Resources in the IRP

2014 IRP Stakeholders
September 12, 2013
Resources in the IRP: Agenda

- Introduction
- Generation Resources
- Fuel Prices
- Conservation Potential Assessment
- Adjourn
Generation Resources
Generation Resources: City Light

- SCL’s Existing Supply Portfolio is Heavily Dependent on Hydro
  - Advantages: Low cost, Considerable Experience
  - Disadvantages: Seasonal and Annual Variability in Precipitation
Generation Resources: Choices Available to Utilities

- **Geothermal**
  - Baseload
  - Limited by underground heat sources; technically challenging

- **Landfill Gas**
  - Baseload
  - Limited to landfills; most potential utilized

- **Biomass**
  - Baseload
  - Fuel competes with other markets; can be expensive

- **Solar**
  - Variable
  - Comparatively high cost and lower capacity factors in PNW

- **Wind**
  - Variable
  - Low capacity values and growing integration costs

- **Natural Gas**
  - Baseload or Peaking (Flexible)
  - CO2 emissions; lingering fuel price stability concerns
# Generation Resources: Cost Comparisons

<table>
<thead>
<tr>
<th>Capacity Type</th>
<th>Initial Capital</th>
<th></th>
<th></th>
<th>Illustrative Levelized Cost ($/MWh)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Low ($/kW)</td>
<td>Med ($/kW)</td>
<td>High ($/kW)</td>
<td>Capacity Factor</td>
</tr>
<tr>
<td>Wind</td>
<td>$1,800</td>
<td>$2,200</td>
<td>$2,500</td>
<td>30-35%</td>
</tr>
<tr>
<td>Biomass</td>
<td>$3,500</td>
<td>$4,000</td>
<td>$8,000</td>
<td>75-85%</td>
</tr>
<tr>
<td>Geothermal</td>
<td>$4,000</td>
<td>$6,600</td>
<td>$9,000</td>
<td>80-90%</td>
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<tr>
<td>Landfill Gas</td>
<td>$2,300</td>
<td>$2,500</td>
<td>$4,000</td>
<td>80-90%</td>
</tr>
<tr>
<td>Central PV</td>
<td>$2,000</td>
<td>$2,700</td>
<td>$3,500</td>
<td>up to 24%</td>
</tr>
<tr>
<td>Eastern Oregon, 20 MW</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Combustion Turbine Natural Gas (before fuel, offsets)</td>
<td>Dispatchable, flexible</td>
<td>$900</td>
<td></td>
<td>1-25%</td>
</tr>
<tr>
<td>Heat rate</td>
<td>10,000</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Combined Cycle Natural Gas (before fuel, offsets)</td>
<td>Dispatchable, baseload</td>
<td>$900</td>
<td>$1,300</td>
<td>$1,500</td>
</tr>
<tr>
<td>Heat rate</td>
<td>7,100</td>
<td>6,700</td>
<td>6,800</td>
<td></td>
</tr>
</tbody>
</table>

Prices assuming resource is on-line in 2018, current dollars

Illustrative cost is without government incentives or delivery.
A Smoother Look at the Time Trend Shows Steep Recent Decline in Pricing; Especially Low Pricing in Interior Region

Source: Lawrence Berkeley Labs, Wiser et al., August 2013
Generation Resources: Solar PV Cost Trends

Source: NPCC, Solar Cost, June 2013
Generation Resources: Solar Output and Regional Load

Shape of PNW Solar PV Not Quite Congruent to Average Regional Load

Source: NPCC June 2013
Generation Resources: Natural Gas

- Natural Gas: Four plants in siting process in Oregon
- Tradeoffs: forecast of regional load growth resulting in less demand compared to planned coal retirements increasing demand

Power Plant Characteristics:
- Combustion Turbines
  - Idaho Power commissioned Langley Gulch plant in 2012
  - May be quick start and dispatchable
  - High heat rate
- Combined-cycle Turbines
  - Port Westward outside Portland
  - Efficient operations (heat rate 6,900) if run as baseload
  - Cycling plant reduces efficiency
Generation Resources: Transmission

- Regional Transmission
  - Many constraints (see map, next page)
  - Some planned improvements
- SCL Can Deliver Power Today
- Future Load Growth and New Resources Will be more Difficult (Expensive) to Serve
Generation Resources: Existing Transmission

BPA’s Transmission Grid and Regional Constraints
Generation Resources: Planned Transmission
Generation Resources: Regional Issues

