

EXECUTIVE SUMMARY

NW Natural is committed to a low-carbon energy future and our role in reducing greenhouse gas emissions. This document illustrates the potential for us to achieve carbon neutrality by 2050 for the energy services we provide to the roughly 2.5 million Northwest residents we serve every day.

So how do we ramp up our existing decarbonization efforts with a goal to achieve carbon neutrality by mid-century?

We start by re-assessing how we will transition our current energy deliveries to a target of carbon neutrality while serving future growth projected for the region. That begins with more aggressive energy efficiency actions, coupled with new equipment technologies that reduce energy consumption while maintaining safety, reliability, and customer satisfaction.

From there we look for lower-carbon energy sources to displace our conventional natural gas supplies. These include renewable natural gas captured and converted from organic waste, as well as clean hydrogen that can be distributed in a dedicated pipe network, blended at certain amounts directly into our system or combined with waste carbon dioxide and converted to synthetic natural gas—all providing climate benefits similar to wind and solar energy. Finally, we look to emerging models for deep carbon reductions that align with our skills and services, such as carbon capture, utilization and sequestration (CCUS).

Over the past several years, we've taken several actions that have made this vision of a carbon neutral future possible. In 2016 we established a Low Carbon Pathway as a cornerstone of the company's strategic plan, setting a voluntary goal of 30% carbon savings by 2035 (using a 2015 customer and company operations baseline). Most recently, this includes investments to develop and procure renewable natural gas, made possible by Oregon's landmark SB 98 (2019) legislation—a first-of-its kind bill.

We've formed partnerships with like-minded utilities to facilitate the adoption of clean hydrogen into our system and supplies. And we're working across the value chain on market transformation of advanced heating equipment such as natural gas-fired heat pumps that can achieve better than 100% efficiency at any temperature, or hybrid heating systems that combine electric heat pumps with a gas furnace for optimal performance.

This report evaluates scenarios using a range of options by which we can realize our vision for a carbon neutral gas utility.

Key Decarbonization Principles

- **Helping customers use less is the fastest and cheapest way to reduce emissions.** We are dedicated to continuing to help customers conserve energy, save money, and reduce emissions through more efficient buildings and equipment.
- **All forms of renewable energy are needed in a balanced, low-carbon future.** We are committed to displacing conventional natural gas over time with renewable natural gas—gases produced from organic waste streams—and clean hydrogen.
- **Communities served by the gas system have greater energy reliability.** We need a dual energy system—gas and electric—to handle peak energy loads and to prepare for a future with potentially more extreme weather events. Homes and businesses with gas service can have energy even when the power is out, providing a resiliency benefit for our communities.
- **Leveraging our existing modern system in new ways is our priority.** We are seeking paths that ensure a renewable energy future without undermining long-term affordability and dependability.
- **Families and businesses should have a choice of energy options to meet their needs.** Energy system diversification and competition provides the best opportunity for accelerated innovation.
- **We must drive toward carbon neutrality in a way that leaves no one behind.** We are committed to pursuing policies and approaches that provide fair and equitable support for our most vulnerable customers.

