Staff Question 2: Re: Data Sources used in Analyses

My analyses of productivity cover 6 topics:

1. a price-dual estimate of TFP change
2. fixed-weight estimates of quantity based TFP change and
3. variable-weight estimates of quantity based TFP change
4. incorporating line losses changes in TFP estimates
5. incorporating reliability changes in TFP estimates
6. benchmarking LDCs' efficiency using DEA

I will not review items 4 and 5 in my response.

In a number of instances, I compare my results to those of PEG.

Data Sources

Recall that for most LDCs PEG's capital starts in 1989 (but 2002 for some) and its OM&A data in 2002. Recall that PEG estimates many of the components of capital like retirements and has sizeable gaps in coverage.

My capital data starts in 1972 and the OM&A in 1988. I have all of the components of capital, none are estimated.

PEG is limited to calculating TFP from 2002-2011. I have done TFP calculations over the 1988-2011 period.

PEG has limited its efficiency analysis to the 2009-2011 period. I have also done DEA calculations over the 1988-2011 period to examine the stability, plausibility, and sources of (in)efficiency.

As indicated in response to #1, I relied upon data collected by the former regulator Ontario Hydro from former MEUs. The data was subsequently collected by the OEB in the initial "PBR" data requests that were directed to all distributors. These same data were codified through the requirements of Chapter 12 of the OEB's original *Distribution Rate Handbook.* Subsequently, These same data were codified through the requirements of RRR filings.

Recent year expense data is available through the OEB's Comparison of Ontario Electricity Distributors Costs (EB-2006-0268), data which the Board's consultant PEG had previously used to benchmark LDC O&M costs. Subsequent to 2005, the OEB publishes the annual Yearbook of Electricity Distributors which contains data from the RRR filings.

PEG's TFP Estimates

For example, Exhibit 4.1 contains the results from PEG's TFP and Benchmarking files.

The link below is the latest. It is in the archive and is called "TFP and BM database 2" (posted May 24). Revised report was posted May 31.

http://www.ontarioenergyboard.ca/OEB/_Documents/EB-2010-0379/PEG%20Working%20Papers%20PartII%20%28version%202%29.zip

Column D "Observation Used in TFP Work" is a "switching variable" that includes or excludes an LDC from the calculations. I have used this "switching variable" to examine what the effects of including Toronto Hydro and Hydro One are on TFP and compared that to PEG's results.

Recall that the 1st Generation TFP analysis included all MEUs[1] including Toronto Hydro. While large MEUs had slightly lower TFP growth, we did not find significant differences among the MEUs by size, type, age of assets, or demand growth. The industry was defined as all MEUs and the Board based its 2000 TFP decision on the performance of all the examined utilities.

Exhibit 4.1. PEG TFP Estimates (percent) with Varied Sample Combinations of Toronto Hydro, Hydro One, and the Remaining Distributors presents the results of running PEG's data files with 4 different samples. We can see that PEG's data files produce an all-inclusive decline in TFP of -1.10 percent over the 2002-2011 period. Over the 2006-2011 period the decline is accentuated to -2.14 percent.

[1] All MEUs meaning the set of 48 utilities covering 85-90 percent of customers.

Exhibit 4.1. PEG TFP Estimates (percent) with Varied Sample Combinations of Toronto Hydro, Hydro One, and the Remaining Distributors

	Toronto Hydro and Hydro One Excluded	Hydro One Excluded	Toronto Hydro Excluded	Toronto Hydro and Hydro One Included
2002-2011	0.10	-0.56	-0.81	-1.10
2002-2006	1.11	0.95	0.18	0.20
2006-2011	-0.70	-1.31	-1.65	-2.14

Source: OEB/PEG Documentation and data files.

I should also note that unlike 1st generation, PEG did not include Contributed Capital in its TFP calculations. Contributed Capital remains a notable source of capital additions investment for many LDCs. CC ranges widely from very little, to 20-25 % for some, and a very large amount for others (e.g., over 200 percent of additions).

CC represents assets used by LDCs and should be included in the analysis as PEG did for benchmarking. The inclusion of CC as was done in 1st Generation would no doubt result in a lower TFP for almost all LDCs and would result in an aggregate that is lower than the -1.10 and -2.14 percent reported in Exhibit 4.1.

Dr. Cronin's Variable-weight estimates of quantity-based TFP change

Exhibit 4.2 presents my results. These calculations employ capital data covering 1972-2011. The OM&A data employ the PBR filings in 2000 and 2001.

Exhibit 4.2. TFP Growth (percent): 2000-2011 Over Mixed Regulatory Approaches (i.e. Cost of Service and IR)

	Toronto Hydro and Hydro One Excluded	Hydro One Excluded	Toronto Hydro Excluded	Toronto Hydro and Hydro One Included
2000-2011	0.10	-0.65	NA	NA
2002-2011	-0.60	-1.28	-1.12	-1.46

Source: OEB data and author calculations.

My 2002-2011 period estimate with all LDCs is -1.46; Peg's is -1.10.

Exhibit 4.5 presents the results of my calculations over the 2006-2011 period. Same data as in Exhibit 4.2.

Exhibit 4.5. TFP Growth for Ontario Electric Distribution Utilities: the 2006-2011 IR Period (average percent per year)

	Toronto Hydro and Hydro One Excluded	Hydro One Excluded	Toronto Hydro Excluded	Toronto Hydro and Hydro One Included
2006-2011[a]	-0.90	-2.36	-1.76	-2.55
2008-2011[b]	-0.50	-2.57	-1.75	-2.81
2009-2011	-0.80	-3.10	-1.99	-3.31

Source: OEB data and author calculations.
[a] Covers growth starting in 2007. 2nd Generation started in 2007.
[b] Covers growth starting in 2009. 3rd Generation started in 2009.

