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Report for

Ontario Energy Board

Third Generation Incentive Regulation Stretch Factor Updates for 2010 (EB-2009-0392)

February 17, 2010

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PSE

About Power System Engineering, Inc.

Founded in 1974, PSE is a full-service consulting firm serving the utility industry with offices in Wisconsin, Indiana, Minnesota, Ohio, and South Dakota. PSE's benchmarking experience includes research for regulatory purposes and utility management improvement applications. In addition to our statistical cost research, PSE has expertise in the areas of demand response, energy efficiency, T&D reliability benchmarking, merger valuations, load forecasting, T&D system planning and design, resource planning, communication technologies, smart grid integration, rate design, alternative regulation, and cost of service studies.

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Executive Summary

This report presents the methodologies and results of a benchmarking study that identifies the 2010 rate year efficiency cohort groupings intended to be used as an update to the Third Generation Incentive Regulation stretch factors for Ontario's power distribution industry. In November 2009, the Ontario Energy Board ("OEB") acquired the professional services of Power System Engineering, Inc. ("PSE") to provide benchmarking evaluations of Ontario power distributors' operations, maintenance and administrative ("OM&A") spending levels using 2002-2008 data previously supplied to the OEB by each company. The study results divide the Ontario industry into three efficiency cohorts. These cohort groupings are based on econometric and unit cost index benchmarking results.

The methodologies employed in this report are founded on methods developed in previous consultations on the topic. The benchmarking approaches developed by Pacific Economics Group put forth in a report to the Ontario Energy Board, dated March 20, 2008 Benchmarking the Costs of Ontario Power Distributors ("Original Report"), are strictly followed.[1] Similarly, the previously established method of determining efficiency cohort groupings based on comparative cost analysis is adhered to. This method is described in the July 14, 2008 Report of the Board on 3rd Generation Incentive Regulation for Ontario's Electricity Distributors, pp. 21-23.[2]

On December 4, 2008 a document detailing the 2009 rate year efficiency cohorts was released ("2009 Update").[3] This document updated the Original Report by adding 2007 data into the benchmarking analysis. It followed the same methodologies described in the Original Report.[4]

This report details the integration of 2008 data into the benchmarking analysis. The 2010 efficiency cohort groups are summarized below. There are 11 members in cohort group one, 62

[1] http://www.oeb.gov.on.ca/documents/cases/EB-2006-0268/PEG_Final_Benchmarking_Report_20080320.pdf
[2] http://www.oeb.gov.on.ca/OEB/_Documents/EB-2007-0673/Report_of_the_Board_3rd_Generation_20080715.pdf
[3] http://www.oeb.gov.on.ca/OEB/_Documents/EB-2007-0673/PEG_Updates_20081203.pdf
[4] The 2009 Update also provided sensitivity analyses which are not incorporated in this research. The updated cohort groupings found in this report are based on the baseline methodology established in the Original Report and replicated in the 2009 Update.

members in cohort group two, and 9 members in cohort group three. Table 8, found in Section 3, displays the full list of companies with their corresponding cohort grouping.

Cohort Group 1

- Hydro Hawkesbury
- Chatham-Kent Hydro
- Northern Ontario Wires
- Cambridge and North Dumfries Hydro
- Grimsby Power
- Hydro 2000
- Hydro One Brampton Networks
- Kitchner-Wilmot Hydro
- Festival Hydro
- Barrie Hydro Distribution
- Renfrew Hydro

Cohort Group 2

- All LDCs not in Group 1 or 3

Cohort Group 3

- Greater Sudbury
- Centre Wellington Hydro
- Whitby Hydro
- ENWIN Powerlines
- West Coast Huron Energy
- Chapleau Public Utilities
- Erie Thames Powerlines
- Great Lakes Power
- Port Colborne (CNP)

The remainder of this report offers the benchmarking methodologies, results, and the research process engaged in by PSE. Following the Introduction, Section Two offers a summary of the benchmarking approaches used in designating efficiency cohort groupings. Section Two also reveals the results for each benchmarking technique. Section Three combines the two benchmarking results into three efficiency cohort groupings. Section Four discusses the replication and update process engaged in by PSE.

1 Introduction

This report presents the methodologies and results of a benchmarking study that identifies the 2010 rate year efficiency cohort groupings intended to be used as an update to the Third Generation Incentive Regulation stretch factors for Ontario's power distribution industry. In November 2009, the Ontario Energy Board acquired the professional services of Power System Engineering, Inc. to provide benchmarking evaluations of Ontario power distributors' operations, maintenance, and administrative spending levels using 2002-2008 data previously supplied to the OEB by each company. The study results divide the Ontario industry into three efficiency cohorts which are based on both econometric and unit cost index benchmarking methods.

As a product of this study, each company will be assigned a productivity stretch factor for the 2010 rate year commensurate with their efficiency cohort group. The assigned stretch factor will be the same for all firms in a given cohort but will differ between cohorts. A full list of cohort groupings can be found in Section 3, Table 8 of this report.

Great care was taken to be consistent with previous benchmarking studies, therefore identical benchmarking methods and model specifications are employed in the 2010 update relative to those described in the Original Report and 2009 Update produced by Pacific Economics Group. The 2010 updated study results are the sole product of incorporating new data into a pre-established benchmarking paradigm. The benchmarking methods applied in this study are summarized in Section 2 of this report. Interested parties are encouraged to review the Original Report for a fuller description of these techniques.

In order to guarantee consistency, PSE engaged in a verification process to assure identical benchmarking methods relative to those previously employed. The verification process was lead by Mr. Steven A. Fenrick and assisted by the involvement of Dr. Donald J. Wyhowski, Mr. Duane T. Kexel, and Mr. Erik S. Sonju.

Mr. Fenrick co-authored the Original Report and also assisted with the 2009 Update.[5] Mr. Fenrick wrote the original OEB database management code using the software package SST,[6]

[5] Mr. Fenrick was employed by Pacific Economics Group during the time these reports were produced.
[6] Statistical Software Tools (SST) by J.A. Dubin and R.D. Rivers.

calculated unit cost index benchmarking results, worked with other co-authors in the development of the econometric models, and assisted in the writing of the final report.

Dr. Wyhowski did not have any direct involvement in the Original Report or 2009 Update, however, he has over two decades of experience in econometric modeling. The econometric benchmarking code, that uses the GAUSS software package[7], comes from the Original Report and 2009 Update, which were modified versions of benchmarking code originally written by Dr. Wyhowski during his tenure at Pacific Economics Group.

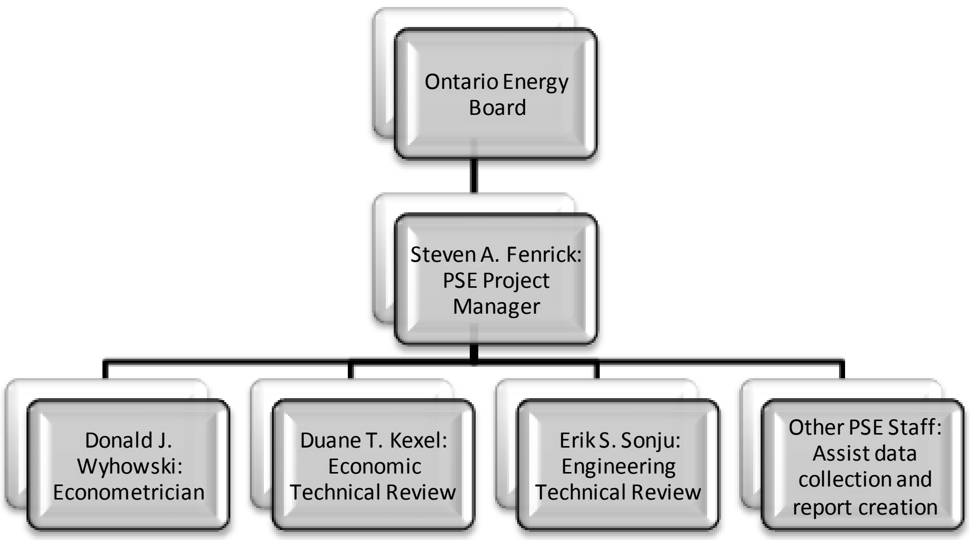
Mr. Kexel and Mr. Sonju provided technical assistance and comments on this report. Mr. Kexel is an economist with over 35 years of consulting experience. Mr. Sonju is a licensed Professional Engineer who leads the distribution System Planning and Line Design service offerings at Power System Engineering.

PSE staff has extensive experience in utility benchmarking. Mr. Fenrick leads PSE's regulatory and internal management improvement benchmarking practice. PSE's performance evaluation studies have included examinations of electric reliability, O&M costs, total costs, and more detailed expenses.[8] These studies have been sponsored by utilities, regulatory commissions, and consumer advocates.

[7] GAUSS version 8.0 from Aptech Systems, Inc.

[8] With LDC trial balance data no longer being confidential, utility management will be able to better leverage this detailed data to derive least-cost strategies to increase utility cost performance.

The 2010 update team and their roles are detailed in the chart below.



In developing this report, PSE embarked on a two step process.

Step 1: Replicate 2009 rate year benchmarking results

Step 2: Update 2010 rate year benchmarking results based on new 2008 data

First, PSE replicated the benchmarking results found in the 2009 Update. This step was intended to provide assurance that the methods and processes employed in the study are identical to those developed in the Original Report. After this replication effort, the update team incorporated new 2008 data to produce the 2010 rate year benchmarking results and efficiency cohort groupings.[9]

As previously indicated, both econometric and unit cost index benchmarking methods were applied. The econometric method uses regression analysis to fashion expected, or benchmark, costs after accounting for the external circumstances of each distributor. Performance is then measured by calculating the ratio of actual cost to benchmark costs. Statistical significance is measured to determine statistically superior and inferior cost performers.

[9] Two other changes were performed due to requests made by certain utilities. ENWIN Powerlines 2007 OM&A data was erroneously reported in their initial filing with the OEB and subsequently revised. This revision is now reflected in this update. After further investigation, Renfrew Hydro is reclassified as being off the Canadian Shield as opposed to on it.

The unit cost indexing method separates the Ontario industry into twelve peer groups based on characteristics found to be significant cost drivers in the econometric research. A unit cost metric is then calculated for each distributor by dividing OM&A cost by a comprehensive output index. The unit cost for each distributor is compared to the mean of their respective peer group to determine the OM&A cost performance of each company. Sorted on this ratio, top and bottom quartile cost performers are identified.

Cohort groupings are directly determined by the two benchmarking results. To be in efficiency cohort group one, the company is required to attain an evaluation of statistical superiority in the econometric benchmarking and in the top quartile of the unit cost indexing. Efficiency cohort group three members are determined by those utilities that are deemed statistically inferior by the econometric approach and are in the bottom quartile of the indexing results. All remaining utilities are placed in cohort group two.

2 Research Methodologies

This Section provides an overview of performance benchmarking, the data sample, definition of OM&A cost, and descriptions of econometric and unit cost benchmarking method, procedures, and results.

2.1 Overview of Benchmarking

Benchmarking allows regulators to objectively compare performance across utilities and jurisdictions. Regulators can use benchmarking when regulating electric reliability, determining appropriate cost or salary levels, evaluating energy efficiency attainment and goals, and in the escalation provisions of multi-year rate or revenue caps. Utility managers can use benchmarking to determine overall performance within the industry, pinpoint areas where cost effective improvements can be made, set challenging yet achievable goals, evaluate strategic options, assist in the development of business cases for specific technologies, and identify best practices.

Performance cost benchmarking enables a comparison to be constructed relating a utility's actual costs to a customized expectation of those costs. Relatively good cost performers will have actual costs below the expected amounts, whereas poor performers will have actual costs above the expected amounts.

$$Performance = \frac{Costs^{Actual}}{Costs^{Expected}} \qquad [1]$$

Equation 1 shows performance to be a function of two terms. Actual costs are reported directly from the utility, whereas expected costs must be estimated. The research challenge is to calculate expected costs in a fair and accurate way, accounting for the specific advantages and disadvantages inherent in the operating circumstances of each utility. This last point is crucial. For benchmarking to accurately evaluate cost management performance, the relevant external operating conditions encountered by each utility must be adjusted for the differences amongst sample members. For econometric benchmarking, these differences are adjusted for through the use of regression analysis. In regards to unit cost indexing, external operating conditions are controlled for through the stratification of utilities into separate peer groups.

2.2 Ontario Data Sample

For the 2010 update the sample includes 82 utilities which are listed in Table 1 of this Section. This number contrasts with the Original Report which consisted of 86 utilities. The reduction in number is due to subsequent amalgamations between industry members. In such cases, data for the individual companies have been combined to form one successor firm. The individual merged companies cease to be included in the benchmarking analysis.

The sample period for the 2010 update is 2002-2008. This is a seven year period allowing a large sample to be developed to increase the precision of the parameter estimates of the econometric model.

