efficiency as the State's electric utilities move to competition. The programs are available to electric distribution customers (residential, commercial, institutional, and industrial) who pay into the SBC.

-40-

Programs | New York Energy $mart[SM] | Funding Opportunities | About NYSERDA | What's New | Energy Information & Analysis | Contact NYSERDA | Search | Comments?

NYSERDA, 17 Columbia Circle, Albany, NY 12203-6399
Toll-Free 1-866-NYSERDA or Local 518-862-1090; Fax 518-862-1091
New York City and Buffalo Regional Offices

B.3 Testimonial on LED Traffic Signals from Onondaga County, New York

Onondaga County Department of Transportation

Installing Electric Meters to Capture the Energy Cost Savings of LEDs

Project Profile

Number of Signalized Intersections:
85

Percent of Intersections Retrofitted:
25

Objective:
Reduce energy bills and in-house maintenance costs

Project Feature:
Using in-house labor to install electric meters to capture the energy cost savings of LEDs

NYSERDA

Background

Located in central New York State, Onondaga County is home to more than 450,000 residents in the City of Syracuse and surrounding towns and villages.

The Onondaga County Department of Transportation (ODOT) maintains the traffic signals for 85 intersections, largely in suburban areas of the county. In 1998, ODOT learned about an exciting opportunity to cut its energy and maintenance costs through the use of light-emitting diode (LED) traffic signals.

ODOT's traffic signal supplier, Traffic Engineering and Sales of Providence, Rhode Island, introduced ODOT staff to the idea of retrofitting traffic signals with LED technology as a way to reduce maintenance and energy costs. Dennis Schueller, ODOT's traffic signal supervisor, was intrigued and agreed to conduct an LED pilot project, which involved replacing two 116-watt incandescent lamps with two Dialight 12-watt red LED signal heads provided by Traffic Engineering and Sales.

Impressed by the brightness of the LEDs and the potential for energy and maintenance savings, shortly after the pilot project began, Schueller decided to move forward with a larger, countywide LED-retrofitting program.

An incandescent traffic signal in Onondaga County being retrofitted with LED technology

Installing LEDs and Meter Sockets

Historically, traffic signal electricity use in Onondaga County was billed at an unmetered rate. To reap the full energy cost savings of LEDs, ODOT decided to convert all intersections with LED traffic signals to a metered utility tariff. ODOT installed the meter sockets for these intersections at its own expense—roughly $200 each—having determined that the energy savings from the LEDs would more than compensate for the cost of the meters.

Based on the department's cost analysis, ODOT determined that it made sense to retrofit the red signals—including red balls and arrows—at its larger intersections (i.e., those with eight or more signal faces) where the energy savings would be the greatest, and to install meters at those intersections. ODOT's largest retrofitted intersection at Route 57 and John Glenn Boulevard has 14 signal faces. ODOT also retrofitted one 4-way stop using red flashers.

ODOT recently experimented with green LED arrow signals in three of its newly-signalized intersections. Based on the outstanding performance of these green LED signals and the potential to garner much greater electricity savings, ODOT plans to expand its LED retrofit program to include green ball and green arrow signals. In addition, ODOT is testing a small number of yellow LED arrows and plans to install a dozen LED pedestrian signals. The first intersection will be operational in early 2002.

In unmetered areas, consider installing meter sockets at intersections retrofitted with LEDs to monitor the full energy cost savings of LEDs.

B.3 Testimonial on LED Traffic Signals from Onondaga County, New York (continued)

Purchasing Over Time

ODOT purchases traffic signals through its annual supply budget. By limiting its retrofits to approximately 10 intersections per year, ODOT is spreading the cost of the retrofits over several years, thereby avoiding hurdles over the additional funds required for LED signal purchases and meter socket installations. Due to its use of in-house labor, ODOT can perform the retrofits and installations without additional up front labor costs. The reduced maintenance associated with LED traffic signals has cut down on overtime for emergency signal maintenance and allows staff to focus on other projects.

The Bottom Line

As of December 2001, ODOT retrofitted 20 intersections with red LED signals, including 19 intersections with three-color signals and one with red flashers. All of the intersections with LED signals were equipped with electric meters. ODOT's inventory includes 358 red, 20 green, and 8 yellow LED signal heads.

ODOT calculates that the installed LED signals have cut the department's electricity consumption by approximately 72,750 kWh per year. At an average electricity cost of $0.066 per kWh, annual energy cost savings have totaled more than $4,800 for red signals alone. Installations of additional green signals will further boost ODOT's energy and dollar savings.

"With energy costs always a concern, LEDs are the way to go," said Dennis Schuelke, ODOT's traffic signal supervisor. Even though the LED signals have a higher purchase cost, the energy savings and relatively low cost of using in-house labor to install electric meter sockets will allow ODOT to recoup its LED retrofitting investments in less than three years.

Enthusiastic Approval

The county is pleased with the performance of its LED installations. Maintenance crews appreciate the ease with which they can install the product. An entire intersection can be retrofitted in less than two hours—about the same time required for a routine relamping of shorter-lived incandescent signals. And many people in the community have voiced a preference for the new LED traffic signals, which are generally perceived to be brighter than incandescent signals.

ODOT welcomes the potential reduced risk of injury and related liability costs to maintenance crews and the public associated with fewer signal outages in LED intersections. "Any time you can avoid sending maintenance crews out in the middle of the night to a dangerous intersection, it's a real plus," said Schuelke.

Type	City Replaced	Annual kWh Savings/ Lamp	Total Annual kWh Savings
8" Red Ball	8	225	1,800
12" Red Ball	100	410	41,000
12" Red Arrow	50	418	20,900
12" Green Arrow	20	418	8,360
12" Yellow Arrow	8	86	688
Total Annual kWh Savings			**72,748**

Based on the current rate of $0.066 per kWh, Onondaga County could save more than $4,800 per year in reduced energy costs.

For More Information

This case study was developed by the New York State Energy Research and Development Authority (NYSERDA) to inform municipalities of the energy saving opportunities offered by LEDs. NYSERDA has many programs available that can help your municipality identify energy saving improvements that will reduce your utility costs, including:

Technical Assistance Program: Offers cost-shared help from energy engineers and experts for technical assistance. Funds are available for Energy Feasibility Studies, Energy Operations Management, and Rate Analysis.

Standard Performance Contracting: Offers fixed-price incentives to energy service companies (ESCOs) that install cost-effective electric energy efficiency measures.

Smart Equipment Choices Program: Offers financial incentives to customers for energy-efficient lighting equipment.

To learn more about these programs and others, visit the NYSERDA website at www.nyserda.org.

Close-up view of a green LED arrow signal.

"With energy costs always a concern, LEDs are the way to go."

Dennis Schuelke, Traffic Signal Supervisor, Onondaga County Department of Transportation

B.4 Correspondence with City of London

Oct. 26. 2004 3:36PM City of London - Parking Div. No. 3698 P. 1

Maguire, Shane

From: Maguire, Shane
Sent: ~~September 10, 2004 2:20 PM~~
To: Gary Rains (rainsg@londonhydro.com) ATTN:
Cc: Nichols, Harmon
Subject: LED Program

Gary,

We have completed the signal head inventory for 155 of the 358 intersections and the balance of the intersections will be completed as the project progresses. Using this information I estimate that the final tally of signal heads will be as follows:

Red		Amber		Green		Arrows	Pedestrian
200mm	300mm	200mm	300mm	200mm	300mm		
90W	135W	90W	135W	90W	135W	90W	60W
107	2,876	2,900	83	2,900	83	483	2,516

The actual number of each type of signal head will be adjusted when the inventory is completed but these numbers should be close enough for your analysis.

Please let me know if you require any additional information.

Shane Maguire, P. Eng.
Division Manager
Parking & Traffic Signals
City of London
824 Dundas Street
P.O. Box 5400
London, ON N6A 4L6
Telephone: (519) 661-8488
Fax: (519) 661-2413
E-mail: smaguire@london.ca

1

B.4 Correspondence with City of London (continued)

Rains, Gary

From: Maguire, Shane [SMAGUIRE@london.ca]
Sent: October 26, 2004 4:18 PM
To: Rains, Gary
Subject: RE: Traffic signal LED modules...

LED Wattage Summary.xls

From those numbers I believe we have 52 existing LEDs (mostly reds but I don't have a split) however that number will have to be confirmed as the installation proceeds. It is our intention to replace all existing LEDs at the same time.

Attached is a spreadsheet listing the wattage information from the various supplier's data sheets. As part of our tender we should have the supplier include this information along with their bid price in order to facilitate our review.

Shane Maguire, P. Eng.
Division Manager
Parking & Traffic Signals

-----Original Message-----
From: Rains, Gary [mailto:rainsg@LondonHydro.com]
Sent: October 26, 2004 4:02 PM
To: Maguire, Shane
Subject: Traffic signal LED modules...

I received your facsimile (which was a retransmission of your September 10th e-mail). It is a good thing that I asked for this because I see now that I hadn't lined up some of the data correctly when I thought I knew what I was doing a month ago...

I know that there a number of traffic signals in-service that have already been retrofitted with a red LED (these are first generation modules that would have been installed in the old London PUC days). Do you have any record of how many of these would be in-service?

1

B.4 Correspondence with City of London (continued)

Rains, Gary

From: Maguire, Shane [SMAGUIRE@london.ca]
Sent: November 3, 2004 1:35 PM
To: Rains, Gary
Subject: RE: Traffic & Pedestrian Signals....

Gary,

The 52 existing LEDs related to the inventory that had been completed to date. I took a quick look at the balance of the intersections and I estimate that we have approximately 125 red LEDs in service.

We are still trying to pull together a tender for the purchase of the LEDs and I was wondering when you thought you would be able to finalize London Hydro's involvement in the program. If you can assist us in completing the conversion program then we could increase the tender quantities and hopefully get better prices.

Shane Maguire, P. Eng.
Division Manager
Parking & Traffic Signals

-----Original Message-----
From: Rains, Gary [mailto:rainsg@LondonHydro.com]
Sent: November 2, 2004 6:50 PM
To: Maguire, Shane
Subject: RE: Traffic & Pedestrian Signals....

Thanks for the information. The analysis that we each conduct will be entirely different because of entirely different objectives. The Ministry of Energy (which is directing the conservation / demand-side management programs) is only interested in achieving energy savings -- your maintenance savings is irrelevant to them.

However, the city has a different mandate -- you want to lower BOTH your energy costs and maintenance costs -- and so your analysis of payback will be different and probably more favourable than ours.

One of the other questions that has been raised is the number of 1st generation RED LED's remaining on the system. In your October 26th e-mail, you indicated the number as being 52 -- is this 52 intersections or 52 signals?

-----Original Message-----
From: Maguire, Shane [mailto:SMAGUIRE@london.ca]
Sent: November 2, 2004 4:22 PM
To: Rains, Gary
Subject: RE: Traffic & Pedestrian Signals....

Gary,

The wattage numbers I gave you were based on our maintenance tender. We called Stacey Electric and they confirmed that your wattage numbers are correct and that the table in our maintenance tender was incorrect. Please use your wattage numbers.

If you are looking for incremental labour costs I would contact any or all of the following for estimates (both Stacey & Guild have been involved in these retrofits):

1. Stacey Electric

1

B.4 Correspondence with City of London (continued)

Contact: Bent Hudson
Phone: (877) 787-5556 ext. 216

2. Guild Electric
Contact: Ken Nepaul
Phone: (416) 288-8222

3. Southwold Diversified
Contact: Wayne Kennedy
Phone: (519) 453-4181

4. Erie Thames Power
Contact: Scott Garton
Phone: (519) 485-1820

As discussed, when considering the incremental labour costs I think it would be better to ask for the incremental cost of replacing 2 heads (red & green) compared to all 3 heads. I suspect that this cost will be relatively low. I don't think there is a comparison between the cost of installing LEDs and mass relamping of the incandescent lamps.

In addition to the reduced energy costs we also anticipate lower annual maintenance costs since there the number of burn-outs will be greatly reduced and emergency burn-outs should be eliminated. We included both of these costs when analysing the program.

Shane Maguire, P. Eng.
Division Manager
Parking & Traffic Signals

-----Original Message-----
From: Rains, Gary [mailto:rainsg@LondonHydro.com]
Sent: November 1, 2004 3:20 PM
To: Maguire, Shane
Subject: Traffic & Pedestrian Signals....

I spent much of the weekend putting together a spreadsheet that calculates the appropriate incentive level for the conversion of traffic and pedestrian signals to LED technology. Basically the guidelines for determining incentive levels are the criteria listed below:

* The incentive level should be such that the customer achieves payback on invested dollars from energy savings within a three-year timeframe.

* The incentive monies expended by utilities to achieve energy savings should not exceed 90% of the cost of new generation.

* The incentive monies should not exceed 25% of the overall investment cost of the conservation measure.

When I was double-checking my spreadsheet entries this morning with Doug Tevlin, he questioned some of my entries in regard to the sizes of incandescent bulbs in existing fixtures. Can you refer to your September 10th e-mail to me and verify the following:

* For the 200 mm (8") signals (red, amber and green), your tabulation shows 90 W bulbs. Doug thought that they were originally 69 W, and have been reduced to 60 W in recent years.

* For the arrows, your tabulation shows 90 W bulbs -- Doug had a recollection of 135 W.

* For the pedestrian signals, your tabulation shows 60 W bulbs -- Doug seems to recall these as being 100 W.

2

B.4 Correspondence with City of London (continued)

The amount of monies at stake here are sufficiently large that it is worthwhile double-checking so that I can go to the Ontario Energy Board in complete confidence.

I haven't heard back from you regarding contact information for experienced contractors (Guild, Stacey, etc.) from which I could obtain realistic incremental retrofit labour costing information.

Once I get this information, I would be pleased to share the information / calculations on my spreadsheet with you and Dave so you have an understanding of the derivation and magnitude of the incentives for this project.

