Tacoma Power Study to Investigate the Future Value of Capacity

2017 IRP Action Item 2: Investigate the future value of flexible capacity

In 2018, Power Management explored various methodologies to estimating the value of capacity in order to more consistently value both traditional resources as well as new, emerging resources. In the past, Tacoma Power had employed several different methodologies to estimate the monetary value of capacity – in some cases attributing a large value and in other cases little to no value at all. While it is possible for individual resources to vary in the magnitude and timing of their contribution to system capacity, the monetary value of capacity to Tacoma Power should in theory be capacity product specific, but resource agnostic.

The goal of the 2018 study was to develop and recommend a methodology to value capacity, in particular flexible capacity, which could be used consistently across Power Management's various functions (Planning, Customer Energy Programs, and Trading & Operations). To arrive at such a recommendation, we started with the following questions:

1. How much flexible capacity is required (for Tacoma and for the WECC Region)?
2. How much flexible capacity is available?
3. How do we quantify the value of capacity in general as a function of time, need and type of capacity product?

Valuation Methodology

After a thorough review of the literature as well as discussions with internal Power Management stakeholders, system planners in the region and research scientists at multiple national laboratories, a large set of valuation methodologies emerged. Of these numerous options, we identified three valuation methods as appropriate for Tacoma Power including the use of reserve constraint shadow prices calculated with the PLEXOS system model, an estimate of net wholesale revenue impacts of incremental reserve capacity, as well as a new and internally developed hybrid method.

Table 1. Comparison of Capacity Valuation Methodologies

	Advantages	Disadvantages
Hybrid: Opportunity Cost & Cost of New Entry	• Simple • Tunable parameters • Market-based valuation • Value a function of surplus • Considers value of capacity for resource adequacy • Resource agnostic	• Parameterization can be arbitrary
Shadow Price	• Rigorous • Based on well-known and used optimization method • Proxy for capacity market • Can produce capacity product specific values	• Requires optimization in production cost modeling (PLEXOS) • Prone to model complexity • Perfect foresight
Net Revenue Impact	• Simple • Can be performed with or without optimization[1] • Market-based valuation • Resource agnostic	• Perfect foresight (w/PLEXOS)

Table 1compares the advantages and disadvantages of each of these three valuation methods evaluated. A complete comparison of the results are in the methodology/results section of the 2018 Value of Capacity report.

The 2018 study recommended a hybrid opportunity cost methodology for valuing surplus flexible capacity and a cost of new entry methodology for valuing capacity shortages. These methods were deemed most appropriate given our current surplus position, our lack of access to a robust centralized capacity market as well as our lack of appropriate modeling tools at the time.

The recommended opportunity cost method estimated the value of capacity by analyzing forecasted peak energy market prices and expected quantity of surplus capacity. Monthly values of capacity are extracted from an hourly energy market price forecast by calculating the difference between each month's 85th percentile price and 50th percentile price. The 50th percentile price represents the average value of energy. The 85th percentile represents an average value of energy during capacity constrained (peak priced) hours. Thus, their difference can be viewed as a market-based proxy for the value of capacity to Tacoma Power:

$$Monthly\ Value\ of\ Capacity\ = Pn - P50,\ \ (n = 85\ for\ average\ surplus)$$

A percentile higher than the 85th is used when surplus capacity is less than average while a percentile lower than the 85th is used when surplus capacity is greater than average. This results in a value of capacity that is also a function of Tacoma Power's surplus (or net position).

[1] For this study, PLEXOS (optimization) was used to calculate the net revenue impacts.

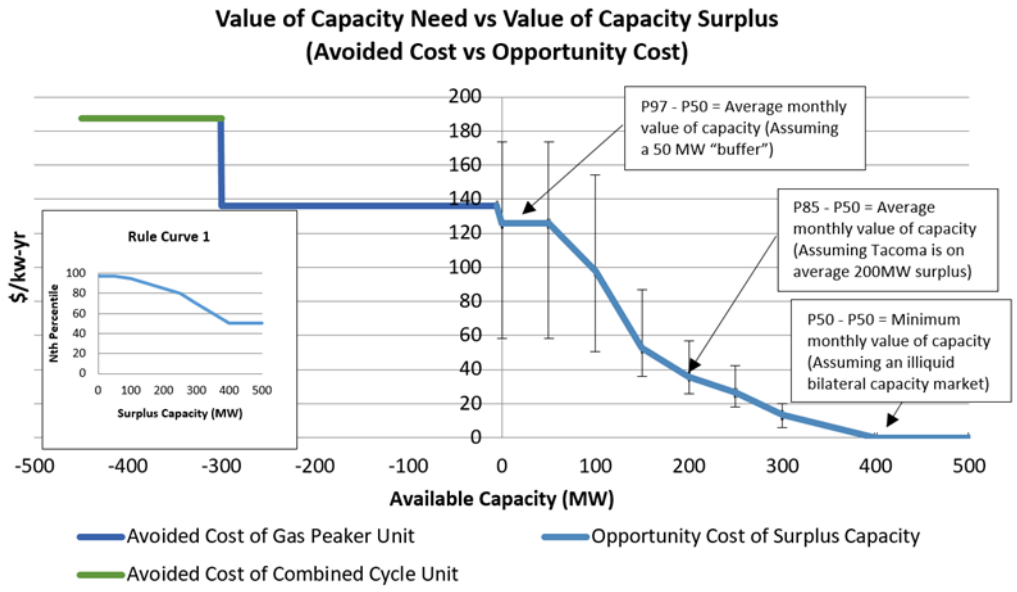

Figure 1: Sample value of capacity based on recommended methodology. Positive values indicate a surplus of capacity and negative values a Need for capacity. The error bars on the opportunity cost curve represent the time varying range in values.

An example of this methodology is illustrated in Figure 1. In this graph, the positive x-axis indicates a capacity surplus and the negative x-axis indicates a capacity need for resource adequacy. So the right side of the graph displays the value of capacity using the opportunity cost method and the left side of the graph displays value of capacity using the CONE method. The error bars on the opportunity cost curve represent the range in values for any level of surplus (driven by the expected range in wholesale energy prices). The shape of the curve is influenced by a rule curve (described in detail in the full report's methodology section) that relates percentile to surplus capacity.

Important Comments on Using Recommended Method

Because Tacoma Power's net position varies hour to hour, day to day, and year to year, any value taken off the graph in Figure 1 represents a single snapshot in time. In order to get a more granular estimate of the value of capacity, a more granular estimate of Tacoma's net position is required.

Because all our surplus capacity is hydro, flexibility and dispatchability are both assumed to be inherent in our current portfolio. This means that the values calculated by this method represent an upper value limit and may need to be weighted by an appropriate capacity factor (if a resource is not dispatchable) and/or a flexibility factor (if a resource is not flexible).

The shape of the rule curve is critical. There are three important points on the opportunity cost curve that are driven by the shape of the rule curve: maximum value, average value, and minimum value. Careful thought should go into the selection of these values.

Finally, it is important to note that the value of capacity calculated in this study is a normative or theoretical value of capacity to Tacoma Power and not the guaranteed price at which we can sell or buy

capacity. We can interpret this value as an estimate of the minimum price at which Tacoma Power would be will to sell capacity instead of energy.

Since the completion of the 2018 study, Tacoma Power has continued to improve modeling tools in order to more accurately assess value of flexible capacity and move away from proxy estimates.