



**2018-2022 Performance-Based Regulation Plans
for Alberta Electric and Gas Distribution Utilities**

December 16, 2016

Alberta Utilities Commission

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

Proceeding 20414

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each of 2018 and 2019.⁸² This will avoid making additional going-in rates adjustments for 2018 and 2019 and clearly identify the ECM amount to be collected.

5 Productivity offset (X factor)

5.1 Setting the X factor

86. In its past decisions dealing with prior generations of PBR plans, the Commission expressed its preference for an approach to setting the X factor that is based on the average rate of long-term productivity growth in the industry.⁸³ The X factor, combined with the I factor, is designed to create incentives similar to those in competitive markets.

87. The first step in determining the X factor is to examine the underlying industry TFP growth over time, commonly determined by measuring TFP growth. The TFP growth value percentage result may then be supplemented by adjustments applicable to the utilities subject to the PBR plans, for example, a stretch factor, to arrive at a final X factor.⁸⁴ Reflecting the above approach, in Decision 2012-237, the X factor of 1.16 per cent was determined as the sum of the underlying long-term industry TFP growth value of 0.96 per cent and a stretch factor of 0.2 per cent.⁸⁵

88. Determination of the X factor in the next generation PBR term was the second item on the final issues list established by the Commission for the current proceeding. Although the Commission decided not to sponsor a new TFP growth study, parties were free to address all aspects of the X factor for the next generation PBR plans.⁸⁶

89. All parties to this proceeding generally agreed that, for the next generation PBR term, the X factor should be determined in the same way as previously; that is, a component based on industry TFP growth and a stretch factor. However, parties disagreed on the details of how TFP growth should be calculated, and limitations on its range, and also on the value of the stretch factor, if any, as discussed in the sections of this decision that follow. Specifically, Section 5.2 discusses the TFP growth studies, including a discussion of assumptions. The use and size of a stretch factor is discussed in Section 5.3. Section 5.4 addresses the Commission's determination on the X factor for the next generation PBR plans, and Section 5.5 addresses the X factor for ENMAX's 2015-2017 PBR plan. Finally, Section 5.6 discusses the proposals for a non-negative I-X provision.

5.2 Revised TFP growth studies

90. In Proceeding 566 leading to Decision 2012-237, the Commission engaged National Economic Research Associates (NERA) to conduct a TFP growth study. NERA's study involved analysis of the distribution component of 72 U.S. electric and combination of electric/gas utilities over the period from 1972 to 2009. Although NERA's was not the only TFP growth study

⁸² Exhibit 20414-X0616, AltaGas argument, paragraph 99; Exhibit 20414-X0622, ATCO utilities argument, paragraph 59; Exhibit 20414-X0624, Fortis argument, paragraph 51; Transcript, Volume 14, page 2965, lines 10-21 (Mr. Zurek).

⁸³ Decision 2009-035, paragraph 176; Decision 2012-237, paragraphs 277 and 288.

⁸⁴ Decision 2012-237, paragraph 279.

⁸⁵ Decision 2012-237, paragraphs 514-515.

⁸⁶ Exhibit 20414-X0026, AUC letter – Final issues list, August 21, 2015, paragraph 34.

considered in that proceeding, the Commission found the NERA study to be preferable because of the “objectivity and transparency of the data and of the methodology used, the use of data over the longest time period available and the broad based inclusion of electric distribution utilities from the United States.”⁸⁷ The final approved TFP growth value of 0.96 per cent, determined as the difference between growth in output and growth in inputs, was obtained as the average of 37 annual TFP growth values for the 1972-2009 period, where each annual value comprised a weighted average of TFP growth values for the 72 individual firms for that year, with weights based on relative firm size in terms of sales volume in megawatt hours (MWh), where these sales were also used as the output measure for the distribution utilities.

91. Three TFP growth studies were provided in this proceeding: (i) a study undertaken by Dr. Brown and Dr. Carpenter of Brattle for the distribution utilities other than EPCOR (Brattle study),⁸⁸ (ii) a study undertaken by Dr. Meitzen of Christensen Associates for EPCOR (Meitzen study),⁸⁹ and (iii) a study undertaken by Dr. Lowry of PEG for the CCA (Lowry study).⁹⁰ Dr. Pavlovic et al. of PCMG filed reply evidence for the UCA, where they criticized a number of aspects of the NERA TFP methodology used in the Brattle and Meitzen studies but did not provide a TFP growth recommendation.⁹¹

92. Both Brattle and Dr. Meitzen described their approach as extending or updating the NERA study analysis for five more years, 2010 to 2014.⁹² Both the Brattle study and the Meitzen study updated the NERA study by including data from 2010-2014 period and also made certain refinements to the NERA study. In contrast, the Lowry study “uses alternative methods and is more customized to special operating conditions in Alberta.”⁹³ Although the Lowry study relied on the same general index approach used by NERA for calculating the TFP growth number,⁹⁴ there were a number of important differences in approach. Among other differences, the Lowry study used a different output measure (number of customers instead of MWh volumes), a shorter data period (1997-2014), a different and larger set of firms (88 instead of the 72 in the NERA study, although the Lowry study also considers smaller subsets of the 88 firms), a different method for aggregating across firms (unweighted instead of weighted), output data combined from two sources (FERC Form 1, as used in the NERA, Brattle and Meitzen studies, and EIA Form 861),⁹⁵ and some different assumptions underlying the determination of the input growth index. In addition, the Lowry study was produced using computer code and proprietary computer software rather than spreadsheets as used in the NERA, Brattle and Meitzen studies.

93. A summary of the TFP growth findings, including recommendations, from the three studies filed in this proceeding, as well as from the NERA study filed in the PBR Proceeding 566 (NERA 2012), are shown in Table 1. In each case, the TFP growth values are averages of all the annual values in the specified time period, although for the Meitzen study, the recommendation

⁸⁷ Decision 2012-237, paragraph 411.

⁸⁸ Exhibit 20414-X0056, Brattle evidence, Section III, pages 23-38.

⁸⁹ Exhibit 20414-X0074, Appendix B, EPCOR evidence of Dr. Meitzen, PDF pages 185-244.

⁹⁰ Exhibit 20414-X0082, CCA evidence of Dr. Lowry, Section 4, pages 42-73.

⁹¹ Exhibit 20414-X0403, UCA reply evidence of K. Pavlovic, M. Griffing and D. Mugrace.

⁹² Exhibit 20414-X0056, PDF pages 27-28 (Brattle), and Exhibit 20414-X0074, PDF pages 202-204 (Meitzen).

⁹³ Exhibit 20414-X0082, page 57.

⁹⁴ The Lowry study refers to multifactor productivity (MFP) rather than TFP, to reflect the use of multiple inputs, but this is principally an issue of nomenclature.

⁹⁵ Specific data sources are U.S. Federal Energy Regulatory Commission (FERC), Form 1: Electric Utility Annual Report, and U.S. Energy Information Administration (EIA), Form 861: Electric power sales, revenue, and energy efficiency.

is to use the average of two averages, one based on all the annual values in the last 15 years and one based on all the annual values in the last 10 years. As this table shows, the Brattle and Meitzen studies yield similar TFP growth value estimates, with differences mainly attributable to the different data periods used.⁹⁶ The table also shows there is a considerable difference in TFP growth calculated in the Lowry study when compared to the results of the Brattle and Meitzen studies. Similarly, TFP growth is almost twice as large in the Lowry sample when a smaller selected sample of the 88 firms is used in the calculation when compared to the full sample. This sample size issue is addressed in Section 5.2.2 below. Finally, differences between initial and final TFP growth calculations reflect corrections made in reply evidence as the result of self-identified errors and/or accepted improvements suggested by other parties.

Table 1. TFP growth study findings

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

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

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

94. The three studies filed in this proceeding provide a relatively wide range of TFP growth values, with all final recommendations smaller than, and in some cases much smaller than, the TFP growth number adopted by the Commission in Decision 2012-237. The issue that the Commission must address, therefore, assuming the Commission finds any of the studies to be acceptable, is not whether the TFP growth component of 0.96 per cent adopted in Decision 2012-237, needs to be lowered for the next generation PBR plans, but rather the extent to which it needs to be lowered. In order to address this issue, the Commission must evaluate the applicability of the various TFP growth values provided by the expert evidence in this proceeding. The Commission's considerations are provided in the following sections 5.2.1 to 5.2.5. Specifically, Section 5.2.1 deals with the objectivity, consistency and transparency of the three studies in this proceeding. Section 5.2.2 focuses on which firms were included in the studies. Section 5.2.3 addresses differences in study calculation methods and assumptions pertaining primarily to growth of inputs. Section 5.2.4 deals with the output measures. Finally, time period considerations are set out in Section 5.2.5.

5.2.1 Objectivity, consistency and transparency of TFP growth studies

95. This section focuses on some of the elements of TFP growth studies that were considered to be of importance in Decision 2012-237. They include objectivity, consistency and

⁹⁶ For example, as per Exhibit 20414-X0256: EDTI-AUC-2016APR15-010, PDF page 41, the Meitzen study growth estimate for the same 67 firms as in the Brattle study sample, using just the last 15 years (2000-2014), is -0.81 per cent.

transparency.⁹⁷ Satisfaction of these conditions by any particular study does not contribute to a determination of the magnitude of an X value, but it does help the Commission decide if the numbers from that study are even worthy of consideration given the regulatory context in which they are presented. In Decision 2012-237, the NERA study was found to satisfy these requirements,⁹⁸ and since the Brattle and Meitzen studies in the current proceeding use the same methodology but update the NERA analysis to include additional years of data from the same publically available data sources, they also satisfy them.

96. The distribution utilities submitted that caution should be exercised when relying on the results of the Lowry study because of the same lack of objectivity, consistency and transparency that the Commission identified with respect to his work in Decision 2012-237.⁹⁹ Specifically, while the Lowry study in this proceeding relied on publicly available data, the distribution utilities stated that these TFP results were obtained using a software package that is not widely used, rather than spreadsheets, and that the underlying calculations and assumptions were not documented or clearly explained.¹⁰⁰ The distribution utilities also expressed concerns with the potential lack of objectivity and consistency in the Lowry study, based on their observation that “PEG’s TFP results vary considerably from study to study, even though the input data and the study time period were exactly the same.”¹⁰¹

97. Dr. Lowry responded that the employed software is used “for all of our [PEG’s] projects since the inception of the company” and is available for purchase.¹⁰² Dr. Lowry defended performing the TFP growth calculation using computer code because it is “easier to review and validate than the array of spreadsheets.”¹⁰³ Dr. Lowry also expressed his view that he provided at least the same level of information, if not more, as NERA in the last proceeding and experts replicating NERA’s study in this proceeding.¹⁰⁴ Further, the CCA submitted that additional information or explanation was available should it be needed and requested.

