MEMORANDUM

TO: Council Members

FROM: Kevin Smit

SUBJECT: Energy Efficiency Supply Curve Development Methodology

BACKGROUND:

Presenter: Kevin Smit, Christian Douglass

Summary: In preparation for the Ninth Power Plan, staff will be providing the Council with a series of presentations on different aspects of developing the Plan. This presentation will be on the development of energy efficiency (EE) supply curves.

Relevance: The Northwest Power Act requires energy efficiency to be treated in the same way as supply side resources when considering the Plan’s resource strategy. To analyze EE in our production cost models (OptGen), staff develops a supply curve that provides bundles of the amount of EE available at different price points, with information on seasonal attributes.

Workplan: B.2.1 Prepare for the ninth power plan, developing a draft scope, preparing models and inputs, and developing environmental methodology.
Energy Efficiency Supply Curve Development Methodology

July 2024 Council Meeting
Kevin Smit
Christian Douglass
Overview

- History of conservation targets
- Conservation in the 2021 Plan
- Definitions (from the Title)
  - Efficiency as a Resource
  - What is Energy Efficiency?
  - What is a Supply Curve?
- Basic formula for estimating EE potential
- Supply curve development process
- New for the Ninth Plan
Context

This is the first in a series of “Primers” that provide background in how we develop various components of the power plan.

Energy Efficiency Supply Curves
Generating Resources Reference Plants
Demand Response Supply Curves
Etc.
Power Plan Targets 2005 - 2022

2021 (8th) Plan Targets:

6-year:
- 700 - 1000 aMW (Region)
- 243 (BPA Program)

20-Year:
- 2400 aMW (Region)
- 865 aMW (BPA)
## Power Plan Targets (2005-2022) – More Detail

<table>
<thead>
<tr>
<th>Plan</th>
<th>Energy Efficiency Target</th>
<th>Significant New EE Measures/Categories</th>
</tr>
</thead>
<tbody>
<tr>
<td>2021 Plan (2022)</td>
<td>750 - 1000 aMW by 2027 (6 years) 2400 aMW by 2041 (20 years)</td>
<td>Motor-driven products: pumps, fans, compressors, advanced motors. VHE DOAS</td>
</tr>
<tr>
<td>Seventh Plan (2016)</td>
<td>1400 aMW by 2021 (6 years) 3000 aMW by 2026 4300 aMW by 2035 (20 years)</td>
<td>Server rooms, LED lighting, Ag sector measures, VRF systems, advanced control systems</td>
</tr>
<tr>
<td>Sixth Plan (2010)</td>
<td>1,200 aMW by 2014 (5 years) 5,900 aMW by 2030 (20 years)</td>
<td>Distribution system efficiency, consumer electronics (LED TVs), exterior and street lighting, Industrial sector EE (2x)</td>
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<tr>
<td>Fifth Plan (2005)</td>
<td>700 aMW by 2009 (5 years) 2,800 aMW by 2024 (20 years)</td>
<td>Compact fluorescent lighting, heat pump water heaters, AC/DC power converters, integrated building design</td>
</tr>
</tbody>
</table>
# Conservation in the 2021 Power Plan

