Draft Schedule E M&V Procedures – RETScreen Comments

Summary

Thank you for providing Natural Resources Canada's RETScreen Division with the opportunity to comment on the draft M&V procedures for the proposed IESO Pay-for-Performance Program. The current release of the **RETScreen Expert - Clean Energy Management Software** (www.retscreen.net) can handle most, if not all, requirements of the proposed M&V procedures. However, some of these might require aggregation and manipulation of data outside the software (e.g. hourly to daily data). We will continue to adapt the software, where possible, to make it more flexible.

Our **biggest concern** for the proposed M&V procedures is that **hourly data** is required for the regression analysis. We believe this creates an unnecessary and significant barrier for the uptake of this proposed program. A number of our current users in Ontario, who are multi-distributor consumers, would be prime candidates for this new program. Our experience with them, and similar organizations in other jurisdictions, concludes that the requirement of hourly data for regression analysis is a significant "over-kill". This level of data is not typically available to these consumers, or if it is, the quality of the data can be problematic. And more importantly, using hourly data can make it very difficult to prepare a proper regression analysis for energy systems. There usually is too much "noise" in the data. However, proper regression analysis is certainly achievable with monthly data, and can be achieved with weekly or even daily data. Beyond that we do not see any benefit for an M&V program to require any higher resolution data than daily. RETScreen Expert's regression analysis is a daily model; it is not designed to handle hourly data. However, it is possible to store data in any time step and then import it as a daily value in RETScreen. A proper aggregation of the data is then required. We have purposely designed the RETScreen software around the typical data available to users. We **strongly recommend that you change the hourly data requirement to at least daily, but even consider allowing monthly data**.

Our **second recommendation** relates to the allowable weather data source. We agree that Environment Canada data, where available, can be used, and is often used in RETScreen. Environment Canada ground data can be imported and used in RETScreen Expert. However, we recommend that you also allow the use of daily **NASA Near Real-time Global Radiation and Meteorology data,** available within the RETScreen Expert software and from NASA's website. This data is used by many of RETScreen's 500,000+ users worldwide and has proven to be robust for M&V. The other advantage is that it is available for the entire surface of the planet, and not limited to the relatively few ground weather stations, like the Environment Canada data. The NASA data is particularly useful in areas not near airports (where ground weather stations are typically located).

The **third recommendation** is that the **baseline year procedure** should provide the flexibility to allow the user to choose, for the baseline year, a period that has an energy consumption that is representative of present operating conditions. It **should not be restricted to the past 12 months of data** (e.g. past 12 months might not be reprehensive of average year for numerous potential reasons).

Finally, regarding weather or not "*users can determine the **statistical indices** listed in Section 6.4 for a model using RETScreen Expert,"* in the current version of RETScreen Expert, **all the required statistical indices are calculated except for the 'Net Determination Bias Error (NDBE)'**. It is easy for us to add this indice to the software. **As a result of this review, we are currently adding this indice to RETScreen Expert,** to be available in the next release (expected early 2017).

We provide more detailed comments below directly referencing the numbering from the draft Schedule E document. The text presented in *italics* below comes from the Schedule E.

Executive summary

1.1.1 "*Minimum 1.5M kWh/yr*" - This would be better written as 1,500,000 kWh/yr or 1,500 MWh/yr.

1.1.4 "*Baseline model input/output will range from hourly to daily*" - This could be too restrictive, for some buildings, the daily data generates too much noise so weekly is often better.

Raw data requirements

4.1 "*Baseline models will be prepared based on historical hourly interval data*" and "*There is no requirement for the baseline model output to be hourly – it could be as coarse as daily – but the underlying actual hourly data for both the Baseline and the Pay-for-Performance Periods must be submitted to the IESO*." - This means that when RETScreen is used, the hourly data must be aggregated to daily data in a separate spreadsheet before being imported in the software, if this hourly data requirement is maintained.

4.3 "*The most recent 12 months of data will be used to reflect the most current operation of the building."* - If a building has made any 'temporary' changes in the last 12 months, the baseline will be incorrect. It is suggested that the energy used is studied over the minimum 24-month period required and the baseline is selected within this period.

