CANADA
PROVINCE DE QUÉBEC
DISTRICT DE MONTRÉAL

RÉGIE DE L'ÉNERGIE
No: R-4057-2018 Phase 2
Demande relative à l'établissement des tarifs d'électricité pour l'année tarifaire 2019-2020;

HYDRO-QUÉBEC
Demanderesse

- ET –

OPTION CONSOMMATEURS
Intervenante

PROPOSITION À L'ÉGARD DU « *SCOPING* » ENCADRANT LA RÉALISATION DE L'ÉTUDE DE PRODUCTIVITÉ MULTIFACTORIELLE À LA SUITE DE LA DÉCISION D-2019-011

Prepared by: Roger Higgin, Ph.D., MBA, P.Eng. Sustainable Planning Associates
Jules Bélanger, M.A. Economics, Option consommateurs

May 14, 2019

Contents

Executive Summary

We have reviewed some Canadian TFP/PMF and Benchmarking studies and find that, *inter alia,* differences in selection of key framework parameters may result in complex debates and lead to differing recommendations that require considerable time and resources from the Regulator to arbitrate and adjudicate.

Competing considerations in regard to Scoping are allowing latitude for the Experts and regulatory efficiency. Moreover:

- It appears that the US Utility FERC Form 1 is a standard source chosen by the Experts;
- Due to data availability and data quality concerns, Canadian utilities may not always be included in the sample;
- Experts retained by utilities may favor a shorter data time frame because of declining distribution industry productivity trends. PEG generally favors a longer timeframe;
- The choice of Input and Output Parameters and data by Experts can lead to significantly different results;

On balance, we conclude it is appropriate that the Régie provide guidance on the key framework parameters for the HQD PMF Study: **Utility Sample composition, Time Horizon, Prices Indices and possibly Input/Output parameters.**

All other parameters and analysis methodologies, including adjustments, should be determined by the Experts.

Statistical Benchmarking is not commonly used by Experts, but can provide additional information to the Regulator, and be useful for setting the stretch factor. Therefore, we strongly support PEG's recommendation to allow the experts to develop statistical benchmarking analysis.

I. Background

1. The Régie has made certain determinations on the IRM formulas and other parameters for the 1st Generation IRMs for HQD and HQT. The Régie is seeking input on Scoping of the HQD PMF (Total Factor Productivity) Study scheduled for 2021.

2. The Régie has determined that 2 separate PMF studies (from HQD and ratepayers) precede a regulatory review. The PMF studies may influence the last two years of the HQD and HQT IRMs. It will also be a backdrop for the next generation electricity distribution IRMs in Quebec.

3. The Régie has requested submissions on Scoping from HQD and from the Intervenors.

II. Scoping Framework Issues

4. The Scoping issues are identified in the Régie's decisions and comments[1].

5. The key considerations offered to date related to Scoping are:

From HQD's evidence[2]:
- selection of a group of companies for purposes of comparison;
- determination of the period of time to study;
- compilation of a large amount of data from different sources;
- establishing bases of comparison for inputs and outputs data possibly calculated in different ways;
- control of external factors influencing the data;
- need to make certain assumptions and establishing some premises;
- development of a mathematical model to calculate productivity.

From PEG's earlier evidence[3] (studies filed in other jurisdictions raise some difficulties and inconsistencies):
- different definitions for each of the categories of expenses;
- quantities of output computed differently;
- different weightings for the outputs according to the types of IRM in place;
- major projects which have had structural impact on the evolution of the charges at the time;
- data that are not "up-to-date".

[1] Décisions D-2017-043, p. 38 et 39, par. 142 et 146 and D-2019-011.
[2] B-0203.
[3] C-AQCIE-CIFQ-0047.

III. HQD Scoping Proposal

6. HQD has provided its scoping proposition[4]. This includes:

- Summary of 6 precedent historic PMF Studies in Canada[5].
- Extensive commentary, particularly on Stretch Factors.
- The "Perimeter" for the PMF studies :
    - Parametric Components
        - Time Horizon
        - Composition of comparable utilities (Sample)
        - Source of data and transparency of results (Reproducibility)
    - Methodology
        - External and Internal measures
        - Methods of Estimation
    - Adjustments
        - Input-price adjustments
        - Productivity differential
        - Productivity Gap
        - Adjustment for Exclusion of Capital
        - Stretch Factor

7. HQD summarizes certain difficulties mentioned by the Régie (p. 5):

> *« La Régie rappelle dans cette décision certaines difficultés propres à la réalisation d'une étude PMF qui pourraient être prises en considération lors de la détermination du scoping, dont notamment :*
> - *la sélection d'un groupe d'entreprises à des fins de comparaison ;*
> - *la détermination de la période de temps à étudier ;*
> - *la compilation d'un volume important de données provenant de différentes sources ;*
> - *l'établissement de bases de comparaison pour des données d'intrants et d'extrants possiblement calculées de manières différentes ;*
> - *la nécessité de faire certaines hypothèses et d'établir certaines prémisses ;*
> - *l'élaboration d'un modèle mathématique pour calculer la productivité ;*
> - *l'identification de catégories de charges selon différentes définitions ;*
> - *les différentes approches pour pondérer les extrants selon les types de MRI mis en place*. »

[4] R-4057-2018 Phase 2 HQD-1 document 1
[5] Ibid HQD-01-01 Section 2

8. HQD offers the following observations and comments (p.8 to 13):

   - « *Considérant ces divergences d'opinion, le Distributeur estime que le choix de l'horizon de temps devrait être laissé à la discrétion de chaque expert, ce choix étant étroitement lié à la composition de l'échantillon et à la disponibilité des données, comme plus amplement expliqué à la section 3.1.2.* »
   - « *Le Distributeur juge toutefois qu'il revient à chaque expert de défendre la composition de l'échantillon d'entreprises canadiennes et/ou américaines qu'il compte utiliser, autant en termes de compatibilité des données quant à la façon dont elles ont été construites, qu'en termes de compatibilité avec l'horizon de temps choisi par celui-ci considérant que les données ontariennes les plus lointaines remontent à 2005*. »
   - « *Le Distributeur est donc d'avis que les mesures d'extrants et d'intrants et les méthodes d'estimation sont des éléments qui ont trait à la méthodologie dans la réalisation d'une étude PMF. Les fixer dans le cadre du scoping pourrait restreindre un expert dans ses choix méthodologiques. Ces mesures et méthodes ne devraient donc pas relever du scoping*. »
   - « *Le Distributeur constate par ailleurs qu'il existe plusieurs ajustements qui peuvent, dans certaines circonstances, être apportés à l'estimation du taux de variation de la productivité de base d'une industrie. Parmi les expertises étudiées, des experts ont discuté des ajustements suivants* :
     - *Input-price differential*
     - *Productivity differential*
     - *Productivity gap*
     - *Ajustement pour exclusion des dépenses en capital*
     - *Stretch factor* »
   - « *Au regard de la finalité des ajustements susmentionnés, le Distributeur juge que les éléments de type Ajustements ne devraient pas relever du scoping mais qu'ils sont essentiellement du ressort de l'expertise, sauf en ce qui concerne le stretch factor qui est basé sur le jugement du régulateur*. »

9. With regard to the utility sample, HQD notes (p. 9):

   « *L'analyse des études PMF en Alberta et en Ontario indique que les sources de données utilisées sont fiables et accessibles au public. En effet, la principale source de données américaines ayant été utilisée a été le Form 1 de la Federal Energy Regulatory Commission (FERC). De plus, d'autres études utilisent également les données du Form 861 de l'Energy Information Agency (EIA). Pour l'Ontario, la source de données est l'Annual Yearbook qui regroupe les données colligées annuellement par l'Ontario Energy Board (OEB) pour l'ensemble des distributeurs d'électricité de l'Ontario.* »

10. As noted above, despite acknowledging that most Experts use the FERC Form 1 data, HQD concludes that *all* of the parameters and components, except for the Stretch Factor, should be determined by the two Experts.