## Sector and Measure Bundles

<table>
<thead>
<tr>
<th>Residential</th>
<th>aMW by 2027</th>
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<tr>
<td>Dryer</td>
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<tr>
<td>Electronics</td>
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<td>HVAC Equipment</td>
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<td>Refrigeration</td>
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<td>Clothes Washers</td>
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<td>Water Saving Devices</td>
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<td>Circulator Controls</td>
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<tr>
<td>Level 2 EVSE</td>
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<td><strong>Total</strong></td>
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<table>
<thead>
<tr>
<th>Commercial</th>
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<tr>
<td>Electronics</td>
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<td>Food Preparation</td>
<td>5</td>
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<tr>
<td>HVAC</td>
<td>40</td>
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<tr>
<td>Lighting</td>
<td>230</td>
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<tr>
<td>Motors/Drives</td>
<td>20</td>
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<td>Process Loads</td>
<td>10</td>
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<td>Refrigeration</td>
<td>40</td>
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<tr>
<td>Water Heating</td>
<td>9</td>
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<td><strong>Total</strong></td>
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<table>
<thead>
<tr>
<th>Industrial</th>
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<tr>
<td>Compressed Air</td>
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<td>Energy Management</td>
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<td>Fans and Blowers</td>
<td>14</td>
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<tr>
<td>HVAC</td>
<td>21</td>
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<tr>
<td>Lighting</td>
<td>41</td>
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<tr>
<td>Material Handling and Processing</td>
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<tr>
<td>Other</td>
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<td>Pumps</td>
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<tr>
<td>Refrigeration</td>
<td>24</td>
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<tr>
<td>Water/Wastewater</td>
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<tr>
<td><strong>Total</strong></td>
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<table>
<thead>
<tr>
<th>Agriculture</th>
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<tr>
<td>Lighting</td>
<td>2.1</td>
</tr>
<tr>
<td>Dairy</td>
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<tr>
<td>Irrigation Hardware</td>
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</tr>
<tr>
<td>Irrigation Motor</td>
<td>4.8</td>
</tr>
<tr>
<td>Other</td>
<td>0.1</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>13</strong></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Distribution System</th>
<th>aMW by 2027</th>
</tr>
</thead>
<tbody>
<tr>
<td>CVR</td>
<td>3.1</td>
</tr>
</tbody>
</table>
How did we get to the 750 aMW and the measure bundles?

Definitions and Process for Developing the EE Supply Curves
Conservation as a Resource

Conservation (Energy Efficiency) is a resource

Conservation is to be evaluated/valued along side of other generating resources

Conservation is defined as a Resource in the NW Power Act:

*Resource means -- electric power, including the actual or planned electric power capability of generating facilities, or actual or planned load reduction resulting from direct application of a renewable energy resource by a consumer or from a conservation measure.* (3(19))
What is Energy Efficiency?

Definition of Conservation Under the Power Act

Conservation means any reduction in electric power consumption as a result of increases in the efficiency of energy use, production, or distribution.

1. Does the opportunity reduce electric power consumption?
2. Is the reduction in electric power consumption the result of an increase in efficiency of energy use, production, or distribution?

Also, must be “...reliable and available within the time it is needed...”

(From cost-effectiveness definition)
Cost-effective means that such measure or resource must be forecast...
• to be reliable and available within the time it is needed, and
• to meet or reduce the electric power demand ... of the consumers of the customers at an estimated incremental system cost no greater than that of the least-cost similarly reliable and available alternative measure or resource, or any combination thereof.

“System cost" means an estimate of all direct costs of a measure or resource over its effective life, including ... the cost of distribution and transmission to the consumer and, among other factors, waste disposal costs, end-of-cycle costs, and fuel costs (including projected increases), and such quantifiable environmental costs and benefits ... are directly attributable to such measure or resource.
What is a Supply Curve?

- Conservation resources need to compete along with supply side resources on an “apples to apples” basis.
- The energy efficiency supply curves include the electricity savings, levelized cost, and other attributes necessary to compare EE with other supply-side resources.
- The supply curves are the result of a region-wide conservation potential assessment.
- The supply curve tells our optimization models how much EE is available and what cost.
- A subset of the supply curve eventually leads to EE goals/targets.
Supply Curve Example
(20-Yr Potential Supply Curve from 2021 Plan)
The Basic Formula for EE Savings

**EE Savings Potential =**
Number Units * kWh savings per Unit * Achievable Amount (%)

**Examples:**
- Number of homes
- Floor area of retail
- Number of refrigerators
- Acres irrigated
- Number of transformers

**Example:**
Attic Insulation R0 – R49 in Heating Zones (HZs) 2&3 in a home with an electric furnace

2,253 kWh/year savings

9308 kWh/year (no attic insulation)
– 7055 kWh/year (R49 attic insulation)
= 2253 kWh/year savings

0.012% - applicability factor (% of all SF homes in HZs 2 & 3, with an electric furnace, with no attic insulation...)

