January 12, 2005

VIA EMAIL & COURIER

Mr. John Zych
Board Secretary
Ontario Energy Board
2300 Yonge St, Suite 2601
Toronto, ON M4P 1E4

Dear Mr. Zych:

Ontario Energy Board – 2006 EDR
Board File No. RP-2004-0188
Energy Probe Evidence

Please find enclosed 8 hard copies of the Pre-filed Evidence of Energy Probe Research Foundation and one copy in PDF format. A PDF electronic copy has been forwarded to Mr. Keith Ritchie of Board Staff.

Should you require additional information, please do not hesitate to contact me.

Sincerely,

David S. MacIntosh
Case Manager

Enclosures

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RP-2004-0188

ONTARIO ENERGY BOARD

IN THE MATTER OF the *Ontario Energy Board Act, 1998*, S.O. 1998, c.15, Schedule B;

AND IN THE MATTER OF the preparation of handbook for electricity distribution rate applications.

Evidence Of
Energy Probe Research Foundation
(" Energy Probe")

Benchmarking Considerations to Guide Ratemaking for the 2006 EDR

By: Thomas (Tom) M. Adams[1]
Alfredo Bertolotti[2]

12 January 2005

[1] Mr. Adams prepared and is presenting this evidence without making a claim to be an expert in benchmarking, but rather as an expert on the design and operation of the Ontario electricity market. His CV is attached as Appendix A.
[2] Mr. Bertolotti has 7 years of professional experience in utility management and the application of quantitative analytical tools to electric LDC costs and operations. His CV is attached as Appendix B.

I SUMMARY

1. This evidence proposes a benchmarking approach as a screening tool to facilitate a determination of just and reasonable rates for electric local distribution companies (LDCs) in 2006. There appears to be no single analytical tool likely to produce satisfactory results for 2006 rate making. Drawing on the U.K. experience with benchmarking, this report considers the advantages of using multiple methodologies. This report proposes the development of an efficiency frontier and also the use of engineering analysis upon which to base judgments of operating cost efficiency. This report is intended to complement the comparators and cohorts methods of cost analysis developed in the analysis of Dr. Camfield.

II REPORT OUTLINE

2. This report is presented in the following chapters:

- **Context for applying benchmarking to 2006 electric LDC rates**
- **Defining benchmarking as applicable to 2006 rates**
- **Summary of lessons arising from recent benchmarking debates in the UK**
- **Comments on Relationships between Proposed Comparators Analysis and Proposed Top-Down Analysis**
- **Energy Probe's Conclusions and Recommendations**

(A) Context For Applying Benchmarking To 2006 Electric LDC Rates

3. The motivation for this presentation is to assist in the identification of just and reasonable rates for 2006 and beyond. The authors believe that quantitative cost analysis can promote best practices among Ontario LDCs and indeed the OEB itself. The normative perspective underlying this presentation is reflective of the long-term consumer interest in efficient, high quality service at as low a long-term cost as reasonably achievable. The authors hope that this contribution to the OEB's policy review process assists the Board and the LDCs by providing practical solutions for the narrowly scoped 2006 rate review.

4. This evidence is presented mindful of a recent ruling of the OEB with respect to benchmarking cost claims associated with the Recovery of Regulatory Assets. Key elements of this recent ruling that guided the preparation of this submission are the following:

> **We see harmonization and normalization of data as key challenges in deriving the many potential benefits from benchmarking.**
>
> **Comparison of one utility with another can be a useful regulatory tool to assess best practices, which may partly explain differences in performances, including costs. A crude benchmarking approach can be beneficial as a screening tool.**
>
> **We reiterate that benchmarking has value as a screening tool. Various adaptations are possible in the effort to streamline the regulatory process for the close to 100 electricity distributors.[3]**

(B) Defining Benchmarking as Applicable to 2006 Rates

5. Benchmarking is one of a family of analytical and regulatory tools that includes yardsticking, best practices, and Performance Based Ratemaking (PBR), designed to measure, incent, and promote industrial efficiency.[4] Benchmarking relies on measuring the efficiency of the services of a population of firms (such as LDCs) and comparing these efficiencies to similar firms. Where better and worse efficiencies can be identified, an efficiency frontier can be estimated describing optimal outputs as a function of an independent variable or variables.

6. There are a variety of approaches that have been applied to the measurement of the relative efficiency of LDCs in relation to an efficiency frontier. These approaches generally subdivide into three main types:

- **Programming techniques (non-parametric);**
- **Econometric techniques (parametric); and**
- **Process approaches often based on engineering judgment.**

This report discusses each of these but concentrates on the latter two.

[3] Decision With Reasons, Dec. 9, 2004, RP-2004-0117/8 et. Al. paragraphs 8.0.15-17.
[4] Energy Probe Evidence at RP-2004-0117/8 et. al. Ex. K p. 3.

7. An important non-parametric approach is Data Envelopment Analysis, involving linear programming techniques.[5] The DEA methodology seeks to determine what units form an envelopment surface or efficiency frontier. Whereas the firms that lie on the surface are considered efficient, the firms above the frontier are termed inefficient and their distance to the frontier provides a measure of their relative inefficiency.

8. Parametric methods impose a functional form to the frontier in order to estimate a cost function by means of econometric tools such as linear regression.

9. Other proposals for efficiency frontier analysis involve deterministic and stochastic methodologies. Estimation of deterministic frontiers involves the utilization of a one-side error term, which implies that it is possible to define accurately the minimum necessary cost to achieve a given level of output. Therefore, the actual cost is simply the least cost plus an inefficiency term[6].

