Using Energy Efficiency As A Resource Option
Three Decades of Experience from the Pacific Northwest

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What You’re About to Hear

- Short History of Power Planning in the PNW
- What We’ve Learned Along the Way
- What We’ve Accomplished
What Happened After Lewis and Clark Left?

A Short History of Power Planning in the Pacific Northwest
The Resource Planner’s Problem

- Don’t have too many resources
- Don’t have too few resources
- Have “just the right amount” of resources*

*Resources include energy, capacity, flexibility and other ancillary services needed for system reliability.
The First Three “Eras” of Power Planning in the PNW

- “New Deal” Mysticism (1930-1950)
  - Politicians plan using “chicken entrails and crystal balls” legislate what’s needed and when

- Engineering Determinism (1950-1970)
  - Engineers, using graph paper and rulers, schedule the next power plants

- Economic Determinism (1970 to April 27, 1983)
  - Economist, using price elasticity, slow the engineer’s construction schedules
Actions Taken in Response to “Engineering and Economic Determinist’s” Forecasts

- PNW Utilities planned and/or started construction on 28 coal and nuclear power plants to be completed over a 20-year period.
- Native American tribes sued the state and federal government over loss of salmon.
- Environmental groups sued Bonneville Power Administration over plans to turn the Columbia River into “Wave World”
Regional Electricity “Engineering and Economic Determinist’s” Forecast vs. Actual Use 1960 to 1985

Economist REALLY Underestimated Consumer Response to Retail Rate Increases Due to Thermal Plant Construction and Termination Costs
Impact of Actions Taken in Response to “Engineering and Economic Determinist’s” Forecasts and Resource Development

Wholesale Prices (BPA Rates) Increase 418% in real dollars over 5 years.
BPA’s Wholesale Rate Increases Translated in Dramatic Changes in PNW Retail Electric Rates

Retail Electric Rates Increase 162% in real dollars over 5 Years

PNW Average Revenue/kWh (Cents)
Political Impact of Actions Taken in Response to “Engineering and Economic Determinist’s” Forecasts

- Utilities terminated or mothballed 9 nuclear and 5 coal plants at a cost to the region’s consumers of more than $7 billion.
- Public Utilities defaulted on $2.25 billion in municipal bonds*
- The region’s politicians, utilities, larger industries and public interest groups agreed to accept the “deals” embodied in the Northwest Electric Power Planning and Conservation Act of 1980

*The Washington Public Power Supply System (WPPSS), was the largest municipal bond default in history
Pacific Northwest Electric Power Planning and Conservation Act (PL96-501)

- Authorized the states of Oregon, Washington, Idaho and Montana to form an **interstate compact** (aka, “the Council”)
  - Council is comprised of two members from each state appointed by their Governors
- Directed the Council to develop:
  - Fish and Wildlife **Program** to “protect, mitigate and enhance” F&W impacted by hydro-system development
  - Regional Power **Plan**
- Mandated **public involvement** in the Program and Plan development processes

The Council Is Unique!
NW Power Act’s Statutory Charge

- Council is to Prepare a Regional Power Plan that contains:
  - A 20-year load forecast for electricity demands
  - A “least cost” resource strategy to meet forecast demand
  - Review and update its Plan every five years
- Conservation (i.e., energy efficiency) is defined as a resource and given 10 percent cost advantage
- Established Resource Development Priorities:
  1. Conservation
  2. Renewable Resources;
  3. Generating resources utilizing waste heat or generating resources of high fuel conversion efficiency
  4. All other resources.

*Note: This statute was enacted 23 years before California issued its “loading order.”
Council’s Planning Process

- Longest running Integrated Resource Planning Process in US (and likely the world)
- Council has published six regional plans since 1983 (7th is currently under development)
- All Plan’s have called for significant reliance on energy efficiency
- Council has no regulatory authority over utilities or state commissions*

*Resource acquisitions by the Bonneville Power Administration (BPA), a federal power marketing agency, must be “consistent with the Plan”
Plans Must Address Three Major Sources of Uncertainty

- Load Uncertainty
- Resource Uncertainty
  - Output
  - Cost
  - Construction Lead Times
- Wholesale Electricity Market Price Uncertainty
Our Analysis Seeks to Answer Six Questions:

1. When Will We Need Resources?
2. How Much Will We Need?
3. What Should We Build/Buy?
4. How Much Will It Cost?
5. What’s the Risk?
6. Who Can We Blame if We Get it Wrong?

The lowest cost, lowest risks resources first.

