MEETING LOGISTICS

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TODAY’S MEETING OBJECTIVES

• Informational meeting
• Review IRP process
• Technical process overview
• City Light’s key model information
• 2020 IRP goals and challenges
• Next steps and feedback
INTEGRATED RESOURCE PLANNING

• Identifies how City Light plans to meet Seattle area’s electric power supply needs for the next 10 to 20 years

• Explains the mix of generation and demand-side resources that we plan to use for:
  o Clean Energy Transformation Act (NEW)
  o Energy Independence Act
  o Adequate power supply
  o Seattle’s policies and ordinances

• Presents a 10-year clean energy implementation plans and a 2-year action plan
HIGH-LEVEL INTEGRATED RESOURCE PLAN TIMELINE

Creating the framework 2019
Conduct Analysis 2019/Q1 2020
IRP Draft review and updates Q2 2020
2020 Plan presented to City Council Q3 2020
TECHNICAL PROCESS

1. Identify Need
   - City Light Demand
   - Existing Resources
   - Resource Adequacy
   - Clean Energy Requirements

2. Develop Alternatives
   - Resource Options
   - Future Electric Market Prices
   - Portfolio Construction

3. Evaluation
   - Baseline
   - Scenarios
   - Sensitivities
   - Risk Analysis
   - Key Performance Indicators

4. Select Plan
   - City Light recommends
   - Stakeholder feedback
   - Finalize Plan
   - City Council Approval
RESOURCE ADEQUACY
Approach and model explained
WHAT IS RESOURCE ADEQUACY?

From John Fazio’s 10/16/2019 presentation

• A power supply is adequate if it can supply all electrical needs, within an acceptable level of tolerance, accounting for unscheduled component outages and unexpectedly high demand
NEW RESOURCE ADEQUACY MODEL

HYDRO RISK AND RELIABILITY ANALYZER

• Objective function: Maximize generation to meet hourly demand given the following
  • Daily water inflows, hydro power plant operating objectives
  • unit efficiencies, unit level outages, min/max unit generation capability
  • operating reserve requirements
  • market reliance levels based on regional analysis/studies

• Produces hydro units’ hourly maximum generation patterns; calculates chronologically hourly energy surplus or deficit for all simulations

• Computes adequacy metrics and contributions by month
HYDRRA - MODELING FRAMEWORK
A MONTE CARLO APPROACH

- Skagit/Boundary Regulation
  (39-Yrs Daily Inflow, License Constraints, Daily Water Budget)

- Outage Distributions by Unit (Time to Failure/Time to Repair)

- Existing/New Renewables (Historical Generation, NREL)

- Hourly Load-Temperature Model
  (30-Yrs Hourly Temps, Wx Sensitive Components)

- Hourly Hydro Unit Commitment (LP)

- Market Reliance Levels Based on Regional Adequacy, BPA, Contracts

- Adequacy Metrics (frequency, duration, magnitude)

- Resource Adequacy Needs (monthly energy)

- Monthly Adequacy Contributions of Resources
MONTHLY ENERGY ADEQUACY NEEDS
HYDRRA OUTPUTS

• define ‘bad’ events or relevant curtailment events, calculate metrics (frequency, duration, magnitude)

• establish a metric target(s) on the bad events

• vary energy loads until the metric target is achieved

• adequacy need is the difference between the current energy available and the energy needed to meet the target metric

• adequacy needs vary by scenario (load, hydro)
  o electrification impacts on load
  o climate change impacts on loads and hydro
### ADEQUACY METRICS CALCULATED BY MONTH

<table>
<thead>
<tr>
<th>Metric</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>LOLEV</strong></td>
<td><strong>Loss of load events</strong> = Total events divided by total number of games (event = contiguous set of curtailment hours )</td>
</tr>
<tr>
<td>(events/year)</td>
<td></td>
</tr>
<tr>
<td><strong>EUE</strong></td>
<td><strong>Expected Unserved Energy</strong> = Total curtailment energy divided by the total number of games</td>
</tr>
<tr>
<td>(MW-hours)</td>
<td></td>
</tr>
<tr>
<td><strong>LOLP</strong></td>
<td><strong>Loss of Load Probability</strong> = Total number of games with one or more curtailment event divided by the total number of games</td>
</tr>
<tr>
<td>(percent)</td>
<td></td>
</tr>
<tr>
<td><strong>LOLH</strong></td>
<td><strong>Loss of load hours</strong> = Total curtailment hours divided by total number of games</td>
</tr>
<tr>
<td>(hours/year)</td>
<td></td>
</tr>
</tbody>
</table>
MONTHLY ADEQUACY CONTRIBUTIONS

• Also known as ELCC-effective load carrying capability

• Amount of incremental load a resource can serve without degrading adequacy; measured as the likelihood that a new resource can reliably contribute to resource adequacy

• Accounts for hydro flexibility, BPA block contract interactions, and can vary by month and year

• Adequacy contributions calculated for each resource option:
  o energy efficiency programs by customer class
  o demand response for winter and summer months
  o renewables: solar (utility scale and behind the meter), wind
  o other renewables: geothermal/biomass
  o other resources: storage, existing(owned/contracts)
BASELINE AND SCENARIO WESTERN POWER MARKET FUTURES