Table 1: List of Ontario Power Distributors Included in this Report

List of Ontario Power Distributors

Atikokan Hydro
Barrie Hydro Distribution
Bluewater Power Distribution
Brant County Power
Brantford Power
Burlington Hydro
Cambridge and North Dumfries Hydro
Centre Wellington Hydro
Chapleau Public Utilities
Chatham-Kent Hydro
Clinton Power
COLLUS Power
Cooperative Hydro Embrun
Dutton Hydro
E.L.K. Energy
Eastern Ontario Power (CNP)
Enersource Hydro Mississauga
ENWIN Powerlines
Erie Thames Powerlines
Espanola Regional Hydro Distribution
Essex Powerlines
Festival Hydro
Fort Erie (CNP)
Fort Frances Power
Grand Valley Energy
Great Lakes Power
Greater Sudbury
Grimsby Power
Guelph Hydro Electric
Haldimand County Hydro
Halton Hills Hydro
Hearst Power Distribution
Horizon Utilities
Hydro 2000
Hydro Hawkesbury
Hydro One Brampton Networks
Hydro One Networks
Hydro Ottawa
Innisfil Hydro Distribution
Kenora Hydro Electric
Kingston Electricity Distribution
Kitchener-Wilmot Hydro
Lakefront Utilities
Lakeland Power Distribution
London Hydro
Middlesex Power Distribution
Midland Power
Milton Hydro Distribution
Newbury Power
Newmarket-Tay Hydro Electric
Niagara Peninsula Energy
Niagara-on-the-Lake Hydro
Norfolk Power
North Bay Hydro Distribution
Northern Ontario Wires
Oakville Hydro Electricity
Orangeville Hydro
Orilla Power Distribution
Oshawa PUC
Ottawa River Power
Parry Sound Power
Peterborough Distribution
Port Colborne (CNP)
Powerstream
PUC Distribution
Renfrew Hydro
Rideau St. Lawrence Distribution
Sioux Lookout Hydro
St. Thomas Energy
Thunder Bay Hydro
Tillsonburg Hydro
Toronto Hydro
Veridian Connections
Wasaga Distribution
Waterloo North Hydro
Welland Hydro-Electric System
Wellington North Power
West Coast Huron Energy
West Perth Power
Westario Power
Whitby Hydro
Woodstock Hydro

2.3 Definition of Cost

The costs examined in this report are defined as total distribution OM&A expenses. The data was provided to PSE by the Ontario Energy Board. The data source was built from data submitted by each utility via the OEB Reporting and Record-keeping Requirements (RRR).[10]

2.4 Econometric Benchmarking Methods and Results

This section begins with a brief overview, in general terms, of the econometric benchmarking approach. It is followed by information specific to the benchmarking results found in this report.

2.4.1 Econometric Benchmarking 101

The econometric approach to benchmarking allows the researcher to fashion an appropriate target (or benchmark) for an examined metric. Econometric benchmarking calculates a prediction of cost customized for the specific operating conditions encountered by each utility. This model prediction is interpreted as the expected costs of a utility with identical characteristics and "average" relative performance. The established benchmark can be compared to a company's actual costs to determine performance, as shown in Equation 2 below.

$$Performance = \frac{OM \ \& \ A \ Cost^{Actual}}{OM \ \& \ A \ Cost^{\text{Model Prediction}}} \qquad [2]$$

The model prediction of the cost level is attained by choosing a functional form, based on theory, and using regression analysis to estimate the parameters embedded within this functional form. This approach not only allows for simultaneous consideration of multiple cost drivers, but also permits statistical testing of these variables and estimates their respective impact on cost. A simplified illustrative functional form is offered below.

$$Expected\ Cost = a + b * No.of\ Customers + c * Percent\ undergrounding \qquad [3]$$

If the researcher postulates that OM&A costs are only linearly influenced by the number of customers and the percent of lines underground, Equation 3 would be the functional form. The

[10] http://www.oeb.gov.on.ca/OEB/Industry/Media+Room/Publications/RRR+Reports/Yearbook+of+Distributors

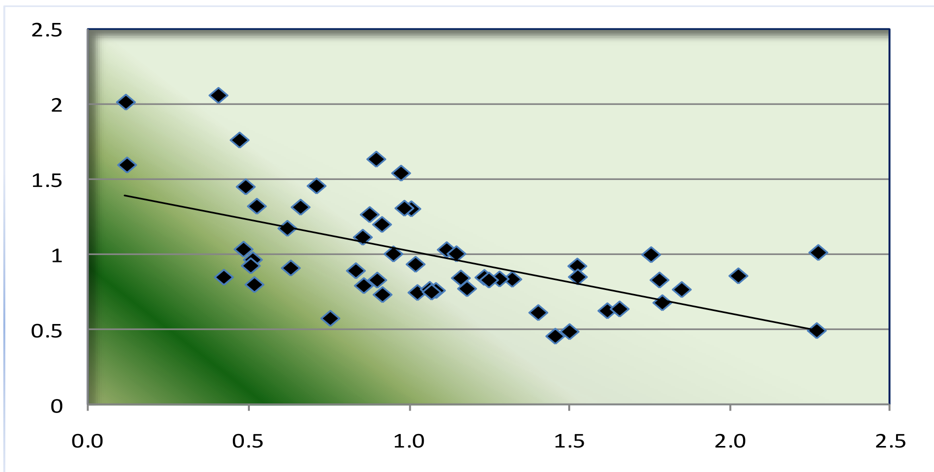
coefficient "*a*" is the intercept term; its interpretation is that it costs money to be in business even if output is zero. The coefficient "*b*" signifies the marginal cost of adding a customer, and the coefficient "*c*" shows the marginal cost of increasing the proportion of undergrounding.

The researcher would then collect a data sample and use regression analysis to estimate these parameter values. The signs of the estimates would need to conform to theory and hypothesis testing would be conducted to assure the researcher that these variables are indeed statistically significant cost drivers. The values of *a*, *b*, and *c* serve as "weights" to determine the magnitude of the impact of each variable on expected cost.

Equation 3, although simplified, shows the advantage of the econometric benchmarking approach because it permits the simultaneous consideration of multiple variables. The researcher can test the significance of hypothetical cost drivers and incorporate them into the analysis. The econometric approach can also be used to better inform peer group selection.

The graph below is an illustrative example of the impact of undergrounding on O&M cost.[11] The x-axis is a measure of the amount of undergrounding; the y-axis is cost per customer. This figure reveals the relationship between undergrounding and distribution O&M expenses. As undergrounding increases, cost per customer tends to decline. The econometric method is able to capture this tendency and incorporate it in the expected cost value of each company.

O&M Cost Impacts of Underground Lines



[11] This graph is based on undergrounding and operation and maintenance expenses of U.S. investor-owned power distributors.

Estimation is enhanced by taking the natural log of each variable. This transforms the parameter estimates from marginal cost to cost elasticity estimates. Cost elasticity measures the *percentage* change in cost relative to a *percentage* change in the cost driver. For example, with this transformation, the interpretation of b in Equation 3 is: if customers increase by 10 percent then cost is predicted to increase by b times 10 percent. If b equals 0.5, then a 10 percent increase in customers is estimated to increase cost by 5 percent.

Econometric benchmarking is further advanced by the inclusion of additional relevant variables. Each explanatory variable allows for an explicit adjustment of the differing circumstances found within the sampled utilities regarding the incorporated variable.

After the candidate variables are chosen, industry data is collected. The econometric approach enables a large sample since utilities with vastly differing operating conditions can be integrated into the analysis. Contrary to the peer group approach, since the econometric method adjusts for numerous conditions, a sample with varied operating conditions actually enhances the evaluation. For example, Hydro One Networks in Ontario lacks a suitable comparison group needed to perform benchmarking using the unit cost indexing method. It can, however, be included in the econometric benchmarking because of the ability of this approach to accommodate dissimilar utilities within the analysis.

2.4.2 Methods Used in this Report

The methods which originated in the Original Report are reiterated in this section in a compressed format.[12] Items such as the functional form of the OM&A econometric model, included variables, estimation procedures, and 2010 rate year parameter estimates are discussed.

2.4.2.1 Functional Form

The functional form used in this report is identical to that used in the Original Report and the 2009 Update. It is a "quadratic" functional form, which has the following general formula:

[12] The reader is again urged to examine the Original Report prepared by Pacific Economics Group for a more in-depth discussion of these items.

$$
\begin{aligned}
ln\,C &= \alpha_o + \sum_i \alpha_i lnY_i + \sum_j \alpha_j lnW_j + \sum_\ell \alpha_\ell lnZ_\ell + \alpha_t T \\
&+ \frac{1}{2}\left[\sum_i \gamma_i lnY_i lnY_i + \sum_j \gamma_j lnW_j lnW_j \right] \\
&+ \varepsilon.
\end{aligned} \qquad [4]
$$

Here, Y_i denotes one of several variables that quantify output and W_j denotes the input price. The *Z*-variables denote the additional business conditions, *T* is a trend variable, and ε denotes the error term. Also, $\alpha's$ and $\gamma's$ represent the econometric parameter estimates. These are elasticity estimates of the impact of each variable on OM&A costs.

2.4.2.2 Included Variables

There are seven explanatory variables included in the OM&A econometric model. These variables can be separated into three categories. The first is an output category which quantifies the amount of output put forth by each distributor. Explanatory variables in the output category are: the number of customers, total volumes (kilowatt hours), and total kilometers of line.

The second category is an input price which is an external measure of the composite market price of procuring inputs. The final category of explanatory variables is the business condition category, also known as Z-variables. This category includes such variables as the percent of distribution lines underground, ten year customer growth divided by an output index[13], and a binary variable of whether most or all of the service territory of the utility is on the Canadian Shield.

The latest year of available values of the included variables for each utility are presented in Table 2 below. This table reveals the actual reported data by each company regarding the latest available year.

[13] Customer information derived from the prior regulator was assembled to calculate ten year customer growth numbers which allowed the construction of this variable.

Table 2: Size and Scope of Included Variables[14]

Size and Scope of Variables Used in Econometric Research by LDC

LDC	OM&A Cost	Customers	Total Volume	Kilometers of Line	Input Price Index	Percent Lines Underground	Canadian Shield	Customer Growth/Output Index
Atikokan Hydro	845,024	1,676	26,563,028	92	1.035	0.01	1.00	-1,801
Barrie Hydro Distribution	10,740,639	69,628	1,528,931,456	1,482	1.097	0.55	0.00	4,925
Bluewater Power Distribution	9,319,532	36,218	1,092,208,896	747	1.079	0.23	0.00	947
Brant County Power	3,334,000	9,456	282,717,120	320	1.043	0.12	0.00	2,191
Brantford Power	7,783,208	37,473	981,223,872	486	1.043	0.45	0.00	2,278
Burlington Hydro	13,485,638	62,737	1,650,537,856	1,643	1.111	0.39	0.00	3,110
Cambridge and North Dumfries Hydro	9,080,481	49,297	1,519,170,816	1,112	1.093	0.34	0.00	2,644
Centre Wellington Hydro	1,604,894	6,309	154,672,352	146	1.071	0.47	0.00	3,340
Chapleau Public Utilities	600,210	1,335	28,582,032	27	1.042	0.04	1.00	-2,023
Chatham-Kent Hydro	5,671,401	32,094	818,165,760	795	1.053	0.28	0.00	388
Clinton Power	545,155	1,639	30,952,476	21	1.035	0.19	0.00	339
COLLUS Power	3,521,232	14,387	322,535,808	327	1.017	0.35	0.00	2,605
Cooperative Hydro Embrun	404,633	1,936	29,483,564	27	1.132	0.44	0.00	6,832
Dutton Hydro	139,787	600	7,491,836	7	1.017	0.14	0.00	2,816
E.L.K. Energy	2,205,478	10,853	251,163,120	147	1.153	0.39	0.00	2,234
Eastern Ontario Power (CNP)	1,112,063	3,543	62,983,632	177	1.017	0.05	0.00	266
Enersource Hydro Mississauga	45,590,804	186,929	7,821,062,656	5,246	1.138	0.65	0.00	2,492
ENWIN Powerlines	22,561,212	84,644	2,735,456,512	1,133	1.153	0.36	0.00	1,262
Erie Thames Powerlines	4,875,977	14,312	397,240,736	265	1.057	0.21	0.00	1,511
Espanola Regional Hydro Distribution	1,025,522	3,349	63,594,844	137	1.042	0.08	1.00	696
Essex Powerlines	5,510,399	27,929	546,871,552	467	1.153	0.51	0.00	2,593
Festival Hydro	3,662,822	19,394	593,387,456	274	1.044	0.33	0.00	1,602
Fort Erie (CNP)	4,560,381	15,616	287,832,992	524	1.036	0.08	0.00	597
Fort Frances Power	1,277,449	4,001	84,002,096	84	1.035	0.10	1.00	1,142
Grand Valley Energy	212,833	681	9,082,809	9	1.117	0.11	0.00	1,165
Great Lakes Power	8,655,085	11,587	179,203,328	1,845	1.004	0.00	1.00	273
Greater Sudbury	10,819,570	46,215	966,827,008	871	1.042	0.20	1.00	21
Grimsby Power	1,773,242	9,937	172,845,120	238	1.111	0.25	0.00	3,570
Guelph Hydro Electric	10,110,726	48,914	1,584,099,968	1,049	1.071	0.59	0.00	3,423
Haldimand County Hydro	7,119,039	20,815	413,377,440	1,716	1.043	0.05	0.00	785
Halton Hills Hydro	5,231,919	20,818	500,675,936	1,363	1.124	0.35	0.00	2,729
Hearst Power Distribution	695,798	2,763	84,590,448	68	1.042	0.16	1.00	172
Horizon Utilities	41,152,528	233,947	5,999,400,960	3,294	1.111	0.54	0.00	1,322
Hydro 2000	244,203	1,177	26,306,508	21	0.995	0.14	0.00	1,274
Hydro Hawkesbury	823,628	5,375	185,032,768	65	0.995	0.14	0.00	1,713
Hydro One Brampton Networks	18,913,216	129,585	3,791,763,456	2,744	1.138	0.71	0.00	5,897
Hydro One Networks	475,498,112	1,187,253	24,181,000,192	120,516	1.102	0.04	1.00	1,045
Hydro Ottawa	54,170,844	291,639	7,561,763,328	5,353	1.132	0.49	0.00	2,735
Innisfil Hydro Distribution	3,535,778	14,471	226,442,144	647	1.097	0.19	0.00	2,361
Kenora Hydro Electric	1,565,665	5,583	110,421,192	98	1.069	0.10	1.00	-227
Kingston Electricity Distribution	5,379,723	26,940	712,456,128	386	1.017	0.35	0.00	172

[14] Values reflect the latest year of available data for each LDC. For most companies this is year 2008 data.

