



## **Power Management**

**November 2015**

# Contents

- 1 Overview ..... 3
  - 1.1 Analysis ..... 3
  - 1.2 Product Comparison ..... 3
  - 1.3 Product Evaluation ..... 4
    - 1.3.1 Slice Benefits ..... 4
    - 1.3.2 Slice Costs ..... 4
    - 1.3.3 Other Considerations ..... 4
- 2 Slice Benefits ..... 4
  - 2.1 Market Revenue from Additional Energy - \$16,425,000/yr ..... 4
    - 2.1.1 Assumptions for Calculating Slice Market Value relative to Shaped Block ..... 5
  - 2.2 Value of Intraday Flexibility - \$881,000/yr ..... 6
    - 2.2.1 Value of Slice LLH flexibility ..... 6
    - 2.2.2 Value of Slice HLH flexibility ..... 6
    - 2.2.3 Assumptions for Calculating Slice Intra-Day Flexibility Benefit ..... 7
    - 2.2.4 Slice Compatibility with Portfolio Power Supply ..... 7
  - 2.3 Value of Additional Market Intelligence - \$144,000/yr ..... 7
- 3 Slice Costs ..... 8
  - 3.1 Reduced Purchase Cost - \$8,767,000/yr ..... 8
  - 3.2 Gross Earnings Tax (GET) liability - \$985,500/yr ..... 8
  - 3.3 Uncertainty Risk - \$327,000/yr ..... 8
    - 3.3.1 Slice Revenue Risk ..... 8
    - 3.3.2 Slice Operation & Trading Risk ..... 9
  - 3.4 Staff & IT Support - \$561,200/yr ..... 9
    - 3.4.1 Staff Requirements ..... 9
    - 3.4.2 IT Support ..... 10
- 4 Strategic Market Objectives ..... 10
- 5 Conclusions ..... 10
  - 5.1 Market Value: Slice vs. Shaped Block ..... 11
  - 5.2 Quantitative Benefits of Slice ..... 11
  - 5.3 Qualitative Benefits and Risks of Slice ..... 11
- 6 Next Steps ..... 12

# 1 Overview

Tacoma Power currently purchases BPA preference power under its Slice/Block product which started in 2011 and will expire in 2028. About half of Tacoma Power's energy supply is provided through Slice/Block at an average annual cost of about \$130 MM.

The utility has the option to switch to a Block with Shaping Capacity product by giving BPA notice of intent by May 31, 2016. A product switch would become effective on October 1, 2019.

Tacoma Power's current Slice/Block (Slice) contract is projected to have a value that is \$6.8 MM/yr. higher than the alternative Block with Shaping Capacity (Shaped Block) product. Calculations were based on an average water year on the Federal System. There are additional operational benefits from Slice which are thought to be significant but which are difficult to accurately quantify. Slice also has additional risks from the operational uncertainty of BPA's hydroelectric system.

## 1.1 Analysis

The data and assumptions for this analysis came from collaborative meetings with staff from Contracts, Operations, Trading, and Risk.

The analysis compared the value of Tacoma Power's current Slice contract with the value of the Shaped Block product. The time frame for comparison are the years 2019-21 which is when the Shaped Block contract would start, if elected. Data used for the analysis is from; the first two years of actual Slice operations, the price forecast for 2019-21, average energy on the Federal Columbia River Power System, and contractual block amounts.

Tacoma Power's two product alternatives were created to have equivalent stand-alone value for BPA. Individual customers may prefer one product over another based on the impacts to their own portfolio. And so in a vacuum where nothing else is considered, and if Tacoma Power calculates the same energy, shaping, and flexibility value as BPA, then it should not make a difference as to which product the utility elects to take. It is because each utility has different power assets, trading floors, business plans, and strategic objectives; that surplus energy and flexibility will naturally be valued differently.

## 1.2 Product Comparison

There are pros and cons with each of the two products. Slice has more average energy and flexibility but comes with the risk as to the quantity of energy and flexibility that will actually be available from month to month and from day to day. Shaped Block schedules would better conform to Tacoma Power's seasonal demand for power but it is flat for the LLH and schedules cannot be changed intraday. The primary differences between the two products are:

- Shaped Block can be shaped for the HLH preschedule but is required to be scheduled flat during the LLH
- The Shaped Block monthly HLH & LLH MW quantities are based upon BPA critical water and are known fixed values
- Slice can be shaped for all hours for both preschedule and real-time (hourly)
- Slice has a block component schedule that is flat for the month

### 1.3 Product Evaluation

The following components were used to evaluate the relative value for Tacoma Power of the current Slice contract vs. the value of the Shaped Block product.

