PNWER
Utility of the Future

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NW NATURAL CUSTOMERS: 8% OF OREGON’S GHG EMISSIONS

Source: State of Oregon DEQ In-Boundary GHG Inventory 2015 preliminary data

Residential, Commercial, and Industrial emissions included are those that are not from electricity or natural gas use (trash, other waste, etc.).

NW Natural analysis, not for investment purposes.
RESIDENTIAL ENERGY USE

Pacific Northwest Residential Annual Energy Use*

- **Space Heating**: 40%
- **Water Heating**: 19%
- **Appliances, Electronics, Lighting, and Other**: 40%
- **Air Conditioning**: 1%

Share of Residential Square Footage in NWN Service Area with Natural Gas Service**

- **Natural Gas Service**: 74%
- **No Natural Gas Service**: 26%

* Data from US Department of Energy 2009 Residential Energy Consumption Survey; energy use for electric or gas.

**Data from 2014 Residential Sites Database; Residences on or near NW Natural main service

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SPACE AND WATER HEATING: 90% OF PEAK HOUR ENERGY USE

PNW Household Usage: Annual vs. Peak Hour

Annual Usage

- Appliances, Electronics, and Lighting: 40%
- Space Heating: 40%
- Water Heating: 19%
- Air Conditioning: 1%

Winter Peak Hour Usage

- Other: 9%
- Water Heating: 6%
- Space Heating: 85%

*Based on kWh usage of a home with a 9.0 HSPF heat pump and standard electric water heater for the 7am hour in the winter with a temperature of 7°F.

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DIRECT USE TAKEAWAYS

NW Natural’s system is a highly efficient way to serve winter peak energy needs.

- **Heats 74%** of residential square footage in the areas we serve
- **Provides 90%** of peak day energy needs for our residential space and water heat customers
- **Serves 60%** of total peak hour energy use of buildings in the areas we serve
- **NW Natural’s emissions account for 8%** of state’s total carbon emissions

For perspective; to serve the current gas peak load with electricity, the Northwest’s winter peak electric load would roughly double (increase by ~25GW).

- Assumes comprehensive adoption of high efficiency heat pumps for space and water heating.
- Assuming adoption of today’s commonly purchased heat pumps, the electric winter peak load would roughly triple (increase by ~50GW).

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LOWER EMITTING GAS

Relative Life-Cycle (LC) Natural Gas Carbon Intensities

- Business as Usual
- Methane Emission Reduction NG
- Renewable Natural Gas (RNG)
- Renewable Electricity Storage- Power to Gas
- Electricity- Solar Photovoltaic
- Electricity- Wind

Lbs CO₂ Equivalent per mmBtu

Life-Cycle (LC) Conventional NG
Reduced Methane Emission NG (LC)
Renewable NG (RNG)-Anaerobic Digestion
Renewable NG (RNG)-Biomass Gasification
Renewable Electricity Storage- Power to Gas

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TRANSPORTATION

Near Zero Emission (NZE) Natural Gas Vehicles (NGVs): Cleanest available technology for heavy duty applications.

• Transportation is the largest contributor to emissions and growing.
• In Oregon, nearly 50% of NOx emissions (air pollution) in the transportation sector come from heavy duty vehicles.
• Heavy duty vehicles account for the bulk of transportation emissions and air quality impacts.
• There are limited electric alternatives for heavy-duty use.
• New NGVs emit 90% less smog-forming pollutants than the cleanest diesel.
• NGV’s deliver about a 20% reduction in carbon emissions
• Allows for drop-in renewable natural gas - provides for 80% or more reduction in GHGs.

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POWER TO GAS (P2G)

EXCESS RENEWABLE GENERATION >> ELECTROLYSIS >> $H_2$ >> RENEWABLE STORAGE ON DISTRIBUTION SYSTEM

Viable Seasonal Renewable Storage Solution

- Create hydrogen and blend up to 15% into the natural gas pipeline system without any impacts on end-use equipment, as we work toward 100% hydrogen utilization.
ENERGY STORAGE TECHNOLOGIES

Power-to-gas is efficient | long term | low energy cost

Source: ITM Power plc
Questions