Continued

Size and Scope of Variables Used in Econometric Research by LDC

LDC	OM&A Cost	Customers	Total Volume	Kilometers of Line	Input Price Index	Percent Lines Underground	Canadian Shield	Customer Growth/Output Index
Kitchener-Wilmot Hydro	13,009,348	84,195	1,877,476,992	1,872	1.093	0.44	0.00	2,892
Lakefront Utilities	1,927,512	9,215	282,245,920	114	1.046	0.17	0.00	2,164
Lakeland Power Distribution	2,676,016	9,295	219,438,640	355	1.050	0.20	1.00	1,116
London Hydro	26,643,136	143,797	3,333,873,408	2,781	1.057	0.51	0.00	2,241
Middlesex Power Distribution	1,418,198	7,026	191,155,216	106	1.053	0.24	0.00	1,842
Midland Power	1,781,207	6,773	215,492,784	115	1.008	0.31	0.00	1,865
Milton Hydro Distribution	5,184,084	25,373	689,929,280	866	1.111	0.37	0.00	7,106
Newbury Power	59,531	199	4,251,408	4	1.035	0.25	0.00	1,194
Newmarket-Tay Hydro Electric	6,621,476	31,874	735,465,664	1,050	1.117	0.44	0.00	2,839
Niagara Peninsula Energy	13,023,884	50,255	1,223,657,088	1,820	1.036	0.24	0.00	3,119
Niagara-on-the-Lake Hydro	1,755,417	7,798	174,363,680	337	1.036	0.27	0.00	2,665
Norfolk Power	5,313,448	18,806	374,499,680	691	1.043	0.12	0.00	3,042
North Bay Hydro Distribution	5,292,130	23,669	567,021,568	612	1.006	0.16	1.00	398
Northern Ontario Wires	1,946,382	6,055	122,730,088	370	1.062	0.01	1.00	-865
Oakville Hydro Electricity	10,476,294	62,038	1,572,154,624	1,414	1.124	0.61	0.00	4,356
Orangeville Hydro	2,179,609	10,200	240,633,232	161	1.117	0.41	0.00	3,335
Orilla Power Distribution	3,843,839	12,797	319,007,968	304	1.097	0.19	0.00	1,286
Oshawa PUC	9,111,936	51,813	1,116,913,280	948	1.138	0.46	0.00	2,244
Ottawa River Power	2,366,857	10,381	196,409,504	146	0.967	0.13	1.00	1,084
Parry Sound Power	1,171,645	3,356	88,199,456	128	1.069	0.09	1.00	661
Peterborough Distribution	7,141,506	34,349	819,538,752	550	1.013	0.30	0.00	1,351
Port Colborne (CNP)	3,785,033	9,229	192,894,432	311	1.036	0.05	0.00	417
Powerstream	47,616,464	244,573	6,828,655,104	6,109	1.138	0.68	0.00	4,771
PUC Distribution	7,271,868	32,734	710,698,624	728	1.004	0.16	1.00	345
Renfrew Hydro	1,046,327	4,194	101,925,472	55	0.967	0.04	0.00	633
Rideau St. Lawrence Distribution	1,505,360	5,859	111,785,104	88	1.038	0.10	0.00	246
Sioux Lookout Hydro	1,143,778	2,734	77,324,320	211	1.035	0.03	1.00	36
St. Thomas Energy	3,274,890	16,133	343,399,648	244	1.057	0.35	0.00	2,751
Thunder Bay Hydro	11,721,791	49,361	1,006,260,736	1,172	1.035	0.20	1.00	389
Tillsonburg Hydro	1,631,765	6,622	208,969,856	156	1.073	0.35	0.00	1,656
Toronto Hydro	179,729,296	684,145	25,139,058,688	9,816	1.138	0.57	0.00	618
Veridian Connections	19,971,080	110,861	2,501,313,792	2,135	1.141	0.35	0.00	2,924
Wasaga Distribution	1,920,444	11,660	116,309,552	232	1.097	0.46	0.00	6,492
Waterloo North Hydro	9,270,146	50,478	1,369,710,336	1,542	1.093	0.31	0.00	2,924
Welland Hydro-Electric System	4,578,177	21,706	467,724,992	443	1.036	0.26	0.00	937
Wellington North Power	1,199,547	3,535	93,707,616	75	1.041	0.12	0.00	1,259
West Coast Huron Energy	1,291,065	3,878	154,353,216	65	1.093	0.20	0.00	1,012
West Perth Power	600,908	2,007	58,793,540	36	1.044	0.31	0.00	1,270
Westario Power	5,055,293	21,592	472,219,424	440	0.991	0.30	0.00	1,372
Whitby Hydro	8,149,072	39,225	868,996,096	1,030	1.141	0.52	0.00	5,415
Woodstock Hydro	3,364,829	14,645	394,324,000	246	1.073	0.37	0.00	1,817

2.4.2.3 Estimation Procedures

Benchmarking performance results are calculated by taking three-year averages of the most recently available scores. For nearly all of the Ontario distributors this entails a 2006-2008 average.

The software package, GAUSS, used in the 2010 rate year update is the same econometric software package used in the Original Report and 2009 Update.[15] The use of GAUSS allows for custom estimation procedures to be developed, in the case of this research corrections for groupwise heteroskedasticity were developed. This allowed for more precision in coefficient estimates relative to an Ordinary Least Squares (OLS) regression.

2.4.2.4 2010 Rate Year Parameter Estimates

Parameter estimates are provided in Table 3. This table corresponds to Table 3 in the Original Report. All parameter estimates are signed according to theory and plausible in magnitude. Explanatory variables are statistically different from zero, at a 90% confidence level, except for the coefficient on the Canadian Shield variable which is statistically significant at an 87% confidence level.

The model quantifies the relationship between OM&A cost and the included variables. As expected, as outputs (customers, volumes, kilometer of line) increase so does predicted OM&A cost. Similarly, higher input prices result in higher expected OM&A costs, all else being equal. OM&A expenses tend to be higher the older a system is and if the system is on the Canadian Shield. Expenses tend to decrease as the percent of underground lines increases.

The adjusted R^2 statistic is also reported in Table 3. This is a measure of the explanatory power of the model relative to the overall variation in sampled OM&A costs. A value of 1.0 indicates that all variation in OM&A expenses amongst distributors is explained by the model, whereas a value of 0.0 indicates that none of the variation is explained. The R^2 value for the 2010 update is 0.984.

[15] PSE did use a newer version of GAUSS than was used in the previous work.

Table 3: Econometric Parameter Estimates

Econometric Model of OM&A Expenses

VARIABLE KEY

N= Number of Customers
V= Total Volumes
M= Total Kilometers of Line
W= Input Price Index
UN= Percent of Distribution Lines Underground
CG= 10 Year Customer Growth / Output Index
CS= Canadian Shield (binary)

EXPLANATORY VARIABLE	PARAMETER ESTIMATE	T-STATISTIC	EXPLANATORY VARIABLE	PARAMETER ESTIMATE	T-STATISTIC
N	0.456	14.17	**W**	0.505	5.29
NN	-0.146	-9.42	**WW**	-1.765	-2.06
V	0.376	12.42	**UN**	-0.106	-9.94
VV	0.127	10.01			
			CG	-0.092	-10.95
M	0.126	5.17			
MM	0.004	0.43	**CS**	0.009	1.52
MCS	0.004	1.75			
Constant	16.339	759.78			
Trend	0.021	6.61			

Other Results

Rbar-Squared	0.984
Sample Period	2002-2008
Number of Observations	560

2.4.3 Econometric Benchmarking Results

The OM&A performance evaluations are presented in Table 4. The ratio of the average actual OM&A costs of each company in the last three years to the model's benchmark cost projections over the same years is reported. A lower ratio of actual cost to predicted cost implies better performance. Distributors have been ranked according to this ratio.

P-value statistical tests were conducted for each utility to test the hypothesis of it being an average cost performer. If a distributor is a good cost performer with a p-value between 0 and 0.10, the hypothesis of average performance is rejected in favor of a statistically superior performer designation. Likewise, if a distributor is a poor cost performer with a p-value between 0 and 0.10, the hypothesis of average performance is rejected in favor of a statistically inferior performer designation. Sixteen companies fit into the statistically superior classification versus twelve distributors which are classified as statistically inferior.

Table 4: Econometric Benchmarking Results

Performance Rankings Based on Econometric Benchmarks

	Years Benchmarked	Actual/Predicted[1]	Deviation Percentage [A-1][1]	P-Value	Rank[1]
Hydro Hawkesbury	2006-2008	**0.623**	-0.377	0.000	1
Chatham-Kent Hydro	2006-2008	**0.699**	-0.301	0.001	2
Northern Ontario Wires	2006-2008	**0.720**	-0.280	0.002	3
Cambridge North Dumfries Hydro	2006-2008	**0.753**	-0.247	0.005	4
Grimsby Power	2006-2008	**0.767**	-0.233	0.008	5
Hydro 2000	2006-2008	**0.770**	-0.230	0.009	6
Hydro One Brampton Networks	2006-2008	**0.805**	-0.195	0.025	7
Oshawa PUC	2006-2008	**0.806**	-0.194	0.026	8
Kitchener-Wilmot Hydro	2006-2008	**0.814**	-0.186	0.032	9
Renfrew Hydro	2006-2008	**0.820**	-0.180	0.037	10
Barrie Hydro	2006-2008	**0.836**	-0.164	0.053	11
Waterloo North Hydro	2006-2008	**0.838**	-0.162	0.055	12
Festival Hydro	2006-2008	**0.844**	-0.156	0.063	13
Kingston Electricity	2006-2008	**0.859**	-0.141	0.084	14
E.L.K. Energy	2006-2008	**0.861**	-0.139	0.088	15
Welland Hydro-Electric	2006-2008	**0.864**	-0.136	0.092	16
Hearst Power	2006-2008	**0.875**	-0.125	0.113	17
Horizon Utilities	2006-2008	**0.880**	-0.120	0.125	18
Middlesex Power	2006-2008	**0.884**	-0.116	0.133	19
Lakeland Power	2006-2008	**0.888**	-0.112	0.142	20
Kenora Hydro	2006-2008	**0.896**	-0.104	0.159	21
Lakefront Utilities	2006-2008	**0.897**	-0.103	0.162	22
Rideau St. Lawrence Distribution	2006-2008	**0.902**	-0.098	0.177	23
Newmarket-Tay Hydro Electric	2006-2008	**0.913**	-0.087	0.205	24
Niagara-on-the-Lake Hydro	2006-2008	**0.913**	-0.087	0.205	25
Atikokan Hydro	2006-2008	**0.922**	-0.078	0.232	26
Halton Hills	2006-2008	**0.926**	-0.074	0.242	27
Innisfil Hydro	2006-2008	**0.927**	-0.073	0.246	28
North Bay Hydro	2006-2008	**0.935**	-0.065	0.271	29
Newbury Power	2005-2007	**0.935**	-0.065	0.272	30
Hydro Ottawa	2006-2008	**0.941**	-0.059	0.291	31
PUC Distribution	2006-2008	**0.951**	-0.049	0.326	32
Orangeville Hydro	2006-2008	**0.954**	-0.046	0.334	33
Veridian Connections	2006-2008	**0.958**	-0.042	0.350	34
Wasaga Distribution	2006-2008	**0.966**	-0.034	0.377	35
Peterborough Distribution	2006-2008	**0.966**	-0.034	0.379	36
Enersource Hydro Mississauga	2006-2008	**0.984**	-0.016	0.441	37
Espanola Regional Hydro	2006-2008	**0.989**	-0.011	0.459	38
Tillsonburg Hydro	2006-2008	**1.004**	0.004	0.485	39
Haldimand County Hydro	2006-2008	**1.011**	0.011	0.460	40
Burlington Hydro	2006-2008	**1.018**	0.018	0.437	41
Oakville Hydro	2006-2008	**1.019**	0.019	0.432	42
Milton Hydro	2006-2008	**1.020**	0.020	0.429	43
Grand Valley Energy	2006-2008	**1.031**	0.031	0.392	44
Brantford Power	2006-2008	**1.033**	0.033	0.384	45
Westario Power	2006-2008	**1.042**	0.042	0.355	46
Woodstock Hydro	2006-2008	**1.043**	0.043	0.351	47
Ottawa River Power	2006-2008	**1.045**	0.045	0.344	48
London Hydro	2006-2008	**1.046**	0.046	0.341	49
Parry Sound Power	2006-2008	**1.052**	0.052	0.325	50
Bluewater Power	2006-2008	**1.052**	0.052	0.322	51
Thunder Bay Hydro	2006-2008	**1.060**	0.060	0.300	52
Cooperative Hydro	2006-2008	**1.065**	0.065	0.283	53
Guelph Hydro	2006-2008	**1.068**	0.068	0.274	54
Sioux Lookout Hydro	2006-2008	**1.071**	0.071	0.269	55
Toronto Hydro Electric	2006-2008	**1.072**	0.072	0.265	56
Brant County Power	2006-2008	**1.075**	0.075	0.256	57
St. Thomas Energy	2006-2008	**1.076**	0.076	0.253	58
Wellington North Power	2006-2008	**1.078**	0.078	0.249	59

[1] Lower values imply better performance.

