ONTARIO ENERGY BOARD
File No. EB-2018-0165
Exhibit No. K9.2
Date July 12, 2019 *jfs*

Toronto Hydro-Electric System Limited

EB-2018-0165

OEB Staff Compendium

Panel 5

July 12, 2019

TAB 1

OEB Staff Interrogatory # 40

Issue:

Issue 10: Are the program-based cost, productivity and benchmarking studies filed by Hydro One appropriate?

Reference:

A-03-02-02 Page: 4 – Sample

PSE states on page 4 of its Benchmarking Report that:

> *"In an effort to produce a dataset that can adequately capture Hydro One's large size and rural characteristics, PSE used a sample consisting of 380 U.S. distributors."*

Interrogatory:

a) Please provide a list of the U.S. utilities in the sample data base, by each of the two groups: (1) U.S. IOUs serving more than 10,000 customers; and (2) RECs serving more than 10,000 customers.

b) Utilities serving a large region with numerous customers typically also serve major metropolitan areas. Rural utilities typically serve far fewer customers and smaller urbanized areas. Please confirm that few, if any, utilities in the U.S. sample satisfy both PSE's large size and rural service territory criteria.

c) In light of the answer to b), why were no Ontario LDCs included in the study?

d) Does Form 7, which provided most operating data for the regional electric cooperatives ("RECs") in the sample, have a uniform system of accounts that is analogous to that which has long been available for FERC Form 1?

e) What precautions were taken concerning mergers of RECs or transfers of assets between the transmission and distribution accounts?

f) Where did PSE obtain its Form-7 data on the operations of RECs for 2012-2015 if "Publicly available Form-7 data" ended in 2011?

Witness: PSE

g) Please test the robustness of your methodology by reporting econometric and benchmarking results from a model that excludes observations relying on RUS-7.

Response:

a)

Rural Electric Cooperatives in PSE Sample

Adams Electric Cooperative, Inc.
Aiken Electric Cooperative, Inc.
Albemarle Electric Member Corp
Alger Delta Cooperative Electric Association
Altamaha Electric Membership Corporation
Amicalola Electric Member Corp
Appalachian Electric Cooperative
Arab Electric Cooperative Inc.
Arkansas Valley Electric Cooperative
Baldwin County Electric Member Corp.
BARC Electric Cooperative Inc.
Bartlett Electric Cooperative Inc.
BENCO Electric Cooperative
Benton Rural Electric Association
Berkeley Electric Cooperative Inc.
Big Sandy Rural Electric Cooperative Co
Blue Grass Energy Coop Corp.
Blue Ridge Electric Cooperative Inc.
Blue Ridge Electric Membership Corporation
Blue Ridge Mountain E M C
Bowie-Cass Electric Cooperative Inc.
Broad River Electric Cooperative, Inc.
Brunswick Electric Membership Corporation
Buckeye Rural Electric Cooperative, Inc.
Butler Rural Electric Cooperative, Inc.
C & L Electric Cooperative Corp.
Caddo Electric Cooperative Inc.
Callaway Electric Cooperative
Canadian Valley Electric Cooperative Inc.
Caney Fork Electric Cooperative Inc.
Canoochee Electric Member Corp.
Capital Electric Cooperative Inc.
Carroll Electric Cooperative Corp.
Carroll Electric Cooperative, Inc.

Investor-Owned Utilities in Sample

Alabama Power Company
Alaska Electric Light & Power
Allete (Minnesota Power)
Appalachian Power Company
Arizona Public Service Company
Atlantic City Electric Company
Avista Corporation
Baltimore Gas and Electric Company
Black Hills Power
Central Hudson Gas & Electric Corporation
Central Maine Power Company
Chugach Electric Association, Inc.
Cleco Power LLC
Cleveland Electric Illuminating Company
Commonwealth Edison Company
Connecticut Light and Power Company
Consolidated Edison Company of New York
Consumers Energy Company
Duke Energy Carolinas, LLC
Duke Energy Kentucky, Inc.
Duke Energy Ohio, Inc.
Duquesne Light Company
El Paso Electric Company
Empire District Electric Company
Entergy Arkansas, Inc.
Entergy Mississippi, Inc.
Florida Power & Light Company
Georgia Power Company
Green Mountain Power Corporation
Gulf Power Company
Idaho Power Co.
Indiana Michigan Power Company
Indianapolis Power & Light Company
Jersey Central Power & Light Company

