

Benchmarking Ontario Power Distributors

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Introduction

The OEB, with jurisdiction over 80 + distributors, has long been interested in using statistics to benchmark their costs

Uniform system of account data suitable for benchmarking have been gathered by Board staff for several years

Pacific Economics Group (PEG) advises Board staff on appropriate benchmarking methods

We are dedicated to objective research in the public interest

This presentation provides an overview of our work to date

Plan of Presentation

Benchmarking Basics

Benchmarking Power Distributor Cost

Benchmarking Methods and Applications

Econometric Cost Models

Unit Cost Indexes

Productivity Indexes

Benchmarking Basics

Benchmarking Basics

Benchmarking: Performance evaluation using comparisons to benchmarks that embody performance standards

Performance Indicators Variables that measure company activities (*e.g.* $\text{Cost}^{\text{Northstar}}$)

Benchmarks Values for these variables that reflect a performance standard (*e.g.* $\text{Cost}^{\text{Bench}}$)

Appraisal Mechanism Method for comparing activity variables to benchmarks
e.g. $\text{Cost}^{\text{Northstar}} / \text{Cost}^{\text{Bench}}$

Benchmarking Basics (cont'd)

Statistical Benchmarking

Any approach to benchmarking that uses statistical methods

Several uses in benchmarking:

- Use industry data to create benchmarks
- Make efficiency appraisals
(*e.g.* statistical tests of efficiency hypotheses)

Benchmarking Basics (cont'd)

External Business Conditions

Performance indicators (*e.g.* unit cost) depend on

- Utility performance
- External business conditions:

Conditions beyond the control of utilities that influence (“drive”) their activities

>>> *Variation in KPIs depends chiefly on variation in external business conditions*

External Business Conditions (cont'd)

Accurate benchmarks “control” for external business conditions

>>> benchmark comparisons isolate performance

External Business Conditions (cont'd)

Cost theory sheds light on cost drivers

Relevant drivers depend on *scope* of benchmarking study

1. Comprehensive Cost Benchmarking

Focus on *total* cost of service (O&M + capital)

$$\text{Total Cost} = f(W, Y, Z)$$

W prices of all inputs

Y output measures (can be multiple)

Z other business conditions

External Business Conditions (cont'd)

2. Non-Comprehensive Benchmarking

e.g. O&M Expenses, Labor Expenses, Line Maintenance Expenses

$$\text{Included Cost} = f(W^{\text{included}}, Y, Z, X^{\text{excluded}})$$

W^{included}	prices of <i>included</i> inputs
Y	output measures (can be multiple)
Z	other business conditions
X^{excluded}	quantities of <i>excluded</i> inputs

2. Non-Comprehensive Benchmarking (cont'd)

Excluded inputs matter due to substitution
arbitrary cost classifications

e.g. Distribution Labor

$$X^{\text{excluded}} = \frac{\text{Quantity of Dx Materials \& Services}}{\text{Quantity of Capital}}$$

>>> Excluded inputs greatly complicate benchmarking

>>> Benchmarking accuracy generally greater at aggregate level

Benchmarking Basics (cont'd)

Capital Cost

Benchmarking often requires capital cost, prices and/or quantities

$$\text{Cost}^{\text{Capital}} = \text{Quantity}^{\text{Capital}} * \text{Price}^{\text{Capital}}$$

Specification depends on method for

Valuing plant

Book (original cost)

Replacement (current cost)

Calculating depreciation

Straight line

Geometric (constant rate) decay

Capital Cost (cont'd)

Capital Quantity Index

Capital quantity indexes often use “perpetual inventory equations”

$$\text{Quantity}^{\text{Capital}}_t = (1-d) * \text{Quantity}^{\text{Capital}}_{t-1} + \text{Capex}_t / \text{WKA}_t$$

Builds on (inflation-adjusted) net plant value in benchmark year

Accuracy enhanced by distant benchmark year (*e.g.* 1965)

Requisite data often unavailable outside US

Capital Quantity Index (cont'd)

Absent capital quantity index, O&M benchmarking benefits from other capital quantity data

System capacity (*e.g.* Substation capacity)

Plant value (net or gross)

System age

The Comprehensiveness Issue

Scope of benchmarking is key threshold issue

Comprehensive: Pro

Total cost matters most in longer run

Most utility businesses are capital intensive

Fewer cost allocation problems

Hard to control for “excluded” inputs

The Comprehensiveness Issue (cont'd)

Non-Comprehensive: Pro

Total cost includes *old* capital

Can't be controlled

Hard to benchmark

Data requirements

Plant vintage issues

Focus on *controllable* costs

Identify areas of strength and weakness

Data Volatility

Data used in cost benchmarking inherently volatile

Some expenditures made intermittently

- Maintenance
- Replacement capex

Certain output measures also volatile (*e.g.* max demand)

Benchmarking Solutions

Performance should be measured using multi-year averages

Benchmarking Power Distributor Cost

Distribution Cost Drivers

Operating Scale

Chief source of variation in sampled costs

Quantity “drivers” of distribution cost

- Customers served
- Peak load
- Delivery volume
- Service quality
- Line length

Service quality rarely considered in benchmarking

Scale Economies

Scale economies vary greatly in Ontario

Incremental scale economies still available up to 1,000,000 customers

Diseconomies may exist beyond this stage

Input Prices

Well documented source of cost variation

Labor & construction costs most likely to vary

Considerable variation in Ontario

High Price Areas: Toronto

Low Price Areas: Thunder Bay

Ruralization & Forestation

Customer density of systems varies widely

High ENWIN, Hydro Mississauga, THES

Low Great Lakes Power, Hydro One, Sioux Lookout

Low density >>> high cost

Density commonly measured with line miles

Forestation boosts cost impact of ruralization

Rural forestation can be estimated with maps

Undergrounding

Undergrounding depends on Urbanization
Local Regulation

Impact depends on cost category

Total cost, capital cost	Undergrounding <i>raises</i> cost
O&M	Undergrounding <i>lowers</i> cost

Undergrounding varies widely in Ontario:

High: Barrie, Hydro Mississauga, Oakville

Low: Atitokan, Great Lakes, Hydro One

System Age

System age varies across US, Canada

Older systems typically involve

- lower capital cost
- higher O&M expenses

Solutions

- Choose peer group with similar age
- Add system age or capital quantity index to cost model

Customer Care Cost Drivers

Customer Turnover

Language Diversity

Retail Competition

Ontario LDC Data

The Good News

Available data are generally of good quality

Sample large & varied enough to develop decent econometric model

Better models possible as data accumulate

Ontario LDC Data (cont'd)

Data Challenges

Capitalization of O&M Expenses
Categorization of O&M Expenses
Service Quality
Deliveries to Other Distributors
Capital Cost
System age

>>> Accurate benchmarking must presently be confined to total O&M expenses

Ontario LDC Data (cont'd)

Data Challenges

Capitalization of O&M Expenses
Categorization of O&M Expenses
Service Quality
Deliveries to Other Distributors
Capital Cost
System age

>>> Accurate benchmarking must presently be confined to total O&M expenses

II. Benchmarking Methods

3 well established approaches to statistical cost benchmarking

- **Econometric Modeling**
- **Indexing (Unit Cost & Productivity)**
- **Data Envelope Analysis**

Each can be used...

- for comprehensive or detailed benchmarking
- with alternative performance standards

Econometric Cost Models

Basic Idea

Formulate a cost model

$$\text{Cost} = \beta_0 + \beta_1 \text{Price}_{\text{Labor}} + \beta_2 \text{Customers}$$

Price, Customers

$\beta_0, \beta_1, \beta_2$

business condition variables

model parameters

Estimate parameters using data on utility operations

Models can have multiple prices, outputs, other business conditions

Econometric Cost Models (cont'd)

Business Condition Variables

Specification should be guided by

- Economic theory (*e.g.* input prices, outputs)
- Casual Empiricism
- Statistical results

e.g. Parameter estimates must be

- Sensible
- Statistically significant at 90% confidence level

Functional Forms

Double log form

$$\ln C = \beta_0 + \beta_1 \ln Price_{Labor} + \beta_2 \ln Customers$$

Parameters measure cost elasticities

elasticity = % change cost due to 1% growth customers

Functional Forms (cont'd)

Flexible forms can better capture non-linear relations

PEG uses transcendental logarithmic (translog) functional form

$$\begin{aligned}
 \ln C = & \beta_0 + \beta_1 \ln Price_{Labor} + \beta_2 \ln Customers \\
 & + \beta_{11} \ln Price_{Labor} \ln Price_{Labor} \\
 & + \beta_{22} \ln Customers \ln Customers \\
 & + \beta_{12} \ln Price_{Labor} \times \ln Customers
 \end{aligned}$$

Better for capturing differential opportunities for scale economies

Use in Benchmarking

Cost can be projected using

- Econometric parameter estimates (*e.g.* b_0 , b_1)
- Business conditions for subject utility

$$\text{Cost}^{\text{Northstar}} = b_0 + b_1 \text{Price}_{\text{Labor}}^{\text{Northstar}} + b_2 \text{Customers}^{\text{Northstar}}$$

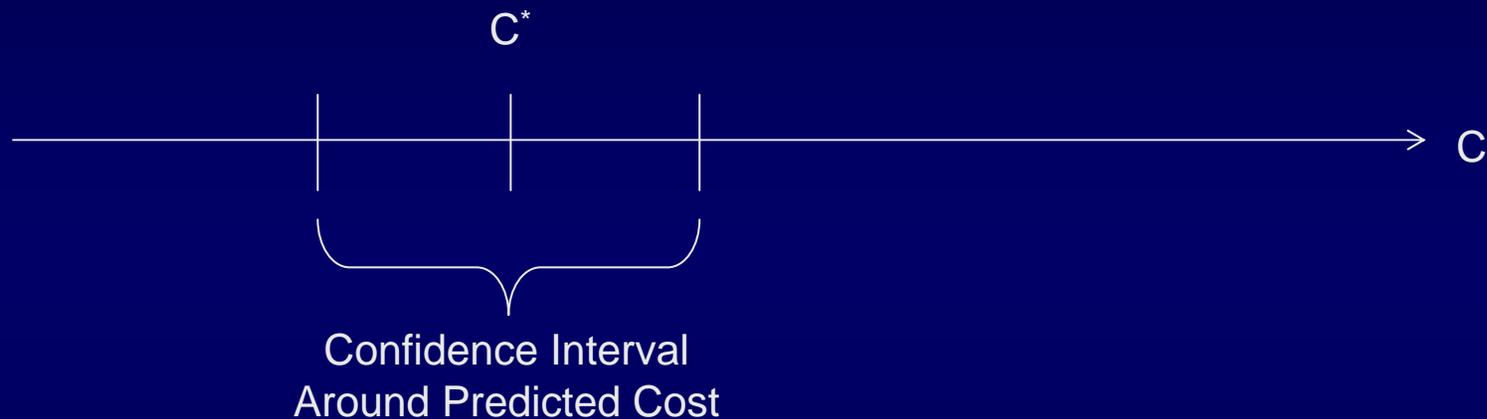
Model can be used to benchmark historical or future costs