Continued

Performance Rankings Based on Econometric Benchmarks

	Years Benchmarked	Actual/Predicted[1]	Deviation Percentage [A-1][1]	P-Value	Rank[1]
Powerstream	2006-2008	**1.078**	0.078	0.247	60
Norfolk Power	2006-2008	**1.079**	0.079	0.247	61
Clinton Power	2005-2007	**1.085**	0.085	0.230	62
Dutton Hydro	2004-2006	**1.089**	0.089	0.219	63
Orillia Power	2006-2008	**1.113**	0.113	0.166	64
Eastern Ontario Power	2006-2008	**1.121**	0.121	0.150	65
Essex Powerlines	2006-2008	**1.132**	0.132	0.132	66
Fort Erie	2006-2008	**1.133**	0.133	0.129	67
Fort Frances Power	2006-2008	**1.136**	0.136	0.125	68
COLLUS Power	2006-2008	**1.139**	0.139	0.120	69
Hydro One Networks	2006-2008	**1.148**	0.148	0.106	70
ENWIN Powerlines	2006-2008	**1.154**	0.154	0.098	71
Greater Sudbury	2006-2008	**1.167**	0.167	0.081	72
West Perth Power	2006-2008	**1.173**	0.173	0.074	73
Centre Wellington Hydro	2006-2008	**1.179**	0.179	0.069	74
Midland Power	2006-2008	**1.205**	0.205	0.046	75
Whitby Hydro	2006-2008	**1.208**	0.208	0.044	76
Niagara Peninsula Energy	2006-2008	**1.213**	0.213	0.040	77
Chapleau Public	2006-2008	**1.258**	0.258	0.019	78
West Coast Huron Energy	2006-2008	**1.296**	0.296	0.010	79
Erie Thames Powerlines	2006-2008	**1.384**	0.384	0.002	80
Great Lakes Power	2006-2008	**1.430**	0.430	0.001	81
Port Colborne	2006-2008	**1.452**	0.452	0.000	82

[1] Lower values imply better performance.

2.5 Unit Cost Indexing Methods and Results

This section begins with a brief overview, in general terms, of the unit cost benchmarking approach. It is followed by information specific to the benchmarking methods found in this report.

2.5.1 Unit Cost Benchmarking 101

When implementing the unit cost index benchmarking approach, the analyst calculates the ratio of the relevant statistic being measured (e.g., OM&A cost) to a measure of output (e.g., number of customers). This ratio is compared to the mean metric of a group of firms sharing similar business and operating conditions to the company being investigated. This group of firms is called a peer group. The peer group's mean serves as an estimate for the expected unit cost of the target utility. If a firm's unit cost ratio is below the peer group average, they are classified as an above average performer, if the unit cost ratio of a company is above the peer group average they are classified as a below average cost performer.

$$Performance = \frac{OM\ \&\ A\ Unit\,Cost^{Actual}}{OM\ \&\ A\ Unit\,Cost^{Peer\ Group\ Average}} \qquad [5]$$

As is the case for the econometric approach, multiple outputs can be integrated in devising an appropriate measure of output. A multi-output index can incorporate the cost impacts inherent in multiple output measures such as, the number of customers, volumes, or kilometers of line. The weights for each individual output measure can be derived from the cost elasticity measurements of the econometric model to calculate a more accurate output index than would be present if only one measure of output were used. A multi-output index is used in this research and will be discussed in further detail in Section 2.5.2.

It should be noted, the unit cost indexing approach does not explicitly adjust for the reality that utilities encounter significantly different external circumstances. Adjustments for heterogeneous conditions rest solely upon the selection of an appropriate peer group. Therefore, peer group selection must be done with care. This is the reason for dividing the Ontario industry into twelve peer groups based on identified significant cost drivers which resulted from the econometric research.

2.5.2 Methods Used in this Report

The Ontario power distribution industry was divided into twelve separate peer groups.[16] The peer groups were based on the criteria of location, size, geography, percent undergrounding, and recent customer growth. These variables were identified on the basis of the OM&A econometric model previously estimated. Table 5 displays the peer groups and the variable data that was used in the development of peer group divisions.

A unit cost index was constructed for each distributor and for each year of available data. The construction of this index has total OM&A expenses as the numerator and a multi-output index as the denominator. This unit cost index is constructed according to Equation 6 for utility *h* in year *t*.

$$\text{Unit Cost}_{h,t} = Cost_{h,t} / Output\,Index_{\text{h,t}} \quad [6]$$

The output index in Equation 6 is calculated by weighting up the identified outputs and creating a composite output index. The estimated output elasticities for customers, volumes, and kilometers of lines were 0.46, 0.38, and 0.13, respectively. The corresponding elasticity weights were 0.48, 0.39, and 0.13.[17] These output elasticities result from the econometric model. Equation 7 offers the formula for calculating this output index.

$$\ln \text{Output } Index_{\text{h,t}} = \sum_i se_i \cdot (\ln Y_{i,h,t} . - \overline{\ln Y_{i,t}}) \ [7]$$

Here for each company h in year *t*,

$Y_{i,h,t}$ = quantity of output dimension *i*

$\overline{\ln Y_{i,t}}$ = sample mean of the logged quantity of output dimension *i* provided by all utilities

se_i = share of output dimension *i* in the sum of the econometric estimates of the cost elasticities of the output quantities.

[16] This number includes the "Large Northern" peer group which only consists of one utility, Hydro One Networks. No other Ontario power distributors are similar enough to offer a fair comparison to Hydro One Networks using the unit cost indexing approach.

[17] The weights are derived by summing the output elasticities and dividing each component output elasticity by this sum.

Table 5: Peer Group Divisions[18]

Peer Groups for Ontario LDCs

Peer Group Designation	Distributor	Customers[1]	% Undergrounding[1]	Canadian Shield	Customer Growth/Output Index[1]
Small Northern Low Undergrounding	Atikokan Hydro	1,676	0.5%	Yes	-1801
Small Northern Low Undergrounding	Chapleau Public Utilities	1,335	3.7%	Yes	-2023
Small Northern Low Undergrounding	Espanola Regional Hydro Distribution	3,349	8.0%	Yes	696
Small Northern Low Undergrounding	Fort Frances Power	4,001	9.5%	Yes	1142
Small Northern Low Undergrounding	Great Lakes Power	11,587	0.2%	Yes	273
Small Northern Low Undergrounding	Northern Ontario Wires	6,055	1.4%	Yes	-865
Small Northern Low Undergrounding	Parry Sound Power	3,356	8.6%	Yes	661
Small Northern Low Undergrounding	Renfrew Hydro	4,194	3.6%	No	633
Small Northern Low Undergrounding	Sioux Lookout Hydro	2,734	2.8%	Yes	36
Small Northern Medium Undergrounding	Hearst Power Distribution	2,763	16.2%	Yes	172
Small Northern Medium Undergrounding	Kenora Hydro Electric	5,583	10.2%	Yes	-227
Small Northern Medium Undergrounding	Lakeland Power Distribution	9,295	20.0%	Yes	1116
Small Northern Medium Undergrounding	Ottawa River Power	10,381	13.0%	Yes	1084
Mid-Size Northern	Greater Sudbury Hydro	46,215	20.1%	Yes	21
Mid-Size Northern	North Bay Hydro Distribution	23,669	15.7%	Yes	398
Mid-Size Northern	PUC Distribution	32,734	15.9%	Yes	345
Mid-Size Northern	Thunder Bay Hydro Electricity Distribution	49,361	19.8%	Yes	389
Large Northern	Hydro One Networks	1,187,253	3.5%	Yes	1045
Small Southern Low & Medium Undergrounding	Brant County Power	9,456	11.9%	No	2191
Small Southern Low & Medium Undergrounding	Clinton Power	1,639	19.0%	No	339
Small Southern Low & Medium Undergrounding	Dutton Hydro	600	14.3%	No	2816
Small Southern Low & Medium Undergrounding	Eastern Ontario Power	3,543	5.1%	No	266
Small Southern Low & Medium Undergrounding	Grand Valley Energy	681	11.1%	No	1165
Small Southern Low & Medium Undergrounding	Hydro 2000	1,177	14.3%	No	1274
Small Southern Low & Medium Undergrounding	Hydro Hawkesbury	5,375	13.8%	No	1713
Small Southern Low & Medium Undergrounding	Lakefront Utilities	9,215	16.7%	No	2164
Small Southern Low & Medium Undergrounding	Port Colborne	9,229	4.8%	No	417
Small Southern Low & Medium Undergrounding	Rideau St. Lawrence Distribution	5,859	10.2%	No	246
Small Southern Low & Medium Undergrounding	Wellington North Power	3,535	12.0%	No	1259
Small Southern Medium-High Undergrounding	Middlesex Power Distribution	7,026	23.6%	No	1842
Small Southern Medium-High Undergrounding	Midland Power Utility	6,773	31.3%	No	1865
Small Southern Medium-High Undergrounding	Newbury Power	199	25.0%	No	1194
Small Southern Medium-High Undergrounding	Tillsonburg Hydro	6,622	34.6%	No	1656
Small Southern Medium-High Undergrounding	West Coast Huron Energy	3,878	20.0%	No	1012
Small Southern Medium-High Undergrounding	West Perth Power	2,007	30.6%	No	1270
Small Southern Medium-High Undergrounding with Rapid Growth	Centre Wellington Hydro	6,309	47.3%	No	3340
Small Southern Medium-High Undergrounding with Rapid Growth	Cooperative Hydro Embrun	1,936	44.4%	No	6832
Small Southern Medium-High Undergrounding with Rapid Growth	Grimsby Power	9,937	25.2%	No	3570
Small Southern Medium-High Undergrounding with Rapid Growth	Niagara-on-the-Lake Hydro	7,798	26.7%	No	2665
Small Southern Medium-High Undergrounding with Rapid Growth	Orangeville Hydro	10,200	41.0%	No	3335
Mid-size Southern Low & Medium Undergrounding	Fort Erie	15,616	8.0%	No	597
Mid-size Southern Low & Medium Undergrounding	Haldimand County Hydro	20,815	4.8%	No	785
Mid-size Southern Low & Medium Undergrounding	Innisfil Hydro Distribution Systems	14,471	18.9%	No	2361
Mid-size Southern Low & Medium Undergrounding	Norfolk Power Distribution	18,806	12.2%	No	3042
Mid-size Southern Low & Medium Undergrounding	Orillia Power Distribution	12,797	19.4%	No	1286
Mid-size Southern Medium-High Undergrounding	Bluewater Power Distribution	36,218	23.2%	No	947
Mid-size Southern Medium-High Undergrounding	Chatham-Kent Hydro	32,094	28.4%	No	388
Mid-size Southern Medium-High Undergrounding	COLLUS Power	14,387	34.6%	No	2605
Mid-size Southern Medium-High Undergrounding	E.L.K. Energy	10,853	39.5%	No	2234
Mid-size Southern Medium-High Undergrounding	Erie Thames Powerlines	14,312	20.8%	No	1511
Mid-size Southern Medium-High Undergrounding	Essex Powerlines	27,929	51.4%	No	2593
Mid-size Southern Medium-High Undergrounding	Festival Hydro	19,394	32.8%	No	1602
Mid-size Southern Medium-High Undergrounding	Kingston Electricity Distribution	26,940	34.7%	No	172
Mid-size Southern Medium-High Undergrounding	Niagara Peninsula Energy	50,255	23.8%	No	3119
Mid-size Southern Medium-High Undergrounding	Peterborough Distribution	34,349	30.2%	No	1351
Mid-size Southern Medium-High Undergrounding	St. Thomas Energy	16,133	35.2%	No	2751
Mid-size Southern Medium-High Undergrounding	Wasaga Distribution	11,660	46.1%	No	6492
Mid-size Southern Medium-High Undergrounding	Welland Hydro-Electric System	21,706	25.5%	No	937
Mid-size Southern Medium-High Undergrounding	Westario Power	21,592	29.8%	No	1372
Mid-size Southern Medium-High Undergrounding	Woodstock Hydro Services	14,645	36.6%	No	1817
Large City Southern Medium-High Undergrounding	ENWIN Powerlines	84,644	36.2%	No	1262
Large City Southern Medium-High Undergrounding	Hydro Ottawa	291,639	49.0%	No	2735
Large City Southern Medium-High Undergrounding	Toronto Hydro-Electric System	684,145	57.0%	No	618
Large City Southern Medium-High Undergrounding	Veridian Connections	110,861	35.1%	No	2924
Large City Southern High Undergrounding	Enersource Hydro Mississauga	186,929	65.4%	No	2492
Large City Southern High Undergrounding	Horizon Utilities	233,947	53.9%	No	1322
Large City Southern High Undergrounding	Hydro One Brampton Networks	129,585	70.6%	No	5897
Large City Southern High Undergrounding	London Hydro	143,797	50.8%	No	2241
Large City Southern High Undergrounding	PowerStream	244,573	68.5%	No	4771
Mid-size GTA Medium-High & High Undergrounding	Barrie Hydro Distribution	69,628	55.0%	No	4925
Mid-size GTA Medium-High & High Undergrounding	Brantford Power	37,473	45.5%	No	2278
Mid-size GTA Medium-High & High Undergrounding	Burlington Hydro	62,737	39.0%	No	3110
Mid-size GTA Medium-High & High Undergrounding	Cambridge and North Dumfries Hydro	49,297	34.4%	No	2644
Mid-size GTA Medium-High & High Undergrounding	Guelph Hydro Electric Systems	48,914	59.1%	No	3423
Mid-size GTA Medium-High & High Undergrounding	Halton Hills Hydro	20,818	35.3%	No	2729
Mid-size GTA Medium-High & High Undergrounding	Kitchener-Wilmot Hydro	84,195	44.2%	No	2892
Mid-size GTA Medium-High & High Undergrounding	Milton Hydro Distribution	25,373	37.0%	No	7106
Mid-size GTA Medium-High & High Undergrounding	Newmarket Hydro & Tay Hydro	31,874	44.5%	No	2839
Mid-size GTA Medium-High & High Undergrounding	Oakville Hydro Electricity Distribution	62,038	61.3%	No	4356
Mid-size GTA Medium-High & High Undergrounding	Oshawa PUC Networks	51,813	46.2%	No	2244
Mid-size GTA Medium-High & High Undergrounding	Waterloo North Hydro	50,478	31.3%	No	2924
Mid-size GTA Medium-High & High Undergrounding	Whitby Hydro Electric	39,225	51.9%	No	5415

[1]Latest year of available data.