85% - achievability factor

4,019,793 * 2,253 * 0.012% * 85%

= 900 MWh/year in total savings
Process Flow – Supply Curve and EE Target

1. Baseline
   - What is the current level of consumption? Connects to the end-use load forecast

2. Measures
   - Define EE measure cost and energy savings per unit, measure life, and peak capacity savings

3. Technical Potential
   - Calculate number of units of each measure available
   - Multiply savings per unit by number of units

4. Achievable Potential
   - Apply achievability rates to the technical potential
   - These include 1) total maximum achievability and 2) ramp rates (annual maximum amounts)
   - The result is our EE supply curve that goes into OptGen

5. Economic Potential
   - The amount of EE that is cost-effective is an output of the plan
   - The amount of cost-effective EE defines the regional and BPA targets

Will cover each of these steps in more detail in subsequent slides...
1. Establish the Baseline and Sync with Electricity Load Forecast

• Forecasts of electricity demand AND conservation potential must both use same baseline efficiency
  – Use the same units and growth forecasts
  – Same unit efficiency assumptions

• Frozen Efficiency Forecast
  – Establish the base year and then “freeze” or fix the baseline
  – This ensures we don’t double count the EE
  – Product stock turnover results in some overall efficiency improvement
Baselines for Each Measure Depends on Decision Timing

**New**
- New Homes, New Buildings
- Decision when new item is built or purchased.
- Baseline is best of minimum code requirement, federal standard, or common practice

**Natural Replacement**
- Replace on Burn-Out, Major Remodel
- Decision when equipment fails or becomes obsolete.
- Baseline is best of minimum code requirement, federal standard, or common practice

**Retrofit**
- Remove & Replace (windows), Add-On (insulate attic of older home)
- Decision timing is discretionary.
- Baseline is as-found condition, unless subject to code or standard
Identify EE Measures

- Over 100 measure categories in the 2021 Power Plan (e.g., Air-Source Heat Pump)
  - Buildings (insulation, windows, heat pumps, etc.)
  - Appliances (refrigerators, dishwashers, ovens, steamers, etc.)
  - Processes (energy management, pump optimization, etc.)
  - Utility distribution system (Conservation Voltage Regulation-CVR, reconductoring, transformers)
  - Across residential, commercial, industrial, agriculture, utility

- Over 2000 measure applications (e.g., Energy Star Air-Source Heat Pump, heating zone 1, new construction)
  - By heating zone, vintage, heating system type
  - Factors that change incremental cost or savings
2021 Plan EE Measure List: Res & Com

- Commercial
  - Compressed Air
  - Compressors
  - Electronics
  - Computers
  - Power/Strips
  - Servers & Power Supplies
  - Food Preparation
  - Cooking
  - Pre-Rinse Spray Valve
  - HVAC
  - ARC
  - Chiller-System
  - Chiller-Upgrade
  - CircPumps
  - Commercial EM
  - Com-PTHP
  - Connected Thermostats
  - DHP
  - Fans
  - Glass
  - HeatPumps
  - Secondary Glazing Systems
  - Unitary AC
  - VHE-DOAS
  - VRF-DOAS

- Lighting
  - Bi-Level Stairwell Lighting
  - Exterior Building Lighting
  - LEC Exit Sign
  - LPD Package
  - Parking Garage Lighting
  - Street and Roadway Lighting

- Motors/Drives
  - Clean Water Pumps

- Process Loads
  - EBHeaterControl
  - Elevators

- Refrigeration
  - GroceryRefrigeration
  - IceAndVending
  - Refrig-Freezer
  - Water Cooler Controls

