Integrated Resource Plan Public Workshop 2
Key Inputs & Assumptions

March 11, 2020
WELCOME!

Thanks for coming back for Round 2.
Portfolio Selection Metrics

How will we evaluate different portfolios?
Reminder of IRP Process

Needs Assessment

Do we have enough resources to meet our load under most conditions?

Portfolio Analysis & Selection

Which set of resources best meet our needs, risk tolerance and values?

Action Items

What are our next steps?

How to determine which portfolio is best?
Portfolio Selection Process

Step 1: Create set of potential portfolios
Add resources to existing portfolio to fill gaps

Step 2: Rule out portfolios that don’t meet minimum standards
Resource Adequacy  CETA compliance

PORTFOLIO SELECTION METRICS
Resource Adequacy (RA) Standard

What is Resource Adequacy?
✓ Having enough resource to serve loads

What is a Resource Adequacy Standard?
✓ Metric + Maximum Threshold

Example
Number of hours per year when we’re short can be no more than 2.4
Principles for a RA Standard

Principles Used to Select a Standard

✓ Probabilistic (evaluates outcomes over all simulations)
✓ Choose from common standards used elsewhere
✓ Address three key dimensions of inadequacy events
  ▪ Duration
  ▪ Magnitude
  ▪ Frequency
✓ Balance high reliability standards with costs
Draft Adequacy Standard

**Duration**
No more than 2.4 hours per year when we’re short on average

*Loss of Load Hours (LOLH) of 2.4 per year*

**Magnitude**
Shortage of no more than 0.001% of total load across the year on average

*Normalized Expected Unserved Energy (NEUE) of 0.001% per year*

**Frequency**
No more than 2 days when we’re short over 10 years (0.2 days per year) on average

*Loss of Load Expectation (LOLE) of 0.2 days per year*

**ADEQUATE** if all three standards are met

**INADEQUATE** if any of the three are not met
CETA Compliance

CETA Rule

✓ 100% of load met by non-emitting resources or alternative compliance 2030-2044 (up to 20% from alternative compliance)

COMPLIANT if 80% or more of load is served by carbon-free power

NON-COMPLIANT if less than 80% of load is served by carbon-free power
Portfolio Selection Process

Step 1: Create set of potential portfolios
Add resources to existing portfolio to fill gaps

Step 2: Rule out portfolios that don’t meet minimum standards
Resource Adequacy | CETA compliance

Step 3: Compare remaining portfolios using objective criteria
Expected costs | Financial risk | Ability to change course
What goes into portfolio costs?

Calculate net present value (NPV) of costs for each simulation

<table>
<thead>
<tr>
<th>Costs</th>
<th>Offsets to Costs</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Capital Expenditure</td>
<td>• Power Market Sales less GET</td>
</tr>
<tr>
<td>• Operation &amp; Maintenance</td>
<td></td>
</tr>
<tr>
<td>• Purchased Power</td>
<td></td>
</tr>
<tr>
<td>• Transmission</td>
<td></td>
</tr>
<tr>
<td>• Renewable Energy Certificates (RECs) to comply with I-937 &amp; CETA</td>
<td></td>
</tr>
<tr>
<td>• Social Cost of Carbon Emissions</td>
<td></td>
</tr>
</tbody>
</table>
### Social Cost of Carbon Emissions

Values determined by Department of Commerce rulemaking

<table>
<thead>
<tr>
<th>Year in which emissions occur or are avoided</th>
<th>Social Cost of Carbon Dioxide (in 2018 dollars per metric ton)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2020</td>
<td>$74</td>
</tr>
<tr>
<td>2025</td>
<td>$81</td>
</tr>
<tr>
<td>2030</td>
<td>$87</td>
</tr>
<tr>
<td>2035</td>
<td>$93</td>
</tr>
<tr>
<td>2040</td>
<td>$100</td>
</tr>
<tr>
<td>2045</td>
<td>$106</td>
</tr>
<tr>
<td>2050</td>
<td>$113</td>
</tr>
</tbody>
</table>

### Applications

- Direct emissions from generation + leakage
- Emissions in market purchases
How do we calculate expected cost?

Expected Cost

= average across all simulations
How do we evaluate financial risk?