[18] Peer groups are identical to those proposed in the Original Report, except where amalgamations necessitated modifications.

2.5.3 Unit Cost Indexing Results

The OM&A performance evaluations for each year of available data are presented in Table 6. The ratio of the average actual OM&A unit cost index of each company in the last three years to the peer group's average OM&A unit cost index over the same years is reported. A lower ratio of actual unit cost to peer group unit cost implies better performance. Table 7 ranks each power distributor according to this ratio.

Two lines have been drawn on Table 7 demarcating the first quartile and the fourth quartile. The utilities on the top (efficiency rankings 1-20) are labeled as top quartile cost performers. The utilities on the bottom (efficiency rankings 62-81) are classified as bottom quartile cost performers according to the unit cost benchmarking method. Recall, Hydro One Networks is not included in Table 7 given its lack of suitable Ontario peers.

Table 6: Unit OM&A Cost Indexes by Peer Group

Unit OM&A Cost Indexes

	2002	2003	2004	2005	2006	2007	2008	Average of Last 3 Available Years[1]	Average / Group Average[1] [A]	Percentage Differences[1] [A - 1]
Small Northern Low Undergrounding										
Renfrew Hydro	0.930	0.996	0.922	0.813	1.004	1.100	1.222	1.108	**0.665**	-33.5%
Northern Ontario Wires	1.271	1.133	1.252	1.098	1.171	1.264	1.380	1.272	**0.763**	-23.7%
Parry Sound Power	0.962	1.155	1.164	1.227	1.279	1.255	1.440	1.325	**0.795**	-20.5%
Espanola Regional Hydro Distribution	1.319	1.097	1.021	1.081	1.396	1.385	1.422	1.401	**0.841**	-15.9%
Sioux Lookout Hydro	1.020	0.823	1.179	1.274	1.302	1.430	1.528	1.420	**0.852**	-14.8%
Fort Frances Power	1.178	1.188	1.211	1.281	1.320	1.417	1.556	1.431	**0.859**	-14.1%
Atikokan Hydro	1.364	2.549	1.625	1.518	1.519	1.876	2.417	1.937	**1.163**	16.3%
Chapleau Public Utilities	1.609	1.667	1.703	1.884	1.806	2.345	2.185	2.112	**1.268**	26.8%
Great Lakes Power	2.444	2.481	2.621	2.792	2.877	2.941	3.141	2.986	**1.793**	79.3%
GROUP AVERAGE								**1.666**		
Small Northern Medium Undergrounding										
Hearst Power Distribution	0.648	0.625	0.783	0.767	0.848	0.888	1.037	0.924	**0.839**	-16.1%
Lakeland Power Distribution	0.987	1.189	0.830	0.834	0.993	0.894	1.238	1.042	**0.946**	-5.4%
Ottawa River Power	0.937	1.045	1.022	0.990	1.068	1.200	1.220	1.163	**1.055**	5.5%
Kenora Hydro Electric	1.085	1.104	1.138	1.099	1.133	1.270	1.433	1.278	**1.160**	16.0%
GROUP AVERAGE								**1.102**		
Mid-Size Northern										
North Bay Hydro Distribution	1.112	0.993	0.979	0.868	1.123	0.986	1.007	1.039	**0.916**	-8.4%
PUC Distribution	0.852	0.922	1.053	1.028	1.007	1.143	1.060	1.070	**0.944**	-5.6%
Thunder Bay Hydro Electricity Distribution	1.050	1.139	1.092	0.983	1.033	1.138	1.152	1.108	**0.977**	-2.3%
Greater Sudbury Hydro	1.017	0.983	1.109	0.991	1.054	1.747	1.159	1.320	**1.164**	16.4%
GROUP AVERAGE								**1.134**		
Large Northern										
Hydro One Networks	N/A	0.936	0.893	0.961	1.152	1.351	1.604	1.369	**NA**	NA
GROUP AVERAGE								**1.369**		
Small Southern Low & Medium Undergrounding										
Hydro Hawkesbury	0.527	0.551	0.504	0.603	0.569	0.616	0.662	0.616	**0.440**	-56.0%
Lakefront Utilities	0.705	0.626	0.718	0.853	0.917	0.934	0.943	0.931	**0.666**	-33.4%
Hydro 2000	0.567	0.645	0.645	1.165	0.929	0.983	1.008	0.973	**0.696**	-30.4%
Brant County Power	1.197	1.358	1.418	1.420	1.571	0.675	1.405	1.217	**0.871**	-12.9%
Rideau St. Lawrence Distribution	1.035	1.069	1.065	1.165	1.197	1.254	1.359	1.270	**0.909**	-9.1%
Wellington North Power	1.134	1.035	1.082	1.128	1.189	1.167	1.507	1.288	**0.921**	-7.9%
Clinton Power	1.250	1.308	1.123	1.231	1.605	1.804	N/A	1.547	**1.106**	10.6%
Eastern Ontario Power	N/A	1.613	1.234	1.474	1.804	1.669	1.456	1.643	**1.175**	17.5%
Dutton Hydro	1.281	1.399	2.284	1.581	1.504	N/A	N/A	1.790	**1.280**	28.0%
Grand Valley Energy	1.587	1.440	1.574	1.795	2.232	1.969	1.934	2.045	**1.463**	46.3%
Port Colborne	0.734	0.821	0.896	2.040	2.051	2.241	1.881	2.058	**1.472**	47.2%
GROUP AVERAGE								**1.398**		
Small Southern Medium-High Undergrounding										
Middlesex Power Distribution	0.967	1.108	0.907	1.083	0.926	0.910	0.928	0.921	**0.816**	-18.4%
Tillsonburg Hydro	0.809	1.334	1.326	1.472	0.979	0.969	1.008	0.985	**0.872**	-12.8%
Midland Power Utility	1.143	1.110	1.086	1.009	1.124	1.099	1.120	1.114	**0.986**	-1.4%
West Perth Power	1.155	1.165	1.075	0.910	1.167	1.127	1.308	1.200	**1.063**	6.3%
Newbury Power	N/A	N/A	1.290	1.017	1.199	1.456	N/A	1.224	**1.084**	8.4%
West Coast Huron Energy	1.164	1.171	1.147	1.440	1.476	1.220	1.301	1.332	**1.180**	18.0%
GROUP AVERAGE								**1.130**		
Small Southern Medium-High Undergrounding with Rapid Growth										
Grimsby Power	0.702	0.711	0.782	0.820	0.788	0.862	0.920	0.857	**0.854**	-14.6%
Orangeville Hydro	0.848	0.905	0.840	0.852	0.836	0.918	1.033	0.929	**0.926**	-7.4%
Niagara-on-the-Lake Hydro	0.837	0.784	0.862	0.792	0.876	0.971	0.973	0.940	**0.937**	-6.3%
Centre Wellington Hydro	1.187	1.131	1.070	1.068	1.083	1.095	1.152	1.110	**1.106**	10.6%
Cooperative Hydro Embrun	0.955	1.031	0.927	1.094	1.107	1.215	1.219	1.181	**1.177**	17.7%
GROUP AVERAGE								**1.003**		
Mid-Size Southern Low & Medium Undergrounding										
Innisfil Hydro Distribution Systems	0.948	1.109	1.156	0.971	1.036	1.108	1.209	1.118	**0.889**	-11.1%
Norfolk Power Distribution	1.087	1.052	0.990	0.977	0.969	1.148	1.306	1.141	**0.908**	-9.2%
Orillia Power Distribution	0.927	1.031	1.062	1.188	1.160	1.249	1.347	1.252	**0.996**	-0.4%
Haldimand County Hydro	N/A	N/A	N/A	1.049	1.120	1.415	1.422	1.319	**1.050**	5.0%
Fort Erie	1.364	1.216	1.230	1.285	1.425	1.531	1.408	1.455	**1.157**	15.7%
GROUP AVERAGE								**1.257**		

[1] Lower values imply better performance.

Continued

Unit OM&A Cost Indexes

	2002	2003	2004	2005	2006	2007	2008	Average of Last 3 Available Years[1]	Average / Group Average[1] [A]	Percentage Differences[1] [A - 1]
Mid-Size Southern Medium-High Undergrounding										
Chatham-Kent Hydro	0.667	0.662	0.696	0.687	0.696	0.714	0.781	0.730	**0.723**	-27.7%
Festival Hydro	0.786	0.739	0.755	0.728	0.815	0.806	0.837	0.819	**0.811**	-18.9%
Kingston Electricity Distribution	0.943	1.036	1.025	0.948	0.857	0.854	0.935	0.882	**0.874**	-12.6%
E.L.K. Energy	0.961	1.013	0.860	0.584	0.858	0.891	1.010	0.920	**0.911**	-8.9%
Welland Hydro-Electric System	0.813	0.899	0.974	0.835	0.779	1.003	1.021	0.935	**0.926**	-7.4%
Peterborough Distribution	0.803	0.747	0.809	0.787	0.892	0.923	0.999	0.938	**0.929**	-7.1%
Woodstock Hydro Services	0.846	0.916	0.938	0.950	0.984	1.018	1.046	1.016	**1.006**	0.6%
Westario Power	0.978	1.124	1.141	1.000	0.988	0.945	1.127	1.020	**1.011**	1.1%
Wasaga Distribution	0.781	0.827	0.899	0.992	1.060	1.036	1.082	1.059	**1.049**	4.9%
St. Thomas Energy	0.791	0.828	0.894	0.975	1.109	1.051	1.028	1.063	**1.053**	5.3%
Niagara Peninsula Energy	0.954	0.983	0.997	1.067	1.069	1.015	1.109	1.064	**1.054**	5.4%
COLLUS Power	0.834	0.798	0.839	0.836	1.005	1.047	1.150	1.067	**1.057**	5.7%
Essex Powerlines	1.054	0.951	1.057	1.175	1.153	1.067	1.018	1.080	**1.069**	6.9%
Bluewater Power Distribution	N/A	1.059	1.027	1.047	1.123	1.063	1.091	1.093	**1.082**	8.2%
Erie Thames Powerlines	1.064	1.257	1.298	1.352	1.298	1.562	1.513	1.458	**1.444**	44.4%
GROUP AVERAGE								**1.010**		
Large City Southern Medium-High Undergrounding										
Hydro Ottawa	0.850	0.771	0.648	0.601	0.727	0.696	0.848	0.757	**0.828**	-17.2%
Veridian Connections	0.962	1.129	0.933	0.831	0.874	0.772	0.863	0.836	**0.914**	-8.6%
Toronto Hydro-Electric System	0.862	0.892	0.921	0.867	0.862	0.932	1.081	0.958	**1.048**	4.8%
ENWIN Powerlines	1.280	1.142	1.142	1.052	1.100	1.059	1.164	1.108	**1.211**	21.1%
GROUP AVERAGE								**0.915**		
Large City Southern High Undergrounding										
Hydro One Brampton Networks	0.584	0.570	0.524	0.521	0.567	0.533	0.624	0.574	**0.757**	-24.3%
Horizon Utilities	0.628	0.719	0.645	0.769	0.679	0.766	0.836	0.760	**1.002**	0.2%
PowerStream	0.631	0.721	0.747	0.770	0.699	0.760	0.829	0.763	**1.006**	0.6%
London Hydro	0.740	0.726	0.720	0.723	0.792	0.827	0.878	0.833	**1.098**	9.8%
Enersource Hydro Mississauga	N/A	N/A	0.762	0.794	0.835	0.878	0.873	0.862	**1.137**	13.7%
GROUP AVERAGE								**0.758**		
Mid-Size GTA Medium-High Undergrounding										
Barrie Hydro Distribution	0.598	0.729	0.636	0.537	0.594	0.592	0.737	0.641	**0.789**	-21.1%
Cambridge and North Dumfries Hydro	0.624	0.615	0.667	0.605	0.604	0.694	0.765	0.688	**0.846**	-15.4%
Kitchener-Wilmot Hydro	0.597	0.611	0.608	0.623	0.682	0.693	0.730	0.701	**0.864**	-13.6%
Waterloo North Hydro	0.822	0.796	0.798	0.754	0.773	0.744	0.770	0.762	**0.939**	-6.1%
Oshawa PUC Networks	0.892	0.958	0.929	0.687	0.701	0.755	0.864	0.773	**0.952**	-4.8%
Milton Hydro Distribution	0.839	0.797	0.777	0.788	0.771	0.784	0.844	0.799	**0.984**	-1.6%
Oakville Hydro Electricity Distribution	0.783	0.863	0.863	0.815	0.879	0.821	0.756	0.819	**1.008**	0.8%
Guelph Hydro Electric Systems	0.753	0.841	0.788	0.747	0.752	0.859	0.848	0.820	**1.009**	0.9%
Newmarket Hydro & Tay Hydro	0.810	0.912	0.887	0.829	0.827	0.815	0.919	0.854	**1.051**	5.1%
Burlington Hydro	0.736	0.769	0.795	0.783	0.851	0.882	0.931	0.888	**1.094**	9.4%
Halton Hills Hydro	0.914	0.826	0.845	0.784	0.936	0.844	0.999	0.926	**1.140**	14.0%
Brantford Power	0.755	0.862	0.925	0.903	0.802	0.987	0.989	0.926	**1.140**	14.0%
Whitby Hydro Electric	0.902	0.973	0.872	0.894	0.940	0.979	0.963	0.961	**1.183**	18.3%
GROUP AVERAGE								**0.812**		
AVERAGE: ALL COMPANIES	**0.957**	**1.010**	**1.007**	**1.020**	**1.071**	**1.110**		**1.121**	**1.000**	**0.000**

[1] Lower values imply better performance.