- Water Heating
  - CircPumps
  - HPWH ResType
  - Showerheads
  - Washer

- Residential
  - Dryer
    - Clothes Dryer
  - Electronics
    - Advanced Power Strips
    - Desktop
    - Laptop
    - Monitor
    - UHD TV
  - Food Preparation
    - Electric Oven
    - Microwave
  - HVAC
    - ASHP Conversion
    - ASHP Upgrade
    - CAC
    - Cellular Shades
    - Circulator Controls
    - Circulators
    - DHP
    - DHP Ducted
    - Duct Sealing
    - GSHP
    - Heat Recovery Ventilation
    - RAC
    - ResWx
    - Smart tstats
    - Whole House Fan

- Lighting
  - Fixtures
  - Lamps
  - Pin Lamps

- Other
  - Air cleaners
  - Well Pump

- Refrigeration
  - Freezer
  - Refrigerator

- Water Heating
  - Aerator
  - Circulator Controls
  - Circulators
  - Clothes Washer
  - Dishwasher
  - HP/WH
  - Showerheads
  - TS DRV
  - Waste/Water Heat Recovery
  - WH Pipe insulation

- Whole Bldg/Meter Level
  - Behavior
  - EV Supply Equip
## 2021 Plan EE Measure List: Ag, Ind, & Utility

### Agriculture
- **HVAC**
  - Dairy
- **Irrigation**
  - Irrigation Hardware
- **Lighting**
  - Dairy
  - Lighting
- **Motors/Drives**
  - Dairy
  - Irrigation Motor
- **Process Loads**
  - Stationary Engine Block Heater
  - Stock Tanks
- **Refrigeration**
  - Dairy

### Industrial
- **All Electric**
  - All Electric
- **Compressed Air**
  - Compressed Air
  - Compressors
- **Fans and Blowers**
  - Efficient_Fan
  - Fans and Blowers
- **HVAC**
  - HVAC
- **Lighting**
  - Lighting
- **Low Temp Refer**
  - Advanced_Motors
  - Low Temp Refer
- **Material Handling**
  - Advanced_Motors
  - Material Handling
- **Material Processing**
  - Advanced_Motors
  - Material Processing
- **Med Temp Refer**
  - Advanced_Motors
  - Med Temp Refer
- **Melting and Casting**
  - Melting and Casting
- **Other**
  - Other
- **Other Motors**
  - Advanced_Motors
- **Pollution Control**
  - Advanced_Motors
- **Pumps**
  - Clean Water Pumps
  - Pumps

**CVR**
2. Develop Measure Data (Cost & Savings)

Energy Savings (kWh)
- Annual kWh per unit at the site
- Line losses from source to site
- Seasonal & daily shape of savings
- Measure interactions

Capacity Benefits (kW)
- Deferring a capacity resource ($/kW-yr)*
- Deferred distribution and transmission line expansion cost ($/kW-yr)
- Measure shape defines the kW impact

Non-Electric Impacts
- Water use changes
- Gas use changes
- Lamp replacements
- Quantifiable environmental impacts

Costs
- Capital & financing
- Labor
- Program administration
- Operations & maintenance
- Reinstallation cost

Measure Life
- Expected time until failure (“burn out”) or replacement

*The capacity resource deferral is usually defined after the portfolio optimization
### Weatherization Savings Values Example:

<table>
<thead>
<tr>
<th>Measure</th>
<th>Heating Zone 1</th>
<th>Heating Zone 1</th>
<th>Heating Zone 1</th>
<th>Heating Zone 2 &amp; 3</th>
<th>Heating Zone 2 &amp; 3</th>
<th>Heating Zone 2 &amp; 3</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Electric FAF</td>
<td>Zonal or DHP</td>
<td>Heat Pump</td>
<td>Electric FAF</td>
<td>Zonal or DHP</td>
<td>Heat Pump</td>
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<td>Attic:R0-R38</td>
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<td>796</td>
<td>2,001</td>
<td>984</td>
<td>748</td>
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<td>Attic:R30-R49</td>
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<td>639</td>
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<td>465</td>
<td>239</td>
<td>667</td>
<td>586</td>
<td>168</td>
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<td>57</td>
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<td>Window:Single-u30</td>
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<td>Window:Double-u30</td>
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<td>356</td>
<td>179</td>
<td>471</td>
<td>561</td>
<td>236</td>
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<td>Window:u30-u22</td>
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<td>Window:Single-u22</td>
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<td>550</td>
<td>270</td>
<td>997</td>
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<td>Window: Single-Storm</td>
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<td>498</td>
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<td>265</td>
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<td>Infiltration:cfm50 reduction</td>
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<td>183</td>
<td>69</td>
<td>141</td>
<td>185</td>
<td>76</td>
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<tr>
<td>DuctInsulation:R0-R11</td>
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<td>NA</td>
<td>170</td>
<td>786</td>
<td>NA</td>
<td>356</td>
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## Weatherization Cost Values Example