- Regional Electrical Energy Changes
  - Coal Retirements
    - Centralia, Boardman have announced changes
    - Others possible
  - Changes to Canadian Return Treaty
    - BPA and Mid-C utilities provide free energy to British Columbia to compensate BC for constructing 3 dams in upper Columbia
    - Earliest possible change is Fall 2024
    - Could result in 200-400 aMW power staying in region (regional load approximately 27,000 aMW)
- Will an Energy Imbalance Market Emerge?
Pacific Northwest Fuel Prices
Fuel Prices: Ventyx Natural Gas Price Outlook Declined From 2011 to 2013

![Graph showing the natural gas price outlook from 2011 to 2013 in 2013 dollars per MMBTU.](Image)
Fuel Prices: Shale Gas Drives Ongoing Decline in Natural Gas Price Outlook

- Shale Gas Supplies Exceeded Expectations
  - A mild winter in 2012 pushed gas storage to the highest on record and Henry Hub prices fell to $2 per MMBTU
  - A large backlog of drilled (but not yet producing) wells suggests continued low prices
- The 2012 IRP Outlook Foresaw Increased Gas Demand, But Overestimated Shale Gas Production Costs
  - Production costs have fallen significantly since 2008 and are estimated at $4 per MMBTU or less
  - Much shale gas production is a joint product with producing higher value oil and natural gas liquids
    - Production of “wet gas” is driving natural gas pricing and supplies
Fuel Prices: Ventyx Coal Price Outlook Increased 2011 to 2013

Dollars per Short Ton


NW-Mid-C 2011

NW-Mid-C 2013
Fuel Prices: Mid-C Coal Price Outlook Lifted By Growing PRB Market Share

- Shrinking Coal Supplies
  - Nationally, more than 150 coal mines have been idled
    - Central Appalachian supplies most reduced
- Uncertain Regulatory Landscape for Coal Emissions Helps Low-Sulfur PRB Coal
  - Use of blended or 100% PRB coal reduces emissions for many plants
- PRB Coal Remains Lower Cost than Natural Gas
- Export Market Stability
  - Non-OECD countries (India, Asia) continue to be a strong market for coal
Fuel Prices: Summary

- Fuel Prices Directly Affect SCL Conservation and Generation Economics
  - Market prices affect SCL revenues for surplus power sales
  - Recent market prices sometimes lower than average utility programmatic conservation costs
- Coal Likely Still Important to Western Power Supply in Next IRP
  - Western coal plants typically use low cost PRB coal
  - PRB coal prices are increasing, but capped by natural gas prices
  - Continuing coal operations lead to lower PNW electric prices
- Lower Natural Gas Price Outlook Expected for Next IRP
  - Oil and natural gas liquids production, plus abundant shale gas supplies are expected to keep natural gas prices low for at least a decade
Conservation Resources:
Conservation Potential Assessment
Seattle City Light
2013 Conservation Potential Assessment
IRP Stakeholder Meeting – CPA Results Summary

September 12, 2013, 4:00pm-6:00pm
Outline

• Conservation Potential Assessment - Overview
• Analysis approach
• High-level market characterization
• Conservation savings potential results
• Avoided cost sensitivity
• I-937 Compliance
Conservation Potential Assessment - Overview

Objectives:
• Meet I-937 requirements
• Establish cost-effective conservation targets
• Support IRP development
• Quantify amount, timing, and cost of conservation resources
• Not intended to design programs
Study objectives

- Characterize the Market
  - Base-year energy use by segment
    - SCL billing data
    - RBSA, RCCS, and other surveys
  - Prototypes and energy analysis (BEST)
  - Codes and standards

- Project the Baseline
  - End-use forecast by segment
    - Prototypes and energy analysis (BEST)
    - SCL forecast data
  - Codes and standards

- Screen Measures and Options
  - Measure descriptions
  - Avoided costs
  - SCL program data
  - NWPCC/RTF workbooks

- Achievable potential
  - Establish Customer Acceptance
    - SCL programs
    - Other studies
    - Market acceptance/ramp rates

- Technical and economic potential
  - Synthesize
    - Develop supply curves
    - Sensitivity analysis

- Study results
  - Synthesize
    - Develop supply curves
    - Sensitivity analysis

- Study approach
## Market segmentation by sector, 2012

<table>
<thead>
<tr>
<th>Sector</th>
<th>Number of meters (customers)</th>
<th>2012 Electricity sales (MWh)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Residential</td>
<td>362,524</td>
<td>3,146,951</td>
</tr>
<tr>
<td>Commercial</td>
<td>40,084</td>
<td>6,255,467</td>
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<tr>
<td>Industrial</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Street Lighting</td>
<td>3,301</td>
<td>91,879</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>405,927</strong></td>
<td><strong>9,494,297</strong></td>
</tr>
</tbody>
</table>