Table 7: Performance Rankings Based on Unit Cost Indexes

Updated Performance Rankings Based on Unit Cost Indexes

	Average / Group Average[1] [A]	Percentage Differences[1] [A - 1]	Efficiency Ranking[1]
Hydro Hawkesbury	**0.440**	-56.0%	1
Renfrew Hydro	**0.665**	-33.5%	2
Lakefront Utilities	**0.666**	-33.4%	3
Hydro 2000	**0.696**	-30.4%	4
Chatham-Kent Hydro	**0.723**	-27.7%	5
Hydro One Brampton Networks	**0.757**	-24.3%	6
Northern Ontario Wires	**0.763**	-23.7%	7
Barrie Hydro Distribution	**0.789**	-21.1%	8
Parry Sound Power	**0.795**	-20.5%	9
Festival Hydro	**0.811**	-18.9%	10
Middlesex Power Distribution	**0.816**	-18.4%	11
Hydro Ottawa	**0.828**	-17.2%	12
Hearst Power Distribution	**0.839**	-16.1%	13
Espanola Regional Hydro Distribution	**0.841**	-15.9%	14
Cambridge and North Dumfries Hydro	**0.846**	-15.4%	15
Sioux Lookout Hydro	**0.852**	-14.8%	16
Grimsby Power	**0.854**	-14.6%	17
Fort Frances Power	**0.859**	-14.1%	18
Kitchener-Wilmot Hydro	**0.864**	-13.6%	19
Brant County Power	**0.871**	-12.9%	20
Tillsonburg Hydro	**0.872**	-12.8%	21
Kingston Electricity Distribution	**0.874**	-12.6%	22
Innisfil Hydro Distribution Systems	**0.889**	-11.1%	23
Norfolk Power Distribution	**0.908**	-9.2%	24
Rideau St. Lawrence Distribution	**0.909**	-9.1%	25
E.L.K. Energy	**0.911**	-8.9%	26
Veridian Connections	**0.914**	-8.6%	27
North Bay Hydro Distribution	**0.916**	-8.4%	28
Wellington North Power	**0.921**	-7.9%	29
Welland Hydro-Electric System	**0.926**	-7.4%	30
Orangeville Hydro	**0.926**	-7.4%	31
Peterborough Distribution	**0.929**	-7.1%	32
Niagara-on-the-Lake Hydro	**0.937**	-6.3%	33
Waterloo North Hydro	**0.939**	-6.1%	34
PUC Distribution	**0.944**	-5.6%	35
Lakeland Power Distribution	**0.946**	-5.4%	36
Oshawa PUC Networks	**0.952**	-4.8%	37
Thunder Bay Hydro Electricity Distribution	**0.977**	-2.3%	38
Milton Hydro Distribution	**0.984**	-1.6%	39
Midland Power Utility	**0.986**	-1.4%	40
Orillia Power Distribution	**0.996**	-0.4%	41

[1] Lower values imply better performance.

[2] Hydro One Networks has no peer group and is not included in this analysis.

Continued

Updated Performance Rankings Based on Unit Cost Indexes

	Average / Group Average[1] [A]	Percentage Differences[1] [A - 1]	Efficiency Ranking[1]
Horizon Utilities	**1.002**	0.2%	42
PowerStream	**1.006**	0.6%	43
Woodstock Hydro Services	**1.006**	0.6%	44
Oakville Hydro Electricity Distribution	**1.008**	0.8%	45
Guelph Hydro Electric Systems	**1.009**	0.9%	46
Westario Power	**1.011**	1.1%	47
Toronto Hydro-Electric System	**1.048**	4.8%	48
Wasaga Distribution	**1.049**	4.9%	49
Haldimand County Hydro	**1.050**	5.0%	50
Newmarket Hydro & Tay Hydro	**1.051**	5.1%	51
St. Thomas Energy	**1.053**	5.3%	52
Niagara Peninsula Energy	**1.054**	5.4%	53
Ottawa River Power	**1.055**	5.5%	54
COLLUS Power	**1.057**	5.7%	55
West Perth Power	**1.063**	6.3%	56
Essex Powerlines	**1.069**	6.9%	57
Bluewater Power Distribution	**1.082**	8.2%	58
Newbury Power	**1.084**	8.4%	59
Burlington Hydro	**1.094**	9.4%	60
London Hydro	**1.098**	9.8%	61
Centre Wellington Hydro	**1.106**	10.6%	62
Clinton Power	**1.106**	10.6%	63
Enersource Hydro Mississauga	**1.137**	13.7%	64
Halton Hills Hydro	**1.140**	14.0%	65
Brantford Power	**1.140**	14.0%	66
Fort Erie	**1.157**	15.7%	67
Kenora Hydro Electric	**1.160**	16.0%	68
Atikokan Hydro	**1.163**	16.3%	69
Greater Sudbury Hydro	**1.164**	16.4%	70
Eastern Ontario Power	**1.175**	17.5%	71
Cooperative Hydro Embrun	**1.177**	17.7%	72
West Coast Huron Energy	**1.180**	18.0%	73
Whitby Hydro Electric	**1.183**	18.3%	74
ENWIN Powerlines	**1.211**	21.1%	75
Chapleau Public Utilities	**1.268**	26.8%	76
Dutton Hydro	**1.280**	28.0%	77
Erie Thames Powerlines	**1.444**	44.4%	78
Grand Valley Energy	**1.463**	46.3%	79
Port Colborne	**1.472**	47.2%	80
Great Lakes Power	**1.793**	79.3%	81

[1] Lower values imply better performance.

[2] Hydro One Networks has no peer group and is not included in this analysis.

3 Efficiency Cohort Groupings

A company will be in cohort one if it is statistically superior based on the econometric benchmarking results (found in Table 4) and in the top quartile of the unit cost benchmarking rankings (found in Table 7). A company will be in efficiency cohort three if it is statistically inferior based on the econometric benchmarking results and in the bottom quartile of the unit cost benchmarking rankings. All remaining companies are placed in efficiency cohort two. PSE's analysis of distributors' OM&A cost performance indicates that there are 11 firms in cohort one, 62 firms in cohort two, and 9 firms in cohort three.

The table below details the cohort changes which occurred from the 2009 Update to the 2010 update. Six cohort group changes occurred. The first column lists the one Local Distribution Company ("LDC") which was in cohort group one in the 2009 update but switched to group two for the 2010 update. The second column lists the distributor which transitioned from group two to group one. The third column reveals that one company went from group two to group three, and the last column lists the three firms which switched from group three to group two.

Cohort Changes from 2009 Update to 2010 Update

From Cohort 1 to 2	From Cohort 2 to 1	From Cohort 2 to 3	From Cohort 3 to 2
E.L.K. Energy	Grimsby Power	Greater Sudbury Hydro	Eastern Ontario Power (CNP)
			Essex Powerlines
			Niagara Peninsula Energy

Table 8 presents the full sample of Ontario power distributors that are identified to be in each of the three designated efficiency cohorts for the 2010 update.

Table 8: Efficiency Cohort Groupings

Efficiency Cohort Grouping Results

Company	Cohort
Hydro Hawkesbury	1
Chatham-Kent Hydro	1
Northern Ontario Wires	1
Cambridge North Dumfries Hydro	1
Grimsby Power	1
Hydro 2000	1
Hydro One Brampton Networks	1
Kitchener-Wilmot Hydro	1
Renfrew Hydro	1
Barrie Hydro	1
Festival Hydro	1
Oshawa PUC	2
Waterloo North Hydro	2
Kingston Electricity	2
E.L.K. Energy	2
Welland Hydro-Electric	2
Hearst Power	2
Horizon Utilities	2
Middlesex Power	2
Lakeland Power	2
Kenora Hydro	2
Lakefront Utilities	2
Rideau St. Lawrence Distribution	2
Newmarket-Tay Hydro Electric	2
Niagara-on-the-Lake Hydro	2
Atikokan Hydro	2
Halton Hills	2
Innisfil Hydro	2
North Bay Hydro	2
Newbury Power	2
Hydro Ottawa	2
PUC Distribution	2
Orangeville Hydro	2
Veridian Connections	2
Wasaga Distribution	2
Peterborough Distribution	2
Enersource Hydro Mississauga	2
Espanola Regional Hydro	2
Tillsonburg Hydro	2
Haldimand County Hydro	2
Burlington Hydro	2
Oakville Hydro	2
Milton Hydro	2
Grand Valley Energy	2
Brantford Power	2
Westario Power	2
Woodstock Hydro	2

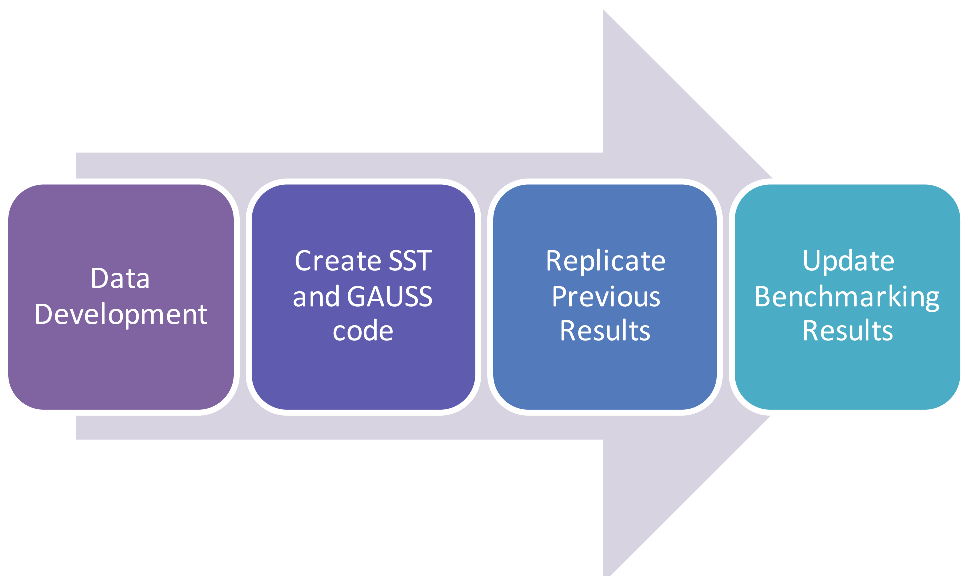
Continued

Efficiency Cohort Grouping Results

Ottawa River Power	2
London Hydro	2
Parry Sound Power	2
Bluewater Power	2
Thunder Bay Hydro	2
Cooperative Hydro	2
Guelph Hydro	2
Sioux Lookout Hydro	2
Toronto Hydro Electric	2
Brant County Power	2
St. Thomas Energy	2
Wellington North Power	2
Powerstream	2
Norfolk Power	2
Clinton Power	2
Dutton Hydro	2
Orillia Power	2
Eastern Ontario Power	2
Essex Powerlines	2
Fort Erie	2
Fort Frances Power	2
COLLUS Power	2
Hydro One Networks	2
West Perth Power	2
Midland Power	2
Niagara Peninsula Energy	2
ENWIN Powerlines	3
Greater Sudbury Hydro	3
Centre Wellington Hydro	3
Whitby Hydro	3
Chapleau Public Utilities	3
West Coast Huron Energy	3
Erie Thames Powerlines	3
Great Lakes Power	3
Port Colborne	3

4 Replication and Update Process

The 2010 rate year cohort groupings are based on identical methodology as was employed in the Original Report and subsequent 2009 Update. This section reveals the process applied by PSE to reassure Ontario stakeholders that no element of the previously established benchmarking methodology was modified. Section 4.1 discusses the PSE staff members who played an essential role in the benchmarking research. Section 4.2 talks about the data development process and incorporating new 2008 data into the benchmarking results. Section 4.3 reveals how PSE updated the SST database manager code. Section 4.4 discusses how PSE updated the econometric estimation code which used the software package GAUSS. A diagram of the overall process PSE engaged in is illustrated below.



4.1 PSE Staff

PSE's benchmarking practice, and other areas of expertise, focuses on the utility industry. Our clients include a number of power distributors interested in using benchmarking to improve their performance, provide recommendations for efficiency improvements, identify best practices, and assist in business case development for specific technologies. These clients include utilities of varied size ranging from a small distributor with less than 3,000 customers to a large distributor with customers in excess of 100,000. Our benchmarking studies encompass costs, as well as, reliability measurements.