10. Rossi and Ruzzier pointed out that the deterministic techniques are in a sense polar opposites of Ordinary Least Squares (OLS). Whereas with OLS all variations in the dependent variable not associated to variations in the explanatory variables are attributed to random shocks, in the deterministic approach all variations in output are attributed to technical inefficiency.

(C) Summary of Lessons Arising from Recent Benchmarking Debates in the U.K.

(C1) Background on LDC Regulation in the U.K.

11. Thorough benchmarking-based rate setting processes in other countries provide opportunities to learn valuable lessons for Ontario. This summary focuses on the U.K. experience.

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[5] For example, Holland's regulator DTe and Norway's regulator NVE have recently placed heavy reliance on DEA.

[6] *On the Regulatory Application of Efficiency Measures*. Martin A. Rossi and Christian A. Ruzzier. Centro de Estudios Económicos de la Regulación (CEER), Departamento de Economía y Finanzas (UADE), Utilities Policy 9, page 81-92, June 2000.

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12. Distribution utility rate setting has been highly contentious in the U.K., particularly in light of spectacularly high returns among what were known as Regional Electricity Companies following privatization in 1989. The predecessor to the Office of Gas and Electricity Markets (OFGEM), OFFER, significantly underestimated the inefficiency of the previously government-operated distribution operations. Application of the retail-price-inflation-minus-efficiency (RPI-X) formula caused rate reductions for the benefit of consumers but also revealed the extent of this inefficiency as demonstrated by large gains in labour efficiency and unexpectedly large profits for shareholders. These profits were so contentious that the newly elected Labour government instituted a windfall profits tax on the RECs.

13. A vigorous debate has recently taken place in the U.K. on the limitations and advantages of various benchmarking approaches to rate setting for electric LDCs.[7] Benchmarking in the U.K. has focused primarily on setting X-factors for RPI-X PBR price control periods, not on setting an efficient level of distribution rates directly. Incentive regulation for distribution costs in the U.K. is now about 15 years old. 2005 marks the beginning of the fourth Distribution Price Control Review period (DPCR 4), which extends an RPI-X PBR period for an additional five years. The two most recent PBR periods began in 1994 and 1999.

14. In DPCR 2 commencing in 1994, limited benchmarking was used. In DPCR 3 in 1999, benchmarking was used to determine efficient operation expenses. (In the U.K., operating expenses accounted for approximately 40% of the allowable distribution revenues of LDCs.) These two approaches were taken into account to establish for regulatory purposes an efficient level of operation expenses for each regulated firm:

- **A top-down regression analysis of the cost drivers of operation expenses to determine the efficiency frontier, that is the optimal cost for a given level of output, and**

[7] "Benchmarking for Distribution Utilities: A Problematic Approach to Defining Efficiency" by Veronica Irastorza, The Electricity Journal, December 2003.

- **A bottom-up efficiency study applying engineering judgment to assess the potential for the distribution business to reduce base operation expenditure.**

15. The underlying concept of most incentive programs is to encourage firms to minimize their costs, and to insure that, eventually, users benefit from these cost reductions. Achievement of this objective would be assisted if the regulator could estimate reasonably accurately the efficiency frontier for various costs achievable at the firm level. Efficiency gains can result from two main sources: shifts in the frontier reflecting efficiency gains at the industry level, and efficiency gains at the firm level, as individual firms catch up with their peers. The role and the scope of the efficiency frontier vary according to the regulatory scheme. In some performance based rates regimes (e.g. price cap), efficiency frontier analysis can be used to estimate the distance from the observed practice to the efficiency frontier. As well, the efficiency factor can be used to help set formula-based rates (e.g. RPI-X) and any regulatory requirements cutting rates to reflect costs being reduced to the frontier.

16. In the U.K., 1997/1998 data was used as input to the benchmarking analysis reflected in DCPR 3.

17. The U.K. currently has 14 electricity distributors, resulting in a limited number of comparators. In addition, several of the separate licensed entities have common owners and operate within holding company structures of corporate groupings. (To maintain comparators, regulators in the U.K. impose significant financial penalties on mergers.)

18. Measured in customer numbers, the average size of the U.K. distributors is 50% larger than the sum of Hydro One and Hydro One Brampton.

19 OFGEM's rules impose financial penalties on LDCs for failure to meet quality of service standards. These rules also allow rewards for exceeding quality of service

standards. Service quality is not currently considered as an output in benchmarking analysis although there is debate suggesting its eventual inclusion in the analysis.[8]

20. In order to enhance the usefulness of benchmarking, OFGEM has undertaken the Information and Incentives Project (IIP). One purpose of this project is to improve cost reporting. Another purpose is to improve the quality and usefulness of service quality data to facilitate its eventual inclusion in efficiency analysis.

21. Although Ontario is not currently developing incentive regulation formulas, we believe that there are aspects of the U.K. debate directly relevant to the challenge of arriving at just and reasonable distribution rates in Ontario for the 2006 rate year. The U.K. experience can provide a contribution to the discussion in a number of areas, including appropriate analytical techniques, focusing benchmarking on operation expenditures vs total expenditures, the analysis of cost drivers, and estimating the reserves of inefficiencies within utilities.