My 2006-2011 period estimate with all LDCs is -2.55; Peg's is -2.14.

I should also note that unlike 1st generation, I did not have available and did not include Contributed Capital in the TFP calculations. The inclusion of CC as was done in 1st Generation would no doubt result in a lower TFP for almost all LDCs and would result in an aggregate that is lower than the figures reported in Exhibits 4.2 and 4.5.

A price-dual estimate of TFP change

Economic assessments of productivity can be derived from either quantities (physical) or prices (called price-dual or price-based). In the former case we base TFP calculations on the comparison between output quantities and input quantities. This is the approach PEG has used. Similarly, we can use prices to calculate TFP: output prices (e.g. rates) are compared with input prices (e.g. Input Price Index - "IPI") to estimate trends in productivity growth.

What can we say about the growth in rates and input prices in Ontario over the 2006 to 2011 period? Exhibit 3.1 presents my findings on the growth in rates in Ontario. Over the 2006 to 2011 period, the input price index (i.e., a weighted average of the prices of inputs used

specifically by LDCs) increased by 1.0 percent per year. This is consistent for the generally low rate of inflation experienced by the economy during this period.[2]

In terms of rates, we note that on average LDCs' rates rose 3.4 percent per year over the period 2006-2011. However, the rate performance experience differed significantly among the Rate Adjustment Mechanisms that the LDCs were subjected to. For example, the rates for LDCs under 3rd Generation rose on average 0.1 percent. For LDCs under Cost of Service (COS) rate adjustments, average rate increases were 8.6 percent over the 2006-2011 period.

Exhibit 3.2 presents the resulting estimated TFP growth rates for Ontario LDCs over the 2006 to 2011 period[3]. That is, our base year is 2006, the year the Board undertook COS reviews for all the LDCs. In 2009, the Board implemented 3rd Generation IR so the 2011 terminal allows us to observe the consequences of several years of IR on LDCs (some LDCs stayed under 2nd Generation through 2011). I choose 2006 for ease of calculation. However, any year since restructuring could theoretically be used as the starting point as long as the required rate and IPI data were available.

Exhibit 3.2. TFP Growth Estimates Using Alternative Methodologies and Weights

	Price-dual	**Quantity-based**	
		Fixed Weight	**Tornquist**
2006-2011	**-2.4%**	**-2.3%**	**-2.4%**

The price-dual TFP estimate is -2.4 percent per year over the period. If we recall the second case described above where output prices rise more than input prices and the firm would have experienced a fall or degradation in productivity, this is in fact what I find for Ontario LDCs: a fall of 2.4 percent per year over the 2006-2011 period. This equates to about a 13 percent fall for the whole period. Recall that this decline in productivity adds to the impact of the IPI on output prices. In this instance we see that the IPI increase of 1.0 percent per year is accentuated by the decline in productivity of 2 percent resulting in a combined effect of a 3.4 percent rise in rates.

How do my findings regarding the price-dual compare with full-information quantity-based TFP estimates? The fixed-weight estimate is -2.3 percent. The variable-weight (Tornquist) estimate is

[2] Although some inputs were subject to stronger cost pressure especially at the beginning of our study period, the pressures cooled somewhat after. In 2006, the IPI rose 3.4 percent. However, by 2009 the increase was only 0.1 percent.

[3] Frank Cronin. *Presentation to Working Group*, February 21, 2013. This presentation also examined the incorporation of line losses and reliability in TFP estimates. This work is discussed below.

-2.4 percent. Furthermore, both estimates of the quantity-based TFP are quite similar to the price-dual estimate of -2.4 percent.

Benchmarking LDCs' efficiency using DEA

Presumably because of data issues, PEG has limited its efficiency analysis to the 2009-2011 period. On the other hand, I have also done DEA calculations over the 1988-2011 period to examine the stability, plausibility, and sources of (in)efficiency.

My efficiency analysis is based on the same original sample from the 1st Generation cost, IPI, and TFP analyses. The 30 year DEA analysis provides important insights into the changing size and nature of (in)efficiency among Ontario LDCs. The work examines the underlying incentives facing the utilities and the consequences for technical, allocative, and cost efficiencies. Scale results are also examined.

In particular, the research examines the stability of the composition of the frontier. The indicated stability is highly plausible. I also find degradation in the frontier in the latter part of the period. This degradation is unlike the findings of the Norwegian regulator who found frontier growth of 1 to 1.5 % per year and designed its PBR accordingly.

I might note also that the DEA results are often quite different from those found by PEG. Of course, even PEG's results differ substantially between the two versions presented by PEG. PEG's unstable results in its own efficiency should give pause in efforts to assign such "laggard" tags to LDCs. Furthermore, the wide divergence in results comparing PEG's to my DEA should call into question the validity of PEG's data, analysis, and results.

Exhibit 6.2. Comparing PEG Efficiency (Percent) Estimates with My Estimates

	PEG	Cronin
Distributor 1	-18.3	-30
Distributor 2	-11.2	6
Distributor 3	-7.3	-17
Distributor 4	-3.5	20
Distributor 5	3.1	-7
Distributor 6	6.5	23
Distributor 7	54.7	39