Beneficial Electrification: Electrification in the Public Interest

RAP Webinar

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1 Introduction
Our Experts

David Farnsworth  Jim Lazar  Jessica Shipley
Questions?

Please send questions through the Questions pane

Thank you for joining us; the webinar will begin shortly.

[Enter a question for staff]

Retooling Regulation
Webinar ID: 294-296-827

GoToWebinar
Beneficial Electrification (BE)

1. Introduction
2. Energy Trends: What is Changing?
3. What Makes Electrification Beneficial?
4. Principles for Operationalizing BE
5. Beneficial Electrification in Practice: Initial Steps
Analysis of Consumer and Marginal Costs for Electric and Natural Gas Space and Water Heat in Single Family Residences in Puget Sound Power and Light Company Service Territory

Prepared Pursuant to inter-agency agreement between Public Counsel Section of the Office of the Attorney General of Washington State and Washington State Energy Office

Prepared by:
Richard Byers
Washington State Energy Office
809 Legion Way SE
Olympia, WA 98504

September, 1989

DIRECT USE OF NATURAL GAS FOR RESIDENTIAL SPACE AND WATER HEAT
COMPARSED TO
GAS-FIRED ELECTRIC GENERATION FOR HYDRO-FIRMING

THERMODYNAMIC, ECONOMIC, AND ENVIRONMENTAL IMPACTS

PREPARED FOR
ASSOCIATION OF NORTHWEST GAS UTILITIES

Portland, Oregon

Jim Lazar
Consulting Economist
Olympia, Washington
What Makes Electrification Beneficial?

Three Criteria: Achieve At Least One Without Adversely Impacting The Others

1. Saves Customers Money Long-Term; New Services
2. Reduces Environmental Impacts
3. Enables Better Grid Management
Energy Trends: What Is Changing?
December 2017: Xcel Bid Median Prices $/kWh

- Solar: $.029
- Wind: $.018
### Existing Power Plant Operating Costs per USEIA

<table>
<thead>
<tr>
<th>Plant Type</th>
<th>Fuel Cost</th>
<th>O&amp;M Cost</th>
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<tr>
<td>Coal</td>
<td>$0.026</td>
<td>$0.011</td>
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<td>Gas</td>
<td>$0.025</td>
<td>$0.005</td>
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<tr>
<td>Nuclear</td>
<td>$0.018</td>
<td>$0.007</td>
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*Existing Plant Average Fuel and O&M from USEIA Table 8.4 Electric Power Annual 2016*
Existing Plants vs. Xcel Bids

<table>
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<tr>
<th>Fuel</th>
<th>O&amp;M</th>
<th>Xcel Bids</th>
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<tr>
<td>$.037/kWh</td>
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<td>$.030/kWh</td>
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<td>$.018/kWh</td>
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</table>

Existing Plant Average Fuel and O&M from USEIA Table 8.4 Electric Power Annual 2016
Innovative & Efficient End Uses – Electrification Is Underway

Photo credits: EPA Energy Star / Cassandra Profita/OPB/EarthFix
3 What Makes Electrification Beneficial?
Is All Electrification Created Equal?

• Brattle: “Utility sales could nearly double by 2050”!

• Is it all about load growth?
What Makes for **Beneficial Electrification (BE)**?

*Three Explicit Criteria: Achieve At Least One Without Adversely Impacting The Others*

1. Saves Customers Money Long-Term; New Services
2. Reduces Environmental Impacts
3. Enables Better Grid Management
An Easy Example:
Oil vs. Heat Pump Water Heater

BOCK 58800 32E OIL FIRED WATER HEATER,
GALLON / 104000 BTU - TANK ONLY

Our Price Per Unit: $1,054.83

Rheem Prestige Hybrid Electric Water Heater

$1,389.00
1. Saves Customers Money Long Term

Consumer Economics

Photo credit: Flickr 401(k) 2012
## Consumer Economics

### Oil Water Heater
- **Capital:** $1,054
- 150 gallons oil/year
- $3.00/gallon
- $450/year
- 10 Years: $5,554

### Heat Pump WH
- **Capital:** $1,389
- 1,500 kWh/year
- $.12/kWh average
- $180/year
- 10 Years: $3,189
Environmental Benefits
Emissions

**Oil Water Heater**

- 150 gallons oil/year
- 22 lb CO₂/Gallon
- 3,300 lb CO₂/year

**Heat Pump WH**

- 1,500 kWh/year
- 50% Gas 50% Coal
- 1,400 lb CO₂/MWh
- 2,100 lb CO₂/year
Grid Management
Water Heater Loads Are Easy to Spot
Grid Management: Grid-Integrated Water Heating

- Water heaters only need to run 2-3 hours/day
- Can store an all-day-long supply
- Can be controlled into low-cost, low-emission hours
- No peak demand impact if managed.
- It’s a place to send excess wind and solar electricity.
Charging Occurs Mid-Day and Mid-Nite on Wind and Solar
No, You Don’t Run Out of Hot Water

State of Charge in Stored kWh

Hours of the day
Questions?