Gary

3

B.5 List Prices for Retrofit LED Modules

Fortran Traffic Systems Limited

Signal Products Price List

Part #	Product	Description	Price
BRK932	Post Top Bracket	for mounting two signal heads	$ 220.00
BRK949	Vertical Bracket	two 16" arms for mounting a signal head	$ 88.00
BRK988	Astro-Brac	mounting bracket for a 3-section signal head	$ 247.00
BSP1340	PolyFlex Backboard	12-8-8 YELLOW	$ 46.00
BSP1344	PolyFlex Backboard	12-8-8 YELLOW ,with plumbizer allowance	$ 46.00
BSP2340	PolyFlex Backboard	8-8-8 YELLOW	$ 39.00
BSP3340	PolyFlex Backboard	12-12-12 YELLOW	$ 48.00
BSP3344	PolyFlex Backboard	12-12-12 YELLOW ,with plumbizer allowance	$ 48.00
BSP3440	PolyFlex Backboard	12-12-12-12 YELLOW	$ 61.00
BSP3444	PolyFlex Backboard	12-12-12-12 YELLOW ,with plumbizer allowance	$ 61.00
BSP5440	PolyFlex Backboard	12-8-8-12 YELLOW	$ 57.00
BSP5444	PolyFlex Backboard	12-8-8-12 YELLOW ,with plumbizer allowance	$ 57.00
BSP6540	PolyFlex Backboard	12-8-8-12-12 YELLOW	$ 66.00
BSP6544	PolyFlex Backboard	12-8-8-12-12 YELLOW, with plumbizer allowance	$ 66.00
BSP7340	PolyFlex Backboard	12-8-12 YELLOW	$ 48.00
CSA003	CSA kit	upgrades signal head to CSA standard	$ 20.00
HAN504	Span Wire Hanger	Four-way hanger	$ 257.00
HAN555	Mast Arm Hanger	Rubber cushioned	$ 106.00
JPT100	Joiner	ABS fastener for joining two signal sections	$ 4.00
LAM069	Lamp	69 watt clear traffic lamp	$ 2.50
LAM116	Lamp	116 watt clear traffic lamp	$ 2.75
LAM135	Lamp	135 watt clear traffic lamp	$ 4.00
LED810	LED Traffic Lamp	8" (200 mm) Round - Red	$ 166.00
LED811	LED Traffic Lamp	8" (200 mm) Round - Yellow	$ 161.00
LED812	LED Traffic Lamp	8" (200 mm) Round - Green	$ 236.00
LED820	LED Traffic Lamp	12" (300 mm) Round - Red	$ 215.00
LED821	LED Traffic Lamp	12" (300 mm) Round - Yellow	$ 268.00
LED822	LED Traffic Lamp	12" (300 mm) Round - Green	$ 418.00
LED830	LED Traffic Lamp	12" (300 mm) Round - Amber/Green bimodal arrow	$ 308.00
LED834	LED Traffic Lamp	12" (300 mm) Round - Yellow Arrow	$ 214.00
LED835	LED Traffic Lamp	12" (300 mm) Round - Green Arrow	$ 281.00
LED840	LED Traffic Lamp	12" (300 mm) Round - Hand/Man bimodal Ped	$ 362.00
LEN121	Polycarbonate Lens	12" (300 mm) Round - Transit Priority	$ 30.00
LEN126	Polycarbonate Lens	12" (300 mm) Round - Green Left Arrow	$ 25.00
LEN127	Polycarbonate Lens	12" (300 mm) Round - Amber Left Arrow	$ 25.00
LEN128	Polycarbonate Lens	12" (300 mm) Round - Amber Diamond	$ 25.00
LEN129	Polycarbonate Lens	12" (300 mm) Round - Walking Man, Lunar White	$ 30.00
LEN130	Polycarbonate Lens	12" (300 mm) Round - Hand, Portland Orange	$ 30.00
LEN132	Polycarbonate Lens	12" (300 mm) Square - Walking Man, Lunar White	$ 40.00
LEN133	Polycarbonate Lens	12" (300 mm) Square - Hand, Portland Orange	$ 40.00
LEN151	Polycarbonate Lens	12" (300 mm) Square - Red	$ 30.00
LEN155	Polycarbonate Lens	12" (300 mm) Round - Red	$ 20.00
LEN156	Polycarbonate Lens	12" (300 mm) Round - Amber	$ 20.00
LEN157	Polycarbonate Lens	12" (300 mm) Round - Green	$ 20.00
LEN160	Polycarbonate Lens	8" (200 mm) Round - Red	$ 15.00
LEN161	Polycarbonate Lens	8" (200 mm) Round - Amber	$ 15.00
LEN162	Polycarbonate Lens	8" (200 mm) Round - Green	$ 15.00
LEN163	Polycarbonate Lens	8" (200 mm) Round - Green Left Arrow	$ 20.00

B.5 List Prices for Retrofit LED Modules (continued)

LEN164	Polycarbonate Lens	8" (200 mm) Round - Amber Left Arrow	$ 20.00
LEN165	Polycarbonate Lens	12" (300 mm) Square - Amber Diamond	$ 40.00
LEN166	Polycarbonate Lens	12" (300 mm) Square - Green Round	$ 40.00
LEN167	Polycarbonate Lens	12" (300 mm) Square - Green Left Arrow	$ 40.00
LEN175	Polycarbonate Lens	12" (300 mm) Square - Amber Left Arrow	$ 40.00
LEN177	Polycarbonate Lens	12" (300 mm) Square - Red X	$ 40.00
LEN186	Polycarbonate Lens	8" (200 mm) Round - Red X	$ 20.00
LEN189	Polycarbonate Lens	8" (200 mm) Round - Transit Priority	$ 35.00
P130409	Polycarbonate Signal	12-8-8 red,amber,green, yellow housing, MTO	$ 209.00
P1LH400	LED Signal Head	12-8-8 red,amber,green, all LED's, yellow housing	$ 751.00
P210400	Polycarbonate Signal	beacon with 8" red lens and yellow housing	$ 59.00
P224400	Polycarbonate Signal	two section, red and green 8" lenses, yellow housing	$ 119.00
P230400	Polycarbonate Signal	3 x 8" red,amber,green, yellow housing	$ 175.00
P2LY400	LED Signal Head	8" amber LED in yellow polycarbonate housing	$ 187.00
P320549	Polycarbonate Signal	Ped Hand-Man, 12" round, Green housing, MTO	$ 195.00
P320649	Polycarbonate Signal	Ped Hand-Man, 12" round, Yel housing, black door, MTO	$ 170.00
P321440	Polycarbonate Signal	Ped Hand-Man, 12" square lenses, Yellow housing	$ 247.00
P330400	Polycarbonate Signal	3 x 12" red,amber,green, yellow housing	$ 228.00
P341400	Polycarbonate Signal	4 x 12' red,amber,green,green left arrow	$ 306.00
P3L6640	LED Signal Head	12" round dual hand/man LED, yellow body, black door	$ 391.00
P3LH400	LED Signal Head	3 x 12" red,amber,green, all LED's, yellow housing	$1,057.00
P541400	Polycarbonate Signal	12-8-8-12, red,amber,green,green left arrow	$ 271.00
P5L2409	Polycarbonate Signal	12-8-8-12, red,amber,green,amber/green LED arrow	$ 531.00
P5LE400	LED Signal Head	12-8-8-12 red,amb,grn, amber/green dual arrow, all LED's	$1,085.00
P654400	Polycarbonate Signal	12-8-8-12-12 red,amb,grn,amb left arrow, grn left arrow	$ 349.00
PLU555	Fortran Plumbizer Arm	For mounting a signal head	$ 129.00
SEA100	Sealing kit	for closing unused top or bottom holes of a signal head	$ 3.75
VIS017	Visor, polycarbonate	8" TUNNEL, YELLOW	$ 15.00
VIS042	Visor, polycarbonate	12" TUNNEL, YELLOW	$ 25.00
VIS080	Visor, polycarbonate	8" COWL, YELLOW	$ 10.00
VIS081	Visor, polycarbonate	8" COWL, GREEN	$ 10.00
VIS082	Visor, polycarbonate	8" COWL, BLACK	$ 10.00
VIS180	Visor, polycarbonate	12" COWL, YELLOW	$ 20.00
VIS305	Visor, polycarbonate	12" SQUARE, YELLOW	$ 18.00
VIS308	Visor, polycarbonate	12" SQUARE, GREEN	$ 18.00

Volume discounts are available. Please contact Signal Sales.
E&OE. Fortran reserves the right to change prices without notice.

B.5 List Prices for Retrofit LED Modules (continued)

This e-mail suggests the volume discounts that may be expected on orders of the magnitude required to retrofit the traffic and pedestrian signals throughout the city of London. For the purposes of incentive analysis a mid-point value of 20% will be used.

Rains, Gary

From: moneill@fortrantraffic.com
Sent: November 26, 2004 9:42 AM
To: Rains, Gary
Cc: plengyel@fortrantraffic.com
Subject: Re: FW: Volume Discounts on LED Traffic & Pedestrian Signals...

Hi Gary, sorry for the delay in getting back to you.
Typically, a public tender is issued based on the quantity you have described .
The City of London currently purchases equipment from our competition.
The signal maintenance contract is with our competition.
Unfortunately I am not able to disclose competitive pricing prior to the issue of a formal tender.
Volume discounts usually range from 10% to 30% on larger orders. Exchange rates affect pricing as well as lead times and shop loading.

If you have any questions, please don't hesitate to call.
thanks

Mike O'Neill
Fortran Traffic Systems Limited
ph:(416)288-1320 #468
fax:(416)288-9914
moneill@fortrantraffic.com
www.fortrantraffic.com

Appendix C

Demand Response Via Dispersed Generation

C.1 Copy of December 14th letter to MVA Engineering Group

C.2 Copy of Engineering Analysis

C.1 Copy of December 14th letter to MVA Engineering Group

Department: Engineering
Attention: G.H. Rains
Telephone: 661-5800 Ext. 4870

December 14, 2004

Mr Fred Harding, CET
MVA Engineering Group Ltd.
219 Consortium Court
London, Ontario
N6E 2S8

Re: London Hydro's Energy Conservation & Demand-Side Management Plan
Demand Response Via Dispersed Generation at Pumping Stations
Our File: E.04-056

This letter will formalize our telephone conversation of Thursday December 9th. As you are no doubt aware, with recent legislative changes, distribution utilities throughout the Province are at various stages in developing portfolios of energy conservation & demand-side management programs. One initiative within London Hydro's portfolio is entitled: *Demand Response Enabling Technologies Program*, and I have included an excerpt of our draft plan which should give you some insight as to the overall scope of this initiative.

We are aware that the City of London has a number of water pumping stations and wastewater treatment plants that are equipped with standby generators intended to keep the stations operational in the event of an extended service interruption on the upstream electrical distribution system. Consistent with generally accepted good maintenance practices, these generators are exercised on a periodic basis. Presumably, if the market price of electricity were expected to exceed some threshold value (e.g. 20¢/kW·h, or during an IMO-declared Critical Peak Period), transferring the pumping station electrical loads to the standby generators would both yield savings to the City and provide demand response capability to better balance the supply and demand relationship on the Provincial transmission grid.

As a local engineering consulting firm on London Hydro's list of pre-qualified consultants that has also been involved in recent years with a number of the City's pollution control plants and water pumping stations, London Hydro wishes to engage your company for a limited engineering assignment. The specific questions to be answered are:

[1] Given the attached list of pumping stations / treatment plants with standby generators, what is the fuel type used for each standby generator, what is the anticipated running duration before the fuel source is exhausted, and what is the operating cost to the City for running each generator, or more specifically, what

C.1 Copy of December 14th letter to MVA Engineering Group (continued)

is the threshold market price for electricity beyond which it is more economic to supply the local load from the standby generators?

[2] Upon reviewing the plant electrical schematic (or visiting the site if necessary), and assuming that a Cannon Technologies *type LCR* direct control receivers, (this is the type of load management controller that Festival Hydro in Stratford is using for their electric storage water heater control program – see: http://www.cannontech.com/products/drdirectcontrol.asp) would be used as the direct controller, provide a budgetary cost estimate to modify the schematic diagrams, and supply and install the controller at each site.

Note: If the subject water pumping station / wastewater treatment plant is already outfitted with distributed process control equipment (interconnected back to the City's control room at Greenway PCP) with extra control outputs, the Cannon *type LCR* unit can be eliminated from the cost estimate.

[3] Any stations for which, in your opinion, remotely starting the standby generator without qualified Operating staff present would pose a safety hazard to the public should be so noted and excluded from further consideration.

[4] Given two years of Market Pricing history (see Figure 13-2 and 13-3 in attached draft plan) calculate, on a station-by-station basis, the bill savings that the City would have enjoyed if the standby generators had been started at the price threshold you provided above in item [1]. With the City's permission, London Hydro can provide you with twelve months of demand and consumption data for each pumping station / treatment plant. You may contact Doug Marshall directly at ☎ 661-5800 Ext 5513 for this information.

I'm expecting that this assignment will take about a week, and the engineering fees will be in accordance with PEO publication: *Schedule of Suggested Fees for Engineering Services*.

Note: So that there is no confusion, London Hydro has no plans to proceed with implementation of the demand response (via dispersed generation) project described above – we simply wish to include this analysis within our submitted *Energy Conservation & Demand-Side Management* plan as a specific example of the potential benefits that are available to customers (and retailers) that may wish to undertake such a project. London Hydro is aware that there are other customers within London Hydro's service territory with standby generation facilities (e.g. casino, hospitals, data centres, etc.) that may give consideration to active participation in the demand response marketplace. However, the City's operations were selected for the purposes of an illustrative example because they likely have the largest installed base of standby generators, they have a distributed process control system that might accommodate demand response functionality, and we both enjoy close working relationships with City staff in the subject departments.

The expected project deliverable will simply be a letter that will be 3 to 5 pages in length (which will be included as an appendix within London Hydro's *Energy Conservation & Demand-Side Management* plan). As we wish to finalize and submit our plan early in the New Year, it would be appreciated if you could finish this project before year-end.

C.1 Copy of December 14th letter to MVA Engineering Group (continued)

You will note that I have taken the liberty of sending copies of this letter to Pat McNally so that he may become acquainted with the purpose and timeframe for this project – I trust he will distribute copies to others within the City that you might need to contact to obtain electrical schematic information. Also I trust you will send Pat a copy of your findings – should the City of London wish to embark on a demand response program, your work will have formed the foundation for such an endeavour.

I shall look forward to receiving your report.

Yours truly,

LONDON HYDRO INC.

Gary Rains, P.Eng.
Director of Network Planning

GHR/ghr

encl. Extract of draft CDM plan; Section 13, *Demand Response Enabling Technologies Program* (pages 74-80).
List of City stations with standby generator facilities.
Cannon Technologies *type LCR-5000* paging load control receiver.

cc: Pat McNally — Director - Water, Environmental & Customer Relations; City of London
Doug Marshall — Account Services Coordinator, London Hydro Inc.

C.2 Copy of Engineering Analysis

MVA ENGINEERING GROUP LTD.
219 Consortium Court
London, Ontario N6E 2S8

Tel: (519) 668-4898
Fax: (519) 668-0701
E-mail: mva@mva.on.ca
Website: www.mva.on.ca

Peak Shaving Using City of London Standby Generators

MVA at the request of London Hydro has prepared this brief to show the benefits of using existing plant to peak shave energy costs. We studied several facilities owned by the City of London that are equipped with standby generators intended to provide backup for essential services during electrical power outages. The industry practice of peak shaving can be achieved with this equipment by displacing the highest levels of the Hourly Ontario Electricity Price (HOEP), selectively based on the operational cost of each machine. The HOEP price can be seen on the Independent Operators web page www.theimo.com.