98. The Commission does not view the use of computer code and proprietary software in and of itself as limiting the transparency of a study, particularly if the analysis can be reproduced in a spreadsheet format with intact formulas and assumptions provided. In the future, the Commission would prefer such analysis to also be reproduced using spreadsheets when, as in this situation, it is possible to do so.¹⁰⁵ The Commission considers that the present proceeding provided sufficient opportunity for all parties, and the Commission, to explore the basis of Dr. Lowry’s calculations and assumptions that were put forward in his direct evidence through IRs and cross-examination.

⁹⁷ Decision 2012-237, paragraph 353.

⁹⁸ Decision 2012-237, paragraph 353.

⁹⁹ Decision 2012-237, paragraph 364.

¹⁰⁰ Exhibit 20414-X0619, ENMAX argument, paragraphs 47-50; Exhibit 20414-X0623, EPCOR argument, paragraphs 71-73.

¹⁰¹ Exhibit 20414-X0634, ENMAX reply argument, paragraph 23; Exhibit 20414-X0635, EPCOR reply argument, paragraph 33. The other studies referred to were provided in other proceedings and/or jurisdictions.

¹⁰² Transcript, Volume 12, page 2422, lines 2-3 (Dr. Lowry) and Exhibit 20414-X0203 CCA-EDTI-2016APR15-001(s).

¹⁰³ Exhibit 20414-X0203 CCA-EDTI-2016APR15-001(t).

¹⁰⁴ Transcript, Volume 12, pages 2425-2426 (Dr. Lowry).

¹⁰⁵ The PEG study data were provided in spreadsheet form in Exhibit 20414-X0100, with variable definitions in Exhibit 20414-X0106. These data were used by Dr. Meitzen in an attempt to reproduce the PEG study results using a spreadsheet in Exhibit 20414-X0417. The replication results obtained by Dr. Meitzen, for input, output, and TFP (MFP) growth, are almost identical to those in Table 5a of the PEG study, Exhibit 20414-X0082, page 64.

99. An additional issue considered by the Commission was the “customization” undertaken in the Lowry study. The CCA stated that “Dr. Lowry customizes his results to the application,” which, in the CCA’s view, “enhances the methodology.”¹⁰⁶ Customization of TFP growth studies introduces a level of subjectivity that may obscure the objectivity and transparency of the TFP growth value that would result without the customization, unless the results are provided both with and without any added customizations. The Lowry study provided TFP growth results, as well as the input and output growth components of TFP growth, for each sample year, for both the full sample of 88 firms and for specific customized subsamples. Consequently, for the purposes of the present proceeding, the Commission will not reject, or attach less weight to, the Lowry study presented in his primary evidence on the grounds of lack of objectivity, consistency, and/or transparency.

5.2.2 Sample of comparative firms in the TFP growth study

100. This section focuses on the particular firms included in the various TFP growth studies. One issue here pertains to input data modifications arising from firm mergers, asset transfers, etc., while another concerns whether analysis that utilizes data from a subset of the available firms, rather than from all available firms, should be afforded lesser, equal, or preferential treatment. As shown in Table 1, TFP growth values from analysis that utilizes subsets of firms selected in the Lowry study are much higher than TFP growth values in the same study that utilizes all firms. Consequently, determination of this issue concerning subsets of firms may affect the range of possible values that the Commission considers for the TFP growth component of the X factor.

101. The NERA study in the PBR Proceeding 566 included 72 firms for which data were available for the full sample period from 1972 to 2009, with certain data series for capital additions and retirements reaching back to 1964. The Brattle study updated the NERA study to 2014; however, in doing so, it discarded the 2010-2014 data for five firms due to issues with missing or inconsistent data; for example, due to mergers.¹⁰⁷ In updating the NERA study, the Meitzen study did not check for inconsistent data,¹⁰⁸ and discarded four utilities for years 2010-2014 for which data were unavailable.¹⁰⁹

102. While both Brattle and Dr. Meitzen excluded data for years 2010-2014 for the discarded utilities, they retained these data in the 1972-2009 calculation, resulting in an unbalanced panel (i.e., a different number of utilities, between 67 and 72, was used in the calculation in different years). In its reply evidence update, Brattle excluded the five utilities for all of the sample years; this did not have a significant effect on the resulting TFP growth value. Dr. Meitzen retained his original recommendation. However, in response to Commission IRs and follow-up calculations, some of Dr. Meitzen’s calculations were undertaken using the 67 firms in the Brattle sample. As shown in this response, using an unbalanced panel in Dr. Meitzen’s case did not appear to have a significant effect on the resulting TFP growth calculation.¹¹⁰

103. In the case of the NERA study and, therefore, the Brattle and Meitzen studies, as well as the Lowry study, their respective samples included all firms for which data of sufficient quality

¹⁰⁶ Exhibit 20414-X0630, CCA revised argument, paragraph 197.

¹⁰⁷ Exhibit 20414-X0056, Brattle evidence, page 26, Q/A 52.

¹⁰⁸ Transcript, Volume 13, pages 2646-2647 (Dr. Meitzen).

¹⁰⁹ Exhibit 20414-X0074, Appendix B, EPCOR evidence of Dr. Meitzen, paragraph 36.

¹¹⁰ Exhibit 20414-X0256, EDTI-AUC-2016APR15-010(a).

were available.¹¹¹ With regard to the input measure, Dr. Lowry indicated that NERA and, therefore, the Brattle and Meitzen studies, did not account for cost transfers due to mergers, divestitures, or transfers of assets between transmission and distribution. These input data changes affected some dozen firms.¹¹² However, Brattle indicated that, after accounting for these data changes, the results were within 0.1 percentage points of the original value for both the Brattle and Lowry studies.¹¹³

104. Consistent with the findings in Section 5.2.4, which deals with the output measure, the Commission is of the view that while modification (correction, patching, or deletion) of particular components of input data series can be useful in certain circumstances, the procedures and the criteria used to determine such modifications, and when and where they are to be applied, needs to be documented carefully, with supporting reasoning. A lack of such detailed documentation and support must be taken into consideration when evaluating analysis that relies on these data, in exactly the same way that would apply to evaluating analysis that utilizes raw (unverified) data that has not been examined, and if necessary adjusted, with reasoning and documentation provided, for the presence of anomalies. In the present circumstances, since the effect of the modifications is minimal, the Commission will not weight the studies differently due to the use or non-use of these input data modifications.

105. The Lowry study includes 88 firms in the full sample, and smaller subsets of these firms in some additional TFP growth calculations. The CCA contended that because the Lowry 88 firm study “involves a substantially larger sample of utilities than the Brattle or Meitzen studies,” it may be viewed as better representing the power distribution industry.¹¹⁴ However, the Lowry study data only extends from 1997, and it is unclear whether all 88 firms could have been included in this study if the longer data period available in the NERA, Brattle and Meitzen studies had been included. On this basis, the Commission does not attribute less weight to the Meitzen and Brattle studies due to their smaller sample sizes.

106. The Lowry study considers several subsets of the 88 firms in the full sample, on the basis that these are likely to be more representative of conditions faced in Alberta. Specifically, the “rapid-growth” subsample comprises those 21 utilities “which experienced customer growth during the full sample period which was similar to the brisk growth which Alberta distributors are likely to experience during the indexing years of the next generation PBR plans,”¹¹⁵ while the “Mountain West” subsample is similar to Alberta geographically, comprising “ten utilities with service territories in the Pacific Northwest and intermountain West.”¹¹⁶

107. In their evidence for the UCA, Dr. Pavlovic et al. expressed their view that the “actual range of possible productivity improvements for electric utilities, however, are in fact restricted by the specific circumstances of electric utilities – geography, meteorology, organizational structure, and regulatory scrutiny.” Therefore, consistent with the Lowry study approach, the UCA witnesses advocated looking “at the results for subsets of the entire population for evidence

¹¹¹ Decision 2012-237, paragraph 322; Exhibit 20414-X0056, Brattle evidence, page 26, Q/A 52; Exhibit 20414-X0074, Appendix B, EPCOR evidence of Dr. Meitzen, paragraph 36; Exhibit 20414-X0082, CCA evidence of Dr. Lowry, page 59.

¹¹² Exhibit 20414-X0468, PEG reply evidence for the CCA, pages 8-11.

¹¹³ Exhibit 20414-X0387, Brattle reply evidence, Table 6 on 36.

¹¹⁴ Exhibit 20414-X0630, CCA revised argument, paragraph 160.

¹¹⁵ Exhibit 20414-X0082, PDF page 70.

¹¹⁶ Exhibit 20414-X0082, PDF page 71.

that individual differences in circumstances actually affect productivity in either the short- or the long-term.”¹¹⁷

108. In the judgement of the Commission, the issue of whether the TFP growth value should be determined based on a customization or tailoring of firms selected to be included within the TFP growth study based on characteristics similar to the Alberta distribution utilities is directly related to the underlying objectives of a PBR plan.

109. In Proceeding 566, the Commission determined that a key reason for implementing PBR for the distribution utilities in Alberta was a desire to ensure that the decision making and outcomes achieved by regulated distribution utilities emulated, to the extent possible, the decision making and outcomes that would have arisen had decision makers in those firms been subject to the incentives found in competitive markets.

110. Dr. Lowry, in his evidence, indicated that productivity trends are influenced by such things as business conditions that “may be unusual in Alberta ...”¹¹⁸

111. Commission counsel, Ms. Wall, then explored other differences that could affect TFP growth, in this case between Alberta and U.S. utilities:¹¹⁹

Q. Okay. Now, I think you would agree there's many possible differences between Alberta and the utilities in the US sample; right? It could be size, service territory, customer density, peak demands, climate, average asset age, all kinds of things; right?

A. Yes.

112. The Commission considers that this answer is not restricted to utilities on different sides of the border. It would apply equally to a comparison of individual Alberta utilities, and indeed to a comparison of individual U.S. utilities.

