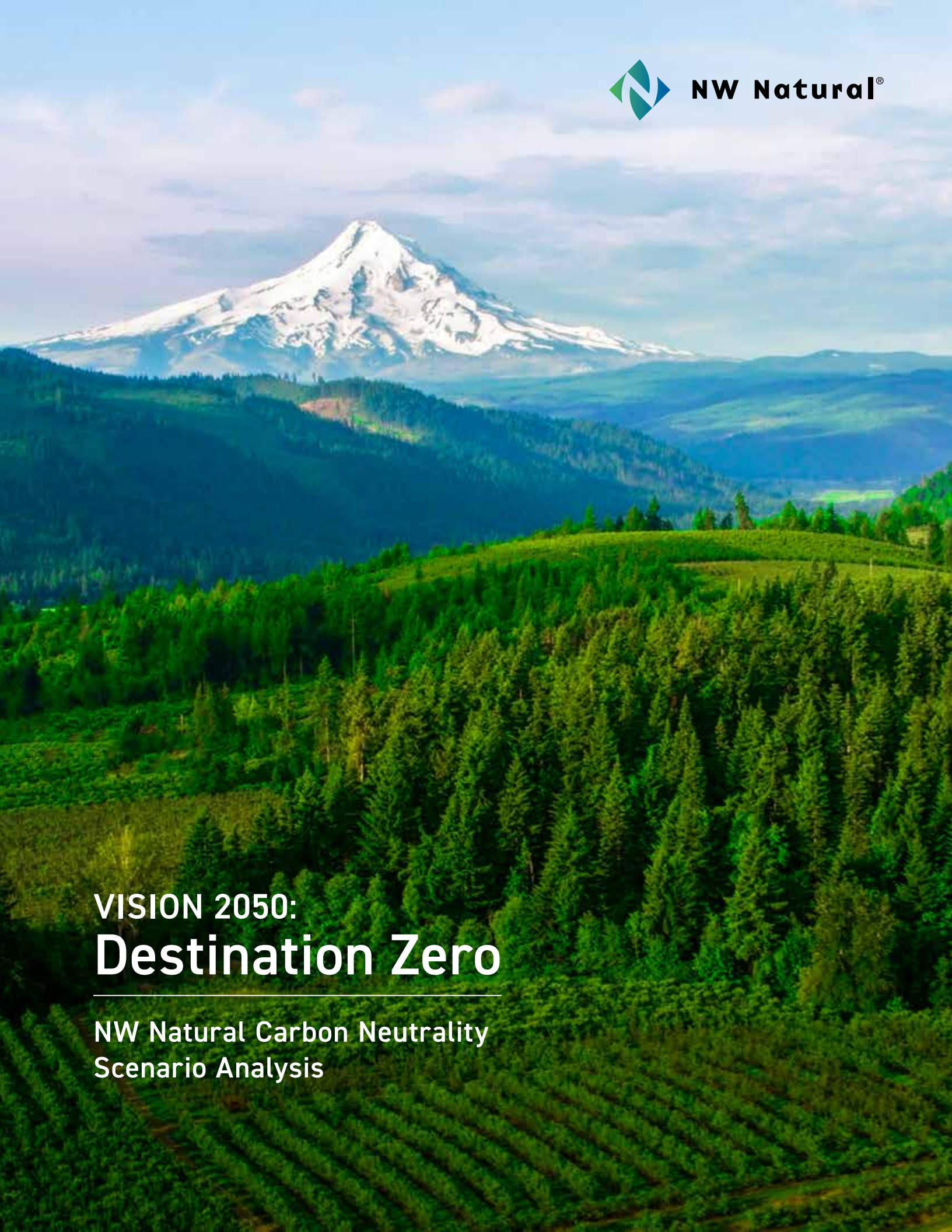
NW Natural®
VISION 2050:
Destination Zero
NW Natural Carbon Neutrality
Scenario Analysis

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Corporate Profile

NW Natural, owned by NW Natural Holdings (NYSE: NWN), was established in 1859 and is the largest natural gas utility in the Pacific Northwest.

Letter from Our CEO

At NW Natural, we are engaged on multiple fronts to reduce emissions.

The Low Carbon Pathway we launched in 2016 began our planning for renewable energy in our pipeline. In 2019, we commissioned Energy+Environmental Economics to conduct a deep decarbonization study designed to achieve the Paris Climate Agreement emission reduction targets by 2050, with the results showing how it can be done using NW Natural's system.

This Destination Zero report is the next evolution for us. It provides in-depth scenario analysis incorporating advancements that leverage our system for more holistic, economy-wide approaches to greenhouse gas reductions.

NW Natural is a 162-year-old company that has evolved many times since 1859 to meet the essential energy needs of our region. We are committed to implementing climate solutions that work for our environment, our customers, and our communities. The renewable supply is growing, the necessary technology exists, and our modern storage and delivery system is ready.

We believe the best way to realize the most promising energy future is through a collaborative effort using a broad spectrum of solutions.

We are eager to share this important work and our vision forward with key stakeholders and community partners, recognizing it will continue to change. We embrace this next evolution and look forward to playing a critical role in the Northwest's energy transition.

David H. Anderson
President and Chief Executive Officer

Key Takeaways

- There are numerous options and solutions for achieving carbon neutrality by 2050—using known technologies.
- While the path exists today, enabling policies that use joint gas and electric system planning and encourage renewable development for the pipeline can help accelerate reductions.
- Using our tight, modern pipeline system and long-duration storage can better enable a faster, more affordable and more resilient energy transition.

Destination Zero:

Our vision for carbon neutrality

A decarbonizing network:

- Renewable Natural Gas
- Hydrogen
- Waste CO_2
- Renewable Electricity

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.