PSE's benchmarking practice also extends into regulatory applications. For example, Mr. Fenrick recently testified before the Illinois Commerce Commission regarding the O&M cost performance of three large power distributors. This work used the econometric benchmarking method to evaluate each distributor's cost performance, similar to the econometric research found in this report.

The 2010 rate year update process was lead by Mr. Steven A. Fenrick and assisted by the involvement of Dr. Donald J. Wyhowski, Mr. Duane T. Kexel, and Mr. Erik S. Sonju. Mr. Fenrick co-authored the Original Report and assisted with the 2009 Update. Mr. Fenrick wrote the original OEB database management code, calculated unit cost index benchmarking results, and worked with other co-authors in the development of the econometric models and results, along with assisting on report development. Mr. Fenrick has authored reports and/or testified in a number of rate cases involving statistical cost analysis. He manages PSE's benchmarking department for both regulatory and internal improvement purposes. Mr. Fenrick also engages in research involving load forecasting and demand side management (DSM) programs.

Dr. Wyhowski did not have any direct involvement in the Original Report or 2009 Update, however, he has over two decades of experience in econometric modeling. He served as an economics professor, most notably at the Australian National University, served as a referee for a number of scholarly economic journals, and has been involved in econometric benchmarking model development. The econometric benchmarking code that uses the GAUSS software package[19] comes from the Original Report and 2009 Update, which were modified versions of benchmarking code originally written by Dr. Wyhowski during his tenure at Pacific Economics Group.

Mr. Kexel served as the economic technical review on this project and has over 35 years of consulting experience. His research focus is on using econometric analysis in load forecasting, stranded cost analysis, risk measurement and management, and competitive assessments for domestic electric utility clients and on carbon reduction projects in eastern and central Europe for the World Bank. Currently he is engaged in assessing electric utility energy efficiency potential in filings before regulatory bodies.

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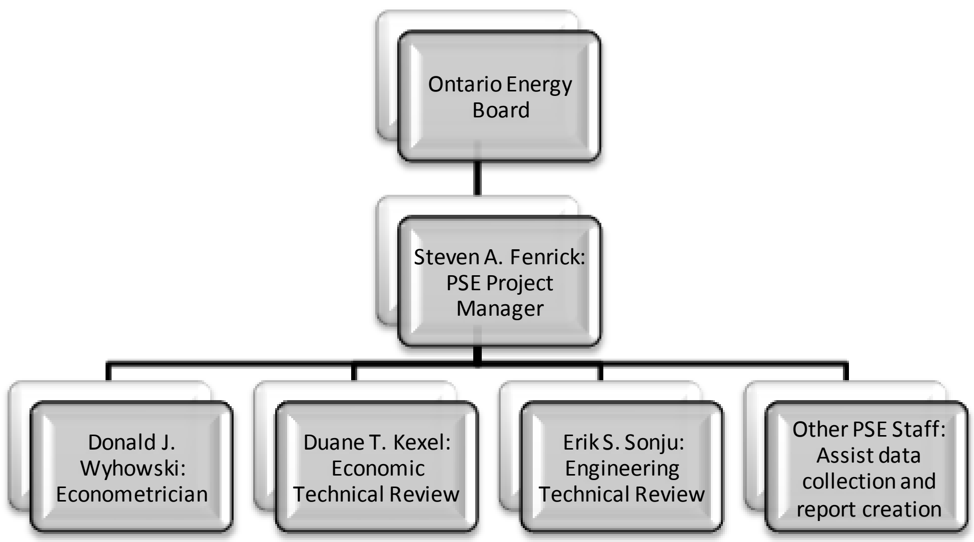
[19] GAUSS version 8.0 from Aptech Systems, Inc.

Mr. Sonju served as the engineering technical review on this project. He is a licensed Professional Engineer in eleven states. Mr. Sonju leads PSE's System Planning and Line Design department. He works closely with Mr. Fenrick in PSE's utility management improvement benchmarking practice. This practice develops benchmarking evaluations of utility cost and reliability performance and provides recommendations for efficiency improvement.

The 2010 update team and their roles are detailed in the chart below.



4.2 Data Development

Ontario cost and output data used in this research was provided to PSE by the Ontario Energy Board. This data originated from Reporting and Record Keeping Requirements (RRR), filed by each power distributor. Data for the 2002-2008 time period was used, with minimal changes being made to the 2002-2007 data relative to that used for the 2009 Update.[20]

[20] As stated earlier, the only changes to the 2002-2007 data are switching Renfrew Hydro to being "off" the Canadian Shield and revising ENWIN's 2007 OM&A expenses. These changes were made subsequent to the replication of the 2009 Update.

Two data items were gathered from Statistics Canada. These items were the GDP-IP for Ontario and a measure of labor wage rates.[21] These two data series correspond to the data series used in the previous benchmarking reports.

PSE used the same definitions for the Canadian Shield binary variable and wage levels that had previously been instituted.[22] One change from the 2009 Update that was necessary was adjusting for the merger between Niagara Falls Hydro and Peninsula West Utilities. PSE summed the data for these two entities, where they were reported separately, to form one data series for the successor utility. The individual companies were then eliminated from the analysis.[23]

4.3 SST Code Development

The SST code is used to manage the database inputs. It calculates variables, creates the econometric dataset, and produces the unit cost index results found in Section Two. The first step was to replicate the 2009 Update results using the SST code. This was done by processing the data, loading it into SST, and verifying the econometric dataset was identical and the unit cost indexing results were identical to those reported in the 2009 Update. This provides reassurance that the only changes in 2010 cohort groups are a result of incorporating 2008 data and not a result of modifying benchmarking procedures or code.

This process was led by Steve Fenrick who wrote the original SST code for the Ontario Energy Board benchmarking work. He also was the primary person who modified it for the 2009 Update. As such, he has intimate knowledge of the OEB benchmarking initiative and is well-suited to verify that identical procedures are being used compared to previous methods.

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[21] External measures of input prices are necessary for two reasons. The first is that internal labor data remains confidential. More importantly, an external measure does not advantage a utility in the benchmarking analysis who is procuring inputs at above market prices. However, further analysis which would include actual internal input prices for each company would assist in determining the source of any identified inefficiencies and enable a researcher to better determine if inefficiencies are occurring due to the company paying higher than market input prices or if its input quantities (e.g., number of employees) are the cause of potential poor cost performance.

[22] Again, except for changing Renfrew Hydro to not being on the Canadian Shield.

[23] This merger was corrected for after the 2009 replication process was complete.

4.4 GAUSS Code Development

After the data has been processed, the SST code produces a dataset with all of the variables needed to run the econometric model. The GAUSS code executes the estimation procedures and produces the parameter estimates found in Table 4. Additionally, it calculates the cost benchmarks used to determine cost performance for the econometric approach.

This process was led by Don Wyhowski. Dr. Wyhowski wrote the original estimation procedures which were modified for use in the Original Report and 2009 Update. Dr. Wyhowski was able to replicate the previous work using an updated version of GAUSS. He then incorporated 2008 data using the same estimation procedures as he did in the replication process.

Appendix

The Appendix contains the resumes of the primary 2010 update team members. These members include the team lead, Steve Fenrick, the econometrician, Don Wyhowski, the economic technical review, Duane Kexel, and the engineering technical review, Erik Sonju.

Steve Fenrick (fenricks@powersystem.org) Economist

Summary of Experience & Expertise

- Statistical cost research including benchmarking, incentive/alternative regulation, and revenue decoupling.
- Develops forecasts related to electric energy efficiency and demand response.
- Experience with load research, end-use surveys, and market research methods.
- Assists with small area forecasts at the substation level to support long range system development plans.

Professional Experience

Power System Engineering, In. – Madison, WI (2009-Present)

Economist

Responsible for providing consulting services to cooperative, investor-owned, municipal electric utilities, regulatory commissions, and consumer advocates in the areas of reliability and cost benchmarking, alternative regulation, revenue decoupling, energy efficiency, demand response, load research, weather normalization, demand-side management, end-use surveys, and market research.

Pacific Economics Group, Inc. – Madison, WI (2001-2009)

Senior Economist

Co-authored research reports that have been submitted as testimony in numerous proceedings in several states and in international jurisdictions. Research topics of reports have included statistical benchmarking, alternative regulation, and revenue decoupling mechanisms. Instructed utility personnel on benchmarking issues at EUCI conference. Directed empirical research efforts on various issues impacting energy utilities.

Publications and papers

- "Altreg Rate Designs Address Declining Average Gas Use", *Natural Gas & Electricity*. April 2008. (With Mark Lowry, Lullit Getachew, and David Hovde).
- "An Introduction to Performance Benchmarking". PSE white paper.
- "Regulation of Gas Distributors with Declining Use per Customer", *Dialogue*. August 2006. (With Mark Lowry and Lullit Getachew).
- "Revenue Decoupling Mechanisms: Designing an Appropriate Revenue Escalator for Central Vermont Public Service". June 2008. PSE Working Paper.

- "Estimation of Household Water Demand Using a Panel of Wisconsin Municipalities". May 2008. PSE Working Paper.

Testimony Experience

- Illinois Commerce Commission – Central Illinois Light Company, Case No. 09-0306, sponsored by the Illinois Attorney General and the Illinois Citizens Utility Board.
- Illinois Commerce Commission – Central Illinois Public Service, Case No. 09-0307, sponsored by the Illinois Attorney General and the Illinois Citizens Utility Board.
- Illinois Commerce Commission – Illinois Power, Case No. 09-0308, sponsored by the Illinois Attorney General and the Illinois Citizens Utility Board.

Education

- University of Wisconsin-Madison (2000)

  Bachelor of Science, Economics (Mathematical Emphasis)
- University of Wisconsin-Madison (2007-Present)

  Masters of Science, Applied Economics – Thesis topic: Statistical Cost and Reliability Benchmarking of Electric Distribution.

Selected List of Research Projects

1. Cost and reliability benchmarking for utility management improvement purposes, numerous U.S. electric utilities, 2009-2010.
2. Demand response program design and reporting for U.S. Department of Energy demonstration grants involving twelve U.S. power distributors, 2010.
3. Business case development for mobile workforce management (MWM) technology options for a U.S. power distributor, 2010.
4. O&M benchmarking of electric operations of Ameren Corp., IL AG/CUB, 2009.
5. Cost benchmarking the electric operations of Union Electric, 2009.
6. O&M cost benchmarking of Vertically Integrated Electric Utility Expenses, OG&E, 2009.
7. Research U.S. power industry revenue decoupling precedents and applications, HECO, 2008.
8. Revenue Adjustment Mechanism for CVPS Revenue Decoupling Proposal, CVPS, 2008.
9. Productivity Research for Bundled Power Service, HECO, 2008.
10. A&G Power Benchmarking Research. 2008.
11. Incentive Regulation of Ontario's Power Distribution Utilities, OEB, 2008.

12. Productivity Research of U.S. Power Generation and Distribution, APS, 2007.
13. Productivity Research of Northeast Power Distribution used for Price Cap Regulation, CMP, 2007.
14. Appropriate revenue and price escalation research for Ontario's Gas Distribution Utilities, OEB, 2007.
15. Benchmarking Research of Ontario's Power Distribution Utilities, OEB, 2007.
16. Benchmarking Research of Electric A&G Expenses, Michigan PSC, 2006.
17. Productivity Research for Gas Distribution, Sempra, 2006.
18. Productivity Research for Power Distribution, Sempra, 2006.
19. Benchmarking Research for Gas Distribution, Nstar Gas, 2006.
20. Benchmarking Research for Power Distribution, Central Vermont PSC, 2005.
21. Benchmarking Research of Nuclear Power Generation, Sempra, 2005.
22. Research on Rate Trends for Electric Power, EEI, 2005.
23. Benchmarking Research of Bundled Power Service, Florida Power, 2005.
24. Benchmarking Research of Canadian Electric Distribution, Hydro One, 2005.
25. Benchmarking Research of Gas Distribution, Bay State, 2005.
26. Benchmarking Research of Electric Distribution, Aquaelectra, 2004.
27. Benchmarking Research for the Caribbean Water Distribution Industry, Aquaelectra, 2004.
28. Compensatory Rate Trend for the U.S. Gas Industry, 2004.
29. Productivity Research for the U.S. Electrical industry, TXU, 2004.
30. Research on Productivity and Benchmarking for Queensland, Australia Electrical Companies, 2004.
31. Research on Productivity and Benchmarking for Gas and Electric Industries for Sempra, 2004.
32. Research on Productivity and Benchmarking for Jamaican Power Company. JPS, 2003-2004.
33. Cost analysis research and benchmarking for the Bolivian Power regulator, 2003.
34. Research on Productivity and Benchmarking for Hydro One, 2002.
35. Research on Productivity and Benchmarking for a Natural Gas Distributor. Boston Gas, 2002-2003.

36. Research on Benchmarking for Bundled Power Service. AmerenUE, 2002
37. Statistical Benchmarking for Electric Power Transmission. Transcend, 2002.
38. Statistical Benchmarking for three Australian Gas Utilities, 2001.
39. Power Distribution TFP trends for Bangor Hydro, 2001.

DONALD J WYHOWSKI

7525 State Road
Coopersville, Michigan 49404
(616) 837 9060
wyhowski@verizon.net

EDUCATION: Michigan State University, East Lansing, Michigan.

August 1988 — **Ph.D. in Economics** specializing in econometrics, macroeconomics, monetary theory, probability and statistics, and mathematical modeling.
Dissertation advisor: Distinguished Professor Peter Schmidt

August 1985 — **Masters of Science in Mathematics** with emphasis in real and numerical analysis.