Compare to company's actual or forecasted (*e.g.* forward test year) cost

$$\text{Performance} = \text{Cost}_{\text{Actual}} / \text{Cost}_{\text{Projected}}$$

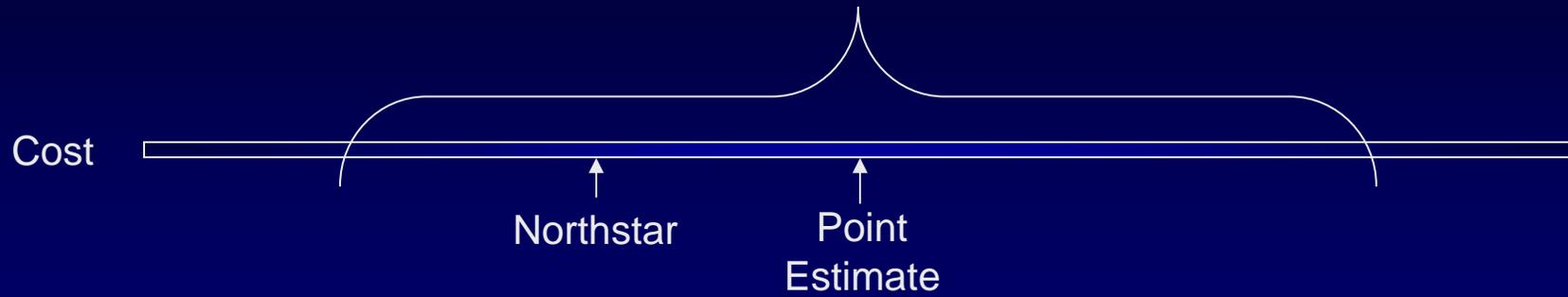
Statistical Tests of Efficiency Hypotheses

Confidence interval can be constructed around model's prediction

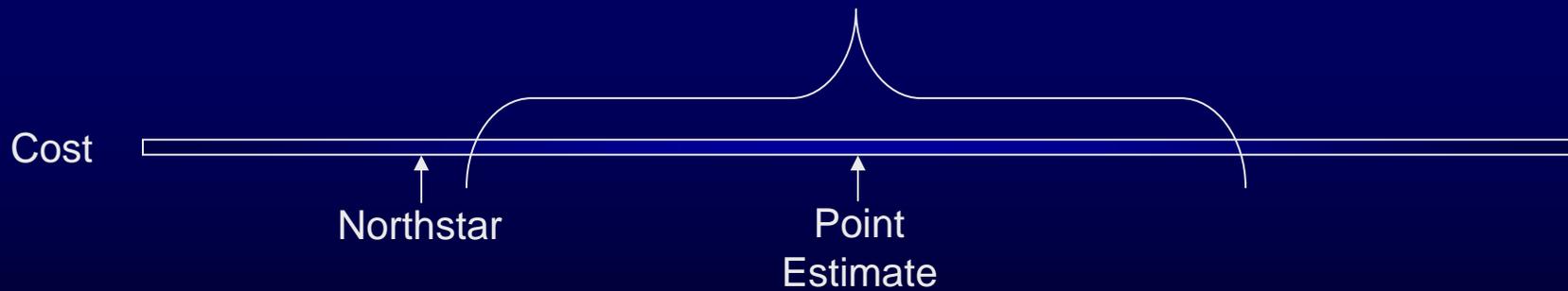


If C^{Actual} lies in interval, performance **NOT** “significantly” different from model projection

Average Performer



Significantly Superior



Statistical Tests of Efficiency Hypotheses (cont'd)

Confidence intervals are wide to the extent that

- Explanatory power of model is low (*e.g.* low R^2)
- Sample size small
- Sample isn't heterogeneous
- Benchmarked utility is “oddball”

>>> Hard to draw efficiency conclusions in many instances

PEG Econometric Results: USA

PEG has prepared several econometric studies of power distributor cost using US data

Local Delivery + Customer Service

Energy Journal June 2005

Most recent study: August 2006 testimony for SDG&E

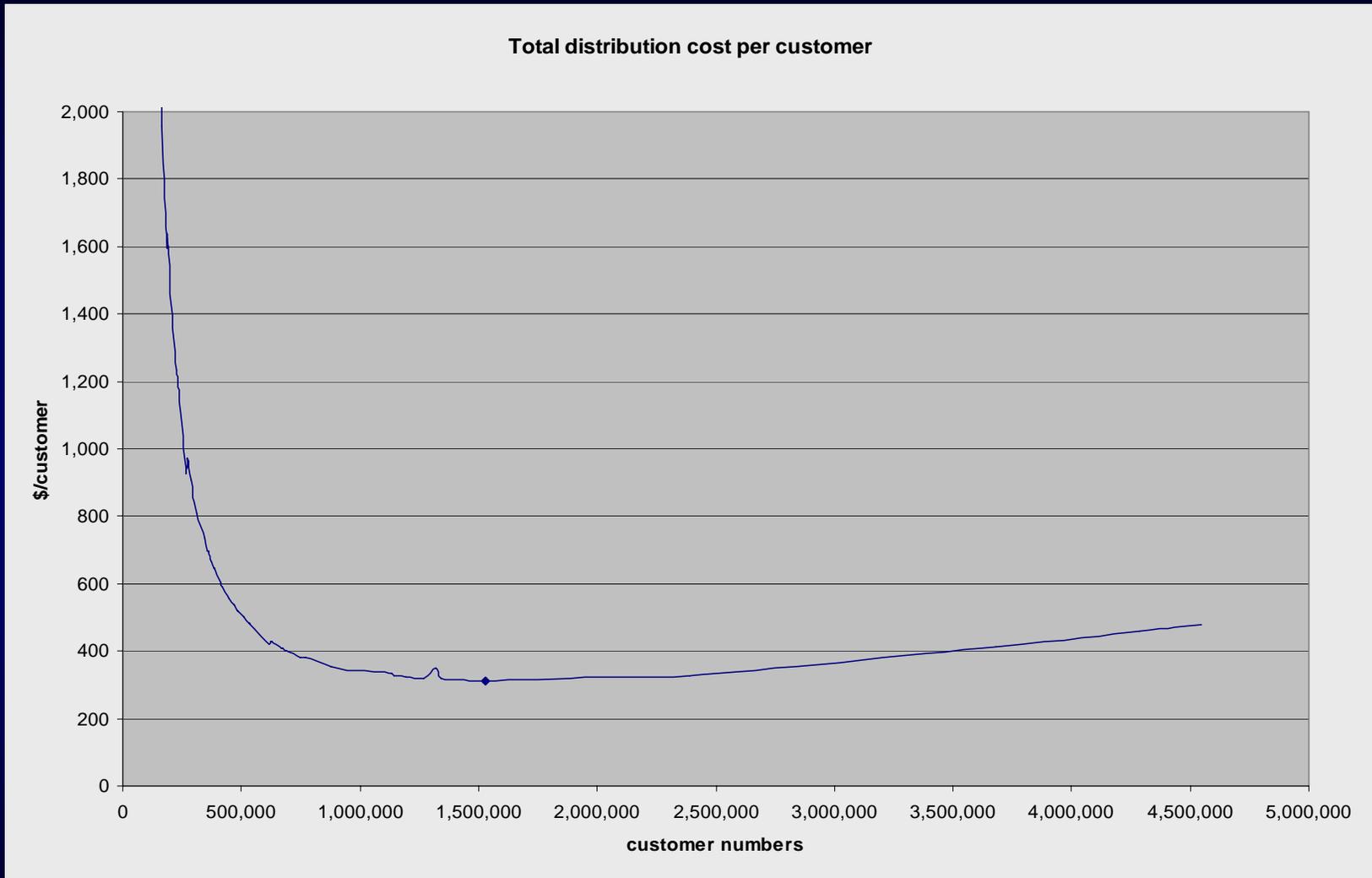
- *Total* cost focus
- 70+ U.S. companies
- 1994-2002 sample period

ECONOMETRIC COST MODEL FOR POWER DISTRIBUTION

VARIABLE KEY

- L = Labor Price
- K = Capital Price
- N = Number Customers
- V = Total Throughput
- M = Distribution Line Miles
- OH = % Plant Overhead
- NG = Number of Gas Customers
- Nadd20 = Twenty Year Customer Growth
- TF = % Territory Forested
- VRC = % Deliveries Residential and Commerical
- NC = Non-Contiguous Service Territory
- TXGX = O&M Expenses for Transmission and Generation
- CD= Competiton Dummy

EXPLANATORY VARIABLE	PARAMETER ESTIMATE	T-STATISTIC	EXPLANATORY VARIABLE	PARAMETER ESTIMATE	T-STATISTIC
WL	0.167	117.55	OH	-0.711	-13.46
LL	-0.074	-4.78	OHM	-0.337	-5.54
LK	0.006	0.53			
LN	0.019	3.66	NG	-0.007	-9.04
LV	-0.039	-9.04			
LM	0.002	0.60	Nadd20	-0.039	-2.81
WK	0.549	266.27	TF	0.064	12.25
KK	0.059	3.30	TFM	0.064	12.96
KN	-0.058	-8.68			
KV	0.092	15.11	VRC	0.281	8.31
KM	-0.017	-3.37			
N	0.410	15.77	NC	0.012	5.76
NN	0.730	7.05	TXGX	-0.020	-2.93
NV	-0.595	-6.24			
NM	-0.142	-2.43	CD	0.005	2.50
V	0.406	19.05	Trend	-0.017	-16.56
VV	1.009	11.22			
VM	-0.368	-7.83	Constant	19.290	1217.52
M	0.199	12.11			
MM	0.461	7.54	System Rbar-Squared	0.985	
			Number of Obsevation	979	