[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

	YEAR	BALANCED APPROACH SCENARIO	MODERATE OFFSETS SCENARIO	RNG-CONSTRAINED SCENARIO
SUPPLY SIDE MEASURES				
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.

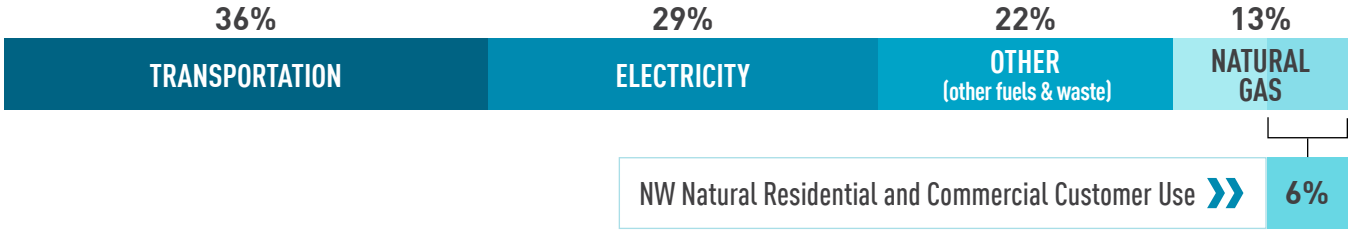
[1] For a discussion of potential cost implications of decarbonizing the gas system relative to electrification of building heat, see the E3 report Pacific Northwest Pathways to 2050: https://www.ethree.com/wp-content/uploads/2018/11/E3_Pacific_Northwest_Pathways_to_2050.pdf.

WHERE WE ARE TODAY

We take pride in delivering reliable, safe and affordable energy in a way that makes us industry leaders. Per J.D. Power's annual independent survey, our customers have given NW Natural a top-2 score in customer satisfaction for large gas utilities in the west for 17 years running.

Natural gas is today's cleanest energy option to meet our region's biggest energy needs reliably and affordably—and we're proud to be providing this essential resource to the communities we serve. On the coldest winter days—those "peak" times for gas and electric demand—NW Natural is providing 90% of the energy our residential space and water heating customers need. Yet the use of the gas we purchase for customers accounts for only 6% of Oregon greenhouse gas emissions. We're working to reduce that number even further.

OREGON GREENHOUSE GAS EMISSIONS BY SECTOR



Source: Oregon DEQ In-Boundary GHG Inventory preliminary 2019 data.

We've begun to decarbonize the energy we deliver by focusing on a shift from conventional supplies to renewables.

Renewable natural gas (RNG) is produced from organic materials like food, agricultural and forestry waste, landfills and wastewater. With recent advancements in technology, the gases from those waste streams can now be captured, cleaned up and added into our pipeline network to serve homes and businesses.

This turns the problem of waste into a powerful climate solution using our pipeline network already in place. Just as the electric grid's transmission lines can deliver electricity made from natural gas, coal, wind or solar, our pipelines can deliver natural gas from conventional or renewable sources.

We've begun to acquire RNG on behalf of customers, and have also interconnected new RNG projects onto our system to fuel heavy duty vehicles and displace diesel. Now we're looking for opportunities to deliver the next renewable gas: low-carbon hydrogen, which can be produced in myriad ways to serve multiple industries and end-uses.

Diversified Solutions

Today we are working with cities on their climate action plans and demonstrating the significant role our system plays in meeting energy demands most efficiently and reliably.

During winter peak-demand periods, the direct-use natural gas system[2] in the Northwest delivers nearly twice as much energy as the electric system, which is also highly dependent upon natural gas during cold weather events. Homes and businesses can rely on natural gas generators and many fireplaces, cooktops and water heaters even when the power is out.

A diversified energy system is fundamentally stronger, more affordable, and more reliable. The electric and gas systems depend on each other to serve our communities—and each system provides different benefits. This diversification helps us effectively meet different energy needs and will be even more important going forward, as climate change and severe weather pose new risks to reliability and resiliency.

Proposals to "electrify everything" put this reliability at risk without advancing emissions reduction goals any differently than innovatively using the gas system already in place. The Northwest electric grid currently faces serious capacity limitations. Driving more peak demand to the electric system will increase this risk.

For the foreseeable future, cities will either be using natural gas for direct heating in homes and businesses or using even more of it to less efficiently generate electricity in natural gas-fired power plants.

Research conducted by the Oregon firm DHM in NW Natural's service territory shows that Oregon and SW Washington citizens don't want bans on new natural gas hookups.[3] Instead, they want choice and a diversified set of solutions to lower carbon emissions affordably. That includes direct use natural gas and renewable natural gas.

So how do we create a decarbonization strategy that leverages the strengths of the natural gas system to get us to our climate protection goals as fast as possible? By building on the foundation of environmental stewardship we have in place today.

A Systematic Approach to Reducing Emissions

Our legacy of environmental stewardship reflects the values held by us and those we serve here in Oregon and Washington. That legacy is embodied in our innovative and voluntary approaches that go beyond business as usual. These include energy efficiency programs, delivered in partnership with Energy Trust of Oregon, and a rate structure that decouples profits from volumes of gas sold, so as not to incentivize consumption.

We were one of the nation's first gas utilities to complete the modernization of our pipeline network, upgrading older cast iron and bare steel pipelines to more resilient polyethylene and cathodically protected steel. This reduced the potential for fugitive system emissions or corrosion and provides us with an energy system prepared to deliver the low-carbon energy of our future, safely and reliably.

Proactive and voluntary efforts in the past have driven down fugitive emissions associated with gas we procure today as well as the system through which we deliver it.

