

Forecasting Using the Benchmarking Spreadsheet Forecast Model

User's Guide

Dave Hovde

Pacific Economics Group Research LLC

August, 2016

Contents

- 1 Background 4
 - 1.1 Model Specification 4
 - 1.2 Overview of the Spreadsheet Model 5
 - 1.3 Background on the Actual Cost Calculation 6
 - 1.4 Background on the Predicted Cost Calculations 7
- 2 Overview of Spreadsheets in the Forecasting Model and Forecasting Issues 8
 - 2.1 Worksheet 1: Model Inputs 8
 - 2.2 Worksheet 2: Calculations 11
 - 2.3 Worksheet 3: Results 12
- Appendix 1: Key Documents 14

As part of the Renewed Regulatory Framework, the Ontario Energy Board (“OEB”) established several rate-setting options for Power Distributors in Ontario (“LDCs”). One of these options is Price Cap Incentive Rate-setting (“Price Cap IR”) which escalates rates by an inflation index (“IPI”) less an amount based on expected productivity growth (“X-factor”). The OEB approved cost benchmarking for the purposes of calibrating the X-factor to reflect the cost performance of individual LDCs. As time has passed additional uses for cost benchmarking are being considered. One such use is to apply the cost benchmarking methodology (“the model”) to future time periods. The benchmarking model is capable of measuring the cost performance associated with forecasted test year data provided as part of a rate filing. The OEB has decided to require all LDCs seeking changes in rates on a cost of service basis to provide the cost performance associated with the forecast data that support their request. The results of this benchmarking work will provide supplemental information on the direction of cost performance implied with the proposal.

The work done to specify the parameters of the benchmarking model necessitated highly complex computer code that was not generally transparent to anyone but experts. In order to avoid repeating this complex work each year and improve incentives for LDCs, it was decided that subsequent updates to the cost benchmarking calculations would include data updates, but not the re-estimation of the model parameters. This allowed updates to the benchmarking results to be performed on a spreadsheet instead of computer code. This spreadsheet is currently called the Enhanced Benchmarking Spreadsheet Model (“spreadsheet model”). The spreadsheet model is designed to improve accessibility and allow LDC personnel to validate the data used in the calculations and better understand how their historical cost performance was determined.

Some forecasting capability had been provided as part of the spreadsheet model to allow LDCs to evaluate the cost performance impact of future business decisions. The forecasting capability has been extracted and can now be used independently of the spreadsheet model. This dedicated forecast model is called the Benchmarking Spreadsheet Forecast Model (“forecast model”). Additional upgrades have been made to make it easier for LDCs to comply with the new forecasting requirement. This guide is designed to be supplemental to the existing documents that support the spreadsheet model and will focus on assisting LDCs in providing the correct information to successfully obtain forecasted benchmarking results.

The guide consists of two sections. The first section provides some background on the cost benchmarking methodology and the spreadsheet model. It focuses on the calculation of historical benchmarking results. This section borrows extensively from the user’s guide to the spreadsheet model

and has a focus on calculations using historical data. The second section provides an overview of what is in the forecast model as well as instructions for providing the required data. Users primarily interested in obtaining a result can skip to the second section. Those users interesting in commenting upon the results or gaining a better understanding of how the calculations are done should also read the first section. An appendix is included with links to key supporting documents.

1 Background

1.1 Model Specification

Distributor cost is modeled as a function of business conditions faced by each distributor. These business conditions include the number of customers served and the price of inputs such as labor and capital. Some business conditions such as the amount of high voltage transformation were explicitly taken into account by adjusting the definition of cost to be benchmarked. Other business conditions such as the area of service territory and percentage of line that is underground were tested but not found to be statistically significant. As such, while not all business conditions faced by a distributor were included in the model, those selected have a statistically significant relationship to cost. The parameters of this model establish the relationship between each selected business condition and distributor cost. These parameters were estimated using Ontario LDC data from 2002-2012. The model therefore provides the relationship between cost and business conditions faced by a typical power distributor in Ontario.

The model can make a prediction of each distributor's cost given identified business conditions by multiplying the values for the company's business condition variables by the model parameters and summing the results. The distributor's actual cost is then compared to that predicted by the model. The percentage difference between actual and predicted cost is the measure of cost performance. When actual cost turns out to be lower than the predicted cost, this demonstrates a better cost performance. As such, companies with larger negative differences between actual and predicted costs are considered to be better cost performers and therefore eligible for lower stretch factor classifications.