RISK = average across 5% highest-cost outcomes
What do we do with the information?

Sample Cost and Risk Results

Superior Portfolios (lower cost, lower risk)

Inferior Portfolios (high cost, high risk)
Ability to Change Course

Five-point scale to qualitatively reflect the value of having flexibility to adjust to a changing world.

- **5** • Demand-side resources (conservation, demand response) that can be invested in piecemeal rather than all at once.
- **4** • Short-term contracts (<10 years)
- **3** • Medium-term contracts (10 to 15 years) with output that cannot be adjusted
  • Long-term contracts with output that adjusts based on need (e.g. BPA)
- **2** • Long-term contracts (>15 years) with output that cannot be adjusted
- **1** • Any large resources that we build or acquire
Tacoma Power’s Current Portfolio

What resources do we have today?
Our Resources Today

- BPA: 56%
- Cowlitz: 26%
- Nisqually: 9%
- Cushman: 5%
- Wynoochee: 1%
- Columbia Basin Hydro: 3%
- Grant County: 0%

Current Portfolio

*Generation Resource*
Section 1: Our Resources

Our Hydro Projects

- **63%** of Tacoma’s average generation
  - Total generating capacity = 466MW
  - Significant storage and flexibility at Mossyrock
  - Continuous outflow at Mayfield
  - Diminished storage at Cowlitz due to Riffe Lake upper seismic operating limit

- **22%** of Tacoma’s average generation
  - Total generating capacity = 116MW
  - Limited storage and some shaping flexibility at Alder
  - Continuous outflow at LaGrande

- **12%** of Tacoma’s average generation
  - Total generating capacity = 135MW
  - Flexible when there are sufficient flows

- **2%** of Tacoma’s average generation
  - Total generating capacity = 13MW
  - Run-of-river operations
Overview

- BPA is a Federal Power Marketing Agency
  - 21 US Army Corp of Engineer Dams (14,650 MW)
  - 10 Bureau of Reclamation Dams (7,800 MW)
  - Columbia Generating Station (Nuclear, 1,100 MW)
  - Several Wind Generation contracts (58 aMW)

- Power is sold at cost (Currently ~ $32/MWh)

- Tacoma Power has been a BPA customer since 1940

- Tacoma Power is BPA’s 4th largest customer
  (~$120M/year, ~5.5% of BPA’s total load)

- Current Contract Expires September 2028
BPA “Preference” Power Products

BPA’s statutes require it to:

- Provide power to public utilities (or “preference customers”) upon request
- Amount of power is based upon the requesting utility’s Total Retail Load less its own resources under “critical water” conditions (“Net Requirement”)
- Net Requirement (NR) is determined annually based upon our load forecasts (Example to right):

```
<table>
<thead>
<tr>
<th>Description</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Retail Load</td>
<td>580 aMW</td>
</tr>
<tr>
<td>Less: Tacoma Resources (Critical Water)</td>
<td>185</td>
</tr>
<tr>
<td>BPA &quot;Net Requirement&quot;</td>
<td>395</td>
</tr>
<tr>
<td>Critical &quot;Slice&quot; @ 2.96%</td>
<td>200</td>
</tr>
<tr>
<td>Block (Net Requirement less Slice)</td>
<td>195</td>
</tr>
</tbody>
</table>
```

Key Challenge: BPA has discretion over whether to allow any new resource we acquire to count against our net requirement
Columbia Basin Hydro

- 5 Irrigation Canals (Staggered Terms 2022-2026)
- ~27 aMW in months of March through October
- Pricing (~$29/MWh) = Cost (~$12/MWh) + Incentive Payment (~$17/MWh)

Grant County Contract

- .29% “slice” share of Priest Rapids and Wanapum Dams (expires 2052)
- ~2.5 aMW Similar in shape to the BPA Slice product
- Pricing (~$11/MWh) = Cost + Share of proceeds from auction of excess energy
Conservation Potential Assessment

How much conservation can we acquire?
How much should we acquire?
1. Role of CPA in Planning
2. Types of Potential
3. Conservation History
4. Conservation Plans
5. Factors Impacting CPA Results
6. Recent CPA Results
Role of CPA in Planning