IV. PEG Scoping Proposal

11. PEG has provided a comprehensive treatise on Scoping and calibration guidelines for the HQD TFP/PMF study[6].

12. Section 2 addresses, in detail, the major parameters and considerations related to the choice of these by the Consultants including:

- Productivity Indexes;
- Monetary Approaches to Capital Cost and Quantity Measurement;
- Capital Cost Controversies;
- Other Methodological Issues in X Factor Calibration
    - Choosing a Productivity Peer Group
- Stretch Factor
- Statistical Benchmarking
- External Business Conditions

13. In Section 3 Dr. Lowry reiterates the scoping issues identified by the Régie in D-2017-043 including:
    - Selection of a peer group;
    - Sample period;
    - Data set;
    - Calculation of outputs;
    - Calculation of inputs;
    - Controls for external business conditions;
    - Key hypotheses and premises;
    - Statistical Benchmarking.

14. Dr. Lowry provides commentary on the scoping issues identified by the Régie and a discussion on general considerations that are pertinent in establishing guidelines for the scope of an X factor calibration study[7]:
    - "*The Régie needs good information on which to base future X factor decisions. There is a particular need in a first generation study for the Régie to get the "lay of the land" on the varied methodological options*."

[6] X Factor Calibration Guidelines for Hydro-Québec Distribution May 12, 2019 (C-AQCIE-CIFQ-0047)
[7] Ibid 8 Page 25 and 26.

- "*There are controversies over the best research methods for X factor calibration. Alternative methods in some cases (but not others) produce materially different results*."
- "*Consultants in MRI proceedings can exploit these controversies to develop evidence that advances their client's interests. An extremely favorable X factor recommendation might be chosen by the regulator. The regulator might instead choose a number in the middle of the various consultant recommendations, and an extreme recommendation can materially shift the midpoint*."
- "*Methods for X factor calibration continue to evolve, and debates in MRI proceedings stimulate progress*."
- "*It can be difficult to test the sensitivity of a consultant's results to their methodological choices. In particular, it can be difficult to know how results would change using a larger peer group or a longer sample period*"
- "*Consultants should have considerable freedom in choosing methods for their X factor research. However, they should be encouraged to provide additional evidence that makes it easy for other parties and the Régie to learn about the options and to test the sensitivity of their results to their methodological choices*."

15. The PEG Report and in particular the discussion in Section 3, is central to Scoping of the 2021 HQD TFP/PMF Study. PEG also provides an Appendix with a comprehensive tabulation of the "Scope of X Factor Calibration in North American MRI Proceedings".

V. Econometric Models for Total Cost and Reliability

16. The use of Statistical Econometric Models for Total Cost and Reliability is relatively new. They have the ability to predict utility performance for both Total Cost and Reliability (SAIFI/SAIDI) relative to the industry over an historic period and an IRM period.

17. Dr. Lowry notes in the PEG submission that[8]:

> "*Econometric cost benchmarking has been used many times in utility regulation. The Ontario Energy Board, for instance, uses an econometric model of total (non-energy) cost to set stretch factors in the MRIs of most provincial power distributors. The Australian Energy Regulator uses econometric CNE benchmarking models developed using Australian, New Zealand, and Ontario data. Results are submitted in rate proceedings and in annual benchmarking reports. Two functional forms and two estimation procedures are considered. Several American utilities have filed benchmarking studies in rate proceedings which use econometric models estimated using U.S. data. They have, for example, been filed in some New England MRI proceedings. Public Service of Colorado has on several occasions benchmarked proposed forward test year revenue requirements*."

[8] Ibid 8 Pages 23-24

18. Parallel use of Econometric Models can provide insights into the drivers for Total Cost and Reliability and complement the baseline PMF Studies.

19. There may be an issue if one of the consultants does not have a proprietary Econometric Models for Total Cost and Reliability. This can be addressed by a partnership/collaboration with a consulting company that has such models.

VI. Review of Canadian Regulatory Decisions relevant to Scoping of HQD PMF Study

20. This section provides a summary that focusses on Scoping of PMF Studies based on information from 5 recent Canadian TFP Studies in British Columbia, Alberta and Ontario (See Appendix A for details).

21. HQD has briefly covered both Hydro One Distribution (EB-2017-0049) and Ontario Power Distribution (EB-2016-0152) in its submission focussing on Scoping issues.

22. As noted above, PEG has provided a comprehensive compilation of X factor Calibration Evidence as an Appendix to its Report.

23. The Purpose of this review is the focus on some of the Scoping Parameters used in these TFP/PMF studies and the regulatory considerations that flow from these.

i. British Columbia Utility Commission

Fortis IRM 2014-2018

24. As noted by the BCUC in its decision[9], the elements influencing measured TFP growth as described by Fortis are:

    1. **TFP growth estimator methodology.** Typically either an econometric modelling or an indexed based approach.
    2. **The sample of companies.** As broad a sample as possible. Since it is impossible to ensure the firms in the study are "exactly compatible" it is important to consider the results of the analysis in the context of the specific utility in question and its proposed PBR plan.
    3. **The measurement period.** In general, the most recent data should be used. The length of study periods from other North American jurisdictions is between five and 20 years.

[9] BCUC Decision, FortisBC Multi-Year Performance Based Ratemaking Plan for 2014-2018, September 15 2014.

4. **Choice of output measure.** Ideally a comprehensive set of cost drivers should be used.
5. **Choice of Input Measures.** Input measures should represent the operating and capital costs associated with the utility. Inclusion or exclusion of particular cost items may add to the bias of TFP estimates.

25. At page 35, the Commission states:

> "*The Panel agrees with Fortis that the result of a TFP growth study is dependent on expert judgement. However, in this proceeding, because there is considerable disagreement between the two experts in many of the study areas, where this occurs, the Commission Panel will assess the differing opinions and we will rely on our own judgement*".

26. At pages 40 to 80 of the decision, the Commission discusses and arbitrates the parameters, inputs and methodology used in the Fortis B&V (Overcast) and CEC/IRG PEG (Lowry) TFP studies.