22. Energy Probe's literature review of aspects of the benchmarking experience in U.K. relevant to Ontario draws on a variety of sources including:

- **a 2003 report prepared by Cambridge Economic Policy Associates (CEPA)[9] on behalf of OFGEM as input to DPCR 4 for a PBR period starting in 2005, including the review of alternative methodologies, analysis of methods used in DPCR 3, the appropriateness of cost drivers and the analysis of data,**
- **comments presented by National Economic Research Associates (NERA)[10] and CE Electric Funding Company[11] on behalf of regulated distributors, addressing aspects of CEPA´s paper of concern to distribution companies, and**
- **additional published literature.**

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[8] *CE Electric Funding Company Distribution Price Control Review*, 2003. (CE is the UK parent company of Northern Electric Distribution Ltd (NEDL) and Yorkshire Electricity Distribution plc (YEDL).

[9] *Background to Work on Assessing Efficiency for the 2005 Distribution Price Control Review*. Prepared for OFGEM. Cambridge Economic Policy Associates. September 2003.

[10] *Comments on CEPA Benchmarking Paper*. A Report for EDF Energy. NERA. November 2003. (EDF is the parent of Eastern, London, and Seeboard)

[11] *CE Electric Funding Company Distribution Price Control Review*, 2003. (CE is the UK parent company of Northern Electric Distribution Ltd (NEDL) and Yorkshire Electricity Distribution plc (YEDL).

23. DPCR 3 in 1999 focused on operation expenses. For top-down econometric analysis of costs, base operation expenses were determined after having adjusted controllable distribution expenses. In particular, the methodology adopted by the OFGEM for establishing base operation expenses is presented as follows:

Total reported operation expenses
Subtract transmission expenses
= Controllable distribution expenses
Adjusted for differing accounting policies, regional labor costs, island systems, and voltage differences (particularly the 132 kV network in Scotland)
= Base operation expenses

24. The accounting policy differences addressed were capitalization of operation costs, repair of underground assets, meter recertification, and the allocation of costs between supply and other activities. Some capital expenditures (e.g. expenditures on IT systems) were sometimes provided by third parties, reducing the direct comparability of raw data reported by distributors. In order to cope with this difficulty, distributors reclassified from network capital expenditures to operation costs (e.g. repairs, metering, and non-operational IT depreciation) and project IT depreciation was removed from operation expenses.[12] The supply activities addressed included advertising and marketing, billing, metering, customer services and associated corporate services. Regarding regional adjustments, OFGEM took in to account higher labor cost in the London areas. As well, Scotland's topology was taken into account.

25. For the DPCR 3 in 1999, OFGEM adopted a form of Corrected Ordinary Least Squares regression (COLS). The regression used one dependent variable (controllable operation expenses) and one independent scale variable for the test year (1997/1998). To address statistical problems associated with a small number of only 14 cases, the scale variable used was a composite variable reflecting number of customers, kWh distributed and network length. After debating the scale variable approach, end weight coefficients were established at 50%, 25% and 25% for the three respective scale variables.

[12] CEPA (2003), page 43.

26. In summary, the regression calculation used followed this general outline:

$$CompositeVariable = Customers^{\hat{I}_1} kWh^{\hat{I}_2} km^{\hat{I}_3} \quad \textbf{(1)}$$

And the regression,

Base operation expenses $= A + B.CompositeVariable + \hat{I}\mu$

As a result of transforming expression (1)[13]

$$AdjustedCompositeVariable = Customers^{\hat{I}_1}\left[1 + \hat{I}_2(\partial U / U) + \hat{I}_3(\partial L / L)\right]$$

Where U is the average value of kWh per customer and ∂U **is the deviations in the data point values from the average; and similarly for L and** ∂L **.**

Thus, the regression equation becomes,

Base operation expenses $= A + B.AdjustedCompositeVariable + \hat{I}\mu$

27. OFGEM also undertook a bottom-up study to assess operation expense efficiency for the base year. In particular, the benchmarking analysis took into account best practices identifying best performing companies' costs. The study involved the following operation activities:

- **Engineering costs (network repairs and maintenance, system control and non-capitalized planning and construction): Various benchmarks were established (e.g. cost/network km).**
- **Meter operation (repair and maintenance, meter recertification and meter changes): an annual cost per customer was estimated based on the best average performing distributor.**
- **Corporate and administrative functions: an annual cost was determined based on the best performing distributor.**
- **Customer service: following consultation, OFGEM set an annual cost per customer.[14]**

[13] CEPA (2003), page 46.
[14] CEPA (2003).

