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**Weather Normalized Distribution System Load Forecast: 2018 Cost of Service**

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[http://elenchus.ca/images/email_footer_01.jpg](http://www.elenchus.ca/)

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# Introduction

This report outlines the results and methodology used to derive the weather normal load forecast prepared for use in the Cost of Service application for 2018 rates for Erie Thames Powerlines (“Erie Thames”).

The regression equations used to normalize and forecast Erie Thames’ weather sensitive load use monthly heating degree days and cooling degree days as measured at Environment Canada’s London Airport weather station to take into account temperature sensitivity. This location is central to the communities in Erie Thames’s service territory, and has strong historical weather data. Erie Thames experiences peak loads in both the summer and winter seasons. Environment Canada defines heating degree days and cooling degree days as the difference between the average daily temperature and 18°C for each day (below for heating, above for cooling).

Overall economic activity also impacts energy consumption. There is no known agency that publishes monthly economic accounts on a regional basis for Ontario. However, regional employment levels are available. Given that income from employment and labour sources accounts for the largest portion of GDP on an income basis, and a study by Statistics Canada that has indicated that “turning points in the growth of output and employment appear to have been virtually the same over the past three decades”[[1]](#footnote-1), employment has been chosen as the economic variable to incorporate into the analysis. Specifically, the monthly full-time employment level for London, Ontario, as reported in Statistics Canada’s Monthly Labour Force Survey (CANSIM series Table 282-0135) was tested and used for the GS < 50 rate class. Employment was found to not have a statistically significant explanatory value for the Residential rate class, the only other class where linear regression was found to be appropriate.

In order to isolate demand determinants at the class specific level, equations to weather normalize and forecast kWh consumption for the Residential and GS<50 classes, have been estimated.

In addition to the weather and economic variables, a time trend variable, number of days and number of working days in each month, number of customers, and month of year variables, have been examined for all rate classes. More details on the individual class specifications are provided in the next section.

Finally, for classes with demand charges, an annual kW to kWh ratio is calculated using actual observations for each historical year and applied to the normalized kWh to derive a weather normal kW observation. For forecast values, the average kW to kWh ratio for 2007-2016 is applied for all metered rate classes. For the Street Light and Sentinel rate classes, a more recent history of 2014-2016 is used as these classes should not be sensitive to weather, and aren’t expected to benefit from the longer time horizon.

## Summarized Results

The following table summarizes the historic and forecast kWh for 2012-2018:

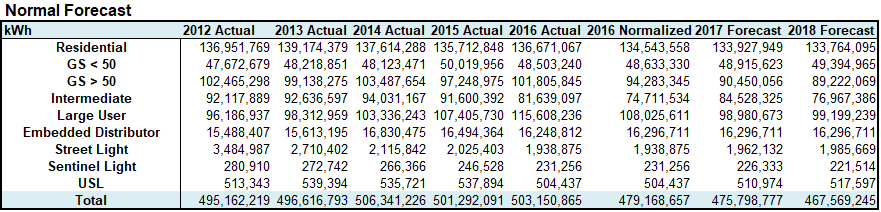


Table kWh forecast by class

The following table summarizes 2015-2020 CDM Adjusted Load Forecast kWh. Details for this calculation can be found in Schedule 6 of this report.

|  |  |  |  |
| --- | --- | --- | --- |
| **CDM Adjusted** |  |  |  |
| **kWh** | **2018 Weather Normal Forecast** | **CDM Adjustment** | **2018 CDM Adjusted Forecast** |
| **Residential** | 133,764,095 | 1,256,917 | 132,507,178 |
| **GS < 50** | 49,394,965 | 1,142,121 | 48,252,843 |
| **GS > 50** | 89,222,069 | 2,246,878 | 86,975,191 |
| **Intermediate** | 76,967,386 | 2,069,177 | 74,898,209 |
| **Large User** | 99,199,239 | 2,264,836 | 96,934,403 |
| **Embedded Distributor** | 16,296,711 | 0 | 16,296,711 |
| **Street Light** | 1,985,669 | 0 | 1,985,669 |
| **Sentinel Light** | 221,514 | 0 | 221,514 |
| **USL** | 517,597 | 0 | 517,597 |
| **Total** | 467,569,245 | 8,979,929 | 458,589,315 |

Table CDM Adjusted kWh forecast

The following table summarizes the historic and forecast kW for 2012-2018. The calculations can be found as follows:

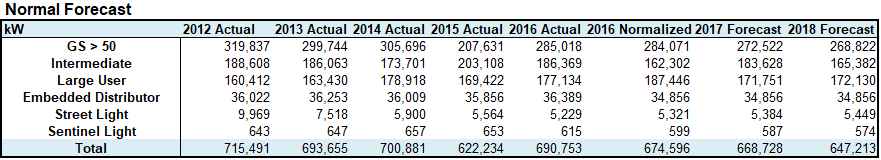


Table kW Forecast

The following table summarizes 2015-2020 CDM Adjusted Load Forecast kW. Details for this calculation can be found at the end of in Schedule 6 of this report.