The entire City's generator fleet uses diesel fuel, and all have a minimum of 24 hours supply and are sized to ensure start-up under automatic unsupervised conditions. Such equipment could be signalled to remotely start on economically appropriate times or during critical power shortages to offset load on the electrical grid. Effectively, on signal, each facility load is transferred to the generator, releasing the grid from having to provide that amount of load.

The principal issue is life safety, followed by pollution and noise, then equipment and process concerns. The standard practice is for this equipment to run unattended, as designed. The only difference is that a remote facility is determining the need and time to run. Consequently, life safety is inherently addressed by the initial design.

Exposure to pollution in the form of stack emissions and noise will increase in direct proportion to the run-time. Certificates of Approval for air and noise emissions issued by the Ministry of the Environment will require to be modified. Please note that the majority of these Facilities are located near to residential areas and those near hospitals or schools will be under close scrutiny by the Minister. Cost to renegotiate C of A's has not been included in this brief and could be significant.

The process and the equipment needs will be satisfied with the tracking and supply of diesel fuel, and maintenance appropriate to the running hours. Maintenance is assumed to increase only marginally, due to this additional application, estimated at 70 to 300 run hours a year these machines. These run hours might replace the need for exercising and so provide additional savings.

The City's cost to implement peak shaving is small relative to the benefits, as the facilities are already configured with SCADA capacity, requiring only a small amount of work to implement a remote start-stop of the generator and the appropriate supervision. The cost is estimated at about $5,000 for each station. Capital costs have not been considered as these are existing or proposed machines required for process or regulatory needs.

It should be noted that standby generators are usually oversized to their loads and consequently when used in these circumstances, can only offset the running load, which is less than the generator nameplate ratings. Embedded generation as herein proposed for the Greenway and S.E Reservoir machines is more expensive to implement due to the higher connection costs, but the full capacity of the generator is then available for cost avoidance.

Professional Engineers Ontario

Authorized by the Association of Professional Engineers of Ontario to offer professional engineering services.

C.2 Copy of Engineering Analysis (continued)

Peak Shaving Using City of London Standby Generators

The following table identifies the facilities within the City with appropriate standby generation suitable for peak shaving; it numerates the estimated running costs and cost savings. Simple payback is found to occur in less than two years for most medium and larger machines.

Pumping Stations with Standby Generators	Generator Size kW	Generator Running Cost $/hr	Market Threshold where Generator is cheaper	2003		2004	
				Total Run hrs	Potential cost savings	Total Run hrs	Potential cost savings
Berkshire P.S.	325	29.48	$0.20	73	$2,580.34	130	$6,178.74
Greenway PCC (future)	2500	415.00	$0.18	97	$48,350.00	165	$102,352.50
Hunt Club P.S.	60	4.75	$0.17	106	$641.61	191	$1,281.66
Medway P.S.	760	66.21	$0.19	88	$6,650.38	148	$14,974.66
Riverbend P.S.	300	27.22	$0.20	73	$2,381.85	130	$5,703.45
Sommercrest P.S.	100	7.92	$0.17	106	$1,069.35	191	$2,136.10
Talbot Village P.S.	230	20.87	$0.20	73	$1,826.09	130	$4,372.65
Westmount P.S.	90	7.13	$0.17	106	$962.42	191	$1,922.49
Arva Reservoir	80	6.34	$0.17	106	$855. 84	191	$1,708.88
Hyde Park P.S.	230	29.48	$0.20	73	$2,580.34	130	$6,178.74
New Uplands P.S.	150	9.90	$0.17	106	$1,336.69	191	$2,670.13
Pond Mills P.S.	270	22.68	$0.20	73	$1,984.88	130	$4,724.88
S.E. Reservoir (future)	1000	166.00	$0.18	97	$19,340.00	165	$40,941.00
Springbank Reservoir	450	11.88	$0.17	106	$4,812.08	191	$9,612.45
Westmount P.S.	250	28.80	$0.14	159	$3,651.13	285	$6,205.63
Wickerson P.S.	125	9.90	$0.17	106	$1,336.69	191	$2,670.13

Notes:
(a) *Running Costs $/hr* is estimated based on $0.60/L diesel fuel costs and the published manufacturer consumption rates for similar machines.
(b) *Market threshold where Generator cheaper* is based on the generator running costs and the available offset load in kW.
(c) *Run hrs* is the HOEP hours where electricity costs (Nanticoke Nodal Cost) are greater than the generator's running costs.
(d) *Potential cost savings* is the product of sum of HOEP event residual costs (actual less generator) and the generator offset load in kW.
(e) Offset load has been assumed at 50% except for embedded generation which has been assumed at 100%.

The calculation results above are sensitive to the difference between the generator size and the effective displaced (offset) load, and the net return is much improved when all the generator capacity is available to offset load. We have used conservative figures but note that better load estimates would improve the quality of the potential cost savings figures. Generators sized 200kW and larger present greater opportunity and should be evaluated further.

MVA's review indicates that these well maintained standby diesel generators could be available to offset over 1,500 kW of demand during economically appropriate times or during critical power shortages and provide a potential of net return or savings to the City of London.

MVA Engineering Group Ltd.
London, Ontario.
January 2005

EO1959

Prepared for London Hydro

Appendix D

Commercial & Industrial Energy Conservation Program Reference Materials

D.1 Announcement of Cool Shops – London Conservation Program

Clean Air Foundation

Ontario

London Set for Cool Shops

Clean Air Foundation's energy conservation program can help London Area small retailers

London, November 30, 2004 – London-area small businesses are about to get a "cool" makeover, with the arrival of the Clean Air Foundation's Cool Shops program. Today, a workshop is being held to determine how to tailor the successful small business energy-saving program to local London retailers.

Cool Shops is a market transformation program targeting street-facing retailers in neighbourhoods across Ontario, including the hundreds of small businesses in the London Area. The program identifies and helps implement in-store measures that encourage small businesses to reduce energy use, save on utility costs, and improve air quality.

As an added bonus, the Clean Air Foundation will include all participants in its Cool Shops marketing program, providing small retailers with exposure in the community. Official "Cool Shops" receive a window decal, in-store signage, nominations for awards and advertising in local media. The goal is to encourage customers to patronize Cool Shops businesses.

Today's workshop – supported by the Ontario Ministry of Energy and the City of London – will bring together London-area businesses, London Hydro, the Ontario government, Natural Resources Canada, Union Gas, local energy management companies and non-profit organizations. The goal of the day is to set a plan for implementation of Cool Shops in London by April 2005.

Building strong communities and a reliable energy system are priorities for the province of Ontario. "The McGuinty government is committed to changing the way people think about energy use. With the help of partners like the Clean Air Foundation, we are providing Ontarians with the tools to better manage their energy consumption," said Dwight Duncan, Ontario's Minister of Energy. "The Cool Shops program provides excellent solutions to help small businesses use less energy and save money."

"Most small businesses aren't aware of some of the simple things they can do to reduce operating costs," said Corey Diamond, Cool Shops Program Manager. "Once small businesses understand the substantial savings realized with even the smallest of efforts, the better the health of the city will be. The Cool Shops program helps them do just that."

Jamie Skimming, Air Quality Manager for the City of London, believes the multi-stakeholder approach will yield positive results for the city's small businesses. "We want to bring all the partners together today to develop the best program for London's street front retail stores. This is similar to London's EnerGuide Partnership, which promotes energy efficiency and conservation for London's homeowners and home builders."

The workshop is being held at the London's Civic Garden Complex. For more information on Cool Shops, visit www.coolshops.ca.

-30-

D.1 Announcement of Cool Shops – London Conservation Program (continued)

About Cool Shops

The Cool Shops program provides small retail businesses with energy efficient solutions, including recommendations on how they can save money in the short-, medium- and long-term. Through working with its delivery agents, the Cool Shops program also provides immediate installation of quick initiatives and direct access to implementation partners who can provide the tools and incentives to encourage a shift to more energy efficient buildings. All official "Cool Shops" receive a window sticker to promote their store as energy efficient and to let the community know they are taking a positive step towards clean air. Visit www.coolshops.ca for more information.

The Cool Shops program is supported by the Ontario Ministry of Environment, Ontario Ministry of Energy, Natural Resources Canada and Enbridge Gas Distribution.

About Clean Air Foundation

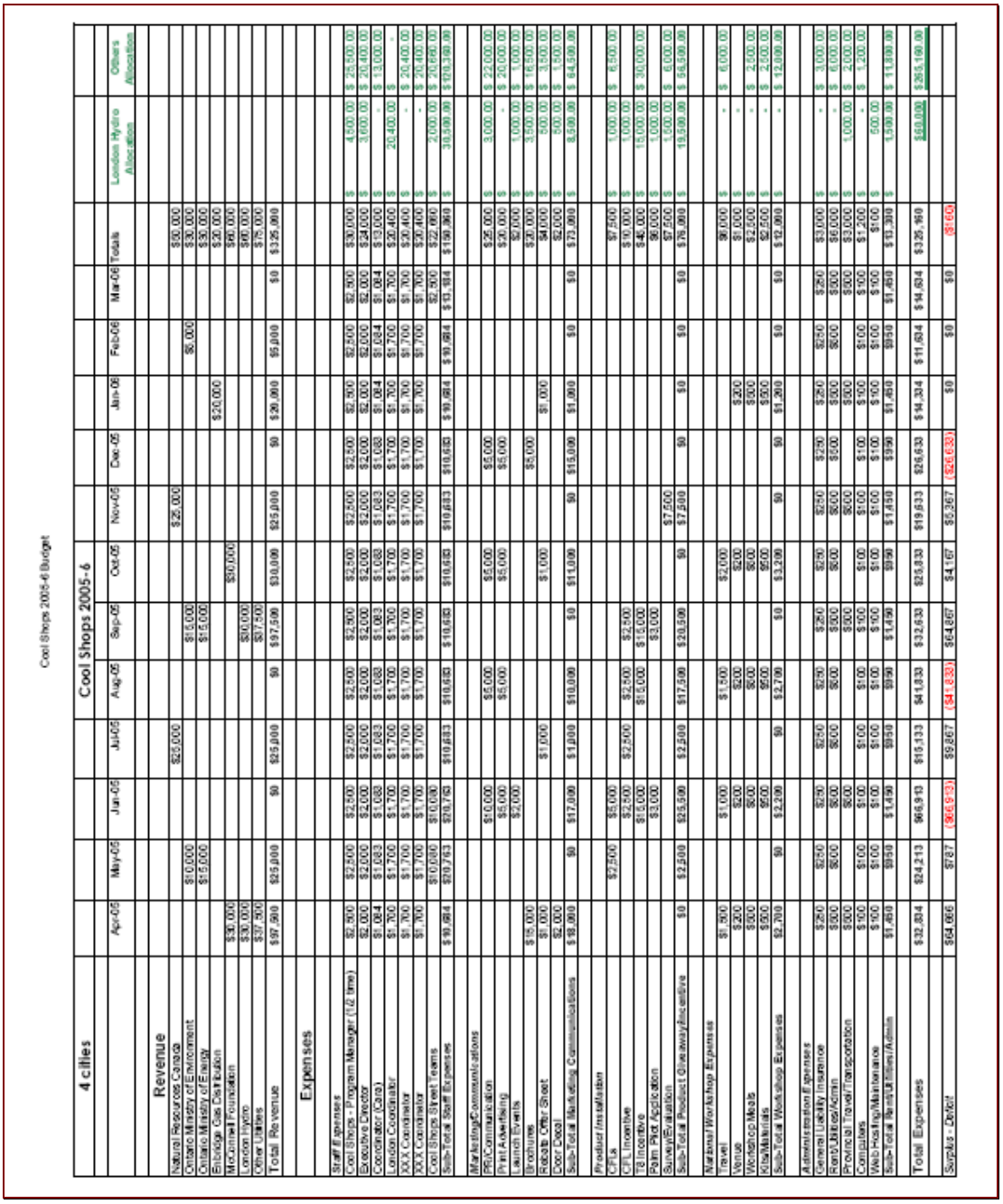
The Clean Air Foundation is a not-for-profit organization dedicated to developing, implementing and managing public engagement programs and other strategic initiatives that result in measurable emission reductions. What distinguishes the Clean Air Foundation from other organizations is our public engagement mandate. The Foundation manages seven public engagement programs - **Car Heaven** (encouraging the retirement and recycling of old vehicles), **Mow Down Pollution** (a lawnmower exchange program), **Switch-Out** (aimed at reclaiming mercury convenience lighting switches from retired vehicles), **Keep Cool** (a window air-conditioner exchange program), **Energy Smarts** (a national retail energy efficiency program), **Cool Shops** (an energy efficiency campaign for the small commercial sector) and **Climate-Air Connections** (the Ontario climate change public engagement and outreach hub). Each program is supported by a diversity of industry, government, and non-government organizations.[1] Further information about the Foundation and its programs can be found on www.cleanairfoundation.org

For further information or to request an interview, please contact:

Corey Diamond
Program Manager
W: 416-922-9038 x 43
C: 416-624-0405
cdiamond@cleanairfoundation.org

[1] The following organizations are supporting partners of the Clean Air Foundation: Trillium Foundation, Parsons, Recycling Council of Ontario, The Kidney Foundation, The Home Depot, Black and Decker, Natural Resources Canada, Climate Change Central, Greater Vancouver Regional District, Clean Nova Scotia, Panasonic, Future Shop, Ontario Automobile Dealers Association, Canadian Petroleum Products Institute, Imperial Oil, Ford Motor Company of Canada, Pollution Probe, Environment Canada, The Lung Association, Ontario Power Generation, Ontario Ministry of the Environment, Ontario Automobile Recyclers Association, Leviton, Intermatic, Venmar Ventilation, Honeywell, 3M, GE/CAMCO, Toronto Atmospheric Fund, Murray Inc., Gardena, Great States Corporation, Philips.