113. In Dr. Meitzen’s view, Dr. Lowry’s approach used in his subset analysis was akin to “cherry-picking,” which he did not support.¹²⁰ Brattle also did not support this approach, commenting as follows:¹²¹

There are many ways in which one utility may differ from another (for example, service territory size, customer density, customers per line mile, peak demand, average load factor, penetration of distributed solar photovoltaic, various dimensions of climate, average asset age and so on). In our view it is not possible to disentangle the parameters which may be relevant for determining the scope for productivity improvement from those which are not relevant.

114. Based on this evidence, the Commission considers that, in general, it is likely that in competitive markets, there is a variety of factors that influence the ability of firms operating in that market to achieve TFP gains. Since the design of the PBR plan for Alberta is meant to emulate these aspects of competitive markets, this suggests that it is preferable to use broad samples that will embody variation in more of the characteristics that influence productivity, as

¹¹⁷ Exhibit 20414-X0403, UCA reply evidence of Dr. Pavlovic et al., page 10, Q/A 24.

¹¹⁸ Exhibit 20414-X0468, CCA reply evidence of Dr. Lowry, page 35.

¹¹⁹ Transcript, Volume 12, page 2359, line 21 to page 2360, line 1 (Dr. Lowry).

¹²⁰ Exhibit 20414-X0412, EPCOR reply evidence of Dr. Meitzen, pages 18-19, Q/A 25.

¹²¹ Exhibit 20414-X0387, Brattle reply evidence, page 29, Q/A 60.

would be found in a competitive market. Accordingly, although the Commission considers that subsamples selected on a single criterion can provide useful information, analysis using the full sample, or possibly subsamples selected on multiple criteria, will better inform the Commission's judgement as to the possible range of TFP growth values that are reflective of competitive markets. For this reason, although the Commission will refer to the subset analysis as indicative of possible difficulties in the measurement of TFP growth, subsequent attention to the Lowry study is limited to its TFP growth findings for its full sample of 88 firms.¹²²

115. This decision, to focus on the Lowry study's full sample rather than results for various subsamples, informs the Commission's decision making concerning the extent to which the TFP growth component of the current X factor, 0.96 per cent, needs to be reduced for the next generation PBR plans. As shown in Table 1, the highest TFP growth values were obtained from the Lowry study subsample, so that focusing on the full sample in the Lowry study suggests a downward adjustment to the TFP growth component compared to its previous value. Of course, as discussed in the following sections, there is considerable variability associated with this TFP growth component, due to the different assumptions that are made, and accounting for this variability means that this TFP growth component is not necessarily prevented from exceeding the highest remaining recommendation (Table 1) of +0.43.

5.2.3 Assumptions pertaining to measuring input growth and study calculation methods

116. This section considers the different assumptions underlying the determination of input growth in the various TFP growth studies, as well as differences in calculation methods, and their effect on the resulting TFP growth values. Consideration of these issues helps inform the Commission about the range of reasonable values that the TFP growth component of the X factor and how sensitive this range is to variations arising from the assumptions employed.

117. Both Dr. Meitzen's and Brattle's studies adopted the NERA methods to calculate TFP growth. As well, those studies relied on NERA's assumptions pertaining to measuring input growth, with one main correction identified by Dr. Meitzen that relates to the measurement of labour input.¹²³ Dr. Lowry took issue with the assumptions used by NERA, and in his study used different calculation methods as well as different input growth assumptions.

118. More specifically, the differences in the calculation methods pertained to the use of the chain-weighted index in the Lowry study, while the NERA-based studies relied on the multilateral index.¹²⁴ As well, NERA's TFP calculations put more weight on larger utilities, whereas the Lowry study averages growth rates across firms in any year, thereby weighting firms equally. The assumptions pertaining to measuring input growth included among others, the depreciation method (one hoss shay, geometric decay or a straight line method), the use of net rather than gross plant in the benchmark year of the TFP growth study, the asset service life, and the choice of price indexes used in calculating such input quantities as labour, materials and

¹²² In some subsequent analysis, attention is focused on utilities that are common to both the Lowry, Brattle and Meitzen studies, but unlike the Lowry study subsamples, this selection is not based on the utilities all satisfying a particular criterion pertaining to one of their characteristics.

¹²³ Exhibit 20414-X0074, Appendix B, EPCOR evidence of Dr. Meitzen, paragraph 39. In its reply evidence, Exhibit 20414-X0387, page 19, Q/A 39, Brattle has adopted this correction.

¹²⁴ See Transcript Volume 11, pages 2280-2281 (Dr. Lowry), and Volume 13, pages 2648-2649 (Dr. Meitzen), for a discussion of the differences between and applicability of these two types of indexes, as well as the conclusion that, in the studies in evidence here, the choice had very little effect on the results.

services. In addition, while NERA-based studies include only costs labelled as “distribution” in FERC Form 1 accounts, the Lowry study includes a wider range of cost categories by allocating some expenses and wages related to customer accounts, administrative and general, and some general plant.

119. These issues were for the most part, debated in the PBR Proceeding 566 and in Decision 2012-237, the Commission noted that “Some of these issues reflect an ongoing academic debate on which consensus has not been reached, or for which there is no right or wrong answer.”¹²⁵ As a result, and contrary to EPCOR’s view in this proceeding,¹²⁶ in Decision 2012-237, the Commission did not explicitly reject the different assumptions used by different parties. Along the same vein, Drs. Brown and Carpenter were generally neutral about the particular assumptions that were adopted, referring to the debate about the various methodologies as being “within the range of statistical precision of a TFP study,”¹²⁷ whereas Dr. Meitzen¹²⁸ and Dr. Lowry¹²⁹ were more adamant that the assumptions each of them had adopted were to be preferred.

120. In the Commission’s view, there is no overwhelming new evidence in this proceeding that any of these particular assumptions are correct or incorrect. The assumptions chosen reflect the practitioner’s decisions and beliefs based on the available choices that can be applied to the data, and there is generally no test presented in evidence that can be applied to determine which assumptions are more applicable to particular data or the purposes for which it is used. It is unlikely that any group of unassociated practitioners will make the same choices for all the assumptions, even with the same universe of data series available to them.¹³⁰ For this aspect of the analysis, the Commission is, therefore, unwilling to specify a preference for the set of assumptions used by any particular one of the three TFP growth studies.

121. Nevertheless, the studies provide the Commission with important information about the sensitivity of the TFP growth measures to combinations of input measurement assumptions used in the different studies. For example, the Lowry study notes that Alberta power distributors are small by U.S. standards, and for this reason contends that calculating industry TFP growth as a simple average across all firms rather than a weighted average (using firm’s share of total volume in the year in question, as is done in NERA-based studies) is more relevant.¹³¹ However, in his testimony Dr. Lowry noted that it would not affect the results greatly.¹³² In testimony, Dr. Brown stated that either the weighted or unweighted index can be meaningful.¹³³ Using the same 53 firms that are common to both the Brattle and Lowry studies, weighted versus unweighted output growth (volume) changed from 0.87 to 0.72 per cent for 1997-2014, and from 0.64 to 0.47 per cent for 2000-2014, indicating a drop of between 0.15 and 0.17 percentage

¹²⁵ Decision 2012-237, paragraph 413.

¹²⁶ In its argument, Exhibit 20414-X0623, at paragraph 77, pages 29-31, and especially at footnotes 179 and 195, EPCOR interpreted that paragraph 413 of Decision 2012-237 constitutes a rejection of similar assumptions by Dr. Lowry in Proceeding 566.

¹²⁷ Transcript, Volume 1, page 167, lines 13-14, following the discussion on pages 161-167. (Drs. Carpenter and Brown).

¹²⁸ Transcript, Volume 14, page 2792, line 13 to page 2793 line 4 (Dr. Meitzen).

¹²⁹ PEG, in its reply evidence, Exhibit 20414-X0468, classified NERA’s choice of assumptions as either “serious,” “obvious methodological and data errors” (page 4), or “substandard practices” (page 17).

¹³⁰ Other practitioners may also make different choices for assumptions other than those that were raised here, including aspects of sample design.

¹³¹ Exhibit 20414-X0468, PDF page 35.

¹³² Transcript, Volume 11, pages 2282-2284 (Dr. Lowry).

¹³³ Transcript, Volume 2, pages 342-345 (Dr. Brown).

points.¹³⁴ For inputs, removing the unequal weighting for these same 53 firms changed input growth from 1.31 to 1.22 per cent for 1997-2014, a drop of 0.09 percentage points, and from 1.36 to 1.33 per cent for the years 2000 to 2014, a drop of 0.03 percentage points.¹³⁵

122. By way of another example, based on the evidence in this proceeding, the inclusion of some of the shared costs not labelled as “distribution” in FERC Form 1 in the TFP growth calculation remains a contested issue, and depends on the practitioner’s decisions and beliefs. While Dr. Lowry for the CCA, and Dr. Pavlovic for the UCA, advocated including these costs using what they considered to be adequate allocation methodologies,¹³⁶ Brattle and Dr. Meitzen argued against such a procedure because there is no unique or universally accepted method to allocate joint and common costs and, therefore, the “judgement inherent in allocating common costs can invite controversy.”¹³⁷ In addition, Dr. Meitzen indicated that if one assumes that shared costs grow at the same rate as other costs irrespective of their absolute quantity, there is no need to allocate those costs when calculating growth rates.¹³⁸

123. The Commission notes, however, that different choices of assumptions that underpin the calculation of the growth rates of inputs do have noticeably different effects on the resulting growth rate of inputs, and hence on TFP growth. In his reply evidence, Dr. Meitzen shows that for the 1997-2014 period, input growth rate in the Lowry study is 0.42 per cent for the full sample of 88 firms, while the Meitzen and Brattle studies have input growth rates of 1.39 per cent and 1.48 per cent, respectively.¹³⁹ However, these different growth rates are not just due to different input assumptions, as they are also affected by differences in the firms that are included in the samples and in methods of aggregation across these firms. Controlling for these differences to enable an apples-to-apples comparison, by limiting the sample of firms just to those 53 that appear in both the Brattle and Lowry study samples, and aggregating across firms by averaging rather than using a weighted average, yields input growth rates of 0.41 per cent (Lowry study) and 1.22 per cent (Brattle study) for 1997-2014.¹⁴⁰ This difference of some 0.80

¹³⁴ Commission staff calculations. Values are based on data in the Brattle study spreadsheet provided in Exhibit 20414-X0396. Firms that are not common to the two studies are deleted, as described in footnote 140. To obtain the unweighted values, output growth rates for each firm and year prior to the inclusion of the weighting factor, as provided in the spreadsheet, are averaged across the common set of firms for each year.