Witness: PSE

Rural Electric Cooperatives in PSE Sample	**Investor-Owned Utilities in Sample**
Carroll Electric Membership Corporation	Kansas City Power & Light Company
Carteret-Craven Electric Cooperative	Kentucky Power Company
Cass County Electric Cooperative Inc.	Kentucky Utilities Company
Central Alabama Electric Cooperative	Kingsport Power Company
Central Electric Cooperative Inc. - PA	Louisville Gas and Electric Company
Central Electric Member Corp.	Madison Gas and Electric Company
Central Electric Power Assn.	Metropolitan Edison Company
Central Florida Electric Cooperative, Inc.	MidAmerican Energy Company
Central Georgia Electric Membership Corporation	Mississippi Power Company
Central Missouri Electric Cooperative Inc.	Nevada Power Company
Central New Mexico Electric Cooperative Inc.	New York State Electric & Gas Corporation
Central Rural Electric Cooperative	Niagara Mohawk Power Corporation
Central Texas Electric Cooperative Inc.	Northern Indiana Public Service Company
Central Valley Electric Cooperative, Inc.	Northern States Power Company - MN
Central Virginia Electric Cooperative	Northern States Power Company - WI
Cherokee County Electric Cooperative Association	Ohio Edison Company
Cimarron Electric Cooperative	Ohio Power Company
Citizens Electric Corporation	Oklahoma Gas and Electric Company
Clark Energy Cooperative	Orange and Rockland Utilities, Inc.
Clarke-Washington E M C	Pacific Gas and Electric Company
Clay County Electric Cooperative Corp.	PECO Energy Company
Clearwater Power Company	Pennsylvania Electric Company
Cloverland Electric Cooperative	Pennsylvania Power Company
Coast Electric Power Association	Portland General Electric Company
Coastal Electric Member Corp	Potomac Edison Company
Colquitt Electric Membership Corp.	Potomac Electric Power Company
Community Electric Cooperative	PPL Electric Utilities Corporation
Co-Mo Electric Cooperative, Inc.	Public Service Company of Colorado
Continental Divide Electric Cooperative, Inc.	Public Service Company of New Hampshire
Cookson Hills Electric Cooperative Inc.	Public Service Company of Oklahoma
Coosa Valley Electric Cooperative Inc.	Public Service Electric and Gas Company
Cotton Electric Cooperative Inc.	Puget Sound Energy, Inc.
Covington Electric Cooperative, Inc.	San Diego Gas & Electric Co.
Coweta-Fayette El Member Corp	Sierra Pacific Power Company
Craighead Electric Cooperative Corp.	South Carolina Electric & Gas Co.
Crawford Electric Cooperative Inc. - MO	Southern California Edison Company
Crow Wing Cooperative Power & Light Co	Southern Indiana Gas and Electric Company
Cullman Electric Cooperative, Inc.	Southwestern Electric Power Company
Cumberland Elec Member Corp	Superior Water, Light and Power Company
Cumberland Valley Electric Inc	Tampa Electric Company