|  |  |  |  |
| --- | --- | --- | --- |
| **CDM Adjusted** |  |  |  |
| **kW** | **2016 Weather Normal Forecast** | **CDM Adjustment** | **2016 CDM Adjusted Forecast** |
| **GS > 50** | 268,822 | 6,770 | 262,052 |
| **Intermediate** | 165,382 | 4,446 | 160,936 |
| **Large User** | 172,130 | 3,930 | 168,201 |
| **Embedded Distributor** | 34,856 | 0 | 34,856 |
| **Street Light** | 5,449 | 0 | 5,449 |
| **Sentinel Light** | 574 | 0 | 574 |
| **Total** | **647,213** | **15,146** | **632,068** |

Table CDM Adjusted kW Forecast

The following table summarizes the historic and forecast customer/connections for 2012-2018:



Table Customer / Connection Forecast for 2009-2020

# Class Specific kWh Regression

## Residential

For the Residential Class kWh consumption the equation was estimated using 120 observations from 2007:01-2016:12.

Heating and Cooling Degree days were used, as measured at the London Airport weather station as described in the introduction. A Trend variable was used, indicating 1 in January 2007, and incrementing once each month, reaching 120 in the last month of the regression, December 2015. Finally, binary indicator variables for the Shoulder months of March, April, and May, September, October, and November, as well as for the months of February and July were used.

Several other variables were examined, and found to not show a statistically significant relationship to energy usage. Those included an economic indicator of full time employment, the number of days in the month, and a count of customer connections.

The following table outlines the resulting regression model:

Model 11: OLS, using observations 2007:01-2016:12 (T = 120)

Dependent variable: Residential\_no\_CDM

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | *Coefficient* | *Std. Error* | *t-ratio* | *p-value* |  |
| const | 1.03976e+07 | 229284 | 45.3480 | <0.0001 | \*\*\* |
| London\_HDD | 5573.62 | 326.222 | 17.0854 | <0.0001 | \*\*\* |
| London\_CDD | 27524.7 | 2309.55 | 11.9178 | <0.0001 | \*\*\* |
| Trend | −4275.06 | 1274.81 | −3.3535 | 0.0011 | \*\*\* |
| Shoulder | −1.41996e+06 | 139198 | −10.2010 | <0.0001 | \*\*\* |
| Feb | −473349 | 184502 | −2.5656 | 0.0116 | \*\* |
| June | −773165 | 189478 | −4.0805 | <0.0001 | \*\*\* |
| Sept | 772942 | 175758 | 4.3978 | <0.0001 | \*\*\* |

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Mean dependent var | 11823416 |  | S.D. dependent var | 1558243 |
| Sum squared resid | 2.61e+13 |  | S.E. of regression | 482936.8 |
| R-squared | 0.909597 |  | Adjusted R-squared | 0.903947 |
| F(7, 112) | 160.9859 |  | P-value(F) | 2.13e-55 |
| Log-likelihood | −1736.650 |  | Akaike criterion | 3489.300 |
| Schwarz criterion | 3511.600 |  | Hannan-Quinn | 3498.356 |
| Rho | 0.184466 |  | Durbin-Watson | 1.611728 |
| Theil’s U | 0.30271 |  |  |  |

Table Residential Regression Model

Using the above model coefficients, we derive the following:

Figure Residential Predicted vs Actual observations

Annual estimates using actual weather are compared to actual values in the table below. Mean absolute percentage error (MAPE) for annual estimates for the period is 0.8%. Annual errors are calculated as the model is used to derive annual forecasts. However, in proceedings Elenchus has been involved in, intervenors and Board Staff have requested MAPE calculated on a monthly basis and this has been provided as well. The MAPE calculated monthly over the period is 3.0%.

|  |  |  |  |
| --- | --- | --- | --- |
|  | Residential kWh | | Absolute |
| Year | Actual | Predicted | Error (%) |
| 2007 | 147,994,308 | 145,309,049 | 1.8% |
| 2008 | 141,699,699 | 143,485,711 | 1.3% |
| 2009 | 140,171,354 | 140,402,646 | 0.2% |
| 2010 | 145,078,569 | 144,144,650 | 0.6% |
| 2011 | 141,624,537 | 143,039,944 | 1.0% |
| 2012 | 139,135,378 | 141,451,855 | 1.7% |
| 2013 | 141,721,481 | 141,429,434 | 0.2% |
| 2014 | 140,644,151 | 140,085,258 | 0.4% |
| 2015 | 139,502,198 | 139,363,325 | 0.1% |
| 2016 | 141,238,267 | 140,098,078 | 0.8% |
|  |  |  |  |
| Mean Absolute Percentage of Error (Annual) | | | 0.8% |
| Mean Absolute Percentage of Error (Monthly) | | | 3.0% |

Table Residential model error

## GS < 50

For the GS < 50 class, the regression equation was estimated using 120 observations from 2007:01-2016:12.

Heating degree days and cooling degree days were used, as measured at the London Airport weather station as described in the introduction.