4.7 "***Weather data****: hourly temperature data from for a local Environment Canada weather station must be used."* - If hourly data are required for weather, NASA data for weather correlation cannot be used directly as the minimum time resolution is daily. It is recommended to allow daily weather data when daily aggregation is performed on the energy data.

Baseline model requirements

5.6 "*Weather data used for modeling shall be traceable to a commercially available source (i.e. Environment Canada)."* - Weather data from Environment Canada can be downloadable in the RETScreen software; there is a procedure to do it automatically.

Baseline model submission requirements

6.3 *"A spreadsheet showing the calculations in terms of how the model output is calculated as a function of the independent variables and the time periods is required"* - This can easily be done using the 'Copy data to clipboard' option in RETScreen. All the data could be pasted to a spreadsheet and calculation could be verified and validated.

6.4 *"Coefficient of Variation of Root Mean Squared Error (CV(RMSE))"* - This is the same as "Coefficient of variation of the RMSE" in RETScreen Expert (see figure below).

6.4 *"Net Determination Bias Error (NDBE)"* - This calculation is currently being added to the software and will be available with the next release (expected early 2017).

Equation

Y = a*x+b

Dependent variable (Y)	Electricity (kWh)
Independent variable (x)	Cooling degree-days 17°C (°C-d)

Regression results

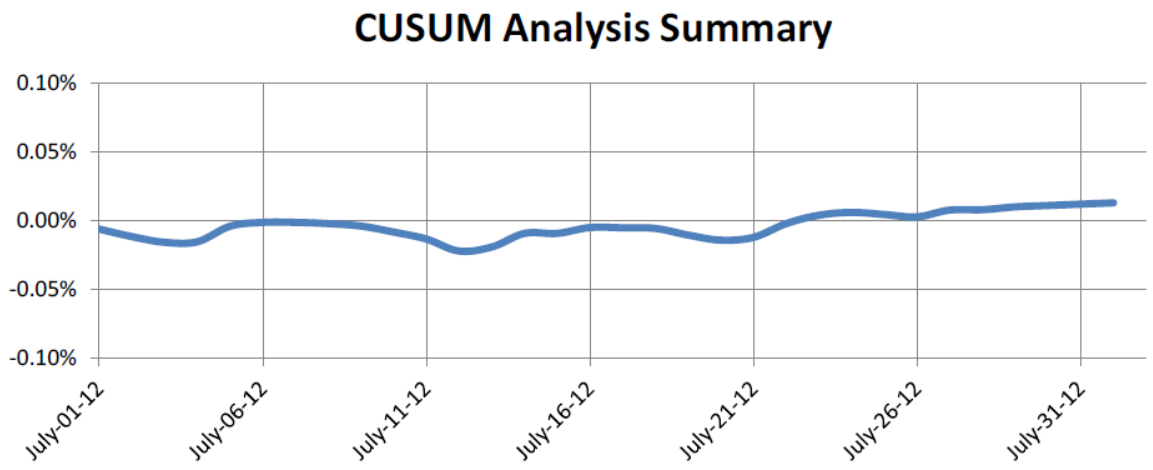
Number of observations:	12
Number of iterations:	3
Sum of residuals:	0.9012
Average residual:	0.0751
Residual sum of squares - Absolute:	642.914
Residual sum of squares - Relative:	633.0936
Standard error of the estimate:	7.9567
Coefficient of multiple determination (R^2):	0.9995
Coefficient of multiple determination - Adjusted (Ra^2):	0.9995
Root-mean-square error (RMSE):	8.0182
Coefficient of variation of the RMSE:	0.007