Conservation Potential Assessment (CPA) data output used in IRP to model conservation impacts on load forecast

Identify measures

- With net benefit to the service area
- With utility costs lower than generation
- That improve the load-resource balance
- For development in conservation acquisition plan
Energy Conservation – State Law

The Energy Independence Act requires qualifying utilities to determine their conservation potential using “methodologies consistent with those used by the Pacific Northwest Electric Power and conservation planning council” (19.285.040(1)(a) RCW)

The Energy Independence Act is codified in WAC 194-37 which requires qualifying utilities to establish a:

- 10-year conservation resource potential every two-years
- Biennial conservation target that is “no less than its pro rata share of its ten-year potential.”
Achievable economic potential simplified here. Due to BPA contract requirements, conservation results in purchase of less BPA resource.
Conservation Accomplishments

Consistently achieve beyond our target

Getting harder to acquire savings

2019 By sector
  • 29% Residential
  • 71% Commercial/Industrial
Major Factors Affecting Potential

End-use saturation and efficiency levels

Baselines – codes, standards, markets

Recent accomplishments

Measure assumptions

New technology

Avoided price forecasts
TRC Forecast Avoided Costs

![Chart showing monthly average wholesale energy costs, average of regulated adders, and average of real adders from 2020 to 2039.](chart.png)
# Active Programs

## Residential
- Weatherization
- Heating Systems
- Consumer Products
- New Construction & Custom Projects
- Quick Energy Savers

## Commercial/Industrial
- Bright Rebates
- Custom Retrofit
- Equipment Rebates
- New Construction
- Strategic Energy Management

## Other
- NEEA
- Distribution Efficiency

### Hard to Reach
- Owner Occupied
- Rentals/Apartments
- Agency Partnerships
## 20-Year Conservation Potential

<table>
<thead>
<tr>
<th></th>
<th>Achievable Technical Potential (GWh)</th>
<th>Economic Achievable Potential (GWh)</th>
<th>Percent 2039 Baseline</th>
</tr>
</thead>
<tbody>
<tr>
<td>Residential</td>
<td>355</td>
<td>84</td>
<td>4.0%</td>
</tr>
<tr>
<td>Commercial</td>
<td>248</td>
<td>171</td>
<td>13.6%</td>
</tr>
<tr>
<td>Industrial</td>
<td>115</td>
<td>94</td>
<td>5.9%</td>
</tr>
<tr>
<td>JBLM Residential</td>
<td>7</td>
<td>2</td>
<td>5.0%</td>
</tr>
<tr>
<td>JBLM Commercial</td>
<td>31</td>
<td>22</td>
<td>7.5%</td>
</tr>
<tr>
<td>Street Lighting</td>
<td>6</td>
<td>6</td>
<td>31.2%</td>
</tr>
<tr>
<td>Distribution Efficiency</td>
<td>14</td>
<td>11</td>
<td>0.2%</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>775</strong></td>
<td><strong>389</strong></td>
<td><strong>8.0%</strong></td>
</tr>
</tbody>
</table>
Lighting accomplishments and federal standards impact remaining potential

Fewer economic weatherization measures make it more difficult to implement the program

A combination of Energy Star appliances will eventually become a significant opportunity
Commercial Potential: 171,549 MWh

Lighting is nearly 30% of commercial consumption and 72% this sector’s conservation potential.

Existing buildings account for 65% of the sector potential.

62% of sector potential is from office, retail, school, hospital and misc. segments.
Industrial Potential: 94,397 MWh

Like previous results, motors continue to dominate industrial potential, about 60% of sector potential.

Lighting is a strong 27% of the sector potential.
Like civilian commercial, lighting dominates at 74% of potential

Combined HVAC potential contributes 14%

JBLM potential assumes a slower implementation
On/Off Street Lighting: 5,649 MWh

Spread among many different wattage and fixtures types
About 50% in the 100 and 400 watt equivalent
By the year 2039, existing state building codes and federal energy standards on equipment are projected to reduce overall load by 122,119 MWh (built into the forecast).