27. We conclude from the above, that in this case, differences in key parameters required specific adjudication by the regulator which, together with different analytic methodologies of the experts, may have contributed to the differing TFP results.

ii. Alberta Utilities Commission

2018-2022 Performance-Based Regulation Plans for Alberta Electric and Gas Distribution Utilities[10]

28. This proceeding resulted in the following proposals for parameters and resulting TFP growth calculations:

Table 1. TFP growth study findings

Study	Output measure	Recommended data period	Number of firms	TFP growth calculation	
				Initial	Final
NERA 2012	Volume (MWh)	1972-2009	72	-	0.96
Brattle	Volume (MWh)	2000-2014	67	-0.89%	-0.79%
Meitzen	Volume (MWh)	Average of last 15 (2000-2014) and last 10 (2005-2014) years	68-72	-1.11% [Note 1]	-1.11% [Note 1]
Lowry	Number of customers	1997-2014	88 21	+0.48% +0.80%	+0.43% +0.78%

Note 1: As per Exhibit 20414-X0074, paragraph 95, clarified in Exhibit 20414-X0623, paragraph 55, EPCOR and Dr. Meitzen recommended a methodology for calculating TFP growth rather than a specific value, with the numerical value to be decided using a new TFP growth study tha utilizes the latest available data before the next generation PBR term begins.

Source: Brattle study initial TFP growth: Exhibit 20414-X0056, PDF pages 36-37, final TFP growth: Exhibit 20414-X0387, PDF pages 21-22; Meitzen study, initial TFP growth (71 firms): Exhibit 20414-X0074, PDF page 225, (67 firms): Exhibit 20414-X0256, EDTI-AUC-2016APR15-010, Table 3, PDF page 41; Lowry study initial TFP growth: Exhibit 20414-X0082, Table 5a on page 64 (88 firms), Table 5c on page 68 (21 firms), final TFP growth: Exhibit 20414-X0468, PDF pages 40, 42.

29. The Table illustrates the major differences between the choice of recommended data period and the number of firms in the samples in the studies and the earlier NERA study.

30. The AUC has specific comments on the issues at page 24 and following of the decision (See Appendix for details):

    5.2.1 Objectivity, consistency and transparency of TFP growth studies
    5.2.2 Sample of comparative firms in the TFP growth study
    5.2.3 Assumptions pertaining to measuring input growth and study calculation methods
    5.2.4 Output measure
    5.2.5 Time period

31. The Commission at page 32 states that :

    "*The Commission's findings in respect of the variability in TFP growth rates, resulting from differences in assumptions pertaining to measuring input growth and study calculation methods, follows the discussion of other relevant factors such as the use of various output measures and time periods used in the TFP growth studies and can be found in Section 5.4 below.*"

[10] AUC Decision 2014-D01-2016 :2018-2022 – Performance Based Regulation Plans for Alberta Electric and Gas Distribution Utilities

32. We conclude from the above, that in this case, differences in key parameters required in-depth arbitration and adjudication by the regulator.

iii. Ontario Energy Board

33. The incentive regulatory regime in Ontario is based on the Renewed Regulatory Framework for Electricity (RRFE) which was created in 2012 to facilitate Incentive regulation for the Province's ~80 Distribution Utilities.

34. The current 4th Generation Incentive Regulation Mechanism (4-GIRM) is based on a 2013 Ontario Sectoral TFP Study commissioned by the Board.

35. Pacific Economics Group (Dr. Kaufman) performed the OEB study[11].

36. Inter alia, it was determined that Toronto Hydro and Hydro One Distribution were "outliers" and were omitted from the Cohorts of Utilities.

37. The OEB RRFE provides for 3 types of Rate Applications:

- Standard Rate increase using a set Escalator and Cohort-based Stretch Factor
- Inflationary Rate Increase (GDDDP)
- Custom IRM, Rate Cap or Revenue Cap, including a Capital Factor, or Incremental Capital Module (ICM).

38. In 2016 the RRFE was extended to Transmission Utilities and also to Ontario Gas Utilities, which had been under separate 2nd generation IRMs.

39. For most Custom IRM Applications, the OEB's practice is to authorize Board Staff to provide either a separate TFP/PMF study, or a critique of the Applicants' Consultant's proposal.

40. The Ontario Energy Board has not specified or scoped the parameters of TFP/PMF Studies and has given the Consultants latitude to determine these. However, as noted, in most cases the Board Staff retain their own Expert.

Hydro One Distribution 2019-2024 CIR Plan (EB-2017-0049)[12]

[11] Ontario Energy Board (2013), EB-2010-0379, *Report of the Board Rate Setting Parameters and Benchmarking under the Renewed Regulatory Framework for Ontario's Electricity Distributors,* Issued on November 21, 2013 and as corrected on December 4, 2013
[12] Ontario Energy Board 2018: EB-2017-0049.Decision :Hydro One Distribution 2019-2024 CIR Plan

41. There were no major issues related to Scoping in this case since both Experts (PSE and PEG) filed similar Conclusions based on their TFP analyses.

Ontario Power Generation (OPG) 2017-2021 Incentive Ratemaking (EB-2016-0152)[13]

42. In its decision[14] the OEB stated the following:

"As directed by the OEB in the 2011-2012 payment amounts decision, OPG contracted with London Economics Inc.(LEI) in 2013 to conduct an independent productivity study of the hydroelectric generation industry. The report summarizing that work was filed with the OEB on December 18, 2014. The report was subsequently updated and filed in this proceeding. Based on an analysis of OPG and 15 US peers using data from 2002-2014, LEI calculated an estimated annual TFP of -1.01%. LEI explained that a negative TFP should be expected for the mature hydroelectric generation industry as there is increasing OM&A, relatively constant capital and relatively stable output. In the application, OPG proposed a 0% productivity factor, noting that the OEB has declined to accept negative productivity for electricity distributors.

OEB staff retained Pacific Economics Group Research LLC (PEG) to review OPG's hydroelectric IRM proposal, LEI's TFP study, and to conduct an independent study. PEG's analysis and its determination that a TFP of 0.29% is appropriate was filed as evidence in the proceeding.

Representatives of both LEI and PEG appeared as expert witnesses at the oral hearing. OPG and the unions urged the OEB to accept LEI's analysis, while OEB staff and the other intervenors argued in favour of PEG's analysis.

The following table summarizes the TFP methodologies and results:

[13] Ontario Energy Board EB-2016-0152, Decision and Order, December 28, 2017
[14] Ibid 13

Table 33: LEI and PEG Productivity Factor Methodologies and Results

	LEI	PEG
Output	Generation (MWh)	Capacity (MW)
Inputs	Operating Cost	Operating Cost
	Capital Measure (MW – physical) No depreciation assumed	Capital Measure (monetary) depreciation based on geometric decay, return on rate base, taxes
Sample	US utilities and OPG (16 total)	US utilities (21 total)
Period	2002 to 2014	1996 to 2014
Total Factor Productivity	-1.01%	0.29%

43. The Scoping issues that the Board addressed for OPGs Hydro Assets were: Comparable Sample, Output Index and treatment of Capital/Depreciation.