Coefficient results

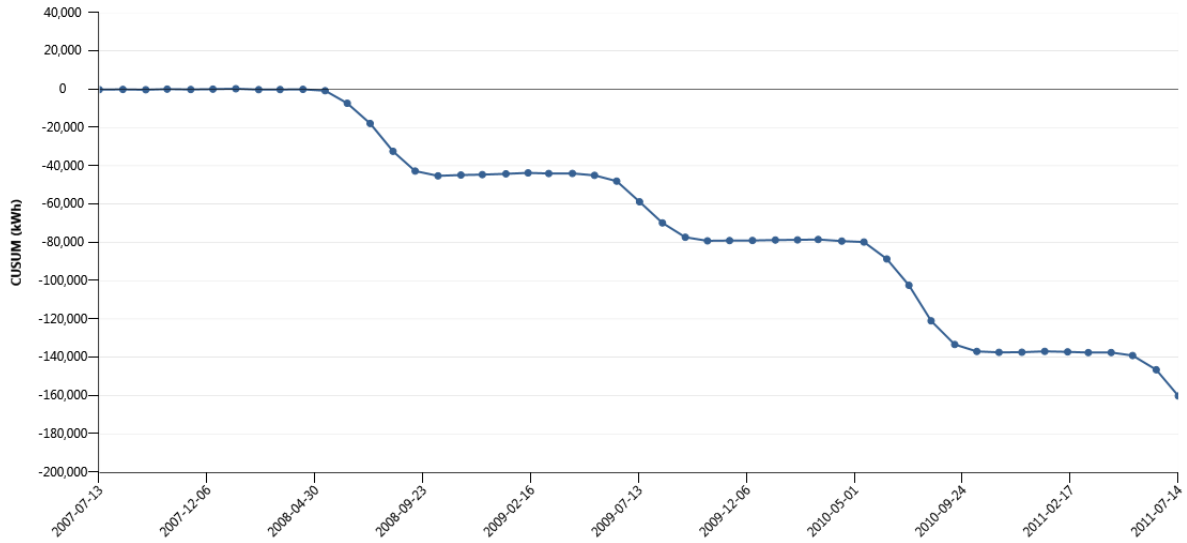
Name	Value	Standard error	t-ratio	Prob(t)
a	130.6459	0.8778	148.8344	4.6044E-18
b	899.9086	2.8071	320.5846	2.1453E-21

IESO Baseline Validation Methodology (Pre-Approval)

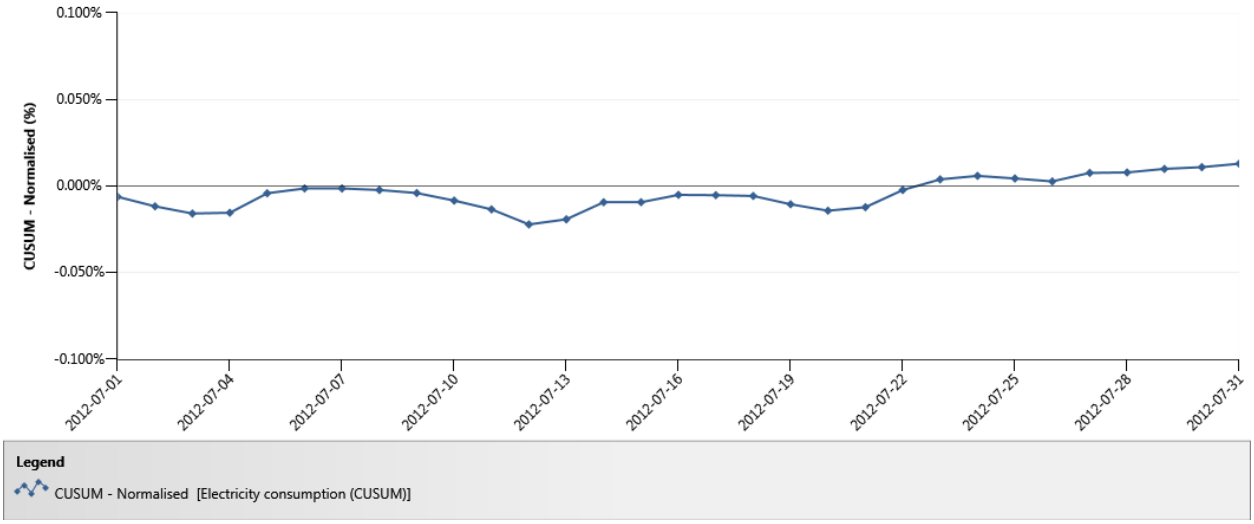
7.1 *"CUSUM Analysis report"* - This particular CUSUM graph is not currently part of the default graphs presented automatically in the RETScreen analysis.