Witness: PSE

Rural Electric Cooperatives in PSE Sample	**Investor-Owned Utilities in Sample**
Deep East Texas Electric Cooperative Inc.	Toledo Edison Company
Delaware Electric Cooperative Inc.	Tucson Electric Power Company
Delta Montrose Electric Assn	Union Electric Company
Dixie Electric Membership Corporation	United Illuminating Company
Dixie Electric Power Association	Upper Peninsula Power Company
Dubois Rural Electric Cooperative Inc.	Virginia Electric and Power Company
Duck River Electric Membership Corporation	West Penn Power Company
Duke Energy Indiana, LLC	Westar Energy (KPL)
East Central Energy	Western Massachusetts Electric Company
East Central Okla Electric Cooperative Inc.	Wisconsin Electric Power Company
Eastern Iowa Light & Power Cooperative	Wisconsin Power and Light Company
Eastern Maine Electric Co-op	Wisconsin Public Service Corporation
Edgecombe-Martin County E M C	
Edisto Electric Cooperative Inc.	
Empire Electric Association, Inc.	
EnergyUnited Electric Member Corp	
Excelsior Electric Membership Corporation	
Fairfield Electric Cooperative Inc.	
Farmers Rural Electric Cooperative Corp.	
Fleming-Mason Energy Coop Inc	
Flint Electric Membership Corp	
Florence City of	
Forked Deer Electric Cooperative Inc.	
Four County Elec Member Corp	
French Broad Electric Membership Corporation	
Gibson Electric Membership Corporation	
Glades Electric Cooperative, Inc.	
Golden Valley Electric Association Inc.	
Grady Electric Membership Corporation	
Grand Valley Rural Power Lines Inc	
Grayson Rural Electric Cooperative Corp.	
Great Lakes Energy Cooperative	
GreyStone Power Corporation	
Guernsey-Muskingum Electric Cooperative, Inc.	
Gunnison County Electric Association Inc	
Habersham Electric Membership Corp	
Halifax Electric Member Corp	
Hamilton County Electric Cooperative Association	
Hancock-Wood Electric Cooperative, Inc.	
Harrison County Rural E M C	

Rural Electric Cooperatives in PSE Sample	**Investor-Owned Utilities in Sample**
Haywood Electric Member Corporation	
Heartland Rural Electric Cooperative	
High Plains Power, Inc.	
Highline Electric Association	
Holmes-Wayne Electric Cooperative, Inc.	
Holston Electric Cooperative Inc.	
Holy Cross Electric Assn, Inc	
Horry Electric Cooperative, Inc.	
Houston County Electric Cooperative Inc.	
Howell-Oregon Electric Cooperative, Inc.	
Illinois Rural Electric Cooperative	
Indian Electric Cooperative, Inc.	
Inter County Energy Cooperative Corp	
Intercounty Electric Cooperative Association	
Irwin County Elec Member Corp	
Jackson County Rural Electric Membership Corporation	
Jackson Electric Member Corp	
Jackson Energy Cooperative Corp.	
Jackson Purchase Energy Corporation	
Jasper-Newton Electric Cooperative, Inc.	
Jefferson Electric Member Corp	
Jemez Mountains Electric Cooperative Inc.	
Johnson County Rural Electric Membership Corporation	
Kankakee Valley Rural E M C	
Karnes Electric Cooperative Inc.	
Kenergy Corporation	
Kit Carson Electric Cooperative Inc.	
Kootenai Electric Cooperative Inc.	
La Plata Electric Assn Inc	
Lake Country Power	
Lamb County Electric Cooperative Inc.	
Laurens Electric Cooperative, Inc.	
Lea County Electric Cooperative, Inc.	
Licking Valley Rural E C C	
Little Ocmulgee El Member Corp	
Little River Electric Cooperative Inc.	
Lorain-Medina Rural Electric Cooperative, Inc.	
Lumbee River Electric Membership Corp.	
Lynches River Electric Cooperative Inc.	
Macon Electric Cooperative	

Rural Electric Cooperatives in PSE Sample	**Investor-Owned Utilities in Sample**
Magnolia Electric Power Assn	
Maquoketa Valley Rural Electric Cooperative	
Meade County Rural E C C	
Mecklenburg Electric Cooperative Inc.	
Medina Electric Cooperative, Inc.	
Menard Electric Cooperative	
Meriwether Lewis Electric Cooperative	
Mid-Carolina Electric Cooperative, Inc.	
Middle Tennessee Electric Membership Corporation	
Midwest Electric, Inc.	
Midwest Energy Cooperative	
Midwest Energy, Inc.	
Mille Lacs Energy Cooperative	
Minnesota Valley Electric Cooperative	
Missoula Electric Cooperative Inc.	
Mohave Electric Cooperative Inc.	
Monroe County Elec Power Assn	
Mora-San Miguel Electric Cooperative Inc.	
Mountain Electric Cooperative	
Mountain Parks Electric, Inc	
Mountain View Electric Association, Inc.	
Navarro County Electric Cooperative Inc.	
Navopache Electric Cooperative Inc.	
Newberry Electric Cooperative Inc.	
New-Mac Electric Cooperative Inc.	
Nodak Rural Electric Cooperative Inc.	
Nolin Rural Electric Cooperative Corp.	
North Arkansas Electric Cooperative, Inc.	
Northern Neck Electric Cooperative Inc.	
Northern Plains Electric Cooperative	
Northern Virginia Electric Cooperative	
Northwestern Electric Cooperative Inc.	
Ocmulgee Electric Member Corp	
Okefenoke Rural Electric Member Corporation	
Orcas Power & Light Cooperative	
Osage Valley Electric Cooperative Association	
Otero County Electric Cooperative Inc.	
Owen County Rural Electric Cooperative Corp.	
Ozark Border Electric Cooperative	
Ozark Electric Cooperative Inc.	

