PBR PLANS FOR ALBERTA:

RESPONSE TO SECOND NERA REPORT

AUC ID 566 RRI

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TABLE OF CONTENTS

1. Introduction

The Alberta Utilities Commission ("AUC" or "Commission") in February 2010 began a Rate Regulation Initiative to reform regulation in the province. Proceeding 566 was established, and gas and electric power distributors were directed to file performance-based regulation ("PBR") plans. The Commission indicated that it would like the plans to have a design broadly similar to that which it approved in 2010 for ENMAX Power Corporation, the power distributor serving Calgary. The ENMAX plan features a multi-year rate case moratorium and a rate escalation mechanism with an inflation – X formula. The inflation measure in the formula is a custom index of Alberta input price inflation.

In North America, the rate escalation mechanisms of PBR plans are often designed using research on utility input price and productivity trends. The AUC retained National Economic Research Associates ("NERA") to prepare a productivity study or studies that would be useful in calibrating X factors for Alberta distributors. In a report filed in December 2010, NERA presented a study of the multifactor productivity ("MFP") trend of power distributors in the United States over the 1973-2009 sample period.[1] It maintained that the results were applicable to Alberta gas distributors as well as to power distributors. The MFP index NERA developed displays a marked slowdown in productivity growth and a negative growth trend over the last eleven years of the sample period.

In testimony filed in July 2011, most Alberta distributors filed PBR proposals. The rate escalation mechanisms in these proposals are diverse. However, all feature an escalation formula with a negative X factor that is rationalized in part by the negative trend in the NERA MFP index for the later years of the sample period. ATCO witness Carpenter and AUI witness Schoech both pronounced the methodology of the NERA MFP index to be fundamentally sound. Most utilities opposed the addition of a stretch factor to the X factor.

[1] NERA describes its index as a *total* factor productivity ("TFP") index but it in fact excludes several classes of inputs, including those for administrative and customer care services.

With respect to other plan provisions, most utilities proposed to monitor service quality ("SQ") but did not include an SQ award/penalty mechanism ("APM") in their PBR plan. Three of the five utilities proposed "efficiency carryover mechanisms" ("ECMs") that are purported to let the companies to keep a share of the benefits of long term performance gains after the first PBR plan terminated.

In December 2011, Pacific Economics Group Research LLC filed a report on behalf of the Consumers' Coalition of Alberta ("CCA") with its views on the design of PBR plans for Alberta energy distributors. Our report focused on the design of plans for gas distributors. We lodged several criticisms of NERA's MFP index methodology and presented results of research, on the MFP trends of a sample of US gas distributors, which could serve as the basis for gas distributor X factors. In addition to gas distribution MFP indexes we developed companion MFP growth targets that are customized to the general operating conditions of Alberta gas distributors using an econometric model of MFP index growth. We used our Incentive Power simulation model to place the development of a stretch factor on a more objective and reasoned foundation. A general approach was outlined for the design of a custom inflation measure. It is based on the cost of service ("COS") approach to capital cost measurement, which is designed to be compatible with regulatory accounting in Alberta. SQ APMs were recommended.

On 22 February 2012, NERA filed its second report in proceeding 566 ("Second Report").[2] The report responded to the commentary of the CCA and other parties on the MFP research detailed in NERA's first report. As commissioned by the AUC, the Second Report also discussed a survey of various provisions of approved PBR plans and compared the proposals of the Alberta utilities to the gathered precedents. NERA limited its survey to PBR plans in the United States and Canada which feature index-based rate escalation mechanisms.

The CCA has asked PEG Research to review and respond to NERA's Second Report. This is the report on our work. Chapter 2 discusses issues in the development of

[2] NERA, *Update, Reply and PBR Plan Review for AUC Proceeding 566 – Rate Regulation*, 22 February 2012.

X factors. Chapter 3 discusses other PBR plan provisions. A postscript briefly discusses the history of PBR.

2. X Factor Issues

In this section we review salient issues in the design of the X factors which are raised by the second NERA Report. For each issue, we first briefly review the record prior to NERA's second report and then discuss the report and our response.

2.1 Power Distribution

2.1.1 Sample Period

Review

Utilities noted in their testimony a marked slowdown in the growth of NERA's original MFP index, which begins around 1999. The average annual growth rate in the index was 0.85% over the full sample period but -1.00% over the last eleven years (1999-2009). Various speculations were lodged by utility witnesses about why MFP growth in the industry might have slowed in these years.

The trend in NERA's output index is a revenue-weighted average of trends in retail service volumes. In our report last December, we stated a concern that such an index is quite sensitive to the extraordinary slowdown in volume growth that occurred in the last two years of NERA's full sample period due to the severe recession that occurred in the States. We recommended that the end date for NERA's MFP index should be 2007. The removal of these two years has a material impact on the MFP trend even with a 1972 start date for the sample period.

Second NERA Report

In its Second Report, NERA advocates use of the "largest time period available" to calculate MFP trends that are used to calibrate utility X factors, and NERA opposes the sample period truncations proposed by utilities. Here are some key arguments.

- The start dates proposed by utility witnesses lack an "objective basis" and reflect the analysts' "subjective judgments" (page 45).

- There is little if any commentary "from disinterested or scholarly sources" that growth in power (or gas) distributor MFP has substantially slowed in recent years (page 5).
- MFP growth may be erratic in the short term but "will eventually revert back to its long-term trend" (page 14). Any use of a shorter sample period in X factor calibration should be justified using a "statistical testing procedure along the lines of accepted research in the area of structural breaks" (page 16).
- Volumetric data can be sensitive to recessions and price shocks, but "our preference has always been to use kWh with the longest time series that Form 1 permits so as to dampen the effects of the kind of short-term or cyclical patterns that would most influence kWh sales as a measure of output" (page 23).

Response

We do not believe that the calculation of the long-term MFP trend for use in X factor calibration is always best served by mechanistically using the longest sample period available. For example, delivery volumes are well known to be volatile due to volatile business conditions such as weather and economic activity. When a volumetric output index is employed in an MFP calculation, the likelihood of identifying the long term MFP trend is therefore increased by choosing start and end dates that reflect broadly similar values for key volume drivers. A long sample period reduces the sensitivity of the trend to the start and end dates, but attention to volume drivers on the start and end dates is still warranted.

Table 1 presents data on US cooling degree days and the unemployment rate (a proxy for the business cycle) during the 1972-2009 period. It can be seen that the US unemployment rate was extraordinarily high in 2009, exceeding 9%. The unemployment rate was only 5.6% in 1972, the first year of NERA's index. Cooling degree days were meanwhile similar in 2009 and 1972.

This evidence underlines the desirability of ending the sample period in 2007. Only two years of data are lost and the unemployment rate is much more similar to that in 1972. If a substantially shorter sample period is desired, ending the sample period in 2007 rather than 2009 is even more imperative. Any test for a recent "structural shift" in the MFP trend should therefore use a sample period ending

