# MRI Design for

# Hydro-Québec Distribution

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# 1. Introduction

The Régie de l'Energie ("Régie") has been engaged for several years in a proceeding (R-3897-2014) to develop *méchanismes de reglementation incitative* ("MRIs") for transmission and distribution services of Hydro-Québec. In April 2017, the Régie's Decision D-2017-043 established some key provisions of the first MRI for Hydro-Québec Distribution ("HQD" or "the Company"). The MRI will take the form of a multiyear rate plan with a revenue cap (*plafonnement des revenus*). Growth in HQD's revenue requirement (*revenu requis*) will be escalated each year by a revenue cap index similar to that which the Régie currently uses in rate cases (*dossiers tarifaires*) to limit growth in the *revenu requis* for operation and maintenance expenses (*charges d'exploitation*). The index formula (*formule d'indexation*) includes a *facteur d'inflation* (measured inflation), a *facteur de productivité* (*X*), a *dividende client* ("stretch factor" or s), and 0.75 x growth in the number of HQD's *abonnements* (customer accounts).

The X factor in the revenue cap escalation formula is a key issue in the proceeding. It will be decided by the Régie without the benefit of new, custom productivity studies. Instead,

> **La Régie retient la méthode basée sur le jugement préconisée par le Distributeur pour déterminer la valeur du Facteur X à inclure dans la Formule d'indexation. À cette fin, le Distributeur devra mettre à la disposition des intervenants les études, analyses et rapports susceptibles d'éclairer la Régie quant à la détermination du Facteur X en phase 3.[1]**

The Régie, paraphrasing remarks by HQD, explained what it meant by a process of *jugement.*

> **Le jugement exercé par la Régie serait basé sur l'étude des valeurs du Facteur X utilisées dans d'autres juridictions, de même que sur l'analyse des gains d'efficience réalisés par le Distributeur à ce jour et du potentiel de réalisation de gains d'efficience supplémentaires dans les années à venir.[2]**

Resolution this and of some other MRI implementation details will occur in Phase III of this proceeding.

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[1] Régie de l'Energie, D-2017-043, R-3897-2014 Phase 1, April 2017, p. 43.

[2] Ibid., p. 37.

HQD submitted the requested X factor evidence in June 30 2017.[3] The Company discussed its own cost performance and submitted commentary on productivity evidence and X factor decisions in North American regulation from its consultant, Concentric Energy Advisors ("CEA").[4] HQD may file further X factor evidence on this topic during the Phase 3 proceeding.

> Dans le cadre de la phase 3B de l'établissement de son MRI, le Distributeur procédera à la mise à jour des études, analyses et rapports existants, le cas échéant, et présentera son positionnement quant à la détermination du Facteur X à utiliser pour son MRI.[5]

The Company filed a *dossier tarifaire* for an increase in rates for the 2018-19 tariff year on 31 July 2017.[6] This filing included a section on Phase 3 MRI issues. Only the Y and Z factor issues were discussed at length. HQD may provide further evidence on unresolved MRI design issues in January 2018.

Pacific Economics Group Research LLC has for many years been the leading North American consultancy on MRIs for gas and electric utilities. Work for a diverse client mix that includes regulators, utilities, and consumer groups has given our practice a reputation for objectivity and dedication to good regulation. In Canada, we have played a prominent role in MRI proceedings in Alberta, British Columbia, and Ontario, as well as in Québec. Research and testimony on productivity trends of power distributors and other energy utilities is a company specialty. AQCIE-CIFQ has retained us and the Régie has authorized us to provide Phase 3 comments on the appropriate X factor and other unresolved provisions of the MRI of HQD.

Section 2 of our report provides a brief review of the Régie's Phase 1 decision. There follows in Section 3 a discussion of principles and methods for selecting the X factor and stretch factor.[7] Section 4

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[3] HQD, *Etudes, Analyses et Rapports pour la Determination du Facteur X Deposes dans le Cadre de l'Etablissement du Mechanisme de Reglementation Incitative du Distributeur.* June 2017.

[4] CEA, *Performance-Based Regulation: Productivity Factor for HQD*, 30 June 2017.

[5] HQD, op. cit., p. 12.

[6] HQD, *Implantation d'un Mechanisme de Reglementation Incitative* (MRI) – *Phase 3*, 31 July 2017.

[7] This discussion reorganizes and elaborates on material presented in Section 4 of our report in Phase 1 of this proceeding.

of this report adds to CEA's evidence by providing an independent review of energy utility productivity studies and commission decisions in MRI proceedings. We hope that this review can help the Régie make informed decisions on X and s. Our recommendations concerning the inflation measure, X factor, and stretch factor for HQD follow in Section 5. Section 6 discusses other plan design issues.

# 2. Background

The Régie made the following additional decisions concerning the design of the MRI for HQD in D-2017-043.

- The basic form of the MRI is a multiyear rate plan. The plan will begin in April 2018 and have a four-year term.
- The initial *revenu requis* will be established in a *dossier tarifaire* that is currently under way.
- The *revenu requis* for most of the cost of HQD's base rate inputs will then be escalated for three years by a revenue cap index. Costs addressed by the index will include *charges d'exploitation* that the Company can control, including fuel expenses (*couts de combustible*) administrative and general expenses (*frais corporatifs*), amortization and depreciation expenses (*amortissement*), the return on rate base (*rendement sur la base de tarification*), and taxes.
- Costs of the Company's autonomous networks will be an integral part of the MRI.
- A study of *productivité multifactorielle* ("PMF") [multifactor productivity] will be undertaken, after the MRI begins, for possible application in the last year of the plan. With respect to this study, "la Régie demande au Distributeur de présenter en phase 3, la méthodologie et l'échéancier rattachés a la realisation d'une etude PMF."[8] Appropriate methods for measuring productivity are thus a key issue in this proceeding.
- The plan will not include revenue decoupling. However, *nivellements pour les aléas climatiques* (weather normalization of revenue) will continue.

[8] Régie, op. cit., p. 44

- A *clause de sortie* ("off ramp" mechanism) will be included.
- There will be no formal *clause de* succession (plan termination provisions). Instead,

> **La Régie se prononcera au moment opportun, après consultation des participants, quant à la forme du recalibrage, la date et les modalités d'un retour éventuel au coût de service, qu'il soit complet ou partiel.**[9]

- A *méchanisme de traitement des ecarts de rendement* ("MTER", or earning sharing mechanism) will be included.[10] This will likely be the same as that currently used.
- There will be no *méchanisme de report des gains d'efficience* (efficiency carryover mechanism) in this plan.[11]
- No additional marketing flexibility will be granted to HQD.
- Metrics for reliability, customer service quality, and safety will be established and linked to the MTER. HQD should develop during the first-generation MRI a metric addressing short-term energy and demand purchases and underutilization of the patrimonial block of power.

The Régie's decision left for Phase 3 the final resolution of the following MRI provisions:

- Inflation measure formula
- X Factor
- Stretch Factor
- Final list of costs eligible for Y factor and Z factor treatment
- Method for Y factoring the rate of return on capital
- Materiality thresholds for Y and Z
- Specific safety, reliability, and customer service metrics

Determination of some additional details of the MRI will be delayed until the fall of 2018.

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[9] Ibid., p. 103.

[10] Ibid., p. 106.

[11] Ibid., p. 109.

# 3. Methods and Principles for Revenue Cap Index Design

In this section of the report we discuss methods and principles for the design of revenue cap indexes. We begin by discussing basic indexing concepts. There follow discussions of the use of indexing research in MRI design, capital cost specifications, Kahn X factors, other methodological issues, and the choice of a stretch factor.

## 3.1 Basic Indexing Concepts

The logic of economic indexes provides the rationale for using price and productivity research to design attrition relief mechanisms. To review this logic, it may be helpful to make sure that the reader has a high-level understanding of basic tools of index research.

### Input Price and Quantity Indexes

The growth (rate) of a company's cost can be shown to be the sum of the growth of an input (*intrant*) price index ("Input Prices") and input quantity index ("Inputs").

growth Cost = growth Input Prices + growth Inputs.[12] [1]

These indexes are typically multidimensional in the sense that they summarize trends in subindexes that are appropriate for particular subsets of cost. This is accomplished by taking a cost-share weighted average of the subindex growth. Capital, labor, and miscellaneous materials and services are the major classes of base rate inputs used by electric power distributors. The technology for providing distributor services is capital intensive, so the heaviest weights in these indexes are placed on the capital subindexes.

Calculation of input quantity indexes is complicated by the fact that firms typically use numerous inputs in service provision. This complication is contained when summary input price indexes are readily available for a group of inputs such as labor. Rearranging the terms of [1] we can calculate input quantity growth using the formula

[12] Cost-weighted input price and quantity indexes are attributable to the French economist Francois Divisia.

$$\text{growth Inputs} = \text{growth Cost} - \text{growth Input Prices}. \qquad [2]$$

This residual approach to input quantity growth calculation is widely used in productivity research. One can, for example, calculate growth in the quantity of labor by taking the difference between salary and wage expenses and a salary and wage price index.

## Productivity Indexes

*The Basic Idea* A productivity index is the ratio of a scale (aka "output") index ("Scale") to an input quantity index.

$$\text{Productivity} = \frac{\text{Scale}}{\text{Inputs}}. \qquad [3]$$

It can be used to measure the efficiency with which firms use inputs to achieve their scale of operation.

Some productivity indexes are designed to measure productivity *trends*. The growth of such a productivity index is the *difference* between the growth in the scale and input quantity indexes.

$$\text{growth Productivity} = \text{growth Scale} - \text{growth Inputs}. \qquad [4]$$

Productivity grows when the scale index rises more rapidly (or falls less rapidly) than the input index. The productivity growth of utilities can be volatile but has historically tended to grow over time. The volatility is typically due to demand-driven fluctuations in operating scale and/or the uneven timing of certain expenditures. The volatility of productivity growth tends to be much greater for individual companies than the average for a group of companies.

Relations [1] and [4] imply that

$$\begin{aligned}\text{growth Productivity} &= \text{growth Scale} - (\text{growth Cost} - \text{growth Input Prices}) \\ &= \text{growth Input Prices} - \text{growth (Cost/Scale)}\end{aligned}$$

Productivity growth is thus the amount by which a firm's unit cost grows more slowly than its input prices.

Some indexes are designed to measure only productivity *trends*. "Bilateral" productivity indexes are designed to compare only productivity *levels*. For example, the productivity level of HQD in 2016 can be compared to the average for U.S. power distributors in the same year. "Multilateral" productivity indexes are designed to measure *both* trends and levels.

The scope of a productivity index depends on the array of inputs which are considered in the input quantity index. Some indexes measure productivity in the use of a single input group such as labor. A *multifactor* productivity index measures productivity in the use of multiple inputs. PMF indexes are sometimes called *total* factor productivity indexes, a term that is usually a misnomer since in practice some inputs are excluded from the index calculations.

*Scale Indexes* A scale index of a firm or industry summarizes trends in the scale of operation. These indexes may also be multidimensional. Growth in each dimension of scale that is itemized is then measured by a subindex. The scale index then summarizes growth in the subindexes by taking a weighted average of them.

In designing a scale index, choices concerning scale variables (and weights, if the index is multidimensional) should depend on the manner in which the index is used. One possible objective is to measure the impact of growth in scale on *revenue*. In that event, the scale variables should measure growth in *billing determinants* and the weight for each itemized class of determinants should be its share of a utility's base rate revenue.[13] In this report we denote by $Scale^R$ a scale index that is "revenue-based" in the sense that it is designed to measure the impact of growth in scale on revenue. A productivity index that is calculated using $Scale^R$ will be denoted as $Productivity^R$.

$$\text{growth Productivity}^R = \text{growth Scale}^R - \text{growth Inputs.} \qquad [5a]$$

Another possible objective of scale indexing is to measure growth in dimensions of scale that affect *cost.* In that event, the scale variable(s) should measure dimensions of the "workload" that drive cost.[14] A multidimensional scale index with elasticity weights is unnecessary if econometric research reveals that there is one dominant cost driver. A productivity index calculated using a cost-based scale index (which may be unidimensional) will be denoted as $Productivity^C$.

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[13] Revenue-weighted scale indexes are attributable to the French economist Francois Divisia.

[14] If there is more than one scale variable in the index, the weights for each variable should reflect its relative cost impact. The sensitivity of cost to a small change in the value of a business condition variable is commonly measured by its cost "elasticity." Cost elasticities of utilities can be estimated econometrically using data on the costs and operating scale of a group of utilities.

$$growth\ Productivity^C = growth\ Scale^C - growth\ Inputs. \qquad [5b]$$

This may fairly be described as a "cost efficiency index."

In measuring the productivity growth of U.S. energy distributors the choice of a scale index can have a major effect on results. To understand why, consider first that under legacy rate designs, the volume of deliveries to residential and commercial ("R&C") customers is the major driver of distributor revenue. Meanwhile, econometric research has repeatedly shown that the number of customers served is by far the most important scale-related driver of energy distributor cost. Customer growth affects cost directly, and is highly correlated with the growth of other demand drivers such as peak load. The difference between the growth trends of revenue- and cost-based scale indexes thus depends on the trend in R&C average use.

A second reason why the scale index matters is that growth in the R&C average use of electric utilities has slowed substantially in recent years due to sluggish economic growth and growth in energy efficiency programs. Table 1 is drawn from a recent white paper on multiyear rate plans which PEG prepared for Lawrence Berkeley National Laboratory, a unit of the U.S. Department of Energy.[15] The table shows that growth in average use of power by R&C customers of U.S. electric utilities was in the neighborhood of 1.5% annually over the 1973-2000 period but is now negative.

A third reason why choice of a scale index matters is that the growth of power delivery volumes is much more volatile than customer growth. This makes results using delivery volumes much more sensitive to the choice of a sample period.

[15] Mark Newton Lowry, Matt Makos, and Jeff Deason, *State Performance-Based Regulation Using Multiyear Rate Plans for U.S. Electric Utilities*, Lawrence Berkeley National Laboratory, July 2017.

Table 1

Average Use Trends of U.S. Electric Utilities

| | Residential[1] | | Commercial[1] | | Average |
|---|---|---|---|---|---|
| | Level | Growth Rate | Level | Growth Rate | Growth Rate |
| **Multiyear Averages** | | | | | |
| **1927-1930** | 478 | 7.06% | 3,659 | 6.67% | 6.86% |
| **1931-1940** | 723 | 5.45% | 4,048 | 2.00% | 3.73% |
| **1941-1950** | 1,304 | 6.48% | 6,485 | 5.08% | 5.78% |
| **1951-1960** | 2,836 | 7.53% | 12,062 | 6.29% | 6.91% |
| **1961-1972** | 5,603 | 5.79% | 31,230 | 8.79% | 7.29% |
| **1973-1980** | 8,394 | 2.03% | 50,576 | 2.53% | 2.28% |
| **1981-1986** | 8,820 | 0.12% | 54,144 | 0.81% | 0.46% |
| **1987-1990** | 9,424 | 1.39% | 60,211 | 2.29% | 1.84% |
| **1991-2000** | 10,061 | 1.15% | 67,006 | 1.68% | 1.41% |
| **2001-2007** | 10,941 | 0.73% | 74,224 | 0.64% | 0.68% |
| **2008-2014** | 11,059 | -0.38% | 75,311 | -0.22% | -0.30% |

[1] U.S. Department of Energy, Energy Information Administration, Form EIA-861, "Annual Electric Utility Report," Form EIA-826, "Monthly Electric Utility Sales and Revenues Report with State Distributions," and EIA-0035, "Monthly Energy Review."

## 3.2 Use of Index Research in MRI Design

Productivity studies have many uses, and the best methodology for one use may not be best for another. One use of productivity research is to measure the trend in a utility's operating efficiency. Another is to calibrate the X factor in a rate-cap or revenue-cap index. A method that is best for measuring efficiency may not be the best for X factor calibration. In this section, we consider the rationale for using productivity research in rate and revenue cap index design.

## Price Cap Indexes

An early use of index research in regulation was to design *price* cap indexes. We begin our explanation of the supportive index logic by considering the growth in the prices charged by an industry that earns, in the long run, a competitive rate of return.[16] In such an industry, the long-run trend in revenue equals the long-run trend in cost.

$$\text{trend Revenue} = \text{trend Cost}. \qquad [6]$$

The growth in the revenue of any firm or industry can be shown to be the sum of the growth in revenue-weighted indexes of its output prices ("*Output Prices*$^R$") and billing determinants ("*Scale*$^R$").

$$\text{growth Revenue} = \text{growth Scale}^R + \text{growth Output Prices}^R. \qquad [7]$$

Recollecting from [1] that cost growth is the sum of the growth in cost-weighted input price and quantity indexes, it follows that the trend in output prices which permits revenue to track cost in the longer run is the difference between the trends in an input price index and a multifactor productivity index constructed with a revenue-weighted scale index.

$$\begin{aligned}\text{trend Output Prices}^R &= \text{trend Input Prices} - (\text{trend Scale}^R - \text{trend Inputs}) \\ &= \text{trend Input Prices} - \text{trend PMF}^R. \qquad [8]\end{aligned}$$

This result provides a conceptual framework for the design of price cap indexes of general form

$$\text{trend Rates} = \text{trend Input Prices} - X. \qquad [9a]$$

where

$$X = \overline{PMF^R} + S \qquad [9b]$$

Here X, the "X factor", is calibrated to reflect a base PMF$^R$ growth target ("$\overline{PMF^R}$"). This has been commonly established by calculating the PMF$^R$ trend of a group of utilities. A stretch factor ("S"),

[16] The assumption of a competitive rate of return applies to unregulated, competitively structured markets. It is also applicable to utility industries and even to individual utilities.

established in advance of plan operation, is often added to the formula which, if positive, benefits customers.