Rural Electric Cooperatives in PSE Sample	**Investor-Owned Utilities in Sample**
Panola-Harrison Electric Cooperative Inc.	
Pea River Electric Cooperative	
Peace River Electric Cooperative, Inc.	
Pee Dee Electric Cooperative Inc.	
Pee Dee Electric Member Corp	
Pennyrile Rural Electric Cooperative Co	
Petit Jean Electric Cooperative Corp.	
Pickwick Electric Cooperative	
Piedmont Electric Member Corporation	
Pioneer Electric Cooperative, Inc.	
Planters Electric Member Corp	
Plateau Electric Cooperative	
Pointe Coupee Elec Member Corp	
Poudre Valley R E A Inc	
Powder River Energy Corp	
Powell Valley Electric Cooperative	
Prince George Electric Cooperative	
Randolph Electric Membership Corporation	
Rappahannock Electric Cooperative	
Rayle Electric Membership Corp	
REA Energy Cooperative, Inc.	
Red River Valley Rural Elec Assn	
Rio Grande Electric Cooperative Inc.	
Rolling Hills Electric Cooperative	
Runestone Electric Assn	
Rusk County Electric Cooperative, Inc.	
Rutherford Electric Membership Corp.	
Sac-Osage Electric Cooperative Inc.	
Salt River Electric Coop Corp.	
San Isabel Electric Assn, Inc	
San Miguel Power Assn, Inc	
Sand Mountain Electric Cooperative	
Sangre De Cristo Elec Assn Inc	
Santee Electric Cooperative, Inc.	
Satilla Rural Elec Member Corp	
Sawnee Electric Member Corp	
Sequachee Valley Electric Cooperative	
Shelby Rural Electric Cooperative Corp.	
Shenandoah Valley Electric Cooperative	
Singing River Electric Power Association	

Witness: PSE

Rural Electric Cooperatives in PSE Sample	**Investor-Owned Utilities in Sample**
Sioux Valley Southwestern Electric Cooperative	
Socorro Electric Cooperative, Inc.	
South Alabama Electric Cooperative Inc.	
South Central Ark Electric Cooperative Inc.	
South Central Power Company	
South Kentucky Rural Energy Cooperative Corporation	
South Louisiana Electric Cooperative Association	
South River Elec Member Corp	
Southeast Colorado Power Association	
Southeastern Indiana Rural Electric Membership Corporation	
Southern Maryland Electric Cooperative, Inc.	
Southern Pine Electric Cooperative Inc.	
Southern Pine Electric Power Association	
Southside Electric Cooperative Inc.	
Southwest Arkansas E C C	
Southwest Louisiana Electric Membership Corporation	
Southwest Mississippi E P A	
Southwestern Electric Cooperative, Inc. - IL	
Stearns Cooperative Electric Association	
Sumter Electric Cooperative Inc.	
Sumter Electric Member Corp	
Surry-Yadkin Elec Member Corp	
Suwannee Valley Electric Cooperative Inc.	
Tallahatchie Valley Electric Power Assoc	
Taylor County Rural E C C	
Tennessee Valley Electric Cooperative	
Three Notch Elec Member Corp	
Three Rivers Electric Cooperative	
Thumb Electric Cooperative	
Tideland Electric Member Corp	
Tipmont Rural Electric Member Corporation	
Tishomingo County Electric Power Association	
Trico Electric Cooperative Inc.	
Tri-County Electric Cooperative - MN	
Tri-State Electric Member Corp	
Umatilla Electric Cooperative Association	
Union Electric Membership Corp	
United Electric Cooperative Services Inc - TX	
Upper Cumberland E M C	
Utilities Dist-Western IN REMC	