Table 1

HISTORICAL VOLUME DRIVERS 1972-2010

Year	Cooling Degree Days [1]	Difference from 2007	Unemployment Rate [2]	Difference from 2007	Combined Impact on Volume
		[A]		[B]	[B] - [A]
1972	**1,187**	**-15.0%**	**5.6%**	**19.7%**	34.7%
1973	1,275	-7.8%	4.9%	6.3%	14.2%
1974	1,157	-17.6%	5.6%	19.7%	37.2%
1975	1,206	-13.4%	8.5%	61.4%	74.8%
1976	1,063	-26.0%	7.7%	51.5%	77.5%
1977	1,325	-4.0%	7.1%	43.4%	47.4%
1978	1,271	-8.2%	6.1%	28.2%	36.4%
1979	1,155	-17.7%	5.8%	23.2%	40.9%
1980	1,353	-1.9%	7.1%	43.4%	45.3%
1981	1,253	-9.6%	7.6%	50.2%	59.8%
1982	1,180	-15.6%	9.7%	74.6%	90.2%
1983	1,293	-6.4%	9.6%	73.6%	80.0%
1984	1,255	-9.4%	7.5%	48.9%	58.3%
1985	1,240	-10.6%	7.2%	44.8%	55.4%
1986	1,294	-6.4%	7.0%	42.0%	48.3%
1987	1,310	-5.1%	6.2%	29.8%	35.0%
1988	**1,325**	**-4.0%**	**5.5%**	**17.9%**	**21.9%**
1989	1,202	-13.7%	5.3%	14.2%	27.9%
1990	1,305	-5.5%	5.6%	19.7%	25.2%
1991	1,370	-0.7%	6.8%	39.1%	39.7%
1992	1,091	-23.4%	7.5%	48.9%	72.3%
1993	1,262	-8.9%	6.9%	40.5%	49.4%
1994	1,266	-8.5%	6.1%	28.2%	36.8%
1995	1,333	-3.4%	5.6%	19.7%	23.1%
1996	1,227	-11.7%	5.4%	16.0%	27.7%
1997	1,205	-13.5%	4.9%	6.3%	19.8%
1998	1,452	5.2%	4.5%	-2.2%	-7.4%
1999	1,335	-3.2%	4.2%	-9.1%	-5.9%
2000	1,276	-7.8%	4.0%	-14.0%	-6.2%
2001	1,292		4.7%		
2002	1,402		5.8%		
2003	1,296		6.0%		
2004	1,248		5.5%		
2005	1,411		5.1%		
2006	1,388		4.6%		
2007	**1,379**		**4.6%**		
2008	1,261		5.8%		
2009	**1,209**		**9.3%**		
2010	1,427		9.6%		

Footnotes:

[1] EIA-861, "Annual Electric Utility Report"

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

[1] National Climatic Data Center, "NNDC Climate Data Online."

[2] United States Department of Labor, Bureau of Labor Statistics, Series ID LNU04000000 Labor Force Statistics From the Current Population Survey. Labor Force Statistics From the Current Population Survey.

in 2007, not 2009.

With respect to the debate between NERA and the utilities concerning the merit of a shorter sample period, we believe that there is some value in a shorter period because even long term drivers of MFP growth such as technological change can change over a period of several decades. On the other hand, the utilities have provided no credible explanation of why the sample period should begin just as the period of slower productivity growth begins. As NERA points out, no credible explanation of this slowdown has been ventured and, in the absence of such an explanation, we cannot know whether the more recent sample period is more or less relevant for Alberta utilities.

Caution is further encouraged by the fact that other recent studies of power distribution MFP growth have not corroborated NERA's finding of a major MFP slowdown. A summary of recent research results is provided in Table 2. It can be seen that no recent study reports a negative MFP trend. For example, a study by Christensen Associates Energy Consulting for Kansas City Power & Light reported 0.7% average annual MFP growth for US power distributors over the 1994-2004 period.[3]

Should the Commission be persuaded of the need for a more recent sample period, we recommend one of intermediate length that has an objective basis. We propose one that ends in 2007 and begins in 1988, a year in which both US CDDs and the unemployment rate were similar to their 2007 levels.[4] Using the old NERA MFP index, the average annual growth rate over the 19 years from 1989 to 2007 is 0.59%.

2.1.2 Labor Quantity Index

Review

In our filing last December we stated a concern that NERA had miscalculated the labor quantity trend for the later years of the sample period. We recommended as an alternative a residual approach to calculating the trend by taking the difference between the trends in salaries and wages and an appropriate salary and wage price index.

[3] See, for example, Direct Testimony of Robert J. Camfield on Behalf of Kansas City Power & Light in Docket No. 06-KCPE-828-RTS, January 2006.

[4] The first relevant productivity growth rate is then that for 1989.

Table 2
Summary of Energy Distribution MFP Research

Author	In Research for	Industry/Company	Time Period Studied	Annual Growth Trend
		Gas Distribution		
PEG Research	Consumers' Counsel of Alberta	US	1996-2009	1.32%
PEG Research	San Diego Gas & Electric Co	US	1999-2008	1.18%
PEG Research	Gaz Metro	Gaz Metro	2000-2009	1.66%
PEG Research	Ontario Energy Board	Enbridge Gas Dist	2005-2010	1.07%
PEG Research	Ontario Energy Board	Union Gas	2005-2010	1.65%
PEG	Ontario Energy Board	Enbridge Gas Dist	2000-2006	0.60%
PEG	Ontario Energy Board	Union Gas	2000-2006	1.47%
PEG	Ontario Energy Board	US	1994-2004	1.61%
Industry Average				**1.32%**
		Power Distribution		
PEG Research	San Diego Gas & Electric Co	US	1999-2008	0.88%
Economic Insights	New Zealand Commerce Commission	New Zealand	1996-2008	0.31%
PEG	Central Vermont Power Service	US	1996-2006	1.03%
PEG	Ontario Energy Board	US	1988-2006	0.72%
PEG	Central Maine Power (CMP)	Northeast US	1993-2005	1.57%
CA Energy Consulting	Kansas City Power & Light (KCPL)	US	1994-2004	0.70%
Industry Average				**0.87%**

Second NERA Report

NERA acknowledged its error and has upgraded its labor quantity specification. The average annual growth rate for the revised MFP index over the full sample period rose from 0.85% to 0.96% and this is now NERA's recommended MFP growth target. The average annual growth rate for the nineteen year 1989-2007 period rose more substantially, from 0.59% to 0.76%. The average annual growth rate for the eleven year 1999-2009 period rose from -1.00% to -0.65%. These and other new MFP results are summarized in Table 3.

2.1.3 Volume Data

Review

We noted in our first report that the volumes NERA used to construct its output index are commonly *sales* volumes obtained from Federal Energy Regulatory Commission ("FERC") Form 1 reports. For U.S. utilities that, like those in Alberta, have been restructured to create retail competition, sales volumes can differ materially from the volumes *delivered* in the later years of the sample period. An alternative data source, the Form EIA 861, is available from the U.S. Energy Information Administration from which it is possible to construct delivery volumes for these utilities. We use these data routinely in our power distribution productivity and econometric cost research. We proposed in our first report to "patch in" EIA 861volume data for the later years of the sample period.

Second NERA Report

In its Second Report NERA acknowledges that the FERC Form 1 volumes are sales volumes. They note that when a patch is added to their index with the labor quantity upgrade, the MFP trend for the full sample period rises from 0.96% to 1.08%. The impact is presumably magnified considerably in the later years of the sample period but NERA does not report results for these years.

NERA nonetheless opposes the idea of an EIA 861 patch. They argue that sales volume data are problematic for only a few companies, that the effect on the long term productivity trend isn't large, and that the EIA 861 data also contain some "anomalies".

Table 3

SUMMARY OF NERA MFP RESULTS WITH CORRECTIONS AND ALTERNATIVE SPECIFICATIONS

	MFP Trend			Output Quantity Trend			Input Quantity Trend		
	1973-2009	1999-2009	1989-2007	1973-2009	1999-2009	1989-2007	1973-2009	1999-2009	1989-2007
NERA First Report	0.85%	-1.00%	0.59%	2.11%	0.80%	1.88%	1.25%	1.80%	1.29%
NERA Second Report	0.96%	-0.65%	0.76%	2.11%	0.80%	1.88%	1.15%	1.46%	1.12%
Three Category Output Index	0.93%	-0.64%	0.76%	2.08%	0.82%	1.88%	1.15%	1.46%	1.12%
Three Category with 861	1.01%	-0.53%	0.84%	2.16%	0.94%	1.96%	1.15%	1.47%	1.12%
Above with Gross Stock	1.14%	-0.37%	0.95%	2.16%	0.94%	1.96%	1.02%	1.30%	1.01%
Volume Weighted Tornqvist Index	**1.20%**	**-0.19%**	**1.08%**	**2.20%**	**1.10%**	**2.05%**	**0.99%**	**1.29%**	**0.97%**
Cumulative Change from First Report	**0.35%**	**0.80%**	**0.49%**	**0.09%**	**0.30%**	**0.17%**	**-0.26%**	**-0.51%**	**-0.31%**

Response

We feel that NERA's stated reservations about an EIA 861 patch are not appropriate grounds for reliance on FERC Form 1 sales data in the later years of the sample period. Arguments favoring the patch can be summarized as follows.

- NERA uses an all-volumetric output index and this makes it especially important to use the best volumetric data available.
- The period in which the EIA 861 data are superior is the period during which MFP growth slows, and this is the period that Alberta utilities propose to rely on in setting their X factors.
- Form EIA 861 data are clearly superior for a number of restructured utilities and tend to be very similar or identical to the sales volumes for vertically integrated utilities, as they should be.