Toronto Hydro Electric System Limited (EB-2018-0165)

44. Relevant to the Scoping issues before the Régie is a comparison of the parameters used by PSE and PEG.

45. PEG provided this comparison in response to an IR[15] and also included a comparison to its 2013 TFP benchmarking study for the Fourth Generation IRM for the Ontario distribution Industry (IRM-4 in Table):

[15] OEB EB-2018-0165 Exhibit L1/Tab 2/Schedule 2 Page 2

		IRM-4	Exhibit M1 (Revised)	PSE
Sample	Region of sampled Utilities	Ontario	U.S., Ontario (THESL only)	U.S., Ontario (6 utilities)
	Sample Size	73	84	90
	Sample Period	2002-2012	1995-2017	2002-2016
Cost Definition	Distribution O&M	Included	Included	Included
	Sales Expenses	Included	Included	Included
	Customer Accounts (less uncollectible)	Included	Included	Included
	Customer Service and Information	Included	Excluded	Excluded
	Pensions and Benefits	Included	Excluded	Included
	Capital Benchmark Year	1989 or 2002	1964 (U.S.), 1989 (THESL)[2]	1989 (U.S.), 2002 (Ontario)
	Contributions in Aid of Construction	Included	Excluded	Excluded
	High Voltage Expenses	Excluded	Included	Included
Price Indexes	Labor Price Index	Ontario AWE	Regionalized ECI[4] (US), Ontario AWE (THESL)	ECI (US), ECI*PPP[6] (Ontario)
	Materials Price Index	Canada GDP-IPI	Canada GDP-PI (US), GDP-IPI (THESL)	GDP-PI (US), GDP-PI*PPP (Ontario)
	Construction Cost Trend Index	EUCPI[3]	HW (US), Custom[5] (THESL)	HW (US), HW*PPP (Ontario)
	O&M Cost Share Weights	Fixed	Varied	Fixed
Function	Translog Treatment of Scale Variables	Yes	Yes	Yes
Estimation Procedure	Cost-share equations, SUR[7]	Yes	No	No
	Composite price index, one equation	No	Yes	Yes
	Correction for Autocorrelation	Yes	Yes	No
	Correction for Heteroskedasticity	Yes	Yes	Yes
Total Cost Model Variables	Number of Customers	Yes	Yes	Yes
	Ratcheted Maximum Peak Demand	Yes	Yes	Yes
	Retail Deliveries	Yes	No	No
	Average Line Length	Yes	No	No
	Customer Growth over 10 Years	Yes	No	No
	Percent Congested Urban	Yes	Yes	Yes
	Percent of Plant Underground	Yes	No	Yes
	Area Not Congested Urban	No	Yes	No
	Percent Forested	No	Yes	Yes
	Percent of Customers Electric	No	Yes	Yes
	Percent of Customers with AMI	No	Yes	Yes
	Elevation Deviation	No	Yes	Yes
	Trend	Yes	Yes	Yes
	Ontario Binary Variable	No	No	Yes
	%UG*%CU	No	No	Yes
	Percent Plant Overhead	No	Yes	No

46. This chart shows there are material variations in Sample, Cost Definition and Price Indices used by PSE and PEG as well as other methodological differences.

47. This case will proceed to hearing.

VII. Conclusions

Regulatory Considerations

48. The focus and primary objective of a PMF study is to provide the Regulator with Expert analysis and opinion on the performance of the subject utility (in this case HQD) relative to the North American and Canadian electricity distribution sectors.

49. To date, Canadian Regulatory Commissions have not Scoped or specified the parameters on which TFP/Benchmarking studies are to be based. They have arbitrated and adjudicated these parameters while considering the analytical methodology and Findings of the Experts.

50. A review of Other Canadian jurisdictions - BC, Alberta and Ontario- shows significant differences in the base study parameters used by the consultants.

51. In part, the differences in Consultants' findings can be related to the embedded data bases that the Consultants use and the time frame that their in-house data covers.

52. Regulatory efficiency is an important consideration in regard to Scoping.

53. Significant debates can occur related to selection of these parameters, such as occurred in BC and Alberta (summarized in Appendix A). The Régie would spend considerable time and resources to arbitrate and adjudicate these differences if they are not clarified beforehand.

Scoping or not for the HQD TFP/PMF Study

54. After looking at Scoping from a ratepayer/customer perspective and in light of the list of Parameters provided by Hydro Quebec, we disagree with Hydro Quebec that the choice of **all** parameters should be left up to the Consultants.

55. Guidance on Scoping from the Régie is appropriate and necessary.

56. We suggest that PEG has responded appropriately to the Régie's request and provides a useful perspective based on Dr. Lowry's extensive experience in TFP/PMF and Benchmarking Studies.

Approach to Scoping

57. Based on our review of Canadian regulatory decisions, we suggest guidance from the Régie on the consultants' choice of: Sample, Time Horizon, Cost Definitions, Price Indices, and possibly Input/Output parameters.

58. With respect to the Utility **Sample**, we suggest that aside from a US Sample (FERC Form 1), an important objective is to position the utility within the appropriate and relevant industry group. Given the differences in regulatory and business conditions between the US and Canada, we believe it is necessary to include comparable Canadian utilities. We note for example, that PSE has included 6 Ontario distribution utilities in its Toronto Hydro Sample. However, we also note PEGs concern about data quality for Ontario utilities.

59. With regard to the **Timeframe/Horizon**, we support PEG's comments for a longer time period, with appropriate adjustments by the Experts to address changes in data.

60. We support consideration of the Experts scoping the primary **Input and Output Indices**.

61. The Experts should follow the guidance of the Régie regarding the Sample and data sources as part of their Study Proposals.

62. A Consultants "sandbox session" (hot tubbing) could provide information to the Régie on the parameters to be Scoped.

63. Below is a table summarizing our recommendations to the Régie.

Table 1 – Summary table of OC's recommendations for the scoping of HQD's PMF study

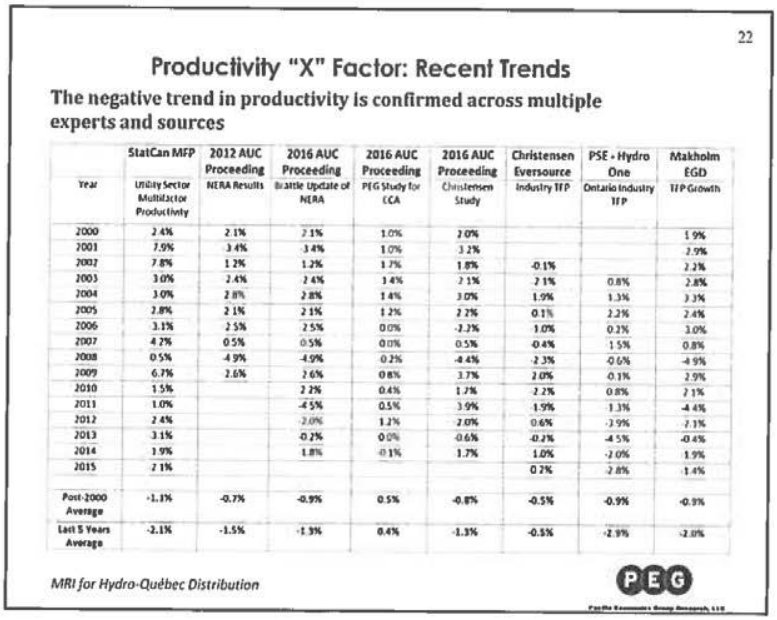
Regulator's Guidance on Calibration/Scoping
Utility Sample
Dataset Consistency/Sources
Timeframe
Inflation Factor
Input Indices - Labour, Capital
Output Indices - Customers and/or Kwh
Consultants' Analysis Methods (Proprietary)
Consultants Analysis- TFP/PMF and Benchmarking.
Econometric Model for Total Cost Benchmarking
Econometric Model for Reliability Benchmarking
Consultants' Conclusions and Recommendations (Expert Opinion)
Productivity Trends and Statistical Benchmarking for HQD
➢ Total Cost
➢ X Factor
➢ Stretch Factor
➢ Reliability

Appendix A: Review of some Canadian IRM Regulatory Proceedings and Decisions

PEG Summary of recent TFP studies and Trends

The following table was compiled by PEG and filed in R-4011-2017 and relates to Electric and Gas Distribution Utilities.