- NW Natural purchases natural gas from Canada and the Rocky Mountain regions—two of the most stringently regulated (i.e., lower methane leaks) production areas in North America.
- We have developed an emissions screening tool that uses EPA data to prioritize purchases from the lowest emitting producers.
- NW Natural is a founding member of the EPA's Natural Gas STAR Methane Challenge, designed for utilities to share emission-reducing best practices in pipeline construction, maintenance and repair.
- We are also a member of ONE Future, working to promote science-based technology and best practices for dramatically lowering greenhouse gas emissions.
- In 2007, we established a voluntary carbon offset program, Smart Energy, allowing our customers to offset the greenhouse gas emissions associated with use of the product we deliver by investing in methane capture at Northwest dairies. Since then, our customers have funded the equivalent of 1.5 million metric tons of carbon dioxide offsets.

NW Natural's Pipeline Replacement and Modernization

In the 1980s, NW Natural worked with our public utility commissions to proactively create a pipeline replacement program, and by 2015 the company had replaced all its cast iron and bare steel pipe. Today we operate one of the tightest, most modern natural gas systems in the nation.

An Environmental Defense Fund study led by Washington State University found that methane emissions on our system were 90% lower than EPA assumptions at the time, with more than 99.9% of natural gas flowing through our system ultimately reaching our customers.[4]

[2] "Direct use" gas is all gas that is not used for electric generation.

[3] DHM survey, October/November 2019.

[4] NW Natural's reporting of fugitive methane emissions from our pipeline network to EPA via Subpart W reporting shows that roughly 0.08% of our total gas deliveries is emitted as fugitive methane from our system.

Continuous Inspection and Monitoring

Completing our pipeline replacement program created a tighter system with fewer leaks and advanced our efforts to distribute natural gas in a safe and environmentally responsible manner. We maintain just over 700 miles of transmission pipelines and approximately 14,000 miles of distribution pipeline, performing preventative maintenance and proactive monitoring, investigating, and repairing potential issues. In 2020, we performed safety inspections on our transmission system at nearly three times the rate required by federal and state regulations, using a combination of direct assessment and technologically advanced inline tools to evaluate the integrity of those transmission pipelines.

Our employees performed approximately 210,000 routine field visits in 2020. We operate a 24/7 emergency hotline so we can immediately dispatch nearby responders if there is a problem.

Learn more about system safety and resilience at NW Natural in our 2020 Environmental, Social and Governance Report: **nwnatural.com/about-us/the-company/sustainability**.

Unmatched Energy Storage Capacity

The issue of energy storage has grown more prominent in recent years, as utilities and grid planners look for ways to store electricity produced from wind and solar resources. Electricity must be used as its generated. In times of system surpluses, those renewable electrons are either sold at deep discounts, or never produced at all due to lack of demand (curtailment). Battery installations offer one way to flex energy availability for short periods, typically by 4-6 hours.

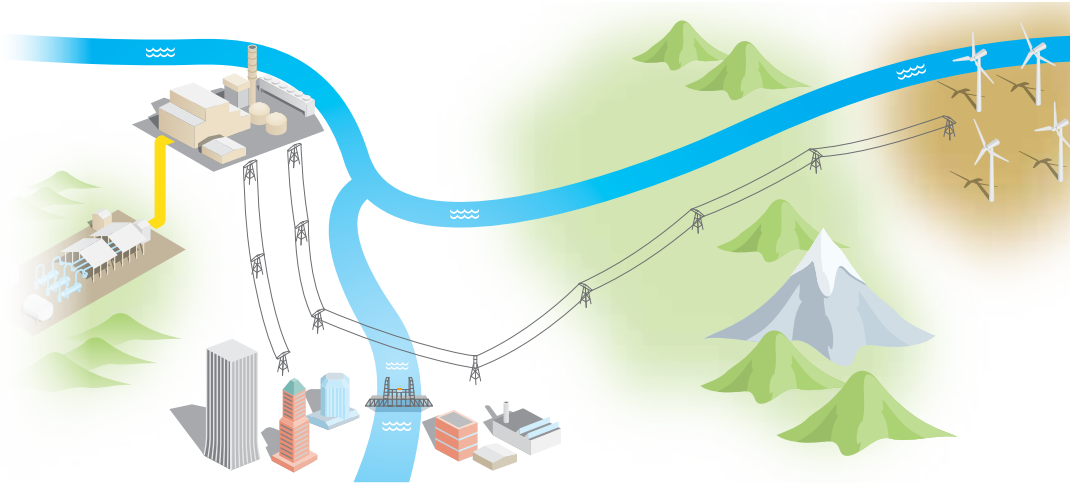
But as electric systems rely more heavily on variable resources like wind, solar and hydropower, the limits and expense of shorter-duration batteries become more apparent—as do the benefits of natural gas infrastructure as a massive, long-term and dispatchable storage resource.

The natural gas grid is built for seasonal variability. Unlike electricity, natural gas can be stored for months or even years after it's produced. From late spring to early fall, system operators fill storage facilities in advance of the winter heating season. This storage provides an additional supply resource that can be used as a hedge against spot market prices or to avoid interstate pipeline constraints during times of peak demand. This storage can be used for low-carbon fuels like renewable natural gas, synthetic gas made from hydrogen and captured carbon dioxide, and potentially even pure hydrogen.

Our facility in Mist, Oregon, provides 20 billion cubic feet of underground storage capacity. That translates into 6 million megawatt hours of renewable storage capability or the equivalent of a $2 trillion dollar battery.[5] This existing storage is already in place, and can deliver on-demand and is primed to store renewable molecules.

GAS STORAGE TO BALANCE RENEWABLE ELECTRICITY

A dedicated 4.1 billion cubic feet reservoir and compressor station at our storage facility in Mist, Oregon, supplies Portland General Electric's Port Westward power plant with "no-notice" natural gas service via a 13-mile pipeline. This project, completed in 2019, gives PGE the flexibility and capacity to manage peak demand and the variability of wind, hydro and solar energy by using natural gas as a reliable resource available to generate electricity when needed.