For example, suppose that the cost for a power distributor could be described by this simple equation: $\text{Cost} = \$1,000,000 + \$300 \times \text{Number of Customers}$. A distributor with 1,000 customers would have cost of 1.3 million dollars that is predicted by this equation. If the distributor on the other hand with 1,000 customers had a cost incurred that was actually only 1 million dollars, this amount would be compared to that predicted by the model and the conclusion would be that cost performance was better than expected by about \$300,000. This amount translated into percentage terms would be their cost performance measure.

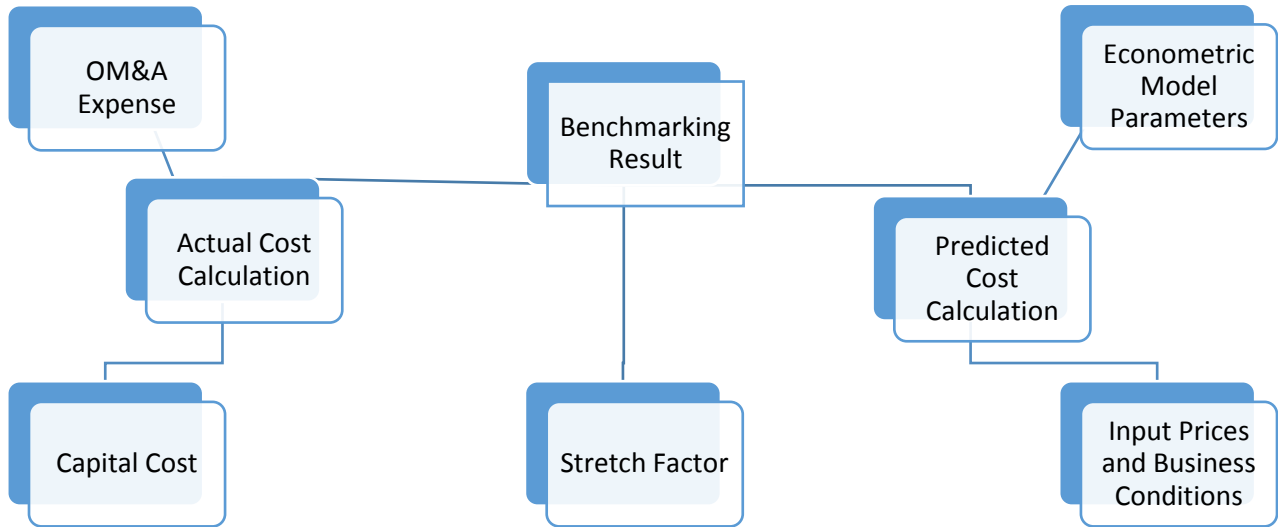
An econometric model uses the statistical technique of regression analysis to specify the parameters of an equation that best fits the observed data. In the context of power distribution cost, the parameters of a cost function were estimated. In the simple equation $\text{Cost} = A + B \times \text{Output}$, both cost and output are known while A and B are the unknown parameters. The regression method is designed to find the combination of the unknown parameters that best fit the observed data. In the simple example above, the values of \$1,000,000 and \$300 were the values for the parameters. For each observation, the parameters times the explanatory variables will generate an estimated value for cost. The difference between this estimate and the actual value is called the error. The square of this error will measure positive and negative deviations from the actual value equally and treat larger deviations from the actual value as being more serious than smaller deviations. The criteria for “best fit” is to minimize the sum of this squared error over all observations.

The estimated parameters establish the relationship between cost and each explanatory variable. Once estimated parameter values are available, it becomes possible to obtain a predicted cost value for any combination of explanatory variables including future values for a company that were not included in the original estimation of the model. The difference between the cost predicted by the model using the observed explanatory variables for a distributor and the actual cost of the distributor is the basis for the cost performance evaluation.

1.2 Overview of the Spreadsheet Model

A large number of calculations are required to obtain benchmarking results and at times the formulae will be complex. To see how the model works, it is useful to break down the calculations into pieces. The first logical division is the calculations involved in the calculation of actual cost vs. those for predicted cost. Figure 1 shows how these calculations may be organized.