#### 1.3.1 Slice Benefits

- 2 Market revenue from additional energy – Tacoma Power receives an additional 60 aMW of energy under the Slice contract.
- 3 Intraday flexibility – Slice can be shaped to follow changes in retail load or be dispatched to market.
- 4 Market intelligence – Slice allows knowledge of Federal Columbia River Power System (FCRPS) operating plans.

#### 1.3.2 Slice Costs

- 2 Reduced Purchase Cost – Charge per MWh will be lower for Slice compared to Shaped Block. Overall annual cost will be higher for Slice because we receive more energy.
- 3 Gross Earnings Tax (GET) liability – Slice obligation to pay additional GET to the City of Tacoma
- 4 Risk – Year to year and month to month uncertainty of hydro supply must be managed and hedged.
- 5 Staff & IT – Managing Slice requires additional staff and IT support.

#### 1.3.3 Other Considerations

Long Term Strategic Objectives – Which product is the best fit for Tacoma Power’s long term trading and operations strategy?

## 2 Slice Benefits

### 2.1 Market Revenue from Additional Energy - \$16,425,000/yr

Tacoma Power will on average receive approximately 60 aMW of additional energy from the Slice/Block product based upon an average water year on the Federal Columbia River Power System (FCRPS). This difference could vary from 0 to 180 aMW on a year to year basis,

dependent on the FCRPS water year. Either Tacoma Power or BPA will realize the market value of the differential energy take between Slice and Shaped Block. If Tacoma Power elects to continue with Slice, then the utility will receive the value of either selling this additional energy into the wholesale power market or using the energy to avoid market purchases. If Tacoma Power switches over to Shaped Block, then BPA will have this extra energy and will credit TPWR with the revenues received from selling the additional energy into its secondary wholesale power market.

### **2.1.1 Assumptions for Calculating Slice Market Value relative to Shaped Block**

1. An average water year on the FCRPS represents the expected mid-range value of preference energy that we receive from BPA (may not be exactly true as prices will tend to be higher when we have less energy during drier years and prices will tend to be lower during wetter years). Consequently:
  - a. Slice will result in approximately 60 aMW of additional energy compared to Shaped Block during an average water year
  - b. During an average water year Tacoma Power will be surplus energy by over 100 aMW
2. The additional energy that the utility receives from Slice compared to Shaped Block is valued as if it were sold into the wholesale power market.
3. Slice and Shaped Block would both be shaped to load and market on a HLH preschedule basis, and so would see equivalent market value for the HLH. The difference between the two products is based on the daily MWh quantity & hourly MW capacity that is available (realizing that the daily shaping flexibility will not be exactly equal and could sometimes be more with the Shaped Block because of variable seasonal constraints on the FCRPS).
4. The market value of the additional Slice HLH energy is approximately the value of the daily wholesale HLH market price multiplied by the amount of surplus daily energy (value of intra-day flexibility is a separate calculation).
5. The difference between the annual summed value of Slice and Shaped Block represents the market value of selling an additional 60 aMW of Slice into the wholesale power market.

This analysis used the 2019-2021 price forecast to calculate market values. The market revenue from Slice is \$135,898,000/yr. The market revenue from Shaped Block is \$119,473,000. Slice revenue is expected to be higher simply because there is 60 aMW more of surplus energy and so the value of this energy has to be compared with what BPA would charge for each product.

## **2.2 Value of Intraday Flexibility - \$881,000/yr**

A Slice customer has increased operational flexibility that allows the utility to operate portfolio elements more efficiently. This flexibility can be used to balance load and inflow shifts and to augment portfolio components such as local pond management and generator machine efficiency.

The following items were identified as intraday operational and market benefits.