¹³⁵ See footnote 134. An undertaking by Brattle, exhibits 20414-X0562, 20414-X0563, shows the effect of removing the weighting on TFP to be a reduction of 0.15 percentage points (from -0.79 per cent to -0.94 per cent) for their sample of 67 firms for 2000-2014, but does not show the separate effects of removing the weighting for input growth and output growth.

¹³⁶ Transcript, Volume 12, pages 2431-2432 (Dr. Lowry), and Transcript, Volume 17, pages 3556 and 3564-3568 (Dr. Pavlovic).

¹³⁷ Exhibit 20414-X0387, Brattle reply evidence, pages 40-41, Q/A 78 and 79; Exhibit 20414-X0412, EPCOR reply evidence of Dr. Meitzen, pages 15-16, Q/A 22; Lawrence Kaufmann, Mark Meitzen, and Mark Newton Lowry, “Controlling for Cross Subsidization in Electric Utility Regulation,” *Edison Electric Institute*, September 1998, p. 13 as referenced in Exhibit 20414-X0412, EPCOR reply evidence of Dr. Meitzen, page 16, Q/A 22.

¹³⁸ Transcript, Volume 14, page 2819, lines 3-16 (Dr. Meitzen).

¹³⁹ Exhibit 20414-X0412, EPCOR reply evidence of Dr. Meitzen, Table 3 on page 11.

¹⁴⁰ Commission staff calculation of the Lowry study value is based on Dr. Meitzen’s spreadsheet replication of the Lowry study, Exhibit 20414-X0417, which uses the Lowry study’s firm and data list from Exhibit 20414-X0100. The firms and data used in the Brattle TFP update calculation are provided in Exhibit 20414-X0396. A comparison of these two spreadsheets identifies the firms in common to both, and data pertaining to other firms are simply deleted from the two spreadsheets. To obtain the Brattle study value, TFP growth rates for each firm and year prior to the inclusion of the weighting factor, provided in Exhibit 20414-X0396, are averaged across the common set of firms for each year. Brattle also attempted a comparison of the Lowry and Brattle

percentage points translates directly into differences in TFP growth rates, since the latter are defined as output growth less input growth, indicating that different input assumptions are a large contributor to the different TFP growth rates observed in Table 1. Brattle and Dr. Meitzen came to the same conclusion.¹⁴¹

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

5.2.4 Output measure

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

126. Considerable debate over whether a volumetric measure, number of customers, or some combination of the two would be a better output measure occurred in the PBR Proceeding 566, with the Commission recognizing in Decision 2012-237 a volumetric measure, MWh sold, to be “an acceptable measure for calculating TFP growth for electric distribution companies.”¹⁴² In that decision, the Commission also agreed that for revenue-per-customer cap plans, such as are in place for gas distribution utilities in Alberta, “the number of customers, rather than a volumetric output measure, is the correct output measure for a TFP study,”¹⁴³ but no adjustment was made to the NERA study's volumetric-based TFP growth estimate for gas distribution utilities due to “the absence of a reliable and transparent TFP study on the gas distribution industry and information on how changes in the relevant output measures and input measures for electric and gas distribution industries compare to each other over the 1972 to 2009 study period.”¹⁴⁴

127. NERA emphasized in the PBR Proceeding 566 that its practice is to use sales volume as an output measure.¹⁴⁵ This practice was adopted by the Brattle and Meitzen studies, which followed NERA's methodology.

128. Dr. Pavlovic et al. objected to the use of the MWh volumetric output measure because “there is virtually no [causal] relationship between the operations and costs of an electric distribution system and the annual volume of electricity actually delivered through the

studies using a common sample, exhibits 20414-X0387 and 20414-X0388, Table 6, but focused just on the TFP growth measures rather than input growth measures.

¹⁴¹ Exhibit 20414-X0387, Brattle reply evidence, page 43, Q/A 84; Exhibit 20414-X0412, EPCOR reply evidence of Dr. Meitzen, pages 6 and 11-12.

¹⁴² Decision 2012-237, paragraph 397.

¹⁴³ Decision 2012-237, paragraph 394.

¹⁴⁴ Decision 2012-237, paragraph 416.

¹⁴⁵ Decision 2012-237, paragraph 380.

distribution system.”¹⁴⁶ Dr. Pavlovic expressed his view that “the proper measures of output for a distribution operation are customers, customers served, and peak capacity.”¹⁴⁷ In explaining his position at the hearing,¹⁴⁸ Dr. Pavlovic discussed the “Electric Utility Cost Allocation Manual” published by the National Association of Regulatory Utility Commissioners,¹⁴⁹ in support of his position. Reasons for his position, linking customers as an output measure and cost drivers and cost allocations for electric distribution utilities, were not fully explained.

129. The Lowry study uses number of customers as the output measure for a number of reasons, including its applicability with a revenue-per-customer cap. Dr. Lowry also pointed to the use of econometric modelling that shows the number of customers to be a more important driver of the costs of energy distributors than delivery volumes. An additional reason is that the number of customers is much more stable (that is, less variable) than the trend in delivery volumes.¹⁵⁰ The Commission does not find these reasons to be particularly persuasive in terms of attaching higher weight to studies that use the number of customers as the output variable rather than a volumetric measure. First, only gas distribution utilities will be under a revenue cap plan in the next generation PBR plans (electric distribution utilities remain under a price cap) and, in any event, as Dr. Carpenter¹⁵¹ and Dr. Meitzen pointed out,¹⁵² what is more relevant is the type of index that applies to the U.S. electric distribution firms in the sample, an issue on which no evidence has been adduced. Second, the evidence provided was insufficient to explain why, finding that the number of customers is a more important driver of the costs of energy distributors than delivery volumes, means that the number of customers is a better measure of output than delivery volumes. Finally, while a lack of variability of an output measure appears to have some advantages in terms of ease of numerical calculation and updating, expert evidence was not provided as to why in and of itself, this characteristic is particularly desirable in terms of deciding which output measure is more relevant.

130. In this context, the Commission acknowledges that with the prevalence of both fixed and variable revenue components for distribution utilities, the number of customers is a relevant output measure along with volume, where the relative weights assigned to these two output measures would ideally reflect the proportion of revenues generated through fixed versus variable (volumetric) charges.¹⁵³ In the absence of such information for the firms in the U.S. sample, the Commission is not prepared to discount TFP growth studies developed using either volume or number of customers as the output measure simply because of the particular output measure that was chosen, but in future would prefer sensitivity analysis that demonstrates the effect on output growth, and hence TFP growth, of varying the relative weights that are assigned to each of these two output measures.

131. The average annual growth rates associated with the number of customers output measure for 1997-2014 were 0.90 per cent for the Lowry study using the full sample,¹⁵⁴ and 0.86 per cent when Dr. Meitzen redid his analysis using this output measure with the 67 firm Brattle sample

¹⁴⁶ Exhibit 20414-X0403, UCA reply evidence of Dr. Pavlovic et al., page 6, Q/A 14.

¹⁴⁷ Transcript, Volume 17, page 3569, lines 6-8 (Dr. Pavlovic).

¹⁴⁸ Transcript, Volume 17, page 3632, line 1 to page 3632, line 18.

¹⁴⁹ UCA reply evidence in Exhibit 20414-X0403, PDF page 8.

¹⁵⁰ Exhibit 20414-X0630, PDF pages 40-42.

¹⁵¹ Transcript, Volume 2, page 406, line 11 to page 407, line 3 (Dr. Carpenter).

¹⁵² Exhibit 20414-X0256, EDTI-AUC-2016APR15-013(f).

¹⁵³ Exhibit 20414-X0173, BRATTLE-AUC-2016APR15-009(b); Exhibit 20414-X0256, EDTI-AUC-2016APR15-013(e); Exhibit 20414-X0321, CCA-AUC-2016APR15-009(d).

¹⁵⁴ Exhibit 20414-X0468, PDF pages 40, 42.

for 2000-2014.¹⁵⁵ For volume, the average annual growth rates were 0.51 per cent for the Brattle study and 0.50 per cent for the Meitzen study, using the last 15 years and the Brattle sample of firms in both cases.¹⁵⁶ These growth rates are not all directly comparable, however, for the same reasons identified previously when comparing the results of the different assumptions pertaining to inputs; namely, differences in the firms included in the samples, in the method of aggregating across firms and, additionally, in this case, in the data period and data sources used. Using the 53 firms that are common to the Brattle and Lowry studies, growth in the number of customers is 0.88 per cent for 2000-2014.¹⁵⁷ Volume growth for these same firms in this same period is 0.64 per cent using the weighted average approach in the Brattle study, or 0.47 per cent if all firms are weighted equally.¹⁵⁸ Therefore, after controlling for differences between the studies, the difference in output measures, number of customers versus volume, affects annual growth by between 0.24 and 0.41 percentage points for this period, a number that translates directly into TFP growth differences since TFP growth is output growth less input growth.

132. A further issue with the output data concerns the source for the customer count data. Most of these data are taken from FERC Form 1, but the Lowry study combines output data from FERC Form 1 and EIA Form 861, as described previously.¹⁵⁹ Specifically, for a majority of firms, the Lowry study uses Form 1 data until 2000 and then Form 861 data thereafter. However, for some firms the Lowry study uses Form 1 data throughout while in others it uses Form 861 data throughout, even though for almost 35 per cent of the 88 firms the two data series are identical in all years, and for a further 30 per cent there are only a few minor differences between the two series for any particular firm in some years.¹⁶⁰ Some parties viewed this patching of data as problematic,¹⁶¹ but patching data in this way can avoid obvious transcription errors in the original data. However, here there are anomalies that remain even in the patched data.¹⁶²

133. While the patching of data can be useful in certain circumstances, the Commission considers that the patching procedure and the criteria used to determine which data series to use in which circumstances – that is, what and when to patch – needs to be documented carefully, with supporting reasoning. A lack of such detailed documentation and support must be taken into consideration when evaluating analysis that relies on the patched data, in exactly the same way

¹⁵⁵ Exhibit 20414-X0256, EDTI-AUC-2016APR15-013(g), table on PDF page 50. Part of this difference arises because Dr. Meitzen calculates annual growth for the aggregated number of customers across all firms, whereas the Lowry study calculates annual growth separately for each firm and then averages these measures across firms.