Figure 1



The term “actual cost” is being used here to distinguish it from predicted cost and it is not intended to imply that this definition of cost is superior to those definitions used for non-benchmarking purposes. The OM&A definition has been chosen to allow better comparisons among distributors. The capital cost calculations use methods that are standard practice in productivity and cost research. The details of the Actual and Predicted Cost calculations are discussed in sections three and four respectively.

1.3 Background on the Actual Cost Calculation

The actual cost calculations can be broken down into calculations for OM&A and capital. The definition of cost was chosen in order to facilitate a fair comparison among companies and include some adjustments to allow for a level playing field. Examples include the addition or removal of certain cost items. For OM&A, high voltage costs were removed to control for the different scope of work done by LDCs. Because low voltage charges from Hydro One Networks to LDCs are not captured by the OM&A accounts used for benchmarking, these charges are added.

Capital cost is calculated as the product of a price and quantity. The quantity is calculated using the perpetual inventory method. Each year, an amount of capital is discarded based on the depreciation rate and new capital is added based on gross plant additions. These amounts are quantities in the sense that price inflation has been removed. This method is preferred for benchmarking because it will help control for differences in the vintage of plant. A cost comparison based on the historical cost of plant would be biased. All else equal, a company with older plant could be seen as a superior cost performer

because its plant and equipment were acquired at a time when construction costs were lower. The capital price equation takes into account the rate of return¹ and depreciation. Both of these were standardized such that differences in the allowed rate of return, depreciation practices, and when debt was incurred would not influence measured performance.

One consequence of the perpetual inventory method is that calculations from previous years carry forward into the current year calculations. For 2016, the quantity of capital for 2015 is used, but not independently calculated in the spreadsheet. The support for this value is found as part of the larger spreadsheet model.

1.4 Background on the Predicted Cost Calculations

The calculation of predicted cost involves gathering data to construct variables consistent with the model. The variables required include business conditions such as measures of LDC output, input prices for capital and OM&A, and other variables to measure the size and age of the system. Once constructed, these variables are multiplied by the parameters of the econometric model to obtain a measure of predicted cost.

Conceptually, the model takes cost data from all the distributors in Ontario and attempts to explain why they are different. Reasons why cost should be different include the fact that some distributors are bigger than others and some have to pay higher prices for labor. The model then attempts to determine how important each business condition is to the level of cost. The importance of each of business condition on cost is called the parameter value. They are determined by what combination of parameters when multiplied by the business condition variables best fit the observed cost data. The statistical term for this method is regression analysis.

Once estimates of how important each factor is on cost is determined, a prediction equation can be specified. By entering data for a set of factors, a predicted cost can be generated consistent with those business conditions. The resulting prediction is the level of cost a typical distributor in Ontario would have if they had faced that particular set of conditions. By entering the conditions faced by each distributor into the equation, the resulting predictions represent the level of cost for a hypothetical distributor with the same values for the business conditions variables as the selected distributor. Other benchmarking studies may rely upon comparisons to groups of peers that are seen to be similar to the

¹ This is the weighted average cost of capital using the methods as detailed on the worksheet titled Electricity Cost of Capital contained in the Spreadsheet Model provided with the most recent benchmarking update work. It is a weighted average of return on equity, rate on long term debt, and rate on short term debt.

subject company. Using an econometric model effectively creates a peer group of one hypothetical company that has the exact same values for identified business conditions as the subject company.

A comparison of the actual cost of the distributor to the hypothetical distributor will generate a difference in cost. The methodology will attribute differences in actual cost vs. the cost generated by the prediction equation to management performance. Those distributors that have cost levels lower than that for a typical distributor with the same values for business conditions will be classified as superior cost performers and those that do not will be classified as inferior cost performers.

2 Overview of Spreadsheets in the Forecasting Model and Forecasting Issues

The model consists of three worksheets. The purpose of the first worksheet is to gather the required data. The purpose of the second worksheet is to perform the calculations. The purpose of the third worksheet is to present the results. Each will be discussed in turn.

2.1 Worksheet 1: Model Inputs

The first worksheet is titled Model Inputs. The goal of this worksheet is to gather 11 data series and pass them to the second worksheet. The 11 data items required in order to do the calculations are numbered in column B. Some of these values may require supporting calculations. However, once these 11 data series are provided, the worksheets will calculate the benchmarking results. Also provided on the Model Inputs worksheet are relevant data and results from the 2015 benchmarking calculations done by PEG.