AURORA Model
AURORA MODEL

• A third-party fundamentals-based COTS production cost model that City Light uses to simulate the western US electric system based on a zonal topology

• Transmission connections allows for economic imports and exports between zones to meet demand, given transfer capacity, losses and wheeling costs

• Resource dispatching that may economically add/retire resources within zones to maintain adequate supply and demand based on user specified reserve margins

• Produces hourly electric market prices based on the variable costs of the marginal resource that meets load for each hour (marginal clearing price methodology)
AURORA ELECTRICITY MARKET MODEL

**Inputs**
- Regional Loads
- Resource Characteristics & Availability
- Fuel Prices & Availability

**Aurora Model**
- Aurora Electricity Market Model
- Long Term Capacity Expansion and Economic Dispatch
- WECC – 16 Zones

**Outputs**
- Wholesale Power Prices
- Resource Builds and Generation
- Regional Emission Rates

**Example Constraints**
- Renewable Portfolio Standards
- CO2 Regulatory Policies
PORTFOLIO
CONSTRUCTION
Seattle Area Resource Addition Advisor
SEATTLE’S AREA RESOURCE ADDITIONS ADVISOR (SARAA)

• Model Output
  o Resource Additions (supply-Side, demand-side, REC, energy transformation)

• Inputs
  o Resource option information (costs, generation, option life, contributions to needs)
  o Regional information (power prices, regional emissions rates)

• Objective Function
  o Minimize Net Present Value of City Light’s portfolio cost (Resource costs includes transmission costs, power purchase costs, market revenues)

• Constraints
  o Resource Adequacy (monthly energy need and resource option contributions)
  o Energy Independence Act
  o Clean Energy Transformation Act requirement
  o User defined constraints
## RESOURCE OPTIONS - ATTRIBUTES

<table>
<thead>
<tr>
<th>Resource Type</th>
<th>CETA Eligible</th>
<th>EIA Eligible</th>
<th>Scenario independent</th>
<th>Scenario dependent</th>
<th>Further Locational Value &amp; Customer Classification Needed</th>
</tr>
</thead>
<tbody>
<tr>
<td>Owned: Hydro</td>
<td></td>
<td>X</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Owned: Renewable PPA</td>
<td></td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
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<tr>
<td>Owned: BPA</td>
<td></td>
<td>X</td>
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<tr>
<td>New Option: Renewable</td>
<td></td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
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<tr>
<td>New Option: Non-Renewable</td>
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<tr>
<td>New Option: Distributed Gen.</td>
<td></td>
<td>X</td>
<td>X</td>
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<tr>
<td>New Option: DR</td>
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<tr>
<td>New Option: Energy Efficiency</td>
<td></td>
<td>X</td>
<td>X</td>
<td></td>
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</tr>
<tr>
<td>Alt – Option: REC Is</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Alt – Option: Energy Transformation Offset</td>
<td></td>
<td>X</td>
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</tbody>
</table>

- **Clean Energy**: Resource type.
- **CETA Eligible** and **EIA Eligible**: Indicators for eligibility.
- **Scenario independent**:
  - **Reliability**
  - **Energy Value**
- **Scenario dependent**:
  - **Resource Adequacy Contribution**
  - **Clean Policy mitigation benefit & Resource Revenues**
- **Further Locational Value & Customer Classification Needed**

Sample Resource Option Variation
WRAP UP AND FEEDBACK
HIGH-LEVEL INTEGRATED RESOURCE PLAN TIMELINE

Meeting held
Kickoff Regional Resource Adequacy
Conservation Potential Assessment
Demand forecast review
Overview technical process and models
2020 IRP GOALS

• Creating flexible framework, methods and tools

• Protect the utility from bad outcomes and identify potential threat

• Providing information to understand costs and risks

• Preparing specific and measurable action plans
CHALLENGES FOR THIS IRP

• More complex analysis requirements
  o seasonality of resource adequacy and contributions
  o new energy policies
  o demand-side resource interactions with hydro and BPA
  o Appropriate methods and metrics for equity and transmission and distribution benefits

• Clean Energy Transformation Act, Electrification, Climate Change
  o Rulemaking ongoing and participation needs
  o What are the rules and how will it be implemented matters
  o Timing and magnitude of impacts on end uses, load shapes
  o Changes in inflow patterns and impacts on hydro regulations
NEXT STEPS

• We need to have time to complete baseline
  o resource adequacy
  o future market prices
  o create initial portfolio results

• How can we work together to achieve successful outcomes?
OUR MISSION
Seattle City Light is dedicated to delivering customers affordable, reliable and environmentally responsible electricity services.

OUR VISION
We resolve to provide a positive, fulfilling and engaging experience for our employees. We will expect and reinforce leadership behaviors that contribute to that culture. Our workforce is the foundation upon which we achieve our public service goals and will reflect the diversity of the community we serve.

We strive to improve quality of life by understanding and answering the needs of our customers. We aim to provide more opportunities to those with fewer resources and will protect the well-being and safety of the public.

We aspire to be the nation’s greenest utility by fulfilling our mission in an environmentally and socially responsible manner.

OUR VALUES
Safety, Environmental Stewardship, Innovation, Excellence, Customer Care
EE SAVINGS INTERACTIONS WITH BPA BLOCK

FY2028 System Loads and BPA Shaped Block

FY2028 Reductions in BPA Take due to Energy Efficiency