- Residential, 3,146,951, 33%
- Commercial, 4,961,098, 52%
- Industrial, 1,294,369, 14%
- Street Lighting, 91,879, 1%
LoadMAP baseline and potential projections

Residential, Commercial, Industrial, and Street lighting

- **Baseline Projection** – Forecast of energy usage absent the effects of customer efficiency programs. Holds efficiency purchasing trends at current levels, but includes the effects of codes and standards.
- **Technical Potential** – Theoretical upper limit of savings potential, assumes all customers adopt the most efficient measures regardless of cost
- **Economic Potential** – Customers adopt all cost-effective measures that pass the TRC test with B/C >1.0
- **Achievable Potential** – Subset of economic potential that can be reasonably achieved given the realities of customer preference, market adoption, limited information and education, and program implementation barriers.
SCL all sectors conservation potential

For 2014 to 2023, ten‐year achievable potential savings are 9.7% of the baseline forecast.

This is 118.4 aMW.

<table>
<thead>
<tr>
<th>Year</th>
<th>Baseline Forecast (MWh)</th>
<th>Cumulative Savings (MWh)</th>
<th>Cumulative Savings (aMW)</th>
<th>Energy Savings (% of Baseline)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Achievable Potential</td>
<td></td>
<td>Achievable Potential</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Economic Potential</td>
<td></td>
<td>Economic Potential</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Technical Potential</td>
<td></td>
<td>Technical Potential</td>
</tr>
<tr>
<td>2014</td>
<td>10,049,821</td>
<td>99,985</td>
<td>376,456</td>
<td>11.4</td>
</tr>
<tr>
<td>2015</td>
<td>10,005,208</td>
<td>197,975</td>
<td>656,464</td>
<td>22.6</td>
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<tr>
<td>2018</td>
<td>10,085,063</td>
<td>433,371</td>
<td>1,243,763</td>
<td>49.5</td>
</tr>
<tr>
<td>2023</td>
<td>10,728,599</td>
<td>1,036,977</td>
<td>2,185,003</td>
<td>118.4</td>
</tr>
<tr>
<td>2028</td>
<td>11,667,344</td>
<td>1,699,082</td>
<td>3,209,910</td>
<td>194.0</td>
</tr>
<tr>
<td>2033</td>
<td>12,706,161</td>
<td>2,195,644</td>
<td>3,938,790</td>
<td>250.6</td>
</tr>
</tbody>
</table>

Energy Savings (% of Baseline)

<table>
<thead>
<tr>
<th></th>
<th>Achievable Potential</th>
<th>Economic Potential</th>
<th>Technical Potential</th>
</tr>
</thead>
<tbody>
<tr>
<td>2014</td>
<td>1.0%</td>
<td>2.8%</td>
<td>3.7%</td>
</tr>
<tr>
<td>2015</td>
<td>2.0%</td>
<td>5.0%</td>
<td>6.6%</td>
</tr>
<tr>
<td>2018</td>
<td>4.3%</td>
<td>9.0%</td>
<td>12.3%</td>
</tr>
<tr>
<td>2023</td>
<td>9.7%</td>
<td>14.7%</td>
<td>20.4%</td>
</tr>
<tr>
<td>2028</td>
<td>14.6%</td>
<td>20.1%</td>
<td>27.5%</td>
</tr>
<tr>
<td>2033</td>
<td>17.3%</td>
<td>22.8%</td>
<td>31.0%</td>
</tr>
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</table>
Avoided cost sensitivity

- Two avoided cost scenarios
- The I-937 Market Avoided Cost Method is used for I-937 purposes
- The 2012 IRP Preferred Portfolio Method is used for SCL’s IRP

Levelized cost over time horizon is approx 50% higher.
Results in approx 10% increase in ten-year savings potential (~130 aMW in 2023)
EnerNOC Consistency with Council Methodology

I-937 Compliance

- End-use model — bottom-up
  - Building characteristics, fuel and equipment saturations
  - Stock accounting based on measure life
  - Codes and standards that have been enacted are included in baseline
  - Lost- and non-lost opportunities treated differently
- Measures – comprehensive list
  - RTF measure workbooks
  - BPA data
  - EnerNOC databases, which draw upon same sources used by RTF
- Economic potential, total resource cost (TRC) test
  - Considers HVAC interactions, non-energy benefits
  - Avoided costs include 10% credit based on Conservation Act
- Achievable potential – ramp rates
  - Based on Sixth Plan ramps rates, but modified to reflect City Light program history
Questions or Comments?

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