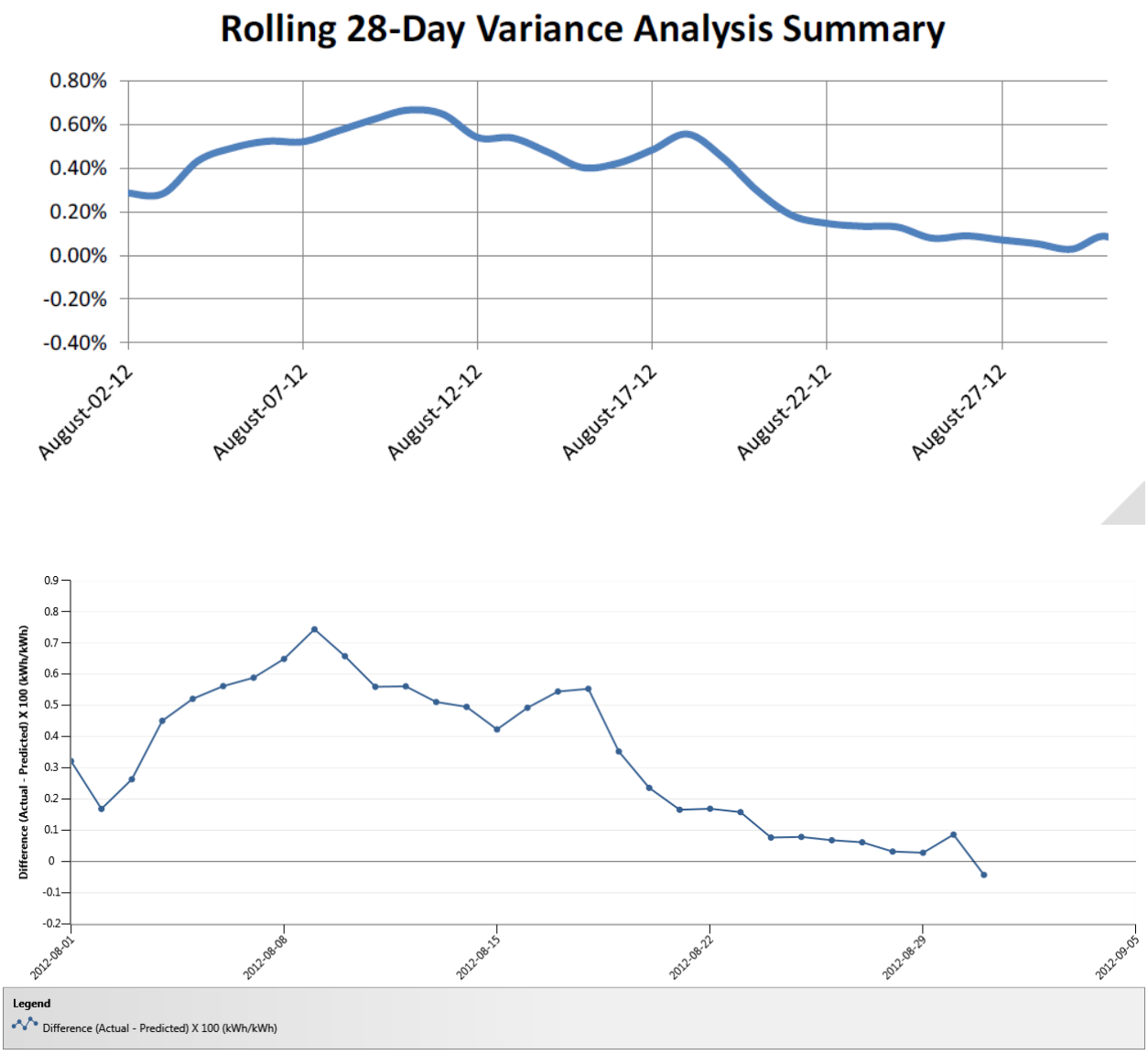
RETScreen uses absolute values in its CUSUM graph as shown below.



However, with a series of simple steps, it is possible to replicate the graph in RETScreen and perform the validation of the baseline analysis as described in the procedure. See graph below. We will also look into updating the software to allow for this variance CUSUM analysis to be calculated on a dynamic basis, in case it is needed beyond the baseline procedure.