<table>
<thead>
<tr>
<th>Sector</th>
<th>Impact (MWh)</th>
<th>% of Baseline Load</th>
</tr>
</thead>
<tbody>
<tr>
<td>Residential</td>
<td>44,678</td>
<td>~2.1%</td>
</tr>
<tr>
<td>Commercial</td>
<td>60,067</td>
<td>~4.5%</td>
</tr>
<tr>
<td>Industrial</td>
<td>5,727</td>
<td>~0.1%</td>
</tr>
<tr>
<td>JBLM</td>
<td>11,647</td>
<td>~1.0%</td>
</tr>
</tbody>
</table>
Base Case Load Forecast

How much load do we expect in our base case?
1. Introduction to Load Forecasting
2. National Trends in Electricity Use
3. Critical Drivers
4. Forecasting Methodology
5. Forecast Products
This is where we answer the question “what is a load forecast?”

Introduction to Load Forecasting
Introduction to Load Forecasting

Tacoma Power is an electric power service provider.

As an electric power provider, Tacoma Power energizes everything from street lights to large industrial operations.

We call the collection of all our retail services our system. The electric power that’s consumed on our system is called system load.
Tacoma Power stands ready to serve every customer’s need at every moment.

*Tacoma Power does this by securing adequate infrastructure and resources.*

*Tacoma Power relies on real-time, short-term, and long-term forecasts to know how much infrastructure and resource will be adequate at every moment.*
Tacoma Power’s long term load forecast is the subject of this presentation.

*Generally speaking, long-term load forecasts inform long-term infrastructure and resource planning.*

Utilities need long-term load forecasts because it usually takes a long time to build things like power plants, substations, and transmission infrastructure.
The long term load forecast is a projection of Tacoma Power’s service requirements.

- Tacoma Power’s long-term load forecast spans the next twenty years.

- The objective of the long-term load forecast is to provide a “business-as-usual case”. No assumptions about new policies or technologies are included.

- The long-term load forecast is developed using a set of models that consider economic, demographic, weather, and service area trends.

- Long term load forecasts are not a prediction of what will happen, but a modeled projection of what may happen given certain assumptions and methodologies.
This is where we take a step back.

National Trends in Electricity Use
Historically, electricity demand was coupled with economic growth. Around 2000, this relationship changed.

**Gross Domestic Product and Net Electricity Production**

*Historical (1950-2016) and Projected (2017-2027)*
National Trends

The decline in the demand growth rate can be attributed to a variety of factors.

Estimated U.S. Energy Savings from Structural Changes in the Economy and Energy Efficiency

1980-2016
A changing policy and market environment has made it difficult to accurately forecast national electric load.


Total U.S. Electricity Sales (TWh)
The same environment has made it difficult to accurately forecast Tacoma Power’s electric load.

Tacoma Power Annual Load Projections
2019-2039
The most recent Annual Energy Outlook projects electricity demand to grow slowly through 2050.

AEO2020 Electricity use growth rate
percentage growth (three-year rolling average)
This is where we answer the question “what affects load?”

Critical Drivers
Many factors affect electric load and our forecast assumes specific values for these factors throughout the forecast horizon.

Load is most notably driven by the weather, the economy, and the demography of a service territory.

We purchase weather data from an independent firm that specializes in weather and environmental information.

We purchase economic and demographic data from an independent firm that specializes in long-term county-level economic and demographic data series.
The economic and demographic inputs considered by our models are specific to Pierce County.

Tacoma Power’s service territory is contained within Pierce County.
Over the historical period, the economy has experienced change. Over the forecast horizon, the economy will continue to change.

<table>
<thead>
<tr>
<th>Critical Drivers</th>
<th>Compound Annual Growth Rate</th>
<th>Forecast Horizon</th>
</tr>
</thead>
<tbody>
<tr>
<td>Residence Adjustment</td>
<td>1.69%</td>
<td></td>
</tr>
<tr>
<td>Non-Industrial Retail Rates</td>
<td>4.20%</td>
<td></td>
</tr>
<tr>
<td>Non-Industrial Energy Efficiency Acquisitions</td>
<td>1.92%</td>
<td></td>
</tr>
</tbody>
</table>
Critical Drivers

The 2019 Forecast Weather Normal is based on 10 years of historical weather.
This is where we answer the question “how is the forecast derived?”