It shows the wide variability of X Factor determinations by experts as well as a general trend to lower sectoral productivity:



22

Productivity "X" Factor: Recent Trends

The negative trend in productivity is confirmed across multiple experts and sources

Year	StatCan MFP Utility Sector Multifactor Productivity	2012 AUC Proceeding NERA Results	2016 AUC Proceeding Brattle Update of NERA	2016 AUC Proceeding PEG Study for ECA	2016 AUC Proceeding Christensen Study	Christensen Eversource Industry TFP	PSE + Hydro One Ontario Industry TFP	Makholm EGD TFP Growth
2000	2.4%	2.1%	2.1%	1.0%	2.0%			1.9%
2001	7.9%	3.4%	3.4%	1.0%	3.2%			7.9%
2002	7.8%	1.2%	1.2%	1.7%	1.8%	-0.1%		2.2%
2003	3.0%	2.4%	2.4%	1.4%	2.1%	2.1%	0.8%	2.8%
2004	3.0%	2.8%	2.8%	1.4%	3.0%	1.9%	1.3%	3.3%
2005	2.8%	2.1%	2.1%	1.2%	2.2%	0.1%	2.2%	2.4%
2006	3.1%	2.5%	2.5%	0.0%	-2.2%	1.0%	0.2%	3.0%
2007	4.2%	0.5%	0.5%	0.0%	0.5%	-0.4%	1.5%	0.8%
2008	0.5%	-4.9%	-4.9%	0.2%	-4.4%	-2.3%	-0.6%	-4.9%
2009	6.7%	2.6%	2.6%	0.8%	3.7%	2.0%	-0.1%	2.9%
2010	1.5%		2.2%	0.4%	1.7%	2.2%	0.8%	2.1%
2011	1.0%		-4.5%	0.5%	3.9%	1.9%	1.3%	-4.4%
2012	2.4%		2.0%	1.2%	2.0%	0.6%	1.9%	2.1%
2013	3.1%		0.2%	0.0%	0.6%	-0.2%	-4.5%	-0.4%
2014	1.9%		1.8%	0.1%	1.7%	1.0%	-2.0%	1.9%
2015	2.1%					0.2%	-2.8%	-1.4%
Post-2000 Average	-1.1%	-0.7%	-0.9%	0.5%	-0.8%	-0.5%	-0.9%	-0.9%
Last 5 Years Average	-2.1%	-1.5%	-1.3%	0.4%	-1.3%	-0.5%	-2.9%	-2.0%

MRI for Hydro-Québec Distribution

PEG

Some Recent Canadian TFP/PMF studies

British Columbia Utilities Commission Fortis IRM 2014-2018

On June 12, 2013, FortisBC Energy Inc. (FEI) applied to the British Columbia Utilities Commission for approval of a proposed multi-year Performance Based Ratemaking (PBR) plan for the years 2014–2018 (Application). The Application was made pursuant to sections 59-61 and 44.2 of the *Utilities Commission Act* (UCA). This BCUC proceeding dealt with an appropriate PBR Plan for Fortis Electric and Fortis Gas.

The TFP studies filed by FortisBC- Black and Veatch (Dr. Overcast) and CEC/IRM PEG (Dr. Lowry) are relevant and analyze the issue of Parameters and Scoping required for such Studies.

Extract Decision Page 35

2.2.3 Setting the X Factor and Stretch Factor
Introduction 2.2.3.1
Fortis states there are two different approaches that can be used to set the X-Factor, a Pure Total Factor Productivity (TFP) approach and a Hybrid Judgement-based approach. Under the pure TFP approach, the X-Factor is derived from rigorous mathematical models that calculate the growth of total factor productivity. In this approach, the X-Factor is ordinarily defined as the measured industry TFP growth plus an adjustment for any difference between the inflation index used in the PBR index formula and the rate of input price inflation for the regulated sector. (FEI Exhibit B-1, pp. 49–50; FBC Exhibit B-1, pp. 45–46)
Fortis describes the following elements as influencing the measured TFP growth:

1. ***TFP growth estimator methodology*.** Typically either an econometric modelling or an indexed based approach.

2. ***The sample of companies*.** As broad a sample as possible. Since it is impossible to ensure the firms in the study are "exactly compatible" it is important to consider the results of the analysis in the context of the specific utility in question and its proposed PBR plan.

3. ***The measurement period*.** In general, the most recent data should be used. The length of study periods from other North American jurisdictions is between five and 20 years.

4. ***Choice of output measure*.** Ideally a comprehensive set of cost drivers should be used.

5. ***Choice of Input Measures*.** Input measures should represent the operating and capital costs associated with the utility. Inclusion or exclusion of particular cost items may add to the bias of TFP estimates.
Fortis

Extract Page 35
In this Decision, the Panel will examine further the underlying assumptions applied by each of the experts, in addition to the judgement-based factors applied by Fortis that underlie its X-Factor recommendations. The Panel will take the following approach:

1. Establish a measure of the MFP/TFP trend upon which to base the X Factor.

There was considerable disagreement between the two experts concerning TFP/MFP trend study methodology. The Panel notes the submission of CEC that "the Commission has a serious problem with the evidence. The differences of opinion are not straight forward and

understandable but are tied into esoteric economic theory and debates about methodology and assumptions, for which only PhD's seem to have perfunctory conclusions" and that "one of the most serious questions for the Commission to resolve is whether or not it is really suitable to impose this morass of complicated debate into the rate making process." (CEC PBR Final Argument, p. 57) We find CEC's comments curious, given the fact that it is referring, at least in part, to its own witness.

To this, Fortis replies that "The Commission is capable of weighing the expert evidence and coming to a considered decision, and should do so." (Fortis PBR Reply, p. 64). The Panel agrees with Fortis. Accordingly, in establishing the measure of TFP growth, we will examine the report submitted by B&V as part of Fortis' Applications, in addition to the report submitted by PEG for CEC.

The Panel agrees with Fortis that the result of a TFP growth study is dependent on expert judgement. However, in this proceeding, because there is considerable disagreement between the two experts in many of the study areas, where this occurs, the Commission Panel will assess the differing opinions and we will rely on our own judgement.

2. Apply any adjustments to the TFP that may be required before applying a stretch factor. Fortis states that an adjustment to account for inflation may be required. In addition, the Panel will consider any changes that arise from criticisms, made by the parties, that we have accepted.