7.2 "*Rolling 28-day Variance Analysis Report*" - A similar graph can be produced using the Moving graph option of RETScreen. We will also look into updating the software to allow for this analysis to be more readily calculated on a dynamic basis.



CUSUM Analysis Calculation (Appendix E)

"An Excel tool will be provided to simplify the analysis for Applicants and to standardize the report for evaluation purposes." - Although these graphs can be replicated in RETScreen (therefore, no external Excel tool required), it is also possible to paste data from RETScreen into this spreadsheet to generate the chart.

Rolling 28-Day Variance Analysis (Appendix F)

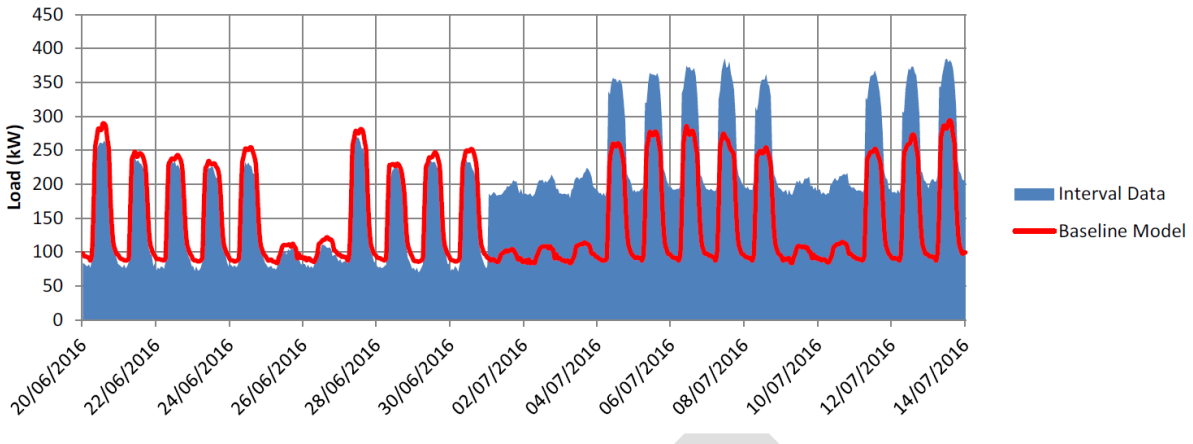
"An Excel tool will be provided to simplify the analysis for Applicants and to standardize the report for evaluation purposes". - Although these graphs can be replicated in RETScreen (therefore, no external Excel tool required), it is also possible to paste data from RETScreen into this spreadsheet to generate the chart.

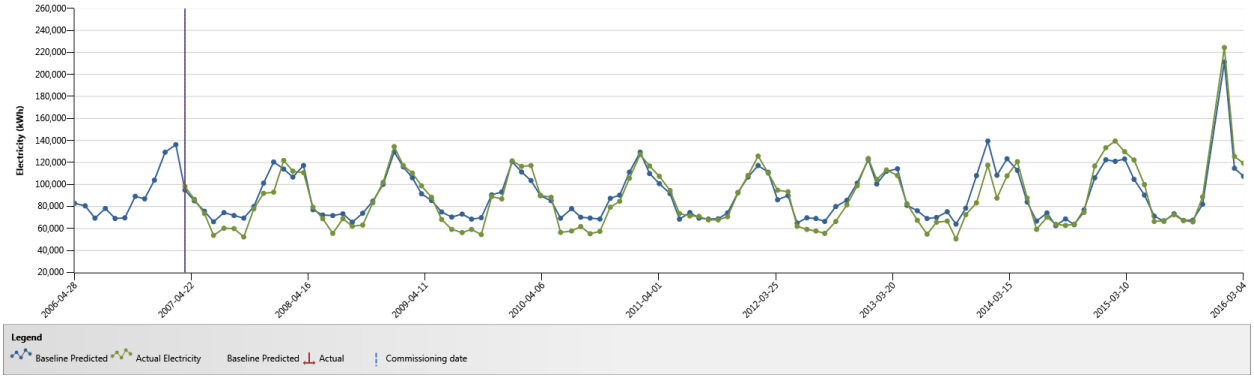
Calculation of savings

"Savings cannot be measured - they must be calculated, as it is impossible to measure the absence of something. Fundamentally:

***Savings = Baseline Energy Use – Pay-for-Performance Period Energy Use**"*

The M&V chart available into RETScreen is similar to the one presented in this procedure.



