NW Natural asked E3 to evaluate scenarios to achieve deep decarbonization in PNW

Oregon and Washington are taking steps to reduce emissions, but exactly how deep decarbonization will be achieved remains uncertain. This study evaluates different strategies to achieve an 80% reduction in greenhouse gases (GHGs), aka deep decarbonization by 2050.
**OUR WHY**

We believe there is a climate imperative

NW Natural has an important role to play in a smart and affordable Northwest climate strategy

**OUR OBJECTIVES:**

1. Long-term goal of deep decarbonization that leaves no one behind.
2. Reduction opportunities take advantage of the infrastructure in place.
3. Lead the way on natural gas innovations and share broadly for larger impact.
WHAT IS OUR STARTING POINT?

NW Natural’s system is highly efficient.

- Our system is one of the most modern in the U.S., thanks to aggressive pipe replacement
- On the coldest mornings of the year, natural gas meets 90% of our customers’ household energy needs
- The gas used by our residential and commercial customers accounts for 5% of the state’s annual GHG emissions
LOW CARBON PATHWAY HELPING REGION ACHIEVE CLIMATE GOALS

<table>
<thead>
<tr>
<th>OUR PRODUCT</th>
<th>OUR CUSTOMERS</th>
<th>TRANSPORTATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>REDUCE CARBON INTENSITY</td>
<td>REDUCE AND OFFSET CONSUMPTION</td>
<td>REPLACE MORE CARBON INTENSIVE FUELS</td>
</tr>
<tr>
<td>NW NATURAL OPERATIONS</td>
<td>ENERGY EFFICIENCY</td>
<td>CNG AND RNG SERVE TRASH TRUCKS AND RETURN-TO-BASE FLEETS</td>
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<tr>
<td>UPSTREAM METHANE REDUCTION</td>
<td>SMART ENERGY (voluntary offsets)</td>
<td></td>
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<tr>
<td>RENEWABLE NATURAL GAS</td>
<td>GAS + RENEWABLE HYBRID EQUIPMENT (solar thermal)</td>
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To achieve deep decarbonization, broad changes will be required across the economy:

- Vehicle Electrification
- Aggressive Energy Efficiency
- Technological Innovation
- Development of biofuels

Builds upon recent similar studies:

- Examines energy needs on the coldest days of the years, especially critical for utility system planning
- The role the direct use of gas plays in our region’s energy portfolio

All pathway scenarios use natural gas:

- The key difference is how gas is utilized (peaker plants vs. direct use)
Significant mitigation efforts are required across all sectors in all scenarios

All scenarios include some measures from each pillar

**Energy efficiency & conservation**
- Smart-growth driven VMT reductions
- Whole-home retrofits & new construction codes
- Electric heat pumps displacing resistance heat

**Electrification**
- Electrification of industry OR buildings
- Electrification of passenger vehicles
- Electrification of trucks and freight transportation

**Low-Carbon Energy**
- Low-carbon electricity
- Low-carbon biofuels
- Potentially renewably produced hydrogen

**Reduce non-combustion GHGs**
- Methane reductions
- Replacement of high global warming potential gases
- Industry process emissions reductions
Scenarios vary based on level of electrification, low-carbon fuels & renewable electricity

<table>
<thead>
<tr>
<th>2050 metrics</th>
<th>Gas Furnaces Scenario</th>
<th>Natural Gas Heat Pumps Scenario</th>
<th>Electric Heat Pumps Scenario</th>
<th>Cold Climate Heat Pumps Scenario</th>
</tr>
</thead>
<tbody>
<tr>
<td>Share of natural gas space- and water heating electrified</td>
<td>0%</td>
<td>0%</td>
<td>96%</td>
<td>96%</td>
</tr>
<tr>
<td>Industry electrification (fuel-switching % of total industrial energy)</td>
<td>30%</td>
<td>30%</td>
<td>5%</td>
<td>5%</td>
</tr>
<tr>
<td>Zero-carbon electricity</td>
<td>97%</td>
<td>97%</td>
<td>95%</td>
<td>95%</td>
</tr>
<tr>
<td>Share of available biofuels used</td>
<td>100%</td>
<td>97%</td>
<td>73%</td>
<td>73%</td>
</tr>
<tr>
<td>Hydrogen mix in pipeline</td>
<td>7%</td>
<td>0%</td>
<td>0%</td>
<td>0%</td>
</tr>
</tbody>
</table>
By 2050, incremental gas capacity is 5-10 times higher in electric heat pump scenarios compared to gas scenarios

+ Electric scenarios include 17 – 37 GW of new gas capacity by 2050 to serve winter space heating peaks (at 1-in-10 winter temperatures)

+ Additional electric sector costs are $3B - $9.5B in 2050 in electric heat pump scenarios, relative to gas heat pump scenario

+ Energy storage could displace some of this new gas capacity, but more detailed reliability analysis of storage as a winter peak solution is needed

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**2050 incremental gas capacity (GW)**

- **Existing Hydro Capacity**
- **New Natural Gas**

**2050 electricity sector cost relative to Reference ($ Billions)**

- **Gas HP**
- **Gas Furnaces**
- **Cold-Climate Electric HP**
- **Electric HP**
Economy-wide scenario costs in 2050 are similar for three scenarios, electric heat pump scenario is highest cost due to winter peak capacity need.

+ **The 2050 economy-wide scenario costs range from $3 - $16 billion/year in 2050, relative to Reference scenario**
  - Equivalent to ~1% of projected 2050 regional Gross Domestic Product

+ **Cost forecasts are uncertain and sensitive to assumptions about technology costs for building heat equipment and biofuel prices**

**Total Annual Scenario Cost in 2050**
($ Billions, incremental to Reference)
There are multiple pathways in the Pacific Northwest to achieve deep decarbonization with different strategies in buildings; Each faces significant challenges and risks

Maintaining gas heat in buildings requires:

- RD&D and commercialization of advanced renewable natural gas (also used in the electrification scenarios but RNG is less pivotal in those cases)
- Either natural gas heat pumps or hydrogen blended into the pipeline
- Additional sources of GHG mitigation in other sectors (e.g. industrial electrification)

Retrofitting to electric heat in buildings requires:

- Rapid consumer adoption, major building retrofits, and market transformation of cold climate electric heat pumps
- Expansion of the electricity system to accommodate winter peak demand, e.g. new gas peaking power plants and/or storage. Ensuring winter peak reliability is a key challenge
Northwest electric demands are already at their highest in the winter; this means that new electric space heating loads require additional peak capacity.

Winter peak needs continue to be met mostly with gas in all of the decarbonization scenarios through 2050, with:

- Gas-fired electric generation (could be partly displaced by energy storage, though reliability of storage is less certain), or
- Direct use of gas

Widespread deployment of electric heat pumps leads to 5 – 10 times increase (17,000 – 37,000 MW) in winter peak electricity demands, relative to gas scenarios:

- This increase is compared to the entire hydroelectric system of ~33,000 MW

Total economy-wide scenario costs in 2050 are similar between scenarios given uncertainties, with the exception of the non-cold climate electric heat pump scenario. That scenario is the most expensive due to the cost of serving winter peak demand.
RESOURCES

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Pacific Northwest Pathways to 2050
Pathways summary
www.lesswecan.com

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