Agenda

• Recapping
  • Needs Assessment
  • Long-Term Capacity Expansion
  • Market Prices
  • Market Limits

• Draft Portfolio Optimization Results (aka Resource Solutions)
2022 Resource Program Process

Needs Assessment
- End Use Load Forecast
- BPA Resource Forecast

Optimization Process
- Conservation Potential Assessment
- Generation Resource Supply Curves
- DR Supply Curves
- Market Price Forecast
- Wholesale Market Reliance

Resource Solutions
30 years of historical streamflows results in more generation in winter and less generation in summer, compared to the 80 years of history.
2022 Resource Program Process

1. Needs Assessment
   - End Use Load Forecast
   - BPA Resource Forecast

2. Needs Assessment Metrics
   - Conservation Potential Assessment
   - Generation Resource Supply Curves
   - DR Supply Curves

3. Optimization Process
   - Market Price Forecast
   - Wholesale Market Reliance

4. Resource Solutions
Cumulative WECC Builds & Retirements
Bonneville Power Administration

PNW Prices Diurnal Month Avg.

LT2019 Base vs LT2021 Base

$/MWh, Nominal

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LT 2021 PNW Prices, Avg. by Month and Hour

[Graph showing price trends over months for 2024, 2026, and 2032]
PNW Price Distributions

- Month flat avg. PNW prices, gray is LT2019, blue is LT2021
- More volatile over time, and price variability is more significant in tighter months (winter & summer)
- Note the difference between average of Aurora forecasts and individual iterations (futures)
BPA Market Limit Results, Month HLH aMW
30 Water Year (WY) and Market Purchase Limits (MPL)
As we reviewed in our Needs Assessment conversation, BPA is looking to incorporate the impacts of climate change on hydro generation, and hence our needs for energy/capacity.

We see the streamflow conditions from 1989 to 2018 (recent 30 years) as representative of the changing climate and a good predictor of conditions in next 10 years.

- Recent 30 years of streamflows aligns well with the RMJOC-II (River Management Joint Operating Committee) streamflow forecasts.

We are now carrying those 30 WY needs into portfolio optimization.
MPLs and Needs in FY 2027

2027 p10 HLH Needs vs Market Purchase Limits

- **p10 Market Purchase Limit**
- **2021 NA p10 Needs**

<table>
<thead>
<tr>
<th>Month</th>
<th>HLH MW</th>
</tr>
</thead>
<tbody>
<tr>
<td>Oct</td>
<td>600</td>
</tr>
<tr>
<td>Nov</td>
<td>0</td>
</tr>
<tr>
<td>Dec</td>
<td>850</td>
</tr>
<tr>
<td>Jan</td>
<td>900</td>
</tr>
<tr>
<td>Feb</td>
<td>800</td>
</tr>
<tr>
<td>Mar</td>
<td>750</td>
</tr>
<tr>
<td>Apr</td>
<td>800</td>
</tr>
<tr>
<td>May</td>
<td>1200</td>
</tr>
<tr>
<td>Jun</td>
<td>1850</td>
</tr>
<tr>
<td>Jul</td>
<td>1900</td>
</tr>
<tr>
<td>Aug</td>
<td>900</td>
</tr>
<tr>
<td>Sep</td>
<td>850</td>
</tr>
<tr>
<td>Oct</td>
<td>850</td>
</tr>
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MPLs and EEI-Adj Needs in FY 2027

2027 p10 HLH Needs with Expected 2020-2023 EEI vs Market Purchase Limits

- MPLs and EEI-Adj
- Needs in FY 2027

<table>
<thead>
<tr>
<th>Month</th>
<th>Oct</th>
<th>Nov</th>
<th>Dec</th>
<th>Jan</th>
<th>Feb</th>
<th>Mar</th>
<th>Apr</th>
<th>May</th>
<th>Jun</th>
<th>Jul</th>
<th>Aug</th>
<th>Sep</th>
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</thead>
<tbody>
<tr>
<td>HLH (MW)</td>
<td>600</td>
<td>438</td>
<td>0</td>
<td>161</td>
<td>261</td>
<td>0</td>
<td>11</td>
<td>0</td>
<td>800</td>
<td>1200</td>
<td>800</td>
<td>850</td>
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<tr>
<td>EEI Needs</td>
<td>1850</td>
<td>1900</td>
<td>207</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>900</td>
<td>850</td>
<td>850</td>
<td>0</td>
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<tr>
<td>p10 Market Purchase Limit</td>
<td>2021 NA p10 Needs with Expected '20-'23 EEI</td>
<td>Draft - For Discussion Purposes Only</td>
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Portfolio Optimization Refresher
Refresher: Portfolio Optimization

- **Step 1:** Find Portfolio 1, the “least-COST” mix of resources that meet P10 HLH Energy needs and don’t violate Market Purchase Limit

- **Step 2:** Find Portfolio 40, the “least-RISK*” mix of resources that meet P10 HLH Energy needs and don’t violate Market Purchase Limit

- **Step 3-40:** Incrementally add budget to Portfolio 1’s budget value and remix resources to find risk minimizing combination at given budget level

*Risk is the variance in total portfolio cost across iterations, with expected resource costs and expected market prices causing most of the variance