Rural Electric Cooperatives in PSE Sample	**Investor-Owned Utilities in Sample**
Verdigris Valley Electric Cooperative Inc.	
Verendrye Electric Cooperative Inc.	
Vernon Electric Cooperative	
Warren Rural Electric Co-op Corporation	
Washington Elec Member Corp	
Webster Electric Cooperative	
West Florida Electric Cooperative Association, Inc.	
West Kentucky Rural E C C	
West River Electric Assn Inc	
Wheeling Power Company	
White River Valley Electric Cooperative Inc.	
Wild Rice Electric Cooperative Inc.	
Wiregrass Electric Cooperative, Inc.	
Withlacoochee River Electric Cooperative, Inc	
Wood County Electric Cooperative Inc.	
Woodruff Electric Cooperative Corp.	
Wright-Hennepin Cooperative Electric Association	
Yampa Valley Electric Association, Inc.	
Yellowstone Valley Electric Cooperative Inc.	
York Electric Cooperative, Inc.	

b) Confirmed. This is one of the key advantages of the econometric benchmarking method over peer group analysis. An econometric model can estimate the impacts of these and other characteristics and incorporate them into the benchmark. An accurate peer group analysis for Hydro One's distribution system would not be possible.

c) Ontario distributors do not generally have either characteristic in question (large size or rural), let alone both. No Ontario distributor in the sample is the size of Hydro One, and most Ontario distributors are serving municipalities rather than vast rural areas. There are two primary reasons for PSE not including the Ontario distributors in the sample. The first and foremost reason is that some of the GIS-related variables are not available for all distributors in the Ontario sample. Important variables such as percent forestation, square kilometres served, and percent of territory that is "artificial surface" could not be included, and this would limit the model's ability to accurately incorporate these cost drivers into the model. The second reason is the experience of Toronto Hydro's last custom IR application (EB-2014-0116), when PSE did provide econometric benchmarking evidence that included two models and datasets: 1) a combined Ontario and U.S. dataset and 2) a U.S. only dataset. PEG conducted research on behalf of the OEB staff in that proceeding and conducted benchmarking research using the U.S. only dataset. Much of the discussion centered around the U.S. only results for both consultants. It appeared that both consultants agreed the U.S. only dataset was the more appropriate one to use when benchmarking an Ontario outlier utility such as Toronto Hydro. Hydro One is also an extreme outlier.

d) Yes. Due to the length of the document, in lieu of a paper copy please see the following link for the Uniform System of Accounts used by RECs.
https://www.rd.usda.gov/files/UPA_Bulletin_1767B-1.pdf

e) PSE examined the data for implausible changes, which would indicate a merger or substantial transfer of assets. In the case of a merger, the issue would be that the reported capital would likely be too low for the newly formed utility, due to the fact that prior year plant additions and 2002 benchmark year net plant would only contain the capital for the pre-merged company. This would lower the total costs for the merged company, likely lowering the benchmark expectation for Hydro One. If there are merger issues within the sample of 380, this will tend to create a more challenging benchmark for Hydro One. Regarding the possible transfers of assets/plant, given the perpetual inventory method of calculating capital, a transfer of gross assets/plant in service from one function to another will not impact the capital cost measure. In the case of transmission and distribution transfers, most of the RECs are distribution-only utilities, and these would not have the ability to transfer assets to/from transmission.

f) The REC data ended in 2011; only the IOU data extended to 2015.

g) This exercise would not "test the robustness" of the methodology. Excluding over 75% of the sample and, specifically, excluding the portion of the sample that is rural and is included to enable accurate estimation for the extreme rural characteristics of Hydro One is not a test of robustness. However, if an IOU-only dataset is to be used then there must be included a variable to adjust for the extreme outlier status of Hydro One as it relates to density. We have re-run the same model with the IOU-only dataset but inserted a quadratic term on the density variable. This variable comes in highly statistically significant. PSE believes the "IOU plus REC" model is superior. However, the results for the IOU-only model (with the only change being an inserted quadratic variable on density to control for Hydro One's extreme density in an IOU-only model) show Hydro One being 18.7% above benchmark costs in 2022. These results are quite close to the IOU plus REC results and continue to indicate that Hydro One should be assigned a stretch factor of 0.45%.