### **2.2.1 Value of Slice LLH flexibility**

- Assist with transitioning units off/on
  - Flexibility to avoid selling into a poor market to transition units
  - Flexibility to avoid buying from a strong market to transition units
- Flexibility to increase imports HE 23,24,05,06
  - Sell when there is demand during the shoulder hours or keep from buying during these hours
- Flexibility for HE 01-04
  - Avoid selling in LLH valley hours when prices are low
  - Opportunity to pond up Slice during valley hours
- Ability to change Slice late in the hour to account for load uncertainty
  - Potential for fewer units online during the LLH with increased ability to adjust NSI at the last minute

### **2.2.2 Value of Slice HLH flexibility**

- Preschedule is based upon the day ahead forecast for loads & local inflows. NSI often needs to be adjusted hourly to manage actual loads and inflows
  - Flexibility to avoid selling into a poor market to account for forecast errors
  - Flexibility to avoid buying from a strong market to account for forecast errors
- Preschedule does not capture hourly opportunity
  - Flexibility to sell during super peaks
  - Flexibility to arbitrage odd lots
    - Buy low, sell high
  - Flexibility to cover and/or market wind variability
  - Flexibility to cover and/or market future solar variability
  - Flexibility to arbitrage unexpected changes in grid loads and unit trips
- Opportunity to store BOS flex for the evening peak
- Opportunity to adjust to keep portfolio units in an efficient operating range
- Added hedge, or to go out on a limb to arbitrage hour to hour
  - Take a risk to purchase/sell extra energy knowing that if it can't be flipped back into the market then Slice can be adjusted

This analysis approximated the market value of intraday shaping flexibility by looking at the historical changes that were made to the Slice schedule as a function of the difference between the daily market price and the hourly market price in which the change was made. This probably understates the market value of intraday shaping because the opportunity cost to reshape Slice hourly could be greater than then the daily market price. The following assumptions were made for this analysis.

### **2.2.3 Assumptions for Calculating Slice Intra-Day Flexibility Benefit**

1. The long term hourly price forecast cannot realistically distinguish between the granularity of the term, daily, and hourly market opportunities, but is just a general approximation of where seasonal HLH and LLH prices are likely to trend.
2. In the absence of a very accurate hydraulic model that fully captures the hourly market value of the combination of the FCRPS and Tacoma Power's portfolio, the best way to approximate the value of intra-day flexibility is to look at historical operations
3. The value of historical intra-day flexibility can be approximated by calculating the delta between Slice day-ahead and Slice hourly MW values and then multiplying by the delta of the day-ahead and hourly market prices.

The calculated value of Slice intraday flexibility is \$881,000/yr.

### **2.2.4 Slice Compatibility with Portfolio Power Supply**

In addition to the quantitative value of intraday flexibility there are qualitative values that are hard to quantify but which are thought to have significant value.

- Assist with transitioning generators on/off line
- Assist with running generators more efficiently
- Enable less generation on-line during the LLH
- Assist with positioning generation for dynamic capacity sales
- Assist with positioning generation for sub-hour market
- Ability to adjust NSI late in the hour

### **2.3 Value of Additional Market Intelligence - \$144,000/yr**

The FCRPS is a major supplier of electric generation in the Pacific Northwest and as such can have a large influence on the wholesale power market. For example, unexpected changes to storage elevation targets at Grand Coulee can impact the market by producing either more or less short term regional energy than what might have been originally anticipated.

Tacoma Power needs to know the detailed operation of the FCRPS in order to schedule Slice generation. This analysis makes the assumption that knowledge of FCRPS operations could allow Tacoma Power to take a market position to sell a monthly block of 25 MW at a \$5/MW premium 3 times per year. This value was calculated to be \$144,000/yr.

## **3 Slice Costs**

### **3.1 Reduced Purchase Cost - \$8,767,000/yr**

Tacoma Power will receive more seasonal shaping value from the Shaped Block product and will on average pay about an additional \$2/MWh for this benefit. This is because BPA gives up some of its portfolio value when it gives Tacoma Power this seasonal shaping capacity. BPA's lost value shows up in a higher tariff rate that Tacoma Power will pay for this service. The question then is; can Tacoma Power take Slice at a lower tariff rate and then seasonally shape it with its own portfolio so that it finds equivalent value or better?

This analysis used the 2019-2021 price forecast to calculate what BPA would charge for the two products. The cost for Slice is \$127,014,000/yr. The cost for Shaped Block is \$118,247,000/yr.