3. Consider, to the extent the Panel finds appropriate, the TFP findings made by the AUC and the OEB as described in the Jurisdictional Benchmarking Report submitted by B&V.

4. Apply a stretch factor. As part of its determination of a stretch factor, the Panel will consider available evidence from the previous PBR period and the X-Factor that was applied during that period. We agree with Fortis that a stretch factor is judgement based and will use our judgement to determine one that is appropriate.

5. Consider any other parameters that may be appropriate in the determination of the X-Factor. This may include consideration of the elements of Fortis' proposed PBR Plan along with any other specific circumstances of Fortis. This also includes X-Factor evidence from other jurisdictions. Here, the Panel will apply its judgement as to what extent this evidence is relevant to the determination of the X-Factor in this Proceeding.

Note to Reader

At Pages 40 to 80 of the Decision, the Commission discusses and arbitrates the parameters and inputs and methodology used in the Fortis B&V (Overcast) and CEC/IRG PEG (Lowry) TFP studies.

Extract Decision Page 80

Commission Determination

The Commission Panel agrees with CEC and IRG and finds the PEG study results to be the best available evidence in this proceeding. In the Panel's view, with the exception of a small adjustment required to account for the use of the fixed price construction index basket, the underlying assumptions are reasonable and the study length is appropriate. **Accordingly the Panel considers these results to be an appropriate basis to set an X-Factor for the six-year PBR term.**

Alberta Proceeding 20414 (2018-2022 Performance-Based Regulation Plans for Alberta Electric and Gas Distribution Utilities). Decision December 16, 2016

Extract Decision 230414 Page 24ff

As this table shows, the Brattle and Meitzen studies yield similar TFP growth value estimates, **with differences mainly attributable to the different data periods used**. The table also shows there is a considerable difference in TFP growth calculated in the Lowry study when compared to the results of the Brattle and Meitzen studies. **Similarly, TFP growth is almost twice as large in the Lowry sample when a smaller selected sample of the 88 firms is used in the calculation when compared to the full sample**. This sample size issue is addressed in Section 5.2.2 below. Finally, differences between initial and final TFP growth calculations reflect corrections made in reply evidence as the result of self-identified errors and/or accepted improvements suggested by other parties.

Table 1. TFP growth study findings

Study	Output measure	Recommended data period	Number of firms	TFP growth calculation	
				Initial	Final
NERA 2012	Volume (MWh)	1972-2009	72	-	0.96
Brattle	Volume (MWh)	2000-2014	67	-0.89%	-0.79%
Meitzen	Volume (MWh)	Average of last 15 (2000-2014) and last 10 (2005-2014) years	68-72	-1.11% [Note 1]	-1.11% [Note 1]
Lowry	Number of customers	1997-2014	88 21	+0.48% +0.80%	+0.43% +0.78%

Note 1: As per Exhibit 20414-X0074, paragraph 95, clarified in Exhibit 20414-X0623, paragraph 55, EPCOR and Dr. Meitzen recommended a methodology for calculating TFP growth rather than a specific value, with the numerical value to be decided using a new TFP growth study tha utilizes the latest available data before the next generation PBR term begins.

Source: Brattle study initial TFP growth: Exhibit 20414-X0056, PDF pages 36-37, final TFP growth: Exhibit 20414-X0387, PDF pages 21-22; Meitzen study, initial TFP growth (71 firms): Exhibit 20414-X0074, PDF page 225, (67 firms): Exhibit 20414-X0256, EDTI-AUC-2016APR15-010, Table 3, PDF page 41; Lowry study initial TFP growth: Exhibit 20414-X0082, Table 5a on page 64 (88 firms), Table 5c on page 68 (21 firms), final TFP growth: Exhibit 20414-X0468, PDF pages 40, 42.

Extract Section 5.2

5.2.1 Objectivity, consistency and transparency of TFP growth studies
the Commission addressed these differences and the impacts on the results.
Some of the sources of the data were public and reproducable e,g, FERC Form 1, as used in the NERA, Brattle and Meitzen studies, and EIA Form 861) some were proprietary as used by Pacific Economics Group

5.2.2 Sample of comparative firms in the TFP growth study
the Commission addressed the differences the Samples and the impacts on the results.
Based on this evidence, the Commission considers that, in general, it is likely that in competitive markets, there is a variety of factors that influence the ability of firms operating in that market to achieve TFP gains. Since the design of the PBR plan for Alberta is meant to emulate these aspects of competitive markets, this suggests that it is preferable to use broad samples that will embody variation in more of the characteristics that influence productivity, as would be found in a competitive market. Accordingly, although the Commission considers that subsamples selected on a single criterion can provide useful information, analysis using the full sample, or possibly subsamples selected on multiple criteria, will better inform the Commission's judgement as to the possible range of TFP growth values that are reflective of competitive markets. For this reason, although the Commission will refer to the subset analysis as indicative of possible difficulties in the measurement of TFP growth, subsequent attention to the Lowry study is limited to its TFP growth findings for its full sample of 88 firms.

5.2.3 Assumptions pertaining to measuring input growth and study calculation methods the Commission addressed these and concluded:

124. Based on the evidence provided, the Commission observes that the combination of assumptions underlying the determination of input growth measurement used in the Brattle and Meitzen studies results in lower TFP growth values than the combination of assumptions underlying the determination of input growth measurement used in the Lowry study. **The Commission's findings in respect of the variability in TFP growth rates, resulting from differences in assumptions pertaining to measuring input growth and study calculation methods, follows the discussion of other relevant factors such as the use of various output measures and time periods used in the TFP growth studies and can be found in Section 5.4 below.**

5.2.4 Output measure
125. Another major difference among the TFP growth studies concerns the output measure. This section considers different choices for the output measure, and the effect of such choices on the resulting TFP growth values. Consideration of this issue also helps to inform the Commission about the range of values that the TFP growth component of the X factor can take, and how sensitive this range is to different sets of assumptions.

137. **Based on the evidence provided, the Commission observes that different choices for the output variable result in different output, and hence TFP, growth values**. These growth values are consistently higher using number of customers as the output variable, and this relative ranking appears to be maintained even if different data sources are used. The Commission's findings in respect of the variability in TFP growth rates, resulting from differences in the output measure, follows the discussion of the various other factors such as time periods used in the TFP growth studies, and can be found in Section 5.4 below.

5.2.5 Time period

138. The final component of the TFP growth studies in which there was some **disagreement among parties concerned the time period to be used for calculating TFP growth.** This section considers different choices for the time period, and the effect of such choices on the resulting TFP growth values. As with the input assumptions and output choices, consideration of this issue helps to inform the Commission about the range of values that the TFP growth component of the X factor can take, and how sensitive this range is to different sets of assumptions.

Note to Reader
As this Extract illustrates, the AUC was provided with a three Consultants Studies that used different Output Measures, Recommended Data Periods and Number of firms in the Sample.

Ontario Energy Board

EB-2017-0049 Hydro One Distribution 2029-2024 Custom IRM Plan
Hydro One applied to the OEB on March 31, 2017 for approval of electricity distribution rates beginning January 1, 2018 until December 31, 2022 under the Custom IR option.