D.1 Announcement of Cool Shops – London Conservation Program (continued)



Cool Shops 2005-6 Budget

4 cities					Cool Shops 2005-6													
	Apr-05	May-05	Jun-05	Jul-05	Aug-05	Sep-05	Oct-05	Nov-05	Dec-05	Jan-06	Feb-06	Mar-06	Totals	London Hydro Allocation	Others Allocation
Revenue															
Natural Resources Canada				$25,000				$25,000			$5,000		$50,000		
Ontario Ministry of Environment		$10,000				$15,000							$30,000		
Ontario Ministry of Energy		$15,000				$15,000							$30,000		
Enbridge Gas Distribution										$20,000			$20,000		
McConnell Foundation	$30,000						$50,000						$80,000		
London Hydro	$30,000					$50,000							$80,000		
Other Utilities	$37,500					$37,500							$75,000		
Total Revenue	$97,500	$25,000	$0	$25,000	$0	$97,500	$50,000	$25,000	$0	$20,000	$5,000	$0	$325,000		
Expenses															
Staff Expenses															
Cool Shops - Program Manager (1/2 time)	$2,500	$2,500	$2,500	$2,500	$2,500	$2,500	$2,500	$2,500	$2,500	$2,500	$2,500	$2,500	$30,000	$ 4,500.00	$ 25,500.00
Executive Director	$2,000	$2,000	$2,000	$2,000	$2,000	$2,000	$2,000	$2,000	$2,000	$2,000	$2,000	$2,000	$24,000	$ 3,600.00	$ 20,400.00
Coordinator (Cara)	$1,084	$1,083	$1,083	$1,083	$1,083	$1,083	$1,083	$1,083	$1,083	$1,084	$1,084	$1,084	$13,000	$ -	$ 13,000.00
London Coordinator	$1,700	$1,700	$1,700	$1,700	$1,700	$1,700	$1,700	$1,700	$1,700	$1,700	$1,700	$1,700	$20,400	$ 20,400.00	$ -
XXX Coordinator	$1,700	$1,700	$1,700	$1,700	$1,700	$1,700	$1,700	$1,700	$1,700	$1,700	$1,700	$1,700	$20,400	$ -	$ 20,400.00
XXX Coordinator	$1,700	$1,700	$1,700	$1,700	$1,700	$1,700	$1,700	$1,700	$1,700	$1,700	$1,700	$1,700	$20,400	$ -	$ 20,400.00
Cool Shops Sport Teams		$10,000	$10,000									$2,500	$22,500	$ 2,000.00	$ 20,500.00
Sub-Total Staff Expenses	$ 10,684	$20,763	$10,683	$10,683	$10,683	$10,683	$10,683	$10,683	$10,683	$10,684	$10,684	$13,384	$190,300	$ 30,500.00	$ 159,800.00
Marketing/Communications															
PR/Communication			$10,000		$5,000		$5,000		$5,000				$25,000	$ 3,000.00	$ 22,000.00
Print Advertising			$5,000		$5,000		$5,000		$5,000				$20,000	$ -	$ 20,000.00
Launch Events			$2,000										$2,000	$ 1,000.00	$ 1,000.00
Brochures	$15,000								$5,000				$20,000	$ 3,500.00	$ 16,500.00
Rebate Offer Sheet	$1,000			$1,000			$1,000			$1,000			$4,000	$ 500.00	$ 3,500.00
Door Decal	$2,000												$2,000	$ 500.00	$ 1,500.00
Sub-Total Marketing Communications	$ 18,000	$0	$17,000	$1,000	$10,000	$0	$11,000	$0	$15,000	$1,000	$0	$0	$73,000	$ 8,500.00	$ 64,500.00
Product Installation															
CFLs	$2,500	$5,000											$7,500	$ 1,000.00	$ 6,500.00
CFL Incentive		$2,500	$2,500	$2,500	$2,500								$10,000	$ 1,000.00	
T8 Incentive		$15,000		$15,000	$15,000								$45,000	$ 15,000.00	$ 30,000.00
Pilot, Pilot Application		$3,000			$3,000								$6,000	$ 1,000.00	
Survey/Evaluation								$7,500					$7,500	$ 1,500.00	$ 6,000.00
Sub-Total Product Give away/Incentive	$0	$25,500	$2,500	$17,500	$20,500	$0	$7,500	$7,500	$0	$0	$0	$0	$76,000	$ 19,500.00	$ 56,500.00
Material/Workshop Expenses															
Travel	$1,500	$1,000		$1,500		$2,000							$6,000	$ -	$ 6,000.00
Venue	$200	$200		$200						$200			$1,000	$ -	
Workshop Meals	$800	$800		$800		$800				$800			$2,500	$ -	$ 2,500.00
Kits/Materials	$500	$500		$500		$500				$500			$2,500	$ -	$ 2,500.00
Sub-Total Workshop Expenses	$2,700	$0	$2,700	$0	$2,700	$0	$3,300	$0	$0	$1,300	$0	$0	$12,000	$ -	$ 12,000.00
Administration Expenses															
General Liability Insurance	$250	$250	$250	$250	$250	$250	$250	$250	$250	$250	$250	$250	$3,000	$ -	$ 3,000.00
Hard/Unlimited Admin	$500	$500	$500	$500	$500	$500	$500	$500	$500	$500	$500	$500	$6,000	$ -	$ 6,000.00
Provincial Travel/Transportation	$500	$500	$500	$500	$500	$500	$500	$500	$500	$500	$500	$500	$6,000	$ 1,000.00	$ 5,000.00
Computers	$100	$100	$100	$100	$100	$100	$100	$100	$100	$100	$100	$100	$1,200	$ -	$ 1,200.00
Web Hosting/Maintenance	$100	$100	$100	$100	$100	$100	$100	$100	$100	$100	$100	$100	$100	$ 500.00	
Sub-Total Rent/Utilities/Admin	$1,450	$950	$1,450	$950	$950	$1,450	$950	$1,450	$950	$1,450	$950	$1,450	$13,300	$ 1,500.00	$ 11,800.00
Total Expenses	$32,834	$24,213	$66,913	$15,133	$41,833	$32,633	$25,833	$19,633	$26,633	$34,334	$11,634	$14,834	$325,160	$60,000	$265,160.00
Surplus - Deficit	$64,666	$787	($66,913)	$9,867	($41,833)	$64,867	$24,167	$5,367	($26,633)	$0	$0	$0	($160)		

D.1 Letter of Support for Keep Cool Program

Jan-13-2005 05:34pm From-MIN OF E&E +416314 4128 T-148 P.002/002 F-880

Ministry of the Environment
135 St. Clair Avenue West
Toronto ON M4V 1P5

Ministère de l'Environnement
135, avenue St. Clair ouest
Toronto ON M4V 1P5

Ontario

January 13, 2005

Hans Schreff
London Hydro
111 Horton Street
London ON N6A 4H6

Dear Hans:

Re: Letter of Support for Clean Air Foundation's Keep Cool Program

On January 7, 2005, Corey Diamond of the Clean Air Foundation (CAF) asked us to confirm our current support for CAF's Keep Cool program.

This letter will confirm the Ministry's current support for the Clean Air Foundation. The funding support is being used to implement the Keep Cool program in Ontario, which encourages the public to retire their old, inefficient air conditioners.

Our partnership with CAF focuses on six public education and outreach projects: Keep Cool; Climate-Air Connections; Cool Shops; Mow Down Pollution; Switch Out; and, Car Heaven. Our association reflects the Ministry's commitment to innovative public outreach, by demonstrating partnership among governments, NGOs, industry, and consumers. We continue to have confidence in the Foundation and their ability to deliver results-based programs. If you have any questions about our partnership, please contact the CAF Executive Director, Ersilia Serafini at (416) 922-9038, ext. 42.

We encourage you to work with the Clean Air Foundation to extend these programs in London in 2005. Your success will contribute to Ontario's efforts to reduce energy use and result in reductions of air pollutants and greenhouse gases.

Yours Truly,

Yvonne Bialowas
Policy Advisor, Global Air Issues

cc: Corey Diamond, Clean Air Foundation

D.2 News Releases Concerning VendingMI$ER™ Devices

PR Newswire
United Business Media

Long Island Power Joins 20 Power Authorities Extending USA Technologies´ VendingMiser Rebate Program Through 2005

MALVERN, Pa., Jan. 04 /PRNewswire/ --

MALVERN, Pa., Jan. 4 /PRNewswire-FirstCall/ -- USA Technologies (BULLETIN BOARD: USTT) announced today that all 20 power utilities that offered rebates in 2004 for its VendingMiser(R) energy management device had agreed to extend the rebate program through 2005.

The Company also announced that the Long Island Power Authority, of New York, would become the 21st power authority to join the rebate program.

Long Island Power will determine the amount it will pay in rebates to their customers who install VendingMiser(R), CoolerMiser(TM), PlugMiser(TM), SnackMiser(TM) and VM2IQ(TM) on a case by case basis.

"That all our rebate partners have agreed to extend the program into 2005 signals that leading energy-related companies are determined to aggressively manage soaring energy costs," said George R. Jensen, Chairman and Chief Executive Officer, USA Technologies. "We're delighted that power authorities, such as Long Island Power Authority, are signing up in increasing numbers and supporting responsible energy conservation to both ease the demand on the national power grid, and help lower energy costs."

The average vending machine consumes approximately 3,000 kilowatt-hours of energy a year, costing as much as $600. USA Technologies' energy management has the technology to power down the machine and reduce the energy consumed and the cost by almost half, as well as reduce greenhouse gasses.

USA Technologies estimates its complete product line of EnergyMiser products sold to date have saved 184,800,000 kWh of electricity a year, resulting in customer savings of nearly $17 million. EnergyMisers at the same time have prevented the release of more than 270 million pounds of CO2 a year.

Power authorities offering VendingMiser rebates are: City of Palo Alto, $65 rebate; Connecticut Light & Power and Western Mass Electric Co, $75 rebate; Dakota Electric, $75 rebate; Efficiency Vermont, $45 rebate; Efficiency Maine, $50 rebate; Eugene Water & Electric Board, $120 rebate; Great River Energy, $75 rebate; Hawaiian Electric Company, $50 rebate; Nevada Power Company, $50 rebate; New York State Energy Research and Development Authority, $40 rebate; NSTAR, Boston, $75 rebate; Pacific Gas & Electric, $90 rebate; PacifiCorp (Pacific Power), $75 rebate; PacifiCorp (Utah Power), $75 rebate; Puget Sound Energy, $80 rebate; San Diego Gas & Electric, $90 rebate; Seattle City Light, $80 rebate; Sierra Pacific Power Company, $50 rebate; Silicon Valley Power, $80-$120 rebate; and Southern Valley California, $90 rebate.

USA Technologies' energy management solutions can be deployed in a variety of commercial appliances, from vending machines, refrigerators and glass front coolers, to plastic meat wrappers in supermarkets. All of the technology has the capability of reducing energy consumption by as much as 50 percent. Parties interested in learning more about the rebate program should contact USA Technologies at 800-633-0340.

About USA Technologies:

USA Technologies is a leader in the networking of distributed assets, wireless non-cash transactions, associated financial/network services and energy management. USA Technologies provides networked credit card and other non-cash systems in the vending, commercial laundry, hospitality and digital imaging industries. USA Technologies is an IBM Business Partner. The Company has marketing agreements with AT&T, Honeywell, MEI, Unilever and ZiLOG Corporation. http://www.usatech.com/

Statement under the Private Securities Litigation Reform Act:

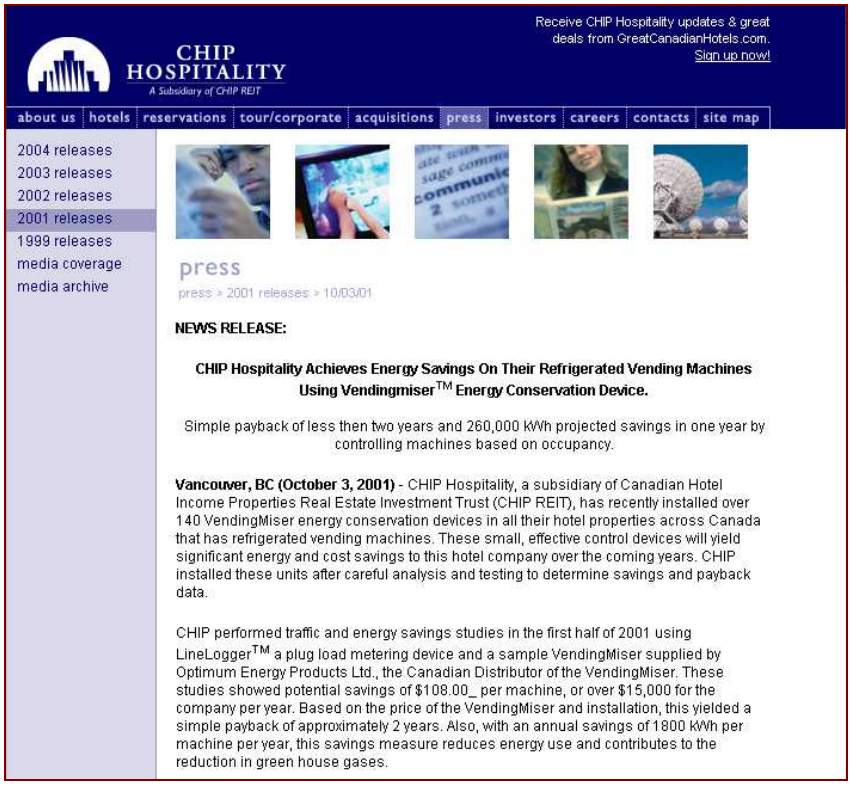
With the exception of the historical information contained in this release, the matters described herein contain forward-looking statements that involve risk and uncertainties that may individually or mutually impact the matters herein described, including but not limited to the ability of the Company to increase revenues in the future due to the developing and unpredictable markets for its products, the ability to achieve a positive cash flow, the ability to obtain orders for or install its products including the G-5 e-Port, the ability to obtain new customers and the ability to commercialize its products, which could cause actual results or revenues to differ materially from those contemplated by these statements.

USA Technologies Contact: Investor Relations Contact: George R. Jensen, Jr., Chairman & CEO Ken Sgro Stephen P. Herbert, President & COO CEOcast, Inc. Phone: (800) 633-0340 Phone: (212) 732-4300 e-mail: sherbert@usatech.com

USA Technologies

CONTACT: George R. Jensen, Jr., Chairman & CEO, or Stephen P. Herbert,
President & COO, sherbert@usatech.com, both of USA Technologies,

D.2 News Releases Concerning VendingMI$ER™ Devices (continued)



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2003 releases
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1999 releases
media coverage
media archive

press

press > 2001 releases > 10/03/01

NEWS RELEASE:

CHIP Hospitality Achieves Energy Savings On Their Refrigerated Vending Machines Using Vendingmiser™ Energy Conservation Device.

Simple payback of less then two years and 260,000 kWh projected savings in one year by controlling machines based on occupancy.

Vancouver, BC (October 3, 2001) - CHIP Hospitality, a subsidiary of Canadian Hotel Income Properties Real Estate Investment Trust (CHIP REIT), has recently installed over 140 VendingMiser energy conservation devices in all their hotel properties across Canada that has refrigerated vending machines. These small, effective control devices will yield significant energy and cost savings to this hotel company over the coming years. CHIP installed these units after careful analysis and testing to determine savings and payback data.

CHIP performed traffic and energy savings studies in the first half of 2001 using LineLogger™ a plug load metering device and a sample VendingMiser supplied by Optimum Energy Products Ltd., the Canadian Distributor of the VendingMiser. These studies showed potential savings of $108.00_ per machine, or over $15,000 for the company per year. Based on the price of the VendingMiser and installation, this yielded a simple payback of approximately 2 years. Also, with an annual savings of 1800 kWh per machine per year, this savings measure reduces energy use and contributes to the reduction in green house gases.

D.2 News Releases Concerning VendingMI$ER™ Devices (continued)

"Energy is one of CHIP's largest expense for our hotels," says Pieter Vannierop, director design and construction of CHIP Hospitality. "This technology is an excellent investment as the misers are quick to install, require no maintenance and start producing an immediate payback on the investment."