The following is a step by step walkthrough of what data need to be provided. The discussion assumes that the LDC is filing for traditional cost of service rates with a 2017 test year, therefore only 2016 and 2017 information is required. If those filing for custom IR choose to use the model, the same procedure applies except that information beyond 2017 should be provided.

The first step is to select the relevant LDC from the drop down box in cell F5. After clicking on this cell a down arrow should appear to the right. Clicking this down arrow will result in the option to select among all the Ontario LDCs. Once the relevant LDC is selected, the historic information for the selected LDC will appear in column G. Not all of the information in column G is used in the calculations, but can serve as a reference for the 2016 and 2017 values to be entered.

The second step is to enter the 11 required data items. A description of what is required and some notes are provided below.

1. Gross Capital Additions: These values should correspond to what would be provided as part of 2.1.5 of the RRR². For the purposes of benchmarking this value should not include any deferred smart meter capital cost from previous years.
2. HV Capital Additions: This the amount of the Total Gross Capital Additions that are due to high voltage assets as described in the RRR instructions.
3. Number of Customers: This is the same as provided as part of RRR 2.1.2
4. Delivery Volumes: This is the same as provided as part of RRR 2.1.5.3
5. Annual Peak Demand: This is the same as provided as part of 2.1.5.5 of the RRR. Please enter the maximum of summer and winter peak with embedded customers.
6. Circuit-km of line: This is the same as that reported as part of 2.1.5.5 of the RRR. The definition of a circuit-km is provided as a link in the RRR instructions. It is the length of the circuits as opposed to the distance covered by poles or the total length of the wires comprising the circuits.
7. Ten-year customer growth percentage: This is equal to the total growth in customers over last 10 years. For 2017 this would equal (Customers [2017] / Customers [2007]) -1.
8. Wage Growth: This is ideally a forecast of the growth in average weekly earnings for the industrial sector of Ontario because this is the index that will eventually be used to evaluate cost performance. Should the LDC have any similar forecast available as part of their evidence, it should replace the default values. In the absence of better values, the default values will suffice. The default values provided are equal to the 2014-2015 growth in average weekly earnings used in the historical benchmarking calculations.
9. Economy-wide inflation: If the proposal includes forecasted growth of economy-wide inflation such as an implicit price index for gross domestic product please replace the default values. For this purpose, the consumer price index (CPI) is not an economy wide inflation measure. In the absence of better values, the default values will suffice. The default values provided are equal to the 2014-2015 growth in GDPIPI (FDD) used in the historical benchmarking calculations.
10. Rate of Return (WACC): Enter the proposed weighted average cost of capital. This should be a weighted averaged of long term debt rates (56%), short term debt rates (4%), and return on equity (40%).

² This explanation applies to all remaining references to RRRs in this list.

11. OM&A expenses: One of two methods to determine this value are provided. In cells E27 and E29, please put a “Y” in the shaded cell of the method to be used and a “N” in the one not to be used.

- a. Method 1: This method relies upon the LDC to provide the values by starting with an available total and removing the cost associated with any account that is not listed as included³. Please provide support for these calculations on a separate worksheet. Please provide HV OM&A separately in 1B such that it will be removed from the total by formula. The amount provided in 1A should include these HV expenses in the total. The LV expenses to add (if any) are the following charges paid to Hydro One for low voltage service: LVDS Low Facility Charge, Specific ST Lines Facility Charge, Meter Charge, and 45% of the HVDS Low Facility Charge. The 2015 values for the sum of these items is provided for comparison, and the support for these values is provided with the full benchmarking model if needed.
- b. Method 2: Rather than the top down approach in method 1, this method adds the forecasts for individual accounts to arrive at a total. Please enter the data for each requested OM&A account in the placeholders provided as well as the LV adjustment as described above. The worksheet will calculate the total applicable OM&A cost.