PEG Econometric Results: Ontario Power Distribution

PEG prepared econometric benchmarking models of power distributor O&M expenses using Ontario data

85 companies, many small

2002-2005

Translog and double log forms considered

Table 1

SAMPLED POWER DISTRIBUTORS FOR BENCHMARKING RESEARCH¹

Company	Customers Served, 2005	Staff Grouping	Headquarters Location
Atikokan Hydro	1,765	Small Northern	W, near Quetico Provincial Park
Barrie Hydro Distribution	65,812	GTA Towns	SC, on Lake Simcoe
Bluewater Power Distribution	34,736	Southwestern Midsize Towns	SW on Detroit River
Brant County Power	9,149	Southwestern Small Towns	SW 40 km W Hamilton
Brantford Power	35,986	GTA Towns	SW, 30 km SW Hamilton
Burlington Hydro	59,537	GTA Towns	SW, near Hamilton
Cambridge and North Dumfries Hydro	47,346	GTA Towns	SW, 30 km NW Hamilton
Centre Wellington Hydro	6,086	GTA Towns	SW, 20 km NW Guelph
Chapleau Public Utilities	1,353	Small Northern	NC, 60 km E Lake Superior Provincial Park
Chatham-Kent Hydro	31,955	Southwestern Midsize Towns	SW, 20 km E Lake St. Clair
Clinton Power	1,633	Southwestern Small Towns	SW, 15 km E Lake Huron
COLLUS Power	14,124	Southwestern Small Towns	SW, on Georgian Bay
Cooperative Hydro Embrun	1,791	Small Eastern	SE 40 KM ESE of Ottawa
Dutton Hydro	586	Southwestern Small Towns	SW 10 km N Lake Erie
Eastern Ontario Power (CNP)	3,537	Eastern	SE on St. Lawrence
E.L.K. Energy	10,524 (2004)	Southwestern Midsize Towns	SW, 30 km SE Windsor
Enersource Hydro Mississauga	178,140	Large City Southern	SC Suburban Toronto
ENWIN Powerlines	84,254	Large City Southern	SW on Detroit River
Erie Thames Powerlines	13,570	Southwestern Midsize Towns	SW 15 km N Lake Erie
Espanola Regional Hydro Distribution	3,315	Small Northern	C 40 km N Little Current
Essex Powerlines	27,437	Southwestern Midsize Towns	SW 30 KM ESE Windsor
Festival Hydro	18,860	Southwestern Midsize Towns	SW 40 km ESE Kitchener
Fort Erie (CNP)	15,230	Southwestern Midsize Towns	Niagara Peninsula, near Buffalo
Fort Frances Power	4,040	Small Northern	W, adjacent to International Falls. MN
Grand Valley Energy	682	Southwestern Small Towns	SW, Between Barrie and Toronto
Great Lakes Power	11,457	Large Northern	C, on Sault St. Marie
Greater Sudbury Hydro	42,814	Large Northern	C, Sudbury
Grimby Power	9,530	Southwestern Small Towns	SC, on Niagara Peninsula 20 km W Hamilton
Guelph Hydro Electric Systems	44,556	GTA Towns	SW, 50 km NW Hamilton
Haldimand County Hydro	20,462	Southwestern Midsize Towns	SW, 20 km SW Hamilton
Halton Hills Hydro	19,873	Southwestern Small Towns	SW, 60 km W Toronto
Hearst Power Distribution	2,780	Large Northern	NC, 300 km NNW Wawa
Horizon Utilities	230,327	Large City Southern	SW, 60 km SW Toronto
Hydro 2000	1,130	Small Eastern	SE 20 KM west of Hawkesbury (WL), 70 KM east of Ottawa (WK)
Hawksbury Hydro	5,248	Small Eastern	SE, on Ottawa River 60 KM ENE Ottawa
Hydro One Networks	1,151,989	Unclassified	SC, Toronto
Hydro One Brampton Networks	116,166	Large City Southern	SC, Suburban Toronto
Hydro Ottawa	278,581	Large City Southern	SE, Ottawa
Innisfil Hydro Distribution Systems	13,793	Southwestern Midsize Towns	SC, 12 KM south of Barrie
Kenora Hydro Electric	5,847	Large Northern	W, Kenora on Lake of the Woods
Kingston Electricity Distribution	26,265	Small Eastern	SE, on St. Lawrence River
Kitchener-Wilmot Hydro	79,487	GTA Towns	SW, 15 km SW Guelph
Lakefront Utilities	8,551	Eastern	SC, on Lake Ontario 100 km E Toronto
Lakeland Power Distribution	8,995	Small Northern	C, between Georgian Bay & Algonquin PP
London Hydro	138,046	Large City Southern	SW, London
Middlesex Power Distribution	6,829	Southwestern Midsize Towns	SW, 80 km E Windsor
Midland Power Utility	6,516	Southwestern Small Towns	C, on Georgian Bay 50 km N Barrie
Milton Hydro Distribution	19,858	GTA Towns	SW, 35 km N Hamilton

Table 1 continued

Newbury Power	189	Southwestern Small Towns	SW, 49 km SW London
Newmarket Hydro	26,176	GTA Towns	SC, between Toronto & Lake Simcoe
Niagara Falls Hydro	33,683	GTA Towns	SC, Niagara Peninsula
Niagara-on-the-Lake Hydro	7,466	Southwestern Small Towns	SC, Niagara Peninsula 15 km N Niagara Falls
Norfolk Power Distribution	18,171	Southwestern Small Towns	SW, near Lake Erie
North Bay Hydro Distribution	23,405	Large Northern	C, on Lake Nipissing 160 km E Sudbury
Northern Ontario Wires	6,202	Large Northern	NE 105 NNE Timmins
Oakville Hydro Electricity Distribution	54,677	GTA Towns	SC, Suburban Toronto on Lake Ontario
Orangeville Hydro	9,927	Southwestern Small Towns	SW, 80 km NW Toronto
Orillia Power Distribution	12,374	Southwestern Midsize Towns	SC, on Lake Simcoe 35 km NE Barrie
Ottawa River Power	10,190	Small Northern	C, on Ottawa River near Algonquin PP
Parry Sound Power	3,265	Small Eastern	C, on Georgian Bay 130 km N Barrie
Peninsula West Utilities	14,988	Southwestern Small Towns	SW, Niagara Peninsula 38 km E Hamilton
Peterborough Distribution	33,531	Small Eastern	70 km ENE Toronto
Port Colborne	9,135	Southwestern Midsize Towns	SC, Niagara Peninsula on Lake Erie 60 km W Buffalo
Powerstream	219,788	Large Southern	SC, suburban Toronto
PUC Distribution	32,497	Large Northern	C, Sault St. Marie
Renfrew Hydro	4,116	Small Eastern	SE, 90 km W Ottawa
Rideau St. Lawrence Distribution	5,823	Small Eastern	SE, on St. Lawrence River 100 km SSE Ottawa
Sioux Lookout Hydro	2,760	Large Northern	W, 230 km ENE Kenora
St. Thomas Energy	15,243	Southwestern Midsize Towns	SW, 10 km N Lake Erie
Tay Hydro Electric Distribution	3,990	Southwestern Small Towns	SC, near Georgian Bay 50 KM north of Barrie
Terrace Bay Superior Wires	938	Large Northern	NC, on Lake Superior 215 km E Thunder Bay
Thunder Bay Hydro Electricity Distribution	49,558	Large Northern	W, on Thunder Bay
Tillsonburg Hydro	6,343	Southwestern Small Towns	SW, 62 km ESE London
Toronto Hydro-Electric System	676,678	Large City Southern	SC, at center of Golden Horseshoes on Lake Ontario
Veridian Connections	106,730	Large City Southern	SC, on Lake Ontario between Toronto & Oshawa
Wasaga Distribution	10,545	Southwestern Midsize Towns	SC, on Georgian Bay 38 km NW Barrie
Waterloo North Hydro	48,041	GTA Towns	SW, adjacent to Kitchener 100 km WSW Toronto
Welland Hydro-Electric System	21,430	GTA Towns	SW, Niagara Peninsula 70 km W Buffalo
Wellington North Power	3,416	Southwestern Small Towns	SW, between Kitchener & Owen Sound
West Coast Huron Energy	3,773	Southwestern Small Towns	SW, on Lake Huron 129 km ENE Sarnia
West Nipissing Energy Services	3,101	Large Northern	C, on Lake Nipissing 38 km E North Bay
West Perth Power	2,653	Southwestern Small Towns	SW, 80 km N London
Westario Power	20,699	Southwestern Midsize Towns	SW, on Lake Huron 89 KM SW Owen Sound
Whitby Hydro Electric	36,235	GTA Towns	SC, on Lake Ontario between Ajaz and Oshawa
Woodstock Hydro Services	14,195	Southwestern Midsize Towns	SW, on Thames River 50 km ENE London

¹ Oshawa Hydro, which has not been benchmarked due to data problems, is a GTA utility that served 49,498 customers in 2005.