Year	**IOU Plus REC (PSE Model)**	**IOU-only Model (with quadratic density)**
2014	29.3%	21.9%
2015	23.2%	16.7%
2016	21.6%	17.2%
2017	21.3%	16.5%
2018	21.4%	16.9%
2019	22.0%	17.6%
2020	22.4%	18.2%
2021	22.4%	18.3%
2022	22.7%	18.7%

TAB 2

ONTARIO ENERGY BOARD

FILE NO.:	**EB-2018-0165**	**Toronto Hydro Electric System Limited**

VOLUME:	**Technical Conference**
DATE:	**February 22, 2019**

expensive, you know, to put in relative to what you have in a congested urban area. And so the, so I what I am saying is that, you know, if you were really trying to get this right, where you just -- wouldn't you want to just want to get it where the, you know, just identify those areas in which you have got to really lay it under the streets.

MR. FENRICK: That's -- what we have done is the ideal approach, in that our engineers have examined when costs are expected to drastically increase when serving the congested urban area. And so doing that engineering analysis, that point, you know, how we have constructed that variable is the ideal approach, in my opinion.

MR. HOVDE: Now, the value that you had for this variable for Toronto Hydro was 1.88 percent, which was the second highest among all sampled companies. I think you presented that in a table.

And then you have got another company like Commonwealth Edison, which serves Chicago, which serves the largest congested area in the sample, had a much lower ratio, at only .05 percent, and I'm just wondering, was there a particular reason why you choose to measure -- to specify this variable against the ratio of a congested area to total area?

MR. FENRICK: The ratio or the percentage expresses the percent of territory that the utility needs to service, you know, at this higher cost level. To the extent that a utility is serving a higher concentration, you would expect those costs to be higher, you know, relative to a utility that, you know, for instance, Commonwealth Edison, that serves -- yes, it serves Chicago, but then it also serves a huge swath of northern Illinois, and that's a much lower cost service territory.

MR. HOVDE: Well, the reason why I mention that is because just from a mechanical standpoint that if you really believed that, you know, the ratio was the most important thing, then, you know, then what Toronto Hydro hypothetically should do to really get their costs down would be to buy a bunch of farms someplace, you know, just buy a bunch of empty land, and then they can lower that value, and then it wouldn't cost them as much, according to their model, and just, to me that seemed like a little bit counterintuitive that the percentage of area is what really mattered, and what we were thinking is did you try anything where -- you know, were you just trying to look at the -- I don't know, just, you know, don't even take the ratio, just put in the -- you know, just put an enumerator, as in just the -- you know, how many kilometres congested do you serve, as opposed to the ratio, or alternatively, how many uncongested -- you know, how many uncongested square kilometres do you serve, and then just expect a sign out of the model. Did you try either of those?

MR. FENRICK: No, we did not. I would say in your hypothetical there's not farm land that Toronto Hydro can expand to essentially because it's surrounded by, you know, suburban -- you know, the city itself is surrounded by suburban area and the service territory is set not necessarily by Toronto Hydro but, you know, it's essentially given to the managers. And so, you know, they can't go and buy farm land, they have to contain costs and have their cost levels based on what the service territory actually is.

And given that Commonwealth Edison, you know, in Chicago has a bunch of service territory that is much lower cost than Toronto Hydro's service territory, you know, there's a lot of customers in that service territory. It's not just farm land, it's suburban, which is the least costly to serve.