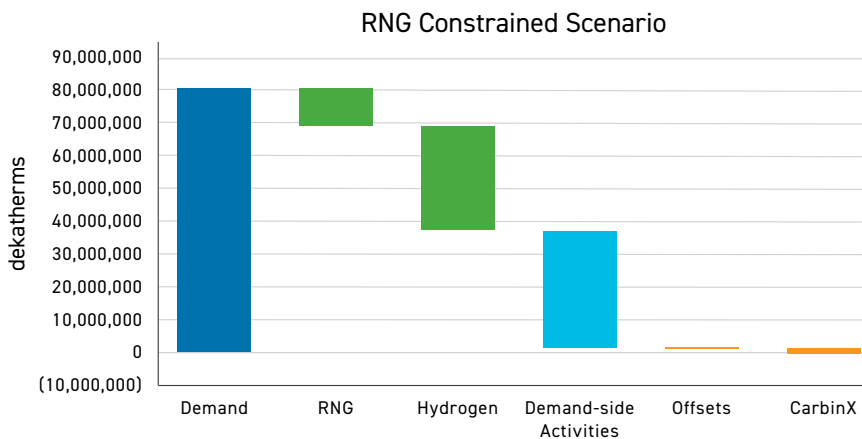
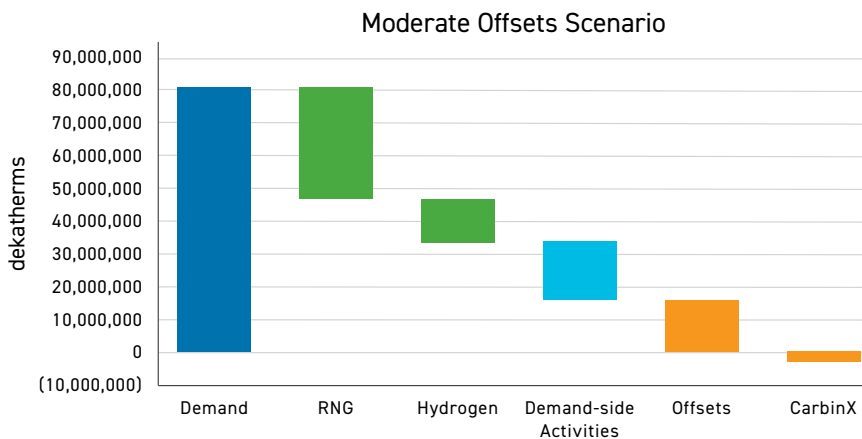
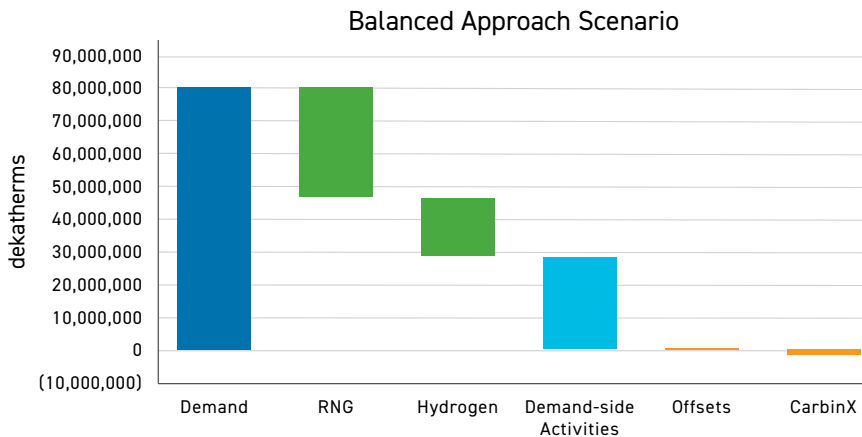
Working with internal teams of subject matter experts and resource planners, we have developed three scenarios that demonstrate it's possible to achieve the goal using different views of the future. All three draw on proven approaches to emissions reductions that are already technically viable. In some instances, such as energy efficiency programs or renewable natural gas procurement, these efforts are in progress at NW Natural now. For some others, such as clean hydrogen or carbon capture, we incorporate lessons from early adopters in Europe and Canada, where favorable policies and market conditions have enabled progress on those innovations sooner.

- Scenario 1 - Balanced Approach:** Includes a balanced mix of renewable supply and demand-side measures and does not employ offsets in 2050
- Scenario 2 - Moderate Offsets:** Utilizes offsets in conjunction with a mix of renewable supply and demand-side activities
- Scenario 3 - RNG Constrained:** Utilizes far less RNG and no offsets in 2050 while emphasizing demand-side activities and clean hydrogen

Our 2020 sales deliveries total nearly 80,000,000 dekatherms of conventional natural gas. To decarbonize, those supplies and the associated GHG emissions must be replaced with carbon neutral alternatives.

Each scenario incorporates the following components: energy efficiency and conservation through building shell improvements, deep retrofits, and advanced heating equipment; lower-carbon fuels such as renewable natural gas and clean hydrogen; technology that extracts carbon alongside natural gas combustion; and verified, quality carbon offsets.