The Staff!
Almost

Resource Portfolio Analysis on One Slide

While the “All Resource Supply Curve” tells us what to acquire, it doesn’t tell us how much, when or the costs and risks of acquisition!

Coal
Conservation
Gas
Renewable
Nuclear

Generic coal, gas and nuclear units are shown at typical project sizes - more units
Council Follows the “Gump” Resource Strategy Testing Model

The Future’s Like A Box of Chocolates.

You Never Know What You’re Gonna Get.
Council Portfolio Analysis Process “Test A Lot of Chocolates”

Regional Portfolio Model

Annual Load Growth

Hydro System Output

Resource Supply Curve

Natural Gas Prices

Wholesale Market Electricity Price

Carbon Price

Portfolio ABCD

Real Levelized Cost (Cents/kWh - 2006$)

Cumulative Supply (MW)

NPV System Cost (billion2006$)

Frequency

Efficient Frontier

Council Portfolio Analysis Process “Test A Lot of Chocolates”

Northwest Power and Conservation Council
The RPM Finds the Lowest Cost “Insurance” for the Same Risk Coverage
This Allows Policy Makers to Compare the Benefits of Risk Reduction Against Their Costs.
## Insights From Prior Plans

### Preferred Resource Characteristics

<table>
<thead>
<tr>
<th>Resource Type</th>
<th>Low Cost</th>
<th>Short Lead Time</th>
<th>Small Increment</th>
<th>No or Low Fuel Price Risk</th>
<th>Low Carbon Policy Risk</th>
</tr>
</thead>
<tbody>
<tr>
<td>Energy Efficiency</td>
<td>✭</td>
<td>✭</td>
<td>✭</td>
<td>✭</td>
<td>✭</td>
</tr>
<tr>
<td>Wind</td>
<td>✭</td>
<td>✭</td>
<td>✭</td>
<td>✭</td>
<td>✭</td>
</tr>
<tr>
<td>Solar PV</td>
<td>✭</td>
<td>✭</td>
<td>✭</td>
<td>✭</td>
<td>✭</td>
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<tr>
<td>Gas SCCT/CCCT</td>
<td>✭</td>
<td>✭</td>
<td>✭</td>
<td>✭</td>
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<tr>
<td>Coal</td>
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<td></td>
<td>✭</td>
<td>✭</td>
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<tr>
<td>Nuclear</td>
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<td></td>
<td></td>
<td>✭</td>
<td>✭</td>
</tr>
</tbody>
</table>

- ✭ = Resource exhibits desired characteristic
- ✭ = Resource partially exhibits desired characteristics
Now to the “Score Card”
Northwest Efficiency Development Has Historically Been Tied To Current Market Conditions

The Result Has Been Mr. Toad’s Wild Ride!

- Response to West Coast Energy Crisis
- Response to “Restructuring Discussions” and surplus
- Response to PNW Recession
- Short Term Memory Loss?

Enlightenment?
Since the West Coast Energy Crisis Actual Program Achievements Have Exceeded Council Plan Goals Every Year

*Achievements reflect utility and NEEA savings only. Savings from codes and standards are included as baseline adjustments in each plan’s baseline load forecast.*
Accomplishments Have Exceeded Targets Every Year Since 2005

Annual Savings (GWH/yr)

<table>
<thead>
<tr>
<th>Year</th>
<th>Target</th>
<th>Actual</th>
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<tbody>
<tr>
<td>2005</td>
<td></td>
<td></td>
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<tr>
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<td>2007</td>
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<td>2008</td>
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<td>2012</td>
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<td></td>
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<tr>
<td>2013</td>
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Since 2005 PNW Utilities Have Acquired Nearly 18,000 GWh/year of Energy Efficiency Savings
Northwest Regional Electric Loads Have Remained Virtually Unchanged for Seven Years, Because We’ve Been Meeting Most Load Growth With Efficiency

We’ve Offset the Equivalent of 1.1% Annual Load Growth With Efficiency Since 2006
Energy Efficiency Also Changes Peak Demands

Residential Water Heating Load Shape in 1990 vs. 2012

System Winter Peak Hours

- 1990_weekday
- 2012_weekday
Efficiency improvements in residential water heating have reduced PNW winter peak hourly demand by over 900 MW since 1990.
Winter Peak Savings from 2010-2012 Utility Efficiency Programs Were Nearly 1,100 MW
Partly As A Result of Energy Efficiency’s Impact on Peak Loads - There’s Been No Growth In Winter Peak Demand Since 1995
Average Cost of Utility Acquired Savings Continues to Be Lower and Far Less Volatile Than Wholesale Market Electricity Prices

