Outline

1. Portfolio Performance
2. Preferred Portfolio
3. Impacts of Climate Change
4. IRP Action Items
5. Feedback for Next IRP Process
Portfolio Performance

How do our candidate portfolios perform according to our metrics?
Reminder: Candidate Portfolios

**Renew BPA Slice/Block**

- Tacoma Power Hydro + BPA Slice
- Tacoma Power Hydro + BPA Slice + renew CBH (continue current portfolio)
- Tacoma Power Hydro + BPA Slice + 60MW Solar
- Tacoma Power Hydro + BPA Slice + 100MW WA Wind
- Tacoma Power Hydro + BPA Slice + 100MW Gorge Wind
- Tacoma Power Hydro + BPA Slice + 150MW Pumped Storage at Cowlitz
- Tacoma Power Hydro + BPA Slice + 150MW 3rd Generator at Cowlitz
- Tacoma Power Hydro + BPA Slice + 50MW Demand Response

**Renew BPA with Shapeable Block**

- Tacoma Power Hydro + BPA Block
- Tacoma Power Hydro + BPA Block + renew CBH
- Tacoma Power Hydro + BPA Block + 60MW Solar
- Tacoma Power Hydro + BPA Block + 100MW WA Wind
- Tacoma Power Hydro + BPA Block + 100MW Gorge Wind
- Tacoma Power Hydro + BPA Block + 150MW Pumped Storage at Cowlitz
- Tacoma Power Hydro + BPA Block + 150MW 3rd Generator at Cowlitz
- Tacoma Power Hydro + BPA Block + 50MW Demand Response (DR)

**No BPA Renewal (not technically feasible at this time)**

- Tacoma Power Hydro + 650MW WA Wind + 650MW Gorge Wind + 100MW MT Wind + 300MW DR
- Tacoma Power Hydro + 700MW WA Wind + 700MW Gorge Wind + 100MW MT Wind + 250MW DR + 150MW Pumped storage
- Tacoma Power Hydro + 700MW WA Wind + 700MW Gorge Wind + 100MW MT Wind + 250MW DR + 150MW Cowlitz Generator
- Tacoma Power Hydro + 700MW WA Wind + 700MW Gorge Wind + 100MW MT Wind + 200MW DR + 100MW Small Nuclear
- Tacoma Power Hydro + 650MW WA Wind + 650MW Gorge Wind + 100MW MT Wind + 100MW DR + 200MW Natural Gas

Feasibility not certain due to licensing requirements

Feasibility not certain, as 50MW of DR may be more than we can acquire
Reminder: Selection Criteria

**Pass/Fail Criteria**
- Resource Adequacy
- CETA compliance

**Criteria for Comparing Portfolios**
- Expected costs
- Financial risk
- Carbon Emissions
Market purchases are comparable for the portfolios that include a BPA product resulting in little to no difference in Percent Clean values across scenarios.

Market price and volatility (as reflected in scenarios) are more impactful to portfolios without BPA.
We are occasionally inadequate in certain years under certain scenarios using certain metrics.

We will need to develop a strategy to prepare for these potential inadequacies.

Renewing our Columbia Basin Hydro (CBH) contract does not improve adequacy.
### Summary of RA Performance Post-2028

<table>
<thead>
<tr>
<th>Portfolio</th>
<th>Share of Years with Inadequacies</th>
<th>Consider Portfolio?</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>NEUE</td>
<td>LOLH</td>
</tr>
<tr>
<td>Shapeable Block Only</td>
<td>0%</td>
<td>0%</td>
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<tr>
<td>Shapeable Block + DR</td>
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<td>0%</td>
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<tr>
<td>Shapeable Block + Pumped Storage</td>
<td>0%</td>
<td>0%</td>
</tr>
<tr>
<td>Shapeable Block + Add Generator</td>
<td>0%</td>
<td>0%</td>
</tr>
<tr>
<td>Shapeable Block with E. WA Wind</td>
<td>0%</td>
<td>0%</td>
</tr>
<tr>
<td>Shapeable Block with Gorge Wind</td>
<td>5%</td>
<td>0%</td>
</tr>
<tr>
<td>Shapeable Block with Solar</td>
<td>0%</td>
<td>0%</td>
</tr>
<tr>
<td>Shapeable Block with CBH</td>
<td>33%</td>
<td>0%</td>
</tr>
<tr>
<td>Slice Only</td>
<td>29%</td>
<td>5%</td>
</tr>
<tr>
<td>Slice + DR</td>
<td>0%</td>
<td>0%</td>
</tr>
<tr>
<td>Slice + Pumped Storage</td>
<td>0%</td>
<td>0%</td>
</tr>
<tr>
<td>Slice + Add Generator</td>
<td>0%</td>
<td>0%</td>
</tr>
<tr>
<td>Slice with E. WA Wind</td>
<td>95%</td>
<td>55%</td>
</tr>
<tr>
<td>Slice with Gorge Wind</td>
<td>81%</td>
<td>35%</td>
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<tr>
<td>Slice with Solar</td>
<td>29%</td>
<td>5%</td>
</tr>
<tr>
<td>Slice with CBH</td>
<td>95%</td>
<td>100%</td>
</tr>
<tr>
<td>Renewables + DR (no BPA)</td>
<td>33%</td>
<td>0%</td>
</tr>
<tr>
<td>Renewables + PSH + DR (no BPA)</td>
<td>5%</td>
<td>0%</td>
</tr>
<tr>
<td>Renewables + Add Gen + DR (no BPA)</td>
<td>5%</td>
<td>0%</td>
</tr>
<tr>
<td>Renewables + SMN + DR (no BPA)</td>
<td>38%</td>
<td>5%</td>
</tr>
<tr>
<td>Renewables + Gas + DR (no BPA)</td>
<td>33%</td>
<td>0%</td>
</tr>
</tbody>
</table>