Table 2

Econometric Model of OM&A Expenses: Double Log Form

VARIABLE KEY

WL= Labour Price
 N= Number Retail Customers
 V= Retail Deliveries
 M= Distribution Line Circuit Kilometers
 F= % Forestation of Rural Service Territory
 UN= Percent of Distribution Plant that is Underground
 CS= Canadian Shield (binary)
 NCT= Non-Contiguous Service Territory (binary)

EXPLANATORY VARIABLE	PARAMETER ESTIMATE	T-STATISTIC	EXPLANATORY VARIABLE	PARAMETER ESTIMATE	T-STATISTIC
WL	0.794	4.835	F	0.014	2.992
N	0.643	20.738	UN	-0.059	-5.833
V	0.142	4.911	CS	0.015	3.522
M	0.140	8.871	NCT	0.004	1.650
Constant	15.788	2081.988			

Other Results

System Rbar-Squared 0.977
 Sample Period 2002-2005
 Number of Observations 324

Table 3

Econometric Model of OM&A Expenses: Translog Form

VARIABLE KEY

WL= Labour Price
 N= Number Retail Customers
 V= Retail Deliveries
 M= Distribution Line Circuit Kilometers
 UN= Percent of Distribution Plant that is Underground
 CS= Canadian Shield (binary)

EXPLANATORY VARIABLE	PARAMETER ESTIMATE	T-STATISTIC	EXPLANATORY VARIABLE	PARAMETER ESTIMATE	T-STATISTIC
WL	1.124	4.544	M	0.138	5.385
WLWL	4.294	0.522	MM	0.209	4.769
WLN	-3.727	-3.288	UN	-0.034	-3.216
WLV	5.356	5.707	CS	0.024	5.186
WLM	-2.423	-5.739	Constant	15.805	1754.127
N	0.576	14.465			
NN	-0.246	-0.957			
V	0.224	6.307			
VV	-0.208	-1.314			

Other Results

System Rbar-Squared 0.98
 Sample Period 2002-2005
 Number of Observations 324

Table 4

Effects of Cost Performance: Translog & Double Log Models

	Years Benchmarked	Translog Model					Double Log Model				
		Actual/Predicted	Deviation Percentage	P-Value	Excess Cost in \$	Rank	Actual/Predicted	Deviation Percentage	P-Value	Excess Cost in \$	Rank
		[A]	[A-1]				[A]	[A-1]			
Hydro 2000	2002-2005	0.686	-0.314	0.096	-74,601	1	0.647	-0.353	0.089	-88,784	1
Hydro One Brampton Networks	2002-2005	0.707	-0.293	0.001	-5,556,551	2	0.757	-0.243	0.012	-4,278,375	9
Hydro Hawkesbury	2002-2005	0.714	-0.286	0.007	-262,382	3	0.654	-0.346	0.000	-346,746	2
Newbury Power	2002-2005	0.717	-0.283	0.110	-16,382	4	0.835	-0.165	0.249	-8,156	16
Hearst Power	2002-2005	0.733	-0.267	0.011	-186,012	5	0.721	-0.279	0.005	-197,236	4
Kitchener-Wilmot Hydro	2002-2005	0.736	-0.264	0.001	-3,356,860	6	0.727	-0.273	0.001	-3,510,160	5
Tay Hydro Electric	2002-2005	0.767	-0.233	0.104	-392,542	7	0.703	-0.297	0.013	-307,747	3
Lakefront Utilities	2002-2004	0.767	-0.233	0.014	-221,328	8	0.819	-0.181	0.131	-286,424	14
Lakeland Power	2002-2005	0.773	-0.227	0.014	-565,560	9	0.820	-0.180	0.046	-422,585	15
Port Colborne (CNP)	2002-2005	0.775	-0.225	0.052	-416,948	10	0.751	-0.249	0.031	-475,272	8
Barrie Hydro	2002-2005	0.789	-0.211	0.054	-2,070,698	11	0.748	-0.252	0.031	-2,627,633	7
Grimsby Power	2002-2005	0.801	-0.199	0.045	-326,436	12	0.735	-0.265	0.006	-473,100	6
Cooperative Hydro Embrun	2002-2005	0.806	-0.194	0.026	-72,437	13	0.886	-0.114	0.167	-38,644	22
Cambridge & North Dumfries	2002-2005	0.811	-0.189	0.024	-1,649,361	14	0.842	-0.158	0.062	-1,331,706	17
Niagara-on-the-Lake Hydro	2002-2005	0.813	-0.187	0.028	-291,049	15	0.817	-0.183	0.042	-283,286	13
Chatham-Kent Hydro	2004-2005	0.818	-0.182	0.021	-1,045,214	16	0.807	-0.193	0.023	-1,131,966	12
Renfrew Hydro	2002-2005	0.827	-0.173	0.046	-150,659	17	0.775	-0.225	0.011	-208,202	11
Orangeville Hydro	2002-2005	0.849	-0.151	0.069	-294,264	18	0.905	-0.095	0.205	-171,832	25
E.L.K. Energy	2002-2005	0.874	-0.126	0.166	-242,263	19	0.937	-0.063	0.282	-114,357	30
Festival Hydro	2002-2005	0.875	-0.125	0.165	-423,298	20	0.878	-0.122	0.134	-409,824	20
Halton Hills Hydro	2002-2005	0.877	-0.123	0.107	-524,215	21	0.849	-0.151	0.093	-663,047	18
Wasaga Distribution	2002-2005	0.906	-0.094	0.158	-133,289	22	0.763	-0.237	0.025	-398,683	10
Fort Frances Power	2002-2005	0.907	-0.093	0.177	-93,677	23	0.863	-0.137	0.099	-144,073	19
Burlington Hydro	2002-2005	0.908	-0.092	0.171	-969,802	24	0.901	-0.099	0.170	-1,043,495	23
Hydro Ottawa	2002-2005	0.917	-0.083	0.096	-3,415,957	25	0.907	-0.093	0.093	-3,869,409	26
Guelph Hydro Electric Systems	2002-2005	0.931	-0.069	0.258	-554,396	26	0.977	-0.023	0.409	-175,301	40
Milton Hydro Distribution	2002-2005	0.934	-0.066	0.232	-85,131	27	0.944	-0.056	0.263	-212,953	31
Kenora Hydro Electric	2002-2005	0.934	-0.066	0.248	-250,934	28	0.950	-0.050	0.318	-63,302	33
St. Thomas Energy	2002-2005	0.940	-0.060	0.285	-159,655	29	0.965	-0.035	0.287	-93,043	35
Ottawa River Power	2002-2004	0.941	-0.059	0.298	-116,515	30	0.984	-0.016	0.358	-29,877	41
Peterborough Distribution	2002-2005	0.943	-0.057	0.280	-310,031	31	0.923	-0.077	0.233	-424,870	27
Oakville Hydro Electricity Distribution	2002-2005	0.947	-0.053	0.260	-511,115	32	0.993	-0.007	0.351	-73,990	42
Powerstream	2002-2005	0.954	-0.046	0.254	-1,610,386	33	0.974	-0.026	0.300	-847,161	37
West Perth Power	2002-2005	0.960	-0.040	0.061	-18,665	34	0.976	-0.024	0.080	-10,833	38
Waterloo North Hydro	2002-2005	0.966	-0.034	0.370	-291,019	35	0.967	-0.033	0.359	-282,562	36
Horizon Utilities	2002-2005	0.968	-0.032	0.252	-1,084,526	36	0.931	-0.069	0.235	-2,341,089	28
London Hydro	2002-2005	0.969	-0.031	0.383	-639,711	37	1.006	0.006	0.449	121,541	43
Espanola Regional Hydro Distribution	2003-2005	0.972	-0.028	0.197	-22,663	38	0.935	-0.065	0.129	-55,305	29
North Bay Hydro Distribution	2002-2005	0.974	-0.026	0.287	-118,142	39	0.905	-0.095	0.250	-485,664	24
Northern Ontario Wires	2002-2005	0.988	-0.012	0.370	-20,809	40	0.962	-0.038	0.314	-68,554	34
Haldimand County Hydro	2002-2005	0.990	-0.010	0.180	-50,003	41	1.169	0.169	0.084	718,639	67
Welland Hydro-Electric System	2002-2005	1.004	0.004	0.304	14,729	42	1.009	0.009	0.320	33,056	44
COLLUS Power	2002-2005	1.008	0.008	0.384	19,608	43	0.977	-0.023	0.404	-57,254	39
Innisfil Hydro Distribution Systems	2002-2005	1.022	0.022	0.163	53,493	44	0.884	-0.116	0.147	-321,759	21
Sioux Lookout Hydro	2002-2005	1.022	0.022	0.181	17,860	45	0.945	-0.055	0.182	-49,012	32
Woodstock Hydro Services	2002-2005	1.024	0.024	0.403	65,012	46	1.057	0.057	0.313	146,709	50
Clinton Power	2002-2005	1.025	0.025	0.364	8,369	47	1.161	0.161	0.146	48,855	65
PUC Distribution	2002-2005	1.034	0.034	0.188	196,030	48	1.023	0.023	0.250	141,529	45
West Nipissing Energy Services	2002-2005	1.041	0.041	0.311	28,231	49	1.051	0.051	0.311	35,115	49