As for NERA's contentions of problems with the EIA 861 data we have the following response. Two of the cited anomalies are related to a change in the classifications of customers into commercial (small) vs. industrial (large). Companies are generally given flexibility to classify these customers based on size or industrial classification. These classification changes happen on both the FERC Form 1 and EIA-861 and therefore we do not believe that this is evidence of the deficiency of the EIA-861 data. We would not object to an appropriate imputation or exclusion of companies that had such classification changes if it mattered for the study.

The other cited data anomalies were minor in our opinion. Other considerations such as a change in the standard deviation are not relevant because the issue is the correct measurement of output. We maintain our opinion that the EIA-861 is a superior data source because it measures the deliveries of power as opposed to only the sales of bundled power in many cases.

PEG Research has accordingly recalculated NERA's new MFP index, with its labor quantity upgrade, using our proposed EIA 861 patch. We use a three–category volumetric index in which the commercial and "other" volume categories have been consolidated. For the full sample period, the patch raises the MFP trend only slightly, from 0.96% to 1.01%. For the 19 year 1989-2007 period, the patch raises the growth trend more substantially, from 0.76% to 0.84%. For the eleven year 1999-2009 period the patch raises the trend from -0.65% to -0.53%. It can be seen that the EIA 861 patch has a material impact in the later years of the sample period. Accordingly, any statistical test of a structural shift in the MFP trend should be based on an MFP index that uses the EIA 861 patch.

2.1.4 Benchmark Year Adjustment

Review

MFP indexes require capital costs that decompose into indexes of capital price and quantity trends. Capital quantity indexes essentially measure the trend in the inflation-adjusted (sometimes described as the "real") value of plant. The first year of the capital quantity index is sometimes called the "benchmark year". In this year, the value of the index is the ratio of the value of plant to a construction cost index. The inflation adjustments are complicated by the fact that reported plant values are expressed in historical dollars and therefore reflect construction costs in prior decades. In the United States, detailed regional power distribution construction cost indexes are available from Whitman, Requardt and Associates. In many MFP studies, a "triangularized" weighted average ("TWA") of past values of these "Handy-Whitman" indexes has been employed in benchmark year calculations. This places a heavier weight on more recent values of the index.

Several operational formulas for calculating capital cost have been used in MFP research. The geometric decay and COS approaches both assume that the quantity of investment from a given capital expenditure declines gradually over time due to depreciation. The quantity of plant in a given year is then the real value of *net* plant. NERA, however, assumed a "one hoss shay" approach to capital costing in its MFP research. Under this approach, the quantity of plant from an investment does not decline gradually but instead falls to zero abruptly when it is retired, much as gross plant value is unchanged until it is removed from the books.

We stated in our December report that the benchmark year adjustment should be theoretically consistent with the basic approach to capital cost measurement. With the geometric decay and COS approaches, the quantity of plant in the benchmark year should be the inflation-adjusted value of *net* plant. With the one hoss shay approach, however, we maintained that the quantity of plant in the benchmark year should be the inflation-adjusted value of *gross* plant. NERA's use of net plant value in the benchmark year adjustment is thus inconsistent with the one hoss shay specification and would tend to impart a downward bias to the MFP trend.

We also stated in our December report that the TWA of past values of the construction cost index that NERA used in its benchmark year adjustment was inconsistent with one hoss shay.[5] We suggested instead that an arithmetic (even-weighted) average of past values of the construction cost index was the proper match for one hoss shay.

Second NERA Report

In its Second Report, NERA rejected our suggestions for a better benchmark year adjustment, venturing two arguments. One is that Dr. Makholm had used this approach in several past studies without challenge. The other is that net plant value and TWAs of construction cost indexes are widely used in the benchmark year adjustments of published MFP studies.

Response

We believe that NERA's arguments in defense of its benchmark year adjustment have little merit. Dr. Makholm has not done a large number of MFP studies, and in his previous (two) uses of the method in the regulatory arena he may not have had to reckon with technically competent reviewers. To our knowledge, he has published no articles using his methodology in refereed economic journals. The association of one hoss shay with gross plant value is so great that the noted Canadian productivity expert Erwin Diewert has commented that "this model is sometimes known as the gross capital stock model."[6] It is true that net plant value and a TWA construction cost deflator are commonly used in benchmark year adjustments but that is because capital costing methods, such as geometric decay, that assume gradual depreciation are much more commonly used than one hoss shay in MFP work.

[5] In fact, the TWA weighting that NERA used can be shown to be consistent with the assumption of COS capital costing that PEG Research uses and constant annual quantity additions.

[6] Erwin Diewert and Denis A. Lawrence, "Progress in Measuring the Price and Quantity of Capital", presented at the Canberra Group on Capital Stock Statistics in Washington DC in November 1999.

We have recalculated NERA's MFP index using an alternative benchmark year adjustment that deflates gross plant in the benchmark year by an arithmetic average of historical construction cost index values. We find that the addition of the upgraded adjustment to our proposed EIA 861 patch raises the MFP trend for the full sample period from 1.01% to 1.14%. The trend for the nineteen year 1989-2007 period is raised from 0.84% to 0.95%. The trend for the eleven year 1999-2009 period is raised from -0.53% to -0.37%.

2.1.5 Index Form

Our development of upgraded MFP index results for NERA was complicated by the fact that they use a multilateral Tornqvist form for their input quantity index. The value of the index is a weighted average of logarithmic comparisons of the quantities of the individual companies to the corresponding sample mean values of these quantities. There are separate quantity comparisons for capital, labor, and other inputs. The weight for each subindex is an arithmetic average of the share of the corresponding cost for the company and an average of the shares for all companies over the full sample period.

The advantage of the multilateral approach is that it permits the input quantities of individual utilities to be compared on both a trend and a levels basis. We could, for example, use such an index to compare the input quantity levels of the utilities in the US sample. However, this capability has no benefit in an X factor calibration exercise, where the focus is exclusively on quantity *trends*. Moreover, it is well established in the economics literature that the multilateral form is not ideal for measuring trends due to the problem of "characteristicity."[7] To calculate trends it is preferable to instead use "chain-weighted" input quantity trend indexes. The growth in such an index is a weighted average of the logarithmic annual growth rates of the quantities. The weights for the quantity subindexes are entirely company specific and change from year to year as cost shares change. If labor productivity is growing rapidly, for example, labor cost will decline and the weight on labor quantity growth will diminish in the later years of the sample period. Another problem with the multilateral approach is that sample means must be changed when the sample period changes. We have spoken above, for example,

[7] See, for example, the discussion in L. Dreschler, "Weighting of Index Numbers in Multilateral International Comparisons", *Review of Income and Wealth*, Vol. 19, 1973 pp. 17-34.

of the trends in MFP indexes for the last eleven years. We did not recalculate NERA's index to use different sample means in reporting these calculations

We have recalculated NERA's MFP index with the upgrade to the labor quantity index using the 861 patch, our upgrade to the benchmark year adjustment, and chain-weighted input quantity indexes of Tornqvist form. We find that the MFP growth trend for the full sample period rises from 1.14% to 1.20%. The MFP growth trend for the nineteen year 1989-2007 period rises from 0.95% to 1.08%. The MFP growth trend for the eleven year 1999-2009 period rises from -.0.37% to -0.19% (close to zero).

2.1.6 Customization of Productivity Targets

Review

Most parties to the proceeding criticized NERA for not considering special features of the Alberta operating environment in establishing MFP growth targets.

Second NERA Report

NERA restated in its Second Report its objection to using custom productivity targets in X factor calibration. Its arguments included the following.

- The theory of PBR calls for the X factor to reflect "the sort of long-term, underlying industry productivity trend that a competitive firm would face in their own industries" (page 18).
- "The theory underlying the kind of PBR *sought by the AUC* seeks to inject the type of incentives experienced by company managements in competitive industries where benchmark prices move according to the productivity of the industry in question rather than to the particular costs of one company" (page 19, italics added).

- The issue in X factor calibration is the MFP *trend.* Many conditions that cause utility cost *levels* to vary between service territories may not have much effect on cost trends.