August 1985 — **Masters of Arts in Economics.**

August 1980 — **Bachelor of Arts in Economics.** Minor in philosophy and accounting.

EMPLOYMENT EXPERIENCE:

March 2005 - Present — **Great Lakes Economics Group,** Coopersville, Michigan.

- Provide economic forecasts for states within the Great Lakes region.
- Developed multivariate-pooled time series models for employment and income across multiple state economies within subregions of the national economy.
- Responsible for numerous policy proposals for revitalizing the manufacturing sector of Michigan.

2003 - 2005 — **Visiting Professor, Department of Statistics,**
Grand Valley State University, Allendale, Michigan.

February 2000 - May 2002 — **Senior Economist, Pacific Economics Group,** Madison, Wisconsin.

- Responsible for overseeing PEG's empirical analysis and econometric research.
- Projects completed include: a wide array of cost performance benchmarking studies of independently owned public utilities involved in gas and/or power distribution and transmission; econometric analyses of the issues of scale and scope economies in the provision of power supply and delivery services; the econometric estimation of the theoretical components of total factor productivity trends; the empirical analysis of marginal costs with application for rate design.

July 1994 - December 1999 — **Associate Professor of Econometrics, Department of Statistics,**
Australian National University, Canberra, Australia.

- Served as a referee for the editorial boards of such influential journals as *Econometric Theory, Journal of Econometrics,* and *Journal of Applied Econometrics.*
- Effectively taught graduate level courses in economic modeling, econometric theory, financial time series.
- Effectively taught undergraduate course in quantitative methods that included introducing students to statistical software and then solving empirical problems using these software programs during weekly tutorials.

September 1993 - June 1994 — **Visiting Professor, Department of Economics,**
State University of New York, Albany, New York.

- Effectively taught graduate level sequence in advanced econometric theory.
- Effectively taught large sections (e.g. 450 students) of Principles of Economics that included concurrently mentoring graduate students during their first experiences as teachers of smaller sections.

September 1987 - August 1993 **Associate Professor, Department of Economics, University of Memphis (Memphis State University),** Memphis, Tennessee.

- Received the University's Outstanding Teaching Award for my lecturing of the large sections (e.g. 250 students) of Introductory Economics.
- Served as the departments' media commentator for the local radio and television stations.

September 1981 - June 1987 **Instructor, Department of Mathematics, Michigan State University,** East Lansing, Michigan.

SELECTED PUBLICATIONS:

"Simultaneous Equations and Panel Data," with C. Cornwell and P. Schmidt, ***Journal of Econometrics***, 51, 1992.

"Efficient Estimation of Panel Data Models with Autocorrelated Errors," with S. Ahn and P. Schmidt, ***Journal of Business and Economic Statistics***, 10, 1992.

"Estimation of a Panel Data Model in the Presence of Correlation Between Regressors and Two-way Effects," ***Econometric Theory***, 10, 1994.

"Supply of Information, Information Asymmetry, and the Bid-Ask Spread: Empirical Evidence from Analysts' Forecasts," with K. Chung, T. McInish, and R. Wood, ***Journal of Banking and Finance***, 1994.

"Decomposing Real and Nominal Exchange Rate Movements of the Australian Dollar," ***Review of Finance and Statistics***, 12, 1996.

"Estimating a Simultaneous-Equations Error Component Model of International Trade for Multiple Countries," ***The Economic Record***, 73, 1997.

"Testing the Generalized Purchasing Power Parity Theory for Pacific Rim Countries," ***Review of Finance and Statistics***, 13, 1997.

"Redundancy of Moment Conditions" with T. Breusch, H. Qian and P. Schmidt, ***Journal of Econometrics***, 91, 1999.

"Monte Carlo Evidence for Dynamic Panel Data Models," Australian National University Working Paper, July 1999.

"Statistical Benchmarking of Utility Service Quality," with Lowry, Kaufman, and Dresher, prepared for Counsel to the Massachusetts Gas and Electric Distribution Companies, 2001.

"Scale in Power Generation and Scope Economies Between Power Transmission and Power Generation: Implications for Public Policy in Western Australia, 2003.

"Estimating of the Theoretical Components of Total Factor Productivity Trends," 2004.

MOST RECENT PRESENTATIONS:

Symposium on the Future of Manufacturing in Michigan, East Lansing, Michigan, 2008.

Conference on Current Issues in Energy Regulation, Boston, Massachusetts 2003

Conference on Performance-Based Regulation, Chicago, Illinois, 2001

DUANE T. KEXEL
Power System Engineering, Inc.

SUMMARY OF EXPERIENCE & EXPERTISE

- Extensive consulting experience with utility, governmental, institutional, and industrial clients in both domestic and international locations.
- Experienced in all areas of electric load forecasting, MISO Module E forecast reporting, energy efficiency evaluation and potential assessments, demand response studies including innovative direct load control and critical peak pricing, financial forecasting, power supply studies, economic feasibility studies, acquisition valuations, and carbon baseline, monitoring and verification studies.
- Current focus on energy efficiency potential and demand response studies, market research on customer response to various incentives, and carbon reduction projects in eastern and central Europe for the World Bank to support sales of more than one hundred million dollars of emission reductions.
- Specialized expertise in econometrics, statistics, load research, and survey and experimental design for electric utilities.
- MA Degree and PhD coursework in economics completed.

PROFESSIONAL EXPERIENCE

Power System Engineering - Madison, Wisconsin (1988 - Present)

Executive Consultant

Manager and principal investigator on senior level consulting projects in emerging practice areas such as energy efficiency and demand response potential and economic evaluations, probabilistic load forecasting and MISO Module E forecasting, carbon studies, and development of monitoring and verification methods for projects proposed for grant funding under 2009 stimulus bill authorizations. Senior advisor and Technical Reviewer for PSE load forecasting and load research projects. Author of Guidebook for Energy Efficiency and Demand Response for the Cooperative Research Network of the National Rural Electric Cooperative Association to be published in June 2009. Frequent speaker and trainer at national and regional conferences on Energy Efficiency, Demand Response and Carbon topics.

Vice President of Economics and Market Research
Manager of Resource Planning

Managerial and primary technical responsibility for resource planning work including power supply, load and price forecasting, competitive assessments, load and market research, risk measurement and management. Also serving as Client Liaison to the World Bank for PSE work in Central and Eastern Europe related to renewable energy and reductions in carbon emissions.

Chief Economist
Senior Staff
Technical responsibility for all PSE economic analyses. Serving as project manager, technical reviewer and client liaison for projects with primary economic or financial focus for both domestic and international clientele.

Manager of Forecasting and Economic Studies
Department head with both technical and supervisory responsibility for load forecasting, financial forecasting, power supply studies and integrated resource planning.

Principal Economist
Project manager with primary technical responsibility for load forecasting, economic feasibility studies, acquisition evaluations, and power supply studies.

Stanley Consultants, Inc. – Muscatine, Iowa (1973 – 1988)

Positions ranging from Senior Economist to Subsidiary Vice President
Wide ranging experience in economic analyses of projects in transportation, water resources, and power sectors for both domestic and international clients in 12 countries.

Grinnell College - Grinnell, Iowa (1969 – 1973)
Instructor of Economics
Taught courses including introductory micro and macro economics, international economics, statistical analysis, and a senior seminar in econometrics.

EDUCATION
University of Wisconsin
Ph.D. course work completed, Economics
MA, Economics
John Carroll University
BA, Magna Cum Laude, Mathematics
Completed Short Courses in:

- Load Forecasting in a Restructured Electric Industry
- Price Forecasting in Deregulated Electric Markets
- Integrated Resource Planning and Demand-Side Management
- Strategic Marketing
- Merchant Power Plant Development
- Electric System Valuation
- Bidding Strategies in LMP Markets

PROFESSIONAL MEMBERSHIPS
- American Economics Association
- National Association of Business Economists
- American Statistical Association

Erik S. Sonju

Power System Engineering, Inc.

SUMMARY OF EXPERIENCE & EXPERTISE

- Experienced Professional Engineer on projects involving electric transmission and distribution system planning, transmission and distribution design, post construction inspections, and system coordination and protection plans.
- Other specialties include reliability assessment and improvement plans, interconnection of distributed generation, connection of large loads, and system operations and maintenance.
- Instructor for professional development in distribution line design and staking courses for various cooperative state wide organizations and investor owned utilities.
- Instructor for professional development in distribution system protection and coordination courses for the National Rural Electric Cooperative Association.
- Registered Professional Engineer in the states indicated below.

PROFESSIONAL EXPERIENCE

Power System Engineering Inc. - Madison, Wisconsin (2006 – Present)

Leader of System Planning & Line Design

Responsible for projects involving transmission and distribution system planning, transmission and distribution line design, overcurrent protection, economic analysis, system operations and maintenance, distributed generation interconnection applications and enterprise databases.

Accomplishments:

- Led and performed transmission short range and long range plans for Minnesota and Arkansas transmission system owners.
- Led and performed distribution short range and long range plans for Illinois, Michigan, Minnesota and Wisconsin distribution system owners.
- Led and performed transmission and sub-transmission energy and demand loss studies for FERC and Kansas PUC rate filings.
- Led and performed distributed generation system impact studies up to 5MW aggregated output capacity.
- Led and performed 34.5 kV through 161 kV transmission line design projects in Arkansas, Iowa, Minnesota, Texas and Virginia.
- Led and performed distribution line design projects in Iowa, Kansas, Michigan, Minnesota and Wisconsin.

Great Lakes Energy - Boyne City, MI (2001 - 2006)

System Engineer and Manager of Engineering & System Technology

Responsibilities included system planning, system protection, daily engineering support, mapping, line design, metering, and distribution system technology applications for a 120,000-member electric distribution cooperative.

Accomplishments:

- Established Engineering Department Strategic Plan after the merger of three electric distribution cooperatives.
- Led in the development of uniform construction design and material standards.
- Led the consolidation of the Milsoft Windmil engineering model designed for the Milsoft DisSPatch outage management system.
- Led the development of a three-year $63.7 million Construction Work Plan.
- Developed system protection and coordination standards. Led the development of a system wide sectionalizing study for over 80 substation areas.
- Team member in the development of Distributed Generation Interconnection Standards for the state of Michigan.
- Established electrical distribution requirements for industrial loads over 1 MW.

Heartland Engineering Services - Rockford, MN (1999 - 2001)

System Engineer

Co-founder of an engineering consulting firm for utilities owning transmission and distribution facilities. Responsible for a wide range of engineering, project management and client relation functions.

Accomplishments:

- Project Coordinator for the construction of a 69 kV to 2.4/4.16 kV, 5 MVA substation and feeder exits. Project included equipment specifications and quote review of steel, grounding material, foundations, high side structure, low side structure, reclosers, voltage regulators, metering and fence.
- Lead Engineer in the investigation and structural analysis of over 100 miles of transmission line that experienced isolated premature failure associated with reconductoring.
- Assisted in the lighting design for the downtown main street of Montevideo, Minnesota.
- Project Manager in the development of a three-year, $25 million Construction Work Plan.
- Developed power factor correction study for the City of Olivia, Minnesota.
- Lead Engineer in the development of protection/sectionalizing studies for three cooperative distribution systems.

- Lead Engineer in the design and construction of six miles of 69 kV transmission line.
- Assisted in the development of a capital credit allocation study for a large cooperative customer.
- Assisted in the development of a cost of service/rate study for a proposed ethanol plant facility.

United Services Group - Elk River, MN (1997 - 1999)

Planning Engineer

Responsible for short and long-range distribution planning studies, reliability analysis, system protection plans, and distribution design projects.

Accomplishments:

- Team member in the development of a distribution system Construction Work Plan.
- Developed multiple phase coordination plans between 69 kV to 7.2/12.47 kV distribution substations and feeder ties.
- Team member in the development of a 7.2/12.47 kV Distribution System Protection Study.
- Team member in the development of a Long Range Construction Work Plan.
- Examined the design calculations of approximately 20 miles of existing 69 kV transmission line. Identified structural weak areas and developed upgrade recommendations.
- Designed and staked over 100 miles of overhead and underground 7.2/12.47 kV distribution facilities.
- Designed and supervised the installation of a series capacitor bank on a 7.2/12.47 kV rural distribution line for voltage stabilization during motor starting.

EDUCATION

North Dakota State University - Fargo, North Dakota, 1997
Bachelor of Science Degree in Electrical Engineering

Continuing Education Courses in:

- PLS-CADD Design of Overhead Transmission Line Design using PLS-CADD
- PSS/E – Introduction to Power Flow and Steady-State Analysis
- NRECA Management Internship Program – University of Nebraska
- Power System Reliability and Risk Assessment – Iowa State University
- Siemens Power Voltage Regulator College
- Cooper Power Systems Distribution System Overcurrent Protection
- S&C Power Quality Seminar
- Rockwell International Electric Motor Seminar

- National Electric Safety Code – University of Wisconsin

REGISTRATIONS

- Arkansas
- Florida
- Illinois
- Indiana
- Iowa
- Kansas
- Michigan
- Minnesota
- South Dakota
- Wisconsin
- Wyoming

PROFESSIONAL MEMBERSHIPS

- NRECA T&D Engineering Committee – Power Quality Subcommittee Member
- Institute of Electrical and Electronic Engineers

PSE Power System Engineering, Inc.

Madison, WI · Minneapolis, MN · Marietta, OH · Indianapolis, IN · Sioux Falls, SD