We are always adequate when we renew BPA with Shapeable Block and don’t reduce the amount we get from BPA (our net requirement).

We are mostly adequate in portfolios where we renew BPA Slice and don’t reduce our net requirement.

We are mostly adequate in most portfolios when we renew BPA with Shapeable Block and “diversify” by reducing the amount we get from BPA slightly but mostly inadequate when we diversify with Slice.

It is very difficult to replace BPA primarily with renewables.
Slice is lowest cost & lowest financial risk but presents some potential adequacy concerns.

- Always adequate
- Minimal adequacy issues
- Adequacy concerns

Replacing BPA primarily with renewables is not only infeasible but also higher cost and higher financial risk than BPA portfolios.

Adding pumped storage or a generator at Cowlitz presents higher financial risk in addition to significant licensing risk.

Small adjustments to Slice portfolio (like adding DR) could eliminate adequacy concerns at a lower cost than switching to a Block product.

Slice is lowest cost & lowest financial risk but presents some potential adequacy concerns.
Most Slice portfolios result in lower emissions in our portfolio.

Portfolios with pumped storage result in more buying & selling, which increases carbon in portfolio.

High renewables portfolios result in more buying & selling, which increases carbon in portfolio.
Preferred Portfolio

Which portfolio is the best fit for Tacoma Power?
Portfolio Takeaways

2020-2028

Adequacy concerns: Identify strategy to eliminate minor adequacy concerns (e.g. small DR investment, participate in interim Resource Adequacy program, etc.)

CBH Renewal: Unlikely to recommend CBH renewal, as it does not improve adequacy, and is unlikely to be offered at a sufficiently low price to make it cost-effective.

Post-2028

BPA Renewal: BPA renewal is more feasible, less costly and lower risk financially and also results in lower portfolio emissions than a renewables-heavy portfolio

BPA Product Choice: Slice/Block product is currently looking most promising from a cost, financial risk and emissions standpoint but some adjustment to portfolio is needed to avoid resource adequacy issues in tail risk events

BPA Diversification: If there is a desire to diversify BPA, small amount of solar diversification looks most promising but will not solve adequacy concerns.
Proposed Additional Portfolios to Test

1. **Renew Slice/Block** and **CBH** (no reduction in BPA net requirement)
   - **Objective:** Confirm recommendation to NOT renew CBH contracts

2. **Renew Slice/Block** and add **60MW of E WA wind** (no reduction in net requirement)
   - **Objective:** Determine whether wind might provide the winter capacity needed to solve potential adequacy concerns

3. **Renew Slice/Block** and add **10MW DR** (no reduction in net requirement)
   - **Objective:** Determine whether more achievable amount of DR might be enough to solve potential adequacy concerns

4. **Renew Slice/Block** and add **60MW of E WA wind** and **10MW DR** (no reduction in net requirement)
   - **Objective:** Determine whether wind + achievable amount of DR might be enough to solve potential adequacy concerns at a reasonable cost if wind or 10MW DR are not enough on their own
Impacts of Climate Change

How might climate change impact our resource adequacy?
Climate Model Selection

✔ Selected same models as NW Power & Conservation Council for this IRP
  • High emissions (RCP8.5) climate models
  • 3 of 80 possible climate/downscaling/hydrology models
  • Models with highest concentration of extreme low and high temps and inflows selected