A count of customers, and a trend variable indicating 1 in January 2007, increasing to 120 in December 2016 were used. As a measure of economic activity, the number of full time employees, “London\_FTE” was included. Binary variables representing the months of March, June, July, August, and September were used.

Other variables were examined, and found to not show a statistically significant relationship to energy usage. Those included an indicator of days in the month, and spring and fall dummy variables.

The following table outlines the resulting regression model:

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Model 50: OLS, using observations 2007:01-2016:12 (T = 120) | | | |  |
| Dependent variable: GS\_lt\_50\_no\_CDM | | |  |  |
|  |  |  |  |  |
|  | coefficient | std. error | t-ratio | p-value |
| const | -11631489.55 | 3030819.386 | -3.837737612 | 0.000208592 |
| GS\_lt\_50\_Cust | 6551.127986 | 1741.140986 | 3.762548834 | 2.73E-04 |
| London\_HDD | 2094.073158 | 109.077515 | 19.19802774 | 9.33E-37 |
| London\_CDD | 5924.857551 | 1108.897466 | 5.343016584 | 5.06E-07 |
| London\_FTE | 10421.48982 | 3094.139807 | 3.368137988 | 1.05E-03 |
| Trend | -4822.694077 | 1876.272497 | -2.570359095 | 1.15E-02 |
| Mar | -156104.0665 | 68013.96157 | -2.295176797 | 0.023637321 |
| June | 359272.7117 | 93117.03515 | 3.858291999 | 0.000193754 |
| July | 411098.3059 | 125921.8156 | 3.264710756 | 0.001464529 |
| Aug | 494220.9231 | 110691.9098 | 4.46E+00 | 1.96E-05 |
| Sept | 249265.1315 | 80695.8435 | 3.09E+00 | 0.002548735 |
|  |  |  |  |  |
| Mean dependent var | 4190028.628 | S.D. dependent var | 442281.5561 |  |
| Sum squared resid | 4.2434E+12 | S.E. of regression | 197307.5945 |  |
| R-squared | 0.817707214 | Adjusted R-squared | 0.800983105 |  |
| F(10, 109) | 48.89391855 | P-value(F) | 1.03E-35 |  |
| Log-likelihood | -1627.606294 | Akaike criterion | 3277.212589 |  |
| Schwarz criterion | 3307.874998 | Hannan-Quinn | 3289.664735 |  |
| rho | 0.086702585 | Durbin-Watson | 1.819920886 |  |
| Theil's U | 0.44297 |  |  |  |

Table GS < 50 Regression Model

Using the above model coefficients we derive the following:

Figure GS < 50 Predicted vs Actual observations

Annual estimates using actual weather are compared to actual values in the table below. Mean absolute percentage error (MAPE) for annual estimates for the period is 0.8%. Annual errors are calculated as the model is used to derive annual forecasts. However, in recent proceedings Elenchus has been involved in, intervenors and Board Staff have requested MAPE calculated on a monthly basis and this has been provided as well. The MAPE calculated monthly over the period is 3.3%.

|  |  |  |  |
| --- | --- | --- | --- |
|  | GS<50 kWh | | Absolute |
|  | CDM Added Back | Predicted | Error (%) |
| 2007 | 51,997,633 | 51,179,679 | 1.6% |
| 2008 | 48,943,216 | 50,195,637 | 2.6% |
| 2009 | 48,039,983 | 48,018,945 | 0.0% |
| 2010 | 49,616,194 | 49,050,622 | 1.1% |
| 2011 | 49,273,917 | 49,953,305 | 1.4% |
| 2012 | 48,699,091 | 48,462,747 | 0.5% |
| 2013 | 49,904,173 | 49,758,085 | 0.3% |
| 2014 | 50,588,552 | 50,348,351 | 0.5% |
| 2015 | 53,413,626 | 53,374,866 | 0.1% |
| 2016 | 52,327,039 | 52,461,199 | 0.3% |
|  |  |  |  |
| Mean Absolute Percentage Error (Annual) | | | 0.8% |
| Mean Absolute Percentage Error (Monthly) | | | 3.3% |

Table GS < 50 model error

# Weather Normalization and Economic Forecast

It is not possible to accurately forecast weather for months or years in advance. Therefore, one can only base future weather expectations on what has happened in the past. Individual years may experience unusual spells of weather (unusually cold winter, unusually warm summer, etc.). However, over time, these unusual spells “average” out. While there may be trends over several years (e.g., warmer winters for example), using several years of data rather than one particular year filters out the extremes of any particular year. While there are several different approaches to determining an appropriate weather normal, Erie Thames has adopted the most recent 10 year monthly degree day average as the definition of weather normal, which to our knowledge, is consistent with many LDCs load forecast filings for cost-of-service rebasing applications.