Notice that a *revenue*-based scale index is appropriate for the supportive productivity research for price caps. This helps to explain why some productivity indexes used in X factor calibration over the years featured a *volumetric* scale index.

## Revenue Cap Indexes

*General Result* Index logic also supports the design of *revenue* cap indexes. Consider first the following basic result of cost theory:

$$\text{growth Cost} = \text{growth Input Prices} - \text{growth Productivity}^{C} + \text{growth Scale}^{C}. \qquad [10a]$$

The growth in the cost of a company is the difference between the growth in input price and cost efficiency indexes plus the trend in a consistent cost-based scale index. This result provides the basis for a revenue cap escalator of general form

$$\text{growth Revenue} = \text{growth Input Prices} - X + \text{growth Scale}^{C} \qquad [10b]$$

where

$$X = \overline{\text{PMF}^{C}} + \text{S}. \qquad [10c]$$

Notice that a *cost*-based scale index should be used in the supportive productivity research for a *revenue* cap X factor.

*Application to Energy Distributors* For gas and electric power distributors, the number of customers served was noted above to be a sensible scale variable when calculating $\text{PMF}^{C}$. For an energy distributor, $\textit{Outputs}^{C}$ can thus be reasonably approximated by growth in the number of customers served and there is no need for the complication of a multidimensional output index with cost elasticity weights. It is then approximately true that

$$\begin{aligned}&\text{growth Cost}\\ &\quad = \text{growth Input Prices} - (\text{growth Customers} - \text{growth Inputs}) + \text{growth Customers}\\ &\quad = \text{growth Input Prices} - \text{growth PMF}^{N} + \text{growth Customers}\end{aligned}$$

where $PMF^N$ is an PMF index that uses the number of customers to measure output.

This result provides the rationale for the revenue cap index formula

growth Revenue = growth Input Prices – X + growth Customers [11a]

where

$$X = \overline{PMF^N} + \text{Stretch.} \quad [11b]$$

An equivalent formula is

trend Revenue – trend Customers

= trend (Revenue/Customer) = trend Input Prices – X. [11c]

This is sometimes called a "revenue per customer" index, and we will for convenience use this expression below to refer to revenue cap indexes which conform to either [11a or 11c].

Revenue caps using formulas like [11a] and [11c] are currently used in the MRIs of ATCO Gas and AltaGas in Canada. The Régie de l'Energie in Québec has directed Gaz Métro to develop a plan featuring a revenue per customer index. Revenue cap indexes like these were previously used by Southern California Gas and Enbridge Gas Distribution ("EGD"), the largest gas distributors in the U.S. and Canada, respectively.

Consider, finally, that whether or not the $PMF^N$ is a fully satisfactory approximation for $PMF^C$, when a revenue per customer index is chosen to regulate a utility the following result must hold if revenue is to track cost.

trend Revenue = growth Input Prices - X + growth Customers

= growth Cost

= growth Input Prices + growth Inputs.

The X factor that causes revenue to track cost must then use the number of customers as the output index.

X = trend Customers - trend Inputs.

This means that the decline in R&C use per customer that has occurred in the United States since 2000 is irrelevant in the calculation of the revenue cap index.

## Inflation Measure Issues

Our discussion has thus far assumed that any rate or revenue cap index under consideration would use an *input price* index as the inflation measure. Suppose, however, that a *macroeconomic* price index is instead used as the inflation measure. This has been common practice in approved U.S. MRIs. The gross domestic product price index ("GDPPI") has been commonly used for this purpose. This the U.S. government's featured measure of inflation in prices of the economy's final goods and services. Final goods and services consist chiefly of consumer products but also include capital equipment and exports.

When a macroeconomic inflation measure is used in a rate or revenue cap index, the X factor must be calibrated in a special way if it is to reflect industry cost trends. Suppose, for example, that the inflation measure is the GDPPI. In that event we can restate the revenue per customer index in [11c], for example, as

$$\text{growth Revenue/Customer}$$
$$= \text{growth GDPPI} - [\text{trend PMF}^{\text{Industry}} + (\text{trend GDPPI} - \text{trend Input Prices}^{\text{Industry}}) + \text{Stretch}] \qquad [12]$$

It follows that a revenue cap index that features GDPPI as the inflation measure can still conform to index logic provided that the X factor effectively corrects for any tendency of GDPPI growth to differ from industry input price growth in addition to reflecting the industry $PMF^N$ trend. The term in parentheses in relation [12] is sometimes called the "inflation differential."

Consider now that the GDPPI is a measure of *output* price inflation. Due to the broadly competitive structure of the U.S. economy, we can use relation [8] to reason that the long-run trend in the GDPPI is the difference between the trends in input price and PMF indexes for the economy.

$$\text{trend GDPPI} = \text{trend Input Prices}^{\text{Economy}} - \text{trend PMF}^{\text{Economy}} \qquad [13]$$

Relations [12] and [13] can be combined to produce the following formula for a revenue cap index:

$$\text{growth Revenue/Customer}$$
$$= \text{growth GDPPI} - [(\text{trend PMF}^{\text{Industry}} - \text{trend PMF}^{\text{Economy}})$$
$$+ (\text{trend Input Prices}^{\text{Economy}} - \text{trend Input Prices}^{\text{Industry}}) + \text{Stretch}] \qquad [14]$$

This formula suggests that when the GDPPI is the inflation measure, the revenue cap index can be calibrated to track industry cost trends when the X factor has two calibration terms: a "productivity differential" and an "input price differential". The productivity differential is the difference between the PMF trends of the industry and the economy. X will be larger, slowing revenue growth, to the extent that the industry PMF trend exceeds the economy-wide PMF trend.

The trend in the GDPPI reflects the PMF trend of the economy provided that the input price trends of the industry and the economy are fairly similar. The growth trend of the GDPPI is then slower than that of the industry-specific input price index by the trend in the economy's PMF growth. In an economy with rapid PMF growth this difference can be substantial. X factor calibration is warranted only to the extent that the input price and productivity trends of the utility industry differ from those of the economy.

PMF trends of the U.S. and Canadian economies are detailed in Table 2. It can be seen that the PMF trend of the U.S. economy was fairly brisk, averaging 1.06% annual growth annually from 1998-2015. A sizable adjustment to the X factor is thus warranted in a U.S. *formule d'indexation* when the GDPPI is used as the inflation measure. The PMF trends of the Canadian and Québec economies have, meanwhile, been much closer to zero.[17] This reality complicates comparisons of X factors in the United States and Canada. It is more useful in the contemplated process of *jugement* to compare U.S. and Canadian commission rulings on industry productivity trends and stretch factors than it is to compare X factors.

The input price differential is the difference between the input price trends of the economy and the industry. X will be larger (smaller) to the extent that the input price trend of the economy is more (less) rapid than that of the industry.[18] In American MRI proceedings, regulators have typically ruled that the input price differential is small (e.g., twenty basis points) or zero.

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[17] PMF trends in the two countries have been closer in recent years.

[18] The input price trends of a utility industry and the economy can differ for several reasons. One possibility is that prices in the industry grow at different rates than prices for the same inputs in the economy as a whole. For example, labor prices may grow more rapidly to the extent that utility workers have health care benefits that are better than the norm. Another possibility is that the prices of certain inputs grow at a different rate in some regions than they do on average throughout the economy. It is also noteworthy that the energy distribution industry has a different and more capital-intensive mix of inputs than the economy.

Table 2
PMF Trends of U.S. and Canadian Economies

| | United States[1] | | Canada[2] | | Québec[3] | |
|---|---|---|---|---|---|---|
| | **Level** | **Growth Rate** | **Level** | **Growth Rate** | **Level** | **Growth Rate** |
| **1997** | 100 | | 100 | | 100 | |
| **1998** | 101 | 1.42% | 101 | 0.63% | 100 | 0.28% |
| **1999** | 103 | 1.86% | 103 | 2.35% | 103 | 3.00% |
| **2000** | 105 | 1.70% | 105 | 2.10% | 105 | 1.79% |
| **2001** | 106 | 0.54% | 105 | 0.06% | 105 | 0.16% |
| **2002** | 108 | 2.16% | 107 | 1.28% | 105 | -0.53% |
| **2003** | 111 | 2.48% | 106 | -0.74% | 105 | 0.22% |
| **2004** | 114 | 2.61% | 106 | -0.32% | 105 | -0.26% |
| **2005** | 115 | 1.52% | 106 | 0.04% | 104 | -0.55% |
| **2006** | 116 | 0.40% | 105 | -0.82% | 104 | 0.24% |
| **2007** | 116 | 0.41% | 103 | -1.15% | 104 | -0.39% |
| **2008** | 115 | -1.18% | 101 | -2.33% | 103 | -1.25% |
| **2009** | 115 | -0.23% | 99 | -2.60% | 102 | -0.29% |
| **2010** | 118 | 2.85% | 100 | 1.77% | 102 | -0.17% |
| **2011** | 118 | 0.20% | 102 | 1.48% | 103 | 0.98% |
| **2012** | 119 | 0.64% | 101 | -0.61% | 103 | -0.21% |
| **2013** | 120 | 0.52% | 102 | 0.90% | 103 | -0.29% |
| **2014** | 120 | 0.61% | 103 | 1.33% | 104 | 1.04% |
| **2015** | 121 | 0.54% | 102 | -1.00% | 104 | -0.23% |
| **2016** | 121 | -0.07% | NA | NA | NA | NA |
| **Average Growth Rates:** | | | | | | |
| **1998-2015** | | **1.06%** | | **0.13%** | | **0.20%** |
| **2001-2015** | | **0.94%** | | **-0.18%** | | **-0.10%** |
| **2006-2015** | | **0.48%** | | **-0.30%** | | **-0.06%** |

[1] Bureau of Labor Statistics, MFP for Private Business Sector (NAICS 11-81), Series MPU4900012.
[2] Statistics Canada, MFP for Aggregate Business Sector: Canada, Table 383-0021.
[3] Statistics Canada, MFP for Aggregate Business Sector: Québec, Table 383-0026.

Whether or not the X factor properly reflects *long-term* inflation trends, macroeconomic inflation measures vary in their ability to track the input price inflation of utilities from year to year. Some are more volatile than others, and volatility typically results from fluctuation in the prices of commodities, such as food and fuel, which have little relevance to the cost of most energy distributors. Inflation measures with irrelevant volatility needlessly increase utility risk.

## Long Run Productivity Trends

Another important issue in the design of a rate or revenue cap index is whether it should be designed to track short-run or long-run industry cost trends. Indexes designed to track short-run growth will also track the long run growth trend if this approach is used repeatedly over many years. An alternative approach is to design the index to track *only* long-run trends. Different approaches can, in principle, be taken for the input price and productivity components of the ARM.

Different treatments of input price and productivity growth are in most cases warranted. The inflation measure should track *short-term* input price growth. Meanwhile, productivity research for X factor calibration commonly focuses on discerning the current *long-run* productivity trend. This is the trend in productivity that is unaffected by short-term fluctuations in outputs and/or inputs. The long run productivity trend is faster than the trend during a short-lived surge in input growth or lull in output growth but slower than the trend during a short-lived lull in input growth or surge in output growth.

This general approach to PCI design has important advantages. The inflation measure exploits the greater availability of inflation data. Making the PCI responsive to short term input price growth reduces utility operating risk without weakening performance incentives. Having X reflect the long run industry PMF trend, meanwhile, sidesteps the need for more timely cost data and avoids the chore of annual PMF calculations.

To calculate the long-run productivity trend using indexes it is common to use a lengthy sample period. However, a period of more than twenty years may be unreflective of current business conditions. Quality data are often unavailable for sample periods of even this length. The need for a long sample period is lessened to the extent that volatile costs are excluded from the study and the scale index does not assign a heavy weight to volatile scale variables such as delivery volumes and system peak demand.

## Sources of Productivity Growth

Research by economists has found the sources of productivity growth to be diverse. One important source is technological change. New technologies permit an industry to attain given levels of scale with fewer inputs.

Economies of scale (*economies d'échelle*) are another important source of productivity growth. These economies are available in the longer run if cost has a tendency to grow less rapidly than scale. A company's potential to achieve incremental scale economies is greater the greater is the growth in its scale.

A third important driver of productivity growth is change in X inefficiency. X inefficiency is the degree to which a company fails to operate at the maximum efficiency that technology allows. Productivity growth will increase (decrease) to the extent that X inefficiency diminishes (increases). The potential of a company to reduce X inefficiency is generally greater the lower is its current efficiency level.

Another driver of productivity growth is changes in the miscellaneous business conditions, other than input price inflation and demand, which affect cost. A good example for an electric power distributor is the share of distribution lines which are underground. An increase in the share of lines that are underground will tend to slow multifactor productivity growth but accelerate growth in the productivity of O&M inputs.

When the goal of productivity research is to calibrate the X factor of a revenue per customer index, another driver of productivity growth is the tendency of the scale index employed in the productivity research to mismeasure the trend in the number of customers served. If a volumetric scale index is employed, for example, the extent of mismeasurement is similar to the trend in R&C average use.

## 3.3 Capital Cost Specification

### Monetary Methods for Capital Cost Measurement

Accurate measurement of trends in the cost and quantity of capital is important in distributor PMF research since the share of capital in the cost of base rate inputs is typically high. The main components of the annual cost of capital are amortization and depreciation expenses, the return on investment, and taxes. "Monetary" approaches to measuring capital costs, prices, and quantities are widely used in productivity research where the requisite data are available. This general treatment of capital cost has a solid basis in economic theory and is widely used in governmental and scholarly empirical work as well in X factor calibration studies.

Monetary approaches decompose capital cost into consistent capital price and quantity indexes such that

$$\text{Cost}^{\text{Capital}} = \text{Price}^{\text{Capital}} \times \text{Quantity}^{\text{Capital}} \qquad [15a]$$

and

$$\text{growth Cost}^{\text{Capital}} = \text{growth Price}^{\text{Capital}} + \text{growth Quantity}^{\text{Capital}}. \qquad [15b]$$

The capital quantity index is constructed by deflating data on the value of assets. In utility PMF research it is common to deflate the value of utility plant using construction cost indexes. The capital price index should reflect the cost of owning or using a unit of capital. Capital cost depends on asset prices (often proxied by construction costs) and market rates of return on capital. The trend in the capital price index should therefore reflect in some fashion the trends in both of these prices.

It is commonplace in PMF research to treat the capital quantity index as a measure of the flow of services which is drawn from acquired assets. The capital price index is then often treated as a consistent index of prices in a competitive market for the rental of capital services. It is important to note that this treatment is markedly at variance with the reality of utility operations, since utilities typically own most of the plant that they manage.

A key issue in the choice of a monetary method is whether assets are valued in historic dollars or current (aka replacement) dollars. Replacement valuation differs from the historical (aka "book") valuation that is commonly used in North American utility accounting. Replacement valuation makes capital price and quantity indexes simpler but implicit capital gains should be netted off of the cost of capital when asset prices (or construction costs) rise.

### Depreciation and Decay Specifications

Another key issue in the choice of a monetary method is the assumed patterns of depreciation of assets and of decay in their quantity once acquired. The capital price and quantity index formulas should both reflect the decay specification. The decline in the quantity of capital from an investment has been called the "age-efficiency profile." Decay can occur for various reasons that include rusting or weathering of materials, wear and tear as assets are used, casualty (e.g. storm and fire) losses, increased maintenance requirements, and technological obsolescence.

Depreciation is the decline in the *value* of assets as they age. This reduces the opportunity cost of asset ownership. In competitive markets, depreciation can result from decay in the flow of services and from the dwindling number of years over which assets provide services.

Consider now that, in North American utility cost accounting, the value of each plant addition depreciates. This reduces the required return on rate base and thereby materially slows growth in the capital revenue requirement. Assets are commonly subject to *straight line* depreciation. However, regulators rarely make explicit assumptions about decay in the flow of services from assets. Rate and revenue cap indexes are intended to adjust utility rates between general rate cases that employ a cost of service ("COS") approach to capital cost measurement. The design of a revenue cap index should therefore reflect depreciation by some means.

Three monetary methods for calculating capital cost have been used in PMF studies used in X factor calibration. These have pros and cons that merit extended discussion here.

*Cost of Service* COS approaches to capital costing are designed to approximate the way capital cost is calculated in utility regulation. This approach is based on the assumptions of straight line depreciation and historic valuation of plant. The formulae are quite complicated, making them more difficult to code and review. PEG has used COS approaches to capital cost measurement in several X factor calibration and benchmarking studies.

*Geometric Decay* The geometric decay method assumes a constant rate of decay in the quantity of capital which results from each investment. The capital quantity index is essentially the inflation-adjusted *net* plant value. The geometric decay formulae for the capital price and quantity indexes are mathematically simple, intuitively appealing, and easy to code and review.