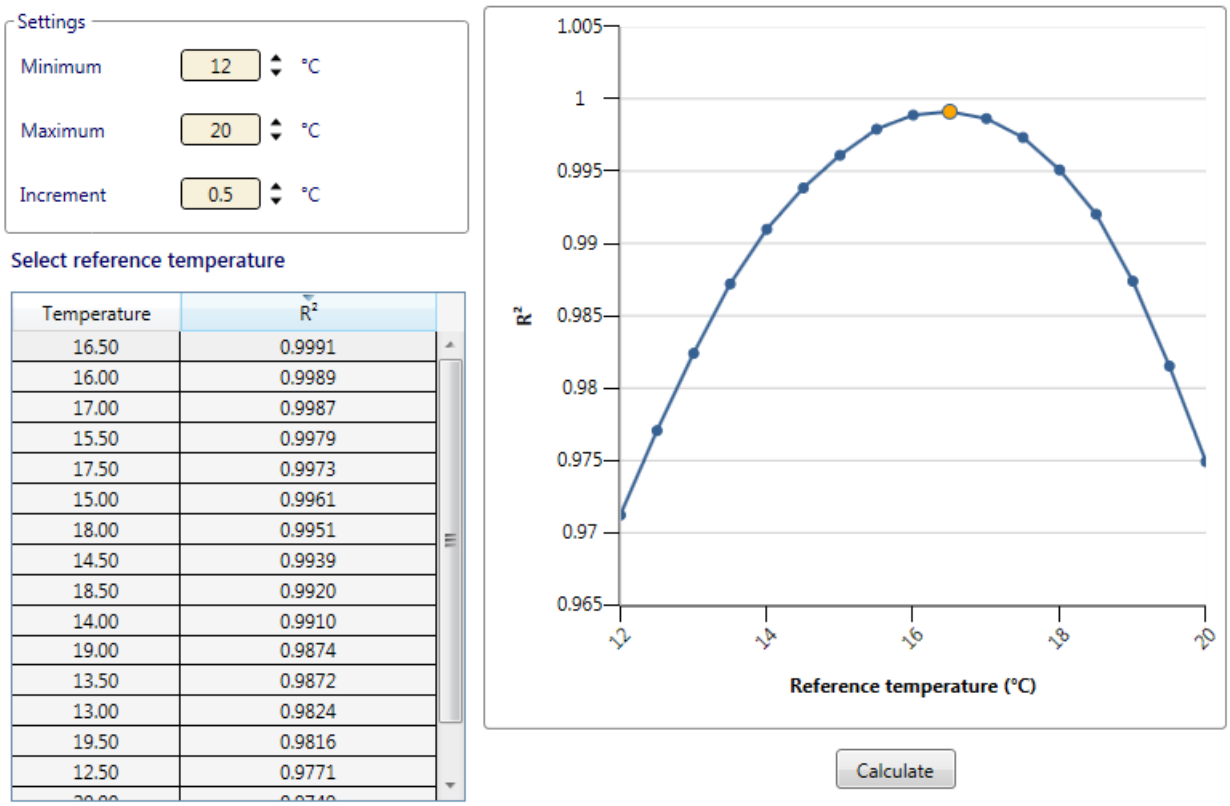


The RETScreen M&V chart follows the International Performance Measurement and Verification Protocol (IPMVP) rules.