Table 4, continued

	Years Benchmarked	Deviation from				Excess Cost in \$	Rank	Deviation from				Excess Cost in \$	Rank
		Actual/Predicted [A]	Sample Mean [A]-1	P-Value				Actual/Predicted [A]	Sample Mean [A]-1	P-Value			
Parry Sound Power	2002-2005	1.042	0.042	0.197	34,146	50	1.061	0.061	0.207	48,700	51		
Middlesex Power Distribution	2002-2005	1.043	0.043	0.143	55,658	51	1.076	0.076	0.141	95,266	55		
Rideau St. Lawrence Distribution	2002-2005	1.058	0.058	0.290	62,738	52	1.074	0.074	0.259	78,955	54		
Grand Valley Energy	2002-2005	1.059	0.059	0.314	9,442	53	1.273	0.273	0.028	36,496	74		
Norfolk Power Distribution	2002-2005	1.067	0.067	0.264	240,460	54	1.067	0.067	0.263	240,460	53		
Brantford Power	2002-2005	1.076	0.076	0.246	433,404	55	1.102	0.102	0.212	569,121	59		
Orillia Power Distribution	2002-2005	1.078	0.078	0.191	189,182	56	1.081	0.081	0.194	198,879	58		
Bluewater Power Distribution	2002-2005	1.080	0.080	0.248	523,764	57	1.112	0.112	0.172	710,804	60		
Greater Sudbury Hydro	2002-2005	1.083	0.083	0.242	243,158	58	1.063	0.063	0.295	483,001	52		
Fort Erie (CNP)	2002-2005	1.083	0.083	0.146	627,525	59	1.050	0.050	0.199	149,442	48		
Terrace Bay Superior Wires	2002-2005	1.084	0.084	0.195	21,600	60	1.046	0.046	0.240	12,481	47		
Great Lakes Power	2002-2005	1.096	0.096	0.133	540,205	61	1.640	0.640	0.000	2,378,666	83		
Newmarket Hydro	2002-2005	1.097	0.097	0.259	453,026	62	1.112	0.112	0.265	513,062	61		
Dutton Hydro	2002-2005	1.099	0.099	0.282	13,588	63	1.314	0.314	0.094	36,182	76		
Thunder Bay Hydro Electricity Distribution	2002-2005	1.116	0.116	0.139	1,071,135	64	1.076	0.076	0.260	723,913	56		
Whitby Hydro Electric	2002, 2003, 2005	1.117	0.117	0.149	690,926	65	1.037	0.037	0.354	238,881	46		
Kingston Electricity Distribution	2003-2005	1.137	0.137	0.113	584,554	66	1.134	0.134	0.120	575,912	63		
Wellington North Power	2002-2005	1.138	0.138	0.109	102,360	67	1.079	0.079	0.253	61,896	57		
Enersource Hydro Mississauga	2002-2004	1.143	0.143	0.116	4,460,773	68	1.200	0.200	0.055	5,918,723	71		
Peninsula West Utilities	2002-2005	1.143	0.143	0.227	488,834	69	1.123	0.123	0.217	423,960	62		
Centre Wellington Hydro	2002-2005	1.181	0.181	0.111	215,739	70	1.185	0.185	0.091	221,737	69		
Westario Power	2002-2005	1.188	0.188	0.082	651,887	71	1.183	0.183	0.099	641,385	68		
Eastern Ontario Power (CNP)	2002-2005	1.192	0.192	0.130	177,762	72	1.165	0.165	0.190	155,462	66		
Niagara Falls Hydro	2002-2005	1.228	0.228	0.021	1,312,580	73	1.259	0.259	0.016	1,449,386	73		
Toronto Hydro-Electric System	2002-2005	1.232	0.232	0.027	26,111,812	74	1.365	0.365	0.003	37,005,031	79		
Essex Powerlines	2002-2005	1.259	0.259	0.024	1,138,847	75	1.224	0.224	0.053	1,013,796	72		
Veridian Connections	2002-2005	1.280	0.280	0.038	4,341,254	76	1.190	0.190	0.151	3,167,842	70		
ENWIN Powerlines	2002-2005	1.292	0.292	0.040	4,529,632	77	1.487	0.487	0.001	6,571,413	82		
West Coast Huron Energy	2002-2005	1.301	0.301	0.013	264,103	78	1.405	0.405	0.006	328,077	80		
Brant County Power	2002-2005	1.318	0.318	0.024	626,533	79	1.322	0.322	0.024	630,455	77		
Tillsonburg Hydro	2002-2005	1.339	0.339	0.079	328,599	80	1.146	0.146	0.177	165,491	64		
Chapleau Public Utilities	2002-2005	1.361	0.361	0.009	123,784	81	1.358	0.358	0.008	123,097	78		
Midland Power Utility	2002-2005	1.430	0.430	0.018	481,871	82	1.302	0.302	0.026	370,681	75		
Erie Thames Powerlines	2002-2005	1.435	0.435	0.002	1,128,102	83	1.428	0.428	0.007	1,115,095	81		

The following companies were excluded due to mergers: Asphodel Norwood Distribution, Aurora Hydro Connections, Gravenhurst Hydro Electric, Guelph Hydro Electric Systems (without Wellington Electric Distribution), Hamilton Hydro, Lakefield Distribution, Peterborough Distribution (without Asphodel Norwood and Lakefield), Powerstream (without Aurora), Scugog Hydro Energy, St. Catharines Hydro Utility Services, Veridian Connections (without Gravenhurst Hydro Electric and Scugog), and Wellington Electric Distribution

These companies were excluded from the sample due to missing or inaccurate data: Oshawa, PUC Networks (no retail volumes reported), Hydro One Networks (no deliveries to other LDCs reported), and Atikokan Hydro (zero underground plant reported).

Pros and Cons of Econometric Benchmarking

Econometric Pro:

Simultaneous consideration of multiple business conditions

- Multiple output quantities
- Other business conditions (*e.g.* undergrounding, forestation)

Model specification guided by

- Economic theory
- Statistical tests of parameter significance

Econometric Pro (cont'd):

Use exact business conditions facing your utility

- No need to choose similarly-situated “peers”
- Sample heterogeneity actually *desirable*

Statistical tests of efficiency hypotheses readily fashioned

Econometric Con:

Estimation procedures can be complicated

Methodology daunting for senior managers
“low tech” jurisdictions

Econometric Modeling Con:

Estimation procedures can be complicated

Methodology daunting for senior managers
“low tech” jurisdictions

Sample may not support sophisticated model development

Unit Cost Indexes

Most common approach to cost benchmarking

Ratio of cost to an output quantity measure

$$\text{Unit Cost} = \text{Cost} / \text{Output Quantity}$$

>>> Controls for differences in operating scale

Performance measured by comparison to peers

$$\text{Performance} = \text{Unit Cost}^{\text{Northstar}} / \text{Unit Cost}^{\text{Peers}}$$

Unit Cost Indexes (cont'd)

Output Quantity Indexes

Most practitioners use simple unit cost metrics

e.g. Labour Cost / Energy Distributed
Labour Cost / Circuit KM
Labour Cost/ Customer

Results using different metrics can differ markedly

How to draw conclusions???

Output Quantity Indexes (cont'd)

Output quantity measures can be multi-dimensional

Quantity Subindexes Number of customers
Energy distributed
Circuit km

Index comparison = weighted average of subindex comparisons

Weights should reflect cost elasticities

Elasticities can be estimated econometrically

e.g. Ontario

	Estimated Cost Elasticity	Elasticity Share
Customers	0.576	0.61
Deliveries	0.224	0.24
Line Miles	<u>0.138</u>	<u>0.15</u>
Total	0.938	1.00

Then

$$\begin{aligned}
 & \text{Unit Cost}^{\text{Northstar}} / \text{Unit Cost}^{\text{Peers}} \\
 &= (\text{Cost}^{\text{Northstar}} / \text{Cost}^{\text{Peers}}) / \\
 & \quad [0.61(\text{Customers}^{\text{Northstar}} / \text{Customers}^{\text{Peers}}) + \\
 & \quad 0.24(\text{Volumes}^{\text{Northstar}} / \text{Volumes}^{\text{Peers}}) + \\
 & \quad 0.15(\text{Miles}^{\text{Northstar}} / \text{Miles}^{\text{Peers}})]
 \end{aligned}$$

Unit Cost Indexes (cont'd)

Control for Scale Economies

Unit cost indexes control for differences in operating scale imperfectly: ignore economies of scale

- Unfair to smaller utilities
- Generous to large utilities

Peer Groups

Unit cost comparisons require peer groups

For benchmark to be fair, cost pressures of peer group must be similar

- Operating scale
- *Other* business conditions
(*e.g.* input prices, undergrounding, forestation)

Econometric research can guide peer group selection

Productivity Indexes

Basic Idea

$$\begin{aligned}\text{Productivity} &= \text{Output Quantity} / \text{Input Quantity} \\ &= \text{Unit Cost} / \text{Input Prices}\end{aligned}$$