The table below displays the most recent 10 year average of heating degree days and cooling degree days as reported by Environment Canada for London Airport, which is used as the weather station for Erie Thames

|  |  |  |  |
| --- | --- | --- | --- |
| **10 Year Average** | |  |  |
|  |  | HDD | CDD |
| London Airport | January | 729.55 | 0 |
| London Airport | February | 678.56 | 0 |
| London Airport | March | 544.77 | 0.22 |
| London Airport | April | 328.11 | 0.32 |
| London Airport | May | 134.48 | 20.89 |
| London Airport | June | 30.43 | 56.13 |
| London Airport | July | 7.85 | 99.98 |
| London Airport | August | 10.43 | 80.19 |
| London Airport | September | 70.58 | 29.43 |
| London Airport | October | 241.15 | 2.87 |
| London Airport | November | 421.52 | 0 |
| London Airport | December | 610.56 | 0 |

Table 10 Year Average HDD and CDD

As part of the minimum filing requirements the OEB has requested monthly degree days calculated using a trend based on 20 years. This is shown in the table below.

|  |  |  |  |
| --- | --- | --- | --- |
| **20 Year Trend (2017)** | | | |
|  |  | HDD | CDD |
| London Airport | January | 772.15 | 0.00 |
| London Airport | February | 759.75 | 0.00 |
| London Airport | March | 589.76 | 0.00 |
| London Airport | April | 365.67 | 0.00 |
| London Airport | May | 144.32 | 18.13 |
| London Airport | June | 33.89 | 25.73 |
| London Airport | July | 10.32 | 72.81 |
| London Airport | August | 13.41 | 57.87 |
| London Airport | September | 84.14 | 15.26 |
| London Airport | October | 266.86 | 0.00 |
| London Airport | November | 441.74 | 0.00 |
| London Airport | December | 618.50 | 0.00 |

Table 20 Year Trend HDD and CDD

# Class Specific Normalized Forecasts

## Residential

Incorporating the forecast economic variables, 10-yr weather normal heating and cooling degree days, and calendar variables, the following weather corrected consumption and forecast values are calculated:



Table Actual vs Normalized Residential kWh

Figure Actual vs Normalized Residential kWh

While Residential customer counts are not a component of the regression model, they are forecasted for the purpose of rate setting. The Geometric mean of the annual growth from 2007 to 2016 was used to forecast the growth rate from 2017 to 2018.

|  |  |  |
| --- | --- | --- |
| Residential | | Percent of Prior Year |
| Year | Customers |
| 2007 | 15,716 |  |
| 2008 | 15,819 | 100.66% |
| 2009 | 15,888 | 100.44% |
| 2010 | 15,992 | 100.65% |
| 2011 | 16,123 | 100.82% |
| 2012 | 16,236 | 100.70% |
| 2013 | 16,383 | 100.90% |
| 2014 | 16,516 | 100.81% |
| 2015 | 16,667 | 100.92% |
| 2016 | 16,855 | 101.13% |
| 2017 | 16,987 | 100.78% |
| 2018 | 17,119 | 100.78% |

Table Forecasted Residential Customer Count

## GS < 50



Table Actual vs Normalized GS < 50 kWh

Figure Actual vs Normalized GS < 50 kWh

GS < 50 customer counts forecasted both for the purpose of the regression model, and for direct use in rate setting. The Geometric mean of the annual growth from 2007 to 2016 was used to forecast the growth rate from 2017 to 2018.

The following table includes the customer Actual / Forecast customer count on this basis:

|  |  |  |
| --- | --- | --- |
| GS < 50 | | Percent of Prior Year |
| Year | Customers |
| 2007 | 1,885 |  |
| 2008 | 1,892 | 100.35% |
| 2009 | 1,895 | 100.19% |
| 2010 | 1,906 | 100.56% |
| 2011 | 1,931 | 101.29% |
| 2012 | 1,921 | 99.51% |
| 2013 | 1,940 | 100.99% |
| 2014 | 1,953 | 100.67% |
| 2015 | 1,989 | 101.86% |
| 2016 | 1,993 | 100.20% |
| 2017 | 2,006 | 100.62% |
| 2018 | 2,018 | 100.62% |

Table Forecasted GS < 50 Customer Count\*

## GS > 50

The GS > 50 rate class is not weather sensitive. The historical consumption of the rate class has been adjusted to reflect the reclassification of two larger customers into the intermediate rate class. Due to changes in the composition of the rate class, usage prior to 2015 is not reflective of the expected load going forward. The GS > 50 forecast was calculated as an average of the 2015-2016 Actual usage.



Table Actual vs Forecast GS > 50 kWh

GS > 50 customer counts are forecasted for the purpose of rate setting. The Geometric mean of the annual growth from 2007 to 2016 was used to forecast the growth rate from 2017 to 2018.

|  |  |  |
| --- | --- | --- |
| GS > 50 | | Percent of Prior Year |
| Year | Customers |
| 2007 | 180 |  |
| 2008 | 185 | 102.73% |
| 2009 | 187 | 100.94% |
| 2010 | 185 | 98.66% |
| 2011 | 186 | 100.72% |
| 2012 | 187 | 100.76% |
| 2013 | 185 | 98.98% |
| 2014 | 181 | 97.44% |
| 2015 | 155 | 85.93% |
| 2016 | 158 | 101.61% |
| 2017 | 155 | 98.52% |
| 2018 | 153 | 98.52% |