"We are pleased CHIP Hospitality chose the VendingMiser for their hotel properties" says Grant Meadows, President of Optimum Energy Products Ltd. "We have thousands of units in the University, College and K12 school markets, and this is our first major installation in hotels . VendingMiser is universally applicable to any facility that has refrigerated vending machines and typically yields at least a 48% annual energy reduction" says Meadows.

About the VendingMiser
VENDINGMISER (patent pending) represents a technological breakthrough in intelligent and economical control of vending machines, which significantly reduces energy consumption without compromising the vended product. Utilizing a custom **passive infrared sensor**, VENDINGMISER powers down a vending machine when the area surrounding it is unoccupied and automatically re-powers the vending machine when the area is reoccupied.

VENDINGMISER's intelligent controller uses fuzzy logic to learn from the habits of the building occupants, and modifies the time-out period accordingly. Additionally, VENDINGMISER monitors the ambient temperature while the vending machine is powered down. Using this information, VENDINGMISER automatically powers up the vending machine at the appropriate intervals, ***independent of occupancy***, to ensure that the vended product stays cold.

VENDINGMISER also monitors electrical current used by the vending machine. This ensures that VENDINGMISER will never power down a vending machine while the compressor is running, so a high head pressure start never occurs. In addition, the current sensor also ensures that every time the vending machine is powered up, the cooling cycle is run to completion before again powering down the vending machine. This unique process also ensures a cold vended product.

About CHIP Hospitality
CHIP REIT is an integrated hotel Real Estate Investment Trust. CHIP Hospitality, the REIT's hotel management company, manages the REIT's assets as well as properties for third party owners and utilizes management strategies, upgrades, repositioning and franchising to improve the operating performance of their properties to create value for investors and third party owners. CHIP Hospitality is one of Canada's top five hotel management companies managing 37 hotels with over 8,000 rooms. CHIP's hotels carry 11 different brand franchises including Radisson, Sheraton, Delta, Crowne Plaza, Residence Inn by Marriott, Four Points by Sheraton, Holiday Inn, Best Western, Quality, Ramada, & Gouverneur. CHIP also has 18 independent properties including The Mayfield Inn & Suites At West Edmonton, The SandalWood Suites Hotel, Toronto Airport and The Citadel Hotel Halifax. CHIP REIT units trade on The Toronto Stock Exchange under the symbol HOT.un. For more information see www.chipreit.com

About Bayview Technologies Group LLC (manufacturer of VendingMiser)
Bayview Technology is the leading international supplier of Intelligent Power Control solutions for energy conservation. Bayview's "Miser Products™" provide the most sophisticated retrofit solutions available to plug load energy conservation. These include vending machines, computer monitors, task lights, Point of Sale (POS) terminals, copying machines, and laser printers.

About Optimum Energy Products Ltd. (Distributor of VendingMiser)
Optimum Energy Products Ltd., based in Calgary AB, is a distributor and reseller of energy metering and energy management hardware and software products around the world. For more information please visit (www.OptimumEnergy.com) or www.ElectricityMetering.com, or email us at info@optimumenergy.com.

Contact:
Grant Meadows
Optimium Energy Products Ltd.
(403) 256-3636 or grantm@optimumenergy.com

Alasdair Douglas
Vice President Marketing, CHIP Hospitality
(604) 646-8451 or adouglas@chipreit.com

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D.3 Reproduction of Dakota Electric Association VendingMI$ER™ Pamphlet

VendingMI$ER™

"Save Energy, Save Money!"

Bayview's Miser family is a line of occupancy-based energy control products. VendingMiser™ (U.S. Patent No. 6,243,626) represents a breakthrough in the power control of cold beverage vending machines. It reduces energy consumption by an average of 46%, while maintaining the temperature of the vended product. VendingMiser typically has a short average payback of between one and two years.*

Utilizing a **Passive Infrared (PIR) Sensor**, VendingMiser powers down a vending machine when the area surrounding it is vacant. For a series of up to 4 machines, VendingMiser can utilize its unique embedded Sensor Repeater, which allows it to be controlled from the PIR sensor of any other Miser in the bank. VendingMiser monitors the room's temperature, and automatically re-powers the vending machine at one to three hour intervals, independent of occupancy, to ensure that the vended product stays cold.

VendingMiser's electrical current sensor will never power down a vending machine while the compressor is running, avoiding high head-pressure starts. In addition, when the vending machine is powered up, the cooling cycle is allowed to run to completion before again powering down. Additionally, VendingMiser's smart technology generates maintenance savings for the machine operator through reduced run time, estimated at $40 - $80 per year. Indicator lights on the unit will alert service personnel if the machine's cooling system is failing.

For outdoor locations and any other location where the VendingMiser may be exposed to water, a waterproof PIR sensor and controller housing are available. An Easy-Install VendingMiser is also available and allows for installation with no tools.

A cold beverage vending machine consumes on average 400 Watts, costing approximately $300 per year to operate at 8¢ per kWh. Powering down such a vending machine when not in use provides savings of $150 or more per year per machine. Additionally, other cooled product vending machines, such as refrigerated candy machines, can also be controlled by VendingMiser. Non-cooled product machines can be controlled by our companion product, SnackMiser™. VendingMiser is made in the USA.

Technical Specifications

ELECTRICAL SPECIFICATIONS

Input Voltage:	115 Volts (230 Volts available)
Input Frequency:	50/60 Hz
Maximum Load:	12 Amps (Steady-State)
Power Consumption:	Less than 1 Watt (Standby)

ENVIRONMENTAL SPECIFICATIONS

Operating Temp:	-15°C to 75°C
Storage Temp:	-40°C to 85°C
Relative Humidity:	95% Maximum (Non-Condensing)

COMPATIBILITY

Vending Machines:	Any machine, except those containing perishable goods such as dairy products.

INACTIVITY TIMEOUTS

Occupancy Timeout:	15 minutes
Auto Repower:	One to three hours, dynamically adjusted, based on ambient temperature

DIMENSIONS

Size:	4.5"W x 1.75"H x 3.25"D
Weight:	2.2 lb. (including power cable)

REGULATORY APPROVALS

Safety:	UL/C-UL Listed Information Technology Equipment (ITE) 9T79

UL LISTED UL LISTED

VendingMisers Benefit the Environment

One VendingMiser reduces greenhouse gas emissions by 2200 lbs. of CO_2 each year.*

* Based on occupancy and the Environmental Information Administration's national average of Carbon emissions and electricity generation.

* Based on electric rate and occupancy.

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4300 220th St W
Farmington, MN 55024
651-463-6212 . 1-800-874-3409
www.dakotaelectric.com

D.3 Reproduction of Dakota Electric Association VendingMI$ER Pamphlet (continued)

Easy-Install MI$ERS™

"Save Energy, Save Money!"

VendingMisers are available with Easy-Install d

which is pre-assembled for tool-less installation. The Easy-Install pre-assembled system contains the controller, sensor repeater, and (if needed) an occupancy sensor.

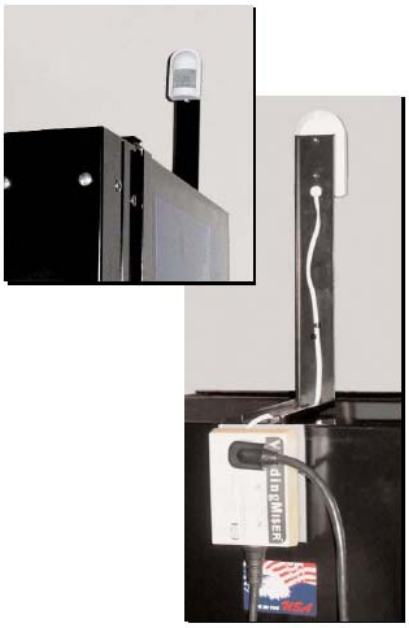
To install the system, simply place the Easy-Install system on top of the vending machine. The system attaches to the back of the vending machine with the supplied Velcro. (See the photos.)

For placements where there are multiple vending machines side by side, the Easy-Install system is supplied without the sensor. A sensor repeater is already built into the Miser, so additional hardware is not required.

The Easy-Install system allows placement of the VendingMiser in under 5 minutes! Once in place, enjoy the energy savings that make Misers popular with so many customers.

For further information about the Easy-Install system

please call Dakota Electric at (800) 874-3409 or visit www.dakotaelectric.com.



ORDERING INFORMATION

VM170	Easy-Install VendingMiser with PIR Sensor
VM171	Easy-Install VendingMiser only

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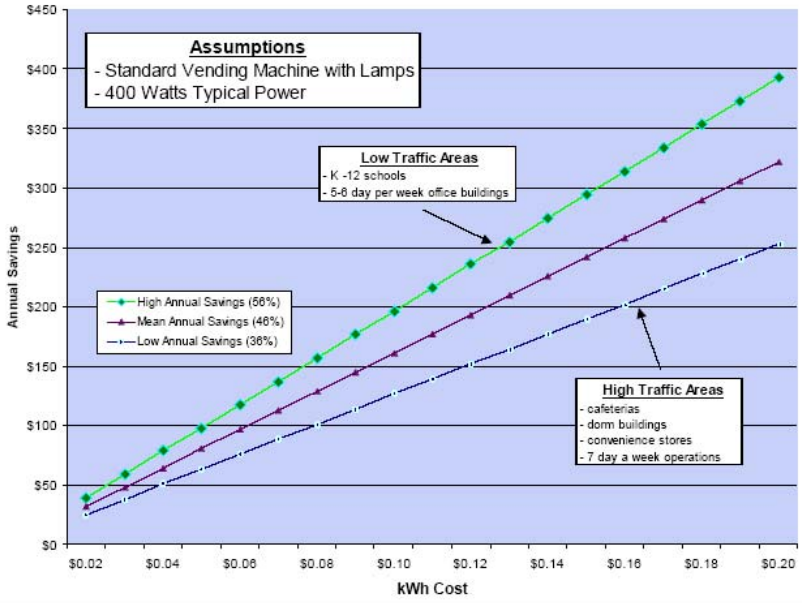
D.3 Reproduction of Dakota Electric Association VendingMI$ER Pamphlet (continued)

TYPICAL SAVINGS GENERATED WITH VendingMI$ER™



COMMON QUESTIONS ABOUT VendingMI$ER™

Will VendingMiser keep my drinks cold?
Absolutely - VendingMiser has been tested and approved for use by both major bottlers. Visit the web site at www.bayviewtech.com or contact us for more details.

Is the VendingMiser easy to install?
Yes! VendingMiser is a simple external plug-and-play product. The VendingMiser can be installed on the wall with simple hand tools or it can be attached to the vending machine without tools using the new **Easy-Install** system. The Easy-Install System allows quick installation in 5 minutes.

Is VendingMiser safe for all machines?
Yes! VendingMiser is compatible with all types of cold drink vending machines. In fact, by reducing run time of the machines, VendingMiser reduces maintenance costs.

Has VendingMiser been field tested?
Tens of thousands of VendingMisers have been operational in the field. Average energy savings have been independently documented to be 46%. Measurement and verification test results as well as testimonials are available on the website.

Are any locations not appropriate for VendingMiser?
Just one - VendingMiser's savings are generated as a result of location vacancy. Therefore, a machine in a location that is occupied 24-hours, 7 days a week will likely generate little savings.

ORDERING INFORMATION

VM150	VendingMiser with PIR Sensor
VM151	VendingMiser only
VM160	Weatherproof VendingMiser with PIR Sensor
VM161	Weatherproof VendingMiser only
VM170	Easy-Install VendingMiser with PIR Sensor
VM171	Easy-Install VendingMiser only

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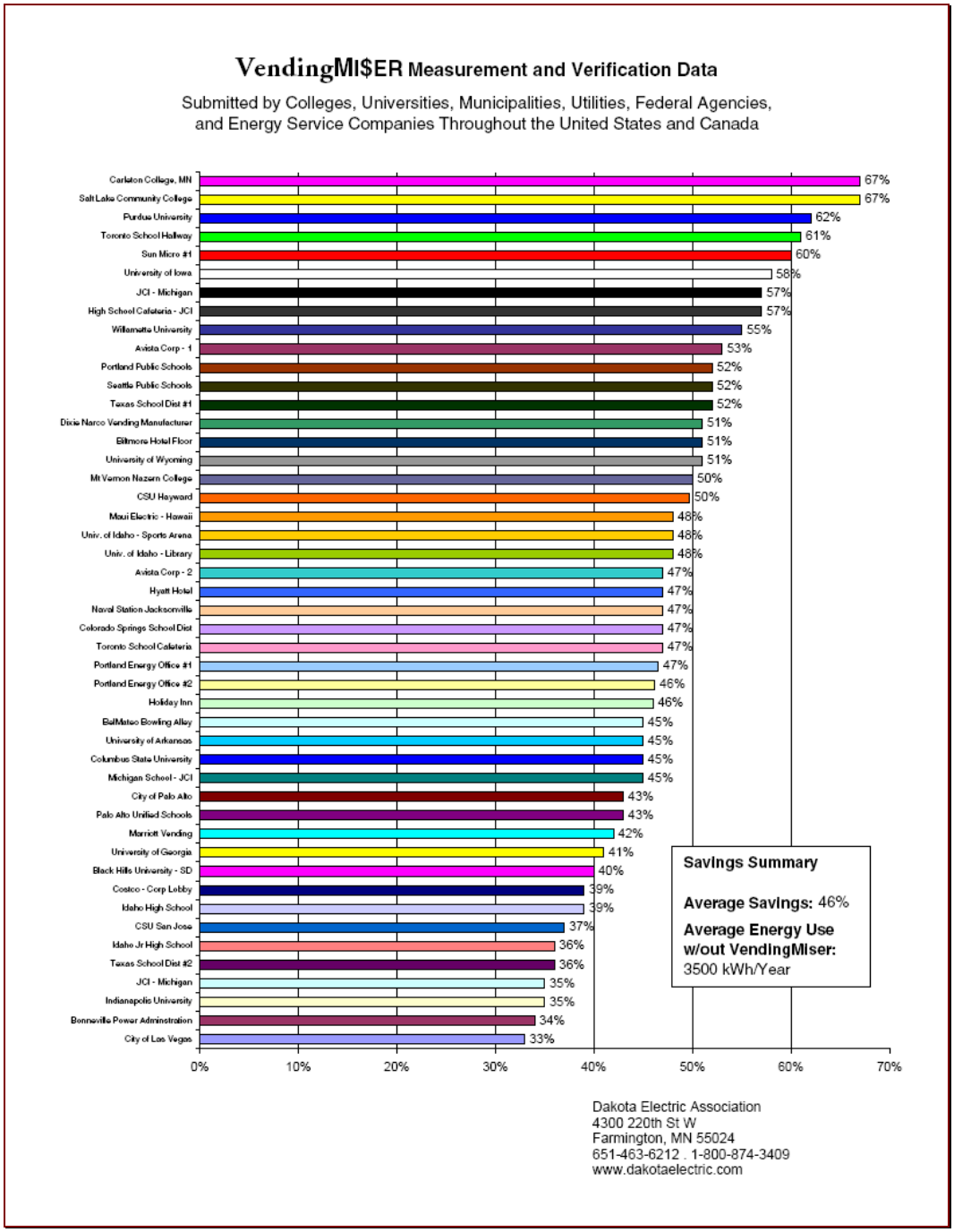
D.3 Reproduction of Dakota Electric Association VendingMI$ER Pamphlet (continued)



D.3 Reproduction of Dakota Electric Association VendingMI$ER Pamphlet (continued)

VendingMI$ER

Frequently Asked Questions

Question: *What is VendingMiser?*

VendingMiser is a power control technology for cold beverage vending machines. VendingMiser invisibly saves nearly 50% of the $200 to $500 in annual electricity costs that the machine consumes. It is a simple plug and play device, with tens of thousands of units installed in school districts, colleges and universities, government offices, retail stores, and hospitality properties. Utilizing a Passive Infrared (PIR) Sensor, VendingMiser powers down the vending machine when the area surrounding it is vacant, while maintaining the temperature of the vended product. In addition, it will reduce the maintenance costs of the vending machine and increase the life of the front panel fluorescent lamps.