Forecasting Methodology
Tacoma Power’s System Energy Load Forecast is the sum of a non-industrial forecast and an industrial forecast.

Non-Industrial Load Forecast + Industrial Load Forecast = System Load Forecast
Within the non-industrial and industrial load forecasts, we account for conservation and codes & standards.

The forecasts of conservation and codes & standards are provided by Tacoma Power’s Conservation Potential Assessment.
The non-industrial load forecast is the product of two separate forecasts.

Non-Industrial loads are relatively weather-sensitive. Variability in weather can distort underlying trends in consumption. We adjust for weather-driven variability through a process called ‘Weather Normalization’.
The industrial forecast is the sum of 11 forecasts.

\[
\sum_{k=0}^{11} \text{Individual Industrial Load Forecasts} = \text{Pre-Conservation Industrial Forecast}
\]

We create individual load forecasts for each of the industrial loads existing or expected within our service territory. Forecasts are based on historical records of consumption and account executive knowledge of customer expectations.
Tacoma Power’s System Energy Load Forecast is the sum of a non-industrial forecast and an industrial forecast.
This is where we discuss the results of the forecasting process.
Let’s begin with the non-industrial load forecast.

The non-industrial load forecast is the product of two separate forecasts.
Tacoma Power’s retail customer base is projected to grow over the forecast horizon.

The 2019 Retail Customer Forecast

- Historical
- 2019 Customer Forecast

Number of Customers

0K  20K  40K  60K  80K  100K  120K  140K  160K  180K  200K  220K

Use-Per-Customer is projected to decline over the forecast horizon.
With the customer and use-per-customer forecasts, non-industrial load is projected to decline over the forecast horizon.
Recall, we account for conservation and codes & standards within the non-industrial and industrial forecasts.

The forecasts of conservation and codes & standards are provided by Tacoma Power’s Conservation Potential Assessment.
Conservation and Codes & Standards accelerate the projected decline in non-industrial load.
Let’s now discuss the industrial load forecast.

\[ \sum_{k=0}^{11} \text{Individual Industrial Load Forecasts} \quad = \quad \text{Pre-Conservation Industrial Forecast} \]

*The industrial forecast is the sum of 11 forecasts.*
Industrial load is expected to grow within the forecast horizon.

The Monthly Industrial Load Forecast
Again, we account for conservation and codes & standards within the non-industrial and industrial forecasts.

Non-Industrial Load Forecast  +  Industrial Load Forecast  =  System Load Forecast

*The forecasts of conservation and codes & standards are provided by Tacoma Power’s Conservation Potential Assessment.*
After accounting for conservation and codes & standards, the projected growth in industrial load is reduced.
After we account for conservation and codes & standards, system load is projected to decline.
Base Case WECC Buildout & Prices

How many resources will be built in our base case scenario?
What will prices look like in our base case scenario?
Forecasting Caveat!

“All models are wrong, but some are useful.”

~George E.P. Box (1919 - 2013)

The AURORA model is useful when:

- its inputs reflect actual or plausible realities
- its outputs are directionally accurate
The “WECC”

Western Electric Coordinating Council:

- 2 Canadian Provinces
- 11 Western States
- Northern Baja Mexico

WECC-US Utility Fun Facts:

- 147 Investor-Owned (~75% of load)
- 241 Non-Investor-Owned (~25% of load)
In 2018, the combined nameplate capacity of all utility-scale resources in the WECC was **258 GW**.

Approximately 1,300 MW of wind and solar capacity were added and natural gas capacity increased by 900 MW.
WECC Load Forecast

WECC Load Forecast (GWh)

*Average annual load growth of 0.7%
WECC 2045 Resource Buildout

**170 GW of New Generation Capacity by 2045**

- **135 GW Renewables**
- **35 GW Gas**

*1.3 GW of Battery Energy Storage Assumed (CA mandate)*
WECC 2045 Economic Retirement

7 GW Economic Gas and Coal Retirements

Nameplate Capacity (MW)

Thousands

0
0.5
1
1.5
2
2.5
3
3.5

WECC_Alaberta
WECC_Arizona
WECC_BritishColumbia
WECC_CA-SP15+
WECC_Colorado
WECC_NewMexico
WECC_Utah
WECC_Wyoming

Coal
Gas

Zone

6600 MW Coal (not including 7GW of announced early retirements)
400 MW Gas
WECC Buildout

32% reduction in WECC emissions rate by 2045
35% reduction in WA emissions rate by 2045
What does the Aurora model say?