Academic research on the value of used assets has supported the geometric decay method to characterize depreciation in many industries.[19] The U.S. Bureau of Economic Analysis ("BEA") and Statistics Canada both use geometric decay as the default approach to measurement of capital stocks in national Income and product accounts.[20] Geometric decay has also been used in numerous productivity

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[19] See, for example, C, Hulten, and F. Wykoff (1981), "The Measurement of Economic Depreciation," in *Depreciation, Inflation, and the Taxation of Income From Capital*, C. Hulten ed., Washington D.C. Urban Institute and C. Hulten, "Getting Depreciation (Almost) Right," University of Maryland working paper, 2008.
[20] The BEA states on p. 2 of its November 2015 "Updated Summary of NIPA Methodologies" that "The perpetual-inventory method is used to derive estimates of fixed capital stock, which are used to estimate consumption of

studies intended for X factor calibration in the energy and telecommunications industries, including many studies prepared for utilities. PEG has used the geometric decay method in most of our utility productivity studies over the years.

*One Hoss Shay* The one hoss shay method for measuring capital cost is based on the assumption that the quantity of capital that results from plant additions does not decay gradually but, rather, all at once as assets reach the end of their service lives. In the simple one hoss shay method that is most commonly used in utility PMF studies, the capital quantity index is essentially the inflation-adjusted *gross* plant value. This index rises with gross plant additions and falls with retirements. Some PMF practitioners have invoked the one hoss shay methodology to use physical asset measures of capital quantities such as generation capacity and kilometers of distribution line.

Proponents of the one hoss shay approach to capital costing argue that the assumption of a constant service flow from individual assets is more reasonable for electric utilities than the alternative assumption of gradual decline. The one hoss shay method has been used several times in research intended to calibrate utility X factors. It has tended in recent years to be favored by the productivity witnesses retained by utilities.

The one hoss shay approach also has some disadvantages. Here are some of the notable problems.

- Implementation of geometric decay and one hoss shay both require deflation of gross plant *additions*. Deflation of gross additions is facilitated by the fact that the dates of the additions are known. However, implementation of one hoss shay *also* requires deflation of plant *retirements*, which North American utilities value and report in historic dollars. The vintages of these retirements are unknown and must be "guesstimated" in a PMF study using an assumption about the average service life of assets. Research by PEG has found that PMF results using one hoss shay are quite sensitive to the assumption concerning the

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fixed capital—the economic depreciation of private and government fixed capital. This method is based on investment flows and a geometric depreciation formula."

average service life of assets. Seemingly reasonable service life estimates can produce negative capital quantities.[21]

- In real-world productivity studies, capital quantity trends are rarely if ever calculated for individual assets. They are instead calculated from data on the value of plant additions (and, in the case of one hoss shay, retirements) which encompass multiple assets of various kinds. Even if each *individual* asset had a one hoss shay pattern of decay, the profile of the *aggregate* plant additions could be poorly approximated by one hoss shay for several reasons. Different kinds of assets can have markedly different service lives. Assets of the same kind could end up having different service lives. Individual assets, in any event, frequently have components with different service lives. The tires of an automobile, for example, can need replacement before the windshield of the vehicle does. It follows that one hoss shay may not approximate the capital service flow of the composite asset. Alternative capital cost specifications such as geometric decay can provide a better approximation of the service flow of a group of assets that individually have one hoss shay patterns or which are composites of assets with such patterns.

Consistent with these remarks, the authors of a capital research manual for the Organization of Economic Cooperation and Development ("OECD") stated in the Executive Summary that

> In practice, cohorts of assets are considered for measurement, not single assets. Also, asset groups are never truly homogenous but combine similar types of assets. When dealing with cohorts, retirement distributions must be invoked because it is implausible that all capital goods of the same cohort retire at the same moment in time. Thus, it is not enough to reason in terms of a single asset but age efficiency and age-price profiles have to be combined with retirement patterns to measure productive and wealth stocks and depreciation for cohorts of asset classes. An

[21] Sensitivity to service life assumptions under OHS can be reduced by using plant addition and retirement data that are itemized with respect to asset type. Unfortunately, itemizations of FERC Form 1 plant addition and retirement data are not publicly available before 1994, while data on total additions and retirements are available back to 1964.

important result from the literature, dealt with at some length in the Manual is that, for a cohort of assets, the combined age-efficiency and retirement profile or the combined age-price and retirement profile often resemble a geometric pattern, i.e. a decline at a constant rate. While this may appear to be a technical point, it has major practical advantages for capital measurement. *The Manual therefore recommends the use of geometric patterns for depreciation* because they tend to be empirically supported, conceptually correct and easy to implement.[22] [italics in original]

- Alternative patterns of *physical* asset decay involve different patterns of asset value *depreciation*. Trends in used asset prices can therefore shed light on asset decay patterns. Several statistical studies of trends in used asset prices have revealed that they are generally not consistent with the one hoss shay assumption.[23] Instead, depreciation patterns like geometric decay appear to be the norm for machinery and are also generally the case for buildings.[24] One expert has concluded that "the empirical evidence is that a geometric depreciation pattern is a better approximation to reality than a straight line pattern [i.e., the pattern more consistent with one hoss shay decay], and is at least as good as any other pattern."[25] [bracketed remark from PEG]

- One hoss shay formulas are somewhat complicated and lack intuitive appeal.

- Depreciation in the value of assets can affect input quantity trends even under constant capital service flows. Under the one hoss shay assumption, increasing age would cause the values of individual assets to decline in real terms due to the shortening of the remaining service life. The annual capital cost of a utility is the sum of the annual costs of assets of various vintage. Cost tends to be lower for older systems.

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[22] OECD, *Measuring Capital OECD Manual 2009*, Second Edition, p. 12.

[23] For a survey of these studies see Barbara M. Fraumeni, "The Measurement of Depreciation in the U.S. National Income and Product Accounts*," Survey of Current Business*, July 1997, pp. 7-23. A recent Canadian study is John Baldwin, Huju Liu, and Marc Tanguay, "An Update on Depreciation Rates for the Canadian Productivity Accounts", *The Canadian Productivity Review*, Catalogue No. 15-206-X, January 2015.

[24] OECD, op. cit., p. 101.

[25] Fraumeni, op. cit., p. 17.

The trend in the capital quantity index can be calculated as a cost-weighted average of the trends in the quantities of assets of each vintage. A given rate of growth in the quantity has a lower impact on the capital quantity index the older is its vintage because of its lower weight. Growth in the average age of assets will therefore tend to slow capital quantity growth.[26] Under COS regulation, the impact of this phenomenon is magnified because assets are valued in historical dollars.

Common one hoss shay treatments gloss over the importance of vintaging by valuing all capital services by a "user cost" of capital methodology in which the capital service price is a function of prices of *new* assets. This treatment is tantamount to treating capital services from all assets as purchases from a market in which prices of services do not depend on the age of assets. Capital service markets in which asset age doesn't matter greatly may exist for some assets (e.g., transoceanic shipping containers), but the cost and efficiency of firms that supply these markets depends very much on the vintages of their assets. HQD is a manager of assets, leases very few assets, and its cost trend depends greatly on their changing vintage.

These disadvantages of the one hoss shay specification help to explain why alternative specifications are more the rule than the exception in capital quantity research. We have noted that geometric decay is widely used. Statistics Canada uses geometric decay in its multifactor productivity studies for sectors of the economy.[27] The U.S. Bureau of Labor Statistics, the Australian Bureau of Statistics, and Statistics New Zealand instead assume hyperbolic decay, but not one hoss shay, in their sectoral PMF studies.

[26] In much the same manner, a household can (at the risk of higher maintenance expenses), increase its wealth by continuing to drive the family car for a few more years. The resale value of the car falls each year due to depreciation. The household has no control over used car prices or the rate of return on alternative investments. The cost saving is instead achieved by (implicitly) reducing the quantity of cars that the household owns by owning a car with a diminishing resale value. Money freed up can be invested in the stock market or real estate.

[27] For evidence on this see John R. Baldwin, Wulong Gu, and Beiling Yan (2007), "User Guide to Statistics Canada's Annual Multifactor Productivity Program", *Canadian Productivity Review*, Catalogue no. 15-206-XIE – No. 14. p. 41 and Statistics Canada, *The Statistics Canada Productivity Program: Concepts and Methods*, Catalogue no. 15-204, January 2001.

### Benchmark Year Adjustments

Utilities have diverse methods for calculating depreciation expenses that they report to regulators. It is therefore desirable when calculating capital quantities using a monetary method to rely on the reporting companies chiefly for the value of *gross* plant additions and then use a standardized depreciation treatment for all companies. Since some of the plant a utility owns may be 40-60 years old, it is desirable to have gross plant addition data for many years in the past.

For earlier years the desired gross plant addition data are frequently unavailable. It is then customary to consider the value of all plant at the end of the limited-data period and then estimate the quantity of capital it reflects using construction cost indexes from earlier years and assumptions about the historical capex pattern. The year for which this estimate is undertaken is commonly called the "benchmark year" of the capital quantity index. The benchmark year adjustment should deflate net plant value if geometric decay is assumed and *gross* plant value if one hoss shay is assumed. Since the estimate of the capital quantity in the benchmark year is inexact, it is preferable to base capital and total cost research on a sample period that begins many years after the benchmark year. Research on capital and total cost will be less accurate to the extent that this is impossible.

## 3.4 Kahn X Factors

An alternative approach to choosing an X factor was developed by the noted American regulatory economist Alfred Kahn. Dr. Kahn detailed the method in a 1993 testimony for a group of shippers in a FERC proceeding on PBR for interstate oil pipelines.[28] The FERC still uses this method to set X factors for oil pipelines. In the words of Dr. Kahn, "The ideal indexation formula would be one that...tracked as closely as possible the actual average costs of the pipeline industry."[29]

The method is straightforward. Suppose, for example, that we seek an X factor for a revenue cap index with formula

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[28] "Testimony of Alfred E. Kahn on Behalf of a Group of Independent Refiner/Shippers" in Docket No. RM93-11-000 (Revision to Oil Pipeline Regulations Pursuant to the Energy Policy Act of 1992), August 12, 1993.

[29] Ibid., p. 2.

*trend Revenue = trend Inflation – X + trend Customers*.

We could then calculate the pro forma cost of service trends for a group of utilities over several years and find the value of X that causes hypothetical revenue cap indexes to have the same trends on average. That is, we seek the value of X such that on average

*trend Inflation – X + trend Customers = trend Cost.*

It can then be shown that

$X^{Kahn}$ = (*trend Inflation – trend Input Prices) + (trend Customers – trend Inputs*).

A Kahn X factor thus reflects inflation as well as changes in productivity. Thus, it is not fully comparable to an PMF trend estimate. However, it sidesteps complicated productivity calculations and produces results consistent with COS accounting. The Kahn method can thus permit X factor calibration without calculating industry input price and PMF indexes. This "indirect" method can yield substantial regulatory cost savings; an ability to avoid calculating capital price and quantity indexes is especially valuable since these calculations are complicated.

In Table 3 we demonstrate the calculation of a Kahn X factor for HQD. The inflation measure reflects growth in labor and non-labor prices in Québec, represented by average weekly earnings and the Consumer Price Index, respectively. These price trends are weighted by the shares labor and non-labor costs represent in the distribution component of HQD's 2016 *revenu requis*. We consider the X factor necessary to track HQD's *revenu requis* from 2005 to 2015.[30] The exercise produces a Kahn X factor of **0.67%**.

## 3.5 Other Methodological Issues

### Choosing a Base Productivity Growth Target

Research on the productivity of other utilities can be used in several ways to calculate base productivity growth targets. Using the average historical productivity trend of the entire industry to

[30] We leave out 2016 since reported costs in that year were apparently affected by a change in accounting standards.

Table 3

## Calculating Kahn X Factors for HQD

| | Revenu Requis (%)<br>[A] | Inflation (%)<br>[B] | Retail Customers (%)<br>[C] | Implicit X Factor<br>[D = (B + C) - A] |
|---|---|---|---|---|
| **2005** | 4.34 | 2.44 | 1.37 | -0.52 |
| **2006** | 5.53 | 1.69 | 1.65 | -2.19 |
| **2007** | 8.47 | 2.04 | 1.40 | -5.03 |
| **2008** | 4.74 | 2.03 | 1.14 | -1.57 |
| **2009** | 5.88 | 0.70 | 1.19 | -3.99 |
| **2010** | 4.97 | 1.61 | 1.31 | -2.05 |
| **2011** | -4.30 | 2.90 | 1.21 | 8.41 |
| **2012** | 0.28 | 2.14 | 1.17 | 3.03 |
| **2013** | 1.56 | 0.82 | 1.11 | 0.38 |
| **2014** | 1.13 | 1.51 | 0.91 | 1.29 |
| **2015** | -7.50 | 1.25 | 0.83 | 9.58 |
| **2016** | -7.47 | 0.81 | 0.71 | 8.99 |
| ***2017*** | *9.53* | *1.12* | *0.96* | *-7.45* |
| ***2018*** | *-2.32* | *1.72* | *0.79* | *4.83* |
| ***Average annual growth rates:*** | | | | |
| **2005-2015** | **2.28** | **1.74** | **1.21** | **0.67** |
| **Sources:** | Growth rates are for the distribution component of revenus requis (i.e., they do not include those for Achats d'Électricité or Service de Transport). For years 2004-2015, data are for "années reels" or "années historiques" as reported in the Regie's rate case decisions. Data for 2016 (année historique), 2017 (année de base), and 2018 (année témoin) are from HQD's most recent rate case filing. | Weighted average of labor and non-labor price growth rates. Labor prices are average weekly earnings in Québec, including overtime, for all employees within the industrial aggregate excluding unclassified businesses (Statistics Canada, Table 281-0026); 2017-2018 values are average weekly earnings in Canada as forecast by the Quebec Minister of Finance (2018 Actuarial Report on the Employment Insurance Premium Rate, Office of the Chief Actuary, 22 August 2017, pg. 52). Non-labor prices are represented by the Consumer Price Index - All Items for Québec (Statistics Canada, Table 326-0021); 2017-2018 values are forecasts by TD Economics for Québec (Provincial Economic Forecast, Dec 14, 2017). The labor weight is 0.19. This is the product of two values: 0.43, which is the average weight assigned to growth in salaries when calculating the "facteur d'évolution combiné des charges" used to establish the 2016 and 2017 "enveloppe des charges d'exploitation" (R-3933-2015, HQD-8, Doc. 1, pg. 6; R-3980-2016, HQD-8, Doc. 1, pg. 7), and 0.44, which is the share that the "charges d'exploitation" represent in the 2016 non-energy, non-transmission revenus requis (2017-07-31, HQD-5, Doc. 1, pg. 5). | 2002-2009: Growth rates based on data from Rapport annuel 2003 (Ventes et revenus par catégories de tarifs et de clientèles, HQD-2, Doc. 3, p. 7), & Rapport annuel 2011 (Historique des ventes, des produits des ventes, des abonnements et de la consommation, HQD-10, Doc. 2, p. 6)<br><br>2010-2016: Growth rates based on data from Rapport annuel 2013 & Rapport annuel 2016 (Historique des ventes, des produits des ventes, des abonnements et de la consommation, HQD-10, Doc. 2, pp. 5 & 6)<br><br>2017 (D-2017-022), 2018 (année témoin): R-4011-2017 (Efficience et performance, HQD-2, Doc. 1, pg 19) | [calculated] |

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calibrate X is tantamount to simulating the outcome of competitive markets. The competitive market paradigm has broad appeal.

On the other hand, individual firms in competitive markets routinely experience windfall gains and losses. Our discussion above of the sources of productivity growth implies that differences in the external business conditions that drive productivity growth can cause different utilities to have different productivity trends. For example, power distributors experiencing brisk growth in the number of electric customers served are more likely to realize economies of scale than distributors experiencing average customer growth.

In the design of rate and revenue cap indexes, there has thus been considerable interest in methods for customizing base productivity growth targets to reflect local business conditions. The most common approach to customization to date has been to use the average productivity trends of *similarly situated* utilities. Relevant conditions for a power distributor include the pace of electric customer growth, growth in the number of gas customers served, and changes in the extent of undergrounding.

A variety of potential peer groups can merit consideration in an X factor calibration exercise. In choosing among these, the following principles are appropriate. First, the group should either exclude the subject utility or be large enough that the average productivity trend of the peer group is substantially insensitive to its actions. This may be called the externality criterion. It is desirable, secondly, for the group to be large enough that the productivity trend is not dominated by the actions of a handful of utilities. This may be called the sample size criterion. A third criterion is that the group should be one in which external business conditions that influence productivity growth are similar to those of the subject utility. This may be called the "no windfalls" criterion.

### Sources of Data for X Factor Calibration Research

*United States* Data on operations of U.S. electric utilities are well-suited for the PMF research needed to calibrate an X factor for HQD. Standardized data of good quality have been available from federal government agencies for dozens of investor-owned electric utilities for decades. The primary source of these data is the Federal Energy Regulatory Commission ("FERC") Form 1, which collects detailed cost data and some useful data on operating scale. Major investor-owned electric utilities in the United States are required by law to file this form annually. Cost and quantity data reported on Form 1 must conform to the FERC's Uniform System of Accounts. Details of these accounts can be found in Title 18 of the Code of Federal Regulations. The data are credibly itemized, permitting calculations of the cost of power distributor services even for the numerous vertically integrated electric utilities ("VIEUs") in the States.

Itemized data on the net value of power distribution and general plant and the corresponding gross plant additions are available since 1964. This makes U.S. data the best in the world for accurate calculation, using monetary methods, of the consistent capital cost, price, and quantity indexes that are needed to calculate multifactor productivity trends.