Sample (simple) baseline model description (Appendix B)

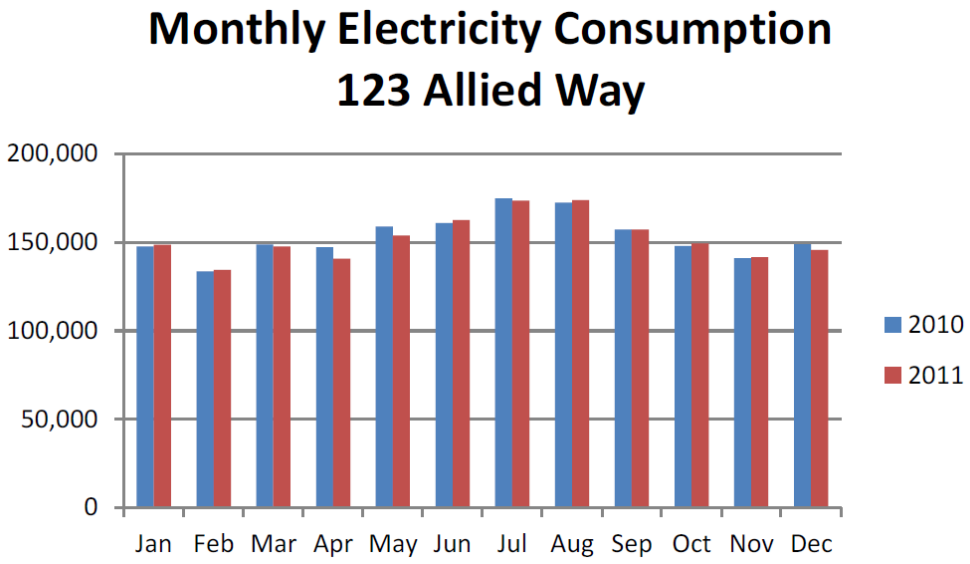
"Cooling degree hours are a function of the balance temperature (the temperature at which the store needs neither heating nor cooling). The balance temperature is a property of the building, and is derived by finding the best fit of the regression model. For clarity, actual weather data for the Baseline Period should be used in the regression analysis. " - The RETScreen software can automatically run a series of

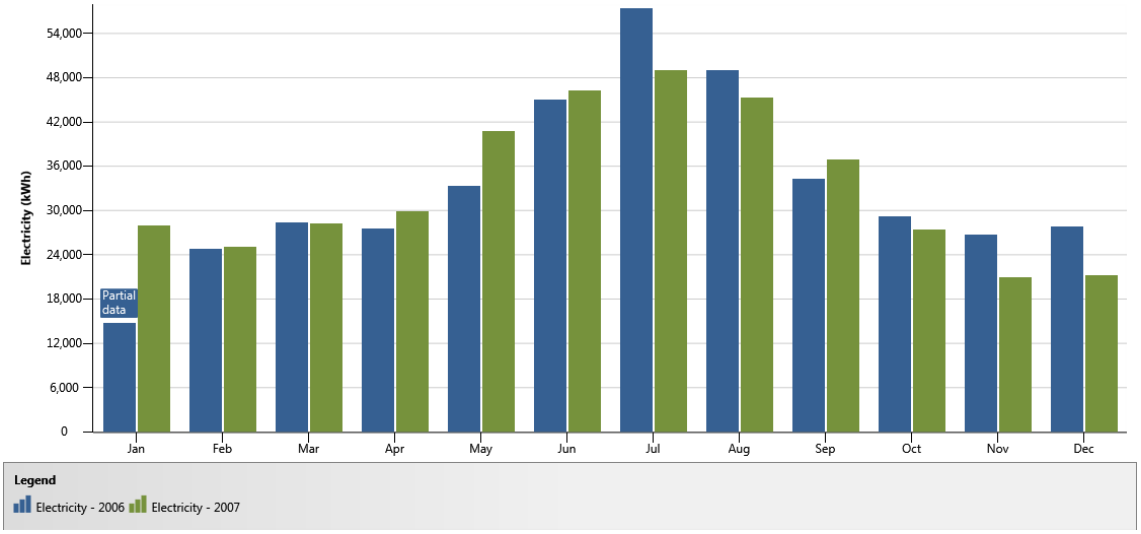
simulations by changing the degree-day reference temperature and choose the one which yields the highest R^2 value. See figure below.



Illustrative example: Sample baseline modeling process (Appendix C)

"Monthly electricity consumption based on the interval data is shown in the following figure."





This type of graph can easily be replicated in RETScreen.