Table Forecasted GS > 50 Customer Count\*

In order to normalize and forecast class kW for those classes that bill based on kW (demand) billing determinants, the relationship between billed kW and kWh is used. The average ratio from 2007-2016 is used to forecast kW for all future years. An adjustment is made to reflect the upcoming end of the Load Transfer arrangement with Hydro One.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **GS>50** | | | |  |  |
| Year | kWh Actual | Ratio | kW Actual |  |  |
|  | **A** | **C = B / A** | **B** |  |  |
| 2007 | 100,838,219 | 0.002977035 | 300,199 |  |  |
| 2008 | 93,760,619 | 0.003045233 | 285,523 |  |  |
| 2009 | 93,480,747 | 0.003077357 | 287,674 |  |  |
| 2010 | 94,650,573 | 0.003158418 | 298,946 |  |  |
| 2011 | 99,076,966 | 0.003144611 | 311,559 |  |  |
| 2012 | 100,446,053 | 0.003184167 | 319,837 |  |  |
| 2013 | 95,822,768 | 0.003128104 | 299,744 |  |  |
| 2014 | 98,638,138 | 0.003099165 | 305,696 |  |  |
| 2015 | 90,572,661 | 0.002292426 | 207,631 |  |  |
| 2016 | 94,283,345 | 0.003022989 | 285,018 |  |  |
|  |  |  |  |  |  |
|  | kWh Normalized |  | kW Normalized | End of LTLT | Forecast |
|  | **D** | **E** | **F = D \* E** | **G** | **H=F+G** |
| 2016 | 94,283,345 | 0.003012951 | 284,071 |  |  |
| 2017 | 90,450,056 | 0.003012951 | 272,522 |  |  |
| 2018 | 89,222,069 | 0.003012951 | 268,822 | 931 | 269,752 |

Table Forecasted GS > 50 kW

## Intermediate

The Intermediate rate class is not weather sensitive. The historical consumption of the rate class has been adjusted to reflect the reclassification of two larger GS > 50 customers into this class. The Intermediate forecast was calculated as an average of the 2007-2016 Actual usage. One customer is discontinuing operations. The historic energy and demand of that customer have been removed from the resulting totals.



Table Actual vs Forecast Intermediate kWh

Intermediate customer counts are forecasted for the purpose of rate setting. Erie Thames expects that the remaining 6 customers will persist into 2018

|  |  |  |
| --- | --- | --- |
| Intermediate | | Percent of Prior Year |
| Year | Customers |
| 2007 | 7 |  |
| 2008 | 7 | 100.00% |
| 2009 | 7 | 100.00% |
| 2010 | 7 | 100.00% |
| 2011 | 7 | 100.00% |
| 2012 | 7 | 100.00% |
| 2013 | 7 | 100.00% |
| 2014 | 7 | 100.00% |
| 2015 | 7 | 100.00% |
| 2016 | 7 | 100.00% |
| 2017 | 7 | 100.00% |
| 2018 | 6 | 85.71% |

Table Forecasted Intermediate Customer Count\*

To normalize and forecast class kW for those classes that bill based on kW (demand) billing determinants, the relationship between billed kW and kWh is used. The average ratio from 2007-2016 is used to forecast kW for all future years.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Intermediate** | | | |  |  |
| Year | kWh Actual | Ratio | kW Actual |  |  |
|  | **A** | **C = B / A** | **B** |  |  |
| 2007 | 108,060,169 | 0.002161745 | 233,599 |  | 233,599 |
| 2008 | 87,009,755 | 0.002226491 | 193,726 |  | 193,726 |
| 2009 | 74,111,478 | 0.002258834 | 167,406 |  | 167,406 |
| 2010 | 95,581,060 | 0.002070326 | 197,884 |  | 197,884 |
| 2011 | 91,188,812 | 0.002029048 | 185,026 |  | 185,026 |
| 2012 | 90,258,341 | 0.002089651 | 188,608 |  | 188,608 |
| 2013 | 89,583,306 | 0.002076987 | 186,063 |  | 186,063 |
| 2014 | 89,565,188 | 0.001939384 | 173,701 |  | 173,701 |
| 2015 | 85,452,092 | 0.002376859 | 203,108 |  | 203,108 |
| 2016 | 74,711,534 | 0.00249451 | 186,369 |  | 186,369 |
|  |  |  |  |  |  |
|  | kWh Normalized |  | kW Normalized | Lost Customer | Net Forecast |
|  | **D** | **E** | **F = D \* E** |  |  |
| 2016 | 74,711,534 | 0.002172383 | 162,302 |  | 162,302 |
| 2017 | 84,528,325 | 0.002172383 | 183,628 |  | 183,628 |
| 2018 | 84,728,009 | 0.002172383 | 184,062 | -18,680 | 165,382 |

Table Forecasted Intermediate kW

## Large Use

The Large Use rate class is not weather sensitive. Due to changes in the composition of the rate class, usage prior to 2015 is not reflective of the expected load going forward. The GS > 50 forecast was calculated as an average of the 2013-2016 Actual usage.