Extract Decision Page 26

For the purposes of the RCI, Hydro One proposed a productivity factor of 0% and a stretch factor of 0.45%.

In support of its proposal, Hydro One submitted a report byPower System Engineering (PSE)[45] analyzing the total factor productivity (TFP) of Hydro One and the Ontario industry. The purpose of PSE's report was to measure the TFP for the electricity distribution operations of Hydro One and for similar utilities in North America. The OEB had directed Hydro One to do such a study in its previous decision.46 PSE's report also included a total

cost benchmarking study comparing Hydro One to a comparator group of U.S. distribution utilities, including Rural Electrical Cooperatives.

PSE recommended that the productivity for Hydro One be set no higher than 0%, and initially recommended a stretch factor no higher than 0.6%. This was updated to a stretch factor no higher than 0.45% once data from 2016 audited financial results was incorporated. PSE noted "the upward trajectory of Hydro One's TFP trend is contrasted with the recent downward TFP trend of the rest of the Ontario industry".

OEB staff filed evidence by PEG.[48] PEG's report provided a critique of PSE's productivity and benchmarking evidence, provided results using alternative methods, and discussed features of Hydro One's Custom IR proposal. PEG expressed certain concerns with technical details of PSE's methodologies and attempted to improve on these in its report.[49] PEG's analysis found that the TFP trend for electricity distribution in Ontario is "fairly close to zero" and therefore a 0% productivity factor is reasonable. PEG found that based on its total cost forecast model, Hydro One's cost performance was improving between 2014 and 2016, continuing to improve in 2017 and 2018, and forecast to improve over the plan term from 2019 to 2022. PEG indicated that a 0.45% stretch factor seems reasonable for Hydro One.[50]

Findings

The OEB accepts Hydro One's proposal for a productivity factor of 0% during the term of the Custom IR plan. There were two expert reports filed in evidence in this proceeding on the productivity factor; one from PSE for Hydro One and another from PEG for OEB staff. The approaches for determining an appropriate productivity factor were similar and both experts recommended a productivity factor of 0%. While there was discussion of the relative merits of the methodologies by PSE and PEG, the concluding recommendations were the same. The OEB is therefore not providing findings on the merits of each methodology, except as noted below.

Note to Reader
There were no major issues related to Scoping and both Experts filed similar Conclusions based on their TFP analyses.

EB-2016-0152 (2017-2021 Incentive Ratemaking for Ontario Power Generation (OPG) prescribed assets,

The OPG application sought approval of $16,800 million of revenue requirement1 over the period 2017 to 2021 for the nuclear facilities, and approval of an inflation and productivity based formula for the determination of payment amounts for the hydroelectric facilities from 2017 to 2021.

8.1.4 Productivity Factor

The OEB and the electricity distributors are experienced with the index method which converts outputs and inputs into an index value for the determination of industry total factor productivity (TFP). There is no precedent for TFP studies of the hydroelectric generation industry for the purposes of ratemaking.

As directed by the OEB in the 2011-2012 payment amounts decision, OPG contracted with London Economics Inc.(LEI) in 2013 to conduct an independent productivity study of the hydroelectric generation industry. The report summarizing that work was filed with the OEB on December 18, 2014. The report was subsequently updated and filed in this proceeding.

Based on an analysis of OPG and 15 US peers using data from 2002-2014, LEI calculated an estimated annual TFP of -1.01%. LEI explained that a negative TFP should be expected for the mature hydroelectric generation industry as there is increasing OM&A, relatively constant capital and relatively stable output. In the application, OPG proposed a 0% productivity factor, noting that the OEB has declined to accept negative productivity for electricity distributors.

OEB staff retained Pacific Economics Group Research LLC (PEG) to review OPG's hydroelectric IRM proposal, LEI's TFP study, and to conduct an independent study. PEG's analysis and its determination that a TFP of 0.29% is appropriate was filed as evidence in the proceeding.145

Representatives of both LEI and PEG appeared as expert witnesses at the oral hearing. OPG and the unions urged the OEB to accept LEI's analysis, while OEB staff and the other intervenors argued in favour of PEG's analysis.

The following table summarizes the TFP methodologies and results:

Table 33: LEI and PEG Productivity Factor Methodologies and Results

	LEI	PEG
Output	Generation (MWh)	Capacity (MW)
Inputs	Operating Cost	Operating Cost
	Capital Measure (MW – physical) No depreciation assumed	Capital Measure (monetary) depreciation based on geometric decay, return on rate base, taxes
Sample	US utilities and OPG (16 total)	US utilities (21 total)
Period	2002 to 2014	1996 to 2014
Total Factor Productivity	-1.01%	0.29%

Extract Decision Page 126

However, the OEB is also not persuaded that PEG's approach using MW as the output measure is appropriate. MW as an output does not seem reasonable as an

underutilized asset will still be considered to be productive. How many MWh can be produced from a plant of a particular MW capacity must bear some relationship to productivity, as, for example, improvements in maintenance (e.g. shorter down time) may result in more output from a plant of the same capacity.
In OPG's situation, the major capital investment in the Niagara Tunnel is intended to result in greater production even if the capacity of the Sir Adam Beck plants is not increased. However, at the same time, there are also factors, such as water availability, which are beyond the control of the plant operator. Not all hydroelectric generation is used as base load, so output may also be reduced due to market conditions.
However, PEG's financial approach, which does take into account depreciation of assets in some form, is in the OEB's view more realistic than LEI's approach, although the OEB observes that there is no consensus on the best method for accounting for economic and physical depreciation or deterioration of assets in these types of analyses.
The OEB also has other reservations about aspects of both LEI's and PEG's studies. Neither study included Canadian generators other than OPG. The OEB accepts that Canadian data was difficult to obtain, **but is concerned about the reliance solely on OPG's own and U.S. based generators' data. T**he OEB notes that neither study provided evidence on how the regulatory environment may influence the production of a hydroelectric generator in a particular jurisdiction. Improved sample, data and
[148]However, **the OEB is also not persuaded that PEG's approach using MW as the output measure is appropriate.** MW as an output does not seem reasonable as an under-utilized asset will still be considered to be productive. How many MWh can be produced from a plant of a particular MW capacity must bear some relationship to productivity, as, for example, improvements in maintenance (e.g. shorter down time) may result in more output from a plant of the same capacity.

Findings
While there have been TFP based empirical studies for generation in academia, the LEI and PEG TFP studies are the first TFP studies for the hydroelectric generation business sector for the purposes of regulatory ratemaking.[147] The OEB is not prepared to completely accept the approach of either expert. As discussed extensively in responses to interrogatories, during the oral hearing, and in submissions, there are strengths and weaknesses of both approaches.
The OEB agrees with LEI that generation (MWh) is the most appropriate measure of output, as it is generation produced, and not capacity, which is the basis for revenues to recover capital and operating costs. However, the OEB also recognizes limitations with LEI's approach. The OEB questions LEI's physical approach which uses MW capacity as an input, as this measure does not take into account financial considerations, such consideration of business and regulatory factors that influence a generator's operations and production would improve the usefulness of the results of studies.