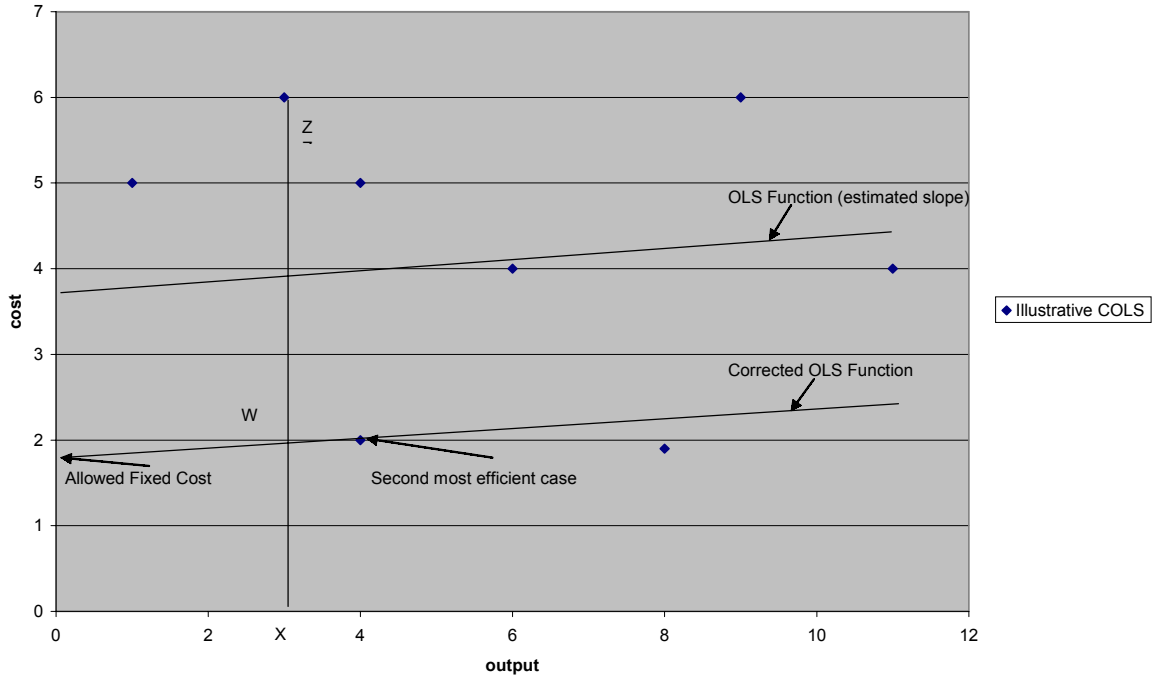
28. Each cost component resulted in an estimated range of the efficiency saving by each distributor. Once the efficient level of cost for each distributor was established, potential savings were calculated.

29. In addition, further analysis of human resources and IT costs were benchmarked to support the analysis conducted on engineering costs.

30. The resulting rankings arising from top-down and bottom-up studies were generally consistent.

31. The correction of the Ordinary Least Squares result was achieved by moving the regression line toward the horizontal axis to reflect the efficiency of the second best case, that of Eastern Electricity. The decision to use the second-most efficient firm was justified with reference to the argument that the most efficient frontier was an outlier according to expert industry judgment. Based on bottom up considerations with the input of independent engineering experts with industry expertise, the vertical axis intercept was established assuming an efficient fixed cost of €25 m. The resulting line was judged to be the efficiency frontier.

Figure 1: Illustrative Corrected Ordinary Least Squares



The figure presents a stylized illustration of the COLS methodology. In this illustration, the second most efficient firm is used to for the OLS correction. An efficiency ratio could be calculated for utility Z using the relationship WX/ZX.

32. In its final determination for DCPR 3, OFGEM determined the operation expenses reduction for each distributor based on the lesser potential reduction implied by the efficiency study and regression analysis. As well, rate determinations were based on a decision whereby firms with high operating costs were required to move only ¾ of the way to the frontier by 2001/02, catching up to the frontier thereafter. In addition the OFGEM established for each company annual allowance for other costs (e.g. asset management IT systems) and a one-off cost which reduced to zero by 2002/2003.

(C2) Examining Options for DPCR 4

33. In its 2003 report designed to support the DPCR 4 development, CEPA recognized that bottom-up process techniques were potentially valuable but left the development of results to others.

34. Instead, CEPA started its assessment of techniques for estimating the efficiency frontier by assessing the appropriateness of the methodology implemented to estimate the efficiency frontier in 1999 DPCR 3 but using 2001/2002 data.

35. CEPA identified a number of concerns, including problems related to a small data set. In addition, frontier approaches assume that the data set includes inefficient and efficient firms. Indeed, the evolution of operation expenses from 1997/1998 to 2001/2002 appears to have deviated from the frontier estimated in 1997/98. Distributors on average outperformed the expected reduction. However, the degree of improvement differed across firms but the results showed an opposite trend to that expected. While intuition might suggest that those distributors furthest from the 1997/98 frontier should have shown the greatest improvement, in fact the firms closest to the frontier showed the greatest improvement and worst performing firms according to the 1997/98 frontier showed the smallest improvement. As a result, operation expenses performance for U.K. distributors appears to be more disparate now than it was in 1997/1998. This inconsistency raises questions about the appropriateness of the methodology and also excessive rates for consumers.[15]

36. CEPA assessed the following alternative top-down techniques:

- **Corrected Ordinary Squares (COLS)**
- **Stochastic Frontier Analysis (SFA)**
- **Data Envelopment Analysis (DEA)**
- **Total Factor Productivity (TFP)**
- **Malmquist productivity indices**

[15] CEPA also observed that international benchmarking suggests that even the most efficient U.K. distributors trail the efficiency of some of their peers in other countries. Based on these observations, CEPA's report suggests that even after 15 years of incentive regulation and substantial cost cutting, substantial reserves of inefficiency may exist within even the most efficient U.K. distributors.

Of these, COLS and DEA have been previously introduced.

37. Stochastic frontier analysis (SFA) attempts to decompose unexplained variation into inefficiency and measurement error. CEPA's report considers SFA as the most elegant from the theoretical perspective. However, in the UK, the small size of data limits the potential detection potential for this approach. Among the four SFA applications undertaken by CEPA, only one application provided significant results. An additional concern identified was that the results are not very robust to small changes in the methodology or data.

38. CEPA considered an X-factor set in line with the average TFP for some external benchmarking industry in the long run, but this requires a high degree of convergence between firms' performance. In this regarding, CEPA calculated the TFP indices, using the Tornqvist methodology, and again the performance over the period 1997/98-2001/02 showed a high variance. In the end, CEPA decided that the use of TFP was premature. Both the TFP and the Malmquist indices methodologies are used to calculate changes in productivity over time, and are therefore of limited value for 2006.