### **3.2 Gross Earnings Tax (GET) liability - \$985,500/yr**

Customers will receive more energy with the Slice product than they will with the Shaped Block product during an average water year on the FCRPS. This means that Slice customers will often have more surplus energy which will need to be sold into the wholesale power market. This additional energy will subject the utility to additional taxes. The GET is currently at 6% but could increase in the future subject to potential voter initiatives. If Tacoma Power elects Shaped Block then BPA will on average have an extra 60 aMW of surplus energy to sell from which the utility would receive a monetary credit that is not subject to the GET. The additional annual GET that the utility would pay under Slice can be calculated as the difference between the anticipated wholesale market revenue of the two products. Since the amount of annual energy from Slice is variable this analysis used an average water year on the FCRPS as the mid-range of expected value. The additional GET liability for Slice was calculated to be \$985,500/yr. This calculation was based upon the 2019-21 price forecast.

### **3.3 Uncertainty Risk - \$327,000/yr**

The amount of surplus energy that Tacoma Power sells into the wholesale power market varies from year to year and is dependent upon inflows into the utilities' hydroelectric projects. In the same way the amount of energy from Slice will vary dependent upon the water supply on the FCRPS while the Shaped Block product would provide a fixed amount of monthly energy that can be planned on throughout the year.

#### **3.3.1 Slice Revenue Risk**

Tacoma Power carries a reserve cash account (Rate Stabilization Fund) to hedge against the risk of lower than anticipated revenues from the wholesale power market. This fund carries enough reserves to cover market revenue shortfalls when power production falls below the adverse range of operation. The amount of extra cash that this fund will need to carry to hedge against the uncertainty of Slice is a function of the difference between expected revenues from Slice



generation under adverse water conditions and expected Slice generation under critical water conditions. And so if we plan for revenues from adverse conditions, our risk exposure would be the amount of revenues that we would generate under critical water, which is an average difference of 37 aMW. The lost opportunity cost of the extra reserve cash that would need to be held for Slice was calculated to be \$327,000/yr. This calculation was based upon a 3% carrying charge and the 2019-21 price forecast.

### **3.3.2 Slice Operation & Trading Risk**

The following is a list of additional risks due to the uncertainty of Slice. While the financial impact from these issues is not anticipated to be significant, they can cause additional marketing and operational problems.

- Need to hold aside extra transmission that could have been sold preschedule in order to account for unplanned hourly Slice changes
- Need to hold aside additional reserves that could have been sold preschedule in order to account for unplanned hourly Slice changes
- Hourly changes in FCRPS operating conditions can unravel daily operating plans
- Aggressive Slice shaping can result in constraint violation penalties and/or additional spill
- Less certainty of supply to support term market sales

## **3.4 Staff & IT Support - \$561,200/yr**

### **3.4.1 Staff Requirements**

Tacoma Power hired two additional Real-Time Energy Traders to support Slice trading and operations. Because of scheduling tool refinements and gained experience in scheduling Slice, there is some question as to whether it will be necessary to continue to staff two additional Traders in the future (even without Slice the utility may need a couple of extra Traders to support a future centralized market). This analysis made the assumption that Slice will continue to require 2 extra Traders at a cost of \$450,000/yr.

Staff overhead to support Slice:

- Traders (2 FTE)
- Analysts/ Ops & Risk
- IT Support
- Coordination meetings/travel (1 trip/month)
- SIG consultant (none currently)
- Share cost of SIG moderator

### **3.4.2 IT Support**

The Slice contract allows flexibility to change intraday power schedules. Tacoma Power successfully built advanced in-house optimization and scheduling applications to schedule Slice. The tools work well but technology will continue to evolve and become more sophisticated. In addition, FCRPS operations may change which will require modifications to the existing Slice scheduling algorithm. This analysis made the assumption that the utilities' Slice scheduling tools will need to migrate to a new technology platform at a cost of \$1,000,000. This cost was amortized to \$111,200/year for the last nine years of the Slice contract. Note: it may not be necessary to migrate to a new platform, and so this is a conservative estimate of future Slice costs.

IT needed to support Slice:

- Optimizer and water routing models
- CFI and communication links with BPA
- Planning tools
- Future modifications (1 major upgrade during the life of the contract)

## **4 Strategic Market Objectives**

Do we see a future where the utility maintains a robust trading floor? Slice is complex to manage but it does gain the utility market intelligence, and it can be used as an asset to complement our intraday trading strategy.