And so if you just did the land area you would say Commonwealth Edison's service territory is the same as Toronto Hydro, and that's not the case. Commonwealth Edison has a lot easier service territory conditions, you know, relative to the congested urban variable than Toronto Hydro. And so that would be a disservice to utilities like Toronto Hydro, which is an outlier in its urban characteristics. It serves a highly urban area, and that's essentially what it has. It doesn't have a whole bunch of farm land and suburban areas. It serves a highly concentrated congested urban service territory, and that factor or variable needs to be adjusted for, and consolidated, as does Edison, and New York City is the same situation. It doesn't have the low-cost areas it serves, it has a much higher proportion of the high-cost areas, and that's going to drive up costs to the utility.

MR. HOVDE: Just one other question about the -- about

TAB 3

Power System Engineering, Inc.

Full-service consultants

Econometric Benchmarking Study: Total Distribution Costs of Hydro One Network

Prepared by:

Power System Engineering, Inc.

March 8, 2017

expected costs (benchmark costs) for each utility represent the costs we would expect from that utility, given its specific variable data, if that utility were an "average" performer. Thus for any utility in the dataset, actual costs can be compared to expected costs. The model is used to predict Hydro One's "expected" (benchmarked) total costs.

A dataset which includes U.S. observations is required for an accurate benchmark assessment of Hydro One's performance. This is due to Hydro One's large number of customers and rural service area relative to an Ontario-only dataset. The need for a dataset beyond Ontario distributors is made clear by the fact that the company's distribution system is, by far, the largest in Ontario and spans approximately 75% of the province.[4] The U.S. utility dataset has a number of utilities with large distribution systems and with systems serving rural areas; these utilities (when used to create the model) reflect how large rural distribution areas can impact costs.

In an effort to produce a dataset that can adequately capture Hydro One's large size and rural characteristics, PSE used a sample consisting of 380 U.S. distributors spanning a time period starting in 2002 and ending in 2015.[5] An appropriate benchmark sample requires observations that have explanatory variable values that encompass those of the studied utility. For example, if the "target" utility has a large rural area, the appropriate benchmark sample will contain a number of utilities with a large rural area (as well as some utilities with a smaller, more urban service area). These utilities are needed to capture the effect that a large rural area has on cost. For this reason, PSE incorporated both U.S. investor-owned utilities ("IOUs") and U.S. rural electric cooperatives ("RECs"). The IOUs tend to serve a large number of customers; a number of IOUs in the sample have customer populations that exceed Hydro One's customer population. The RECs tend to serve the rural areas of the U.S.; a number of cooperatives in the sample have fewer customers per square kilometer than Hydro One.

The total number of observations in the dataset is 3,998 (here an "observation" means one utility's costs over one year, with the variable data for that year). This is a relatively large and diverse dataset.[6] The large number of distributors and diversity within the dataset enhances the model's ability to adequately capture the cost impacts of specific variables. For some utilities, certain individual years did not yield usable observations, due to incomplete or missing data.

The general approach of our benchmarking analysis is as follows:

1. PSE assembled the historical costs of all utilities in the dataset, along with the variables that affect cost, such as customer levels, weather, wage levels, etc.
2. Using the historical data, PSE estimated an econometric model that expresses the relationship between the variables and cost.
3. PSE can then produce "benchmark" values for a given utility. The benchmark values are determined from the model. In Hydro One's case, the benchmark represents the total cost

[4] http://www.hydroone.com/OurCompany/Pages/QuickFacts.aspx

[5] Not all included distributors will have data for every year due to unavailable or implausible reported data in individual years.

[6] To PSE's knowledge, this is the largest econometric benchmarking dataset used in a North American regulatory proceeding.

3 Total Cost Benchmarking Results

The estimates from the total cost model are presented in Table 3-1. We note that the cost function parameter estimates are plausibly signed and have reasonable magnitudes. The first order terms of all variables have the theoretically expected signs and are statistically significant at a 99% level of confidence.