Question: *How Does VendingMiser Accomplish This Feat?*

VendingMiser uses three different technologies to intelligently manage the power to a vending machine. VendingMiser will completely power down the vending machine when the area around the vending machine is unoccupied, yet maintain the desired product temperature.

- Using state-of-the-art electronics, VendingMiser is able to automatically determine whether or not the compressor of the vending machine is operating. Therefore, VendingMiser will never short cycle the compressor.
- The VendingMiser uses a custom PIR sensor to determine if there is anyone within 25-30 feet of the machine. VendingMiser waits for 15 minutes of vacancy and then completely powers off the vending machine. If the compressor is running, power down is delayed until the current cycle is completed.
- Once powered off, VendingMiser will monitor the room's temperature, and based on this measurement will automatically re-power the vending machine in 1.5 to 3.0 hours. VendingMiser allows the vending machine to run a complete cooling cycle, and then powers it down again.

If a customer approaches the vending machine while powered down, VendingMiser will sense the person's presence and power up immediately.

Question: *Have the Major Bottlers Tested the VendingMiser?*

Yes! Both The Coca-Cola Company and The Pepsi-Cola Company have tested the VendingMiser and both have accepted it for use on their cold drink vending machines.

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Question: *Have the Vending Machine Manufactures Tested the VendingMiser?*

Yes! Dixie-Narco has tested VendingMiser and duplicated Bayview's findings. Other manufacturers are being encouraged to test VendingMiser as well.

Question: *Does VendingMiser Have Any Impact on Product Temperature?*

Absolutely not! Coca-Cola's and Pepsi-Cola's approvals are based on extensive testing performed by their labs to document that even in very hot locations, VendingMiser ensures that the vended product meets their temperature requirements. Additionally, Dixie-Narco tested the VendingMiser and documented that the vended product temperature actually got colder with VendingMiser controlling the machine. Bayview's own tests have also shown no significant temperature change.

Question: *Have Other Independent Third Parties Tested VendingMiser?*

Hundreds of documented tests have been performed by independent parties, generating average savings of 46%. Letters documenting these are available from Bayview.

Question: *Is VendingMiser Safe for My Machine?*

Yes! VendingMiser is compatible with all types of cold drink vending machines. VendingMiser will not damage your vending machine - this has been validated by VendingMiser acceptance from Coca-Cola and Pepsi-Cola, and Dixie-Narco testing. In addition to being safe, it will extend the machine's life and reduce its maintenance costs (see next question).

Question: *What Impact Will VendingMiser Have on Vending Machine Maintenance Costs?*

VendingMiser will reduce overall vending machine maintenance costs. How? During standard operation, the machine's compressor typically cycles three to four times per hour, running each time for about ten to fifteen minutes. In a two-hour period, a compressor will run through as many as eight short duration cycles. While the vending machine area is occupied, VendingMiser leaves the vending machine powered and the compressor will operate in this same fashion. However, when the area around the machine is vacant, VendingMiser will typically cycle the compressor only once every two hours for a longer cycle, usually about 20 – 30 minutes in length. This will extend the life of the compressor, allowing it to run fewer and longer cycles.

In addition, the replacement frequency of the fluorescent lamps will be reduced. While it is true that power cycling fluorescent lamps will shorten their life, the hours that the machine is powered down greatly exceeds this reduction in burn hours. The net effect is that the lamps will need replacement less often.

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D.3 Reproduction of Dakota Electric Association VendingMI$ER Pamphlet (continued)

A recent study by Foster-Miller, a third-party independent engineering and analysis firm serving the vending industry, concludes that the VendingMiser creates an annual savings of $45-$86 per machine in operation and maintenance costs. The study finds that the controller technology reduces vending machine operating costs by decreasing the frequency and direct expense of component failures, and thus the number of service calls.

Question: *How Does VendingMiser Affect Machine Sales?*

Sales will certainly not decrease with VendingMiser controlling the machine. Whenever a person can see the machine, it will be powered on just as it normally would be. Since product temperature is maintained, customers will not even know that a VendingMiser has been installed on the vending machine.

Sales actually can increase with a VendingMiser! As a potential customer approaches a vending machine that was powered down, the VendingMiser sensor will sense the person and "Pop" on the machine and its lights, thereby attracting attention. This attraction may increase sales by drawing attention to the machine.

Question: *Is Using VendingMiser Preferable to De-Lamping?*

Absolutely! De-lamping of vending machines has been demanded by some customers as a way to cut their operating costs. However, most operators contacted have indicated that de-lamping nearly always has a negative impact on machine sales. Not so with VendingMiser! Also, VendingMiser will save more energy than de-lamping alone. VendingMiser can certainly be used on a de-lamped vending machine, as the average 46% energy savings will still accrue, but the payback period will be longer as the average machine power consumption will drop.

Question: *What Does It Take to Install a VendingMiser?*

Installing VendingMiser is very simple. It is a plug-and-play device – no settings or adjustments are needed. Simply unplug the vending machine and plug it into the control unit, and then plug the control unit back into the wall outlet. Mount the control unit with two screws using the supplied metal bracket. Mount the occupancy sensor above the machine with two screws, plug it into the control unit, and you are done! Installation takes only a few minutes.

Also available is the Easy-Install VendingMiser, which allows for installation without tools. Simply attach the Easy-Install bracket, which holds the VendingMiser unit and the PIR Sensor, to the machine with the supplied velcro.

VendingMiser is self-testing, and has LEDs that will immediately tell you the status of the unit.

Question: *What Happens if VendingMiser Fails?*

VendingMiser is a member of Bayview Technology's extensive Miser family, a product line of occupancy-based control technologies with over 60,000 units installed in the field at Fortune 500

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D.3 Reproduction of Dakota Electric Association VendingMI$ER Pamphlet (continued)

customers. Our nearly perfect field record allows us to provide a five-year, no quibble warranty on the VendingMiser. Life expectancy is known to be 5 years or more.

In addition, the VendingMiser is designed to be fail-safe. Should any component in the sensor or the control unit fail, the system is designed so that in most cases the vending machine will be left powered on as in normal operation, so there should be no impact on product sales.

Question: *Can VendingMiser Be Used on Machines That Are Outside?*

Yes. The Weatherproof VendingMiser, with waterproof PIR sensor and controller housing, can be used in outdoor locations and any other location where the VendingMiser may be exposed to water.

Question: *Are There Any Applications That Are Not Suitable for VendingMiser?*

Yes, but only a few. VendingMiser is not designed to be used on any vending machines containing perishable goods. VendingMiser's savings mode assumes that its location is not occupied around the clock. Therefore, an example of an application that would probably not produce any meaningful savings would be in a train station that is open and occupied 24-hours per day, seven days a week.

Question: *How About Vandalism?*

Very few cases of vandalism to a VendingMiser have been reported. The steel mounting bracket attaches the control unit behind the vending machine, where it is hidden from view. The sensor looks like a security device, and hence it is rarely disturbed. Anecdotal evidence indicates that vandalism decreases on machines controlled by VendingMiser since vandals are concerned that the sensor is part of a security system. A wire grid mask is available for protecting the sensor if necessary. Note that if the vending machine is already located inside a cage, the VendingMiser is also protected in this enclosure.

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Appendix E

Public Education Campaign Reference Material

Appendix E.1 London Free Press Clipping – Conservation Forum

Londoners swap old bulbs for new savings on power

BY JOE BELANGER
Free Press City Hall Reporter

Londoners could soon know the cost of turning on a stove or dryer at any given time.

And they could also know how to plan their day to tap into cheaper electricity.

Those were a few of several new technologies on display yesterday at an energy conservation information forum at the Central Library.

"We say every megawatt saved is as good as every megawatt built," said MPP Donna Cansfield (L— Etobicoke Centre).

Cansfield, assistant to Energy Minister Dwight Duncan, heads a provincial energy conservation action team and was in London to promote conservation.

A steady stream of conservation- and cash-conscious Londoners stopped by the displays in the indoor walkway off Dundas Street and just outside the library.

Many carried incandescent light bulbs to exchange for a compact fluorescent bulb that can last seven years and save $45 over its lifespan.

London Hydro had 500 fluorescent bulbs to exchange.

"I'm finding a lot of people now making a genuinely conscious effort to be more aware of how much energy they're using," said utility spokesperson Nancy Hutton.

London Hydro workers were at display booths explaining two ongoing pilot projects.

In one, some London Hydro customers are using so-called smart meters read remotely by telephone, saving the utility on meter reading costs and allowing customers to visit a secure website that displays the previous day's hour-by-hour use.

> "We're not necessarily trying to get people to use less power, but trying to provide them the opportunity to use it at times when it's less expensive and wiser."
> *Nancy Hutton, London Hydro*

Customers can adjust their consumption and tap into the spot market, where electricity is cheaper during off-peak hours.

The province is considering a program to provide residential users with the new meters.

The other project allows some households to monitor their power use with a wireless display box that shows how much power an appliance uses, the cost and an estimate of their monthly bill.

"We're not necessarily trying to get people to use less power, but trying to provide them the opportunity to use it at times when it's less expensive and wiser," Hutton said.

Other participants included Natural Resources Canada and a few private-sector companies, such as LEDesignWorks, which sells the newest in light bulb technology, light emitting diode (LED), a microchip that produces light.

The display drew an audience, impressed by the savings shown on meters attached to standard Christmas lights and the LEDs.

The strings of 55 standard lights drew 160 watts, costing $1.61 while the strings of 105 LEDs used a little more than five watts at a cost of half a cent.

LEDs are in use commercially for vehicle signal and tail lights, traffic signals and exit lights and are just cracking the residential market.

"We've seen an increase in interest at both the commercial level and the consumer level," said Brian Owen, president of FirsTeam Corp. and principal owner of LEDesignWorks.

"People are really concerned with conservation and the dollar savings."

DEREK RUTTAN The London Free Press

BRIGHT IDEA: Nancy Hutton from London Hydro helps distribute 500 fluorescent bulbs to promote sensible energy use at an energy conservation information forum at Galleria London.

E.2 Letter from Donna Cansfield, re: Conservation Forum

Ministry of Energy

Office of the
Parliamentary Assistant

Hearst Block
900 Bay Street
Toronto ON M7A 2E1
Tel: (416) 325-7875
Fax: (416) 325-5316

Ministère de l'Énergie

Bureau de
l'adjointe parlementaire

Édifice Hearst
900, rue Bay
Toronto ON M7A 2E1
Tél: (416) 325-7875
Télé: (416) 325-5316

Ontario

December 13, 2004

Ms. Nancy Hutton
Director of Public Relations
& Corporate Communications
London Hydro, 111 Horton St.
London ON N6A 4H6

Dear Ms. Nancy Hutton:

Thank you for your participation in the London Energy Conservation Forum on November 27th 2004. London Hydro's outstanding contribution of 500 compact fluorescent lightbulbs, distributed among attendees at the forum, helped make the day a great success. It is important that our government takes a moment to thank you for your continued commitment to helping consumers make informed decisions about how to manage their energy use, contributing to our overall goal of the creation of a "culture of conservation" in our province.

As you know, our government is dedicated to maintaining a vibrant, prosperous and sustainable Ontario. This includes the goal of ensuring that the people of our province benefit from safe, clean, reliable and affordable energy sources. Given Ontario's long-term electricity supply needs, reducing energy consumption remains an essential part of developing a responsible and sustainable approach. As citizens of this province, we must all take responsibility to conserve energy and protect our environment. It is by raising awareness through publications and programs like those offered by London Hydro that we can make the important goal of energy conservation a success.

I applaud you for raising awareness among your consumers about the importance of energy conservation. Thank you for being a leader in your support for programs that encourage the more efficient use of electricity in Ontario. I look forward to continuing to work with utilities like your own towards the creation of a conservation culture.

Sincerely,

Donna Cansfield

Donna Cansfield, MPP Etobicoke Centre
Parliamentary Assistant to the Minister of Energy

Cc: Hon. Chris Bentley, Minister of Labour
Khalil Ramal, MPP London-Fanshawe
Deb Matthews, MPP London North Centre

E.3 London Free Press Clipping, re: Seasonal Lighting

WWW.LFPRESS.COM/LTW WEDNESDAY, DECEMBER 22, 2004 LONDON THIS WEEK PAGE 5

THE FRONT SECTION

NEWS ■ SPORTS ■ BUSINESS ■ COVER STORY ■ NEIGHBOURHOOD NEWS

Saving energy on your Christmas lighting

CYNDI MILLS
Special to London This Week

Light-emitting diode (LED) lights came and went in London this holiday season.

They came to the store shelves and they went home with customers.

According to the Canadian Tire store on Wonderland Road, they experienced "good sales in the LED light department."

For many merchants this is the first year they carried LED lights, which are attractive to consumers because the lights use 80-90 per cent less energy than traditional Christmas lights.

According to Randy Stanklake, seasonal manager for Rona Home and Garden, this is the first year their store sold LED lights and they were popular with energy conscious consumers.

"They are more expensive," said Stanklake, than the traditional lights.

However, "you pay now and save later," said Stanklake.

LED lights are guaranteed for five years and are virtually unbreakable and the price comparison between using 600 traditional mini lights for 30 days at six hours a day where electricity is 12 cents per kilowatt-hour costs $6.

However, using 600 LED lights over the same period of time costs 45 cents according to NOMA a manufacture of LED lights.

> "You pay now and save later."
>
> ***Randy Stanklake, seasonal manager for Rona Home and Garden***

In London, the cost of electricity is 9.2 cents per kilowatt-hour.

Even with the popularity of LED lights Londoners use of power on Dec. 14 surpassed last year's peak usage of 509 megawatts for the month of December.