[5] This figure was developed based on the National Renewable Energy Laboratory's Cost Projections for Utility-Scale Battery Storage report (2019), as well as hydroelectric and battery generation data reported in the U.S. Energy Information Administration's Power Plant Operations Report (EIA-923).

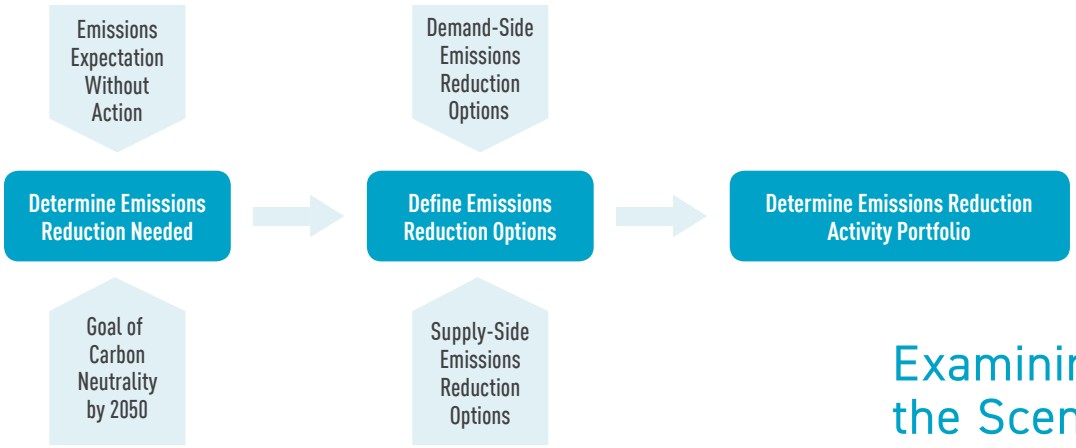
DESTINATION ZERO

Carbon neutrality means having a balance between emitting carbon and absorbing carbon from the atmosphere. To achieve net-zero emissions, all greenhouse gas (GHG) emissions produced must be countered with actions to reduce emissions. While these emissions know no boundaries, the regulations, policies, and markets designed to address them are bounded at every level of government, varying by industry and sector. Efforts to bridge these sectors with policies such as cap and trade, or pricing emissions, have been limited to a few states or regions.

Natural gas utilities such as NW Natural have a unique role in facilitating more holistic approaches to waste reduction and carbon capture that can help society achieve climate goals faster and more effectively.

Modeling Approach: Charting the Paths to 2050

Our approach to developing these models is somewhat like an integrated resource planning exercise. Technical data from third party resources, subject matter experts at NW Natural and industry partners provided forecasts on the various measures, and uncertainties are accounted for through scenario planning.

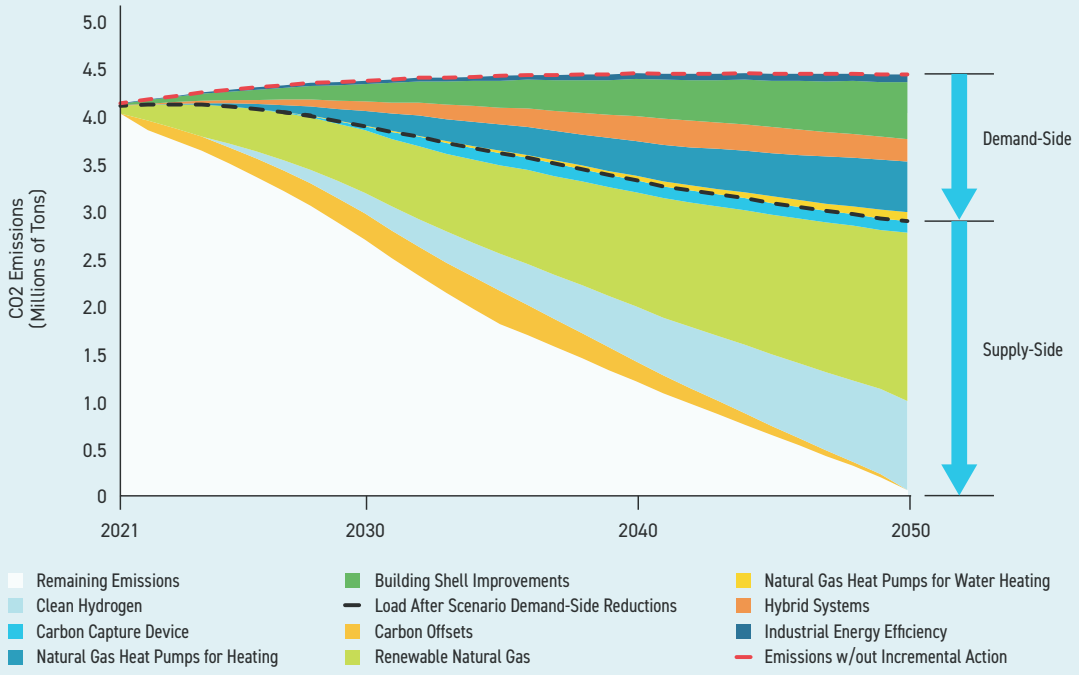


Examining the Scenarios

The following graphs display the breakdown of the emissions reduction activities for the scenarios ▶