Custom productivity peer groups have frequently been used in X factor calibration research, and that practice has by no means been confined to regulatory commissions and consumer advocates. In New England, for example, utilities have proposed and regulators have approved X factors in index-based PBR plans that are calibrated using research on the productivity trends of Northeast utilities.

*Canada* In Canada, standardized data on utility operations which could be used to accurately measure their productivity trends are not readily available in most provinces including Québec. A notable exception is Ontario. Standardized data are publicly and electronically available on operations of about seventy Ontario power distributors for more than a decade. PEG has used these data to estimate industry productivity trends in X factor calibration work commissioned by the Ontario Energy Board.

Based on our experience, we believe that the Ontario data have some notable disadvantages in an X factor calibration exercise for HQD.

- Plant value data are available for most Ontario distributors only since 1989. For several utilities (including Hydro One Networks), these data are available only since 2002. The benchmark year adjustments must therefore be fairly recent. Data on *gross* plant additions, which we prefer to use to calculate capital costs and quantities, are only available starting in 2013. It is necessary to impute gross plant additions in earlier years using data on changes in the gross value of all plant.[31] These circumstances tend to reduce the accuracy of statistical research on the capital cost and total cost performance of Ontario utilities.

[31] Another problem in measuring Ontario capital costs is that itemized data on distribution and general plant are not readily available.

- Many Ontario distributors are transitioning to International Financial Reporting Standards ("IFRS"). This has reduced capitalization of O&M expenses for some distributors, thereby materially slowing their O&M and multifactor productivity trends in the last few years.

- Itemization of O&M salary and wage and material and service expenses is not available so that company-specific cost share weights cannot be calculated for O&M input quantity indexes.

Due to the limitations of Canadian data, regulators in Alberta and British Columbia have based X factors in their MRIs for gas and electric power distributors on the productivity trends of national samples of U.S. distributors. The Ontario Energy Board used estimates of U.S. productivity trends to choose the productivity target in its third-generation MRIs for power distributors but used Ontario data in two other MRIs.

The complications of basing X on the productivity trends of other utilities have occasionally prompted regulators to base X factors on a utility's *own* recent historical productivity trend. This approach will weaken a utility's incentives to increase productivity growth if used repeatedly. Furthermore, a utility's productivity growth in one five or ten-year period may be very different from its productivity growth potential in the following five years. For example, a ten-year period in which productivity growth was slowed by high capex may be followed by a period of brisk productivity growth.

#### Data Quality

The quality of data used in index research has an important bearing on the relevance of results for the design of MRIs. Generally speaking, it is desirable to have publicly available data drawn from a standardized collection form such as those developed by government agencies. Data quality also has a temporal dimension. It is customary for statistical cost research used in MRI design to include the latest data available.

## 3.6 Choosing a Stretch Factor

The stretch factor term of a revenue cap index formula should reflect an expectation of how the productivity growth of the subject utility will differ from the base productivity growth target. This depends in part on how the performance incentives generated by the plan compare to those in force for utilities in the productivity studies used to set the base productivity trend. It also depends on the company's operating efficiency at the start of the PBR plan. Productivity growth should be more rapid to the extent that inefficiency is greater.

Statistical benchmarking should be considered as a means of setting stretch factors. Benchmarking can address O&M expenses, capital cost, total cost, and reliability. Benchmarking is routinely used to set stretch factors for power distributors in Ontario. Benchmarking is also extensively used by Australian and British power distribution regulators. These precedents are noteworthy since these regulators have extensive PBR experience.[32]

# 4. Review of Productivity and Stretch Factor Evidence

## 4.1 Salient Proceedings

Productivity trends of energy and telecommunications ("telecom") utilities have often been considered by North American regulators in proceedings in which MRIs with rate or revenue cap indexes are proposed. The earliest proceedings to approve such MRIs for energy utilities took place in New England and California. An MRI with a price cap index was approved for the vertically integrated electric services of Central Maine Power in 1995. Price cap indexes were later twice approved for the company's distributor services after it restructured. Several MRIs with index-based price cap indexes were approved for Massachusetts energy distributors between 1996 and 2006. Massachusetts then rejected proposals by several energy distributors for rate or revenue cap indexes before recently approving one for power distributor services of Eversource Energy. Vermont has on several occasions approved rate plans with escalators for O&M revenue which reflect a multifactor productivity study filed by Central Vermont Public Service in a 2008 proceeding.[33]

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[32] PEG Research has prepared transnational power distribution cost benchmarking studies for both the Australia Energy Regulator and the Ontario Energy Board, and benchmarks the costs of all Ontario Power distributors each year using the latest available Ontario data.

[33] Dr. Lowry was the company productivity witness.

MRIs with index-based rate or revenue caps were approved for three California energy utilities between 1996 and 1999. In addition, larger California energy utilities were for many years required to file studies of their own productivity growth in general rate cases. The Sempra companies (San Diego Gas and Electric and Southern California Gas) filed *industry* productivity studies on some of these occasions.[34]

The province of Ontario approved an MRI with price cap indexes in 2000. There have been three successor plans. In one of the four MRIs, the X factor was based on the productivity trends of U.S. power distributors while in two it was based on the productivity trends of Ontario distributors.[35] The Ontario Energy Board has, additionally, approved MRIs with index-based rate or revenue cap indexes twice for Enbridge Gas Distribution and three times for Union Gas.

In Alberta, an MRI with an indexed price cap was approved for ENMAX, the power distributor serving Calgary, in 2009. The Alberta Utilities Commission has since then mandated two generations of MRIs with index-based rate or revenue cap indexes for all of the larger provincial gas and electric power distributors. British Columbia approved MRIs for FortisBC and FortisBC Energy in 2014 with X factors based on U.S. productivity evidence.

Table 4 summarizes results of these proceedings for the Régie's convenience. In considering these results please note the following.

- Regulators do not always itemize their chosen X factors into key components of interest such as base productivity trends and stretch factors. One reason is that the X factors are sometimes the outcomes of settlements between parties where any components of X that might have been agreed to were not itemized.
- Rate and revenue cap indexes in the United States frequently feature macroeconomic inflation measures, as noted above. In these instances, the X factors have on several occasions been lowered to reflect the brisk PMF growth of the U.S. economy.

[34] Dr. Lowry was the productivity witness for the Sempra utilities in these proceedings.

[35] The X factor in a fourth plan was based on Board judgment. Dr. Lowry advised the Board in that proceeding.

Table 4

# Index-Based ARMs of North American Energy Utilities[1]

| Applicable Service | Utility | Jurisdiction | Term | Cap Form | Inflation Measure (P) | Acknowledged Productivity Trend (A) | Stretch Factor[2] (B) | X-Factor [3] |
|---|---|---|---|---|---|---|---|---|
| Bundled Power Service | PacifiCorp (I) | California | 1994-1997, extended to 1999 | Price Cap | Industry-specific | 1.40% | NA | 1.40% |
| Bundled Power Service | Central Maine Power (I) | Maine | 1995-1999 | Price Cap | GDPPI | NA | NA | 0.9% (Average) |
| Gas Distribution | Southern California Gas | California | 1997-2002 | Revenue Cap | Industry-specific | 0.50% | 0.80% (Average) | 2.3% (Average) |
| Power Distribution | Southern California Edison | California | 1997-2002 | Price Cap | CPI | NA | NA | 1.48% (Average) |
| Gas Distribution | Boston Gas (I) | Massachusetts | 1997-2003 | Price Cap | GDPPI | 0.40% | 0.50% | 0.50% |
| Power Distribution | Bangor Hydro Electric (I) | Maine | 1998-2000 | Price Cap | GDPPI | NA | NA | 1.20% |
| Power Distribution | PacifiCorp (II) | Oregon | 1998-2001 | Revenue Cap | GDPPI | NA | NA | 0.30% |
| Gas Distribution | San Diego Gas and Electric | California | 1999-2002 | Price Cap | Industry-specific | 0.68% | 0.55% (Average) | 1.23% (Average) |
| Power Distribution | San Diego Gas and Electric | California | 1999-2002 | Price Cap | Industry-specific | 0.92% | 0.55% (Average) | 1.47% (Average) |
| Power Distribution | All Ontario distributors | Ontario | 2000-2003 | Price Cap | Industry-specific | 0.86% | 0.25% | 1.50% |
| Gas Distribution | Bangor Gas | Maine | 2000-2009, extended to 2012 | Price Cap | GDPPI | NA | NA | 0.36% (Average) |
| Gas Distribution | Union Gas | Ontario | 2001-2003 | Price Cap | GDPPI | NA | NA | 2.50% |
| Power Distribution | Central Maine Power (II) | Maine | 2001-2007 | Price Cap | GDPPI | NA | NA | 2.57% (Average) |
| Power Distribution | Southern California Edison | California | 2002-2003 | Revenue Cap | CPI | NA | NA | 1.60% |
| Power Distribution | EPCOR (I) | Alberta | 2002-2005, Terminated at end of 2003 | Price Cap | Industry-Specific | NA | NA | 15% * Inflation |
| Gas Distribution | Berkshire Gas | Massachusetts | 2002-2011 | Price Cap | GDPPI | 0.40% | 1.00% | 1.00% |
| Gas Distribution | Blackstone Gas | Massachusetts | 2004-2009 | Price Cap | GDPPI | NA | NA | 0.50% |
| Gas Distribution | Terasen Gas | British Columbia | 2004-2009 | Revenue Cap | CPI | NA | NA | 63% x Inflation (Average) |
| Gas Distribution | Boston Gas (II) | Massachusetts | 2004-2013, terminated in 2010 | Price Cap | GDPPI | 0.58% | 0.30% | 0.41% |
| Power Distribution | All Ontario Distributors | Ontario | 2006-2009 | Price Cap | GDPIPI | NA | NA | 1.00% |
| Power Distribution | Nstar | Massachusetts | 2006-2012 | Price Cap | GDPPI | NA | NA | 0.63% (Average) |
| Gas Distribution | Bay State Gas | Massachusetts | 2006-2015, terminated in 2009 | Price Cap | GDPPI | 0.58% | 0.40% | 0.51% |
| Power Distribution | ENMAX | Alberta | 2007-2013 | Price Cap | Industry-specific | 0.80% | 0.40% | 1.20% |
| Gas Distribution | Enbridge Gas | Ontario | 2008-2012 | Revenue Cap | GDPPI | NA | NA | 47% x Inflation (Average) |
| Gas Distribution | Union Gas | Ontario | 2008-2012 | Revenue Cap | GDPPI | NA | NA | 1.82% |
| Power Distribution | Central Vermont Public Service | Vermont | 2009-2011, extended to 2013 | Revenue Cap | CPI | 1.03% | NA | 1.00% |
| Power Distribution | Central Maine Power (III) | Maine | 2009-2013 | Price Cap | GDPPI | NA | NA | 1.00% |
| Power Distribution | All Ontario Distributors | Ontario | 2010-2013 | Price Cap | GDPPI | 0.72% | 0.40% (Average Across Firms) | 1.12% (Average Across Firms) |
| Power Distribution | Green Mountain Power | Vermont | 2010-2013 | Revenue Cap | CPI | NA | NA | 1.00% |

## Table 4 (continued)

## Index-Based ARMs of North American Energy Utilities[1]

| Applicable Service | Utility | Jurisdiction | Term | Cap Form | Inflation Measure (P) | Acknowledged Productivity Trend (A) | Stretch Factor[2] (B) | X-Factor [3] |
|---|---|---|---|---|---|---|---|---|
| Power & Gas Distribution | All Distributors | Alberta | 2013-2017 | Price Cap for Power, Revenue per Customer Cap for Gas | Industry-specific | 0.96% | 0.20% | 1.16% |
| Power Distribution | Green Mountain Power | Vermont | 2014-2017 | Revenue Cap | CPI | NA | NA | 1.00% |
| Gas Distribution | Union Gas | Ontario | 2014-2018 | Revenue Cap | GDPPI | NA | NA | 60% x Inflation |
| Power Distribution | All Distributors except those who opt out | Ontario | 2014-2018 | Price Cap | Industry-specific | 0.00% | Range of 0% to 0.6% | Range of 0% to 0.6% |
| Bundled Power Service | FortisBC | British Columbia | 2014-2019 | Revenue Cap | Industry-specific | 0.93% | 0.10% | 1.03% |
| Gas Distribution | FortisBC Energy | British Columbia | 2014-2019 | Revenue Cap | Industry-specific | 0.90% | 0.20% | 1.10% |
| Power & Gas Distribution | All Distributors | Alberta | 2018-2022 | Price Cap for Power, Revenue per Customer Cap for Gas | Industry-specific | NA | NA | 0.30% |
| Power Distribution | Eversource Energy | Massachusetts | 2018-2023 | Revenue Cap | GDPPI | -0.46% | 0.25% if GDPPI growth exceeds 2% | -1.56% |
| Hydro Power Generation | Ontario Power Generation | Ontario | 2017-2021 | Price Cap | Industry-specific | 0.00% | 0.30% | 0.30% |

| | | | | |
|---|---|---|---|---|
| **Averages*** | **Gas Distributors** | **0.63%** | **0.46%** | **1.05%** |
| | **Electric Utilities** | **0.65%** | **0.29%** | **0.95%** |
| | **Power Distributors** | **0.60%** | **0.32%** | **0.96%** |
| | **All Utilities** | **0.62%** | **0.39%** | **1.00%** |

*Averages exclude X factors that are percentages of inflation.

[1] Shaded plans have expired.

[2] Some approved X factors are not explicitly constructed from such components as a base productivity trend and a stretch factor. Many of these are the product of settlements.

[3] X factors may not be the sum of the acknowledged productivity trend and the stretch factor, where these are itemized, for the following reasons: (1) a macroeconomic inflation measure is employed in the attrition relief mechanism, (2) a revenue cap index does not include a stand alone scale variable, or (3) the X factor may incorporate additional adjustments to account for special business conditions.

- Some rate and revenue cap indexes take the form of a percentage of measured inflation and thus do not have explicit X factors.

The following results in Table 4 are especially pertinent to the Régie's *jugement* process.

- The average of the utility PMF trends acknowledged by regulators has been **0.60%** for power distributors and **0.63%** for gas distributors.
- A negative base productivity trend has only once been acknowledged by a North American regulator.

- The average approved stretch factor has been **0.39%.**

## 4.2 A Closer Look at Recent Notable Studies

We now take a closer look at some recent energy utility productivity studies. Key results are summarized in Table 5.

### Alberta (2012)

The Alberta Utilities Commission ("AUC") held a generic proceeding from 2010 to 2012 to develop MRIs applicable to multiple provincial gas and electric power distributors. The commission retained Jeff Makholm of National Economic Research Associates ("NERA") in Boston to prepare a study of the productivity trends of U.S. power distributors. Dr. Makholm had filed power distributor productivity studies in two prior MRI proceedings. His study used an unusually lengthy sample period (1973-2009), a volumetric output index, and a simple one hoss shay approach to capital cost measurement. PMF grew much more rapidly in the early years of his sample period than it did after 1998, when it typically declined. Makholm recommended as the PMF growth target the 0.96% trend for the *full* sample period and made no X factor recommendation.

Utilities in this proceeding hired several witnesses to appraise NERA's study. These witnesses embraced most aspects of NERA's methodology but argued that more recent sample periods beginning around the year 2000 were appropriate, during which productivity growth was negative.[36] They had mixed opinions about the need for a stretch factor.

Dr. Lowry of PEG, who had previously done more than a dozen energy utility productivity studies, including several for energy distributors, was retained by the Consumers' Coalition of Alberta in this proceeding. He submitted a study of U.S. *gas* utility productivity trends and recommended a 0.19% stretch factor for all distributors. His gas productivity study used the number of customers as the output measure and a COS approach to capital cost measurement. He reported a 1.32% productivity trend for the full sample but recommended that the X factor for gas distributors be based on the more rapid

[36] They also argued in favor of a national sample that ignored local business conditions in Alberta that are favorable to productivity growth.