<table>
<thead>
<tr>
<th>Measure Name</th>
<th>Subcategory</th>
<th>Technology, Measure or Practice</th>
<th>Cost</th>
<th>Units</th>
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<tbody>
<tr>
<td>Single Family Weatherization - Insulate Attic - R0 to R38</td>
<td>Insulation</td>
<td>Attic:R0-R38</td>
<td>$1.33</td>
<td>$/ sf</td>
</tr>
<tr>
<td>Single Family Weatherization - Insulate Attic - R0 to R49</td>
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<td>$1.60</td>
<td>$/ sf</td>
</tr>
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<td>Single Family Weatherization - Insulate Attic - R11 to R38</td>
<td>Insulation</td>
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<td>$1.06</td>
<td>$/ sf</td>
</tr>
<tr>
<td>Single Family Weatherization - Insulate Attic - R11 to R49</td>
<td>Insulation</td>
<td>Attic:R11-R49</td>
<td>$1.33</td>
<td>$/ sf</td>
</tr>
<tr>
<td>Single Family Weatherization - Insulate Attic - R19 to R38</td>
<td>Insulation</td>
<td>Attic:R19-R38</td>
<td>$1.06</td>
<td>$/ sf</td>
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<td>Attic:R19-R49</td>
<td>$1.13</td>
<td>$/ sf</td>
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<td>$/ sf</td>
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<tr>
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<td>Attic:R30-R49</td>
<td>$0.89</td>
<td>$/ sf</td>
</tr>
<tr>
<td>Single Family Weatherization - Insulate Wall - R0 to R11</td>
<td>Insulation</td>
<td>Wall:R0-R11</td>
<td>$1.68</td>
<td>$/ sf</td>
</tr>
<tr>
<td>Single Family Weatherization - Insulate Floor - R0 to R19</td>
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<td>Floor:R0-R19</td>
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<td>$/ sf</td>
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<td>Single Family Weatherization - Insulate Floor - R0 to R25</td>
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<td>$1.28</td>
<td>$/ sf</td>
</tr>
<tr>
<td>Single Family Weatherization - Insulate Floor - R0 to R30</td>
<td>Insulation</td>
<td>Floor:R0-R30</td>
<td>$1.51</td>
<td>$/ sf</td>
</tr>
<tr>
<td>Single Family Weatherization - Insulate Floor - R19 to R30</td>
<td>Insulation</td>
<td>Floor:R19-30</td>
<td>$1.09</td>
<td>$/ sf</td>
</tr>
<tr>
<td>Single Family Weatherization - Insulate Ducts - R0 to R11</td>
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<td>DuctInsulation:R0-R11</td>
<td>$2.37</td>
<td>$/ sf</td>
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<tr>
<td>Infiltration Reduction - CFM50 reduction</td>
<td>Infiltration Control</td>
<td>Infiltration:cfm50 reduction</td>
<td>$0.680</td>
<td>$/ sf</td>
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<tr>
<td>Windows - Single Pane to Class 30</td>
<td>Window or Patio Door Replacement</td>
<td>Window:Single-u30</td>
<td>$24.09</td>
<td>$/ sf</td>
</tr>
<tr>
<td>Windows - Double Pane to Class 30</td>
<td>Window or Patio Door Replacement</td>
<td>Window:Double-u30</td>
<td>$24.09</td>
<td>$/ sf</td>
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<tr>
<td>Windows - Single Pane to Class 22</td>
<td>Window or Patio Door Replacement</td>
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<td>$/ sf</td>
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<td>$/ sf</td>
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<td>Windows - Class 30 to Class 22</td>
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<td>Windows - Add a Low-e Storm Window to an existing Single Paned Window</td>
<td>Low-e Storm Window</td>
<td>Window: Single-Storm</td>
<td>$10.46</td>
<td>$/ sf</td>
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<tr>
<td>Windows - Add a Low-e Storm Window to an existing Double Paned Window</td>
<td>Low-e Storm Window</td>
<td>Window: Double-Storm</td>
<td>$10.46</td>
<td>$/ sf</td>
</tr>
</tbody>
</table>
Measure Savings Shapes