Table Actual vs Forecast Large Use kWh

The Large Use rate class has had 1 customer for at least the past 10 years, and is expected to have 1 customer going forward.

In order to normalize and forecast class kW for those classes that bill based on kW (demand) billing determinants, the relationship between billed kW and kWh is used. The average ratio from 2017-2016 is used to forecast kW for all future years.

|  |  |  |  |
| --- | --- | --- | --- |
| **Large Use** | | | |
| Year | kWh Actual | Ratio | kW Actual |
|  | **A** | **C = B / A** | **B** |
| 2007 | 87,269,418 | 0.001858888 | 162,224 |
| 2008 | 84,565,114 | 0.001904589 | 161,062 |
| 2009 | 107,470,119 | 0.001645558 | 176,848 |
| 2010 | 95,770,767 | 0.001748532 | 167,458 |
| 2011 | 97,907,919 | 0.001629855 | 159,576 |
| 2012 | 94,151,553 | 0.001703762 | 160,412 |
| 2013 | 94,970,953 | 0.001720841 | 163,430 |
| 2014 | 98,447,967 | 0.00181739 | 178,918 |
| 2015 | 100,676,055 | 0.001682845 | 169,422 |
| 2016 | 108,025,611 | 0.001639737 | 177,134 |
|  |  |  |  |
|  | kWh Normalized |  | kW Normalized |
|  | **D** | **E** | **F = D \* E** |
| 2016 | 108,025,611 | 0.0017352 | 187,446 |
| 2017 | 98,980,673 | 0.0017352 | 171,751 |
| 2018 | 99,199,239 | 0.0017352 | 172,130 |

Table Forecasted Large Use kW

## Embedded Distributor

The Embedded Distributor rate class is not sufficiently weather sensitive for meaningful regression analysis. The GS > 50 forecast was calculated as an average of the 2013-2016 Actual usage.

|  |  |  |  |
| --- | --- | --- | --- |
|  | Embedded |  |  |
| Year | Actual | Connections | Normal Forecast |
|  |  |  |  |
| 2007 | 17,391,305 | 2 |  |
| 2008 | 15,895,270 | 3 |  |
| 2009 | 17,281,081 | 3 |  |
| 2010 | 17,355,209 | 3 |  |
| 2011 | 17,333,527 | 3 |  |
| 2012 | 15,488,407 | 3 |  |
| 2013 | 15,613,195 | 4 |  |
| 2014 | 16,830,475 | 4 |  |
| 2015 | 16,494,364 | 4 |  |
| 2016 | 16,248,812 | 4 | 16,296,711 |
| 2017 |  | 4 | 16,296,711 |
| 2018 |  | 4 | 16,296,711 |

Table Actual vs Forecast Embedded kWh

The Embedded Class is served by 4 connections, and this configuration is expected to remain in 2018.

In order to normalize and forecast class kW for those classes that bill based on kW (demand) billing determinants, the relationship between billed kW and kWh is used. The average ratio from 2007-2016 is used to forecast kW for all future years.

|  |  |  |  |
| --- | --- | --- | --- |
| **Embedded Distributor** | | | |
| Year | kWh Actual | Ratio | kW Actual |
|  | **A** | **C = B / A** | **B** |
| 2007 | 17,391,305 | 0.001642597 | 28,567 |
| 2008 | 15,895,270 | 0.002199981 | 34,969 |
| 2009 | 17,281,081 | 0.00224659 | 38,824 |
| 2010 | 17,355,209 | 0.001991137 | 34,557 |
| 2011 | 17,333,527 | 0.002107823 | 36,536 |
| 2012 | 15,488,407 | 0.002325707 | 36,022 |
| 2013 | 15,613,195 | 0.002321959 | 36,253 |
| 2014 | 16,830,475 | 0.002139482 | 36,009 |
| 2015 | 16,494,364 | 0.002173833 | 35,856 |
| 2016 | 16,248,812 | 0.002239499 | 36,389 |
|  |  |  |  |
|  | kWh Normalized |  | kW Normalized |
|  | **D** | **E** | **F = D \* E** |
| 2016 | 16,296,711 | 0.002138861 | 34,856 |
| 2017 | 16,296,711 | 0.002138861 | 34,856 |
| 2018 | 16,296,711 | 0.002138861 | 34,856 |

Table Forecasted GS > 50 kW

# Street Light, Sentinel and USL Forecast

The Street Lighting, Sentinel, and Unmetered Scattered Load Classes are non-weather sensitive classes. The tables below summarize the historic annual energy consumption for both classes and the anticipated consumption in the forecast period.