## Table 5

# Survey of Recent Multifactor Productivity Studies

| Proceeding | Industry Studied | Year | Author (Consultancy) | Client | Author Recommendations: Industry Productivity Trend | Author Recommendations: Recommended Stretch Factor | Author Recommendations: X Factor | Previous Known Energy Productivity Studies | Outcome |
|---|---|---|---|---|---|---|---|---|---|
| Ontario Energy Board, Cases EB-2007-0606 and EB-2007-0615 | US Gas Distributors | 2007 | Lowry (PEG) | Ontario Energy Board | 1.40% to 1.61% | 0.5% for both Revenue per Customer Cap and Price Cap | **Union Gas**: 1.98% for Revenue per Customer Cap and 1.01% for Price Cap **Enbridge Gas:** 2.08% for Revenue per Customer Cap and 0.48% for Price Cap | More than 20 productivity studies submitted as testimony | PBR plan was approved outlined in separate settlements for Union Gas and Enbridge. Union adopted PEG methodology and results. Enbridge's settlement defined the X factor as a share of the inflation measure, which increased in each year of the plan. |
| | | | Carpenter & Bernstein (Brattle) | Enbridge Gas Distribution | -0.14% to -0.08% | 0.00% | -0.14% to 0.01% | First known Brattle evidence on productivity. Research relied on PEG's database with some changes in methodology | |
| Alberta Utilities Commission Proceeding 566 | US Power Distributors | 2010-2012 | Makholm & Ros (NERA) | Alberta Utilities Commsision | 0.96% | No recommendation | No recommendation | Two prior studies of power distribution productivity | AUC adopted these productivity results for the first generation PBR plan |
| | US Gas Distributors | 2011 | Lowry (PEG) | Consumers' Coalition of Alberta | 1.32% to 1.84% | 0.19% | 1.51% to 2.03% | More than 20 productivity studies submitted as testimony | AUC adopted X factor of 1.16%. This was the sum of a 0.96% productivity trend and a 0.20% stretch factor. |
| Régie de l'énergie, R-3693-2009, Phase 2 | Gaz Metro | 2011 | Lowry (PEG) | Gaz Metro (Task Force) | 1.11% to 1.67% | 0.2% to 0.5% | 1.31% to 2.17% | More than 20 productivity studies submitted as testimony | Gaz Metro's proposal was rejected. Company was ordered to file a revenue per customer indexing plan featuring revenue decoupling. |
| Québec's Régie de l'énergie, R-3693-2009, Phase 3 | US Gas Distributors | 2012 | Lowry (PEG) | Gaz Metro | 0.85% to 1.00% | 0.20% | 1.05% to 1.20% | More than 20 productivity studies submitted as testimony | Proceeding suspended to address other matters |
| Ontario Energy Board Case EB-2010-0379 | Ontario Power Distributors | 2013 | Kaufmann (PEG) | Ontario Energy Board | 0.00% | 0% to 0.6% depending on cost performance | 0% to 0.6% depending on cost performance | Previously reported productivity trends for numerous clients including Jamaica Public Service (2008), the Ontario Energy Board (2008), Bay State Gas (2004-05), Boston Gas (2002-03) | OEB adopted PEG results |
| British Columbia Utilities Commission, Project 3698719 | US Power Distributors | 2013 | Overcast (Black & Veatch) | FortisBC | -3.9% to -5.5% | No explicit recommendation | 0% (Company proposed 0.5% X factor) | None | BCUC adopted PEG results and rejected B&V study in its entirety. |
| | | | Lowry (PEG) | Commercial Energy Consumers Association of British Columbia | 0.93% to 1.18% | 0.20% | 1.13% to 1.38% | More than 20 productivity studies previously submitted as testimony | |
| British Columbia Utilities Commission, Project 3698715 | US Gas Distributors | 2013 | Overcast (Black & Veatch) | FortisBC | -3.2% to -4.9% | No explicit recommendation | 0% (Company proposed 0.5% X factor) | None | BCUC adopted PEG results with one change and rejected B&V study in its entirety. |
| | | | Lowry (PEG) | Commercial Energy Consumers Association of British Columbia | 0.96% to 1.13% | 0.20% | 1.16% to 1.33% | More than 20 productivity studies submitted as testimony | |
| Ontario Energy Board Case EB-2012-0459 | US Gas Distributors | 2013 | Coyne, Simpson, and Bartos (Concentric) | Enbridge Gas Distribution | -0.32% | No explicit recommendation | 0.00% | First publicly-released productivity study | Company proposed a Custom IR plan which did not include an explicit X factor. Much of the company's proposal was accepted. |
| Massachusetts Department of Public Utilities, D.P.U. 13-90 | Northeast US Power Distributors | 2013 | Lowry (PEG) | Fitchburg Gas & Electric dba Unitil | 1.19% | 0.20% | 0.01% | More than 20 productivity studies submitted as testimony | PBR proposal rejected by Department |
| | | | Dismukes (Acadian) | Massachusetts Office of the Attorney General | 0.79% to 1.59% | No recommendation | No recommendation | Multiple energy utility productivity studies, all prepared in response to utility proposals | |
| Maine Public Utilities Commission, Case 2013-00168 | Northeast US Power Distributors | 2013 | Lowry (PEG) | Central Maine Power | 0.56% to 1.06% | 0.00% | -1.9% to -1.02% | More than 20 productivity studies submitted as testimony | Settlement withdrew PBR plan proposal |
| Alberta Utilities Commission, Proceeding 20414 | US Power Distributors | 2016 | Brown and Carpenter (Brattle) | ATCO Gas, ATCO Electric, Altagas, Enmax, FortisAlberta | -0.79% | 0.00% | -0.79% | First power distributor productivity study. Brattle has not conducted an independent study to date. | AUC adopted an X factor of 0.3%. Meitzen study rejected. Brattle study set lower bound of reasonable X factor range. |
| | | | Meitzen (Christensen) | EPCOR | -1.11% | 0.00% | -1.11% | First productivity study outside of telecom | |
| | | | Lowry (PEG) | Consumers' Coalition of Alberta | 0.43% to 1.28% | 0.20% | 0.63% to 1.48% | More than 20 productivity studies submitted as testimony | |

Table 5 (continued)

## Survey of Recent Multifactor Productivity Studies

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Ontario Energy Board Case EB-2016-0152 | US Hydro Generators | 2016 | Frayer (London Economics) | Ontario Power Generation | -1.18% to -1.01% | No recommendation | No recommendation | Two prior studies on power distribution productivity | OEB adopted Ontario Power Generation proposed productivity trend, but rejected both productivity studies |
| | | | Lowry (PEG) | Ontario Energy Board | 0.29% | 0.30% | 0.59% | More than 20 productivity studies submitted as testimony | |
| Massachusetts Department of Public Utilities, D.P.U. 17-05 | US Power Distributors | 2017 | Meitzen (Christensen) | Eversource Energy | -0.41% (regional) to -0.46% (nationwide) | 0%, Company proposed a 0.25% stretch factor if inflation exceeds 2% | -2.64% | Second productivity study outside of telecom, largely reliant on others' methodology | Massachusetts DPU adopted the results of the Meitzen study, An adjustment to X was made to reflect that grid modernization costs would be tracked |
| | | | Dismukes (Acadian) | Massachusetts Office of the Attorney General | 0.37% to 0.85% | No explicit recommendation | -1.36% | Multiple energy utility productivity studies, all prepared in response to utility proposals | |
| Lawrence Berkeley National Laboratory | US Power Distributors | 2017 | Lowry (PEG) | Lawrence Berkeley National Laboratory | 0.45% | No recommendation | No recommendation | More than 20 productivity studies submitted as testimony | Productivity study featured in a report about the effectiveness of MRIs. |
| Ontario Energy Board Case EB-2017-0049 | Ontario Power Distributors | 2017 | Fenrick (PSE) | Hydro One Networks | -0.90% | 0.45% | 0.6% maximum | We are aware of 2 prior productivity studies Mr. Fenrick has undertaken. | Pending |
| Ontario Energy Board, Case EB-2017-0307 | US Power Distributors | 2017 | Makholm (NERA) | Enbridge Gas Distribution and Union Gas Limited | 0.54% | 0.00% | 0.00% | 3 prior publicly-released productivity studies. First productivity study since 2010. | Pending |

1.84% productivity trend of sampled distributors that, like those in Alberta, experienced brisk customer growth.

The AUC ultimately chose a 0.96% base productivity trend and a 0.20% stretch factor for all gas and electric distributors. In its decision, the commission ventured opinions on several methodological issues. With respect to the output specification, for example, the commission stated on page 82 of AUC Decision 2012-237 that

> The Commission agrees with NERA's and PEG's view that when selecting a particular output measure, it must be matched to the type (price cap or revenue-per-customer cap) of a PBR plan….The Commission agrees with Dr. Lowry and his colleagues at PEG that for revenue-per-customer cap plans, the number of customers, rather than a volumetric output measure, is the correct output measure for a TFP study….Using similar logic, the Commission agrees with Dr. Lowry that output measures that place a heavy weight on volumetric and other usage measures should be used for TFP studies that are part of a price cap PBR plan.

### Ontario (2013)

The X factors in the Ontario Energy Board's fourth-generation MRIs for most provincial power distributors were based on the average PMF trends of these distributors. PEG senior advisor Larry Kaufmann prepared productivity research and testimony for Board Staff. Dr. Kaufmann had undertaken several previous energy distributor productivity studies. Although this MRI (still in effect) features *price* cap indexes, an *elasticity*-weighted scale index was employed in the productivity research, due in part to the fact that data were not readily available which might provide the basis for a *revenue*-weighted scale index. This treatment placed considerable weight on the trend in system use. A variant on the geometric decay approach to measuring capital cost was employed. With this methodology, Dr. Kaufmann reported an Ontario industry productivity trend of -0.33% for the full sample period but nonetheless recommended a 0% base productivity trend for the price cap indexes due, in part, to data peculiarities in the last sample year.[37] The Board agreed to the 0% base PMF trend, and chose stretch factors for each utility which varied between 0.0 and 0.6% depending on the results of an econometric total cost benchmarking study that PEG prepared.

### Maine (2014)

In 2013, Central Maine Power proposed a fourth generation MRI for its power distributor services. The company claimed a need for supplemental revenue to fund high capex after many years of operation under MRIs. Dr. Lowry was retained by the company to prepare productivity research and testimony. The company proposed a revenue cap (and decoupling), and his study used the number of customers as the scale variable. A COS approach to capital cost measurement was featured. Dr. Lowry reported annual PMF trends for two groups of Northeast power distributors which ranged from 0.56% for New York state and New England to 1.06% for the broader Northeast. He proposed a 0.0% stretch factor and a special adjustment to the X factor based on his finding that Northeast distributors with unusually old systems tended to have slow productivity growth. The company's proposal was dropped in the settlement approved by Maine's commission and no decisions on industry productivity trends or the stretch factor were rendered.

### Massachusetts (2014)

In 2013, Unitil proposed an MRI for power distributor services of Fitchburg Gas and Electric. It retained Dr. Lowry to undertake research and testimony on the productivity trends of Northeast power distributors. He reported a 1.19% PMF growth trend for Northeast distributors and recommended a 0.20% stretch factor.

The Massachusetts Attorney General's Office retained Dr. David Dismukes of Acadian Consulting to review and comment on Dr. Lowry's study. His review of Dr. Lowry's evidence suggested that the

[37] The trend for 2003-11 period that excludes the last year 0.19%.

PMF trend should lie between 0.79% and 1.59%. He did not comment on the appropriate stretch factor. Unitil's proposal was rejected by the Massachusetts commission and no decisions on industry productivity trends or the appropriate stretch factor were rendered.

## British Columbia (2014)

In 2013 FortisBC (formerly West Kootenay Power) and FortisBC Energy (formerly Terasen Gas) proposed MRIs for their gas and electric services which featured index-based revenue caps. Fortis retained a Black and Veatch consultant, who reported no prior productivity research experience, to prepare gas and electric power distribution productivity studies. Black and Veatch reported productivity trends for these industries in the neighborhood of -4% but nevertheless recommended a 0% productivity growth target and a 0% stretch factor for the companies. Notwithstanding the research results of its witness, Fortis recommended a 0.5% X factor for both utilities.

Dr. Lowry was retained by the Commercial Energy Distributors of British Columbia and prepared studies of U.S. gas and electric distributor productivity trends. He reported PMF trends of 0.93% for the full sample of power distributors and 0.96% for the full sample of gas utilities and recommended a 0.20% stretch factor for both companies. The BC commission chose a 0.93% base productivity trend and a 0.10% stretch factor for electric services. For gas it chose a 0.90% base productivity trend and a 0.20% stretch factor. The Black and Veatch study was rejected in its entirety.[38]

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[38] The commission stated in its decisions on the Fortis MRIs that

> The Panel has a number of concerns about the B&V studies and is not persuaded that the TFP trend results reported by B&V can be used as a basis to establish an X-Factor. Dr. Overcast employs a study methodology that is, by his own admission, non-standard. There is no evidence that this methodology has been accepted in any other proceeding. Further, Dr. Overcast has not previously conducted a TFP trend study. The Panel previously found B&V's use of output and input level indexes inappropriate and cannot be relied upon to generate meaningful input and output trends. We have also made determinations in the areas of input cost inflation, the use of arithmetic vs logarithmic measures and the study length. In all cases, we found flaws in the study methodology that tend to understate TFP trends. **Given the number of shortcomings in B&V's methodology and the errors that arise from these shortcomings, the Panel does not accept B&V's study results.**

Reference: British Columbia Utilities Commission (2014), *In the Matter of FortisBC Inc. Multi-Year Performance Based Ratemaking Plan for 2014 Through 2018 Decision*, September 15, p. 56.

## Alberta (2016)

The AUC held a proceeding 2015-2016 to resolve key issues in the design of next-generation MRIs for Alberta energy distributors. EPCOR hired Christensen Associates while other utilities hired the Brattle Group to prepare productivity studies. Although Christensen had previously done a few energy utility productivity studies, EPCOR retained Dr. Mark Meitzen, Christensen's expert on *telecommunications* productivity. Both consultancies updated NERA's power distributor study with few adjustments and then advocated basing X on results the later years of the full sample period, when PMF growth was materially negative. National samples were once again embraced. Brattle proposed a base PMF growth trend of -0.79% while Christensen proposed a trend of -1.11%. Both consultancies also proposed a 0% stretch factor.

The Consumers Coalition of Alberta hired Dr. Lowry again, and he prepared an independent study of U.S. power distributor productivity growth. He used the number of customers as the scale variable and a geometric decay approach to measuring capital cost. His sample was substantially larger than that used by the utility witnesses or in his own prior studies. Dr. Lowry reported a 0.43% PMF trend for the full sample of power distributors but recommended basing X on the higher 0.78% trend for rapidly-growing distributors. Lacking persuasive benchmarking evidence, Dr. Lowry recommended a 0.20% stretch factor for all companies.

The sample period was 1997-2014. Dr. Lowry reported a 0.43% PMF trend for the full sample of power distributors but recommended basing X on the higher 0.78% trend for rapidly-growing distributors. Lacking persuasive benchmarking evidence, Dr. Lowry recommended a 0.20% stretch factor for all companies.

Dr. Lowry once again lodged extensive criticisms of NERA's methodology for PMF measurement. His evidence showed that the decline in PMF growth over the full sample period was due chiefly to the slowdown and ultimate decline in average use of power by residential and commercial customers. He argued that this slowdown was irrelevant to the choice of X factors for Alberta's gas distributors, which operated under revenue per customer indexes.

Dr. Lowry also demonstrated that results using NERA's methodology were very sensitive to the assumption concerning the average service life of assets. NERA had assumed a 33-year service life, and this assumption was never well substantiated by Dr. Makholm or the utility witnesses in Alberta.[39] Based on Dr. Lowry's extensive experience, a materially higher average service life was warranted. EPCOR, for example, reported a 37-year average service life in the proceeding.

When various problems with NERA's method were corrected and a 37-year service life was used, the resultant PMF trend was similar to that from Dr. Lowry's method. Thus, the negative PMF trend of recent years was due to an inappropriate service life assumption that, over the *full* sample period, was masked by brisk growth in R&C average use in the earlier years of the sample period. *This evidence by Dr. Lowry, which is provided in Attachment 1 to this report, severely compromised the credibility of NERA's methodology. However, it was not considered by the AUC when it made its X factor decision,* ostensibly because Dr. Lowry had not provided working papers for his final research.[40] Working papers were prepared but not provided on the advice of PEG's client because the evidence was submitted in rebuttal testimony shortly before oral hearings and working papers were never requested by any party. We believe that this evidence is highly pertinent to the Régie's *jugement*

[39] Dr. Makholm noted the 33-year assumption in his report but did not defend or explain it. When asked to explain the assumption in a data request from PEG, he stated only that "The 33-year service life is a more updated average of the lifetimes of utility capital."

[40] The AUC did not mention this evidence in its decision on the MRI, but stated in the related cost award decision that

> The Commission also considers that there were certain areas of evidence that did not contribute to the Commission's understanding of the issues or was of limited assistance because the supporting information was not provided... Another example is related to PEG's evidence Table 2, "Summary of Corrections and Modifications to NERA/Brattle/LRCA Productivity Calculations," found in Pacific Economics Group's rebuttal evidence. Table 2 shows the steps in reconciling PEG's and NERA-based studies, which effectively resulted in Dr. Lowry's reproduction of the Brattle Group and Dr. Meitzen studies on the record of the original proceeding . . . These papers were not provided on the record to support the Table 2 calculations. Because working papers were not provided, the Commission and parties were unable to test the veracity of the numbers in Table 2 and the Commission was not able to assess the probative value of the information provided. While generally PEG's evidence was of assistance to the Commission, this specific information in Table 2 did not contribute to a better understanding of the total factor productivity to be used in determining X. Accordingly, the Commission cannot approve the hours related to the preparation of Table 2, the corresponding narrative to Table 2, and the associated working papers. (AUC Decision 22082-D01-2017, p. 12)

process and is just as valid as any other evidence that has not yet been completely vetted by opposing parties (e.g., the Fenrick study for Hydro One Networks).

The AUC ultimately chose a 0.30% X factor for both gas and electric power distributors and did not itemize a stretch factor.

### Lawrence Berkeley National Laboratory (2017)

Dr. Lowry calculated the PMF trends of a large sample of U.S. power distributors in his recent study on multiyear rate plans for Lawrence Berkeley National Laboratory.[41] The number of customers was the scale variable and geometric decay was assumed with a 37-year average service life. He reported PMF trends of 0.45% for the full 1980-2014 sample period and of 0.39% for the more recent 1996-2014 sample period. Using his method, which is not sensitive to average use trends, there has *not* been a large slowdown in power distributor productivity growth since 2000 and recent productivity growth has not been negative.[42] In a fall 2017 presentation funded by LBNL which Dr. Lowry made to the New England Council of Public Utility Commissions, Dr. Lowry reported that the PMF trend of sampled power distributors for the more recent 1996-2016 sample period was 0.43% per annum for the full U.S. sample and 0.31% for the Northeast U.S.