Price Forecast
Average Annual Price Forecast

Comparison of Historic Mid-C Prices and Aurora Mid-C Price Forecast

- Historic Mid-C
- Aurora Mid-C Forecast

$/MWh (2019$)
Hourly Price Forecast Volatility

2020 vs 2045 February Price Volatility

2020 vs 2045 May Price Volatility

2020 vs 2045 August Price Volatility

2020 vs 2045 November Price Volatility
Preliminary Scenarios
Reminder from Last Time

**Scenarios**

- **Base Case**
  - Business-as-usual load forecast
  - Existing laws and trends

- **Alternative Scenario 1**
  - Alternative set of assumptions 1

- **Alternative Scenario 2**
  - Another alternative set of assumptions 2

**Random Variability**

- Run many simulations with different weather & prices
- Run many simulations with different weather & prices
- Run many simulations with different weather & prices

PRELIMINARY SCENARIOS
# Survey Results

## Changes to Tacoma Power Service Area

<table>
<thead>
<tr>
<th>LOCAL CHANGES</th>
<th>Employees</th>
<th>%</th>
<th>Working Group</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Population growth</td>
<td>17</td>
<td>77%</td>
<td>5</td>
<td>71%</td>
</tr>
<tr>
<td>Acceleration of electric vehicle adoption</td>
<td>13</td>
<td>59%</td>
<td>4</td>
<td>57%</td>
</tr>
<tr>
<td>Changing energy usage patterns due to climate change</td>
<td>11</td>
<td>50%</td>
<td>4</td>
<td>57%</td>
</tr>
<tr>
<td>Economic growth</td>
<td>8</td>
<td>36%</td>
<td>3</td>
<td>43%</td>
</tr>
<tr>
<td>Economic decline</td>
<td>2</td>
<td>9%</td>
<td>2</td>
<td>29%</td>
</tr>
<tr>
<td>Even more efficient energy-using equipment</td>
<td>10</td>
<td>45%</td>
<td>1</td>
<td>14%</td>
</tr>
<tr>
<td>Addition of new large load(s)</td>
<td>7</td>
<td>32%</td>
<td>1</td>
<td>14%</td>
</tr>
<tr>
<td>Loss of large load(s)</td>
<td>5</td>
<td>23%</td>
<td>1</td>
<td>14%</td>
</tr>
<tr>
<td>Increased use of natural gas for heating</td>
<td>2</td>
<td>9%</td>
<td>1</td>
<td>14%</td>
</tr>
<tr>
<td>Increased adoption of rooftop solar</td>
<td>2</td>
<td>9%</td>
<td>1</td>
<td>14%</td>
</tr>
<tr>
<td>Infrastructure inadequacies (water &amp; sewer)</td>
<td>0</td>
<td>0%</td>
<td>1</td>
<td>14%</td>
</tr>
<tr>
<td>Increased use of electricity for heating</td>
<td>6</td>
<td>27%</td>
<td>0</td>
<td>0%</td>
</tr>
<tr>
<td>Population decline</td>
<td>0</td>
<td>0%</td>
<td>0</td>
<td>0%</td>
</tr>
<tr>
<td>Policy changes forcing electrification</td>
<td>1</td>
<td>5%</td>
<td>0</td>
<td>0%</td>
</tr>
<tr>
<td>Continued gentrification and housing issues</td>
<td>1</td>
<td>5%</td>
<td>0</td>
<td>0%</td>
</tr>
<tr>
<td>Economic uncertainty</td>
<td>1</td>
<td>5%</td>
<td>0</td>
<td>0%</td>
</tr>
<tr>
<td>Utilities becoming more energy integrators than power suppliers</td>
<td>1</td>
<td>5%</td>
<td>0</td>
<td>0%</td>
</tr>
<tr>
<td>Figuring out how to use lots of power between 10AM and 2PM</td>
<td>1</td>
<td>5%</td>
<td>0</td>
<td>0%</td>
</tr>
</tbody>
</table>