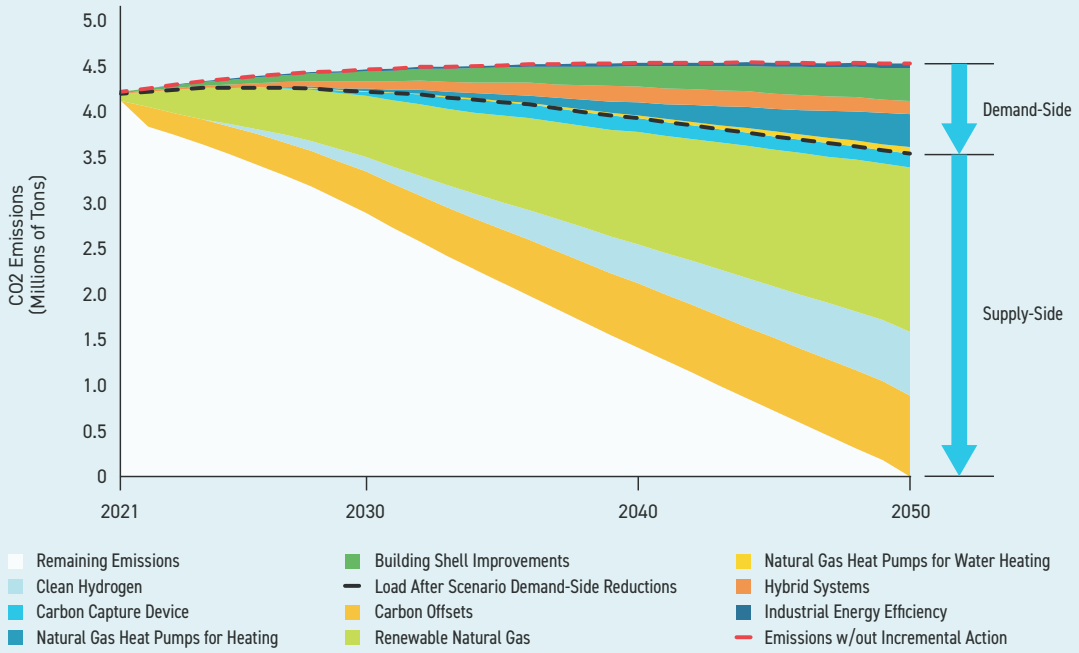
BALANCED APPROACH SCENARIO

The Balanced Approach relies upon a mix of renewable natural gas, clean hydrogen, and energy efficiency measures like natural gas heat pumps, hybrid heating systems, and building shell improvements. This approach achieves carbon neutrality in 2050 without the continued use of carbon offsets.



MODERATE OFFSETS SCENARIO

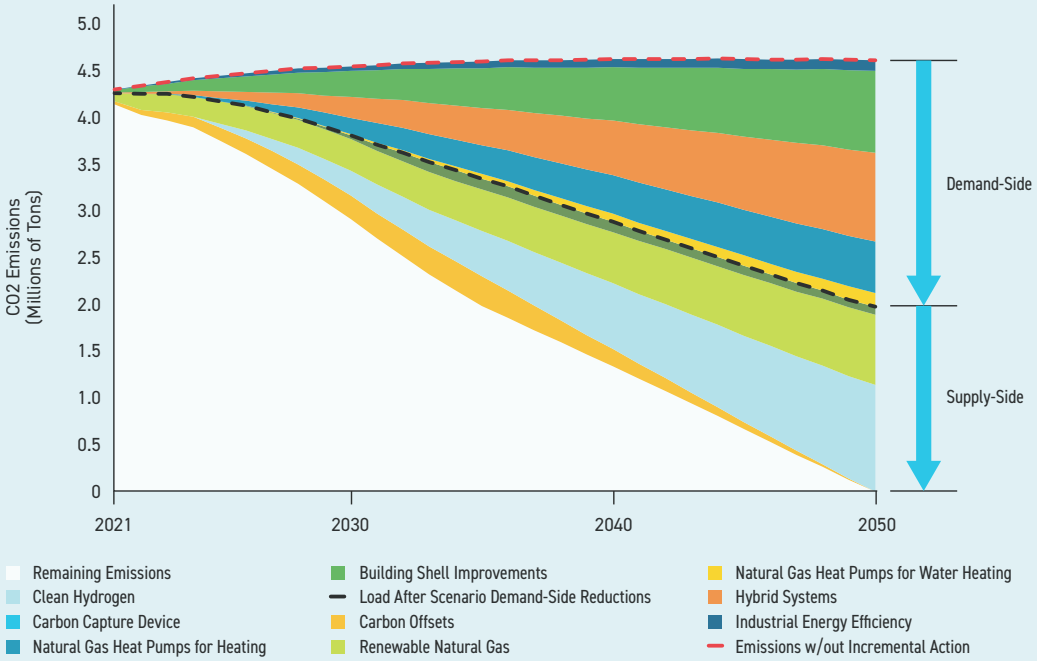
The Moderate Offsets scenario relies less upon the demand side emissions reduction activities than is used in the Balanced scenario, and utilizes a moderate amount of carbon offsets to achieve carbon neutrality in 2050.



RNG CONSTRAINED SCENARIO

A growing body of data shows there is vast potential for renewable natural gas across North America—with innovations increasing RNG supply in real time. But to be conservative, we developed a third scenario that imposes artificial limits on the amount of renewable natural gas that can be procured, capping volumes at around 14 million dekatherms annually, compared to 34 million dekatherms acquired in the Balanced Approach and Moderate Offsets scenarios.

Some of this energy is replaced with clean hydrogen, but this pathway places a greater reliance on demand side measures in 2050 than any other and does not rely upon offsets by midcentury.