Note to Reader
The issues that the Board Addressed for OPGs Hydro Assets were Comparable Sample Output Parameter and treatment of Capital/Depreciation.

Toronto Hydro EB-2018-0165 (Hearing in Process)

Toronto Hydro Has Filed for OEB approval of a Custom Incentive Regulation CIR Plan for the years 2019-2024. The Proposal includes Rate- setting using an Index and a Custom Capital Factor.
Toronto Hydro has retained Power Systems Engineering (PSE) to provide evidence on the X and Stretch Factor and Total Cost and Reliability Benchmarking using Econometric Models.
Board Staff have retained Pacific Economics Group (PEG) to critique the PSE Study and provide an independent assessment.

Extract
PEG Interrogatory Response Re Differences between PEG and Power Systems Engineering TFP Studies to set the X factor for Toronto Hydro[16]

Exhibit 1B/Tab 4/Schedule 3 is based on Toronto Hydro's recent and forecasted total cost benchmarking scores under the IRM-4 Ratemaking Framework. These scores are generated from annual updates of PEG's 2013 benchmarking study1 and are different than the results from PEG's revised total cost model. **Key differences, expanded upon in the table below, are the companies in the econometric study sample, sample periods, price indexes, cost definitions, estimation**
procedures, and model specifications.

Note to Reader
"IRM-4" refers to the 2013 PEG study (and its annual updates) and Exhibit M1 refers to the PEG's revised TFP Benchmarking study of Toronto Hydro This Interrogatory was submitted in response to M1-TH-026.
The table also lists differences found between the latter study and PSE's study in Exhibit 1B Tab 4 Schedule 2.

[16]EB-2018-0165 Exhibit L1/Tab 2/Schedule 2 Page 2

		IRM-4	Exhibit M1 (Revised)	PSE
Sample	Region of sampled Utilities	Ontario	U.S., Ontario (THESL only)	U.S., Ontario (6 utilities)
	Sample Size	73	84	90
	Sample Period	2002-2012	1995-2017	2002-2016
Cost Definition	Distribution O&M	Included	Included	Included
	Sales Expenses	Included	Included	Included
	Customer Accounts (less uncollectible)	Included	Included	Included
	Customer Service and Information	Included	Excluded	Excluded
	Pensions and Benefits	Included	Excluded	Included
	Capital Benchmark Year	1989 or 2002	1964 (U.S.), 1989 (THESL)[2]	1989 (U.S.), 2002 (Ontario)
	Contributions in Aid of Construction	Included	Excluded	Excluded
	High Voltage Expenses	Excluded	Included	Included
Price Indexes	Labor Price Index	Ontario AWE	Regionalized ECI[4] (US), Ontario AWE (THESL)	ECI (US), ECI*PPP[6] (Ontario)
	Materials Price Index	Canada GDP-IPI	Canada GDP-PI (US), GDP-IPI (THESL)	GDP-PI (US), GDP-PI*PPP (Ontario)
	Construction Cost Trend Index	EUCPI[3]	HW (US), Custom[5] (THESL)	HW (US), HW*PPP (Ontario)
	O&M Cost Share Weights	Fixed	Varied	Fixed
Function	Translog Treatment of Scale Variables	Yes	Yes	Yes
Estimation Procedure	Cost-share equations, SUR[7]	Yes	No	No
	Composite price index, one equation	No	Yes	Yes
	Correction for Autocorrelation	Yes	Yes	No
	Correction for Heteroskedasticity	Yes	Yes	Yes
Total Cost Model Variables	Number of Customers	Yes	Yes	Yes
	Ratcheted Maximum Peak Demand	Yes	Yes	Yes
	Retail Deliveries	Yes	No	No
	Average Line Length	Yes	No	No
	Customer Growth over 10 Years	Yes	No	No
	Percent Congested Urban	Yes	Yes	Yes
	Percent of Plant Underground	Yes	No	Yes
	Area Not Congested Urban	No	Yes	No
	Percent Forested	No	Yes	Yes
	Percent of Customers Electric	No	Yes	Yes
	Percent of Customers with AMI	No	Yes	Yes
	Elevation Deviation	No	Yes	Yes
	Trend	Yes	Yes	Yes
	Ontario Binary Variable	No	No	Yes
	%UG*%CU	No	No	Yes
	Percent Plant Overhead	No	Yes	No

7 SUR = seemingly unrelated regression technique for estimating parameters of multiple equations.

Footnotes

[1] Kaufmann, Lawrence, Hovde, Kalfayan, Rebane. *Productivity and Benchmarking Research in Support of Incentive Rate Setting: Final Report to the Ontario Energy Board.* November 5, 2013.

[2] Exceptions are Toronto Hydro and Northern States Power – WI, which both received a 1989 benchmark year.

[3] Electric utility construction price index for distribution systems (Statistics Canada).

[4] Regionalized Utility Salaries and Wages ECIs (Employment Cost Indexes from the U.S. Bureau of Labor and Statistics). Note that PSE uses the salaries and wages version of ECI too even though pensions and benefits are included in their cost.

[5] PEG's preferred Ontario LDC plant additions deflator originates from Statistics Canada Stock and Consumption of Fixed Non-Residential Capital ("SCFNRC") program. The annual survey collects data on utility-business capital expenditure on over 140 different types of machinery, equipment, and construction assets, which is then used to construct an annual index of deflated capital investment. Since deflated investment is provided in both constant (2012) and current prices, the ratio of the two implicitly yields capital asset price change over time. The indexes are constructed by industry and region and in particular, are available for the utility business in Ontario. Handy-Whitman (HW) regional power distribution construction cost indexes are used for the U.S. companies.

[6] Utility Employment Cost Index (U.S. Bureau of Labor Statistics). Purchasing Power Parity between U.S. and Canada.

Note to Reader
In its recent Evidence and Interrogatories PEG proceeds to set out the reasons that its Benchmarking results should be adopted by the Ontario Energy Board:

> c) PEG believes that its revised benchmarking results prepared for OEB Staff in this proceeding should provide the basis for Toronto Hydro's stretch factor. The advantages of PEG's benchmarking work include the following.
> - **A considerably larger sample size** was used for model estimation due to the inclusion of **additional years of data that include 2017**. Thus, estimates of model parameters should be more precise.
> - The PEG model has a **more balanced treatment of urban and rural challenges.** The Company does face urban challenges but does not face rural challenges. Cost benchmarks should reflect both of these realities.
> - **Pension and benefit expenses are excluded because these are hard to benchmark** accurately and will be addressed by variance accounts in the proposed IRM. In addition, Toronto Hydro may have different health insurance obligations than does the typical U.S. utility.
> - **Using a 1964 benchmark year for the U.S. utilities to start the calculation of capital costs means that capital costs were estimated more accurately.**
> - Better input price indexes were used for Toronto Hydro.
> - PEG also presents benchmarking results for OM&A expenses, capital cost, and capital expenditures using **econometric models that are experimental but informative.**

EB-2018-0165 Exhibit M1, p. 26.

<u>Note to Reader</u>
PEGs Response in Part b is relevant

b) The considerable differences in the total cost benchmarking scores of PSE and PEG **are due to differences in methodology which PEG discussed in response to Exhibit L1/Tab 2/Schedule 2.**