"This year, so far, our peak demand for December 2004 is 525 megawatts," said Nancy Hutton, director of communications at London Hydro.

Hutton said there are a lot of factors to consider, and Christmas lights were not solely to blame.

"You have to take a lot of things under consideration. Weather plays a large factor because people go home and turn their furnace up, while performing other household chores, for example laundry, using the oven and running the dishwasher.

As many homes perform these tasks within the same time period it creates a large demand on the system," said Hutton.

This past Sunday, Londoners used 496 megawatts of power during the cold snap.

People wanting to save money over the holiday season, but haven't purchased LED lights Hutton suggests using timers for Christmas lights, because some people forget to turn the lights off during the night and to save money throughout the winter months Hutton suggests consumers used a programmable thermostat and to set it back while out of the house.

"By lowering the thermostat by one degree a person can save approximately three per cent on energy costs," said Hutton.

The peak record for London's power use was 680 megawatts, which happened in Aug. 2001.

Cyndi Mills Special to London This Week
Nancy Hutton of London Hydro says there are many ways to save energy.

E.4 Mock-Up of Inaugural Article

La conservacion de electricidad en London…

Saludo a la comunidad hispanohablante de London. Mi nombre es Gary Rains y soy un ingeniero en London Hydro. Hoy estoy escribiéndoles a ustedes sobre el tema de la conservación de electricidad.

Estoy aprendiendo el español y este es mi primer articulo en este idioma. En artículos futuros, ustedes conocerán varios de mis profesores de español y se enteraran lo que ellos están haciendo para conservar ambos energia y su dinero.

Hoy en Ontario, hay muchos problemas con la generacíon de electricidad. Las plantas nucleares son caras para edificar y la reparación de las que existen están un alto alcance del presupuesto. Por esta razón, el gobierno no quiere construir mas plantas nucleares que preducen electricidad.

Ademas, el gobierno quiere quitar de servicio las seis plantas a carbón porque no son buenas para el ambiente. Actualmente estas plantas de generacion electrica producen el 28% de la electricidad que se usa en la Provincia de Ontario.

La población y numero de compañías en Ontario están aumentando diariamente, de manera que habrá un déficit de energía electrica en nuestro futuro si nosotros no empezamos hacer algo ahora.

Una parte de la solución es la conservación de electricidad. Este termino no significa que usted no use electricidad, sencillamente saber como usar electricidad … apagando luces y televisions en cuartos que no esten en uso, remplazando bombillas con nuevos bombillas de mayor rendimiento energético …

Si usted vive en la ciudad de London y quiciera probar bombillas que conserban energia, yo le enviare gratis una bombilla fluorecente.

✂----------

una bombilla fluorescente compacta

Esta bombilla fluorescente compacta de 15W está equivalente a una bombilla incandescente de 60W. Estas bombillas consumen hasta el 80% menos de energia eléctrica que las bombillas obtieniendo el mismo flujo luminoso.

Nombre: _____

Calle: _____

Ciudad: London, Ontario

: _____

Mail to: Gary Rains
London Hydro
P.O. Box 2700
London, Ontario
N6A 4H6

London Hydro

✂----------

Ejemplo...

Appendix F

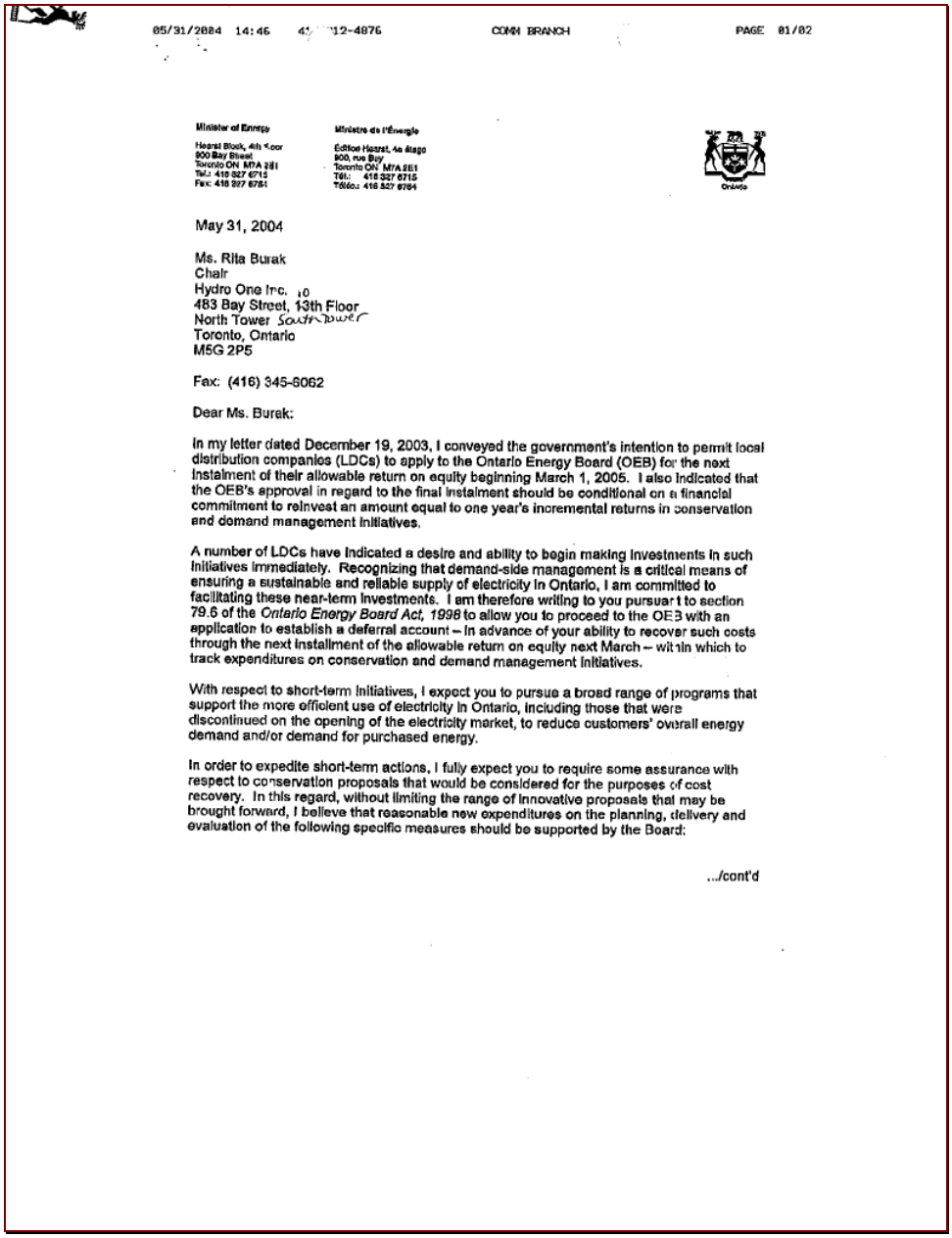
Regulatory Requirements and Guidelines for Energy Conservation / DSM Plans

F.1 May 31st Letter from Minister of Energy to LDC's

F.2 August 30th Information Bulletin For Electricity Distributors

F.3 Frequently Asked Questions

F.1 May 31st Letter from Minister of Energy to LDC's



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Minister of Energy
Hearst Block, 4th Floor
900 Bay Street
Toronto ON M7A 2B1
Tel.: 416 327 6715
Fax: 416 327 6754

Ministre de l'Énergie
Édifice Hearst, 4e étage
900, rue Bay
Toronto ON M7A 2B1
Tél.: 416 327 6715
Télécop.: 416 327 6754

Ontario

May 31, 2004

Ms. Rita Burak
Chair
Hydro One Inc.
483 Bay Street, 13th Floor
North Tower
Toronto, Ontario
M5G 2P5

Fax: (416) 345-6062

Dear Ms. Burak:

In my letter dated December 19, 2003, I conveyed the government's intention to permit local distribution companies (LDCs) to apply to the Ontario Energy Board (OEB) for the next instalment of their allowable return on equity beginning March 1, 2005. I also indicated that the OEB's approval in regard to the final instalment should be conditional on a financial commitment to reinvest an amount equal to one year's incremental returns in conservation and demand management initiatives.

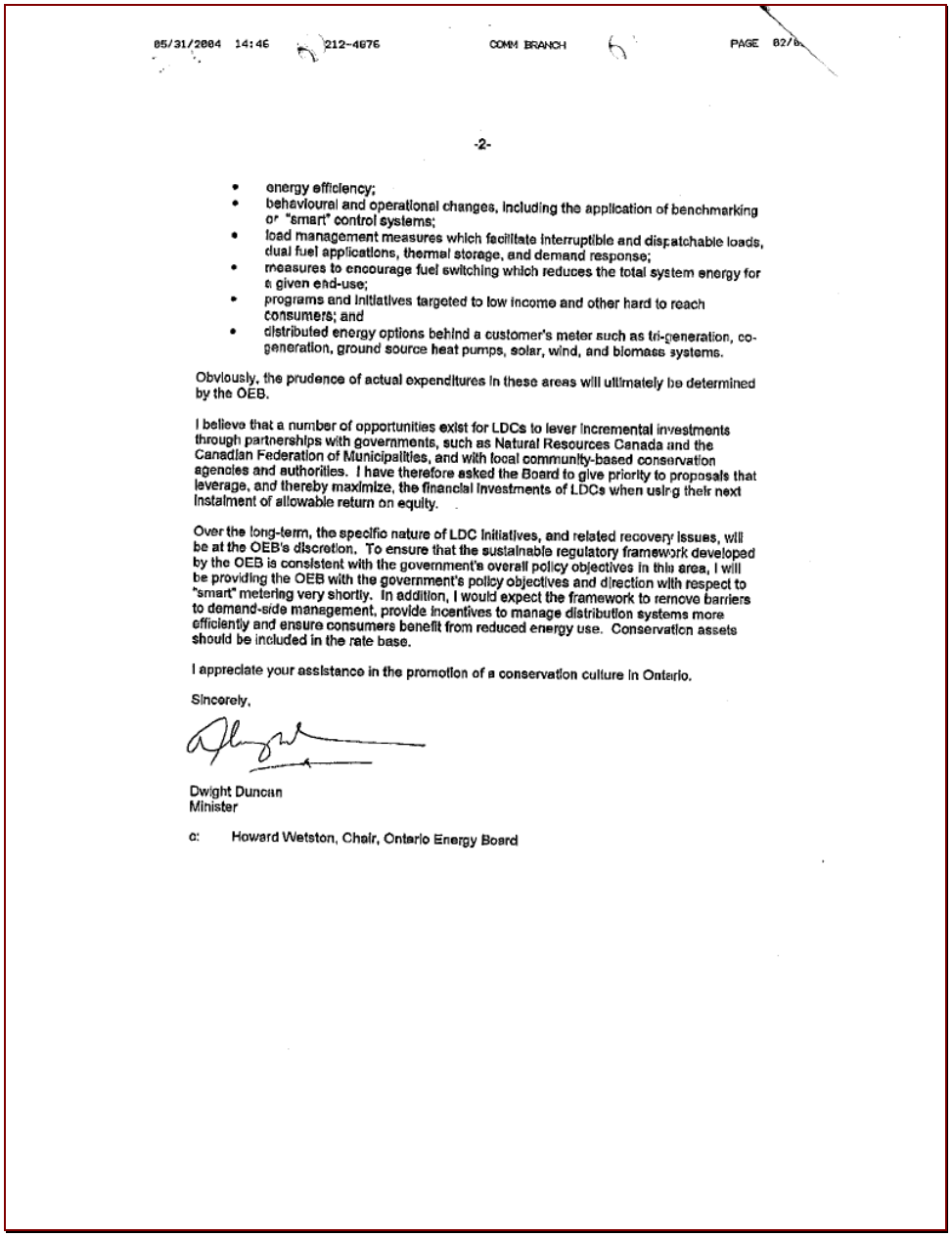
A number of LDCs have indicated a desire and ability to begin making investments in such initiatives immediately. Recognizing that demand-side management is a critical means of ensuring a sustainable and reliable supply of electricity in Ontario, I am committed to facilitating these near-term investments. I am therefore writing to you pursuant to section 79.6 of the *Ontario Energy Board Act, 1998* to allow you to proceed to the OEB with an application to establish a deferral account – in advance of your ability to recover such costs through the next instalment of the allowable return on equity next March – within which to track expenditures on conservation and demand management initiatives.

With respect to short-term initiatives, I expect you to pursue a broad range of programs that support the more efficient use of electricity in Ontario, including those that were discontinued on the opening of the electricity market, to reduce customers' overall energy demand and/or demand for purchased energy.

In order to expedite short-term actions, I fully expect you to require some assurance with respect to conservation proposals that would be considered for the purposes of cost recovery. In this regard, without limiting the range of innovative proposals that may be brought forward, I believe that reasonable new expenditures on the planning, delivery and evaluation of the following specific measures should be supported by the Board:

.../cont'd

F.1 May 31st Letter from Minister of Energy to LDC's (continued)



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- energy efficiency;
- behavioural and operational changes, including the application of benchmarking or "smart" control systems;
- load management measures which facilitate interruptible and dispatchable loads, dual fuel applications, thermal storage, and demand response;
- measures to encourage fuel switching which reduces the total system energy for a given end-use;
- programs and initiatives targeted to low income and other hard to reach consumers; and
- distributed energy options behind a customer's meter such as tri-generation, co-generation, ground source heat pumps, solar, wind, and biomass systems.

Obviously, the prudence of actual expenditures in these areas will ultimately be determined by the OEB.

I believe that a number of opportunities exist for LDCs to lever incremental investments through partnerships with governments, such as Natural Resources Canada and the Canadian Federation of Municipalities, and with local community-based conservation agencies and authorities. I have therefore asked the Board to give priority to proposals that leverage, and thereby maximize, the financial investments of LDCs when using their next instalment of allowable return on equity.

Over the long-term, the specific nature of LDC initiatives, and related recovery issues, will be at the OEB's discretion. To ensure that the sustainable regulatory framework developed by the OEB is consistent with the government's overall policy objectives in this area, I will be providing the OEB with the government's policy objectives and direction with respect to "smart" metering very shortly. In addition, I would expect the framework to remove barriers to demand-side management, provide incentives to manage distribution systems more efficiently and ensure consumers benefit from reduced energy use. Conservation assets should be included in the rate base.

I appreciate your assistance in the promotion of a conservation culture in Ontario.