Our Customers Use Less Over Time

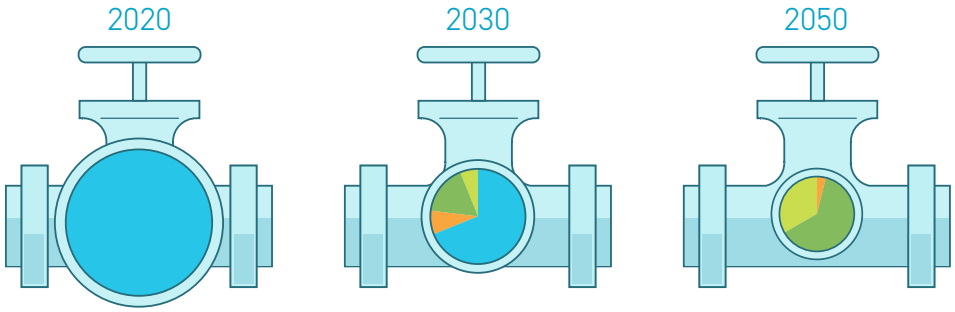
Customers are expected to use less natural gas to meet individual energy needs in both the business-as-usual case and all Vision 2050 scenarios. This reflects ongoing trends in customer usage, which have declined by half since 1970 for residential customers, thanks to improvements in efficiency programs, building codes and appliance standards.

The use declines more substantially in our scenarios due to acceleration of advanced heating equipment, like gas heat pumps or hybrid systems, not yet supported by existing energy efficiency programs, as well as building retrofits and exterior shell improvements, which also reduce heating needs.

Summary of Supply Mix by Scenario

BALANCED APPROACH SCENARIO

- % that is conventional (fossil) gas
- % carbon capture/offsets cancelling out fossil emissions
- % that is renewable natural gas
- % that is clean hydrogen

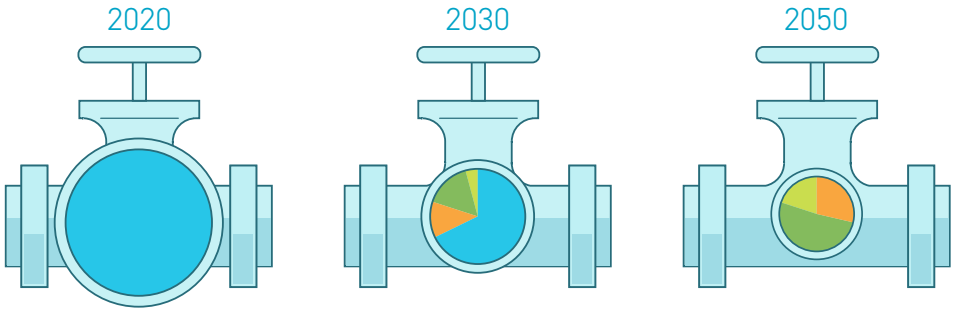


	2020	2030	2050
TOTAL GAS DELIVERIES	80.9M dekatherms	73.6M dekatherms	54.6M dekatherms

2020: 100% conventional (fossil) gas
2030: 69% conventional (fossil) gas, 8% carbon capture/offsets cancelling out fossil emissions, 17% renewable natural gas, 6% clean hydrogen
2050: 0% conventional (fossil) gas, 4% carbon capture/offsets cancelling out fossil emissions, 62% renewable natural gas, 33% clean hydrogen*

* Carbon capture in 2050 begins to sequester biogenic CO_2 emissions from renewables, meaning that the scenario has shifted to a carbon-negative system.

MODERATE OFFSETS SCENARIO

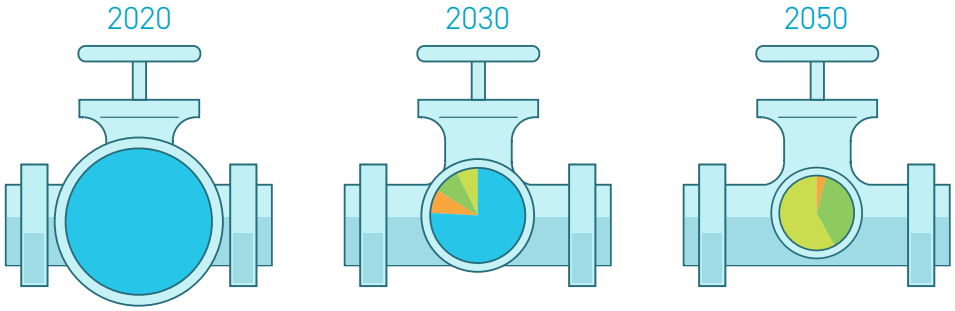


	2020	2030	2050
TOTAL GAS DELIVERIES	80.9M dekatherms	78.2M dekatherms	65.8M dekatherms

2020: 100% conventional (fossil) gas
2030: 68% conventional (fossil) gas, 12% carbon capture/offsets cancelling out fossil emissions, 16% renewable natural gas, 4% clean hydrogen
2050: 0% conventional (fossil) gas, 29% carbon capture/offsets cancelling out fossil emissions, 52% renewable natural gas, 20% clean hydrogen*

* Carbon capture in 2050 begins to sequester biogenic CO_2 emissions from renewables, meaning that the scenario has shifted to a carbon-negative system.

RNG CONSTRAINED SCENARIO



	2020	2030	2050
TOTAL GAS DELIVERIES	80.9M dekatherms	69.3M dekatherms	36.4M dekatherms

2020: 100% conventional (fossil) gas
2030: 76% conventional (fossil) gas, 8% carbon capture/offsets cancelling out fossil emissions, 9% renewable natural gas, 7% clean hydrogen
2050: 0% conventional (fossil) gas, 4% carbon capture/offsets cancelling out fossil emissions, 38% renewable natural gas, 58% clean hydrogen*

* Carbon capture in 2050 begins to sequester biogenic CO_2 emissions from renewables, meaning that the scenario has shifted to a carbon-negative system.

ELEMENTS OF OUR VISION: SUPPLY SIDE

COMPONENTS THAT ENABLE OUR STRATEGY

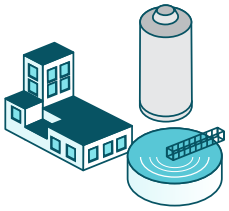
Renewable Natural Gas

Renewable natural gas turns the problem of waste into a powerful climate solution using our pipeline network already in place. RNG is considered carbon neutral because both combustion and lifecycle emissions do not contribute a net-increase in greenhouse gases into the atmosphere. It also improves local air and water quality and offers clean energy jobs for rural communities.