>>> Indicator controls for differences in output quantities
+ *input prices*

Essential for *international* unit cost comparisons

Multidimensional output indexes preferred

Control for operating scale still imperfect

Table 5

Unit Cost and Productivity Indexes for Total OM&A Expenses ^{1, 2}

	Average OM&A Expenses	Unit Cost (Low Values suggest good cost management.)								Productivity (High values suggest good cost management.)							
		2002	2003	2004	2005	Average of Available Years	Average / Group Average [A]	Percentage Differences [A - 1]	Excess Cost Per Year	2002	2003	2004	2005	Average of Available Years	Average / Group Average [B]	Percentage Differences [B - 1]	Excess Cost Per Year
Unclassified																	
Hydro One Networks	\$322,140,448	1.182	1.169	1.113	1.307	1.193	N/A	N/A	N/A	0.846	0.866	0.925	0.804	0.860	N/A	N/A	N/A
Small Northern LDCs																	
Hearst Power Distribution	\$512,184	0.776	0.701	0.857	0.883	0.804	0.634	-36.6%	-\$187,428	1.242	1.393	1.158	1.147	1.235	1.488	48.8%	-\$249,691
Lakeland Power Distribution	\$1,931,900	0.853	0.973	0.899	0.939	0.916	0.722	-27.8%	-\$536,842	1.136	1.009	1.111	1.084	1.085	1.307	30.7%	-\$593,093
Ottawa River Power	\$1,854,822	0.965	1.082	1.065	1.034	1.037	0.817	-18.3%	-\$338,669	0.946	0.855	0.883	0.928	0.903	1.088	8.8%	-\$162,845
Kenora Hydro Electric	\$1,210,292	1.124	1.166	1.188	1.171	1.162	0.917	-8.3%	-\$101,003	0.872	0.851	0.849	0.879	0.863	1.040	4.0%	-\$47,871
Sioux Lookout Hydro	\$831,596	1.109	0.924	1.297	1.399	1.182	0.932	-6.8%	-\$56,304	0.865	1.051	0.762	0.721	0.850	1.023	2.3%	-\$19,369
Espanola Regional Hydro Distribution	\$802,114	1.384	1.143	1.070	1.116	1.178	0.929	-7.1%	-\$56,908	0.696	0.854	0.928	0.907	0.846	1.019	1.9%	-\$15,542
Northern Ontario Wires	\$1,725,352	1.296	1.185	1.280	1.173	1.234	0.973	-2.7%	-\$46,983	0.753	0.834	0.785	0.874	0.812	0.978	-2.2%	\$38,601
Fort Frances Power	\$911,479	1.209	1.169	1.222	1.303	1.226	0.967	-3.3%	-\$30,455	0.793	0.831	0.809	0.773	0.802	0.966	-3.4%	\$31,405
Terrace Bay Superior Wires	\$278,342	1.690	1.486	1.382	1.681	1.560	1.230	23.0%	\$64,033	0.567	0.654	0.715	0.600	0.634	0.764	-23.6%	\$65,819
Chapleau Public Utilities	\$467,979	1.763	1.811	1.619	1.930	1.781	1.404	40.4%	\$189,143	0.547	0.539	0.613	0.525	0.556	0.669	-33.1%	\$154,689
Atikokan Hydro	\$738,959	1.511	2.581	1.732	1.659	1.870	1.475	47.5%	\$350,961	0.635	0.377	0.571	0.608	0.547	0.659	-34.1%	\$251,745
GROUP AVERAGE						1.268								0.830			
Large Northern LDCs																	
North Bay Hydro Distribution	\$4,678,187	1.029	1.063	0.995	0.867	0.989	0.773	-22.7%	-\$1,062,606	0.913	0.896	0.974	1.139	0.980	1.179	17.9%	-\$837,108
PUC Distribution	\$6,254,896	0.880	0.936	1.089	1.085	0.997	0.780	-22.0%	-\$1,378,448	1.068	1.017	0.889	0.910	0.971	1.167	16.7%	-\$1,046,056
Greater Sudbury Hydro	\$8,171,498	1.006	0.995	0.980	1.099	1.020	0.797	-20.3%	-\$1,655,383	0.958	0.981	1.013	0.921	0.968	1.164	16.4%	-\$1,341,231
Thunder Bay Hydro Electricity Dist.	\$10,287,890	1.055	1.094	1.055	1.023	1.057	0.826	-17.4%	-\$1,789,708	0.909	0.888	0.937	0.985	0.930	1.118	11.8%	-\$1,214,525
West Nipissing Energy Services	\$720,306	1.359	1.250	1.413	1.365	1.347	1.053	5.3%	\$37,956	0.692	0.762	0.686	0.724	0.716	0.861	-13.9%	\$100,341
Great Lakes Power	\$6,100,416	2.169	2.305	2.168	2.423	2.266	1.771	77.1%	\$4,705,664	0.433	0.413	0.446	0.407	0.425	0.511	-48.9%	\$2,983,487
GROUP AVERAGE						1.279								0.832			
Southwestern Small Town LDCs																	
Grimsby Power	\$1,314,250	0.722	0.708	0.799	0.848	0.769	0.677	-32.3%	-\$424,760	1.392	1.438	1.295	1.245	1.342	1.431	43.1%	-\$566,194
Niagara-on-the-Lake Hydro	\$1,267,288	0.838	0.757	0.851	0.792	0.810	0.712	-28.8%	-\$364,386	1.145	1.284	1.162	1.274	1.216	1.296	29.6%	-\$375,201
Halton Hills Hydro	\$3,744,491	0.918	0.851	0.863	0.796	0.857	0.754	-24.6%	-\$920,482	1.102	1.204	1.208	1.335	1.212	1.292	29.2%	-\$1,094,049
Orangeville Hydro	\$1,651,565	0.895	0.964	0.829	0.907	0.899	0.791	-20.9%	-\$345,247	1.125	1.059	1.252	1.167	1.151	1.227	22.7%	-\$374,498
Tay Hydro Electric Distribution	\$736,780	0.777	0.873	0.972	1.115	0.934	0.822	-17.8%	-\$131,108	1.283	1.157	1.056	0.939	1.108	1.181	18.1%	-\$133,653
COLLUS Power	\$2,463,634	0.903	0.859	0.919	0.907	0.897	0.790	-21.0%	-\$518,191	1.049	1.117	1.063	1.097	1.082	1.153	15.3%	-\$376,245
West Perth Power	\$450,079	N/A	1.251	1.224	0.766	1.080	0.951	-4.9%	-\$22,133	N/A	0.781	0.812	1.323	0.972	1.036	3.6%	-\$16,216
Norfolk Power Distribution	\$3,826,365	1.117	1.073	0.992	0.957	1.035	0.911	-8.9%	-\$341,897	0.863	0.911	1.001	1.059	0.959	1.022	2.2%	-\$82,806
Peninsula West Utilities	\$3,895,811	1.018	1.019	1.200	1.257	1.124	0.989	-1.1%	-\$43,211	0.987	0.998	0.862	0.839	0.922	0.982	-1.8%	\$68,705
Newbury Power	\$42,155	N/A	N/A	1.384	0.967	1.175	1.034	3.4%	\$1,446	N/A	N/A	0.724	1.057	0.891	0.949	-5.1%	\$2,135
Tilsonburg Hydro	\$1,302,458	0.943	1.299	1.169	1.380	1.198	1.054	5.4%	\$70,474	1.042	0.767	0.866	0.748	0.856	0.912	-8.8%	\$114,482
Wellington North Power	\$847,699	1.107	1.132	1.188	1.251	1.169	1.029	2.9%	\$24,612	0.870	0.862	0.835	0.809	0.844	0.900	-10.0%	\$84,973
Midland Power Utility	\$1,598,480	1.270	1.254	1.205	1.089	1.204	1.060	6.0%	\$96,072	0.741	0.761	0.805	0.908	0.804	0.857	-14.3%	\$228,960
Clinton Power	\$354,117	1.131	1.340	N/A	1.341	1.271	1.118	11.8%	\$41,878	0.860	0.736	N/A	0.762	0.786	0.838	-16.2%	\$57,535
Brant County Power	\$2,603,177	1.120	1.342	1.489	1.301	1.313	1.156	15.6%	\$405,733	0.861	0.728	0.667	0.779	0.759	0.809	-19.1%	\$498,502
West Coast Huron Energy	\$1,148,015	1.244	1.396	1.373	1.722	1.434	1.262	26.2%	\$300,593	0.799	0.721	0.746	0.607	0.718	0.766	-23.4%	\$268,982
Grand Valley Energy	\$171,219	1.529	1.468	1.585	1.832	1.604	1.411	41.1%	\$70,456	0.659	0.695	0.655	0.578	0.647	0.689	-31.1%	\$53,218
Dutton Hydro	\$155,646	1.311	1.436	2.335	1.638	1.680	1.478	47.8%	\$74,477	0.742	0.686	0.429	0.624	0.620	0.661	-33.9%	\$52,739
GROUP AVERAGE						1.136								0.938			

¹The output index was calculated using the elasticity weights drawn from our translog econometric cost model. The weights were 61.4% for customers, 23.9% for retail volume, and 14.7% for circuit KM of line.

²Companies are ranked by the productivity indexes.

