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Witness: Julia Frayer
Request from: Public Utilities Regulatory Authority

Question:

(OM&A PFP AND X-FACTOR) Exhibit CLP-PBR-2; Interrog. Resps. OCC 538 and OCC-560. London Economics International (LEI) calculates average OM&A Partial Factor Productivity (PFP) growth of approximately –0.03 over the 2005-2024 period.

a. Explain why the arithmetic average, rather than another measure of central tendency (e.g., median, trimmed mean, etc.), is the appropriate measure for establishing the X-factor, particularly given the variation in annual in OM&A growth rates.
b. Provide the average OM&A PFP growth rate and resulting X-factor after minorizing the highest and lowest annual observations to the second-highest and second-lowest observations, respectively.
c. Explain whether the results from subpart (b) change the Company's position that -0.03 is a reasonable estimate of expected industry OM&A productivity growth.

Response:

a. LEI uses the arithmetic average of annual logarithmic OM&A PFP growth rates because the objective of the Industry TFP Study is to measure the annualized rate of productivity growth[1] over the full 2005–2024 study period, rather than the productivity growth rate of a "typical" individual year. As explained in Section 2.5 of Exhibit CLP-PBR-2, LEI calculates annual productivity growth using natural-log changes in the OM&A PFP index. This approach is consistent with established productivity and index-number literature, which measures productivity growth through changes in output and input indexes over time.[2] Because logarithmic growth rates are additive over time,[3] the arithmetic average of the annual growth rates is mathematically equivalent to the logarithmic change between the beginning and ending index values divided by the number of annual observations. It therefore preserves the cumulative productivity change actually measured over the study period.

b. A median answers a different question. A median identifies the midpoint of a data series, in our case, that would be the midpoint of a monotonically increasing series composed of the 19 annual observations, but it does not measure the annualized growth rate associated with the actual cumulative change in the PFP index over the study period. Similarly, a trimmed mean or winsorized mean removes or modifies information in the tails of the annual distribution and therefore does not preserve the mathematical relationship between

the annual growth observations and the actual beginning-to-ending change in the chained PFP index. Please refer to the response to subpart (b) for additional discussion of winsorization.

c. The variation in annual OM&A PFP growth does not, by itself, provide a reason to use a median or trimmed mean. Year-to-year productivity growth can vary because of changes in operating conditions, expenditure timing, economic conditions, and other factors. As explained in Exhibit CLP-PBR-2 and LEI's prior discovery responses, the 20-year study period was selected to reduce the influence of short-term volatility and unusual individual years while remaining sufficiently recent to reflect industry conditions relevant to the prospective PBR period. Accordingly, both favorable and unfavorable annual observations contribute to the measurement of the industry's long-run productivity trend.

d. LEI views the reference to "minorizing" in the question as a typographical error and that Staff intended to refer to "winsorizing." Winsorization is a statistical procedure that replaces extreme observations with less extreme values rather than excluding those observations.[4] In this instance, Staff specifies replacing the highest and lowest annual observations with the second-highest and second-lowest observations, respectively.

e. The largest annual OM&A PFP observation in the 2005–2024 study period is 7.21% for 2020–2021, and the second-largest is 4.63% for 2012–2013. The smallest annual observation is -12.72% for 2019–2020, and the second-smallest is -5.79% for 2006–2007. For purposes of fulfilling the request, applying the procedure specified in the question results in an average OM&A PFP growth rate of approximately 0.20%.

f. LEI provides this calculation as requested by Staff but does not consider the winsorized result to be an alternative estimate of the 2005–2024 industry OM&A PFP growth rate to be appropriate for setting the X Factor. Applying winsorization alters two observed annual productivity changes that LEI has not identified as erroneous and breaks the mathematical year-over-year relationship between the annual logarithmic growth rates and the cumulative change in the OM&A PFP index over the study period. The resulting 0.20% therefore represents the average of a modified series rather than the annualized growth rate of the OM&A PFP index actually measured over 2005–2024.

g. Accordingly, while the calculation illustrates the numerical effect of modifying the two tail observations, LEI does not view it as providing a sound methodological basis for substituting the winsorized result for the -0.03% long-run OM&A PFP estimate. LEI therefore continues to consider the 2005–2024 result of -0.03% appropriate for purposes of the Company's proposed X Factor.

h. No. The result in subpart (b) does not change the Company's position that -0.03% is a reasonable estimate of expected industry OM&A productivity growth. The winsorized result reflects a sensitivity in which two valid observed annual growth rates are replaced. It therefore does not properly measure the industry trends over the 2005–2024 study period as captured by LEI's estimate. LEI has not identified any of the purported extreme observations as erroneous. Accordingly, while the calculation in subpart (b) illustrates the numerical effect of modifying the tail observations, the theory of index number-based productivity measures does not support replacing the -0.03% long-run OM&A PFP estimate for purposes of establishing the X Factor under the Company's proposed plan.

[1] Jeff D. Makholm, Agustin J. Ros, and Stephen C.W. Collins, "North American Performance-Based Regulation for the 21st Century," The Electricity Journal, Vol. 25, No. 4 (May 2012), pp. 33–47. < https://www.sciencedirect.com/science/article/abs/pii/S1040619012000905?via%3Dihub>

[2] *See*, e.g., D.W. Jorgenson and Z. Griliches, "The Explanation of Productivity Change," Review of Economic Studies, Vol. 34, No. 3 (1967), pp. 249–283. <https://academic.oup.com/restud/article-abstract/34/3/249/1533121?redirectedFrom=fulltext>; W.E. Diewert, "Exact and Superlative Index Numbers," Journal of Econometrics, Vol. 4, No. 2 (1976), pp. 115–145 < https://www.sciencedirect.com/science/article/abs/pii/0304407676900099?via%3Dihub>; D.W. Caves, L.R. Christensen, and W.E. Diewert, "The Economic Theory of Index Numbers and the Measurement of Input, Output, and Productivity," Econometrica, Vol. 50, No. 6 (1982), pp. 1393–1414, < https://www.jstor.org/stable/1913388?origin=crossref>

[3] Christopher Kask and Edward Sieber, "Productivity Growth in 'High-Tech' Manufacturing Industries," Monthly Labor Review, U.S. Bureau of Labor Statistics (March 2002). < https://www.bls.gov/opub/mlr/2002/03/art2full.pdf>

[4] National Institute of Standards and Technology (NIST), *Winsorize*, Engineering Statistics Handbook/DataPlot Reference Manual, < https://www.itl.nist.gov/div898/software/dataplot/refman2/auxillar/winsor.htm>