39. According to CEPA the estimated frontier using COLS model gave a plausible intercept (the fixed cost) and a realistic relationship between scale and cost. However, CEPA admitted that the intercept is sensitive to outliers.

40. CEPA pointed out that while the DEA approach is theoretically more appealing than COLS as it determines efficiency, calculated efficiency scores using DEA are dependent on the variables selected. In addition, the method does not provide a test to assess the appropriateness of variables included in the model.

41. CEPA suggested the possibility of combining DEA and COLS models, taking efficiency scores resulting from the DEA model and using the COLS approach "to assess the appropriateness of the output variables, the significance of the DEA

efficiency scores obtained and whether particular companies were being treated unfairly under DEA"[16].

42. Counter arguments were presented to the effect that some firms may not be able to meet the frontier. Concern over fairness between LDC were also voiced, based on the argument that inefficient distributors were in condition to cut costs more rapidly making them better able to realize higher returns than efficient companies.

(C3) Operation Expenses vs. Total Expenditures

43. As previously noted, in 1999 OFGEM assessed efficiency on the basis of operation expenses in isolation from capital costs. However, there has been a discussion on the appropriateness of benchmarking operation costs or total expenditures. CEPA pointed out disadvantages for efficiency estimation of using partial factor productivity focused on operation expenditures but disregarding the effect of capital. This is a particular concern where capital and labour inputs are substitutable. Hypothetically, a distributor that has in the recent past invested in equipment and technology might appear to be more efficient, with lower operation costs than those that have not done so, although viewed from an overall efficiency perspective the relative relationship might be the reverse.

44. CEPA recommended benchmarking total expenditures. However, the consultant warned about additional complications associated with measuring capital stock. CEPA also recommended undertaking a further analysis in order to avoid possible distortions resulting from gaming strategies[17].

45. In its commentary on CEPA's benchmarking paper, NERA pointed out that there is no reason for OFGEM to accept CEPA's recommendation for using total expenditures. "In particular, the use of the Regulatory Asset Base (RAB) to define capital costs is indefensible. The RAB is distorted by past regulatory decisions and

[16] CEPA (2003), page 96.
[17] CEPA (2003), page 97.

historical accidents."[18] NERA focused on privatization as a turning-point: "although the privatization assets are starting to drop out of companies's RAB, many of the assets are still in use. Moreover, pre-privatization investment affected subsequent investments needs, and hence the current value of the RAB. Thus, the RAB offers little guidance on the efficiency with which each distributor is using its resources, or has invested since privatization." [19]

(C4) Analysis of Cost Drivers

46. CEPA suggested categorizing cost drivers under four headings:

- **Scale (in the 1999 DPCR 3, this consisted of a weighted combination of customer numbers, kWh, and network length)**
- **Topography and climate**
- **Customer mix (customer class proportions)**
- **Quality of service**

47. In order to select cost drivers for each cost category, CEPA presented a correlation matrix to test selected cost drivers and to identify highly correlated drivers so that they could be eliminated.

48. With respect to the correlation matrix, CEPA did an analysis for the four categories. For illustrative purpose we only present the analysis for the customer mix cost driver. In particular, the matrix reflects the correlation coefficient among the costs of supply associated with the high voltage customers (%HV), and three low voltage customers groups (%LV1, %LV2, %LV3).

Correlation coefficient	%HV	%LV1	%LV2	%LV3
%HV	1.00	-0.36	-0.58	-0.17
%LV1		1.00	0.73	-0.81
%LV2			1.00	-0.61
%LV3				1.00

[18] NERA (2003), page 7.
[19] NERA (2003), page 7.

These results suggest that that two variables need to be selected: %HV and %LV1. %HV shows a low correlation with the each of the three other variables. %LV1 is a good proxy for %LV2 and %LV3.

49. For testing cost drivers, CEPA performed a linear regression for the four cost drivers as independent variables and the efficiency scores resulting from the 1999 methodology were applied to the 2001/2002 data. According to CEPA's analysis, none of the four cost drivers are significantly correlated to the efficiency score obtained in 1999 methodology, and as a result CEPA concluded that the original composite cost driver is sufficient for measuring efficiency differences.

(C5) Robustness Analysis and the Treatment of Outliers

50. With respect to robustness, CEPA stated that "one of the major criticisms leveled at the use of benchmarking techniques is that the choice of model and data is subjective, and so benchmarking is inappropriate for use in regulatory price controls. Consequently, the model selected must be robust to changes in assumptions and methodologies.[20]

51. Robustness can be improved by comparing top-down and bottom-up approaches. If best to worst performance rankings resulting from applying alternative methodologies appear to be reasonably consistent, confidence in the methodologies will grow.

52. The treatment of outliers may prove to be critical for achieving robustness. Using benchmarking techniques as screening tools will assist in identifying outliers.

53. As previously discussed, the COLS model used to estimate the efficiency frontier is sensitive to outliers.

54. CEPA's sensitivity analysis consisted of regressing operation expenditures and the composite variable, applying 1999 methodology to 2001/02 data. The presentation

[20] CEPA (2003), page 10.

of this analysis represents an illustrative example of how to deal with outliers and the impact on the robustness of the result.

55. In particular, regressions were run on four different data sets, those being:

- **data for the all 14 distributors**
- **the exclusion the most efficient firm**
- **the exclusion of the most and least efficient outlier**
- **the exclusion of the two most efficient outliers[21]**

56. By excluding outliers, the measure of goodness of fit (R2) of the regression model improved significantly. The intercept (the fixed cost) decreases significantly as the most efficient outliers were excluded.

