Appendix L

Methodological Changes

2018 WA IRP

Introduction

The Methodological Changes Appendix outlines the key changes in methodologies that occurred in the 2018 WA IRP. Cascade will identify each change with a brief analysis of pros and cons of the new approach.

Section 3: Demand Forecast

Cascade has made a slight change to the forecast methodology this year by using a dynamic regression approach to modeling. Dynamic regression is simply an ARIMA term in a standard regression model. Also, Cascade has used wind as a predictor for usage, and therefore a coefficient for the demand forecast formula. Cascade has utilized R along with SAS Analytics, statistical analysis software programs, and has used models that follow a dynamic regression methodology. The Company plans to continue improving the customer and demand forecast model through R and SAS. Cascade has also started forecasting at the daily level rather than the monthly level.

Pros:

- Dynamic Regression approach allows Cascade to capture the non-linear impacts from weather and other demand drivers.
- ARIMA terms allow Cascade to accurately account for autocorrelations between data points in a stationary time series.
- Wind is an additional enhancement to capture the non-linear relationship between weather and demand beyond a simple linear model between HDDs and demand.
- R and SAS contain vast analytical tools that go beyond the functionality of Excel.
- Forecasting at the daily level give Cascade more data points to capture the relationship between weather and demand.

Cons:

- The Dynamic Regression approach requires more processing power and additional resources to complete the 20-year customer and demand forecasts.
- Increasing the number of explanatory variables in a model creates a risk of overfitting. Cascade will continue to cross-validate forecasted values with actuals.

Section 4: Supply Side Resources

Cascade now derives the weights of the price forecast by calculating the Symmetric Mean Absolute Percentage Error (SMAPE) of each of its sources versus actual Henry Hub pricing since 2010. The inverse of these error terms was then used to determine the weight given to each source.

To ensure that the forecast is accounting for the most current information in the market, Cascade has introduced an age dampening mechanism to its price forecast. Every month, if there is a source that is over one year old, all sources' weights are reduced by their share of the total number of months that all sources are outdated by. The detracted weights are then added back into the weight of the forwards market, since that will always be the most current source (as it is updated daily).

Also new to the 2018 WA IRP, Cascade has decided to weight the futures market at 100% for the first fifteen months of the forecasting period. The weights are then linearly interpolated over the next two years in order to align them with the calculated weights as described above.

Pros:

- Using the daily NYMEX forwards for short term forecasting allow the Company's forecast to incorporate current market data, such as weather and force majeure events, into its projections.
- The age dampening mechanism favors sources that have been updated more recently, which better captures a paradigm shift in the markets on a long-term basis versus a forecast that may be a few months or even years old.
- The use of SMAPE to assign weights to the sources creates a more scientific rationale for the blending of forecasts.

Cons:

- Since the forecast is a blending of other forecasts, the Company is at the mercy of the accuracy of its sources. While the SMAPE calculation helps to reward the more accurate forecasts, if all sources failed to capture a major market movement, Cascade's forecast would ultimately end up inaccurate as well.
- Some sources produce fairly infrequent forecasts, creating a small sample size for them to be evaluated in the SMAPE calculation. The Company is monitoring these problems to ensure they do not skew the forecast, and does have mechanisms in place to allow for a manual adjustment if market intelligence deem such a modification to be appropriate.

Section 5: Environmental Considerations

In this IRP, Cascade has used the Social Cost of Carbon (SCC) with a three percent discount rate as the main CO_2 adder in modeling impacts of a potential price that could be placed on CO_2 emissions from customers' usage of natural gas sales. Additionally, Cascade modeled three Carbon sensitivities for inclusion in the 2018 WA IRP; Washington SB 6203, Protect Washington Act (I-1631), U.S. House of Representatives Market Choice Bill. The new methodology replaces the Northwest Power and Conservation Council's Carbon Cost Risk approach which was used in the 2016 WA IRP.

Pros:

- The SCC is a methodology that has shown to be favored by WUTC Commissioners and Staff as a relevant proxy for quantifying carbon compliance costs.
- Analysis of multiple carbon sensitivities allows the Company to model a wide range of potential carbon compliance costs due to the uncertainty of future carbon legislation.

Cons:

- Cascade and stakeholders have expressed concerns around committing to one carbon future as the baseline for carbon analysis. The Company recognizes it is important to measure the impact of other potential carbon futures, which is why Cascade has included the results of three carbon sensitivities in the IRP.

Section 6: Avoided Costs

The new methodology for avoided cost calculation identifies and compiles costs related to transportation, storage, commodity, carbon compliance, and distribution system costs into a final dollar per therm figure for each climate zone over a 45-year horizon. Distribution system costs are a new element to the 2018 WA IRP.

Pros:

- Breaking out individual cost components provides greater transparency to stakeholders when evaluating Cascade's avoided cost.
- Inclusion of distribution system costs enhances the accuracy of the companies final avoided cost figures.

Cons:

- Cascade current methodology does not quantify a risk premium associated with the cost of purchasing gas versus the relative certainty of energy efficiency costs.