Table 3-1 Total Cost Model Estimates

Total Cost Model Estimates						
VARIABLE KEY						
		N=	Number retail customers			
		D=	Maximum peak demand			
		A=	Square kilometers of territory per customer			
		E=	Percent electric customers			
		F=	Percent forestation in service territory			
		CSI=	Percent customer service and information expenses			
		W=	Extreme weather			
		Art=	Percent of territory that is artificial surfaces			
EXPLANATORY VARIABLE	**ESTIMATED COEFFICIENT**	**T STATISTIC**		**EXPLANATORY VARIABLE**	**ESTIMATED COEFFICIENT**	**T STATISTIC**
N	0.811	130.712		CSI	0.010	9.195
NN	0.130	10.393				
ND	-0.134	-6.026		W	0.00001	13.284
D	0.097	16.269		Art	1.868	23.086
DD	0.019	1.893				
				Trend	-0.002	-3.955
A	0.066	31.493				
				Constant	12.043	1358.844
E	0.109	12.205				
				Adjusted R-Squared	0.996	
F	0.057	25.095				
				Sample Period:	2002-2015	
				Number of Observations	3998	

At the sample mean, a 1% increase in the number of customers (N on the table) and maximum peak demand (D) are estimated to raise cost by 0.811% and 0.097%, respectively. The number of

TAB 4

Power System Engineering, Inc.

Full-service consultants

Reply Report to PEG's Report ("IRM Design for Toronto Hydro-Electric System")

Prepared by:

Power System Engineering, Inc.

May 31, 2019

The column labeled "PEG TC Results (2012 Capital Level)" shows the updated PEG results from their Interrogatory Answers. PEG corrected their results from the initial PEG Report in their response found in M1-TH-026 (f).[1]

Table 1 PSE Total Cost Results vs. PEG Total Cost Results

Year	PSE TC Results	PSE—Average Results Prior 3 Years	PEG TC Results (2012 Capital Level)	PEG—Average Results Prior 3 Years
2015	-18.4%		-7.6%	
2016	-15.7%		-3.1%	
2017	-13.8%		-0.2%	
2018	-10.5%	**-16.0%** (SF=0.15%)	3.5%	-3.6% (SF=0.30%)
2019	-9.3%	**-13.3%** (SF=0.15%)	4.8%	0.1% (SF=0.30%)
2020	-7.2%	**-11.2%** (SF=0.15%)	7.5%	2.7% (SF=0.30%)
2021	-5.5%	**-9.0%** (SF=0.30%)	9.4%	5.3% (SF=0.30%)
2022	-3.3%	**-7.3%** (SF=0.30%)	11.8%	7.2% (SF=0.30%)
2023	-1.6%	**-5.3%** (SF=0.30%)	13.8%	9.6% (SF=0.30%)
2024	-0.1%	**-3.5%** (SF=0.30%)	15.4%	11.7% (SF=0.45%)
CIR Avg.	**-3.5%**		**+11.6%**	

In Table 1 we show each model's annual benchmarking score and included the average of the prior three years for both PSE's results and PEG's results. We also included the applicable stretch factor (SF) based on the 4th Generation SF cohorts.[2]

As can be seen in the table, PSE's results suggest a 0.30% SF for the majority of the Custom IR period and for the 2020 to 2024 average. PEG's model results also suggest a 0.30% SF for the majority of the Custom IR period. If the full custom IR forecasted period is averaged, PEG's recommended stretch factor becomes 0.45%.

This convergence in results toward a 0.30% stretch factor is primarily due to the advancement of the congested urban variable. PSE and PEG each use the new variable in their models. The congested urban challenges of Toronto Hydro are now being recognized in both models, and the total cost benchmarking results of both consultants reflect this advancement.

[1] In PEG's response to interrogatory questions M1-TH-026 (e) and (f), PEG calculated total costs using 2008 and 2012, respectively, as the capital levelization year. In Table 1 we show the results using the newer 2012 capital levelization found in part (f) of the interrogatory response. In Section 3.1.1 we discuss why using the more recent capital levelization provides the most accurate depiction and partially mitigates the impact of PEG using inconsistent asset price escalators between Toronto Hydro and the rest of the sample. We note that in the PEG Revised Report, PEG used the older and less accurate 2008 capital levelization year.

[2] The 4th Generation SF cohorts are based on the 3-year historical total cost benchmarking scores. Average scores greater than 25%, between 10% to 25%, between 10% to -10%, between -10% to -25%, and less than -25% suggest a SF of 0.60%, 0.45%, 0.30%, 0.15%, and 0.00%, respectively.