May 1996 – March 2013
Average Wholesale Market Price (2014$)

Levelized Cost of Utility Efficiency Acquisitions (2014$)

Monthly Average Wholesale Market Price @ Mid-C Trading Hub (20014$)
Regional Utility/SBC Energy Efficiency Investments Per Person are Nearly Double the US Average

<table>
<thead>
<tr>
<th>Year</th>
<th>Investment per Capita (2014$)</th>
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<tbody>
<tr>
<td>2008</td>
<td>$19.70</td>
</tr>
<tr>
<td>2009</td>
<td>$24.49</td>
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<tr>
<td>2010</td>
<td>$31.30</td>
</tr>
<tr>
<td>2011</td>
<td>$35.11</td>
</tr>
<tr>
<td>2012</td>
<td>$31.83</td>
</tr>
<tr>
<td>2013</td>
<td>$32.06</td>
</tr>
<tr>
<td>US Average</td>
<td>$18.50</td>
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Region Invests About Twice the National Average Share of Its Retail Electric Revenues in Energy Efficiency

* 2013 is based on 2012 revenues data from EIA. 2013 data is expected in October/November 2014
Utility/SBC-Funded Savings Equaled 1.3% of Regional Electricity Sales in 2013 More Than Double the US Average

- 2008: 1.10%
- 2009: 1.12%
- 2010: 1.29%
- 2011: 1.38%
- 2012: 1.24%
- 2013: 1.34%
- US Average: 0.58%

* 2013 is based on 2012 loads data from EIA. 2013 data is expected in October/November 2014.
Northwest Electricity Use Per Person Has Been Decreasing

Annual Use Relative to 1980

PNW
US

Northwest Power and Conservation Council
Northwest Electric Bills Are Lower Than the National Average

2012 $ per Capita per Month

- National Average
- Regional Average


Northwest Power and Conservation Council
Northwest Electricity Intensity Per Unit of Economic Output Has Been Decreasing

Gross Domestic Product: BEA- 2005 constant dollars
Energy Consumption: State Energy Data
Northwest Electric Revenues Comprise A Smaller Share of GDP Than The National Average

Gross Domestic Product: Based of Bureau of Economic Analysis - measured in $2005 dollars.
Electric revenue from: State Energy Data System - includes electricity sales to all sectors (i.e., residential, commercial, industrial and transportation).
Efficiency Has Met Nearly 62% of PNW Load Growth Since 1980
Since 1978 Utility & BPA Programs, Energy Codes & Federal Efficiency Standards Have Produced Almost 50,000 GWH/yr of Savings
So What’s 50,000 GWH/yr?

- It’s enough electricity to serve the entire state of Oregon

- It saved the region’s electricity consumers nearly $3.51 billion in 2013

- It lowered 2013 PNW carbon emissions by an estimated 21.9 million MTE.
Energy Efficiency Has Been The Region’s Second Largest Resource Since 2012

- Hydropower: 46%
- Energy Efficiency: 17%
- Coal: 12%
- Wind: 6%
- Biomass: 1%
- Natural Gas: 7%
- Geothermal: <1%

Based on 2012 Actual Dispatch and Hydro Resource Output
Savings from Energy Efficiency Since 1978 Nearly Equal the Annual Firm Energy Output of the Six Largest Hydro Projects in the Region

<table>
<thead>
<tr>
<th>Hydro Projects</th>
<th>Energy Efficiency</th>
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</thead>
<tbody>
<tr>
<td>McNary</td>
<td>4,400</td>
</tr>
<tr>
<td>Rocky Reach</td>
<td>4,700</td>
</tr>
<tr>
<td>The Dalles</td>
<td>5,400</td>
</tr>
<tr>
<td>John Day</td>
<td>7,000</td>
</tr>
<tr>
<td>Chief Joseph</td>
<td>9,700</td>
</tr>
<tr>
<td>Grand Coulee</td>
<td>16,400</td>
</tr>
</tbody>
</table>

Grand Coulee: 49,000 GWh/yr
It took 50 years to develop the PNW Hydro-system. Over the following 50 years, energy efficiency will extend that legacy.
Efficiency Extends a PNW Legacy by
“Stretching the River”

The next great hydro electric development to be undertaken
must be that on the Columbia River. FDR - 1932

Franklin D. Roosevelt

... and reduced the power systems carbon-footprint 15% below 1990 levels without further harming fisheries or native peoples.
Questions?