¹⁵⁶ Exhibit 20414-X0396 (Brattle); Exhibit 20414-X0256, PDF page 41 (Meitzen).

¹⁵⁷ Exhibit 20414-X0417, spreadsheet replication of Lowry study by Dr. Meitzen using the patched customer count data utilized by Dr. Lowry, as described subsequently. Firms that are not common to the two studies are deleted, as described in footnote 140.

¹⁵⁸ See footnote 140.

¹⁵⁹ See footnote 95.

¹⁶⁰ The two sets of customer count data are provided in Exhibit 20414-X0100, in columns “AA” (Form 1) and “BD” (Form 861), and are reproduced in the Meitzen spreadsheet replication of the Lowry study, in Exhibit 20414-X0417, tab “Query1,” with these same labelled columns and with the patched series used in the Lowry study in column “DF.”

¹⁶¹ Transcript, Volume 14, page 2845, line 5 to page 2846, line 2 (Dr. Meitzen).

¹⁶² Examples include firms that experience very large customer count percentage increases in one year that are followed by almost equivalent large customer count percentage decreases in the following year(s). These are evident in Exhibit 20414-0417, the spreadsheet replication of the Lowry study by Dr. Meitzen. Specific examples include, but are not limited to, Niagara Mohawk Power Corporation, +32.2 per cent in 2001 and -35.7 per cent in 2003; and Green Mountain Power Corporation, +14.4 per cent in 2012, and -13.14 per cent in 2013.

that would apply to evaluating analysis that utilizes raw (unpatched) data which has not been examined and, if necessary, adjusted, with reasoning and documentation provided, for the presence of anomalies. None of the studies are perfect in this regard, but there are no clear general guidelines on when data are unsuitable for analysis, and all the studies appear to have attempted to ensure that the data were satisfactory for use in their analysis.

134. In terms of the likely magnitudes of the effects on output growth due to this patching, for the 53 firms in common to the Lowry and Brattle study data sets, for the period 2000 to 2014, average annual growth using the patched customer count data (Lowry study) is 0.88 per cent, while the unedited Form 1 customer count data (as used by Dr. Meitzen) yields average annual growth of 0.99 per cent.¹⁶³ So for these firms and this period, the difference in output growth measures, arising just from the particular data set used for the number of customers, which translates directly into TFP growth differences, is of the order of 0.10 percentage points.

135. In addition to these differences pertaining to data on number of customers, the two forms (FERC Form 1 and EIA Form 861) also have different volume data for some utilities and years. The Lowry study highlights this issue in reply evidence, pointing out differences between sales volumes and delivery volumes, arguing that the latter, provided in Form 861, are a better measure due to the restructuring that occurred with investor-owned electric utilities in the U.S.¹⁶⁴

136. Both the Brattle and Meitzen studies limit their volume data to those provided on FERC Form 1, thus precluding an examination of the effects of these data differences. In an IR response to the Commission, Dr. Lowry provides TFP calculations, using his methodology and assumptions, but using volume rather than the number of customers as the output measure and, alternately, using the different output data sources.¹⁶⁵ For his full sample of 88 utilities, for the period 1997-2014, output growth is 0.28 per cent using Form 1 data only, but 0.91 per cent using data combined from Form 1 and Form 861. With input growth for this period of 0.42 per cent, the corresponding average TFP growth measures are -0.14 per cent and +0.49 per cent, respectively, a difference of 0.63 percentage points that also changes the sign of average TFP growth from negative to positive.

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

5.2.5 Time period

138. The final component of the TFP growth studies in which there was some disagreement among parties concerned the time period to be used for calculating TFP growth. This section

¹⁶³ The three sets of customer count data are in Exhibit 20414-X0417, as described in footnote 160. Firms that are not common to the two studies are deleted, as described in footnote 140. For the reported comparisons, in both cases annual growth is calculated separately for each firm and then averaged across firms for each year. See footnote 155.

¹⁶⁴ Exhibit 20414-X0468, CCA reply evidence of PEG, pages 6-10.

¹⁶⁵ Exhibit 20414-X0321, CCA-AUC-2016APR15-009(f), with spreadsheet attachments in Exhibit 20414-X0266. Analysis is performed using code rather than spreadsheets.

considers different choices for the time period, and the effect of such choices on the resulting TFP growth values. As with the input assumptions and output choices, consideration of this issue helps to inform the Commission about the range of values that the TFP growth component of the X factor can take, and how sensitive this range is to different sets of assumptions.

139. Although the Brattle and Meitzen studies both calculate TFP growth for each year from 1972 to 2014, as described in Table 1, they recommend basing the TFP growth component of X on some type of average using just the most recent 15 years of data. For comparison purposes, these studies calculated the average TFP growth based on the full 1972-2014 period to be approximately +0.75 per cent.¹⁶⁶ The Lowry study only has data from 1997 to 2014, and as shown in Table 1, bases its recommendation for the TFP growth component of the X factor on that full period.

140. In argument, the CCA, sponsor of the Lowry study, recommends that if a TFP growth factor is to be based on the NERA data set, it should use the full sample period.¹⁶⁷ One reason for this recommendation is based on the suggestion that the TFP trend calculated using number of customers as the output measure, as in the Lowry study, is more stable and, therefore, a long-term trend can be identified with a shorter sample period,¹⁶⁸ with the apparent corollary being that without this stability of data, a longer sample period would be required to identify the long-term trend. However, although it would appear to be correct that the number of customers as an output measure is more stable than a volumetric measure over a shorter sample period, it does not necessary follow that stability for a volumetric measure is any different over the long term when compared to a customer measure since number of customers data for years prior to 1997 were not provided in evidence. Accordingly, the Commission regards this stability conclusion as being speculative.

141. A second reason for the CCA's recommendation to use the full sample period if the NERA data set is used is that "The most principled basis for choosing a sample period in this proceeding is to capture a period in which productivity growth drivers are most similar to those facing Alberta utilities in the long run,"¹⁶⁹ and recent years, as recommended by the Brattle and Meitzen studies, do not reflect this. The Brattle and Meitzen studies do not support this view because their analyses are not based on utilities selected for characteristics similar to those of the Alberta distribution utilities. Therefore, based on the evidence provided, the Commission considers that the time period that should be used to determine TFP growth based on the NERA approach, as in the Brattle and Meitzen studies, is an open question for determining the TFP growth value to be used in the next generation PBR plans.

142. Both the Brattle and the Meitzen studies argue that the annual TFP growth series has changed over time in a way that causes TFP growth data from recent years to be a better determinant or predictor of TFP growth that can be expected during the next generation PBR term. The Brattle study does this through a series of statistical tests designed to show that

¹⁶⁶ Exhibit 20414-X0396, Brattle TFP calculation update spreadsheet, reflective of Dr. Meitzen's correction and balanced panel. From data in Exhibit 20414-X0074, Table B.1 on PDF page 238, the Meitzen study calculated average 1972-2014 TFP growth to be 0.71 per cent. In response to Commission IRs, Exhibit 20414-X0256, PDF page 41, the 0.75 per cent TFP growth number was calculated based on Brattle's sample and balanced panel.

¹⁶⁷ Exhibit 20414-X0630, CCA revised argument, paragraph 139.

¹⁶⁸ Exhibit 20414-X0630, CCA revised argument, paragraphs 172-173.

¹⁶⁹ Exhibit 20414-X0630, CCA revised argument, paragraph 165.

average TFP growth in recent years is significantly different to average TFP growth from 1972 to 1999.¹⁷⁰ In addition to their own tests, which the Commission finds to have limited usefulness due to their tendency to test differences of means between periods that overlap without sufficient statistical support for such a testing strategy, Brattle also undertook additional testing in response to IRs from the Commission. These test results indicate significant differences between means (of annual TFP growth rates) in the period 1972-1999 versus the ensuing 15 years, and in the period 1972-2004 versus the ensuing 10 years.¹⁷¹ Structural change (Chow) tests conducted by Brattle, testing whether the parameters underlying TFP growth in one period are significantly different from those in the subsequent period, although subject to the caveats they describe, at the very least point to evidence of instability in the TFP growth rates beginning somewhere in the mid to late 1990s. These tests, however, do not formally identify any one particular year or combination of years where a structural break may have occurred.¹⁷² Dr. Meitzen's test results, pertaining to non-stationarity tests with possible structural breaks, provided in an undertaking, also support this instability conclusion. For example, in the 1972-2014 sample, depending on the test chosen and how it is implemented, he found significant breakpoints in TFP growth at 1985, 1986, 1989, 1990, 1996, 2004, 2008 and 2010.¹⁷³ Dr. Meitzen concludes that "many of the breakpoints are at least 15 years from the end of the series, providing support that a 10- to 15-year time period appropriately captures the behavior of this series in the latter time period."¹⁷⁴

143. Although not utilizing a formal testing strategy for structural breaks, the Meitzen study recommends a time period involving the last 15 years based on its focus on the Commission's interpretation, noted previously, that the X factor, in general terms, can be viewed as the expected annual TFP growth during the PBR term. The Meitzen study interprets this to mean that "the role of a TFP study in determining the X factor is as a predictor of expected annual productivity growth over the course of the subsequent price cap term"¹⁷⁵ (emphasis added). Subsequently, the Meitzen study calculates an average of (i) the average of annual TFP growth over the previous 10 years, and (ii) the average of annual TFP growth over the previous 15 years (the 10/15 moving average) and shows that between 1987 and 2009, generally (since 1998) this has been a better predictor of TFP growth for the next five years (a "forward-looking five-year average") than the NERA approach of using the average of all previous years.¹⁷⁶ Although the Meitzen study shows that since 1998 the 10/15 moving average is "closer" to the forward-looking five-year average than is the average of all previous annual TFP growth values,¹⁷⁷ "closeness" is a relative term, and no level of statistical significance is attached to the improvement for the 10/15 method that this figure demonstrates. Alternative methods (10/12, 8/15, etc.) could yield predictors that are even closer.

144. The Meitzen study recognizes that the 10/15 method is not necessarily the best predictor, but argues that it avoids cherry-picking dates or time periods, and that qualitatively similar results are obtained using a simple 10-year or 15-year moving average.¹⁷⁸ The choice of 10 to 15 years is based on the general span of recommendations made by parties in Proceeding 566,

¹⁷⁰ Exhibit 20414-X0387, Brattle reply evidence, page 20, Q/A 41.