The Street Light class has a significant increase in connection count in December 2015. The growth rate from 2007-2015 is expected to reflect the norm from 2017-2018.

|  |  |  |
| --- | --- | --- |
| Street Light | Lamps / Devices | Percent of Prior Year |
| Year |
| 2007 | 4,197 |  |
| 2008 | 4,283 | 102.05% |
| 2009 | 4,283 | 100.00% |
| 2010 | 4,283 | 100.00% |
| 2011 | 4,283 | 100.00% |
| 2012 | 4,283 | 100.00% |
| 2013 | 4,498 | 105.02% |
| 2014 | 4,498 | 100.00% |
| 2015 | 4,617 | 102.65% |
| 2016 | 5,927 | 128.37% |
| 2017 | 5,998 | 101.20% |
| 2018 | 6,070 | 101.20% |

Table Forecasted Street Light lamps (devices)

|  |  |  |
| --- | --- | --- |
| Sentinel Light | Connections | Percent of Prior Year |
| Year |
| 2007 | 301 |  |
| 2008 | 301 | 100.00% |
| 2009 | 301 | 100.00% |
| 2010 | 301 | 100.00% |
| 2011 | 301 | 100.00% |
| 2012 | 301 | 100.00% |
| 2013 | 248 | 82.39% |
| 2014 | 248 | 100.00% |
| 2015 | 248 | 100.00% |
| 2016 | 248 | 100.00% |
| 2017 | 243 | 97.87% |
| 2018 | 238 | 97.87% |

Table Forecasted Sentinel connections

|  |  |  |
| --- | --- | --- |
| USL | | Percent of Prior Year |
| Year | Connections |
| 2007 | 113 |  |
| 2008 | 123 | 108.81% |
| 2009 | 128 | 104.49% |
| 2010 | 127 | 99.35% |
| 2011 | 124 | 97.71% |
| 2012 | 120 | 96.31% |
| 2013 | 124 | 103.34% |
| 2014 | 121 | 97.78% |
| 2015 | 128 | 105.58% |
| 2016 | 126 | 99.02% |
| 2017 | 128 | 101.30% |
| 2018 | 130 | 101.30% |

Table Forecasted USL connections

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | Street Light |  |  |  |
| Year | Actual | Lamps / Devices | Average per Customer | Normal Forecast |
|  |  |  |  |  |
| 2007 | 4,143,939 | 4,197 | 987 |  |
| 2008 | 3,636,366 | 4,283 | 849 |  |
| 2009 | 3,489,623 | 4,283 | 815 |  |
| 2010 | 4,583,498 | 4,283 | 1,070 |  |
| 2011 | 3,899,368 | 4,283 | 910 |  |
| 2012 | 3,484,987 | 4,283 | 814 |  |
| 2013 | 2,710,402 | 4,498 | 603 |  |
| 2014 | 2,115,842 | 4,498 | 470 |  |
| 2015 | 2,025,403 | 4,617 | 439 |  |
| 2016 | 1,938,875 | 5,927 | 327 | 1,938,875 |
| 2017 |  | 5,998 | 327 | 1,962,132 |
| 2018 |  | 6,070 | 327 | 1,985,669 |

Table Forecasted Street Light kWh

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | Sentinel |  |  |  |
| Year | Actual | Connections | Average per Customer | Normal Forecast |
| 2012 | 280,910 | 301 | 933 |  |
| 2013 | 272,742 | 248 | 1,100 |  |
| 2014 | 266,366 | 248 | 1,074 |  |
| 2015 | 246,528 | 248 | 994 |  |
| 2016 | 231,256 | 248 | 932 | 231,256 |
| 2017 |  | 243 | 932 | 226,333 |
| 2018 |  | 238 | 932 | 221,514 |

Table Forecasted Sentinel kWh

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | USL |  |  |  |
| Year | Actual | Connections | Average per Customer | Normal Forecast |
|  |  |  |  |  |
| 2007 | 539,336 | 113 | 4,791 |  |
| 2008 | 539,138 | 123 | 4,401 |  |
| 2009 | 605,366 | 128 | 4,729 |  |
| 2010 | 565,196 | 127 | 4,445 |  |
| 2011 | 556,906 | 124 | 4,482 |  |
| 2012 | 513,343 | 120 | 4,290 |  |
| 2013 | 539,394 | 124 | 4,362 |  |
| 2014 | 535,721 | 121 | 4,430 |  |
| 2015 | 537,894 | 128 | 4,213 |  |
| 2016 | 504,437 | 126 | 3,990 | 504,437 |
| 2017 |  | 128 | 3,990 | 510,974 |
| 2018 |  | 130 | 3,990 | 517,597 |

Table Forecasted USL kWh

|  |  |  |  |
| --- | --- | --- | --- |
| **Street Light** | | | |
| Year | kWh Actual | Ratio | kW Actual |
|  | **A** | **C = B / A** | **B** |
| 2007 | 4,143,939 | 0.002722248 | 11,281 |
| 2008 | 3,636,366 | 0.002895418 | 10,529 |
| 2009 | 3,489,623 | 0.002699011 | 9,419 |
| 2010 | 4,583,498 | 0.002608577 | 11,956 |
| 2011 | 3,899,368 | 0.002765679 | 10,784 |
| 2012 | 3,484,987 | 0.002860599 | 9,969 |
| 2013 | 2,710,402 | 0.002773733 | 7,518 |
| 2014 | 2,115,842 | 0.002788507 | 5,900 |
| 2015 | 2,025,403 | 0.002747221 | 5,564 |
| 2016 | 1,938,875 | 0.002696838 | 5,229 |
|  |  |  |  |
|  | kWh Normalized |  | kW Normalized |
|  | **D** | **E** | **F = D \* E** |
| 2016 | 1,938,875 | 0.002744188 | 5,321 |
| 2017 | 1,962,132 | 0.002744188 | 5,384 |
| 2018 | 1,985,669 | 0.002744188 | 5,449 |