57. The results of CEPA's regression analysis suggest that the 1999 methodology applied to 2001/2002 data did not produce robust results.

(C6) The Analysis of Composite Scale Variables

58. Starting with the 1999 methodology, CEPA undertook a sensitivity analysis of the efficiency frontier as a result of alterations in the weights associated with the components of the composite scale variable (i.e. customer numbers, kWh and network length). The investigation considered the implications of using the initial weight set by the OFGEM, a two-variable composite (i.e. allocating a 0% weight to one of the variables) and single scale variable cost driver (i.e. attaching 0% to the two remaining cost drivers). As an alternative weight, another proposal was to include the average weight resulting from the DEA analysis.

59. The sensitivity analysis involved four steps:

- **elaborating a correlation matrix reflecting correlations between the three components (customer numbers, kWh and network length) of the composite variable,**

[21] CEPA (2003), Annex 5.

- **the efficiency scores and implied potential efficiency savings for each company and each alternative variable,**
- **constructing a correlation matrix to assess the relationship between the resultant efficiency scores, and**
- **assessing whether there is any reason for changing the weight on the proportions of the composite.**

60. Interestingly, density was discovered not to be statistically significant. Although this result may be an anomaly masked by the relative homogeneity of the firms with respect to density, CEPA recommended simplifying the scale term by eliminating either customer numbers or volumes distributed.

(D) Comments on Relationships between Proposed Comparators Analysis and Proposed Top-Down Analysis

61. Robert Camfield's comparators evidence focuses on costs associated with four categories of unbundled services (i.e. wires and interconnections, settlement, administration and customer services expenses). Our view of the proposed comparators methodology is that it might provide another approach to bottom-up analysis since it focuses on discrete, disaggregated functions.

62. Identifying statistically significant explanatory variables associated with the unbundled services based on input prices, output prices, inputs, outputs and Z factors as defined in Robert Camfield's evidence[22] can guide and support the development of top-down analysis of operating cost.

63. The relative efficiencies across the Province for each of the four unbundled services examined in the comparators analysis should support conclusions resulting from top-down analysis of cost.

64. If there are significant cost tradeoffs between the four unbundled services or accounting issues that reduce the ability to accurately compare results for unbundled

services accurately, more aggregated top-down analysis may be able help in the identification of these deficiencies.

(E) Energy Probe's Conclusions and Recommendations

65. In determining appropriate distribution rates for Ontario in 2006, a hybrid analysis might be used applying both a top-down and a bottom-up analysis. Both approaches are subject to a range of valid concerns. Top-down techniques suffered from low performance in term of robustness in estimating an adequate efficiency frontier. Taking these concerns into account, the regulatory scheme adopted in the U.K. for operation cost allowance continues to rely heavily on the results achieved by the top-down methodology.

66. An efficiency frontier might be used as a screening tool.

67. Econometric techniques are likely to be useful in Ontario to develop an efficiency frontier. In the U.K. the sparseness of observations reduced the robustness of the results. In the case of Ontario, the larger population of firms should allow more robust results. One of the interesting observations arising from the U.K. experience is the occurrence of counter-intuitive results, such as the rate of efficiency gain being highest among efficient firms, the apparently large reserve of inefficiency after a long PBR experience, and the lack of explanatory power for a regression against density. These observations suggest that efficiency analysis will benefit from experimentation and expansive hypothesis testing.

68. We recommend continuing in the direction initiated by Professor Adonis Yatchew in Ontario. After having examined the relevance of applying econometric approaches to the electricity distribution market, Professor Yatchew concluded:

> ***"The Econometric models can inform the regulatory process in important ways. They can be used to estimate the effects of critical variables such as scale, density, and load factor on the cost of operating a distributing utility. Flexible specifications such as nonparametric and***

[22] Findings and Recommendations: Comparators and Cohorts for Electricity Distribution Rates. Page 19

semiparametric models, and robust estimation techniques such as median and quantile regressions, can inspire greater confidence in the statistical results". [23]

69. In determining 2006 rate, it might be best to search for LDCs´ cost anomalies at the level of operating expenses and not attempting to analyze capital efficiency. LDCs may have different criteria in allocating costs to operation and capital expenses. As well, some costs usually considered as capital expenses may be allocated to operating cost when they are provided by third parties. Theses different practices may diminish the value for comparison purposes of raw data reported by LDCs. In order to achieve consistent results, it may be advisable to recalculate and adjust operation expenses adding capital expenses. For this purpose, it is recommended that Schedule 4-1 of the Draft Handbook include information requirements for capital expenses consistent with the cost categories adopted for the use of comparators and cohorts.

70. The U.K. experience suggests a possible solution to solve data inconsistency problems, especially in cases where some activities usually treated as capital expenditures are provided by third parties. In this case, "several items were reclassified from network capex to opex (e.g. repairs, metering and non-operational IT depreciation) and project IT depreciation was removed from opex."[24] As previously discussed, in the U.K. capital efficiency estimation has been highly controversial. TFP methodology might potentially be used to calculate the improvement in productivity of all factors over the specified time period. However, given the problems associated with valuing LDC capital stock and also because 2006 distribution rates does not include a X-factor, TFP does not appear to be applicable at this time. We admit that there are important limitations and potential inaccuracies associated with assessing the efficiency of operating costs when the efficiency of capital use is not taken into account.