### Massachusetts (2017)

Eversource Energy retained Dr. Meitzen of Christensen Associates to prepare productivity research and testimony in support of an MRI proposal for its power distribution services in Massachusetts. Dr. Meitzen updated NERA's study to 2016, making only a few changes to the methodology. Eversource proposed a *revenue* cap index, and Dr. Meitzen used the number of customers served rather than a volumetric index as his scale variable. However, he did not reconsider the 33-year average service life assumption and did not report results for the earlier years of NERA's sample period. Thus Eversource, a company based in the Boston area, did not hire Boston's most experienced power distribution productivity consultant but instead hired Christensen's telecom

[41] Lowry, op. cit., p. B.18

[42] Slower growth in the number of customers served has, however, produced a modest (e.g., 10 basis point) slowdown in the realization of scale economies

productivity expert to use NERA's methodology for a recent sample period, a practice NERA had opposed. Meitzen reported productivity trends of around -0.40% for both regional and national distributor samples and proposed a 0% stretch factor.

The Massachusetts Office of the Attorney General retained Dr. David Dismukes of Acadian Consulting Group to prepare productivity research and testimony.[43] He reported a +0.37% simple average PMF trend for the full sample, a +0.42% weighted average for the full sample, a +0.71% simple average for the Northeast sample, and a +0.85% weighted average for the Northeast sample. He did not address the stretch factor issue.

In its decision approving an MRI for Eversource, the Massachusetts Department of Public Utilities acknowledged a -0.46% U.S. industry power distributor productivity trend. It also embraced the one hoss shay approach to measuring capital cost.

### Ontario (2017)

Ontario Power Generation ("OPG") proposed an MRI for its regulated hydroelectric generating services in 2016. It retained London Economics to prepare a supportive study of trends in the productivity of North American hydroelectric generators. London Economics had done two prior productivity studies and used a "physical assets" approximation to a one hoss shay approach to measuring the capital quantity trend.[44] They reported a PMF trend in the -1.01 to -1.18% range and made no stretch factor recommendation. The company proposed a 0% base productivity trend and a 0.3% stretch factor.

Ontario Energy Board staff retained Dr. Lowry to prepare an independent study of the productivity trends of the company and a sample of U.S. hydroelectric generators. Using generation capacity as the scale metric and geometric decay to measure capital cost, he reported a 0.29% PMF trend and recommended a 0.3% stretch factor. Using a Khan method, Dr. Lowry also showed that the X factor implicit in the company's recent revenue and volume trends from 2008 to 2014 was +1.34%. The

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[43] Dr. Lowry was not a witness in this proceeding so many of his criticisms of NERA's method were not considered.

[44] They specifically used generation capacity as the capital quantity index.

propriety of the one hoss shay and related physical asset approaches to capital cost and quantity measurement was a salient issue in the proceeding.

The Board issued a decision last month which approved a 0% base productivity trend and a 0.3% stretch factor. In its decision the Board declined to fully embrace the entire PMF methodology used by either witness but, unlike the AUC in its recent decision, did venture opinions on several methodological issues. In particular, it indicated a preference for Dr. Lowry's method for measuring capital cost stating that

> 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 as the capital costs. Although many hydroelectric generation assets have very long useful lives, the OEB is not convinced that there is no functional depreciation until end of life. In fact, reviews of capital projects to sustain, refurbish and replace hydroelectric stations and assets in OPG's prior payment amount applications confirm that capital expenditures and operating costs are needed to maintain capacity to the end of a station's life. Absent ongoing capital and operating expenditures, hydroelectric generation assets will depreciate over time. In the OEB's view, LEI's physical method, which assumes no depreciation until the end of life, is not a realistic basis for the analysis of productivity of hydroelectric generation facilities.[45]

The Board stated the hope that its opinions on methodological issues would be considered in future productivity studies, stating that

> The OEB expects that OPG and other stakeholders will take into account the OEB's concerns about the approaches and limitations of the experts' analyses on the record in this proceeding. Improvements in methodology and data, and translation of the results of the studies as to how they more directly translate to rate-setting would provide more useful and convincing information on which OPG could make its next proposal and the OEB would make its determination for subsequent IRM plans.[46]

## Ontario (2017)

Hydro One Networks filed evidence in 2017 in support of a custom MRI for its power distributor services. The company retained Steve Fenrick of Power Systems Engineering to prepare supportive productivity and benchmarking evidence. Mr. Fenrick had prepared a few previous energy distributor

[45] Ontario Energy Board, EB-2016-0152, Decision and Order, December 28, 2017, pp. 126-127.

[46] Ibid., p. 128.

productivity studies. He updated PEG's Ontario power distributor productivity study to 2015, reporting a -0.90% annual PMF growth trend for the full sample period, and proposed a 0.45% stretch factor based on the result of his total cost benchmarking study. Hydro One proposed a base productivity trend of zero and a 0.45% stretch factor. PEG has been retained by Board Staff to review Mr. Fenrick's submission. However, the project has been delayed and no review has yet been undertaken.

### Ontario (2017)

Union Gas and Enbridge recently proposed a merger and an MRI for their consolidating Ontario gas utility operations. The so-called "Amalco" companies retained Dr. Makholm of NERA to update his power distributor PMF study. He reports a 0.54% PMF trend for his full 1973-2016 sample period, but the negative PMF trend in recent years has continued. Notwithstanding his support for basing X factors on results for the full sample period when he was a commission witness, Makholm recommends a 0% base productivity factor for the combined company and a 0% stretch factor. The Amalco made the same recommendations. Dr. Lowry has been retained by Board staff to respond to Makholm's new study. The project is just beginning, however, and Makholm's evidence has not yet been reviewed or challenged.

### Canadian Utility Sector Productivity

CEA notes on p. 12 of its June 2017 X factor evidence the declining productivity of the Canadian utility industry as measured by *Statistique Canada*. The pertinence of the Canadian utility industry productivity indexes was discussed at some length by Dr. Lowry in the first Alberta MRI proceeding. He explained that *Statistique Canada* has calculated PMF indexes for the utility sector of the Canadian economy and two subsectors: “Electric power generation, transmission, and distribution” and “natural gas distribution, water, and other systems”. Though *Statistique Canada* continues to maintain the utility sector index, the two subsector indexes were terminated in 2010.

Each index has been calculated on a “gross output” and a “value added” basis. The gross output approach is more similar to that conventionally used in productivity studies for X factor calibration because it includes intermediate inputs like materials and services. The value-added approach does not include intermediate inputs because it is intended for use in the calculation of the PMF growth of Canada's aggregate business sector.[47]

Only results for the value-added utility PMF index are reported on a timely basis, and it is these results that CEA reports on p. 13 of its July submission. Between 1962-2015 this index exhibited a 0.41% average annual growth rate. However, over the last twenty years (1996 to 2015) this index averaged a 0.83% annual decline, and over the last ten years (2006 to 2015), it averaged a 1.75% annual decline.

Results of the value-added utility PMF index that CEA features are of limited relevance in setting an X factor for HQD, for several reasons.

- It is a value-added calculation. As such, it ignores productivity in the use of intermediate inputs.
- It is sensitive to developments in the generation sector of the electric utility industry. This has little relevance to network industries such as power distribution. For example, the growth in the index has in recent years been slowed by Hydro-Québec projects to develop remote hydroelectric resources.
- The electric utility industry restructured in Alberta and Ontario. It is not clear how well this has been handled by *Statistique Canada*.
- A volumetric scale index is employed. This makes results sensitive to changing business conditions including, particularly, the slowing growth in average use of energy. Declining average use has been more pronounced in the gas utility industry than in the electric utility industry.
- Measured productivity growth is slowed by growth in expenses for utility conservation and load management programs, which are large in several Canadian provinces, but will likely be Y factored in HQD's MRI.

The *Statistique Canada* PMF indexes for “electric power generation, transmission, and distribution” and “natural gas distribution, water, and other systems” are available on a gross value basis through 2010. On average, the productivity of the gas and water sector grew by 0.55% annually

[47] It is difficult to use macroeconomic data to compute the PMF of the aggregate private business sector if intermediate inputs are included.

between 1962-2010. For the most recent 20 years (1991-2010) productivity declined by 0.09% per year on average, and for the most recent ten (2001-2010) it declined by 1.44%. Note that output is measured volumetrically, and thereby reflects the material decline in average use of gas by Canadian residential and commercial customers that has been underway for many years.

As for the PMF index for the "electric power generation, transmission, and distribution," using the gross output approach, Statistics Canada reports a 0.61% average annual growth rate in utility sector productivity for the full 1962-2010 period. For the most recent 20 years (1991-2010), the average growth rate is 0.41%. For the most recent ten years (2001-2010), productivity declines by a modest 0.12% annually.

The Center for the Study of Living Standards ("CSLS") retained Statistics Canada to prepare a study of productivity trends at the provincial level. A report on the research was released in 2010.[48] This study reported results only for value-added PMF indexes. After extensive correspondence between PEG Research and principals of this study, the principals conceded that the study used an experimental methodology and is not of a high enough standard to be used in X factor determination.

The AUC stated in its decision on first-generation MRI for provincial energy distributors that

> Overall, the Commission considers that while Statistics Canada's MFP indexes and the CSLS report can be a useful reference for gauging the general productivity trends of the utilities sector, these analyses cannot be a substitute for a TFP study for either the electric or gas distribution industries.

## Commentary

This review of recent PMF studies and MRI proceedings prompts several comments.

- Productivity research has various uses, and the methods appropriate for one use may not be appropriate for another. In this proceeding, we seek productivity research that can inform selection of an X factor for a revenue per customer index between *dossiers tarifaires*. A different methodology might be appropriate for a study concerned solely with cost efficiency or the calibration of X in a price cap index.

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[48] CSLS, *New Estimates of Labor, Capital, and Multifactor Productivity Growth and Levels for Canadian Provinces at the Three Digit NAICS Level 1997-2007.*

- Commissions that have made X factor decisions often comment on the research methods used by PMF witnesses. This encourages witnesses to use better methods in subsequent MRI proceedings.
- Much of the recent variation in PMF trends reported by witnesses in MRI proceedings is due to research methods that the Régie may find objectionable or inappropriate for application to a revenue cap index. It is reasonable for the Régie to give little or no weight to such evidence in its decision.
- Utilities have frequently hired witnesses in recent years who have little experience in the measurement of PMF trends of energy utilities. It is chiefly these witnesses who have recommended substantially negative productivity growth trends. These witnesses also frequently propose 0% stretch factors.
- The slowdown in productivity growth which utility witnesses often highlight is due chiefly to slowing growth in residential and commercial average use which is irrelevant to the choice of an X factor for HQD. They often conjecture that slow productivity growth is also driven by high capex requirements but provide little evidence to substantiate this notion.
- Commissions are sometimes reluctant to embrace results of one productivity study because they do not prefer every aspect of any one study's methodology. However, this does not mean that they routinely take an average of the recommendations of all witnesses when choosing a base productivity trend or stretch factor. An averaging approach incentivizes parties to produce outlier results that can move the average. Judgement can instead focus on the most recent studies and the best methodologies.

# 5. Application to HQD

## 5.1 Inflation Measure

Régie Ruling

The Régie traced the outlines of an inflation measure for HQD's revenue cap index in D-2017-043 but made no final decision. It suggested that the inflation measure should summarize growth in two inflation subindexes: the *indice des prix a la consommation* ("IPC", aka consumer price index) for Québec and the average weekly earnings (“AWE”) of Québec industrial workers. Both of these price indexes are calculated by Statistique Canada. The revenue cap index inflation measure would take the average AWE inflation in the last three years ending 31 March and the inflation in $IPC^{Québec}$ for the last year. Cost share weights would be used for these subindexes, following the precedent of the Company's current *formule paramétrique* for the *charges d’exploitation revenu requis.*

> **la Régie retient la proposition du Distributeur à l’effet que le facteur de pondération entre l’inflation et le taux de croissance des salaires soit déterminé selon une méthode similaire à celle utilisée actuellement dans les demandes tarifaires aux fins du calcul de l’enveloppe des charges d’exploitation, soit en fonction de la quote-part de la masse salariale, excluant la portion capitalisable, sur les charges totales couvertes par la formule paramétrique.** [49]

This general approach to the design of a rate or revenue cap inflation measure is sensible and is currently used to regulate energy utilities in Alberta, British Columbia, and Ontario. It helps the revenue cap index track local inflation pressures that utilities experience while sidestepping the complicated issue of capital price measurement which might be encountered with a more complex utility input price index.

We nonetheless have concerns with the Régie’s suggested inflation measure treatment in three areas: the choice of a macroeconomic inflation measure, the cost share weights, and the appropriate time period to consider. We discuss these issues in turn.

## Macroeconomic Inflation Measure

Table 6 shows trends in six macroeconomic price indexes that are sensible candidates for use in Québec. We also include the average weekly earnings of Canadian and Québec industrial workers. Here are the indexes with brief discussion of noteworthy features.

[49] Régie, op. cit., p. 37.