Topics that will need to be addressed in the next iteration of this analysis:

- Comparative product values in an organized market
- Comparative product values if a new large load is installed within our service area

## **5 Conclusions**

The net incremental dollar value of Slice is about \$6.8 MM/yr higher than Shaped Block. The net market revenues are the largest value component and will be about \$7.7 MM higher with Slice, after the BPA purchase costs are factored in. Tacoma Power will receive about 60 aMW of additional energy with Slice during an average water year and consequently wholesale market revenues will be higher because the utility will have more surplus power to sell. Shaped Block energy will cost about \$2/MW more than Slice but then it is supplied to better align with the utilities seasonal demand for power, and its surplus can be sold into the wholesale power market at a higher value.

There are additional qualitative benefits from Slice for which it is difficult to accurately calculate a dollar amount, but their value is thought to be significant. There are also additional risks with Slice because of operational uncertainty on the FCRPS.

## 5.1 Market Value: Slice vs. Shaped Block

		<b>Slice / Blk</b>		<b>Blk / SCap</b>
<b>Market Benefit</b>	\$	135,897,961	\$	119,472,970
<b>BPA Cost</b>	\$	127,013,849	\$	118,246,599
<b>Net</b>	\$	8,884,111	\$	1,226,371
<b>Total MW</b>		4,039,642		3,510,375
<b>aMW</b>		461		401
<b>Mkt Benefit-\$/MW</b>	\$	33.64	\$	34.03
<b>BPA Cost-\$/MW</b>	\$	31.44	\$	33.68

## 5.2 Quantitative Benefits of Slice

\$	7,657,741	<b>Slice Market Value relative to Block/SCap</b>
\$	881,420	<b>Slice Intra-Day Flexibility Benefit (does not include ability to adjust NSI late in the hour)</b>
\$	144,000	<b>Slice - Market Intelligence (3 monthly HLH pieces of 25MW traded at a \$5 premium)</b>
\$	(985,499)	<b>Slice additional GET Tax (6% of delta mkt revenue between the two alternatives)</b>
\$	(326,994)	<b>Slice Risk Premium (Extra Cash in RSF, 37 aMW at 3% interest rate)</b>
\$	(400,000)	<b>Slice FTE Costs (2 extra Traders; may be needed even without Slice for subhour market)</b>
\$	(111,111)	<b>Slice IT Costs (one major upgrade during life of the Slice Cotract)</b>
\$	6,859,556	<b>Total Slice Incremental Benefit</b>

## 5.3 Qualitative Benefits and Risks of Slice

### Benefits

- Assist with transitioning generators on/off line
- Assist with running generators more efficiently
- Enable less generation on-line during the LLH
- Assist with positioning generation for dynamic capacity sales
- Assist with positioning generation for sub-hour market
- Ability to adjust NSI late in the hour

## **Risks**

- Need to hold aside extra PTP transmission that could have been sold preschedule in order to account for unplanned hourly Slice changes
- Need to hold aside additional reserves that could have been sold preschedule in order to account for unplanned hourly Slice changes
- Hourly changes in FCRPS operating conditions can unravel daily operating plans
- Aggressive Slice shaping can result in constraint violation penalties and/or additional spill
- Less certainty of supply to support term market sales

## **6 Next Steps**

The conclusion of Tacoma Power's preliminary analysis of the value difference between Slice and Shaped Block is that Tacoma Power should continue with Slice. Although the incremental Slice value appears to be compelling the utility should expand the analysis to include sensitivity to a range of forward market prices and different operating conditions. Also the assumptions about future scenarios should be expanded.

The following additional work needs to be completed by April of 2016 to insure that the utility makes the best decision going forward.

- 1) Compare the value of Shaped Block HLH daily shaping vs. observed Slice shaping flexibility
  - a) Impact of reduced Slice shaping flexibility
- 2) Calculate LLH value of Slice
  - a) Shaped Block does not have LLH shaping value
- 3) Run analysis with forward market price and reservoir inflow sensitivities
  - a) Range of prices to reflect both increasing and decreasing gas prices
  - b) Range of inflows from critical water to high water
- 4) Value comparison in an organized market
- 5) Value comparison if a new large load is installed within Tacoma Power's service area