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Preliminary Results
• EE aMWs are consistent with Council target in Power Plan

• DR shows up as a regularly deployed, low impact, low cost energy related load management product

• Renewables are selected to reduce volatility in risk reducing scenarios, highlighting the potential benefit of resource diversity from potential thin-market futures
Preliminary Resource Solutions
## EE Results and Comparison to 2020

<table>
<thead>
<tr>
<th>Portfolio</th>
<th>2022RP Cumulative Savings (aMW)</th>
<th>2020RP Cumulative Savings (aMW)</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>2-year</td>
<td>4-year</td>
</tr>
<tr>
<td>Portfolio 1</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>96</td>
<td>223</td>
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<tr>
<td>Portfolio 2</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>103</td>
<td>242</td>
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<tr>
<td>Portfolio 3</td>
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</tr>
<tr>
<td></td>
<td>105</td>
<td>245</td>
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Comparison to Council’s 2021 Power Plan

• The 2022 Resource Program uses updated EE supply curves from the 2021 Plan
  – BPA’s market price forecast, needs assessment, market purchase limits

• 2022 RP, Portfolio 1 EE Savings over 2021 Plan Timeline:

<table>
<thead>
<tr>
<th></th>
<th>2022*</th>
<th>2023*</th>
<th>2024</th>
<th>2025</th>
<th>2026</th>
<th>2027</th>
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<tr>
<td>2022 RP Port 1</td>
<td>38</td>
<td>76</td>
<td>119</td>
<td>171</td>
<td>231</td>
<td>299</td>
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</table>

• NWPCC 2021 Draft Plan EE target for BPA is 270-360 cumulative aMW by 2027


*Represents anticipated EE acquisitions for 2022 and 2023, prior to 2022 RP study horizon
Demand Response Assumptions

- Demand response can be used to meet energy needs

- DR products are split into summer and winter classes
  - “Summer” is April – September
  - “Winter” is October – March
### Demand Response Capacity (Peak MW)

<table>
<thead>
<tr>
<th>Portfolio</th>
<th>Season</th>
<th>2-year</th>
<th>4-year</th>
<th>10-year</th>
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</thead>
<tbody>
<tr>
<td>1</td>
<td>Summer</td>
<td>213</td>
<td>436</td>
<td>371</td>
</tr>
<tr>
<td></td>
<td>Winter</td>
<td>158</td>
<td>283</td>
<td>243</td>
</tr>
<tr>
<td>2</td>
<td>Summer</td>
<td>213</td>
<td>474</td>
<td>488</td>
</tr>
<tr>
<td></td>
<td>Winter</td>
<td>158</td>
<td>283</td>
<td>260</td>
</tr>
<tr>
<td>3</td>
<td>Summer</td>
<td>213</td>
<td>474</td>
<td>488</td>
</tr>
<tr>
<td></td>
<td>Winter</td>
<td>158</td>
<td>283</td>
<td>260</td>
</tr>
</tbody>
</table>

- Least-cost DR totals are mainly comprised of four products: DVR, and Residential, Commercial, and Industrial CPP programs.
- DVR comprises roughly half of the total for the 2-year and 4-year periods.
- Risk-reducing portfolios start to add other DR products
- Portfolio 1 acquires DVR and CPP
  - And winter residential BYOT in 2033
- Portfolios 2 and 3 acquire those and additionally Residential Summer TOU in 2024
## Generating Resources in 2022 RP

### Generating Resources (Nameplate Capacity, MW)

<table>
<thead>
<tr>
<th>Portfolio</th>
<th>Resource</th>
<th>2-year</th>
<th>4-year</th>
<th>10-year</th>
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</thead>
<tbody>
<tr>
<td>1</td>
<td>Solar PV</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>Offshore Wind OR S</td>
<td>0</td>
<td>0</td>
<td>0</td>
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<tr>
<td>2</td>
<td>Solar PV</td>
<td>0</td>
<td>0</td>
<td>500</td>
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<tr>
<td></td>
<td>Offshore Wind OR S</td>
<td>0</td>
<td>0</td>
<td>106</td>
</tr>
<tr>
<td>3</td>
<td>Solar PV</td>
<td>0</td>
<td>0</td>
<td>500</td>
</tr>
<tr>
<td></td>
<td>Offshore Wind OR S</td>
<td>0</td>
<td>0</td>
<td>428</td>
</tr>
</tbody>
</table>

- No non-DSM resources are acquired in the least-cost portfolio
- 500MW of Solar PV acquired in 2030 in portfolios 2 and 3
- Offshore wind in southern Oregon is acquired starting in 2033 in portfolios 2 and 3
- Any resource in portfolio 2 or onward reduces market reliance during volatile (i.e. high variance) periods
FY 2027 Resource Build

Solid black line = P10 HLH Needs that are EEI adjusted
Solid black line = P10 HLH Needs that are EEI adjusted

Compressed Air
Demand Response
Electronics
Food Preparation
HVAC
Irrigation
Lighting
Motors_Drives
Process Loads
Refrigeration
Utility_Transmission_System
Water_Heating
Water_Wastewater
Whole_Bldg_Meter_Level
Next Steps

- Final Resource Program public workshop in August
  - Share High Policy scenario results
  - Share next steps for BPA’s Potential Resource Solutions