## Table 6
## Alternative Inflation Measures for Canada and Québec[1]

| | Canada | | | | | | | | Québec | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | IPC[1] | | GDPIPIs[2] | | | | AWE[3] | | IPC[1] | | GDPIPIs[2] | | | | AWE[3] | |
| | All Items | | Final Consumption | | Final Domestic Demand | | All Employees | | All Items | | Final Consumption | | Final Domestic Demand | | All Employees | |
| Year | Level | GR | Level | GR | Level | GR | Level | GR | Level | GR | Level | GR | Level | GR | Level | GR |
| 1982 | 56.1 | 10.4% | 55.8 | 10.0% | 59.0 | 9.1% | | | 57.1 | 10.9% | 58.1 | 10.6% | 61.7 | 9.6% | | |
| 1983 | 59.4 | 5.7% | 59.6 | 6.6% | 62.2 | 5.4% | | | 60.3 | 5.4% | 61.4 | 5.6% | 64.7 | 4.8% | | |
| 1984 | 62.0 | 4.2% | 62.3 | 4.4% | 64.9 | 4.1% | | | 62.8 | 4.0% | 64.4 | 4.8% | 67.6 | 4.4% | | |
| 1985 | 64.4 | 3.9% | 64.8 | 3.9% | 67.2 | 3.6% | | | 65.5 | 4.3% | 67.1 | 4.1% | 70.0 | 3.6% | | |
| 1986 | 67.1 | 4.0% | 67.5 | 4.1% | 69.8 | 3.8% | | | 68.7 | 4.7% | 69.9 | 4.1% | 72.8 | 3.9% | | |
| 1987 | 70.0 | 4.3% | 70.3 | 4.1% | 72.8 | 4.1% | | | 71.6 | 4.2% | 73.0 | 4.4% | 75.9 | 4.2% | | |
| 1988 | 72.8 | 3.9% | 73.1 | 3.9% | 75.5 | 3.7% | | | 74.3 | 3.6% | 75.6 | 3.5% | 78.4 | 3.3% | | |
| 1989 | 76.5 | 4.9% | 76.5 | 4.5% | 78.9 | 4.4% | | | 77.4 | 4.2% | 78.9 | 4.2% | 81.4 | 3.8% | | |
| 1990 | 80.2 | 4.7% | 80.1 | 4.6% | 82.0 | 3.8% | | | 80.8 | 4.3% | 82.4 | 4.4% | 84.6 | 3.7% | | |
| 1991 | 84.7 | 5.5% | 83.9 | 4.7% | 84.7 | 3.3% | | | 86.7 | 7.1% | 86.5 | 4.8% | 87.3 | 3.2% | | |
| 1992 | 85.9 | 1.4% | 85.7 | 2.1% | 86.4 | 2.0% | | | 88.4 | 1.9% | 87.9 | 1.7% | 88.8 | 1.6% | | |
| 1993 | 87.5 | 1.9% | 87.4 | 1.9% | 88.0 | 1.8% | | | 89.5 | 1.3% | 89.3 | 1.5% | 89.9 | 1.2% | | |
| 1994 | 87.6 | 0.1% | 88.5 | 1.3% | 89.5 | 1.7% | | | 88.4 | -1.3% | 89.7 | 0.5% | 90.9 | 1.1% | | |
| 1995 | 89.6 | 2.2% | 89.8 | 1.4% | 90.5 | 1.1% | | | 89.9 | 1.7% | 90.5 | 0.9% | 91.7 | 0.9% | | |
| 1996 | 90.9 | 1.5% | 90.9 | 1.2% | 91.5 | 1.1% | | | 91.3 | 1.6% | 91.4 | 1.0% | 92.2 | 0.6% | | |
| 1997 | 92.4 | 1.7% | 92.2 | 1.5% | 93.0 | 1.6% | | | 92.7 | 1.4% | 92.5 | 1.2% | 93.3 | 1.2% | | |
| 1998 | 93.4 | 1.0% | 93.5 | 1.3% | 94.3 | 1.5% | | | 94.0 | 1.4% | 93.6 | 1.2% | 94.4 | 1.2% | | |
| 1999 | 95.0 | 1.7% | 95.2 | 1.8% | 95.6 | 1.3% | | | 95.4 | 1.5% | 95.3 | 1.8% | 95.8 | 1.4% | | |
| 2000 | 97.5 | 2.7% | 97.9 | 2.8% | 98.1 | 2.6% | | | 97.8 | 2.4% | 98.2 | 3.0% | 98.2 | 2.5% | | |
| 2001 | 100.0 | 2.5% | 100.0 | 2.2% | 100.0 | 1.9% | 657 | | 100.0 | 2.3% | 100.0 | 1.8% | 100.0 | 1.8% | 623 | |
| 2002 | 102.2 | 2.2% | 102.4 | 2.3% | 102.4 | 2.4% | 673 | 2.4% | 102.0 | 2.0% | 102.2 | 2.2% | 102.2 | 2.2% | 639 | 2.4% |
| 2003 | 105.1 | 2.8% | 104.4 | 2.0% | 104.0 | 1.5% | 691 | 2.7% | 104.6 | 2.5% | 104.4 | 2.1% | 103.9 | 1.6% | 657 | 2.8% |
| 2004 | 107.1 | 1.8% | 106.1 | 1.6% | 105.9 | 1.8% | 709 | 2.6% | 106.6 | 1.9% | 105.9 | 1.5% | 105.6 | 1.6% | 673 | 2.4% |
| 2005 | 109.4 | 2.2% | 108.3 | 2.1% | 108.2 | 2.1% | 737 | 3.8% | 109.1 | 2.3% | 108.2 | 2.1% | 107.6 | 1.9% | 695 | 3.2% |
| 2006 | 111.6 | 1.9% | 110.3 | 1.9% | 110.7 | 2.3% | 755 | 2.4% | 110.9 | 1.7% | 109.8 | 1.5% | 109.2 | 1.5% | 707 | 1.8% |
| 2007 | 114.0 | 2.2% | 112.5 | 1.9% | 113.4 | 2.4% | 787 | 4.2% | 112.7 | 1.6% | 111.9 | 1.8% | 111.1 | 1.7% | 737 | 4.1% |
| 2008 | 116.7 | 2.3% | 114.8 | 2.1% | 116.2 | 2.5% | 810 | 2.8% | 115.0 | 2.1% | 113.5 | 1.5% | 113.3 | 2.0% | 751 | 1.9% |
| 2009 | 117.0 | 0.3% | 115.9 | 0.9% | 117.6 | 1.2% | 823 | 1.5% | 115.7 | 0.6% | 114.1 | 0.5% | 114.4 | 1.0% | 759 | 1.0% |
| 2010 | 119.1 | 1.8% | 117.4 | 1.4% | 118.8 | 1.1% | 852 | 3.6% | 117.1 | 1.2% | 115.4 | 1.2% | 115.4 | 0.9% | 784 | 3.3% |
| 2011 | 122.6 | 2.9% | 120.4 | 2.5% | 121.7 | 2.4% | 874 | 2.5% | 120.7 | 3.0% | 118.3 | 2.5% | 118.2 | 2.4% | 804 | 2.5% |
| 2012 | 124.4 | 1.5% | 122.2 | 1.5% | 123.7 | 1.7% | 895 | 2.5% | 123.3 | 2.1% | 120.5 | 1.8% | 120.3 | 1.8% | 823 | 2.4% |
| 2013 | 125.6 | 0.9% | 124.4 | 1.8% | 125.9 | 1.7% | 911 | 1.8% | 124.2 | 0.7% | 123.0 | 2.1% | 122.8 | 2.0% | 832 | 1.2% |
| 2014 | 128.0 | 1.9% | 126.9 | 2.0% | 128.7 | 2.2% | 935 | 2.6% | 125.9 | 1.4% | 125.2 | 1.7% | 125.2 | 2.0% | 850 | 2.0% |
| 2015 | 129.4 | 1.1% | 128.3 | 1.1% | 130.8 | 1.7% | 952 | 1.8% | 127.2 | 1.0% | 126.7 | 1.2% | 127.1 | 1.5% | 868 | 2.1% |
| 2016 | 131.3 | 1.4% | 129.6 | 1.0% | 132.5 | 1.3% | 956 | 0.4% | 128.2 | 0.7% | 127.7 | 0.8% | 128.2 | 0.9% | 878 | 1.2% |
| **Average Annual Growth Rates** | | | | | | | | | | | | | | | | |
| **1982-2016** | | **2.7%** | | **2.7%** | | **2.6%** | | **NA** | | **2.6%** | | **2.6%** | | **2.4%** | | **NA** |
| **1997-2016** | | **1.8%** | | **1.8%** | | **1.9%** | | **NA** | | **1.7%** | | **1.7%** | | **1.6%** | | **NA** |
| **2002-2016** | | **1.8%** | | **1.7%** | | **1.9%** | | **2.5%** | | **1.7%** | | **1.6%** | | **1.7%** | | **2.3%** |
| **Standard Deviations** | | | | | | | | | | | | | | | | |
| **1982-2016** | | **1.9%** | | **1.9%** | | **1.6%** | | **NA** | | **2.2%** | | **2.0%** | | **1.7%** | | **NA** |
| **1997-2016** | | **0.7%** | | **0.5%** | | **0.5%** | | **NA** | | **0.6%** | | **0.6%** | | **0.5%** | | **NA** |
| **2002-2016** | | **0.7%** | | **0.5%** | | **0.5%** | | **0.9%** | | **0.7%** | | **0.5%** | | **0.5%** | | **0.8%** |

[1] All growth rates are logarithmic.
[2] Consumer price index (Statistics Canada, Table 326-0021).
[3] Gross domestic product implicit price index (Statistics Canada, Table 384-0039).
[4] Average weekly earnings, including overtime, for all employees in current dollars (Statistics Canada, Table 281-0026).

- The IPC for Canada is the inflation measure most familiar to Canadian consumers. This type of inflation measure is the norm in British and Australian MRIs. It is less common in North American MRIs because it places a fairly heavy weight on price-volatile consumer commodities like gasoline, natural gas, and food. These commodities make the $IPC^{Canada}$ more volatile and have much more impact on the budget of a typical consumer than they do on the cost of a typical energy distributor's base rate inputs.[50] On the other hand, the revenue cap index for HQD may apply to *couts de combustibles* such as *diesel leger*, *diesel arctique*, and *mazout*.
- The IPC for Québec ($IPC^{Québec}$) has the drawbacks just noted for the $CPI^{Canada}$ but has the advantage of being specific to the province. It should therefore be more sensitive to local business conditions than $IPC^{Canada}$.
- Gross domestic product implicit price indexes ("GDPIPIs") track inflation in prices of capital equipment and net exports as well as consumer products. They are periodically updated and are available for Québec as well as Canada. However, the GDPIPI for Québec is released with a considerable lag. In the United States, we noted above that a gross domestic product price index has been preferred over IPCs in MRIs because the impact of price-volatile consumer commodities is watered down. However, in Canada's economy with its sizable reliance on natural resource exports, this stabilizing benefit is offset by the impact of incorporating inflation in commodity exports. The GDPIPIs for final domestic demand ($GDPIPI^{FDD}$) remove the inflation impact of price volatile exports. They are available for Québec as well as Canada.

Table 6 shows that these indexes vary in their volatility, which we measure in the last three rows of the table by the standard deviations of their growth rates. The CPIs for Canada and Québec are more volatile than the corresponding GDPIPIs for final domestic demand. In 2009, for instance, the CPI (all items) for Canada and Québec grew only 0.3% and 0.6%, respectively, while the GDPIPIs for final

[50] Non-seasonal CPIs also have the characteristic of not being revised.

domestic demand in Canada and Québec rose by 1.2% and 1.0%. Average weekly earnings of Québec workers are even more volatile.

The table also shows that trends in Québec inflation tend to be fairly similar to those for Canadian inflation. Please also note that, in Canada and Québec alike, the growth trends in average weekly earnings are more rapid than those for the macroeconomic price indexes. This incentivizes utilities to propose heavier weights on the labor price indexes in the inflation measures of rate and revenue cap indexes.

We conclude that the $IPC^{Québec}$ is a reasonable subindex for HQD's inflation measure if the formule d'indexation applies to fuel costs. The GDPIPI for final domestic demand in Canada merits consideration if the Régie decides to add a price subindex for fuel cost to the inflation measure.

## Cost Share Weights

The inflation in an input price index was shown in Section 3.1 to be a cost-weighted average of the growth in price subindexes for various input groups. This inflation measure for HQD will apply to most costs of base rate inputs, including capital costs. The weight on the labor price index in the inflation measure should therefore be the share of non-capitalized labor expenses in the applicable portion of the pro forma total cost of service. Table 7 summarizes precedents for inflation measures in current Canadian MRIs. It can be seen that similarly low labor price weights are used in Ontario inflation measures. Our review of HQD's *revenu requis* for 2016 suggests that a labor price index weight of approximately 19% is appropriate. This is roughly the share of labor in *charges d'exploitation* times the share of *charges d'exploitation* in the applicable total *revenu requis*. The weight assigned to labor would be reduced if pension and benefit expenses are Y factored.

## Timing

With respect to timing, we recommend that the *revenu requis* of HQD be escalated on April 1 of the new rate year on the basis of historical inflation for the period ending on December 31st of the prior year. The requisite inflation measures should be available by early March.

Table 7

Inflation Measures in Current Canadian MRIs

| Jurisdiction | Company | Term | Industry | Labor Price Subindex | Labor Weight | Non-Labor Price Subindexes | Non-Labor Weight |
|---|---|---|---|---|---|---|---|
| Ontario | Ontario Power Generation | 2017-2021 | Power Generation | Average Weekly Earnings for Ontario - Industrial Aggregate | 12% | Canadian Gross Domestric Product Implicit Price Index - Final Domestic Demand | 88% |
| British Columbia | Fortis BC Inc. and FortisBC Energy Inc | 2014-2019 | Bundled Power Service and Gas Distribution | Average Weekly Earnings for British Columbia | 55% | Consumer Price Index - British Columbia | 45% |
| Ontario | All Ontario Distributors | 2014-2018 | Power Distribution | Average Weekly Earnings for Ontario | 30% | Canadian Gross Domestric Product Implicit Price Index - Final Domestic Demand | 70% |
| Alberta | ATCO Electric, FortisAlberta, EPCOR, AltaGas, ATCO Gas | 2018-2022 | Power and Gas Distribution | Average Weekly Earnings for Alberta | 55% | Consumer Price Index - Alberta | 45% |

## 5.2 X Factor

The preponderance of evidence assembled suggests that an X factor of +**0.30%** is just and reasonable for the first-generation MRI of HQD.

- The average power distributor PMF growth trend that North American regulators have acknowledged is **0.60%**. Only one North American regulator (Massachusetts) has ever acknowledged a negative productivity growth target. Dr. Lowry was not a witness in that proceeding.

- The OEB most recently set the base productivity growth target for Ontario power distributors at 0%. However, Ontario power distributor operating data have numerous flaws, and the scale index that the OEB uses assigns a substantial weight to usage variables (e.g., delivery volume) that are sensitive to the large energy efficiency programs in the province.

- With regard to productivity studies (rather than commission decisions), Dr. Lowry's method for measuring the PMF trend of power distributors has been shown to be the most appropriate one for setting an X factor for HQD, for several reasons. The number of customers served is clearly the most appropriate scale variable to use when calibrating the X factor of a revenue per customer index. The geometric decay approach to capital cost measurement has many advantages. His assumptions about the average service life are empirically founded and reasonable, and results using his method are in any event not highly sensitive to the service life assumption. Dr. Lowry's sample includes more companies than those in other studies. He prepares productivity studies for diverse clients, and not just utilities. Dr. Lowry recently reported a **0.39%** power distributor PMF growth trend over the 1996-2014 period in his paper for Berkeley Lab. He reported a **0.43%** trend for his full sample for the more recent 1996-2016 period in a recent presentation for regulators which was funded by Berkeley Lab.

- Studies based on a one hoss shay capital cost specification also merit some consideration by the Régie. The most relevant of these are Dr. Meitzen's recent study for Eversource and Dr. Makholm's recent study for the Amalco gas utilities in Ontario. Both studies incorporate recent data. Dr. Meitzen's study additionally features the number of customers as the scale variable. His estimate of the PMF growth trend of all sampled utilities in recent years is **-0.46%**. Dr. Makholm continues to use a less appropriate volumetric index and reported a 0.54% trend for his full sample period but nonetheless recommended a 0% base PMF trend on the basis of his research.

  Both of these studies use an unrealistic and poorly substantiated 33-year average service life. PMF growth would likely be much higher with a higher and more realistic service life. Dr. Meitzen was under no obligation to use NERA's method and in fact has found errors with other aspects of the method. His failure to reconsider the 33-year average service life assumption in his Eversource testimony despite its being an issue in the Alberta proceeding is therefore noteworthy. In the simple one hoss shay methodology, average service life effectively becomes a "fudge factor" that can be used to produce any result. HQD reports a 39-year average service life in its current rate case.[51]

  It should also be noted that Dr. Meitzen routinely used the geometric decay approach to capital cost measurement in his telecommunications productivity research and testimony.

[51] HQD-3, document 2, p. 10.

All other productivity practitioners at Christensen who have prepared energy utility productivity studies have used geometric decay. Dr. Meitzen lacks the expertise to credibly argue that a one hoss shay approach is somehow relevant to power distribution but not to telecommunications. CEA witness James Coyne employed a geometric decay specification in gas productivity research and testimony for Enbridge Gas Distribution.

- Using the Kahn method, an inflation measure like that which the Régie has discussed, and data on HQD's *revenu requis* and customer trends for the 2005-2015 period, we found that an X factor of **0.67%** is indicated.
- The *cibles d'efficience* (efficiency improvement targets) in the Régie's current *formule paramétrique* for *charges d'exploitation* has risen since 2013 from 1% to 1.5%.
- While some utilities have recently proposed negative X factors on the basis of productivity studies prepared by their witnesses, others have not. For example, Fortis recently proposed an X factor of 0.50% in BC, and Hydro One Networks, Ontario Power Generation, and the gas Amalco have all proposed base productivity growth factors of 0%.

Our review of recent PMF studies and MRI proceedings has implications for the kind of PMF study that is appropriate for HQD after the Company's MRI begins. The study should

- calculate productivity trends in the use of capital and *charges d'exploitation* inputs as well as PMF;
- be based primarily on U.S. data, but also consider productivity trends of HQD;
- use the number of customers served by distributors as the scale variable (though other variables could be examined);
- exclude costs that are Y factored;
- consider a geometric decay capital cost specification, and possibly alternative specifications including one hoss shay;
- assemble solid evidence concerning the average service life of power distributor assets, and consider the sensitivity of productivity results to the service life assumption; and
- include a Kahn X factor exercise as a point of comparison.

## 5.3 Stretch Factor

We noted in Section 2 that the stretch factor term of an X factor should reflect an expectation of how the productivity growth of the subject utility will differ from the base productivity growth target. This depends in part on how the performance incentives generated by the plan compare to those in force for utilities in the productivity studies that are used to set the base productivity trend. It also depends on the company's operating efficiency at the start of the PBR plan. Statistical benchmarking should be considered as a means of setting stretch factors.

### Initial Operating Efficiency

Regarding HQD's operating efficiency, we note first that the Company has not previously operated under a comprehensive MRI. To the contrary, it has operated under frequent rate cases for many years, a system that typically yields week cost containment incentives. Growth in the Company's *revenu requis* for many *charges d'exploitation* has, however, been restricted by a *formule paramétrique* for several years.

In reaction to a marked increase in operating expenses, in 2007 the Régie directed HQD to present an integrated efficiency improvement plan in its next rate case that would control cost growth without compromising service quality or grid reliability.[52] Such a plan was approved in Décision D-2008-024, with the goal of reducing the net *charges d'exploitation* by $10 million on a recurring basis. This represented about 1% of controllable costs. In the same decision, the Régie adopted an ongoing efficiency target of 1% of the *charges d'exploitation*, and stated its expectation that HQD would maintain the average annual growth of a set of indicators below inflation over a moving five-year window going forward. In 2014 the Régie increased the efficiency target from 1% to 1.5%.[53]

The efficiency improvement plan was broadly conceived, and the actions taken were numerous. They can be divided roughly into actions taken by current management and those that are structural in nature. The former refers to minor adjustments to current practices, the implementation of which was

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[52] Décision D-2007-12.

[53] Décision D-2014-037, pg. 80.

to be the responsibility of HQD's various business units. The latter refers to more major changes, which often required significant up-front investment and were to be individually approved and monitored.

Growth in the Company's *charges d'exploitation* has been slow in recent years. However, it is difficult to ascertain how its current level of efficiency compares to industry norms. For years HQD has participated in benchmarking studies of its customer services and distribution costs.[54] The company reports simple unit cost metrics and its general position related to the other participants in a benchmarking study but does not generally provide further details, nor describe the characteristics of the firms to which its scores are compared.[55] Controls for external business conditions in these studies are crude. The company refused to provide details of a recent benchmarking study in response to an information request from PEG. Thus, it is difficult to interpret the benchmarking results or know what weight to assign to them. On the basis of available evidence, it is reasonable to assume that the Company is an average cost performer.

There is no credible argument for setting stretch factors at zero just because utilities have operated for a few years under a cap on the *revenu requis* for *charges d'exploitation*.

- The performance incentives generated by this cap are not likely to be strong enough to eliminate the accumulated inefficiencies of utilities.
- Even if incentives provided by this cap were much stronger, it is notable that companies in competitive markets have widely varying degrees of operating efficiency.
- Sophisticated benchmarking studies of total cost performance like those required in Ontario have not been reported.

[54] Décision D-2008-024, pp. 27-30.