Please send questions through the Questions pane
1. Put Efficiency First
Efficiency Across Fuel Types

2. Recognize the Value of Flexible Load for Grid Operations
Value of Flexibility for Integrating Renewable Energy

Avoid Home Charging during these hours

Workplace Charging

Source: California ISO
Wind Curtailment Is Already Significant

Note: All curtailment percentages shown in the figure represent both forced and economic curtailment. PJM’s 2012 curtailment estimate is for June through December only.

Source: ERCOT, MISO, CAISO, NYISO, PJM, ISO-NE, SPP
3. Understand the Emissions Effects of Changes in Load
The Grid Is Getting Cleaner
Importance of Marginal Emissions on a “Dirty” Day

NEISO July 27, 2016

# of Marginal Generating Units

$/MWh of Marginal Generating Units
4. Use *Emissions Efficiency* to Measure the Air Impacts of Beneficial Electrification
More Carbon Intensive

Uncontrolled heat pump Water heater

Controlled heat pump Water heater

Less Carbon Intensive

Energy Star
Natural Gas Water heater

Uncontrolled electric resistance Water heater

Controlled electric resistance Water heater

More Energy Efficient

Standard Natural Gas Water heater

Less Energy Efficient
More Carbon Intensive      Less Carbon Intensive

More Energy Efficient      Less Energy Efficient

Uncontrolled heat pump Water heater

Energy Star Natural Gas Water heater

Standard Natural Gas Water heater

Uncontrolled electric resistance Water heater

Controlled electric resistance Water heater

Controlled heat pump Water heater
More Carbon Intensive  |  Less Carbon Intensive
---|---
More Energy Efficient  |  Less Energy Efficient

- **Energy Star**
  - Natural Gas Water heater
- **Uncontrolled heat pump**
  - Water heater
- **Controlled heat pump**
  - Water heater
- **Uncontrolled electric resistance**
  - Water heater
- **Controlled electric resistance**
  - Water heater
## 5. Measure Life Matters

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<th>Equipment</th>
<th>2015</th>
<th>2020</th>
<th>2025</th>
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As The Grid Gets Cleaner, Electric Options Become More Beneficial

- Electric Resistance Water Heater
- Heat Pump Water Heater
- Gas Water Heater
6. Design Rates to Encourage Beneficial Electrification
Rate design should make the choices the customer makes to minimize their own bill consistent with the choices they would make to minimize system costs.
TOU Rates Can Focus On The System Peak Period

Price Can Influence When EVs Are Charged

Dallas/Ft Worth
(standard rates)

San Diego
(time-of-use rates)

Adapted from: M.J. Bradley, 2017
5 Beneficial Electrification In Practice: Initial Steps
Develop Your Policy Framework

- Set Goals
- Identify Barriers
- Adopt Metrics
- Recognize Timing
- Include Affected Participants
- Develop an Inclusive Process
More On Beneficial Electrification

• This is the first of four papers.

• *Ensuring Electrification in the Public Interest*: June, 2018

• Space Heat: Summer, 2018

• Water Heat: Summer, 2018

• Electric Vehicles: Fall, 2018
Things Can Change Quickly

5th Avenue, NYC, Easter 1900
See any automobiles?

Source: Tony Seba
Things Can Change Quickly

Park Avenue, NYC, Easter 1913
See any horses?

Source: Tony Seba
Questions?

Please send questions through the Questions pane
Summary

• Given the innovations occurring in the electric sector, there are lots of opportunities for electrification.

• In this webinar RAP sets out a framework and principles for states to ensure that electrification is beneficial to consumers, the environment and the grid.
About RAP

The Regulatory Assistance Project (RAP)® is an independent, non-partisan, non-governmental organization dedicated to accelerating the transition to a clean, reliable, and efficient energy future.

Learn more about our work at raponline.org
Resources from RAP

- Beneficial Electrification: Ensuring Electrification in the Public Interest
- Utilities Can Get a “LEG” Up with Beneficial Electrification—But Regulators Also Have to be Ready
- Beneficial Electrification: A Growth Opportunity
- Beneficial Electrification: A Key to Better Grid Management
- Brewing up the Regulation of the Future