Section 7: Demand Side Management

The DSM tool and modeling methodology for this iteration of the IRP have been updated. Previously Cascade used Nexant Inc's TEA-Pot modeling software to estimate energy efficiency savings in the form of technical potential, economic potential and achievable potential through the Utility Cost Test (UCT) and Total Resource Cost (TRC) test. This model was built on a platform to allow the Company to run multiple scenarios and recalculate potential savings based on variable inputs like volume, customer and avoided costs by climate zone, load profiles, avoided costs, long term discount rates, transmission loss rates, inflation rates, adoption curves and rebate levels set as a portion of incremental costs. AEG's modeling framework tool, LoadMAP was developed as an end-use load forecasting model to allow estimation of conservation potential, also built in Microsoft Excel and tailored to meet the needs of the client. Due to the scalable nature of the model, it allows utilities to analyze potential for a combination of market sectors, segments, climate zones, end uses, technologies and measures under the UCT, TRC and Resource Value Test (RVT) concurrently.

Pros:

- While TEA-Pot allowed the company to calculate potential internally through a third-party tool, evolution of regional energy efficiency programs and processes found its methodology (obtaining potential as Technical, Achievable and Economic) no longer aligned with that of other LDC's within Washington State. LoadMAP was built to reflect the latest NWPCC's methodology, calculating the Company's Achievable Technical Potential similarly to others within the region.
- Program potential (i.e. the subset of achievable potential attainable given constraints on program budget and implemented measures) is not presented in Nexant's TEA-Pot model, nor AEG's LoadMAP mode. However, LoadMAP offers a more nuanced approach to setting program savings goals based on the adjustable inputs.
- Ramp Rate (Adoption Curves) best practices and guidance were provided as part of the Conservation Potential Assessment delivery, allowing for incorporation on the measure level in the model rather than tied to rebate amounts as a percent of incremental costs under TEA-Pot. In addition, ramp rates in LoadMAP were updated to reflect current NWPCC's methods from TEA-Pot's, which were based on 2012 NWPCC's methodology.
- The LoadMAP model allows for the Company to calculate potential in future years under an additional cost-effectiveness test, the RVT. In addition, LoadMAP allows for the three cost-effectiveness tests to be calculated concurrently, rather than run as separate scenarios.
- Similarly, LoadMAP allows all three climate zones' in the Company's service territory to be run concurrently, with individual customer counts, baseline forecasting and avoided costs to be incorporated. Under TEA-Pot, these had to be run as separate scenarios.
- Updates were made to the measure libraries per AEG's guidance through the CPA and LoadMAP model build, allowing for incorporation of current market assumptions, latest technologies and updated weather factors.

Cons:

- Updating the baseline year in LoadMAP is not possible, however, the Company is working with AEG to provide more detailed guidance or a new version of the model where this will be possible for the next forecast runs.
- Administrative cost entry in LoadMAP requires a more intricate approach. LoadMAP has administrative costs entered on a measure by measure basis as a percent of the incremental costs, which provides less flexibility on allocating the costs within the portfolio. TEA-Pot allowed administrative costs to be entered as dollars per therm by end-use which was quicker, albeit less precise.
- The new model requires data entry of the same inputs multiple times, which requires diligence to avoid entry errors. For example, when updating the base or starting year, every table on every tab of every spreadsheet needs to be diligently checked, and exceptions exist for certain tables whose years must not be updated.

Section 8: Resource Integration

Cascade has greatly enhanced its Supply Resource Optimization Process. Cascade now models multiple portfolios under deterministic and stochastic analysis. These portfolios include an all-in, NWP transport only, NWP transport and storage, GTN transport only, GTN transport and storage, and storage only. The Monte Carlo simulations are now performed with the statistical analysis software R. This allows the company to now run 10,000 draw weather and price simulations. Cascade utilized the Cholesky Decomposition Matrix and Geometric Brownian Motion to calculate a temperature and NYMEX price Monte Carlo draw, respectively. The portfolios are now ranked based on a risk-adjusted total system cost metric, which gives 75% weight to the total system cost under deterministic conditions for a given portfolio, and 25% weight to the costs under stochastic conditions. Once a portfolio is determined to be the Top Ranked candidate portfolio under baseline conditions, Cascade now runs vigorous scenario and sensitivity analysis on the Top Ranked candidate portfolio. Cascade has introduced Value at Risk (VaR) to the 2018 WA IRP as a way to quantify the risk associated with the uncertainty around forecasted demand and total system cost.

Pros:

- Evaluating multiple portfolios with a risk adjusted total system cost metric produces a more robust analysis than past IRPs.
- A 10,000 draw Monte Carlo simulation creates a denser probability distribution. This allows for more confidence in the accuracy of identifying the VaR at the 95th percentile confidence interval.
- Creating a proprietary Monte Carlo simulation engine within R allows the Company to be transparent on each step of the stochastic analysis process.

- The Cholesky Decomposition Matrix allows for correlations between weather zones to be included when drawing or sampling data distributions for Monte Carlo runs.

Cons:

- Stakeholders have raised concerns regarding whether the portfolios selected provide a complete representation of all potential solutions for identified shortfalls. As a gas only utility, Cascade does not have the same breadth of potential portfolio components as a combined utility. Cascade welcomes any suggestions to improve this process.
- Modeling Monte Carlo simulations within R requires more processing power and additional resources to complete the 20-year weather and price projections.
- By correlating random variables, there is always the potential issue of overfitting and not allowing for enough randomness between each draw. Also, Cascade is aware of the possibility of introducing bias into its models. This is something Cascade is keeping a close eye on by constantly evaluating and cross-validating the results.