[55] Under the Hydro-Québec Act (sections 7.2 and 20.1), the effectiveness and performance of the company must be assessed by an independent firm every three years, and the results of any such benchmarking studies must appear in the company's annual reports (e.g., Annual Report 2012, pg. 114; Annual Report 2015, pg. 99). Benchmarking results are also discussed periodically in the context of regulatory proceedings.

Comparison to Other Regulatory Systems

The MRI will have a term of only four years. An MTER will be included and will likely share all surplus earnings between the Company and its customers. Meanwhile, the investor-owned utilities whose data are likely to be used in the productivity research have typically averaged rate cases about every three years in recent years. There is therefore not a large difference in the incentive power of HQD's new regulatory system and the systems under which U.S. power distributors have typically operated. Stronger incentives can be hoped for in future MRIs.

Conclusions

Considering all of these factors, and precedents in other jurisdictions, we believe that a stretch factor of **0.20%** is reasonable for HQD.

# 6. Other Plan Provisions

## 6.1 Y Factor

### Régie Ruling

In D-2017-043, the Régie ruled that Y factor treatment should be permitted for costs that are recurrent but of unpredictable size, sensitive to events outside HQD's control, and in excess of a materiality threshold (*seuil de materialite*). Costs eligible for Y factor treatment shall include HQD's power purchase and transmission expenses and the impact of changes in market rates of return on the weighted average cost of capital (*cout moyen pondere du capital*). The Régie, suggested without rendering a final decision, that retirement costs would be addressed by the *formule d'indexation* but costs of *interventions en efficacite energetique* (*IEE*) would be Y factored. A $15 million materiality threshold was also suggested.[56] The Régie stated that each element of HQD's current variance and deferral accounts [*comptes d' ecarts et reports* (*CER*)] should be examined for eligibility for Y factor or Z factor treatment.

[56] Régie, op. cit., p. 76.

## HQD Comments

HQD favors Y factor treatment for its costs of retirement, fuels, *IEE* and support for *Transition energetique Québec* ("TEQ"), bad debt (*mauvaises creances*), low income programs (*strategie por la clientele a faible revenue*), and vegetation management (*maitrise de la vegetation*).

## PEG Response

Table 8 presents information on *charges d'exploitation* and accounts that are eligible for Y factoring in contemporary North American energy utility MRIs. It can be seen that diverse costs are typically accorded Y factor treatment. Costs that are commonly eligible for Y factoring include those for energy procurement, upstream transmission, and conservation. Some of the sampled utilities that do not Y factor costs of conservation programs do not have such programs.

PEG has a number of general concerns about the Y factoring of costs in an MRI. Y factoring can weaken incentives to contain the affected costs and raises the cost of regulation. Customers benefit when utilities absorb operating risk. On the other hand, some costs are difficult to address through a rate or revenue cap index because they are sensitive to volatile external business conditions or government directives. Y factoring can materially reduce operating risk.

PEG supports Y factoring all of HQD's costs for IEE and TEQ. These programs can produce material cost savings for HQD's customers. The MRI envisioned in D-2017-043 includes some incentives for the Company to embrace conservation and demand management. These incentives include the revenue cap and the capitalization of some IEE costs. They also include normalization of revenue for weather-induced load variances, since this reduces the risk to HQD from rate designs with high usage charges (including time sensitive rates) that encourage conservation and demand management. However, the incentive to contain load-related distribution capex is weakened in the contemplated MRI by the relatively brief four-year term of the plan, the lack of an efficiency carryover mechanism, the sharing of surplus earnings through the MTER, and the door (discussed further below) which has been opened for the Company to obtain supplemental capital revenue through the Z factor. HQD's incentive to use IEE to contain power supply costs and transmission capex is weakened by the tracking of these costs. Tracking all IEE and TEQ costs would encourage a better balance between Hydro-Québec's incentives to embrace conservation and demand management and its incentives for load-related

Table 8

# Approved Y Factors in Current North American MRIs

| Company | Jurisdiction | Plan Term | Eligible Costs and Accounts | Citation |
|---|---|---|---|---|
| Eversource Energy | Massachusetts | 2018-2023 | Not discussed in decision. Company currently has approved riders to address the costs of DSM programs, pensions, Attorney General Consulting Expenses, pensions and post-employment benefits, state funded renewable programs, solar program, and storm reserves. A Y factor to address the costs of an enhanced vegetation management pilot program was approved in this proceeding. | DPU 17-05 |
| All Distributors | Alberta | 2018-2022 | All costs that meet the AUC's Y factor criteria. To date, the following costs have been found to meet these criteria: AESO flow-through items<br>Farm transmission costs<br>Accounts that are a result of Commission directions (e.g., AUC assessment fees, intervener hearing costs, UCA assessment fees, AUC tariff billing and load settlement initiatives, Commission-directed Rural Electrification Associations (REA) acquisitions, effects of regulatory decisions)<br>Income tax impacts other than tax rate changes<br>Municipal fees<br>Load balancing deferral accounts<br>Weather deferral account (ATCO Gas only)<br>Production abandonment costs | Decision 20414-D01-2016 (Errata) |
| Ontario Power Generation | Ontario | 2017-2021 | Hydroelectric Water Conditions Variance Account<br>Ancillary Services Net Revenues Variance Account – Hydroelectric and Nuclear Sub-Accounts<br>Hydroelectric Incentive Mechanism Variance Account<br>Hydroelectric Surplus Baseload Generation Variance Account<br>Income and Other Taxes Variance Account<br>Capacity Refurbishment Variance Account<br>Pension and OPEB Cost Variance Account<br>Hydroelectric Deferral and Variance Over/Under Recovery Variance Account<br>Gross Revenue Charge Variance Account<br>Pension & OPEB Cash Payment Variance Account<br>Pension & OPEB Cash Versus Accrual Differential Deferral Account<br>Niagara Tunnel Project Pre-December 2008 Disallowance Variance Account | EB-2016-0152 |
| FortisBC | British Columbia | 2014-2019 | Numerous costs are Y factored including pensions and other post retirement benefits, regulatory hearing costs, accounting standards changes, on-bill financing, interim rate variance | Project #3698719, Decision; September 2014 |
| FortisBC Energy | British Columbia | 2014-2019 | Numerous costs are Y factored including overhead costs recovered from thermal energy customers, energy policy programs, pensions and other post-employment benefits, midstream gas costs, energy efficiency and conservation, biomethane program, hearing costs, on-bill financing, BCUC assessments, gains and losses on disposition or retirement of property | Project #3698715, Decision; September 2014 |
| Union Gas | Ontario | 2014-2018 | Upstream gas and transportation costs, incremental DSM costs, LRAM volume reductions for contract rate classes, Unaccounted for Gas Volume Variances, 50% share of tax changes | EB-2013-0202 |
| Incentive Regulation Mechanism Power Distributors except those who opt out | Ontario | 2014-2018 | **Group 1 includes accounts that do not require a prudence review. This group will include account balances that are cost pass-through and accounts whose original balances were approved by the Board in a previous proceeding.**<br>Low Voltage Account<br>Wholesale Market Service Charge Account<br>Retail Transmission Network Charges Account<br>Retail Transmission Connection Charge Account<br>Power Account<br>Global Adjustment Account<br>**Group 2 includes accounts that require a prudence review.**<br>Other Regulatory Assets - Sub-Account - Deferred IFRS Transition Costs<br>Other Regulatory Assets - Sub-Account - Incremental Capital Charges<br>Other Regulatory Assets - Sub-Account - Financial Assistance Payment and Recovery Variance - Ontario Clean Energy Benefit Act<br>Retail Cost Variance Account<br>Board-Approved Conservation and Demand Management Variance Account<br>Others | EB-2010-0239, Filing Requirements For Electricity Distribution Rate Applications (Group 1), EB-2008-0046 and 2018 DVA Continuity Schedule |

transmission and distribution capex. PEG also supports Y factoring costs of the *strategie pour la clientele a faible revenu.*

Y factoring retirement costs is a judgement call as there are arguments on both sides. Y factoring these costs can encourage HQD to shift employee compensation from salaries and wages to retirement benefits. Review of these costs can be challenging. On the other hand, these costs are substantial and variable due to business conditions beyond HQD's control. The labor price subindex of the inflation measure tracks trends in salaries and wages but not retirement costs. Retirement costs have been Y factored in several MRIs. The decision on whether to Y factor retirement costs should depend on the extent to which the MRI protects HQD from other kinds of risk.

PEG opposes Y factoring vegetation management, fuel, and bad debt costs. Vegetation management costs are a normal cost of doing business and are very much within a distributor's control. The performance incentive mechanism for reliability should encourage effective vegetation management. Vegetation management is rarely Y factored in MRIs for electric utilities.

Tracking the costs of fuel would weaken the Company's IEE incentives. Indexation of fuel prices is fairly straightforward. Power procurement costs are typically Y factored in MRIs but this is due in part to the difficulty of indexing them in an era of complicated managed power markets. Gasoline prices receive a substantial weight in $IPC^{Québec}$. The inflation measure could, alternatively, include one or more generation fuel price subindexes with appropriate cost share weights. In that event, PEG recommends using the GDPIPI for Canada as the inflation measure for "other" (e.g., capital) inputs.

Bad debt costs rise and fall with the economy but are fairly small. In Québec, the risk of bad debts is limited by the low cost of the patrimonial power block. These costs are not commonly subject to Y factor treatment even in jurisdictions where power supply costs are much more volatile.

The method for Y factoring change in the weighted average cost of capital is up for discussion in Phase 3. PEG believes that, over a plan of only four years, it is necessary to index only the bond yield to market trends. PEG also believes that only 50% of the change in the bond yield should be Y factored since changes in market rates of return on capital are reflected in the IPC in the long run.

## 6.2 Z Factor

## Régie Ruling

In D-2017-043, the Régie ruled that Z factor treatment should be permitted for *elements exogénes* which are particularly difficult to foresee, of unpredictable size, tied to events outside HQD's control, and in excess of a materiality threshold. The Régie also suggested that the Z factor could be used to obtain supplemental revenue for capital, stating that

> **La Régie ne croit donc pas nécessaire, ni souhaitable, d'inclure un mécanisme de suivi des dépenses en immobilisation. Cependant, et tel que le Distributeur le suggère dans son argumentation concernant l'inclusion de l'amortissement, si le Distributeur souhaite réaliser des investissements majeurs et d'une ampleur inhabituelle durant le MRI, il lui sera possible de demander à la Régie de traiter de tels investissements comme un exogène, de type Facteur Z.**[57]

## HQD Comments

In its submission last July, Hydro-Québec recommended Z factoring unforeseeable events in the *reseaux autonomes,* unfunded costs of major outages (*pannes majeures*), contributions to connections, and miscellaneous other events including changes in the regulatory regime, demands flowing from decrees or changes in laws, and unforeseen major projects.

## PEG Response

PEG supports allowing HQD to request Z factor treatment of unforeseeable events in the *reseaux autonomes*, unfunded costs of major outages (*pannes majeures*) that are attributable to external events, contributions to connections, the *tarif de maintien de la charge*, changes in accounting standards, and miscellaneous other events that include changes in the regulatory regime and demands flowing from decrees or changes in laws. However, PEG is very concerned about the Z factor "loophole" that the Régie has created for supplemental capital revenue. Z factors by their nature provide supplemental revenue for capex resulting from difficult to forecast events such as major storms. The protection afforded by Z factors can be broadened by expanding the eligibility criteria to generally include projects that are mandated for various reasons (e.g., highway relocations) by government agencies. The G factor reduces the risk of unexpectedly rapid growth in the demand for distribution

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[57] D-2017-043 p. 64.

services. The term of the MRI is only four years, and underfunding in the last plan years is less problematic. Y factoring changes in the weighted average cost of capital further reduces capital cost risk.

To permit supplemental revenue for other kinds of capex surges opens the door to the several problems that PEG discussed in its Phase I report and responses to information requests. For example, HQD will be incentivized to exaggerate its capital spending requirements and to “bunch” its capex so that it qualifies for tracker treatment. The Company may receive dollar for dollar compensation for capital spending shortfalls when business conditions are unfavorable but receive the full revenue that indexing provides when business conditions are favorable. Customers are not then guaranteed the benefit of industry productivity growth even when it is achievable.

A mechanism for providing supplemental capital revenue such as the Incremental Capital Module in Ontario involves major design challenges and can have unforeseen consequences. In Alberta, a lengthy proceeding was devoted to finalization of capital cost trackers after the outlines of the first-generation MRI were approved. The tracker mechanism ultimately chosen was much more generous to utilities than originally envisioned, and was aggressively used by utilities during the MRI. The scope of capital cost tracking was substantially narrowed by the Commission in the next MRI.

The report and responses to information requests prepared by PEG in Phase 1 provide the Régie with several ideas to make provisions for supplemental capital revenue more reasonable. These include a substantial materiality threshold and the continued tracking of capital costs accorded tracking treatment in subsequent plans. There is currently a 10% adder to the materiality threshold in Ontario's Incremental Capital Module. The X factor can be raised to account for the fact that some large capital projects get Z factor treatment. PEG has addressed the size of X factor adjutments that might be needed in other proceedings.

## 6.3 Materiality Thresholds

### Régie Ruling

In D-2017-043, the Régie suggested $15 million materiality thresholds for Y factors and Z factor events.

### PEG Response

Materiality thresholds have several advantages in a system of cost trackers. They can reduce regulatory costs and strengthen a utility's incentive to contain costs. Thresholds can also reduce overcompensation for events (e.g., highway relocations and severe storms) that are routinely encountered by utilities in the productivity growth sample.

Table 9 presents information on materiality thresholds in contemporary MRIs for the Régie's perusal. It can be seen that Z factors are more typically subject to materiality thresholds in the surveyed plans than Y factors. Materiality thresholds are more common for capital cost trackers and are sometimes substantial. It should also be noted that incentivization of cost trackers by limiting the full true up of revenue requirements to actual costs also occurs in North American regulatory systems that do not feature MRIs.[58]

PEG believes that $15 million thresholds are reasonable for a Company of HQD's size. These should apply on a per event basis to Z factors. The first $15 million of variances between Y factored costs and the corresponding revenue requirements should be non-recoverable each year. The thresholds should be escalated annually by the revenue cap index.

## 6.4 Metrics

### Régie Ruling

In D-2017-043, the Régie ruled that the MTER would be linked to an array of service quality and safety metrics.

### PEG Response

PEG recommended a performance metric system for HQD in its Phase I report. There should at a minimum be performance incentive mechanisms for the system average interruption duration index, the system average interruption frequency index, various aspects of customer service, and worker safety. There should also be PIMs for analogous itemized reliability indexes for sensible regions of

[58] Cost trackers are widely used in U.S. regulation today.

Table 9

## Materiality Thresholds for Y and Z Factors

| Company | Jurisdiction | Plan Term | Y Factor Materiality Threshold | Z Factor Materiality Threshold | Citation |
|---|---|---|---|---|---|
| Eversource Energy | Massachusetts | 2018-2023 | Some Y Factors (e.g., $1.2 million per event for the storm fund) have a materiality threshold | $5 million escalated by GDPPI for each year of the plan for each Z factor event | DPU 17-05 |
| All Alberta Distributors | Alberta | 2018-2022 | Common threshold for Y factor and Z factors: Dollar value of a 40 basis point change in ROE on an after-tax basis calculated on the distribution utility's equity used to determine the final approved notional revenue requirement on which going-in rates were established (2017). This dollar amount threshold is to be escalated by I-X annually. Z factor materiality is determined on a per event basis. | | Decision 20414-D01-2016 (Errata) |
| Ontario Power Generation | Ontario | 2017-2021 | O&M materiality threshold not discussed in decision, separate capital materiality threshold established | $10 million | EB-2016-0152 |
| Enmax | Alberta | 2015-2017 | O&M materiality threshold not discussed in decision, separate capital materiality threshold established | $1.7 million per event per year | Decision 21149-D01-2016 (Errata) |
| FortisBC | British Columbia | 2014-2019 | O&M materiality threshold not discussed in decision, separate capital materiality threshold established | 0.5% of 2013 Base O&M Expense, approximately $300,000 per Z factor event | Project #3698719 |
| FortisBC Energy | British Columbia | 2014-2019 | O&M materiality threshold not discussed in decision, separate capital materiality threshold established | 0.5% of 2013 Base O&M Expense, approximately $1.15 million per Z factor event | Project #3698715 |
| Union Gas | Ontario | 2014-2018 | O&M materiality threshold not discussed in decision, $5 million revenue requirement impact for capital projects | $ 4 million per Z factor event | EB-2013-0202 |
| Incentive regulation mechanism power distributors except those who opt out | Ontario | 2014-2018 | O&M materiality threshold not discussed in decision, separate capital materiality threshold established | Per Z factor event: Utility with Revenue Requirement less than or equal to $10 million: $50,000 Utility with Revenue Requirement between $10 and $200 million: 0.5% of distribution revenue requirement Utility with Revenue Requirement above $200 million: $1 million | EB-2010-0379 |

Québec such as urban and rural areas. IEEE standard 1366 should be used to calculate reliability metrics in order to enhance the comparability of reliability metrics to those of other utilities. HQD already has several customer service quality metrics.

PEG also recommends that some additional metrics be monitored. These metrics include a momentary average interruption frequency index and metrics addressing worst performing circuits. Metrics addressing the quality of service to distributed generation customers are increasingly popular in the United States.

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