¹⁷¹ Exhibit 20414-X0173, PDF pages 22-26; Exhibit 20414-X0175.

¹⁷² Exhibit 20414-X0173, PDF pages 27-31; Exhibit 20414-X0175, tabs "Request (e)(ii)," "Request (e)(iii)."

¹⁷³ Exhibits 20414-X0599 and 20414-X0601.

¹⁷⁴ Exhibit 20414-X0599, page 2.

¹⁷⁵ Exhibit 20414-X0074, Appendix B, EPCOR evidence of Dr. Meitzen, PDF page 214.

¹⁷⁶ Exhibit 20414-X0074, Appendix B, EPCOR evidence of Dr. Meitzen, pages 34-37, PDF pages 220-224.

¹⁷⁷ Exhibit 20414-X0074, Appendix B, EPCOR evidence of Dr. Meitzen, Figure 4a on PDF page 223.

¹⁷⁸ Exhibit 20414-X0074, Appendix B, EPCOR evidence of Dr. Meitzen, PDF pages 218 and 221.

with Dr. Meitzen arguing that “this span of years provides a sufficiently long period that overcomes transient, short-run shocks that could influence TFP growth (such as with a 5-year average) and also avoids anchoring the forward-looking estimate with values from the distant past that no longer provide a reasonable basis for establishing a forward-looking X factor.”¹⁷⁹ A drawback of the 10/15 method compared to simple averages of either the last 10 or last 15 years is that the last 10 years appear in both components that are averaged in the 10/15 method and, therefore, have higher weights than do the five years that precede them. A different choice of years (such as 8/13) would necessarily result in a different weighting scheme. This unequal weighting can only be avoided with a simple average and for this reason, the Commission prefers this latter approach.

145. The effect of the Commission’s determination to dismiss the Meitzen study recommendation of the 10/15 method in favour of a simple average is to increase the lower bound of recommended TFP growth values in Table 1, which was previously associated with the 10/15 method. Again, however, due to the variability that results from the use of different assumptions underlying input growth, and the choice of the output measure, as described in the previous sections, and accounting for this variability means that this TFP growth component is not necessarily prevented from lying below the lowest remaining final recommendation (as shown in Table 1) of -0.79.

5.3 Stretch factor

146. Generally speaking, a stretch factor is an additional percentage incorporated in the X factor, thereby increasing the overall value for X and thus slowing the price or revenue cap growth determined by the I-X indexing mechanism. On this basis, the stretch factor can be viewed as sharing with customers the expected additional cost reductions that result from the move from a low-incentive regime such as COS regulation to a higher-incentive regime such as PBR. For this reason, stretch factors are common in first-generation PBR plans.

147. In this proceeding, parties disagreed on whether a stretch factor should be applied in the next generation PBR plans. The distribution utilities and their experts contended that readily available efficiency gains (the “low hanging fruit”) have already been captured in the current generation PBR term.¹⁸⁰ In contrast, all interveners argued for a continuation of a stretch factor in the next generation PBR term in an amount not lower than the 0.2 per cent approved in Decision 2012-237.¹⁸¹

148. Among other arguments, the interveners submitted that a stretch factor is necessary as it strengthens the incentives under PBR.¹⁸² On this point, the Commission disagrees. As indicated in Decision 2012-237, while the size of a stretch factor affects a utility’s earnings, it has no

¹⁷⁹ Exhibit 20414-X0074, Appendix B, EPCOR evidence of Dr. Meitzen, PDF page 219.

¹⁸⁰ Exhibit 20414-X0056, Brattle evidence, page 36, Q/A 70; Exhibit 20414-X0069, ENMAX PBR plan proposal, paragraph 43; Exhibit 20414-X0070, ATCO PBR plan proposal, paragraph 44; Exhibit 20414-X0081, AltaGas PBR plan proposal, paragraph 79; Exhibit 20414-X0073, Fortis PBR plan proposal, paragraph 60; Exhibit 20414-X0074, EPCOR PBR plan proposal, paragraphs 92-94.

¹⁸¹ Exhibit 20414-X0630, CCA revised argument, paragraph 204; Exhibit 20414-X0618, UCA argument, paragraph 86; Exhibit 20414-X0625, Calgary argument, paragraph 77.

¹⁸² Exhibit 20414-X0625, Calgary argument, paragraph 75. Exhibit 20414-X0618, UCA argument, paragraphs 74 and 88. Exhibit 20414-X0630, CCA revised argument, Section 12 was titled “Including a Stretch Factor Will Increase Efficiencies Not Yet Realized.”

influence on the incentives for the utility to reduce costs. PBR plans derive their incentives from the decoupling of a utility's revenues from its costs as well as from the length of time between rate cases and not from the magnitude of the X factor (to which the stretch factor contributes).¹⁸³

149. Brattle confirmed this observation stating that the existence of a stretch factor does not increase the benefits seen by customers. Rather, a stretch factor benefits customers because it provides the expected gains of PBR to them more quickly than the alternative of waiting until rebasing.¹⁸⁴ Brattle explained:

... the purpose of the stretch factor is to anticipate additional cost savings that are expected to be achieved under PBR, and set the path of base rates lower than it would have been in the absence of the stretch factor because of the anticipated additional savings. One way to characterize a stretch factor is that it passes on to customers anticipated additional savings (over and above those incorporated into the X-factor) immediately which would otherwise, in the absence of the stretch factor, be passed back to customers at the end of the PBR plan (by rebasing).¹⁸⁵

150. Dr. Weisman expressed a similar view and indicated that "the question is whether those efficiency gains, to the extent they exist, the additional efficiency gains, should be guaranteed to consumers through the stretch factor rather than be passed along to consumers at the time of rebasing."¹⁸⁶ From this perspective, Dr. Weisman noted that the relevant factor for a regulator to consider when determining the need for the stretch factor is the certainty of additional efficiency gains, so as to make a decision on whether such gains should be passed along in the form of rebasing rather than guaranteed to consumers *a priori* through the stretch factor in the PBR formula.¹⁸⁷

151. The distribution utilities and their experts have interpreted the Commission statement in paragraph 479 of Decision 2012-237 to mean that the inclusion of a stretch factor is warranted only during a transition from COS regulation to PBR.¹⁸⁸ Although the context for paragraph 479 concerned a transition from COS to first-generation PBR, the UCA's more general interpretation is that a stretch factor was approved in Decision 2012-237 because increased efficiencies were expected to be realized from the transition from a low incentive regulatory regime (in that case, COS) to a higher incentive regulatory regime (in that case, first-generation PBR). In the UCA's view, a better general definition of the purpose for a stretch factor is to share the efficiency gains that are expected to result when the subsequent generation of regulatory framework provides enhanced incentives relative to the previous generation (i.e., when there is a transition from a less-incentivized form of regulation to regulation that embodies greater incentives).¹⁸⁹

152. Parties in this proceeding pointed out that because expenditures under the capital tracker mechanism in the 2013-2017 PBR plans were largely treated on a COS basis, they were not

¹⁸³ Decision 2012-237, paragraph 500.

¹⁸⁴ Exhibit 20414-X0387, Brattle reply evidence, page 47, Q/A 97.

¹⁸⁵ Exhibit 20414-X0056, Brattle evidence, pages 35-36, Q/A 68.

¹⁸⁶ Transcript, Volume 14, page 2915, lines 11-17 (Dr. Weisman).

¹⁸⁷ Transcript, Volume 14, page 2915, lines 18-23 (Dr. Weisman).

¹⁸⁸ Exhibit 20414-X0623, EPCOR argument, paragraph 79; Transcript, Volume 14, page 2917, lines 4-10 (Dr. Weisman); Exhibit 20414-X0446, Brattle supplemental reply evidence, page 9, Q/A 24; Exhibit 20414-X0624, Fortis argument, paragraph 70.

¹⁸⁹ Exhibit 20414-X0618, UCA argument, paragraphs 73 and 77.

subject to the same high-powered incentives to control costs as the expenditures under I-X.¹⁹⁰ The Commission agrees. In Section 6 of this decision, the Commission approves the K-bar mechanism, which, as Dr. Weisman put it, is “a lot more high powered in terms of incentives,”¹⁹¹ compared to capital trackers. Mr. Baraniecki for EPCOR agreed with the logic that if capital is moved from a low-powered incentive regime, such as capital trackers, to a higher-powered incentive regime, such as K-bar, there may be a need for a stretch factor.¹⁹²

153. Given that current generation PBR plans include a COS-based capital trackers mechanism, which will be mostly replaced in the next generation PBR plans by the K-bar mechanism, the Commission expects that next generation PBR plans will be largely devoid of any significant COS elements. Therefore, the Commission finds merit in including a stretch factor component in the X factor for the next generation PBR plans for all distribution utilities. In a similar vein, because ENMAX was regulated under COS in 2014, the commencement of the 2015-2017 PBR plan warrants inclusion of a stretch factor in the X factor for the ENMAX 2015-2017 PBR plan as well.

5.4 Commission determination on the X factor for the 2018-2022 PBR plans

154. The TFP growth values that have been produced by the various studies in evidence are the result of an index-number type of calculation, rather than estimation, that can (but need not) be obtained using a spreadsheet. Despite this characteristic, even were the examination of the three TFP growth studies in this proceeding limited to a period comprising the last 15 years, a range included in all three studies, the range of TFP values that have been proposed for this period is strikingly large. Brattle expressed its view that “it is unusual for there to be more than one TFP study in evidence in a single proceeding,”¹⁹³ as in the case of the current proceeding where three TFP growth studies were filed, at least two of which involve some fundamental differences. Had only one objective and transparent study been filed in evidence, the variability inherent in the TFP growth value, which is a function of the assumptions and data used, and is evident from a comparison of the three studies, easily could have remained unknown. This could have led the Commission to conclude that there is a single TFP growth value that could be regarded as “correct.” Rather, the Commission views the variety of results that have been provided as confirming that the TFP growth value is likely not a correct single number, but that a reasonable value likely falls within a range of values, demarcated by the breadth of assumptions and data sets that may be reasonably employed in producing the studies. This view was shared by some of the experts in this proceeding. For example, in its evidence, Brattle indicated that “Certainly estimating TFP trends is not an exact science.”¹⁹⁴ This opinion was explained further in testimony by Dr. Carpenter when he stated the following:

There's noise in the data, and there's noise in the results. So I think you have to take a practical view as to how much uncertainty there is in these numbers. I think at some point in our evidence we say there's probably about 150 basis points of potential just noise in

¹⁹⁰ Transcript, Volume 1, page 63, lines 3-8 (Dr. Brown); Transcript, Volume 12, page 2443, line 12 to page 2444, line 8 (Dr. Lowry); Transcript, Volume 14, page 3021, lines 2-21 (Dr. Weisman); Exhibit 20414-X0618, UCA argument, paragraph 83.