General agreement that growth is likely
## Survey Results

### Policy Changes

<table>
<thead>
<tr>
<th>City, County or Statewide Law</th>
<th>Employee Survey</th>
<th>Stakeholder Survey</th>
</tr>
</thead>
<tbody>
<tr>
<td>All new buildings must be built with EV chargers</td>
<td>14</td>
<td>64%</td>
</tr>
<tr>
<td>All new buildings must be &quot;solar-ready&quot;</td>
<td>3</td>
<td>14%</td>
</tr>
<tr>
<td>Adoption of a national or statewide tax on carbon</td>
<td>14</td>
<td>64%</td>
</tr>
<tr>
<td>City, county or statewide requirement that all ships docked at Port of Tacoma run on electricity rather than diesel while docked</td>
<td>13</td>
<td>59%</td>
</tr>
<tr>
<td>Adoption of a national or statewide cap and trade program for carbon</td>
<td>11</td>
<td>50%</td>
</tr>
<tr>
<td>City, county or statewide ban on natural gas in new homes</td>
<td>8</td>
<td>36%</td>
</tr>
<tr>
<td>Clean Fuel Standard</td>
<td></td>
<td>0%</td>
</tr>
<tr>
<td>Moratorium on fracking</td>
<td>1</td>
<td>5%</td>
</tr>
<tr>
<td>IOUs become public and controlled by the federal government</td>
<td>1</td>
<td>5%</td>
</tr>
<tr>
<td>RA compliance laws</td>
<td>1</td>
<td>5%</td>
</tr>
<tr>
<td>Early retirement of CGS</td>
<td>1</td>
<td>5%</td>
</tr>
</tbody>
</table>

Some agreement that vehicle/port electrification policies and a price on carbon are likely.
Employee Survey Results

What are the biggest changes that we will see in the power industry over the next 20 years?

<table>
<thead>
<tr>
<th>Types of Change</th>
<th>Number of Responses</th>
</tr>
</thead>
<tbody>
<tr>
<td>Technological solutions to integrating renewables</td>
<td>8</td>
</tr>
<tr>
<td>Changing markets</td>
<td>6</td>
</tr>
<tr>
<td>Electrification</td>
<td>5</td>
</tr>
<tr>
<td>Acceleration of green policies/laws</td>
<td>5</td>
</tr>
<tr>
<td>DERs (Rooftop Solar, Home Batteries, etc.)</td>
<td>3</td>
</tr>
<tr>
<td>Climate change impacts on our hydro projects</td>
<td>3</td>
</tr>
<tr>
<td>Policies outside of WA that are bad for Tacoma Power</td>
<td>3</td>
</tr>
<tr>
<td>Reductions in consumption</td>
<td>3</td>
</tr>
<tr>
<td>Reliability challenges due to more renewables</td>
<td>3</td>
</tr>
<tr>
<td>More renewables</td>
<td>2</td>
</tr>
<tr>
<td>Changing customer expectations for information &amp; products</td>
<td>2</td>
</tr>
<tr>
<td>Cybersecurity</td>
<td>1</td>
</tr>
<tr>
<td>Transmission constraints for Tacoma Power</td>
<td>1</td>
</tr>
<tr>
<td>Increased AC</td>
<td>1</td>
</tr>
<tr>
<td>Natural gas price increases</td>
<td>1</td>
</tr>
</tbody>
</table>
Write-in Scenarios

Employee Survey

Large solar projects/PURPA puts (1MW+)
Would be good to see climate goals & Tacoma EAP considered in resource planning
Power industry is nationalized
Massive electrification
No transmission into & out of Tacoma due to BPA changes to OATT practices & policies
Cybersecurity costs become high
Increased drought events (frequency & duration)
Transmission constraints in Puget Sound as portfolios become more varied
Increased expectation that Tacoma Power lead the way on citywide GHG reduction
Reduced liquidity due to EIM participation

Working Group Survey

Energy storage, intelligent controls & utility process/controls that easily integrate renewables
Infrastructure inadequacies (water & sewer)
Critical Uncertainties

Resource Adequacy
• Loads
• Water supply
• Energy supply from contracted resources (BPA, etc.)