- NERA used regional peer groups in *both* of its MFP studies for X factor calibration, including a western peer group in work for Utiliticorp Alberta. It stated in the Second Report that it did not calculate results for such a peer group because data were available for fewer companies and results could be unstable.

Response

Index theory reveals that the trend in the prices of a *firm or industry* earning a competitive rate of return is the difference between the trends in the corresponding input prices and total factor productivity. The *revenue* of a firm or industry earning a competitive rate of return is the difference between the trends in its input prices and total factor productivity plus the growth in output.

One possible use of these results is to invoke a "competitive market paradigm" in which a rate or revenue cap escalator is based on industry input price and productivity research. However, firms in competitive markets can experience substantial windfall gains and losses. Wheat farmers in Saskatchewan, for instance, can have a good year if drought conditions in the States (which reduce productivity there and thereby raise prices) do not cross the border. Since participants in utility regulation are generally not keen on windfall gains and losses, it is understandable that index logic could be placed at the service of developing rate and revenue caps more tailored to local business conditions. Performance incentives can be still be strong provided that the escalators are sensitive only to local *external* business conditions such as the opportunity to realize scale economies and not to the productivity growth of the subject utility.

We do not agree with NERA that customized productivity growth targets are inconsistent with the seminal works of PBR theory. William Baumol, for example, devised an early statement of index-based regulation in collaboration with Arthur Okun.[8] The guiding principle is to recreate market pressures that exist under competition using an inflation – X formula. While inflation and productivity targets should be constructed

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[8] William J. Baumol, "Productivity Incentive Clauses and Rate Adjustments for Inflation", *Public Utilities Fortnightly, July 22 1982*, at 11.

so that they can not be changed by the companies' actions, the productivity trend target should reflect "the prospective rate of growth of the company's productivity."

E. Fred Sudit was another early proponent of index based regulation for public utilities that are based on productivity performance.[9] Nothing in his method precludes a customized approach in calculating the productivity trend. He notes the potential for business conditions that are cost drivers outside the company's control.

As NERA acknowledges in its responses to a data request from the CCA, Denny, Fuss and Waverman ("DF&W") undertook a decomposition of MFP growth in a classic 1981 paper.[10] The authors show that MFP *growth*, and not just cost *levels*, depends on diverse external business conditions and these can vary between service territories. Econometric analysis can quantify the relative importance of these business conditions, and this can guide the search for an MFP growth peer group or the development of an econometric MFP growth target. PEG Research used the DF&W analysis to project productivity targets for Union Gas and Enbridge Gas Distribution in work for the Ontario Energy Board. An article discussing this research has been published in the *Review of Network Economics.*[11]

As for NERA's contention that the AUC does not seek custom productivity targets, its April 2010 commentary in proceeding 566 states that

> While the Commission is satisfied that the bases for the inflation and productivity factors in the ENMAX formula are acceptable for electric utilities, the inflation and productivity factors will need to be determined for the gas distribution utilities. The rate structures (fixed/variable charges), geographic territories served and sizes of the various companies may, for example, need to be considered in determining the values of

[9] E. Fred Sudit, "Automatic Rate Adjustments Based on Total Factor Productivity Performance in Public Utility Regulation" in *Problems in Public Utility Economics and Regulation* 55 (Michael A. Crew ed. Lexington Books, 1979.

[10] Michael Denny, Melvyn A. Fuss and Leonard Waverman (1981), "The Measurement and Interpretation of Total Factor Productivity in Regulated Industries, with an Application to Canadian Telecommunications," in Thomas Cowing and Rodney Stevenson, eds., *Productivity Measurement in Regulated Industries*, (Academic Press, New York) pages 172-218.

[11] Mark Newton Lowry and Lulitt Getachew, "Econometric TFP Targets, Incentive Regulation, and the Ontario Gas Distribution Industry", *Review of Network Economics* Vol. 8 Issue 4, December 2009.

various factors in the formula. In addition, there may be other matters specific to individual companies that will need to be considered before a PBR formula is determined and applied.

While it is possible that the AUC gave NERA different directions in retaining them for a productivity study, NERA states in their response to data request CCA-NERA-19 that they have had no supplemental correspondence with the Commission concerning its research preferences.

2.2 Gas Distribution

2.2.1 Second NERA Report

NERA supports the methodology used by PEG Research in its MFP index study (page 46). This is a noteworthy finding, since utilities may in their follow-up testimony dispute some details of this methodology. NERA goes on to say on this page that "the X factor that Dr. Lowry recommends is in the range that one would consider acceptable given experience for other energy utilities in North America." NERA does express concern about the use of proprietary data in our study.

Concerning the econometric TFP growth model that we developed, NERA states that it has value in peer-reviewed scholarly research but may be ineffective in an adversarial proceeding "where every element of subjective or expert choice (and in a complex econometric analysis there are many) opens the door to esoteric debate amongst experts" (page 24). NERA recommends against the use of such methods in X factor determinations.

2.2.2 Response

Concerning the proprietary nature of the data in our gas study, only the older capital cost data, which are used to improve the accuracy of the capital quantity indexes and corresponding cost weights, are not drawn from sources that are entirely public. These data were drawn from Uniform Statistical Reports ("USRs") that gas utilities file with the American Gas Association ("AGA"). These data are "quasi-public" inasmuch as the forms are standardized and were developed by the AGA; industry-level data from USRs are published periodically by the AGA in *Gas Facts*; some companies have shared (and may continue to share) their USRs with the public; and the data we have obtained are freely available for use in this proceeding to witnesses prepared to sign a confidentiality agreement. All of our other data are in the public domain but much of it has been purchased from a respected commercial vendor (SNL Financial) and there are contractual limits on our ability to freely share these. Any other purchaser of these quality data would face the same restrictions.

To allay concern about this data issue, we recomputed the MFP trend of the industry using data that are entirely in the public domain in our response to data request ATCO-CCA-32. We used 1994 as the benchmark year for the capital quantity index. The sample consists of the same 34 companies used in our previous calculations. Growth rates are calculated and averaged for the fourteen year 1996-2009 period.

Results of this research are reported in Tables 4 and 5. It can be seen in Table 4 that with the new benchmark year the average MFP trend of the sampled utilities for the full sample period fell modestly, from 1.32% to 1.19% for the full sample. Output growth averaging 1.46% annually outpaced input growth averaging 0.27%. The MFP trend for the western distributors in the sample fell from 1.84% to 1.59%. Table 5 provides details of the input quantity subindexes and associated partial factor productivities.

2.3 Stretch Factor

2.3.1 Review

EPCOR proposed a stretch factor of 0.2% for its PBR plan. Other utilities opposed the addition of a stretch factor to the X factors. PEG Research noted that 0.5% stretch factors are typical in PBR plans designed using productivity research. We also enunciated the principle that the stretch factor should share the expected acceleration in productivity growth that results from PBR. Our Incentive Power simulation model indicated a stretch factor of only 0.13% because the base MFP growth factor already reflects the incentive power of regulatory systems with more incentive power than that currently used in Alberta. The Incentive Power model producing these results had been calibrated to produce MFP growth similar to that of the industry under normal regulatory conditions. However, the results reflected an MFP growth trend somewhat slower than

Table 4

Gas Productivity Index Results

	Output Quantity		Input Quantity		MFP	
Year	Full Sample	Western Sample	Full Sample	Western Sample	Full Sample	Western Sample
1996	2.08%	3.92%	1.24%	1.63%	0.84%	2.29%
1997	1.92%	2.40%	-1.11%	0.44%	3.03%	1.96%
1998	1.86%	2.98%	-0.20%	2.60%	2.07%	0.38%
1999	2.04%	3.91%	-0.20%	-1.75%	2.24%	5.66%
2000	1.94%	2.78%	2.08%	-0.14%	-0.14%	2.92%
2001	1.70%	2.74%	-1.67%	1.50%	3.37%	1.24%
2002	1.38%	1.88%	0.45%	0.62%	0.93%	1.26%
2003	1.10%	2.29%	1.09%	3.59%	0.01%	-1.30%
2004	1.33%	2.41%	1.32%	0.50%	0.01%	1.91%
2005	1.65%	3.48%	0.95%	1.89%	0.70%	1.59%
2006	1.23%	2.42%	-1.88%	0.00%	3.11%	2.41%
2007	1.07%	2.20%	0.94%	1.04%	0.13%	1.16%
2008	0.77%	1.35%	-0.58%	-2.93%	1.35%	4.28%
2009	0.38%	0.46%	1.32%	3.91%	-0.94%	-3.45%
1996-2009	**1.46%**	**2.52%**	**0.27%**	**0.92%**	**1.19%**	**1.59%**