Table 5, continued

	Average OM&A Expenses	Unit Cost (Low Values suggest good cost management.)								Productivity (High values suggest good cost management.)							
		2002	2003	2004	2005	Average of Available Years	Average / Group Average [A]	Percentage Differences [A - 1]	Excess Cost Per Year	2002	2003	2004	2005	Average of Available Years	Average / Group Average [B]	Percentage Differences [B - 1]	Excess Cost Per Year
Southwestern Midsize town LDCs																	
Chatham-Kent Hydro	\$4,698,529	0.705	0.690	0.734	0.727	0.714	0.727	-27.3%	-\$1,281,658	1.376	1.424	1.362	1.404	1.391	1.325	32.5%	-\$1,525,987
Festival Hydro	\$2,954,023	0.824	0.758	0.802	0.762	0.787	0.801	-19.9%	-\$587,022	1.170	1.289	1.239	1.330	1.257	1.197	19.7%	-\$580,796
Wasaga Distribution	\$1,292,945	0.724	0.775	0.844	0.930	0.818	0.833	-16.7%	-\$215,311	1.375	1.303	1.215	1.125	1.255	1.194	19.4%	-\$251,451
Port Colborne (CNP)	\$1,447,646	0.699	0.873	0.853	N/A	0.808	0.823	-17.7%	-\$255,948	1.373	1.114	1.159	N/A	1.215	1.157	15.7%	-\$227,068
Innisfil Hydro Distribution Systems	\$2,465,220	0.861	0.884	0.975	0.977	0.924	0.941	-5.9%	-\$144,626	1.157	1.141	1.053	1.071	1.106	1.053	5.3%	-\$129,486
E.L.K. Energy	\$1,679,279	0.935	1.029	0.879	N/A	0.948	0.965	-3.5%	-\$58,328	1.098	1.011	1.204	N/A	1.104	1.051	5.1%	-\$86,078
St. Thomas Energy	\$2,549,829	0.813	0.868	0.941	1.009	0.908	0.924	-7.6%	-\$192,956	1.196	1.135	1.065	1.013	1.102	1.050	5.0%	-\$126,308
Bluewater Power Distribution	\$7,072,941	0.944	1.001	0.925	0.942	0.953	0.971	-2.9%	-\$206,701	1.044	0.998	1.098	1.100	1.060	1.009	0.9%	-\$65,046
Woodstock Hydro Services	\$2,746,297	0.919	0.943	1.021	1.034	0.979	0.997	-0.3%	-\$7,819	1.069	1.056	0.992	0.999	1.029	0.980	-2.0%	\$56,113
Orillia Power Distribution	\$2,629,754	0.916	1.050	1.089	1.169	1.056	1.076	7.6%	\$198,599	1.087	0.961	0.942	0.895	0.971	0.925	-7.5%	\$197,470
Fort Erie (CNP)	\$3,148,520	1.231	0.900	1.091	0.984	1.052	1.071	7.1%	\$223,379	0.780	1.080	0.906	1.024	0.948	0.902	-9.8%	\$308,217
Middlesex Power Distribution	\$1,359,979	1.070	1.124	0.915	1.175	1.071	1.091	9.1%	\$123,509	0.907	0.874	1.093	0.868	0.936	0.891	-10.9%	\$148,682
Essex Powerlines	\$5,561,232	1.141	1.025	1.133	1.247	1.137	1.158	15.8%	\$876,645	0.900	1.015	0.934	0.865	0.928	0.884	-11.6%	\$645,797
Haldimand County Hydro	\$4,978,903	1.088	1.042	1.122	1.153	1.101	1.121	12.1%	\$640,083	0.886	0.938	0.886	0.879	0.897	0.854	-14.6%	\$726,213
Westario Power	\$4,157,664	1.003	1.117	1.120	N/A	1.080	1.100	10.0%	\$146,244	0.927	0.843	0.855	N/A	0.875	0.833	-16.7%	\$694,147
Erie Thames Powerlines	\$3,755,379	1.157	1.333	1.479	1.529	1.374	1.400	40.0%	\$1,500,691	0.841	0.739	0.677	0.668	0.732	0.696	-30.4%	\$1,139,980
GROUP AVERAGE						0.982								1.050			
Eastern LDCs																	
Hydro Hawkesbury	\$656,384	0.596	0.630	0.570	0.687	0.621	0.636	-36.4%	-\$238,969	1.566	1.500	1.684	1.426	1.544	1.443	44.3%	-\$290,935
Hydro 2000	\$170,263	0.578	0.678	0.659	1.230	0.786	0.805	-19.5%	-\$33,173	1.614	1.394	1.459	0.797	1.316	1.230	23.0%	\$199,171
Lakefront Utilities	\$1,307,426	0.711	0.678	0.808	0.971	0.792	0.811	-18.9%	-\$246,706	1.358	1.443	1.232	1.045	1.270	1.186	18.6%	-\$243,810
Peterborough Distribution	\$5,103,207	0.835	0.781	0.814	0.831	0.815	0.835	-16.5%	-\$840,314	1.132	1.226	1.196	1.195	1.187	1.109	10.9%	-\$557,701
Cooperative Hydro Embrun	\$302,333	0.993	1.079	0.974	1.151	1.049	1.075	7.5%	\$22,653	1.023	0.954	1.074	0.927	0.995	0.929	-7.1%	\$21,318
Renfrew Hydro	\$719,735	0.967	0.947	0.949	0.906	0.942	0.965	-3.5%	-\$25,028	0.944	0.977	0.992	1.059	0.993	0.928	-7.2%	\$51,852
Kingston Electricity Distribution	\$4,903,757	0.982	0.962	0.992	0.999	0.984	1.008	0.8%	\$37,745	0.965	0.998	0.983	0.997	0.986	0.921	-7.9%	\$386,326
Rideau St. Lawrence Distribution	\$1,152,996	1.054	1.114	1.130	1.109	1.102	1.129	12.9%	\$148,327	0.912	0.874	0.876	0.910	0.893	0.834	-16.6%	\$190,866
Parry Sound Power	\$856,835	1.037	1.138	1.302	1.365	1.210	1.240	24.0%	\$205,328	0.945	0.873	0.775	0.755	0.837	0.782	-21.8%	\$186,491
Eastern Ontario Power (CNP)	\$1,100,647	N/A	1.632	1.216	1.534	1.461	1.496	49.6%	\$546,063	N/A	0.588	0.803	0.649	0.680	0.635	-36.5%	\$401,229
GROUP AVERAGE						0.976								1.070			
Large City Southern LDCs																	
Hydro One Brampton Networks	\$13,370,715	0.629	0.609	0.544	0.587	0.592	0.704	-29.6%	-\$3,954,232	1.618	1.694	1.930	1.823	1.766	1.368	36.8%	-\$4,916,642
Hydro Ottawa	\$37,805,068	0.852	0.698	0.634	0.625	0.702	0.834	-16.6%	-\$6,259,186	1.193	1.475	1.652	1.709	1.507	1.167	16.7%	-\$6,318,605
Powerstream	\$33,730,504	0.644	0.733	0.780	0.818	0.744	0.884	-11.6%	-\$3,901,481	1.581	1.408	1.345	1.308	1.411	1.092	9.2%	-\$3,113,947
Horizon Utilities	\$31,469,808	0.654	0.729	0.735	0.829	0.737	0.876	-12.4%	-\$3,905,639	1.537	1.395	1.408	1.273	1.403	1.087	8.7%	-\$2,724,183
London Hydro	\$20,321,872	0.773	0.757	0.785	0.782	0.774	0.921	-7.9%	-\$1,613,649	1.259	1.302	1.276	1.306	1.286	0.996	-0.4%	\$91,428
Enersource Hydro Mississauga	\$35,667,848	0.810	0.833	0.887	0.924	0.864	1.027	2.7%	\$955,497	1.257	1.239	1.184	1.158	1.209	0.936	-6.4%	\$2,270,048
Toronto Hydro-Electric System	\$138,488,976	0.869	0.928	0.946	0.898	0.910	1.082	8.2%	\$11,377,729	1.172	1.112	1.109	1.192	1.146	0.888	-11.2%	\$15,556,149
Veridian Connections	\$19,922,136	1.022	1.233	1.000	0.889	1.036	1.232	23.2%	\$4,618,033	0.998	0.838	1.051	1.206	1.023	0.792	-20.8%	\$4,135,764
ENWIN Powerlines	\$20,080,970	1.265	1.239	1.228	1.112	1.211	1.440	44.0%	\$8,830,250	0.812	0.840	0.861	0.970	0.871	0.674	-32.6%	\$6,539,766
GROUP AVERAGE						0.841								1.291			
GTA towns LDCs																	
Kitchener-Wilmot Hydro	\$9,351,437	0.594	0.610	0.608	0.619	0.608	0.699	-30.1%	-\$2,816,163	1.673	1.653	1.685	1.688	1.674	1.383	38.3%	-\$3,584,171
Barrie Hydro Distribution	\$7,813,820	0.607	0.749	0.655	0.559	0.643	0.739	-26.1%	-\$2,400,601	1.641	1.348	1.566	1.874	1.607	1.328	32.8%	-\$2,559,109
Cambridge and North Dumfries Hydro	\$7,104,172	0.711	0.698	0.760	0.706	0.719	0.826	-17.4%	-\$1,233,504	1.398	1.443	1.348	1.481	1.417	1.171	17.1%	-\$1,214,983
Burlington Hydro	\$9,539,784	0.751	0.778	0.823	0.824	0.794	0.913	-8.7%	-\$828,373	1.338	1.308	1.256	1.280	1.296	1.070	7.0%	-\$671,762
Oakville Hydro Electricity Distribution	\$9,223,560	0.784	0.880	0.827	0.798	0.822	0.945	-5.5%	-\$503,719	1.291	1.165	1.261	1.331	1.262	1.042	4.2%	-\$391,637
Guelph Hydro Electric Systems	\$7,535,517	0.801	0.817	0.775	0.808	0.800	0.920	-8.0%	-\$600,090	1.224	1.216	1.304	1.276	1.255	1.037	3.7%	-\$277,380
Waterloo North Hydro	\$8,171,374	0.863	0.846	0.848	0.801	0.839	0.965	-3.5%	-\$283,320	1.152	1.190	1.208	1.305	1.214	1.003	0.3%	-\$22,253
Milton Hydro Distribution	\$3,572,770	0.958	0.889	0.849	0.870	0.891	1.025	2.5%	\$89,066	1.049	1.145	1.219	1.213	1.156	0.955	-4.5%	\$159,426
Whitby Hydro Electric	\$6,584,501	0.949	1.025	0.918	0.950	0.960	1.104	10.4%	\$685,235	1.076	1.009	1.145	1.129	1.090	0.900	-10.0%	\$656,917
Welland Hydro-Electric System	\$3,693,122	0.858	0.939	0.961	0.862	0.905	1.041	4.1%	\$150,503	1.119	1.035	1.028	1.170	1.088	0.899	-10.1%	\$373,639
Brantford Power	\$6,180,431	0.841	0.923	1.001	0.982	0.937	1.078	7.8%	\$479,152	1.146	1.058	0.992	1.031	1.057	0.873	-12.7%	\$783,669
Newmarket Hydro	\$5,165,882	0.916	1.327	0.926	0.866	1.009	1.160	16.0%	\$825,951	1.100	0.769	1.121	1.223	1.053	0.870	-13.0%	\$671,072
Niagara Falls Hydro	\$7,093,752	1.026	1.035	1.048	1.106	1.054	1.212	21.2%	\$1,503,067	0.935	0.939	0.944	0.911	0.932	0.770	-23.0%	\$1,630,269
Centre Wellington Hydro	\$1,420,028	1.295	1.214	1.151	1.114	1.194	1.373	37.3%	\$529,154	0.758	0.818	0.878	0.925	0.845	0.698	-30.2%	\$429,044
GROUP AVERAGE						0.870								1.210			

¹The output index was calculated using the elasticity weights drawn from our translog econometric cost model. The weights were 61.4% for customers, 23.9% for retail volume, and 14.7% for circuit KM of line.

²Companies are ranked by the productivity indexes.