These charts show how we expect these various measures, applied across three distinct scenarios, could achieve carbon neutrality by 2050.



■ Conventional Gas ■ Carbon Neutral Gas
■ Conservation and Efficiency ■ Offsets & Carbon Capture

¹ For a discussion of potential cost implications of decarbonizing the gas system relative to electrification of building heat, see the E3 report Pacific Northwest Pathways to 2050: https://www.ethree.com/wp-content/uploads/2018/11/E3_Pacific_Northwest_Pathways_to_2050.pdf.

Vision 2050 Technologies & Measures

| SUPPLY SIDE MEASURES | | | | |
|---|------|----------------------------|---------------------------|--------------------------|
| | YEAR | BALANCED APPROACH SCENARIO | MODERATE OFFSETS SCENARIO | RNG-CONSTRAINED SCENARIO |
| Decarbonized gas supplies (dekatherms) | 2050 | 52.2M | 47.4M | 35.2M |
| Renewable Natural Gas | | 34.2M | 34.2M | 14M |
| Clean Hydrogen or Clean Hydrogen Derived Synthetic Gas | | 18M | 13.2M | 21.2M |
| DEMAND SIDE MEASURES | | | | |
| Natural gas heat pumps as a percentage of natural gas space heating equipment installed in year | 2025 | 3% | 4% | 3% |
| | 2030 | 17% | 12% | 17% |
| | 2050 | 72% | 55% | 60% |
| Hybrid heating systems as a percentage of natural gas space heating equipment installed in year | 2025 | 9% | 8% | 18% |
| | 2030 | 16% | 8% | 33% |
| | 2050 | 0% | 0% | 40% |
| Natural gas heat pumps for water heating as a percentage of new gas-fired water heating equipment installed in year | 2025 | 7% | 4% | 7% |
| | 2030 | 36% | 15% | 36% |
| | 2050 | 91% | 65% | 91% |
| Industrial energy efficiency increase (percentage) beyond current Energy Trust of Oregon expectations | 2050 | 23% | 13% | 30% |
| Percentage reduction in building heating requirements, due to building shell improvements | 2050 | 21% | 13% | 30% |
| CARBON OFFSETS AND CARBON CAPTURE | | | | |
| Certified carbon offsets used to account for conventional gas supply not yet decarbonized | 2025 | 4.2% | 7.1% | 2.7% |
| | 2030 | 7.5% | 11% | 8% |
| | 2050 | 0% | 25% | 0% |
| Natural gas supplies decarbonized with CARBiN-X carbon capture equipment (dekatherms) | 2025 | 38k | 37k | 38k |
| | 2030 | 0.8M | 0.8M | 0.8M |
| | 2050 | 2.3M | 2.8M | 1.7M |

This document illustrates a breadth of options for reducing emissions. It also makes projections nearly 30 years into the future and as such, is limited by future uncertainties around economics, policies, and innovations. And while we've relied on the same types of models and expertise that our resource planning team uses to develop our integrated resource plan, scenarios presented here have not been cost-optimized. So, while we presume that elements such as renewable natural gas supplies or energy efficiency savings acquired here will be done in the most cost-effective manner, we do not present any single pathway as a least-cost option.¹

We do believe, however, that our Vision 2050 provides an optimized approach to our shared energy future. Two energy systems, carrying renewable electrons along wires and renewable and clean molecules in pipes, provides greater resilience, reduces risks, and limits cost impacts for energy users. A concerted effort to decarbonize the gas system alongside the electric system offers synergies in meeting peak demands, redundancy, and long-term storage needs.

Through this document our intent is to show that it's possible and that we are committed to pursuing that future.

¹ For a discussion of potential cost implications of decarbonizing the gas system relative to electrification of building heat, see the E3 report Pacific Northwest Pathways to 2050: https://www.ethree.com/wp-content/uploads/2018/11/E3_Pacific_Northwest_Pathways_to_2050.pdf.