Sincerely,

Dwight Duncan
Minister

c: Howard Wetston, Chair, Ontario Energy Board

F.2 August 30th Information Bulletin For Electricity Distributors

Ontario Energy Board
P.O. Box 2319
2300 Yonge Street
26th Floor
Toronto, ON M4P 1E4
Telephone: (416)481-1967
Facsimile: (416)440-7656

Commission de l'Énergie de l'Ontario
C.P. 2319
2300, Rue Yonge
26e étage
Toronto, ON M4P 1E4
Téléphone: (416)481-1967
Télécopieur: (416)440-7656

Ontario

Information Bulletin For Electricity Distributors

August 30, 2004

Electricity Distributor Conservation and Demand Management Activities

On May 31, 2004, the Minister of Energy wrote to electricity distributors pursuant to section 79.6 of the *Ontario Energy Board Act, 1998* to allow them to proceed to the Board with applications to establish deferral accounts to track expenditures on conservation and demand management initiatives in advance of the distributors' ability to recover the costs through the next instalment of the allowable return on equity in March, 2005. On July 16, 2004, the Board issued its Preliminary Guidelines for Distributor Conservation and Demand Management Activities and set out the process for distributors to apply for deferral accounts.

Some electricity distributors have expressed concern over the certainty of recovering costs incurred to plan, deliver, and evaluate conservation and demand management activities. Some distributors have indicated that they do not know what kind of activities to pursue or where to find helpful information and resources.

The Board offers the following suggestions to distributors.

Conservation and Demand Management Activities

The Board has received a number of requests from distributors for deferral accounts and will post these requests on its web site for easy reference. Please look at them for ideas on potential initiatives for your company to pursue. In general, the requests received to date include activities such as:

- incentive programs to encourage consumers to purchase energy efficient equipment (e.g., ENERGY STAR® appliances);
- distributor load control programs (e.g., hot water heater, pool pump, air conditioning load control); and
- pilot programs on remote load management (i.e., for peak shaving or load shifting) that may involve the purchase of interval meters and communications equipment and development of data management and reporting systems.

.../2

F.2 August 30th Information Bulletin For Electricity Distributors (continued)

Information Bulletin For Electricity Distributors

In addition, Natural Resources Canada's Office of Energy Efficiency offers a wide range of programs and services to improve energy efficiency. The Office of Energy Efficiency offers financial incentives and other resources, including workshops, data interpretation and hundreds of free publications, to help Canadians save energy and reduce greenhouse gas emissions that contribute to climate change. Programs that may be of interest to distributors to leverage and build upon, include but are not limited to:

- The *Commercial Building Incentive Program* which provides financial incentives to building owners who incorporate energy efficiency features in the design of new commercial or institutional buildings.
- *EnerGuide for Houses* offers consumers individualized professional advice on how to improve the energy performance of their houses. An energy evaluation by a certified energy advisor will show the consumer where and how she can improve her home's energy efficiency. An *EnerGuide for Houses* rating for a home could make the home owner eligible for an energy renovation grant from the Government of Canada. An evaluation service for house plans is also available to builders of new homes.
- Rebates and incentives for selected *ENERGY STAR*® qualified products in Canada. Links are provided to a number of utilities involved in the promotion and use of the ENERGY STAR® symbol in Canada.

All of these programs and incentives are detailed on the Office of Energy Efficiency's web site at http://oee.nrcan.gc.ca/english/index.cfm.

Board Review of Distributor Activities and Expenditures

It is not the Board's intent to burden distributors with uncertainty on conservation and demand management investments.

In its July 16, 2004 letter to distributors, the Board stated: "distributors should not expect approval in advance of any particular activity or expenditure." The Board has reconsidered this position and is now prepared to provide preliminary approval of planned activities, and will base its determination on the information about the planned activities that a distributor files with the Board. The Board in granting preliminary approval will confirm that the proposed activity is appropriate.

The Board will subsequently carry out a review of the prudence of actual expenditures. The Board anticipates that final approval will be given providing the money spent was in accordance with the distributor's proposal and that commitments outlined in the plan have been met. That is, did the distributor achieve what it said it would and was it done cost effectively.

.../3

F.2 August 30th Information Bulletin For Electricity Distributors (continued)

Information Bulletin For Electricity Distributors

The Board hopes that this information is helpful to you. If you have any questions, please call the *Market Operations Hotline* at 416 440-7604, or e-mail us at market.operations@oeb.gov.on.ca.

Yours truly,

original signed by

John Zych
Board Secretary
Ontario Energy Board

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F.3 Frequently Asked Questions

Conservation and Demand Management Frequently Asked Questions

1. **What does Conservation and Demand Management (CDM) mean?**

   Conservation in the context of this proceeding includes initiatives undertaken by local distribution companies (LDCs) to reduce electricity system waste and usage. Demand Management in this context includes initiatives designed to limit peak system loading by shifting load timing.

2. **What is the goal of the CDM initiative?**

   The Ontario Government is committed to building a culture of conservation with the goal for Ontario to become a North American leader in conservation. The government has set a target of reducing province-wide electricity demand by five percent by 2007. LDCs are well positioned to influence the outcome of this initiative and as such, the Minister of Energy has asked LDCs to invest in CDM programs.

3. **What is the commitment of the LDC?**

   As indicated in the Minister of Energy's letter to all distributions companies dated May 31, 2004, LDCs can make application to the Ontario Energy Board ("the Board") for third installment of their incremental market adjusted revenue requirement. Approval of the third installment is conditional on LDCs reinvesting the equivalent of one year's incremental returns in CDM.

4. **What is the third instalment of the incremental market adjusted revenue requirement?**

   Prior to the opening of Ontario's electricity market to competition, LDCs were required to undertake a number of changes. One of the changes required that LDCs become business corporations, and as such, they were entitled to earn a selected market-based rate of return (MBRR) between 0 and 9.88%. A calculation was performed to determine the incremental revenue required by the LDC to generate its MBRR. This incremental revenue requirement is called the market adjusted revenue requirement (MARR). The incremental MARR was to be recovered by LDC through rate increases in three instalments called "tranches". The first tranche and second tranche were recovered in 2001 and 2002 rates, respectively. In 2002 a rate freeze was put in place by the government and the third instalment of incremental MARR was not recovered in 2003 as planned.

   Currently, the Minister is allowing LDCs to recover the third instalment of the incremental market adjusted revenue requirement (the 3rd tranche) conditional on a commitment to reinvest an equivalent amount in CDM initiatives.

F.3 Frequently Asked Questions (continued)

5. **What is the process for opening a deferral account?**

   As indicated in the Procedural Order issued by the Board on October 5, 2004, all LDCs have the authority to automatically establish a deferral account without seeking approval of the Board to be used in tracking expenditure related to CDM. The Board has amended the Accounting Procedures Handbook and the Uniform System of Accounts to allow for the automatic approval of the deferral account. The Board's letter of October 29, 2004 details the accounting treatment of the deferral account.

6. **How is the $25,000 development expense to be used?**

   Further to the Procedural Order of October 5, 2004, the Board indicated that it was prepared to allow development expenses up to $25,000 as part of the 3rd tranche for research of technologies or programs that could be employed for CDM. The Board also indicated that the funds would be counted against the 3rd tranche irrespective of whether any programs were undertaken. The intent of pre-approval of the development expense is to initiate CDM Plan development without the risk of not recovering the allocated resources.

7. **Is the development expense the upper limit to spending on research of technologies and programs for CDM?**

   No, the development expense relates to the costs associated with development of a CDM Plan and does not restrict initiatives within the plan.

8. **What is the evidence the applicant must submit for approval of the CDM Plan?**

   As indicated in the Procedural Order of October 5, 2004, the criteria for approval of a CDM Plan are:

   1. a description of the proposed programs identifying the affected customer classes and the specific details of each program;
   2. the total program budget including the total amount and schedule of the annual expenses for the 2004-2007 time period; and
   3. the anticipated program benefits, including quantifiable benefits where these can be identified (i.e.: energy savings (kW or kWh)). Where the program has anticipated qualitative benefits (such as enabling technologies or customer education), these expected qualitative benefits must be described.

9. **What types of programs are eligible for CDM Plan approval by the OEB?**

   Further to the Minister of Energy's letter to LDCs on May 31, 2004 initiatives which fall endure the following categories are eligible:

F.3 Frequently Asked Questions (continued)

- energy efficiency;
- behavioural and operational changes, including application of benchmarking or "smart" control systems;
- Load management measures which facilitate interruptible and dispatchable loads, dual fuel applications, thermal storage, and demand response;
- Measures to encourage fuel switching which reduces the total system energy for a given end-use;
- Programs and initiatives targeted to low income and other hard to reach consumers; and
- Distributed energy options behind a customer's meter such as tri-generation, co-generation, ground source heat pumps, solar wind, and biomass systems.

10. If a utility elected an ROE less than 9.88%, but would like approval of program funding in excess of their 3rd tranche, what other approvals are needed?

An LDC that desires a CDM Plan budget that is in excess of the previously determined 3rd tranche must file an application to the Board for approval of a CDM. The application to the Board must include authorization of the Minister for approval of spending equivalent to the 3rd tranche at the full 9.88% ROE. The application must also include an explanation of the calculated amount of the 3rd tranche had the LDC elected the maximum allowable ROE (9.88%).

To determine the calculated amount of the 3rd tranche, the LDCs should consult the procedure set out in Sheet 7 of the Rate Unbundling Design (RUD) Model in 2001, which defines the concept of incremental MARR. The maximum CDM budget would be:

CDM Budget = 1/3 x (MARR),

where:

MARR = RATE BASE x [(CER x ROE)] + [(1-CER) x DEBT RATE)],

Rate Base is fully explained on Pages 3-5 to 3-8 of the Rate Handbook

CER is the Common Equity Ratio (inputted decimal places),

ROE is the Return on Equity (usually 9.88% and inputted as 0.0988), and,

Debt Rate is the debt/equity split. For utilities with rate bases less than $100 million the debt equity split was deemed to be 50/50 (inputted as 0.5).

F.3 Frequently Asked Questions (continued)

11. Does the OEB support LDCs making group applications for approval of the CDM Plan?

Yes, it is clear that a group application can eliminate much of the duplication and effort in CDM Plan development and research. A group application must clearly indicate the programs, budgets and spending schedules by individual LDC as an appendix.

12. Does a distributor have to conduct a total resource cost (TRC) test to submit a CDM initiative to the OEB, for the purposes of the 3rd tranche?

No. The Procedural Order of October 5, 2004 contains the complete instructions for obtaining prior approval of the CDM Plan. A TRC test may assist utilities in developing cost effective programs. The TRC test is useful where all of the costs and energy savings impacts are available.

13. What is the schedule for investment and cost recovery associated with CDM?

LDCs can seek to recover costs associated with CDM investments dating back to July 1, 2004. Investments in CDM under this program are expected to be completed by September 30, 2007. LDCs that have or expect to incur costs associated with CDM initiatives outside of this schedule are invited to make applications to the Board for approval on a case-by-case basis.

14. Will investments made in distribution assets be included in calculating rate base in future years?

Yes, distribution assets acquired under the CDM program may form part of the rate base calculation in future years. The first opportunity LDCs will have to apply these assets to rate base will be for the purposes of setting of 2006 rates.

15. How will LDCs determine resource savings?

As per the Procedural Order of October 5, 2004, a calculation of benefits should be accurate to the extent possible, whether qualitative or quantitative in nature.

16. What happens after the CDM Funds are exhausted?

Once the equivalent of the 3rd tranche is fully invested in CDM initiatives the LDC would no longer have the ability to make further investments under this program. As a completely separate process, the 2006 Electricity Distribution Rate Process is establishing a long-term approach to CDM programs.

17. Must the LDC continue to make investments in CDM beyond 2005 to keep the 3rd tranche in rates?

F.3 Frequently Asked Questions (continued)

No, in order for the LDC to get the 3rd tranche in rates, the LDC must make a commitment to invest an amount equivalent to one year's incremental revenue in CDM initiatives over a three-year period until Sep 2007. The current Board review relates to the CDM plans required to fulfill the commitment related to the 3rd tranche, however it is expected that utilities will be further developing their CDM activities and that the rate treatment of these activities will be considered in future rates applications.

18. Are smart meters eligible?

Smart meters and the associated information systems are technologies that enable conservation and demand management. A component of a LDCs CDM plan may include smart meters. LDCs should take note of the Smart Meter Initiative (RP-2004-0196). More information on the Smart Meter Initiative can be found at http://www.oeb.gov.on.ca/html/en/industryrelations/ongoingprojects_smartmeters.htm

19. Can a distributor hire staff with funds made available through the CDM Plan to administer CDM initiatives?

Yes, LDCs can use these funds to cover overhead costs associated with developing and implementing CDM initiatives.

20. Who authorises CDM Plans and spending?

The OEB reviews CDM Plans and the associated budgets. The LDC will be responsible to ensure that spending is done in accordance with the plan.

21. What spreadsheets and input data will be provided by the Board to enable LDC's to supply the Board with the information they require.

The Board will not be providing spreadsheets or input data in support of CDM applications.

22. Will the Board provide a standard template document for CDM plan submissions?

The Board will not provide a standard template for CDM plan submissions, as a template would likely constrain potential plans. Many LDCs are discussing innovative approaches to group submissions.

23. What happens if the actual program benefits of the 3rd tranche initiatives are less than what was originally projected? Will some portion of the program costs be disallowed on this basis?

F.3 Frequently Asked Questions (continued)

Given the pilot nature of initiatives begun with 3rd tranche funding, the Board recognizes that specific targets may not be met.

24. To what extent can the CDM funds be applied to distribution system enhancements?

Distribution system enhancements are among a variety of initiatives that can be looked at to achieve conservation benefits. LDCs are encouraged to strike a balance between customer and utility focused CDM initiatives.

25. Given that LDCs will generate increased revenue associated with the 3rd tranche, how will the increase in PILs be dealt with?

The rate increase for 2005 will include a PILs provision.

26. Is the 3rd tranche encumbered or is the LDC making a commitment to spend an amount equivalent to the 3rd tranche?

Under this program, in order for the LDC to receive the 3rd tranche in rates, the LDC must commit to spend an equivalent amount on CDM initiatives over a 3 year period ending on September 30, 2007. Therefore the 3rd tranche is not encumbered and can be recognized as income, when received. Accounting under GAAP is different than the reporting and record keeping requirements (RRR) filings requested by the Board.

27. How would a utility budget for operating/maintenance and administration costs associated with CDM?

In designing the CDM budget, costs allocated to the CDM Plan must be identified as being incremental to the existing OM&A budget.

28. From a reporting perspective, how would the utility track OM&A costs associated with CDM?

For RRR purposes, a utility should track costs in a manner similar to the recording of regulatory assets. Account 1565 has been established for this purpose and instructions on how to used this account are covered in the Board's letter to all LDCs on October 29, 2004.

F.3 Frequently Asked Questions (continued)

29. Can the LDC use CDM funds to provide low or zero interest loans to third parties wishing to undertake CDM initiatives?

It is up to the LDC to decide how to use CDM funds for CDM initiatives. If the LDC provides a loan to a third party, the amount of the loan would not be considered part of CDM spending as the funds would be repaid to the LDC at a later date. An LDC might want to consider other options including paying the interest on behalf of a third party.

12.1.2004

Appendix G

Program *Cost of Saved Energy* Analyses

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