71. As a partial remedy, we recommend considering the age of assets as a cost driver. We believe that the age of assets should be investigated as a potential cost

[23] *Incentive Regulation of Distributing Utilities Using Yardstick Competition*. Adonis Yatchew. The Electricity Journal. January/February 2001.
[24] CEPA (2003) page 43.

driver, particularly for costs associated with wires and interconnection services. Consequently, we suggest that LDCs file data on this issue. In particular, we recommend filling age data broken out for distribution stations, overhead lines, and underground lines, and distribution transformers. We believe these accounts represent almost 80% of the total assets for Toronto Hydro and Hydro One.

72. With respect to the DEA methodology, we do not recommend this approach for assessing operating expense levels at this time. It is widely accepted that efficiency scores tend to be sensitive to the selection of the input and output variables. In addition, DEA has been criticized for the absence of any performance measure.

73. A bottom-up analysis can support and improve confidence in the results achieved by the selected top-down methodologies. Bottom up engineering-based estimates might be applied to costs associated with particular activities such as a comparison of line maintenance costs between underground and overhead systems of similar capacity and connection characteristics.

74. External benchmarking might be used for particular cost categories where good comparables exist. For example, labour costs might be compared to those of gas and water utilities. The IMO's application in EB 2004-0477 presents evidence on external labour cost benchmarking. This general approach appears to be applicable to the Ontario electric LDCs. At minimum, labour cost benchmarking should be undertaken within the population of LDCs. Pension and benefit costs should be reflected in compensation comparisons.

75. The unique corporate character of much of the Ontario LDC sector should also be taken into account for any benchmarking. In particular, data collection and cost analysis might benefit from the identification of multi-utility services such as shared water billing.[25]

[25] Municipal ownership of many Ontario LDCs may lead some utilities to attempt to pursue multiple competing and potentially incompatible objectives. For example, in the article "Transparency of a Municipal Electrical Distribution Company" in Municipal World, January 2005, authors R.A. Slavickas and M.A. Kady suggest that LDC profits be distributed in the community through a combination of dividends to the

76. In the long term, rates must generate sufficient revenue so that utilities can recover the cost of efficient operations and maintain access to capital to make investments when necessary. Irrespective of the approach used in rate setting, the financial results after the fact of each LDC are relevant to a complete understanding of the implications of rates. A simple ranking of the rate of return on capital employed might be used as a screening tool. It appears that the debt rates paid by some LDCs are substantially above market levels and therefore return on capital employed appears to be a superior method of comparison relative to return on equity. Extra regulatory attention might be directed at utilities with either unusually high or low rates of return on capital employed.

77. Energy Probe is concerned that since the electricity market reforms of 1998, the regulatory construct under which LDCs function in Ontario has effectively discouraged LDCs from investing incremental capital to achieve loss reductions where these investments would be cost effective from a customer perspective. Line loss analysis and mitigation is a highly technical field deserving of active regulatory consideration. Benchmarking of best practices might play a role in line loss management. Significant data might be required. As a starting point, a simple ranking of LDC losses as a percentage of combined variable reflecting total deliveries and kilometers of line might provide some value for screening losses. Physical loss indices are better suited for extra-jurisdictional benchmarking than financial loss indices, because the complications associated with issues like currency valuation and tax treatments do not cleave to the assessment. Losses might be treated as a comparator to assess performance, in terms of Dr. Camfield's discussion of comparators used for comparative diagnostics.

78. The OEB should concentrate on the disclosure of detailed cost and operational information to facilitate independent analysis by consumers.

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municipality for tax relief or spending on non-electric municipal infrastructure, rate reductions, and investment in LDC capital requirements.

Appendix A

Thomas (Tom) M. Adams

Consulting and Research

2001-present
Director, Resource Efficient Agricultural Production

1996-present
Executive Director, Energy Probe

1997-2003
Investigator, Environmental Bureau of Investigation

1999-2001
Independent Director, Ontario Independent Electricity Market Operator (IMO)

1998-1999
Member, Ontario Electricity Market Design Committee (MDC)

1991-present
Senior Consultant, Borealis Energy Research Association

Administrative Law Experience

1989-present
Interventions before the Ontario Energy Board, Manitoba Public Utilities Board, Ontario Joint Board, Ontario Environmental Assessment Board and the New Brunswick Public Utilities Board on energy and environmental subjects. Expert witness appearances before the Ontario Energy Board, Manitoba Public Utilities Board, and the New Brunswick Public Utilities Board on matters related to gas rates and system expansion, bundled and unbundled electricity rates, electric utility facility expansion, nuclear economics, electricity market design, and demand side management.

Civil Law Experience

1989-1996
Energy Probe, Rosalie Bertell and the Corporation of the City of Toronto vs. the Attorney General of Canada, Ontario Hydro and New Brunswick Power Corporation (unsuccessful constitutional challenge of the federal Nuclear Liability Act)

1997
New Brunswick Power Corporation and James F. Hankinson vs. Atlantic Institute for Market Studies, Thomas Adams, et. al. (successfully defended defamation action)

Prosecution Law Experience

1997-present
J. Fletcher v. Canada, Province of Ontario, Kingston Region (conviction on related pollution charges)

1997-2000
J. Fletcher v. Canada, Province of Ontario (citizen-based pollution charges, acquittal)

1998-2000
T. Adams v. Canada, Province of Ontario (citizen-based pollution charges, acquittal)

Academic Publications

1996
Comments on "The Future of Ontario Hydro: A Review of Structural and Regulatory Options," by R. J. Daniels and M. J. Trebilcock, in *Ontario Hydro at the Millennium: Has the Monopoly's Moment Passed?* edited by R. J. Daniels

1995
Comment on: 'Changing Canadian Electricity Markets and the Future Role of Government', in *Energy Studies Review*, Vol. 7, No. 1

1993
Ontario Hydro's Fatal Condition: Implications for Canadian Public Policy, in *Canadian Business Economics*, Vol. 1, No. 3

1989
Review of: Nucleus: A History of Atomic Energy of Canada Limited, in *Energy Studies Review*, Vol. 1, No. 1

Selected Publication

Contributor to *The Citizen's Guide to Environmental Investigation and Private Prosecution* (2000), published by the Environmental Bureau of Investigation.