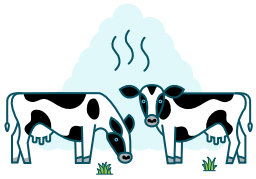
TURNING WASTE INTO RENEWABLE ENERGY

North American sources of organic waste that can be converted to RNG to displace conventional natural gas are vast—and provide similar climate benefits to wind and solar:

MORE THAN
144
MILLION METRIC TONS
of food waste produced each year



17,000
WASTEWATER FACILITIES



19,000
LARGE FARMS AND DAIRIES

4,400
LANDFILLS

Source: Coalition for Renewable Natural Gas

A 2018 report by the Oregon Department of Energy found enough potential in feedstocks for renewable natural gas supply in Oregon to meet the annual usage for every residential gas customer in the state.

GROUNDBREAKING RNG BILL

A coalition of industry, municipal and nonprofit agencies worked together with elected officials in 2019, leading to bipartisan support and passage of Oregon Senate Bill 98 (2019), and the subsequent rulemaking (finished in July 2020), which enables the development and procurement of renewable natural gas and renewable hydrogen for our customers.

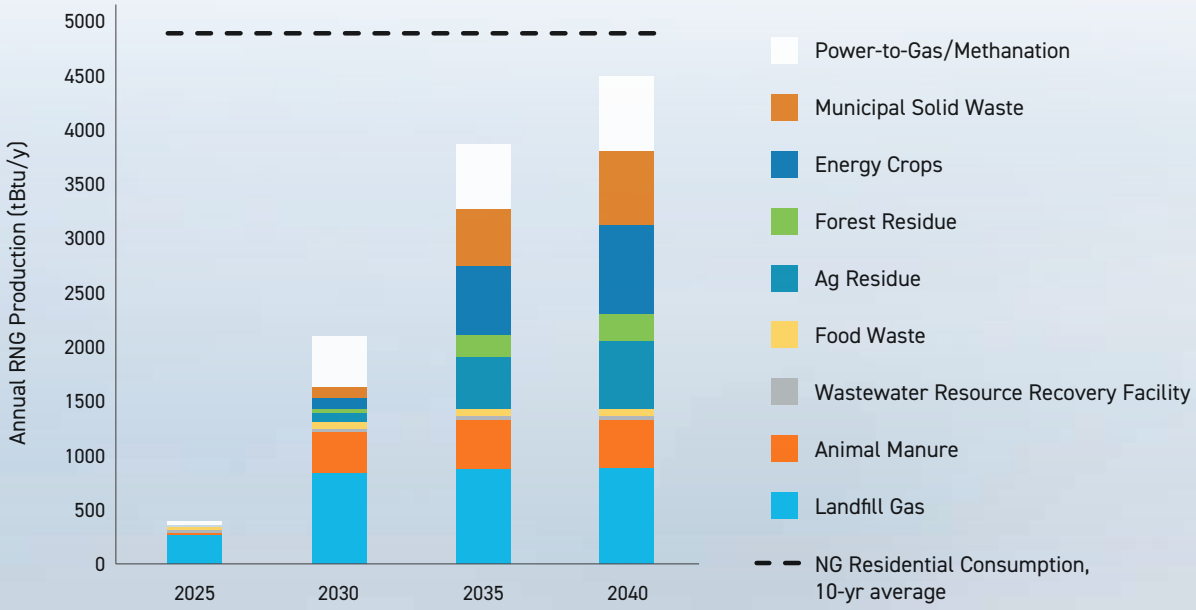
At the national level, RNG technical potential is vastly greater (see chart on page 15).

In the Balanced and Moderate Offsets scenarios, we assumed that in 2040 NW Natural can deliver roughly half of our customers' population-weighted share of national RNG production—23 million dekatherms—for a cost of less than $20/Dth, as estimated by ICF Consulting in the 2019 *Renewable Resources & Emission Reduction Assessment*, the most comprehensive evaluation of U.S. RNG technical potential done to date. Given NW Natural's early participation in the RNG market and differences in regional policy, we consider this to be a conservative estimate of the amount of RNG that we will be able to procure for our customers.

There is rapid development and new advancements driving availability of RNG supply. For instance, a new process called "recuperative thickening" allows for much greater volumes of renewable gas to be produced at a lower overall cost. Another new technology now in use produces RNG from very dry waste streams that had previously been untapped. This is all helping drive new supply to market—from 50 RNG facilities a few years ago to more than 430 now online or in development in North America.

Assessing the availability of RNG is an important consideration in analyzing paths to achieving decarbonization for a natural gas utility. The most comprehensive study to date on the availability of RNG in the United States, *Renewable Sources of Natural Gas: Supply and Emissions Reduction Assessment*, completed by ICF for the American Gas Foundation (2019), was utilized in our analysis to determine the maximum amount of RNG that NW Natural assumed could be available for its customers. Estimates of the annual RNG production of the "High Resource Potential" scenario of the ICF study are shown in the graph below. This estimate of annual RNG production assumes that roughly one third of the total RNG technical resource potential that exists in the United States is produced in 2040.