Table 5

Gas Input Quantity and Partial Factor Productivity Results: Full Sample

Year	O&M Quantity	Capital Quantity	Output Quantity	O&M PFP	Capital PFP
1996	1.09%	1.15%	2.08%	0.99%	0.93%
1997	-4.59%	1.24%	1.92%	6.51%	0.68%
1998	-1.45%	0.28%	1.86%	3.31%	1.59%
1999	-2.30%	0.45%	2.04%	4.34%	1.59%
2000	5.61%	0.51%	1.94%	-3.67%	1.43%
2001	-6.63%	0.92%	1.70%	8.33%	0.78%
2002	0.15%	0.95%	1.38%	1.23%	0.42%
2003	0.79%	1.32%	1.10%	0.31%	-0.22%
2004	3.08%	0.57%	1.33%	-1.75%	0.75%
2005	3.19%	-0.37%	1.65%	-1.55%	2.02%
2006	-5.87%	0.41%	1.23%	7.10%	0.82%
2007	3.09%	-0.19%	1.07%	-2.01%	1.26%
2008	-1.65%	-0.01%	0.77%	2.42%	0.78%
2009	4.38%	-0.36%	0.38%	-4.01%	0.74%
1996-2009	**-0.08%**	**0.49%**	**1.46%**	**1.54%**	**0.97%**

that resulting from our new gas MFP trend research.

2.3.2 Second NERA Report

NERA's survey revealed that stretch factors are a common addition to the X factors in North American index-based PBR plans. By our count, stretch factors are noted in roughly a third of the plans that NERA reports. One reason they are not more common is that X factors have frequently been a feature of settlements in which base productivity trend and stretch factor components of the X factor were not itemized.

NERA did not comment on the specific stretch factor proposed by EPCOR or on the range of stretch factors proposed by PEG Research for Alberta's gas utilities. By way of general commentary, NERA noted that stretch factors reflect "subjective judgments" concerning the opportunity for a PBR plan to spur productivity growth.

2.3.3 Response

We believe that our incentive power model takes important steps in the direction of making the calculation of stretch factors more objective. We recalibrated the model to reflect our new gas MFP growth trend estimate in our supplemental response to data request ATCO-CCA-59. With the incentive power model recalibrated, the indicated stretch factor rises six basis points, from 0.13% to 0.19%.

3. Other Plan Design Issues

3.1 Inflation Measure

3.1.1 Review

The PBR plan approved by the AUC for ENMAX featured a custom inflation measure. The "I Factor" is a weighted average of the growth in Alberta Average Hourly Earnings and the Canadian Electric Utility Construction Price Index ("EUCPI"). The weighting on the two input price subindexes is apparently 50/50. ATCO Gas and AltaGas have both proposed I Factors featuring two subindexes: average weekly earnings in Alberta ("AWE") and the comprehensive Consumer Price Index for Alberta. The 57% weight for ATCO is apparently the estimated share of labor in the sum of O&M and capital expenditures, where the labor component of contract services has been extracted from the other cost categories. AltaGas also proposes a 57% labor index weight.

PEG Research acknowledged in its December report the general desirability of an Alberta-specific inflation measure given the unusual inflation activity that is generated by the large natural resource extraction and processing industry in the province. We further commented that in the construction of such a measure the EUCPI should not be used in its *raw* form *a la* ENMAX because the capital price index that is implicit in cost of service regulation is a function of a weighted average of a lengthy series of past values of a construction cost index and also of a rate of return on capital. We criticized the I Factor design proposed by ATGO Gas for placing an excessive weight on the AWE, which is likely to grow more rapidly. The theoretically appropriate weight for labor is the share of direct labor O&M expenses in the total cost of base rate inputs. We also recommended Alberta's Gross Domestic Product Implicit Price Index for final domestic demand (GDPIPI-FDD) as the most pertinent measure of general price inflation in the province.

3.1.2 Second NERA Report

NERA observes in its survey that although most PBR plans surveyed use rate escalation mechanisms with macroeconomic inflation measures, there are precedents in both the US and Canada for industry-specific measures. The most common macroeconomic price indexes employed in the surveyed PBR plans were gross domestic product price indexes. As a matter of principle, NERA states that "an inflation index should be exogenous, reasonably reflecting the cost behavior facing the industry" (page 44). NERA says little concerning the inflation measure proposals of the Alberta utilities, noting that they seem to be constructed from "objective and reliable price indexes." In response to data request ATCO-NERA-03, NERA stated that it "sees nothing problematic about Dr. Lowry's discussion of inflation indexes, even though it requires more time to process than those proposed by the other parties."

3.1.3 Response

We believe that the design of an appropriate inflation measure for a PBR plan depends on much more than whether they are constructed from objective and reliable component price indexes. The subindexes should have appropriate cost share weights and, in the case of capital prices, should ideally be consistent with way that capital cost is calculated in rate cases. We developed a workable industry-specific input price index for Alberta in response to data request ATCO-CCA-63. An index of this kind is potentially applicable to both gas and electric power distributors.

Highlights of this work can be found in Tables 6-10. Table 6 shows some details of index construction. The labor price index employed was the fixed-weight index of average hourly earnings for all workers in Alberta. The GDPIPI-FDD for Alberta was used as the proxy for the materials and services price index. The capital price index is the product of a rate of return and a triangularized-weighted moving average of an Alberta-adjusted EUCPI. The weights for this index were based on the cost shares for O&M expenses and capital (*not* capital expenditures) reported in recent ATCO Gas and AltaGas rate filings. In this calculation, the O&M expense cost share was divided 50/50 between labor and materials & services. The resultant cost shares for the input price index were about 42% for capital and about 29% each for labor and material & service O&M expenses.

Table 7 shows how we calculated a custom Alberta EUCPI by adding to the annual growth rate of the national EUCPI the difference between the annual growth rates in industrial structure construction price indexes for Alberta and Canada. Table 8 shows

Table 6

Calculation of the PEG Research Custom Alberta Input Price Index

	Labor			Materials & Services			Capital			PEG Research Custom Alberta Input Price Index	
Year	Fixed Weight Index of Average Hourly Earnings for all employees, Industrial Aggregate[1 2]	Annual Growth Rate	Weight	GDPIPI-FDD Alberta[3]	Annual Growth Rate	Weight	Custom Alberta Capital Price Index	Annual Growth Rate	Weight	Index	Annual Growth Rate
1995	83.08		29.3%	86.70		29.3%	27.70		41.5%	1.000	
1996	87.21	4.8%	29.3%	88.30	1.8%	29.3%	27.72	0.1%	41.5%	1.020	1.98%
1997	88.96	2.0%	29.3%	90.50	2.5%	29.3%	26.93	-2.9%	41.5%	1.021	0.10%
1998	92.18	3.6%	29.3%	91.90	1.5%	29.3%	26.09	-3.2%	41.5%	1.023	0.17%
1999	94.78	2.8%	29.3%	93.30	1.5%	29.3%	27.27	4.4%	41.5%	1.055	3.10%
2000	96.56	1.9%	29.3%	95.60	2.4%	29.3%	28.17	3.3%	41.5%	1.083	2.61%
2001	98.96	2.5%	29.3%	97.40	1.9%	29.3%	29.17	3.5%	41.5%	1.113	2.71%
2002	100.20	1.2%	29.3%	100.00	2.6%	29.3%	29.90	2.5%	41.5%	1.137	2.15%
2003	104.75	4.4%	29.3%	100.90	0.9%	29.3%	30.04	0.5%	41.5%	1.157	1.75%
2004	107.87	2.9%	29.3%	103.00	2.1%	29.3%	30.42	1.3%	41.5%	1.180	1.98%
2005	112.16	3.9%	29.3%	106.00	2.9%	29.3%	29.66	-2.5%	41.5%	1.191	0.94%
2006	117.23	4.4%	29.3%	111.10	4.7%	29.3%	30.34	2.3%	41.5%	1.235	3.61%
2007	124.18	5.8%	29.3%	116.10	4.4%	29.3%	31.57	4.0%	41.5%	1.293	4.62%
2008	132.16	6.2%	29.3%	120.10	3.4%	29.3%	32.14	1.8%	41.5%	1.340	3.54%
2009	136.40	3.2%	29.3%	121.30	1.0%	29.3%	32.75	1.9%	41.5%	1.367	2.00%
2010	139.88	2.5%	29.3%	122.30	0.8%	29.3%	33.11	1.1%	41.5%	1.387	1.43%
Average Annual Growth Rates											
2001-2010		**3.7%**			**2.5%**			**1.6%**			**2.5%**
1996-2010		**3.5%**			**2.3%**			**1.2%**			**2.2%**
Standard Deviation 1996-2010		**1.4%**			**1.2%**			**2.4%**			**1.3%**