¹⁹¹ Transcript, Volume 14, page 2918, lines 15-18 (Dr. Weisman)

¹⁹² Transcript, Volume 14, page 2932, line 15 to page 2933, line 12 (Mr. Baraniecki).

¹⁹³ Exhibit 20414-X0387, Brattle reply evidence, page 43, Q/A 85.

¹⁹⁴ Exhibit 20414-X0387, page 43 Q/A 85.

the TFP results. The minus .79 figure that we've referred to is a midpoint in a wide range.¹⁹⁵

155. It is this observation that allows the reconciliation of two quite disparate statements made by different experts at the hearing concerning TFP growth values, the authors of the Brattle study who “don’t think that ... there’s a right answer necessarily”¹⁹⁶ while Dr. Lowry emphasized that his result “is computed to four decimal places.”¹⁹⁷ Once a set of assumptions, concerning all aspects of the calculation have been determined, such as input and output growth measures, source for output and input data, and all the many other considerations, some of which were discussed in Section 5.2, then what is left is a calculation, and it can be computed to as many decimal places as the data will support. However, should a change be made to one aspect of any one of a number of assumptions, then a different numerical value will result.

156. As shown in Table 1, all final recommendations concerning the TFP growth component of the X factor are lower than, and in some cases much lower than, the TFP growth number of +0.96 per cent adopted by the Commission in Decision 2012-237. Consequently, as noted previously, based on the expert evidence received in this proceeding, the issue before the Commission is not whether the TFP growth component of the current X factor needs to be lowered for the next generation PBR, but rather the extent to which it needs to be lowered. To address this issue, the Commission has evaluated the applicability of the various TFP growth values provided by the expert evidence presented in this proceeding.

157. Based on the criteria of objectivity, consistency and transparency, the Commission finds, in Section 5.2.1, that equal weights should be applied to the Brattle and Meitzen studies, and to the Lowry study that was provided in direct evidence. Further, since the effect of input data modifications made in the studies is minimal, as discussed in Section 5.2.2, the Commission also will not weight the studies differently due to the use or non-use of such modifications.

158. The Commission found in Section 5.2.2 that the subsample analysis in the Lowry study can provide useful information, but analysis using the full sample, or possibly subsamples selected on multiple criteria, better informs the Commission’s judgement as to the possible range of TFP growth values that are reflective of competitive markets. For this reason, the Commission limited further consideration of the Lowry study to TFP growth findings for the full sample of 88 firms. Since the highest recommended TFP growth values were obtained from the Lowry study subsample, focusing on the full sample in the Lowry study suggests a downward adjustment to the TFP growth component compared to its previous value. Of course, there is considerable variability due to the different assumptions that are made, and accounting for this variability means that this TFP growth component is not prevented from exceeding the highest remaining recommendation.

159. In Section 5.2.3, the Commission found that the input growth assumptions used by each expert to be reasonable. Based on this finding and the critiques provided by other parties, the Commission cannot rule out any of the corresponding TFP growth numbers. However, the Commission notes that the input growth assumptions are crucial, in that changing the assumptions leads to significant variability in the TFP growth value.

¹⁹⁵ Transcript, Volume 3, page 430, line 19, to page 431 line 1.

¹⁹⁶ Transcript, Volume 4, pages 663-664.

¹⁹⁷ Transcript, Volume 12, page 2480, line 13.

160. The choice of output measures, and associated assumptions, discussed in Section 5.2.4, were all found to be valid by the Commission. Based on this finding and the validity of the various critiques that were provided, the Commission cannot rule out either of the volumetric or number of customers output measures, nor the TFP growth values that follow from different assumptions. As discussed in that section, in view of this finding, the Commission believes that a useful way to proceed in future TFP growth studies might be to use some combination of the output measures, and, as a starting point, to examine the sensitivity of the TFP growth results to different combinations of output measures. Based on analysis presented in this proceeding, however, changing the output measure leads to moderate variability in output growth, and hence, in TFP growth.

161. The time period used to determine the TFP growth value, considered in Section 5.2.5, is important. The starting point for the Commission's analysis in this proceeding is the Commission's finding in Decision 2012-237, which continued to be supported by some parties in this proceeding, that the longest available time period best reflects the long-term TFP growth that has the greatest relevance in determining the X factor. This is especially the case when the PBR plan includes a capital mechanism that can be used to account for the idiosyncratic nature of utilities. Specifically, it is the capital mechanism, in part, that can respond to shorter term shocks to TFP, including the health of the economy. Despite this desire for the longest available time period, several features of the analysis, in the TFP growth studies that were provided, support an argument for placing less weight on the longest available time period. These features include the possibility of structural breaks, and the practical problem of the length of the time series data associated with a particular choice of output measure (number of customers). Since numerical values of all the output measures are not available for the same length of time, the only consistent time periods for comparison of all the TFP numbers is 15-17 years. Nevertheless, given the evidentiary support demonstrating that the longest available time period best reflects the long-term TFP growth for using the longest available time period for determining TFP growth, the Commission places some weight on the longest-term TFP growth results presented in evidence, namely, the approximately +0.75 value determined for the 1972-2014 period.¹⁹⁸

162. As a result of the above analysis, the Commission considers that the range of TFP growth values is defined by three remaining values: -0.79 for the Brattle study, and +0.43 for the Lowry study, both from Table 1, and approximately +0.75 for the full 1972-2014 time period. In addition, based on the analysis in sections 5.2.3 to 5.2.5, additional information about the variability of these TFP values to changes in assumptions and hence, the possible range of values that TFP growth might take, is available.

163. Dr. Meitzen indicated that he does not view a TFP growth study as open to any number of assumptions or data sets and that "there's a right way of doing them."¹⁹⁹ As set out earlier in Section 5.2, it was EPCOR's recommendation that the X factor for the next generation PBR plans be established at the time of rebasing, employing Dr. Meitzen's TFP growth calculation methodology and using the most recent available data.²⁰⁰ In a similar vein, the UCA submitted that "the Commission should ultimately approve an X Factor for the second generation PBR plan calculated on the basis of a TFP study that is correctly prepared," that is, "using appropriate input and output indices, as well as the appropriate time period and sample, as determined

¹⁹⁸ In response to Commission IRs, Exhibit 20414-X0256, PDF page 41, the 0.75 per cent TFP growth number was calculated by Dr. Meitzen based on Brattle's sample and balanced panel.

¹⁹⁹ Transcript, Volume 14, page 2885, lines 11-13 (Dr. Meitzen).

²⁰⁰ Exhibit 20414-X0074, EPCOR PBR plan proposal, paragraph 95.

through statistical testing.”²⁰¹ In its argument, the CCA, sponsor of Dr. Lowry’s study, recommended selecting one of the specific numerical values of TFP growth put on the record of this proceeding, to “discourage witnesses from filing extreme recommendations in the hopes that the Commission will choose a number in the middle.”²⁰²

164. These statements appear to suggest that there is just one correct TFP growth number and any others that are provided are just distractions. The Commission does not subscribe to this view, and considers it has, in fact, benefitted from examining different TFP growth studies in this proceeding that rely on different assumptions and calculations pertaining to the input and output measures. However, studies must provide information describing all aspects of the study, with considerable detail – including easily reproducible supporting calculations – on the effects, both separately and jointly, of changing each of the assumptions used, where the set of assumptions is widely defined, and includes assumptions with respect to data source selection. In the absence of such complete information, the Commission must take the limited set of information that it does have, and apply its expertise and judgement to the available evidence provided in this proceeding to arrive at a TFP growth value to be used as a component of an X factor for the next generation PBR plans.

165. In promoting his approach to determining the TFP growth value to use as a component of the X factor, Dr. Meitzen focuses on determining how well TFP growth calculated using an average annual value over a long period, succeeds at forecasting annual average TFP growth over the ensuing five years compared to a calculation using a shorter data period; that is, the length of the next generation PBR term.²⁰³ Using volumetric output data, the Meitzen study shows that using an average based on all previously available annual TFP growth performed poorly over the 2009-2014 period, and that an average based on a shorter period performed better.²⁰⁴ While the Commission finds this evidence to be informative, it is not conclusive, since it only pertains to one particular TFP growth outcome, using one particular set of assumptions. In the Commission’s view, the knowledge that one particular methodology, including all the assumptions it involves, is a poorer predictor if longer, rather than shorter, data series are used in its construction, does not generalize to all other methodologies. For example, a methodology that involves a customer count output measure, or combined volumetric and customer count output measures, with particular types of weighting, and involving certain other choices, may perform very well in this forecasting context even if its construction were to be based on a longer data period, should it be available.

166. As a further consideration, the Commission notes the concern that has been expressed by Calgary and the UCA with a negative value of the X factor.²⁰⁵ Experts for the distribution utilities pointed out that incentives are not affected by the choice of a particular value of the X factor, whether it is negative, zero or positive, except to the extent that the value selected may affect availability of incremental capital funding through particular capital tracker mechanisms.²⁰⁶ Rather, these incentives derive from the decoupling between revenues and costs that is explicit in

²⁰¹ Exhibit 20414-X0618, UCA argument, paragraphs 56-57.

²⁰² Exhibit 20414-X0630, CCA revised argument, paragraph 139.

²⁰³ Exhibit 20414-X0074, Appendix B, EPCOR evidence of Dr. Meitzen, PDF pages 214-219.

²⁰⁴ Exhibit 20414-X0074, Appendix B, EPCOR evidence of Dr. Meitzen, PDF pages 220-224.

²⁰⁵ Exhibit 20414-X0625, Calgary argument, paragraphs 69-73; Exhibit 20414-X0618, UCA argument, paragraphs 58-63.