The accuracy of the 2016 bridge year values provided are more important for some data items than others. They are important for items 1 and 2 because all historical additions are used to calculate the current-year total amount of capital employed. The 2016 values for annual peak demand provided with item 5 will only matter if the assumed value is forecasted to set a new historic high. The 2016 inflation rates assumed for item 8 and 9 will figure into the 2017 price levels. However, the model is robust to modest differences in assumed inflation rates. The 2016 values for the remaining items will not affect the calculations, but must be positive values for the spreadsheet to calculate results. The requested values provided for 2016 should be reasonable, but it is not expected that the LDC should go to extensive additional effort to supply values that do not already exist. In many cases, values as provided in the application or reasonable estimates should suffice for the bridge year.

At this point, the relevant data have been provided, results calculated and summarized on the results worksheet. The third step is to verify that the values provided in step 2 appear reasonable relative to 2015 values. Large deviations should be examined to make sure the units and scope of the item are consistent

³ Examples of accounts not included are 5335 Bad Debt and 5660 General Advertising Expenses.

with the 2015 values. The last step is to go to the results sheet. The columns for 2016 and 2017 should now show performance results.

Should you find that the results have not been calculated or error messages exist for 2016 or 2017, please save the spreadsheet under a different name. Either a required formula has been inadvertently modified or an unknown problem with the calculations has been discovered. The first can be checked by downloading a new or previously saved working copy of the spreadsheet and comparing formulae. If this does not resolve the issue, please contact OEB staff.

2.2 Worksheet 2: Calculations

The second worksheet does the calculations. It takes the data from the first worksheet and calculates actual forecast and predicted forecast cost in the same manner as historical years. The data on the first worksheet will (presumably) include higher levels of prices, customers, and other business conditions that reflect the passage of time. These higher values will result in higher predicted forecast cost levels. Therefore, despite the fact that the estimates of the impact of each business condition on cost were established using historical data, the forecast model is still capable of producing a valid calculation of future cost performance.

The calculation worksheet has four sections. The first gathers data. The second calculates Actual Forecast Cost. The third calculates Predicted Forecast Cost and the fourth calculates cost performance. Each will be briefly discussed to give the user a notion of what calculations are taking place. The user's manual for the spreadsheet model has a much more involved discussion.

Section 1 gathers the relevant data for later use. The addition of the Model Inputs worksheet has largely replaced this section. The values that are transferred from the Model Inputs worksheet are shaded. In some cases, the referenced values are used in a formula instead of used on their own.

Section 2 calculates Actual Forecast Cost. It is the sum of the relevant OM&A expenses plus capital cost. Capital cost is the product of a price and quantity. The quantity is calculated by updating previous calculations that go back to 1989. The update is done by adding the new quantity of capital which is measured by plant additions divided by a construction price index and removing depreciated capital. The depreciation rate is fixed and the construction price index is updated from previous values using the economy-wide inflation provided on the Model Inputs worksheet. The price index for capital represents the hypothetical price that an LDC would rent the capital that it actually owns. It includes a term for debt and equity cost as well as depreciation. This "perpetual inventory" method for measuring capital quantity and a capital "service price" is standard practice in productivity measurement.

Section 3 calculates Predicted Forecast Cost. The cost prediction can be thought of as a long equation with 18 items added together. Each of the 18 items can be thought of as the product of how important a given business condition is in determining total cost multiplied by how different a given company is from average for that business condition. For example, if a company has 50% more customers than average and having more customers raises cost by 0.5% for each 1% difference in customers, then having 50% more customers would raise predicted cost by 25%. The predicted forecast cost calculation can be thought of as a series of adjustments to average LDC cost to account for how a given company is different than average.

Section 4 calculates the percent difference between actual and predicted forecast cost which is how cost performance is determined. This final result is the goal of this work. Negative values imply that the LDC has lower cost than expected given its circumstances. These results are presented in tabular form in worksheet 3 which is discussed in section 2.3.

2.3 Worksheet 3: Results

The third worksheet presents the results as a table. In addition to the cost performance results, information is provided as to where the performance would fit within the categories established by the Board to determine stretch factors. Deviations of more than 25% from predicted cost resulted in the highest (1) and lowest (5) categories. Deviations of 10% - 25% were assigned to category (2) and (4) for better and worse than average performance respectively. Category number 3 was assigned to those that had performance within 10% of predicted. A distinction is made between how the annual values fit vs. how a three-year average fits. The three-year average is the method used to set stretch factors. The single year values give an indication of the stretch factor that would be warranted under the current system if that level of performance is maintained. Both results are presented on the table.