[1] Statistics Canada. Table 281-0039 - Fixed weighted index of average hourly earnings for all employees (SEPH), excluding overtime, unadjusted for seasonal variation. Available for selected industries classified using the North American Industry Classification System (NAICS), monthly (index, 2002=100)

[2] Industrial aggregate covers all industrial sectors except those primarily involved in agriculture, fishing and trapping, private household services, religious organisations, and the military personnel of the defence services.
[3] Statistics Canada. Table 384-0036 - Implicit price indexes, gross domestic product (GDP), provincial economic accounts, annual (index, 2002=100)

Table 7

Canadian Electric Utility Construction Price Index Adjustment for Alberta

	EUCPI [1]		Industrial Structure Constrution Price Index [3] / CPI							Adjustment	Alberta Adjusted EUCPI	
	Canada		Metropolitan Area Composite		Calgary, Alberta		Edmonton, Alberta		Alberta	Alberta - Composite		
Year	Level	Growth Rate [2] [A]	Level	Growth Rate [B]	Level	Growth Rate [C]	Level	Growth Rate [D]	Growth Rate [E] [4]		Level	Growth Rate [F] [5]
1956	17.7		**na**		**na**	**na**	**na**	**na**			100.0	
1957	18.0	1.68%	**na**	3.16%	**na**	**na**	**na**	**na**	2.73%	-0.43%	101.3	1.25%
1958	17.4	-3.39%	**na**	2.65%	**na**	**na**	**na**	**na**	2.13%	-0.52%	97.4	-3.91%
1959	18.1	3.94%	**na**	1.10%	**na**	**na**	**na**	**na**	1.31%	0.21%	101.5	4.16%
1960	18.7	3.26%	**na**	1.22%	**na**	**na**	**na**	**na**	0.91%	-0.31%	104.6	2.95%
1961	18.7	0.00%	**na**	0.94%	**na**	**na**	**na**	**na**	0.64%	-0.29%	104.2	-0.29%
1962	19	1.59%	**na**	1.19%	**na**	**na**	**na**	**na**	0.89%	-0.30%	105.6	1.29%
1963	19.1	0.52%	**na**	1.70%	**na**	**na**	**na**	**na**	1.14%	-0.56%	105.6	-0.04%
1964	19.5	2.07%	**na**	1.80%	**na**	**na**	**na**	**na**	0.50%	-1.30%	106.4	0.78%
1965	19.9	2.03%	**na**	2.39%	**na**	**na**	**na**	**na**	1.49%	-0.90%	107.6	1.13%
1966	20.9	4.90%	**na**	3.66%	**na**	**na**	**na**	**na**	3.27%	-0.39%	112.6	4.52%
1967	21.7	3.76%	**na**	3.53%	**na**	**na**	**na**	**na**	3.86%	0.33%	117.3	4.08%
1968	21.5	-0.93%	**na**	3.97%	**na**	**na**	**na**	**na**	4.38%	0.41%	116.7	-0.52%
1969	22.4	4.10%	**na**	4.45%	**na**	**na**	**na**	**na**	3.98%	-0.47%	121.0	3.63%
1970	24.1	7.32%	**na**	3.24%	**na**	**na**	**na**	**na**	2.91%	-0.33%	129.7	6.98%
1971	25	3.67%	**na**	2.84%	**na**	**na**	**na**	**na**	2.43%	-0.41%	134.0	3.26%
1972	26.1	4.31%	**na**	4.59%	**na**	4.43%	**na**	4.49%	4.46%	-0.14%	139.7	4.17%
1973	28.5	8.80%	**na**	7.50%	**na**	6.44%	**na**	7.33%	6.88%	-0.61%	151.6	8.18%
1974	34.3	18.52%	**na**	10.29%	**na**	9.56%	**na**	9.83%	9.69%	-0.59%	181.4	17.93%
1975	38.5	11.55%	**na**	10.23%	**na**	10.95%	**na**	10.29%	10.62%	0.39%	204.4	11.94%
1976	40.7	5.56%	**na**	7.20%	**na**	7.85%	**na**	7.70%	7.77%	0.57%	217.3	6.13%
1977	43.4	6.42%	**na**	7.70%	**na**	8.22%	**na**	8.67%	8.45%	0.75%	233.5	7.17%
1978	46.6	7.11%	**na**	8.59%	**na**	7.95%	**na**	8.67%	8.31%	-0.28%	250.0	6.83%
1979	52.9	12.68%	**na**	8.73%	**na**	8.32%	**na**	8.46%	8.39%	-0.34%	282.8	12.34%
1980	60.3	13.09%	**na**	9.68%	**na**	9.88%	**na**	9.69%	9.78%	0.10%	322.7	13.20%
1981	65.7	8.58%	52.5	11.6%	68.3	12.5%	68.6	11.8%	12.16%	0.52%	353.5	9.09%
1982	71.8	8.88%	56.5	7.21%	71.4	4.48%	72.6	5.77%	5.13%	-2.08%	378.3	6.80%
1983	74.8	4.09%	56.4	-0.18%	66.8	-6.70%	70.0	-3.68%	-5.19%	-5.01%	374.9	-0.92%
1984	78.1	4.32%	56.3	-0.04%	63.0	-5.82%	64.2	-8.73%	-7.27%	-7.23%	364.1	-2.91%
1985	82.1	4.99%	58.7	4.04%	61.7	-2.04%	62.8	-2.21%	-2.13%	-6.17%	359.8	-1.18%
1986	84.0	2.29%	62.0	5.51%	63.1	2.24%	62.6	-0.24%	1.00%	-4.51%	351.9	-2.22%
1987	86.6	3.05%	65.9	6.06%	63.7	0.87%	63.1	0.76%	0.81%	-5.25%	344.2	-2.20%
1988	91.9	5.94%	70.6	6.97%	65.7	3.09%	63.8	1.06%	2.08%	-4.89%	347.9	1.05%
1989	95.5	3.84%	75.8	7.11%	72.9	10.47%	72.1	12.31%	11.39%	4.28%	377.3	8.13%
1990	98.5	3.09%	78.1	2.93%	76.7	5.08%	76.7	6.15%	5.62%	2.69%	399.8	5.78%
1991	97.7	-0.82%	76.0	-2.66%	75.7	-1.34%	76.9	0.23%	-0.56%	2.10%	405.0	1.29%
1992	100.0	2.33%	76.1	0.07%	76.5	1.02%	77.9	1.29%	1.16%	1.09%	419.1	3.42%
1993	102.5	2.47%	76.7	0.85%	77.3	1.04%	78.7	1.05%	1.05%	0.20%	430.4	2.67%
1994	108.2	5.41%	78.8	2.64%	78.9	2.02%	80.5	2.23%	2.12%	-0.51%	452.0	4.90%
1995	116.7	7.56%	81.2	3.09%	81.4	3.18%	83.2	3.33%	3.26%	0.16%	488.3	7.72%
1996	116.6	-0.09%	82.8	1.92%	82.7	1.61%	84.3	1.37%	1.49%	-0.43%	485.8	-0.51%
1997	118.0	1.19%	85.0	2.65%	85.3	3.07%	86.6	2.66%	2.86%	0.21%	492.7	1.41%
1998	122.8	3.99%	86.8	2.01%	87.4	2.43%	88.6	2.31%	2.37%	0.36%	514.6	4.35%
1999	126.1	2.65%	88.6	2.14%	89.1	1.95%	90.3	1.82%	1.89%	-0.25%	527.1	2.40%
2000	128.7	2.04%	94.3	6.18%	93.8	5.11%	94.3	4.39%	4.75%	-1.43%	530.3	0.61%
2001	129.6	0.70%	97.9	3.72%	97.5	3.89%	97.8	3.62%	3.76%	0.03%	534.2	0.73%
2002	130.5	0.69%	100.0	2.17%	100.0	2.51%	100.0	2.28%	2.39%	0.22%	539.1	0.91%
2003	130.6	0.08%	103.1	3.08%	103.1	3.00%	102.5	2.47%	2.74%	-0.34%	537.7	-0.26%
2004	131.1	0.38%	111.1	7.40%	111.8	8.17%	111.2	8.14%	8.16%	0.75%	543.8	1.14%
2005	133.6	1.89%	118.0	6.09%	120.3	7.31%	119.6	7.24%	7.27%	1.18%	560.8	3.07%
2006	142.4	6.38%	127.3	7.55%	136.5	12.62%	133.7	11.17%	11.89%	4.35%	624.2	10.72%
2007	148.8	4.40%	138.4	8.36%	159.0	15.29%	154.7	14.57%	14.93%	6.57%	696.6	10.97%
2008	150.3	1.00%	154.2	10.83%	187.9	16.68%	178.0	14.03%	15.36%	4.53%	736.2	5.53%
2009	151.1	0.53%	146.7	-5.00%	168.6	-10.84%	153.3	-14.92%	-12.88%	-7.88%	684.1	-7.35%
2010	154.8	2.42%	146.2	-0.32%	162.6	-3.64%	155.7	1.55%	-1.04%	-0.72%	695.8	1.70%
Average Annual Growth Rates												
1957-2010		**4.02%**		**4.19%**		**4.43%**		**4.33%**	**3.77%**	**-0.42%**		**3.59%**
1973-2010		**4.68%**		**4.84%**		**4.43%**		**4.33%**	**4.38%**	**-0.46%**		**4.23%**
1990-2007		**2.46%**		**3.34%**		**4.33%**		**4.24%**	**4.29%**	**0.94%**		**3.41%**
2000-2010		**1.86%**		**4.55%**		**5.46%**		**4.96%**	**5.21%**	**0.66%**		**2.52%**