Example: Air Source Heat Pump: Heating zone 1
How are the EE Measure Shapes Used?

- System load shape is used for calculating the marginal line losses (site to busbar).
- Measure shapes are used to define the amount of electricity being saved (kW) at the defined peak hour(s), or hour of greatest need:
  - Avoided transmission value
  - Avoided distribution value
Calculate Levelized Cost

- The cost and benefit streams are levelized over the lifetime of the measure.
- The final measure is defined by its:
  - Electricity savings (kWh)
  - Levelized cost ($/kWh)
  - Capacity impact (kW)
- Formula:

  \[
  \text{NRC Net Levelized Cost} = \frac{NPV(\text{cap cost} \times (1 + \text{admin}) + \text{ann O&M} + \text{other fuel} + \text{NEI} - \text{Def T&D} - \text{RAC} - \text{OFB})}{\text{Measure kWh Savings}}
  \]
3. Estimate Technical Potential

- The technical EE potential is essentially multiplying the measure savings by the number of units for each measure.

- The technical potential is the theoretical maximum EE that could be achieved/acquired for a given measure.

Data Sources:
- Stock assessments (RBSA, CBSA, IFSA)
- Council forecast models
- EIA - RBECs, CBECS, MECS
- DOE Rule making data sets (TSDs)
- Product sales data

Annual Estimates
- Year-by-year for 20-year forecast period
- Existing stock minus demolition
- New stock added
- New appliances added
- Appliance & equipment turnover
## Technical Potential Data Examples: Residential Housing and Commercial Building SF Forecasts

<table>
<thead>
<tr>
<th>Sector</th>
<th>Building/Industry Type</th>
<th>Vintage / Subcategory</th>
<th>Forecast Units</th>
<th>2022</th>
<th>2023</th>
<th>2024</th>
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<tbody>
<tr>
<td>Res</td>
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<td>New</td>
<td>Buildings</td>
<td>51,978</td>
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<tr>
<td>Com</td>
<td>MiniMart</td>
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<tr>
<td>Com</td>
<td>Restaurant</td>
<td>Existing</td>
<td>Millions SqFt</td>
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<tr>
<td>Com</td>
<td>Lodging</td>
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<td>Hospital</td>
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<td>Residential Care</td>
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<td>Assembly</td>
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<td>Other</td>
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<td>369</td>
<td>365</td>
<td>362</td>
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</table>
RBSA and CBSA Data Examples

Figure 19. Primary Heating System by Building Type

<table>
<thead>
<tr>
<th>Building Type</th>
<th>2022</th>
<th>2017</th>
</tr>
</thead>
<tbody>
<tr>
<td>Assembly</td>
<td>53%</td>
<td>57%</td>
</tr>
<tr>
<td>Grocery</td>
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</tr>
<tr>
<td>Hospital</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lodging</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mixed Commercial</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Office</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Other</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Residential Care</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Restaurant</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Retail/Service</td>
<td></td>
<td></td>
</tr>
<tr>
<td>School</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Warehouse</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