✔ Preliminary attempts at adjusting loads & generation are presented

✔ More work to follow in next IRP to refine choice of climate models & approach to modeling
Temperature Changes

Maximum Daily Temperatures

[Graph showing temperature changes over the year with different models and the maximum temperatures for January/February with box plots.]
Temperature Changes

Minimum Daily Temperatures

![Graph showing minimum daily temperatures over the year, with different models represented by lines and box plots for January/February showing temperature ranges and outliers.](image)
Load Changes

Yearly Peak

<table>
<thead>
<tr>
<th>Model</th>
<th>Prediction</th>
</tr>
</thead>
<tbody>
<tr>
<td>CNRM-CM5</td>
<td>&lt;1% increase</td>
</tr>
<tr>
<td>CCSM4</td>
<td>4.5% decrease</td>
</tr>
<tr>
<td>CanESM2</td>
<td>4.9% decrease</td>
</tr>
</tbody>
</table>

Diagram showing yearly peak loads from 2020 to 2039 with different models and their predictions.
Load Changes

Yearly Average Energy

- CNRM-CM5: 2.1% decrease
- CCSM4: 2.5% decrease
- CanESM2: 2.8% decrease
Inflow Changes

Grand Coulee Dam

Inflows: Grand Coulee Dam

Streamflow (cfs)

Month
Inflow Changes

Snake River

Inflows: Snake River

- **Streamflow (cfs)**
  - 25000
  - 50000
  - 75000
  - 100000
  - 125000
  - 150000
  - 175000

- **Month**
  - 2
  - 4
  - 6
  - 8
  - 10
  - 12

- **Model**
  - Historical
  - CanESM2
  - CCSM4
  - CNRM-CM5
Inflow Changes

Cowlitz Project Mossyrock Dam

![Inflows: Cowlitz Mossyrock](chart.png)

- **Streamflow (cfs)**: 10000, 8000, 6000, 4000, 2000
- **Month**: 2, 4, 6, 8, 10, 12

Legend:
- **Historical**
- **CanESM2**
- **CCSM4**
- **CNRM-CM5**
Generation Changes

Total Monthly Generation

2039 Total Generation, Slice Portfolio

- Historical
- Cal/ESM0
- CCSMR
- CNRM CM5

Generation (MW)

Month

1 2 3 4 5 6 7 8 9 10 11 12
Climate change may relieve small adequacy concerns with Slice as potential winter issues lessen.

**Adequacy with Climate Change vs. Historic Weather**

- Magnitude Metric (NEUE)
- Duration Metric (LOLH)
- Frequency Metric (LOLE)
- Likelihood Metric (LOLP) – Not Used for 2020 IRP
IRP Action Items

What do we need to do for next time?
Next steps for 2020 IRP

July 22
- Draft IRP document complete & sent to stakeholders for review
- Public Utility Board reviews findings & recommendations

August 12
- Request Public Utility Board approval of IRP
- Stakeholder satisfaction survey

September 1
- IRP document submitted to Department of Commerce
- IRP document made available to public

October 1
- Public summary document made available to public
<table>
<thead>
<tr>
<th>Draft List of Action Items Following 2020 IRP</th>
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<tbody>
<tr>
<td><strong>Next 2 years</strong></td>
</tr>
<tr>
<td><strong>Resource Acquisition/Retirement</strong></td>
</tr>
<tr>
<td>Acquire 2-year CPA potential</td>
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<tr>
<td>Notify parties of CBH renewal decision</td>
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<tr>
<td><strong>Further Investigation into Resources</strong></td>
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<tr>
<td>Actively participate in discussions with BPA on future product options</td>
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<tr>
<td>Conduct DR “potential assessment”</td>
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<tr>
<td>Further investigate value of solar diversification</td>
</tr>
<tr>
<td><strong>Continue Improving Modeling &amp; Analysis</strong></td>
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<tr>
<td>Refine approach to modeling DR</td>
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<tr>
<td>Model EE as a resource in system model (SAM)</td>
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<tr>
<td>Refine climate change modeling</td>
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<tr>
<td>Incorporate impacts of electrification</td>
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<tr>
<td>Update models to include most recent weather years</td>
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<tr>
<td>Improve WECC modeling of storage</td>
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<tr>
<td><strong>Equity</strong></td>
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<tr>
<td>Develop metric(s) to account for equity in resource acquisition decisions</td>
</tr>
<tr>
<td><strong>Public Input</strong></td>
</tr>
<tr>
<td>TBD</td>
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</tbody>
</table>
Feedback for Next IRP Process

What can we do to improve?
Reminder: Next steps

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