Sources:

[1] Statistics Canada. Table 327-0011 - Electric utility construction price indexes (EUCPI), annual (index, 1992=100)

[3] Statistics Canada. Table 327-0043 - Price indexes of non-residential building construction, by class of structure, quarterly (index, 2002=100). For years prior to 1982 the CP for cities in Alberta was used. Prior to 1972 the cities were not reported separately.

Notes:

[2] All growth rates calculated logarithmically.

[4] [E]= ([C]+[D])/2

[5] [F]= [A]+ ([E]-[B])

Table 8

Computation of Triangularized Weighted Moving Average Construction Cost Index

Year	Alberta Adjusted EUCPI	Growth Rate	40 year TW Moving Average	Growth Rate	Undepreciated Years of Plant Remaining	Triangular Weight
1956	100.0				1	0.12%
1957	101.3	1.25%			2	0.24%
1958	97.4	-3.91%			3	0.37%
1959	101.5	4.16%			4	0.49%
1960	104.6	2.95%			5	0.61%
1961	104.2	-0.29%			6	0.73%
1962	105.6	1.29%			7	0.85%
1963	105.6	-0.04%			8	0.98%
1964	106.4	0.78%			9	1.10%
1965	107.6	1.13%			10	1.22%
1966	112.6	4.52%			11	1.34%
1967	117.3	4.08%			12	1.46%
1968	116.7	-0.52%			13	1.59%
1969	121.0	3.63%			14	1.71%
1970	129.7	6.98%			15	1.83%
1971	134.0	3.26%			16	1.95%
1972	139.7	4.17%			17	2.07%
1973	151.6	8.18%			18	2.20%
1974	181.4	17.93%			19	2.32%
1975	204.4	11.94%			20	2.44%
1976	217.3	6.13%			21	2.56%
1977	233.5	7.17%			22	2.68%
1978	250.0	6.83%			23	2.80%
1979	282.8	12.34%			24	2.93%
1980	322.7	13.20%			25	3.05%
1981	353.5	9.09%			26	3.17%
1982	378.3	6.80%			27	3.29%
1983	374.9	-0.92%			28	3.41%
1984	364.1	-2.91%			29	3.54%
1985	359.8	-1.18%			30	3.66%
1986	351.9	-2.22%			31	3.78%
1987	344.2	-2.20%			32	3.90%
1988	347.9	1.05%			33	4.02%
1989	377.3	8.13%			34	4.15%
1990	399.8	5.78%			35	4.27%
1991	405.0	1.29%			36	4.39%
1992	419.1	3.42%			37	4.51%
1993	430.4	2.67%			38	4.63%
1994	452.0	4.90%	296.7		39	4.76%
1995	488.3	7.72%	309.4	4.20%	40	4.88%
1996	485.8	-0.51%	321.4	3.80%		
1997	492.7	1.41%	333.3	3.62%		
1998	514.6	4.35%	345.7	3.67%		
1999	527.1	2.40%	358.3	3.57%		
2000	530.3	0.61%	370.5	3.35%		
2001	534.2	0.73%	382.4	3.15%		
2002	539.1	0.91%	393.9	2.98%		
2003	537.7	-0.26%	404.9	2.75%		
2004	543.8	1.14%	415.7	2.62%		
2005	560.8	3.07%	426.7	2.62%		
2006	624.2	10.72%	440.3	3.13%		
2007	696.6	10.97%	456.8	3.68%		
2008	736.2	5.53%	474.5	3.81%		
2009	684.1	-7.35%	488.9	2.99%		
2010	695.8	1.70%	503.2	2.88%		
Average Annual Growth Rate						
1995-2010		**2.70%**		**3.30%**		
Standard Deviation of Growth Rates						
1995-2010		**4.51%**		**0.48%**		
1957-2010		**4.73%**		**na**		

the construction of a triangularized weighted moving average construction cost index from the raw Alberta Adjusted EUCPI. It can be seen to be far more stable than the raw EUCPI. Table 9 shows the calculation of the rate of return from data on Canada long bond yields and an authorized return on equity.

Table 10 compares the growth in the PEG Research custom input price index to that of the Alberta Gross Domestic Product Implicit Price Index for final domestic demand and a custom inflation measure similar to those proposed by ATCO Gas and AltaGas. It can be seen that the year to year growth rates in the two indexes differed considerably. The longer term trends in the GDPIPI and the PEG Research Custom Alberta Input Price Index were quite similar. However, this is due to a material decline in the allowed rate of return that may not be repeated prospectively. The ATCO Gas-style inflation measure grew much more rapidly than the other two indexes.

In response to data request CCA-NERA-22 NERA stated concerning this research that

> NERA believes that the added complexity to which Dr. Lowry refers in AUC-CCA-20, and as shown in Attachment ATCO-CCA-63, would not be a barrier to an "objective and reliable" inflation index as long as all parties generally found that the added complexity was easily understood and acceptable, both for the current proceeding and for the intervals at which the PBR plan is re-set.

3.2 Service Quality Provisions

3.2.1 Second NERA Report

NERA notes that most of the PBR plans it surveyed contain SQ award penalty mechanisms. NERA advocates the use of SQ APMs with both awards and penalties for Alberta utilities.