- Furnace
- Baseboard / Wall or Unit Heater
- Ductless Mini-Split Heat Pump
- Central Air Source Heat Pump
- Boiler
- Geothermal Heat Pump
- Fireplace or Stove
- Other

% of Conditioned Floor Space
4. Achievable Potential

- **Achievable Potential** is Always Less Than **Technical Potential**
  - Less than 100% adoption assumed (we use 85% to 95%)
  - Assumes not all customers will accept the efficient unit, even if offered at no cost to the consumer
  - Reference: Hood River Project in the 80’s

- **Achievability Assumes**:
  - Utility system can pay all cost (if measure is cost-effective based on power system benefits)
  - Many efficiency requirements can be embedded in codes/standards
  - 20-year time frame

- **Annual Achievability is limited by “Ramp Rates”**
  - Not all energy efficiency can be acquired immediately
  - Identifies the pace of EE adoption over time
  - Developed through advisory committee input
Achievability is first capped at 85% to 95% of total technical potential, and then ramp rates are applied.

Data Sources that inform Ramp Rates:

- Past program performance
- Cost of measure
- Consumer acceptance
- Non-energy impacts
- Physical availability of equipment
- Training & education requirements
- Advisory committee discussions
Achievable Potential Supply Curve: Add Up Each Measure Cost and Savings

-2500 aMW of potential is available at <$30/MWh
-4000 aMW of potential is available at <$70/MWh
Annual Conservation Resource Availability
(Includes the impact of ramp rates and achievability limits)
Units by Regional Zone/BA

- For the Ninth Plan, we will need to disaggregate the units by BA
  - Instead of one supply curve for the region, we will develop 17 different supply curves
- Locational differences, e.g., weather, T&D deferral
Hand-off to OptGen - Resource Strategy

- Supply curve: amount (aMW) by levelized cost bin ($/MWh)
- Peak impacts: hourly energy shape

Modeling and resource strategy development take place after the handoff to OptGen
5. Economic Achievable Potential

The Economic Potential is determined by the resource strategy analysis

- Council determines this potential based on analytical results and judgment
- Results in the regional EE targets/goals

After the regional EE target is established, we need a method for determining if new measures are cost-effective relative to the Plan results

- RTF continues to develop measures
- BPA and utility EE programs
EE Cost-Effectiveness – Always Relative to Alternative Resources From the Plan

Based on Resource Strategy from the Power Plan

**Benefits**
- Avoided Energy
- Avoided Capacity
- Regional Act Credit
- Non-Energy Benefits

**Costs**
- Capital and Labor
- Annual O&M*
- Program Admin
- Non-Energy Costs

Additional benefits may include: Other fuel benefits, avoided periodic replacement, risk mitigation

Additional costs may include: Other fuel costs, periodic replacement

If benefits > costs, measure is cost effective relative to the Plan findings

The Avoided Energy, Avoided Capacity, and Risk Mitigation benefits are determined based on resource strategy results
An Example: Res Heat Pump Water Heater (HPWH)

HPWH Costs and Benefits

- **Capital Cost**: $800
- **Program Admin Costs**: $400
- **Power Act Credit**: $200
- **Deferred Generation**: $600
- **Avoided T&D**: $1,000
- **Electric Energy Savings**: $1,200

Present Value of Costs and Benefits (2016$)

**Note**: Tier 4 efficiency HPWH in a garage, heating zone 1, using 2021 Plan inputs.
What is new for the upcoming Ninth Plan?

• Expanding our work to 17 zones/BAs
• Research is underway for:
  – Data centers
  – Strategic energy management
  – Ag sector EE
  – Distribution efficiency, including reconductoring
  – Administrative/overhead costs of EE
  – Water Supply and Wastewater Treatment EE
  – Motor measures
  – HVAC and Heat pumps
• Seeking new emerging technologies that are “reliable and available”
  – Ozone laundry
  – UV and Ultrasonic dryers
  – Micro heat pumps (VS window heat pump)
  – Industrial High Temperature Heat pumps
  – Etc.
Questions/Comments