Portfolio Costs
• Market price levels
• Market price volatility
• Generation costs
• Contract costs

Carbon Emissions/ CETA compliance
• Market emissions rate
• CETA rules for spot market purchases
Employee Survey Results

How will prices change by 2040?

**PRICE LEVELS**
- Much higher: 5%
- Somewhat lower: 25%
- About the same: 40%
- Somewhat higher: 30%

**PRICE VOLATILITY**
- Increase (more volatility): 70%
- Decrease (less volatility): 15%
- Stay the same: 15%

Creating Scenarios

- Cruise Control (Base Case)
- Technology Solves Everything
- Carbon Policy First
- Reliability Reigns

- High Volatility
- Low Volatility
- High Electric Prices
- Low Electric Prices
“Cruise Control” (Base Case)

What does the world look like?

Business as usual. Policies as they exist today with no additional changes. Standard forecasts of loads, storage and renewables costs.

**DEMAND**
Utility load forecasts

**RENEWABLES**
Prices similar to current forecasts

**STORAGE**
Prices similar to current forecasts

**CARBON POLICY**
Existing policies

**NATURAL GAS**
Prices similar to current forecasts

**COAL RETIREMENTS**
Announced retirements + economic retirements
Carbon reduction policies are extremely strong and spread to almost every state in the WECC. Policies are numerous, fast approaching, costly to implement, and there is a very limited opportunity for new thermal generation buildout. In fact, carbon taxes force existing thermal generation to economically retire. International carbon reduction policies have resulted in substantial increases in liquefied natural gas (LNG) exports, which cause natural gas prices to rise and expose markets to more volatility.

What does the world look like?

<table>
<thead>
<tr>
<th>DEMAND</th>
<th>RENEWABLES</th>
<th>STORAGE</th>
<th>CARBON POLICY</th>
<th>NATURAL GAS</th>
<th>COAL RETIREMENTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Electrification without widespread demand management</td>
<td>Prices similar to current forecasts</td>
<td>Costs remain high</td>
<td>Carbon taxes in NW</td>
<td>High prices due to international competition for supply</td>
<td>Accelerated</td>
</tr>
</tbody>
</table>
Poor planning and a series of unfortunate gas events lead to power shortages/outages and price extremes. Low income customers' access to power becomes a fundamental equity issue. With storage technology still expensive, policy makers decide to roll back clean energy policies (including RPS and Carbon Tax rules) in favor of more inexpensive and reliable resources.

**What does the world look like?**

- **DEMAND**
  - Electrification without widespread demand management

- **RENEWABLES**
  - Prices similar to current forecasts

- **STORAGE**
  - Costs remain high

- **CARBON POLICY**
  - Roll back of carbon policies around 2030

- **NATURAL GAS**
  - Prices similar to current forecasts

- **COAL RETIREMENTS**
  - Announced & economic retirements until 2030 only
Low-cost solutions allow utilities to efficiently and cost-effectively integrate large quantities of renewable resources. This includes demand-side resources optimized for grid integration (electric vehicles, demand response, large flexible loads, etc.) and supply-side resources like storage. Because of the diversity of demand-side resources and significant investments in renewables, energy market prices are both stable and low.

**DEMAND**
Strong reliance on demand-side resources

**RENEWABLES**
Accelerated decline in costs

**STORAGE**
Low cost
Substantial buildout

**CARBON POLICY**
Existing policies

**NATURAL GAS**
Low gas prices due to low demand for natural gas

**COAL RETIREMENTS**
Announced & economic retirements
Next Steps and Action Items

What are we covering next?
Workshop Plan

**Workshop 1**
IRP Overview

**Workshop 2**
Present key inputs
Present and discuss metrics
Present and discuss scenarios

**Workshop 3**
Review current situation
Present and discuss resource alternatives

**Workshop 4**
Present analysis results
Present and discuss preferred portfolio
Discuss action items
Workshop 3

Current Resource Performance and Future Options

Scenarios
- Buildout & Prices in Alternative Scenarios

Resources
- Performance of Current Portfolio
- Resource Options