³Low values suggest good cost management

⁴High values suggest good cost management

Table 6

Performance Rankings Based on Peer Group Comparisons¹

	Unit Cost Index (Low values suggest good cost management.)				Productivity Index (High values suggest good cost management.)			
	Average / Group Average [A]	Percentage Differences [A - 1]	Excess Cost Per Year	Efficiency Ranking	Average / Group Average [B]	Percentage Differences [B - 1]	Excess Cost Per Year	Efficiency Rankin
Hearst Power Distribution	0.634	-36.6%	-\$187,427.78	1	1.488	48.8%	-\$249,690.71	1
Hydro Hawkesbury	0.636	-36.4%	-\$238,968.93	2	1.443	44.3%	-\$290,935.12	2
Grimsby Power	0.677	-32.3%	-\$424,759.78	3	1.431	43.1%	-\$566,193.56	3
Kitchener-Wilmot Hydro	0.699	-30.1%	-\$2,816,163.17	4	1.383	38.3%	-\$3,584,170.75	4
Hydro One Brampton Networks	0.704	-29.6%	-\$3,954,232.42	5	1.368	36.8%	-\$4,916,641.96	5
Barrie Hydro Distribution	0.739	-26.1%	-\$2,040,600.56	9	1.328	32.8%	-\$2,559,109.06	6
Chatham-Kent Hydro	0.727	-27.3%	-\$1,281,658.43	8	1.325	32.5%	-\$1,525,987.12	7
Lakeland Power Distribution	0.722	-27.8%	-\$536,841.84	7	1.307	30.7%	-\$593,093.35	8
Niagara-on-the-Lake Hydro	0.712	-28.8%	-\$364,386.45	6	1.296	29.6%	-\$375,200.81	9
Halton Hills Hydro	0.754	-24.6%	-\$920,482.09	10	1.292	29.2%	-\$1,094,048.97	10
Hydro 2000	0.805	-19.5%	-\$33,172.55	17	1.230	23.0%	-\$39,170.71	11
Orangeville Hydro	0.791	-20.9%	-\$345,246.93	14	1.227	22.7%	-\$374,498.32	12
Festival Hydro	0.801	-19.9%	-\$587,021.55	16	1.197	19.7%	-\$580,795.87	13
Wasaga Distribution	0.833	-16.7%	-\$215,310.51	24	1.194	19.4%	-\$251,450.92	14
Lakefront Utilities	0.811	-18.9%	-\$246,705.88	18	1.186	18.6%	-\$243,810.25	15
Tay Hydro Electric Distribution	0.822	-17.8%	-\$131,107.98	20	1.181	18.1%	-\$133,653.10	16
North Bay Hydro Distribution	0.773	-22.7%	-\$1,062,606.25	11	1.179	17.9%	-\$837,108.39	17
Cambridge and North Dumfries Hydro	0.826	-17.4%	-\$1,233,503.80	23	1.171	17.1%	-\$1,214,982.75	18
PUC Distribution	0.780	-22.0%	-\$1,378,447.97	12	1.167	16.7%	-\$1,046,055.52	19
Hydro Ottawa	0.834	-16.6%	-\$6,259,185.68	25	1.167	16.7%	-\$6,318,604.52	20
Greater Sudbury Hydro	0.797	-20.3%	-\$1,655,382.72	15	1.164	16.4%	-\$1,341,231.36	21
Port Colborne (CNP)	0.823	-17.7%	-\$255,948.15	21	1.157	15.7%	-\$227,068.03	22
COLLUS Power	0.790	-21.0%	-\$518,191.07	13	1.153	15.3%	-\$376,244.90	23
Thunder Bay Hydro Electricity Dist.	0.826	-17.4%	-\$1,789,708.16	22	1.118	11.8%	-\$1,214,524.53	24
Peterborough Distribution	0.835	-16.5%	-\$840,314.47	26	1.109	10.9%	-\$557,701.48	25
Powerstream	0.884	-11.6%	-\$3,901,480.72	28	1.092	9.2%	-\$3,113,946.64	26
Ottawa River Power	0.817	-18.3%	-\$338,668.70	19	1.088	8.8%	-\$162,844.95	27
Horizon Utilities	0.876	-12.4%	-\$3,905,638.98	27	1.087	8.7%	-\$2,724,182.93	28
Burlington Hydro	0.913	-8.7%	-\$828,373.10	30	1.070	7.0%	-\$671,762.33	29
Innisfil Hydro Distribution Systems	0.941	-5.9%	-\$144,625.98	37	1.053	5.3%	-\$129,486.20	30
E.L.K. Energy	0.965	-3.5%	-\$58,327.69	41	1.051	5.1%	-\$86,078.13	31
St. Thomas Energy	0.924	-7.6%	-\$192,956.13	34	1.050	5.0%	-\$126,307.61	32
Oakville Hydro Electricity Distribution	0.945	-5.5%	-\$503,719.28	38	1.042	4.2%	-\$391,636.70	33
Kenora Hydro Electric	0.917	-8.3%	-\$101,003.21	31	1.040	4.0%	-\$47,870.84	34
Guelph Hydro Electric Systems	0.920	-8.0%	-\$600,090.18	32	1.037	3.7%	-\$277,380.08	35
West Perth Power	0.951	-4.9%	-\$22,132.61	39	1.036	3.6%	-\$16,216.32	36
Sioux Lookout Hydro	0.932	-6.8%	-\$56,304.48	36	1.023	2.3%	-\$19,369.26	37
Norfolk Power Distribution	0.911	-8.9%	-\$341,897.28	29	1.022	2.2%	-\$82,806.17	38
Espanola Regional Hydro Distribution	0.929	-7.1%	-\$56,907.89	35	1.019	1.9%	-\$15,542.46	39
Bluewater Power Distribution	0.971	-2.9%	-\$206,700.51	44	1.009	0.9%	-\$65,045.75	40
Waterloo North Hydro	0.965	-3.5%	-\$283,320.32	42	1.003	0.3%	-\$22,253.10	41
Hydro One Networks	1.000	0.0%	\$0.00	48	1.000	0.0%	\$0.00	42

Table 6, continued

	Unit Cost Index (Low values suggest good cost management.)				Productivity Index (High values suggest good cost management.)			
	Average / Group Average	Percentage Differences	Excess Cost Per Year	Efficiency Ranking	Average / Group Average	Percentage Differences	Excess Cost Per Year	Efficiency Ranking
	[A]	[A - 1]			[B]	[B - 1]		
London Hydro	0.921	-7.9%	-\$1,613,648.94	33	0.996	-0.4%	\$91,427.97	43
Peninsula West Utilities	0.989	-1.1%	-\$43,210.88	46	0.982	-1.8%	\$68,705.40	44
Woodstock Hydro Services	0.997	-0.3%	-\$7,819.02	47	0.980	-2.0%	\$56,112.51	45
Northern Ontario Wires	0.973	-2.7%	-\$46,983.06	45	0.978	-2.2%	\$38,601.17	46
Fort Frances Power	0.967	-3.3%	-\$30,455.34	43	0.966	-3.4%	\$31,404.62	47
Milton Hydro Distribution	1.025	2.5%	\$89,065.70	50	0.955	-4.5%	\$159,426.24	48
Newbury Power	1.034	3.4%	\$1,445.78	53	0.949	-5.1%	\$2,135.40	49
Enersource Hydro Mississauga	1.027	2.7%	\$955,496.90	51	0.936	-6.4%	\$2,270,048.34	50
Cooperative Hydro Embrun	1.075	7.5%	\$22,652.87	59	0.929	-7.1%	\$21,317.68	51
Renfrew Hydro	0.965	-3.5%	-\$25,027.61	40	0.928	-7.2%	\$51,852.02	52
Orillia Power Distribution	1.076	7.6%	\$198,599.29	60	0.925	-7.5%	\$197,469.58	53
Kingston Electricity Distribution	1.008	0.8%	\$37,744.93	49	0.921	-7.9%	\$386,325.84	54
Tillsonburg Hydro	1.054	5.4%	\$70,474.17	56	0.912	-8.8%	\$114,481.75	55
Fort Erie (CNP)	1.071	7.1%	\$223,379.37	58	0.902	-9.8%	\$308,216.98	56
Whitby Hydro Electric	1.104	10.4%	\$685,234.66	65	0.900	-10.0%	\$656,917.22	57
Wellington North Power	1.029	2.9%	\$24,611.77	52	0.900	-10.0%	\$84,972.72	58
Welland Hydro-Electric System	1.041	4.1%	\$150,502.79	54	0.899	-10.1%	\$373,639.15	59
Middlesex Power Distribution	1.091	9.1%	\$123,508.84	63	0.891	-10.9%	\$148,682.44	60
Toronto Hydro-Electric System	1.082	8.2%	\$11,377,728.57	62	0.888	-11.2%	\$15,556,149.03	61
Essex Powerlines	1.158	15.8%	\$876,645.40	70	0.884	-11.6%	\$645,797.11	62
Brantford Power	1.078	7.8%	\$479,151.74	61	0.873	-12.7%	\$783,668.74	63
Newmarket Hydro	1.160	16.0%	\$825,951.49	71	0.870	-13.0%	\$671,072.20	64
West Nipissing Energy Services	1.053	5.3%	\$37,956.27	55	0.861	-13.9%	\$100,340.58	65
Midland Power Utility	1.060	6.0%	\$96,072.34	57	0.857	-14.3%	\$228,959.52	66
Haldimand County Hydro	1.121	12.1%	\$604,082.96	67	0.854	-14.6%	\$726,213.03	67
Clinton Power	1.118	11.8%	\$41,878.44	66	0.838	-16.2%	\$57,535.01	68
Rideau St. Lawrence Distribution	1.129	12.9%	\$148,327.18	68	0.834	-16.6%	\$190,865.77	69
Westario Power	1.100	10.0%	\$416,244.07	64	0.833	-16.7%	\$694,146.78	70
Brant County Power	1.156	15.6%	\$405,733.13	69	0.809	-19.1%	\$498,502.09	71
Veridian Connections	1.232	23.2%	\$4,618,032.59	74	0.792	-20.8%	\$4,135,763.85	72
Parry Sound Power	1.240	24.0%	\$205,328.36	75	0.782	-21.8%	\$186,491.18	73
Niagara Falls Hydro	1.212	21.2%	\$1,503,067.32	72	0.770	-23.0%	\$1,630,269.16	74
West Coast Huron Energy	1.262	26.2%	\$300,593.36	76	0.766	-23.4%	\$268,982.40	75
Terrace Bay Superior Wires	1.230	23.0%	\$64,033.12	73	0.764	-23.6%	\$65,819.45	76
Centre Wellington Hydro	1.373	37.3%	\$529,153.63	77	0.698	-30.2%	\$429,043.89	77
Erie Thames Powerlines	1.400	40.0%	\$1,500,690.90	78	0.696	-30.4%	\$1,139,979.93	78
Grand Valley Energy	1.411	41.1%	\$70,455.61	80	0.689	-31.1%	\$53,218.09	79
ENWIN Powerlines	1.440	44.0%	\$8,830,250.28	81	0.674	-32.6%	\$6,539,765.80	80
Chapleau Public Utilities	1.404	40.4%	\$189,142.67	79	0.669	-33.1%	\$154,688.53	81
Dutton Hydro	1.478	47.8%	\$74,476.58	83	0.661	-33.9%	\$52,739.25	82
Atikokan Hydro	1.475	47.5%	\$350,960.94	82	0.659	-34.1%	\$251,745.42	83
Eastern Ontario Power (CNP)	1.496	49.6%	\$546,062.59	84	0.635	-36.5%	\$401,229.37	84
Great Lakes Power	1.771	77.1%	\$4,705,663.70	85	0.511	-48.9%	\$2,983,486.88	85

¹Ranked by comparisons to peer group norms

Table 7

Spearman Rank Correlation Coefficients

METHODOLOGY KEY

UC= Unit Cost Index
PFP= Productivity Index
ET= Translog Cost Function
EDL= Double Log cost Function

	UC	PFP	ET	EDL
UC	1.00			
PFP	0.99	1.00		
ET	0.68	0.67	1.00	
EDL	0.70	0.69	0.94	1.00

Benchmarking Hydro One

Hydro One difficult to benchmark accurately due to uniqueness

- Large operating scale
- Forested, rural service territory
- Toronto headquarters
- Large deliveries to embedded distributors
- “Big city” customer services

Benchmarking with Ontario data may nonetheless prove feasible when more data are available using translog cost function

Benchmarking Hydro One

Benchmarking with other data opens new cans of worms

- Large, quality data set unavailable in Canada
- Few peers in Canada or the U.S.
- U.S./Ontario comparability issues
 - Operating conditions
 - Reporting guidelines
 - System characteristics (*e.g.* substations)
 - Input prices

Appendix