²⁰⁶ See, for example, Exhibit 20414-X0619, PDF pages 13-14 (ENMAX, Brattle); Exhibit 20414-X0623, PDF pages 17-18 (EPCOR, Dr. Weisman).

a PBR plan. The Commission agrees. However, the Commission also is aware that indexing prices or revenues by I-X is based on the idea that part of the expected efficiency gains from PBR are passed on to consumers during the PBR plan term through the X factor, regardless of the actual performance of the distribution utilities.²⁰⁷ The appeal of this approach to consumers is obviously decreased when there are efficiency losses, and the value of X is negative.

167. The Commission is aware that the value of the X factor can be negative, and there was considerable discussion of this issue in Decision 2012-237, as well as in this proceeding. However, given the manner in which TFP growth is calculated in the studies in evidence, negative values of TFP growth mean that more inputs are used to produce the same amount of output or that less output is produced using the same amounts of inputs. Any industry, including the electricity (and gas) distribution industry, may have periods when this phenomenon is observed, but it is not clear why such a phenomenon should persist over a long period. In the Brattle and Meitzen studies, TFP growth is negative in nine of the last 15 years, and more particularly, in seven of the last nine years.²⁰⁸ Yet, many of the utilities in the current proceeding went to great lengths to explain some of the efficiency-improving procedures (productivity improvements) they have adopted, and there is no reason to expect that at least some of this type of behaviour would not be observed in many of the U.S. firms in the sample used in the TFP growth calculations being examined here.²⁰⁹ These findings suggest that there may be some concerns with the calculation of TFP growth using only volume as the measure of output, whatever the time period used, especially when combined with the particular data and input growth assumptions utilized in the Brattle and Meitzen studies, with the sample of U.S. electric distribution utilities. The evidence is not conclusive, but it does cause the Commission to be mindful of the extent to which the results differ with different choices of assumptions, including output measures.

168. Finally, all parties in this proceeding indicated a common X factor, based on their preferred TFP growth number, could be applied to both gas and electric utilities.²¹⁰ Further, apart from Dr. Lowry's proposal to focus on subsamples of the U.S. electric distribution utilities that, in his view, were likely to be more representative of conditions faced in Alberta (which the Commission discounted in Section 5.2.2), no party recommended making any specific adjustments to account for the fact that the TFP growth component of the X factor for the Alberta distribution utilities is based on the average rate of TFP growth in the U.S. electric distribution industry.²¹¹ In addition, as observed above, the inclusion of an incremental capital funding mechanism in the next generation PBR plans helps to address the unique requirements of

²⁰⁷ See Decision 2012-237, paragraph 17. Additional efficiency gains may be passed to consumers through the rebasing mechanism.

²⁰⁸ Exhibit 20414-X0396, updated Brattle study; Exhibit 20414-X0074, Appendix B, EPCOR evidence of Dr. Meitzen, Table B.1, PDF page 238.

²⁰⁹ This may point to a need, in future TFP growth studies using these U.S. utilities, to focus on the type of regulation they face and, in particular, the period that they were regulated under a PBR-type of approach.

²¹⁰ Exhibit 20414-X0619, ENMAX argument, paragraph 76. Transcript, Volume 1, page 413, lines 16-24 (Dr. Brown); Transcript, Volume 14, page 2881, lines 16-24 (Dr. Meitzen); Transcript, Volume 12, page 2410, lines 2-25 (Dr. Lowry); Exhibit 20414-X0625, Calgary argument, paragraph 74. The UCA, in its argument, Exhibit 20414-X0618, at paragraph 56, recommended that "the Commission should ultimately approve an X Factor for the second generation PBR plan calculated on the basis of a TFP study that is correctly prepared."

²¹¹ Although Brattle noted in their evidence, Exhibit 20414-X0056, page 34, Q/A 64 that the existence of a positive productivity gap between the U.S. and Canadian economies means that their X factor recommendation "is more likely to be too high than too low."

each of the distribution utilities in the Alberta context, consistent with the Commission's five PBR principles.

169. The Commission has determined an X factor, using its judgement and expertise in weighing the evidence and in taking into account the multitude of considerations set out above, in particular evidence demonstrating that the TFP growth value cannot with certainty be identified as a single number, but rather, in view of the variability resulting from the assumptions employed, must be considered as falling within a reasonable range of values, between -0.79 and +0.75. The Commission finds that a reasonable X factor for the next generation PBR plans for electric and gas distribution utilities in Alberta, inclusive of a stretch factor, will be 0.3 per cent.

5.5 X factor for ENMAX's 2015-2017 PBR plan

170. Decision 21149-D01-2016 approved an interim X factor for the ENMAX 2015-2017 PBR plan, with the direction that the final X factor will be determined in the present proceeding.²¹² ENMAX submitted that the same X factor, based on Brattle's recommendation, should apply to both of its 2015-2017 and 2018-2022 PBR plans.²¹³

171. The UCA recommended that the 0.96 per cent X factor, based on the TFP growth number approved in Decision 2012-237, be used for ENMAX's 2015-2017 PBR plan, given that this plan is, in most material respects consistent with the PBR plans approved in Decision 2012-237. In the alternative, the UCA recommended that the 0.80 per cent X factor, based on the TFP growth number approved for ENMAX's FBR plan in Decision 2009-035, and approved as an interim measure in Decision 21149-D01-2016, be approved.²¹⁴

172. Given the updated TFP growth numbers put forward in this proceeding, including the extension of that data series from 2010 to 2014, the Commission considers that it would not be reasonable to base the X factor on the TFP growth numbers approved in prior decisions dating back to 2009 or 2012. Further, as ENMAX highlighted, in this proceeding, the Brattle and Meitzen studies specifically undertook to update NERA's TFP growth numbers on which the Commission relied in Decision 2012-237.²¹⁵ Therefore, based on its considerations of the TFP growth numbers and a stretch factor as set out earlier in this decision, the Commission finds that the same X factor of 0.3 per cent that has been determined for the next generation PBR plans for all gas and electric distribution utilities should also apply to the ENMAX 2015-2017 PBR plan.

5.6 Proposals for a non-negative I-X provision

173. The five distribution utilities sponsoring Brattle's evidence proposed that the value of the I-X index should be restricted to be non-negative with zero as a lower bound (i.e., in years when the I-X index value is negative, the index would be held at a floor of zero per cent). ENMAX asked for the same provision to apply to its 2015-2017 PBR plan.²¹⁶

174. These distribution utilities submitted that the value of the input price inflation measure in PBR plans, the I factor, has recently entered the negative range, and that a positive value of the X factor would tend to enhance this (i.e., cause I-X to be even more negative), at a time when

²¹² Decision 21149-D01-2016 (Errata), paragraph 53.

²¹³ Transcript, Volume 8, page 1467, lines 10-12 (Mr. Hildebrandt).

²¹⁴ Exhibit 20414-X0618, UCA argument, paragraphs 70-71.

²¹⁵ Exhibit 20414-X0634, ENMAX reply argument, paragraph 71.

²¹⁶ Exhibit 20414-X0619, ENMAX argument, paragraph 94.

utilities are finding that many of their costs, such as those flowing from union agreements, are escalating at a positive rate.²¹⁷ Brattle experts expressed their view that if the I factor in the PBR formula were to be negative, that could signal that the approved inflation measure is not representative of the price changes facing the utilities.²¹⁸ The five distribution utilities agreed with this observation and submitted that a non-negative I-X provision would allow them to mitigate the issues with the approved inflation measure. AltaGas and ENMAX called for a revision of the I factor in some future proceeding.²¹⁹

175. EPCOR confirmed it did not make a request for a non-negative I-X provision in its next generation PBR plans. At the hearing, Mr. Baraniecki indicated that even though EPCOR is facing the same conditions as other distribution utilities, it did not apply for such a provision because it was inconsistent with the principles of PBR.²²⁰ The UCA agreed with EPCOR's view that there is no principled basis on which to impose a floor of zero on the I-X value.²²¹

176. The I factor value is not within the scope of this proceeding; however, the proposal to restrict I-X to be non-negative can also be framed as a recommendation involving the X factor value.²²² As such, the Commission has considered this request.

177. Dr. Brown and Dr. Carpenter for Brattle, Dr. Meitzen and Dr. Weisman for EPCOR and Dr. Lowry for the CCA, indicated that there is no apparent theoretical basis for restricting I-X to be non-negative.²²³ The Commission agrees and accordingly, will not impose such a provision at this time. Specifically, restricting I-X to be non-negative may result in blunting of incentives to control costs for certain categories of expenditures. As well, the I-X index value is just one component of a number of interacting components of the next generation PBR plans. As set out in Section 9, in designing next generation PBR plans, the Commission has considered all relevant factors, including those that may affect the distribution utilities during the next generation PBR term – such as the current economic climate in Alberta – that the non-negative I-X proposal was aiming to address.

6 Treatment of capital additions

178. In Decision 2012-237, the Commission recognized that while the TFP study used in determining the X factor for the Alberta distribution utilities reflected a rate of long run productivity growth for a set of distribution utilities over time and, therefore, necessarily included capital input costs, there are nevertheless circumstances where an Alberta distribution utility may require capital funding in addition to the funding generated under the I-X mechanism

²¹⁷ Exhibit 20414-X0619, PDF pages 29-31; Appendix A, PDF pages 47-48 (ENMAX); Exhibit 20414-X0622, PDF pages 25-26 (ATCO); Exhibit 20414-X0624, PDF pages 21-22 (Fortis); Exhibit 20414-X0639, PDF pages 10-11 (AltaGas).

²¹⁸ Exhibit 20414-X0173, BRATTLE-AUC-2016APR15-011(b).

²¹⁹ Exhibit 20414-X0639, AltaGas reply argument, paragraph 31; Exhibit 20414-X0619, ENMAX argument, paragraph 94.

²²⁰ Exhibit 20414-X0256, EDTI-AUC-2016APR15-015(a) and Transcript, Volume 14, page 2939 lines 15-22 (Mr. Baraniecki).

²²¹ Exhibit 20414-X0618, UCA argument, paragraph 67.

²²² Specifically, if the Commission were to set some value of X, say X_0 , the recommendation from the utilities could be expressed as: $X = \begin{cases} X_0, & \text{if } I > X_0 \\ I, & \text{if } I < X_0 \end{cases}$

²²³ Exhibit 20414-X0173, BRATTLE-AUC-2016APR15-011(b); Exhibit 20414-X0256, EDTI-AUC-2016APR15-015(c); Exhibit 20414-0321, CCA-AUC-2016APR15-012(b).