Guest editorialist, *National Post* (Financial Post Comments Section), columns include: "Failure to sell will cost Ontario billions" (1998/10/28), "Ontario enters new world of hydro competition" (1999/02/02), "Ontario's 'new' Hydro still a bad deal"(1999/07/13), "Ontario high-voltage hydro payout" (1999/10/22), "Ontario hydro cash grab set to burn consumers" (2000/01/28), “Dim bulb idea (2003/09/24).

Mr. Adams has been listed in *Canadian Who's Who* since 2002.

Education

1990
Master of Environmental Studies, York University

1984
Bachelor of Science, University of Guelph

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Appendix B

Alfredo Daniel BERTOLOTTI 416- 890-1428

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PROFILE

- Master's Degree in Applied Economics.
- Seven years of experience in energy economics with a solid background in electricity distribution rate setting and regulatory issues.
- Participated in regulatory processes concerning electricity distribution rates review.
- Experience in energy planning issues and familiar with customer service support issues.
- Strong analytical and research capabilities, problem-solving skills, function well independently and as a team member.

PROFESSIONAL EXPERIENCE

Economist **2003**
***SIGLASUL*, Rio de Janeiro, Brazil**

- Participated in electricity rates review regulatory processes.
- Performed methodological analysis for distribution cost allocation among customers.
- Assisted in processing meter data and designing load data sampling.

Clients: *LIGHT S.A.* (electricity distribution company of the city of Rio de Janeiro), *CFLCL* (electricity distribution company) and *CENF* (electricity distribution company). Brazil.

Economist **2002-2003**
***JorgeLapeña & Asociados*, Buenos Aires, Argentina**

- Participated in electricity rates review regulatory processes.
- Conducted asset valuation for an electricity distribution company.
- Evaluated financial risk for the electricity distribution industry.
- Prepared forecasts of revenues and expenditures.
- Estimated cost of serving electricity in remote areas.

Clients: *EPRE San Juan* (Electricity Board of the Province of San Juan). Argentina.

Economist **2000-2002**
***RN Consultores*, Mendoza, Argentina**

- Identified opportunities in providing regulatory management services for the electricity market.
- Conducted regulatory and rates analysis.
- Assisted end customers in filing claims of incorrect billing to the distributor or the local electricity board.
- Prepared and monitored regulatory filings.
- Recommended supply and transmission cost-cutting measures that benefited customers.
- Conducted asset valuation for an electricity distribution company.

- Analysed and reported sales revenue and cost of sales.
- Assisted in a benchmarking cost study for electricity distributors.

Clients*: EDESTE SA* (electricity distribution company), *Federación de Cooperativas Eléctricas de la Province de Mendoza* (Electricity Cooperative Asociation of the Province of Mendoza), medium and large industrial electricity users. Argentina

Rates Manager **1998-2000**
***EDEMSA* (electricity distribution Company), Mendoza, Argentina**

- Organized the Tariff Department according to the new regulatory framework.
- Responsible for adjusting quarterly rates.
- Prepared and monitored regulatory filings.
- Analyzed economic and financial impact when new rules came into effect.
- Assisted legal advisers of the company in financial and rates issues.
- Operated database management to analyze economical and financial impact.
- Conducted rates and cost of service studies.
- Assisted in developing, improving and implementing procedures.
- Recommended accounting policies.
- Provided guidance to junior staff.
- Participated in the specifications of a new billing system.
- Analyzed investment projects.
- Controlled billing system and generated monthly customer service report.
- Produced and monitored electricity sale budget.

Energy Economist **1992-1995 and 1997-1998**
Secretariat of Energy (Federal energy authority), Buenos Aires, Argentina

- Analyzed the impact of Southern Cone integration on the Argentinean natural gas and the electricity industries.
- Implemented simulation models for the natural gas transport system.
- Performed long term energy supply forecasts. Applied econometric techniques and analytical models.
- Provided guidance to junior staff.
- Assisted in a compared energy study for *MERCOSUR* countries.
- Analyzed the natural liquid gas world trade and the possibility of being introduced in the Argentine market.
- Elaborated and prepared statistics about electricity demand of end users.

EDUCATION

- DEA Économie Appliquée, Option Énergie. *Université Pierre Mendes France*. Grenoble, France. 1995-1996.
  (Equivalent to a Master's Degree in Economics in Canada)
- Licenciatura en Economía. *Universidad de Buenos Aires*. Buenos Aires, Argentina. 1984-1990.

SPECIALIZED TRAINING

- Electricity Demand Forecasting for Nuclear Power Planning. *International Atomic Energy Agency*. *Argonne National Laboratory*, Il, U.S.A. March-April 1995.

OTHER SKILLS

- Computer Skills: Word, Excel, Access, Power Point, statistics softwares, Internet.
- Other Languages: French, Spanish, and Portuguese.