The interpretation and use of these results deserves a few comments. The first is to provide some caveats about any comparisons of actual and predicted forecast costs to other levels of cost. The second comment is to help clarify the use of historical data to draw conclusions about future cost performance.

The comparison of actual and predicted forecast cost is only valid if the same notion of cost is used in both cases. As discussed earlier, the scope of OM&A cost and capital cost is specific to these benchmarking calculations. A lot of decisions were made with the goal of making comparisons among distributors comparable. The work accomplished this, but at the cost of making the measures of predicted forecast cost not comparable with other, more familiar, notions of LDC cost. Therefore, it is not possible to make a direct comparison between the cost predicted by the model and values such as a proposed revenue requirement.

The forecast model addresses this problem by taking data consistent with the development of a proposed revenue requirement and using these data to calculate actual and predicted costs that are consistent with the model. For example, the model will cover most, but not all OM&A accounts in a revenue requirement and a cost of capital that addresses most capital additions made by an LDC over time. The predicted forecast cost will use the same customer and volumes assumed by the LDC for the test year along with reasonable inflation expectations.

The results of the calculations will allow one to determine if the information implicit in the proposal would lead to better or worse cost performance if the cost levels and business conditions were realized. In this sense the results can be used to gain an indication of the direction, but not the level of test year cost performance.

The second comment is to address concerns about the use of historical data to predict future performance. In general, the cost performance result is a comparison of current year actual and current year predicted cost. The predicted cost is calculated from current year business conditions and the parameter estimates which are the estimated impact of each business condition on total cost. The role of historical data is limited to how the parameter estimates were obtained.

The data used to estimate the impact of each business condition on cost was from 2002-2012. It was decided that the statistical work done to estimate these parameters would not be done each year. In theory, this statistical work could be repeated with 2013-2015 data included. The only benefit to doing this would be to obtain parameters that are based 14 years of data instead of 11. This would come at the cost of having a slightly different prediction equation each time the model parameters are updated. Updating the statistical work would not likely generate parameter estimates radically different from what is currently being used. For example, the model estimates that for the average LDC, for each 1% of capital price inflation, there will be a 0.63% increase in LDC cost. A model that includes additional data may result in a modestly different impact from 0.63%.

The cost comparison that takes place in the forecast model is between actual forecast cost and a predicted forecast cost that is calculated using test year data. The relative importance of each current-year business condition is fixed and therefore timeless. Although adding additional historical data would result in improved estimates of these model parameters, it does not follow that the actual forecast cost is being compared to a non-comparable historical standard.

Appendix 1: Key Documents

Benchmarking Documents Associated with IRM-4

Report of the Board – A Renewed Regulatory Framework for Electricity Distributors: A Performance Based Approach (Oct 18, 2012)

http://www.ontarioenergyboard.ca/oeb/ Documents/Documents/Report_Renewed_Regulatory_Framework_RRFE_20121018.pdf

Benchmarking Update Reports, Spreadsheet Models, User's Guides, and Training Materials

<http://www.ontarioenergyboard.ca/OEB/Industry/Rules+and+Requirements/Audit+and+Performance+Assessment> Memorandum to Ontario Energy Board Staff

http://www.ontarioenergyboard.ca/oeb/ Documents/EB-2010-0379/EB-2010-0379_PEG_Memorandum_Corrections_20131219.pdf

Productivity and Benchmarking Research in Support of Incentive Rate Setting in Ontario: Final Report to the Ontario Energy Board

http://www.ontarioenergyboard.ca/oeb/ Documents/EB-2010-0379/EB-2010-0379_Final_PEG_Report_20131111.pdf

PEG IRM-4 Working Papers Documentation and Files

http://www.ontarioenergyboard.ca/oeb/ Documents/EB-2010-0379/EB-2010-0379_Documentation_PEG_Working_Papers.pdf

<http://www.ontarioenergyboard.ca/oeb/ Documents/EB-2010-0379/EB-2010-0379%20PEG%20TFP%20and%20BM%20database%20calculations.xlsx>

Benchmarking Documents Prior to IRM-4

Benchmarking the Costs of Ontario Power Distributors

http://www.ontarioenergyboard.ca/documents/cases/EB-2006-0268/PEG_Final_Benchmarking_Report_20080320.pdf