3.2.2 Response

We believe that the limitation of NERA's survey to index-based North American PBR plans may actually have understated the frequency with which SQ APMs are featured in PBR generally. When it comes to these mechanisms, there is no need to ignore other PBR precedents because they involve alternative rate escalation mechanisms or a country with different institutional arrangements. SQ APMs are common in many

Table 9

Calculation of the Weighted Average Cost of Capital

Year	Bond Yield Long-term	20 Year Moving Average	Imputed Utility Bond Yield [1]	Authorized Return on Equity[2]	Weighted Average Cost of Capital
1976	9.61				
1977	9.15				
1978	9.57				
1979	10.50				
1980	12.82				
1981	15.59				
1982	14.75				
1983	12.08				
1984	13.00				
1985	11.20				
1986	9.30				
1987	9.75				
1988	10.05				
1989	9.66				
1990	10.69				
1991	9.72				
1992	8.68				
1993	7.86				
1994	8.69				
1995	8.41	10.55	11.28	9.50	8.95
1996	7.75	10.46	11.18	9.50	8.62
1997	6.66	10.34	11.05	9.50	8.08
1998	5.59	10.14	10.84	9.50	7.55
1999	5.72	9.90	10.58	9.50	7.61
2000	5.71	9.54	10.20	9.50	7.60
2001	5.76	9.05	9.68	9.50	7.63
2002	5.68	8.60	9.19	9.50	7.59
2003	5.34	8.26	8.83	9.50	7.42
2004	5.14	7.87	8.41	9.50	7.32
2005	4.40	7.53	8.05	9.50	6.95
2006	4.28	7.28	7.78	9.50	6.89
2007	4.32	7.01	7.49	9.50	6.91
2008	4.05	6.70	7.17	9.50	6.77
2009	3.90	6.42	6.86	9.50	6.70
2010	3.66	6.06	6.48	9.50	6.58
Average 1999-2009	**-3.85%**			**0.00%**	**-1.28%**

[1] The imputed bond utility bond yield uses the actual average debt rate for ATCO in 2010 and then imputes the earlier values using the change in the 20 year moving average of the long bond yield.
[2] The return on equity used is a modest discount from that propsed by ATCO and is held constant.

Table 10

Inflation Differential Calculations for Alberta

	GDPIPI Final Domestic Demand - Alberta[1]			**ATCO Input Price Index**			**PEG Research Custom Alberta Input Price Index**			**Inflation Differentials**			
Year	Level	Growth Rate	Average Growth Rate Ending in 2010	Level	Growth Rate	Average Growth Rate Ending in 2010	Level	Growth Rate	Average Growth Rate Ending in 2010	PEG - GDPIPI	Average Growth Rate Ending in 2010	PEG-ATCO	Average Growth Rate Ending in 2010
1995	86.7			1.000			1.000						
1996	88.3	1.83%	1.83%	1.034	3.33%	3.16%	1.020	1.98%	2.18%	0.15%	-0.11%	-1.35%	-0.98%
1997	90.5	2.46%	2.46%	1.064	2.85%	3.15%	1.021	0.10%	2.19%	-2.36%	-0.13%	-2.74%	-0.96%
1998	91.9	1.54%	1.54%	1.086	2.06%	3.17%	1.023	0.17%	2.36%	-1.37%	0.04%	-1.89%	-0.82%
1999	93.3	1.51%	1.51%	1.106	1.86%	3.27%	1.055	3.10%	2.54%	1.58%	0.16%	1.24%	-0.73%
2000	95.6	2.44%	2.44%	1.141	3.09%	3.40%	1.083	2.61%	2.49%	0.17%	0.01%	-0.48%	-0.92%
2001	97.4	1.87%	1.87%	1.166	2.14%	3.43%	1.113	2.71%	2.47%	0.84%	0.00%	0.57%	-0.95%
2002	100.0	2.63%		1.200	2.89%		1.137	2.15%		-0.48%		-0.73%	
2003	100.9	0.90%		1.246	3.81%		1.157	1.75%		0.85%		-2.06%	
2004	103.0	2.06%		1.278	2.49%		1.180	1.98%		-0.08%		-0.51%	
2005	106.0	2.87%		1.331	4.07%		1.191	0.94%		-1.93%		-3.13%	
2006	111.1	4.70%		1.391	4.41%		1.235	3.61%		-1.09%		-0.79%	
2007	116.1	4.40%		1.467	5.35%		1.293	4.62%		0.22%		-0.73%	
2008	120.1	3.39%		1.537	4.61%		1.340	3.54%		0.16%		-1.07%	
2009	121.3	0.99%		1.560	1.53%		1.367	2.00%		1.00%		0.47%	
2010	122.3	0.82%		1.607	2.96%		1.387	1.43%		0.61%		-1.53%	
Average Annual Growth Rates													
1996-2010		**2.29%**			**3.16%**			**2.18%**		**-0.11%**		**-0.98%**	
2001-2010		**2.46%**			**3.43%**			**2.47%**		**0.01%**		**-0.95%**	

[1]Statistics Canada. Table 384-0036 - Implicit price indexes, gross domestic product (GDP), provincial economic accounts, annual (index, 2002=100).

PBR plans overseas and in the many PBR plans approved in the United States that do not involve index-based rate escalators. A good example of the latter are the numerous PBR plans in New York state that are not covered by the NERA survey because they have "stairstep" allowed revenue escalators.[12]

3.3 Efficiency Carryover Mechanisms

3.3.1 Second NERA Report

NERA's survey of index-based North American PBR plans found that ECMs were "uncommon in North America" (page 52) and, more generally, "unprecedented in PBR." NERA spoke disapprovingly of ECMs, stating on page 9 that "we have seen no evidence demonstrating that that particular innovation to PBR – a partial lengthening of regulatory lag – is worth the additional complications it would pose for the periodic future rate cases."

3.3.2 Response

We believe that this is another area where a broader survey would have been more helpful to the AUC. There has in fact been considerable experimentation with ECMs in recent years, but it has mostly occurred overseas or in US PBR plans that don't involve index-based rate escalation mechanisms. ECMs have, for example, been a feature of PBR plans approved in the United States for AmerenUE, Granite State Electric, Massachusetts Electric, and Narragansett Electric. Overseas, they have been used several times, for both gas and electric utilities, by the Essential Services Commission in Victoria State of Australia. The ESC has emphasized the value of ECMs in discouraging an opportunistic timing of O&M expenses.

We believe that ECMs merit consideration for the Alberta utilities in this proceeding. However, this is one area where resolution through settlement would be preferable given the lack of a record in this proceeding that would direct the AUC to ECMs that share benefits fairly between the companies and their customers.

[12] For an example of a New York gas utility SQ APM please the joint proposal filed in New York PSC Case 09-G-0796. For an example of a New York electric SQ APM please see the joint proposal in New York PSC Case 09-E-0428.

4. POSTSCRIPT: PBR HISTORY

As a closing note, we would like to make some corrections to the brief history of PBR that NERA presents on pages 25-27 of their Second Report. PBR in North America is characterized in these pages as an outgrowth of experiments in regulation that attended the privatization of utility industries in Britain in the 1980s. Although PBR in Britain is not based on input price and productivity research, we are nonetheless led to believe that PBR based on index research somehow evolved in North America from British precedent.[13]

In point of fact, the approach to index-based PBR that is popular in North America developed independently of British precedents and during a contemporaneous time period.[14] As noted in Section 2.16 above, economists in the US were considering in the late 1970s and early 1980s how input price and productivity research could be used to regulate utilities. An entire book on the use of productivity research in utility regulation was published in 1981. The first large-scale use of indexing in North American regulation began in the early 1980s in the US railroad industry where a rail cost adjustment factor ("RCAF") was established that featured a railroad industry input price index and a productivity offset based on the industry productivity trend. About the same time, California gas and electric utilities began filing rate cases at three year intervals in accordance with the California commission's "rate case plan" and began escalating the O&M portion of their allowed revenue using inflation indexes. By the early 1990s industry-specific input price indexes were used for this purpose. Price cap indexes based on input price and productivity were first approved for use in US telecommunications in the late 1980s and PBR based on index research subsequently spread to the US oil pipeline industries, to gas and electric utilities in New England, and to railroad, telecommunications, and energy distribution utilities in Canada.

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[13] NERA notes correctly on page 27 that "In current practice in both the UK and Australia, the *X factor* does not come from a TFP growth study but rather is a way to synchronize current prices (or revenues) with long-term economic forecasts … of capital and operating costs."

[14] The early history of PBR in the United States is discussed in Lawrence Kaufmann and Mark Newton Lowry, "Performance-Based Regulation of Utilities", *Energy Law Journal*, Vol. 23, No. 2, 2002.

Most American PBR plans today use rate and revenue caps with "stairstep trajectories." Canada has emerged as the leading North American practitioner of what is now properly called the "North American" approach to PBR indexing. This approach has also been adopted in several countries overseas.