Table Forecasted Street Light kW

|  |  |  |  |
| --- | --- | --- | --- |
| **Sentinel** | | | |
| Year | kWh Actual | Ratio | kW Actual |
|  | **A** | **C = B / A** | **B** |
| 2012 | 280,910 | 0.002288993 | 643 |
| 2013 | 272,742 | 0.002372208 | 647 |
| 2014 | 266,366 | 0.002466529 | 657 |
| 2015 | 246,528 | 0.002648789 | 653 |
| 2016 | 231,256 | 0.002659389 | 615 |
|  |  |  |  |
|  | kWh Normalized |  | kW Normalized |
|  | **D** | **E** | **F = D \* E** |
|  |  |  |  |
| 2016 | 231,256 | 0.002591569 | 599 |
| 2017 | 226,333 | 0.002591569 | 587 |
| 2018 | 221,514 | 0.002591569 | 574 |

Table Forecasted Sentinel kW

# CDM Adjustment to Load Forecast

The current Chapter 2 OEB Minimum Filing requirements, consistent with the Board’s CDM Guideline EB-2012-0003, expects the distributor to integrate an adjustment into its load forecast that takes into account the six-year (2015-2020) targets for kWh and kW reductions.

The filing requirements note that the distributors license condition targets and the LRAMVA balances are based on the IESO targets, which are annualized. It is recognized that the CDM programs in a year are not in effect for the full year, although persistence of previous year’s programs will be. Therefore, the actual impact on the load forecast for the first year of the program should not be the full annualized amount. For this reason, the amount that will be used for the LRAMVA will be related to, but not necessarily equal to, the CDM adjustment for the load forecast.

The following is the proposed allocation of the CDM kWh load forecast adjustment and final proposed load forecast, based on a half-year of savings from 2016, a full year of savings from 2017, and a half year of savings from 2018. The IESO verified savings persisting to 2020, as well as the 2015-2020 Draft Historic Target and Budget Analysis dated July, 2014 informed the Residential and General Service apportionment of the target. The class volumes were used for the GS < 50 and GS > 50 apportionment of the General Service portion of the target.

For 2018 LRAMVA Elenchus reasons that the effects of 2015-2017 IESO CDM programs should be included in the LRAMVA calculation. In particular, full years of 2016-2018 are included.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | **2015 Verified CDM** | **Share** | **CDM Adjustment** | **LRAMVA Target** |
| Residential | 743,199 | 14.0% | 1,256,917 | 1,885,376 |
| GS < 50 | 675,321 | 12.7% | 1,142,121 | 1,713,182 |
| GS > 50 | 1,328,549 | 25.0% | 2,246,878 | 3,370,316 |
| Intermediate | 1,223,477 | 23.0% | 2,069,177 | 3,103,766 |
| Large Use | 1,339,168 | 25.2% | 2,264,836 | 3,397,254 |
| Total | 5,309,714 | 100.0% | 8,979,929 | 13,469,894 |

Table Proposed CDM Adjustment

In order to calculate the kW Elenchus proposes using a proportional ratio utilizing the base load forecast kW and kWh.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | **Weather Normalized 2018 Forecast (kWh)** | **CDM Adjustment (kWh)** | **% Savings** | **Weather Normalized 2018 Forecast (kW)** | **CDM Adjustment (kW)** |
| GS > 50 | 89,222,069 | 2,246,878 | 2.5% | 268,822 | 6,770 |
| Intermediate | 76,967,386 | 2,069,177 | 2.7% | 165,382 | 4,446 |
| Large Use | 99,199,239 | 2,264,836 | 2.3% | 172,130 | 3,930 |
| Total | 265,388,694 | 6,580,891 | 0 | 606,334 | 15,146 |

Table Proposed kW CDM adjustment

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | **Weather Normalized 2018 Forecast (kWh)** | **LRAMVA Adjustment (kWh)** | **% Savings** | **Weather Normalized 2018 Forecast (kW)** | **LRAMVA Adjustment (kW)** |
| GS > 50 | 89,222,069 | 3,370,316 | 3.8% | 268,822 | 10,155 |
| Intermediate | 76,967,386 | 3,103,766 | 4.0% | 165,382 | 6,669 |
| Large Use | 99,199,239 | 3,397,254 | 3.4% | 172,130 | 5,895 |
| Total | 265,388,694 | 9,871,336 | 0 | 606,334 | 22,719 |

\* Note that LRRAMVA kW is the proportional LF kW over LF kWh times kWh LRAMVA

Table LRAMVA kW threshold by class

1. Philip Cross, “Cyclical changes in output and employment,” *Canadian Economic Observer*, May 2009. [↑](#footnote-ref-1)