Potential National Annual RNG Production



RNG PROJECTS ACROSS NORTH AMERICA

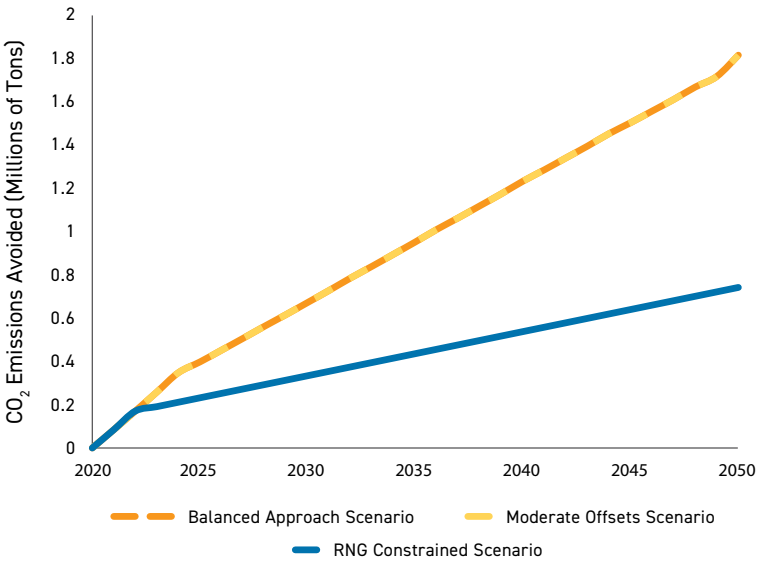
Operational: **189**
Under Construction: **146**
Planned: **95**

TOTAL: **430**

Source: 2021 RNG Coalition

The RNG Constrained scenario limits the amount of RNG available to NW Natural to 70% of our customers' population-weighted share (14 million dekatherms) of national RNG production estimated by ICF in the "Low Resource Potential" scenario. While data suggests this very low assumption of RNG supply is not likely, it was included in the assessment to show carbon neutrality can still be achieved.

Emissions Reductions from Renewable Natural Gas (RNG)



POLICY TO ACCELERATE RENEWABLES FOR THE PIPELINE

Congress started incentivizing wind and solar projects as early as 1992 through the use of tax credits aimed at bending the cost curve of the technologies until the market developed enough to make wind and solar competitive with other conventional sources of energy. This approach is working.

NW Natural has joined other utilities in asking Congress to do the same thing for renewable natural gas and renewable hydrogen to accelerate the development of renewable energy for the pipeline, and make it more affordable for gas customers across the country.

Clean Hydrogen

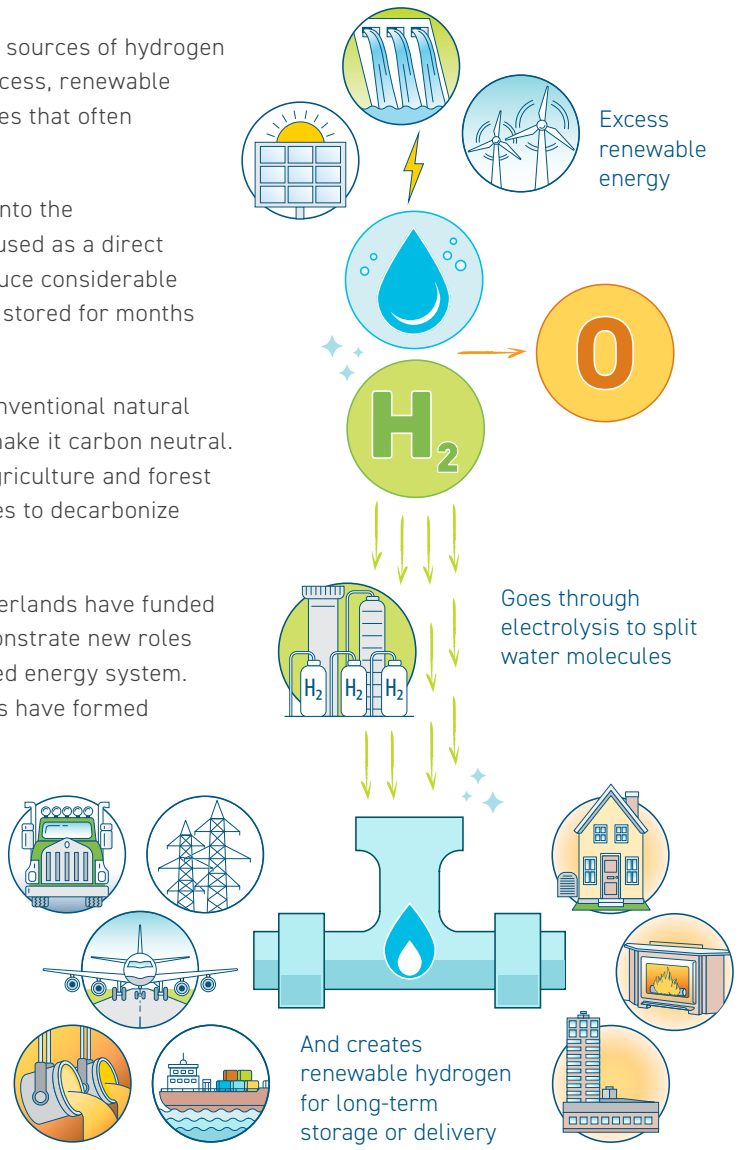
Looking ahead, we see emerging opportunities to bring low-carbon sources of hydrogen into our energy mix at a large scale. Through the power-to-gas process, renewable hydrogen can be created using wind, solar and hydro energy sources that often produce excess power at times of low demand.

Renewable hydrogen can be blended with natural gas for delivery into the existing pipeline system or converted to synthetic natural gas and used as a direct replacement for conventional natural gas. Power-to-gas can introduce considerable flexibility into the energy system since renewable hydrogen can be stored for months and then delivered to provide energy when it's needed.

Clean, low-carbon hydrogen can also be produced by reforming conventional natural gas, paired with carbon capture and storage ("blue hydrogen") to make it carbon neutral. Other options include gasification of biomass feedstocks such as agriculture and forest waste. These various technologies create even greater opportunities to decarbonize heating and industrial process loads across the economy.

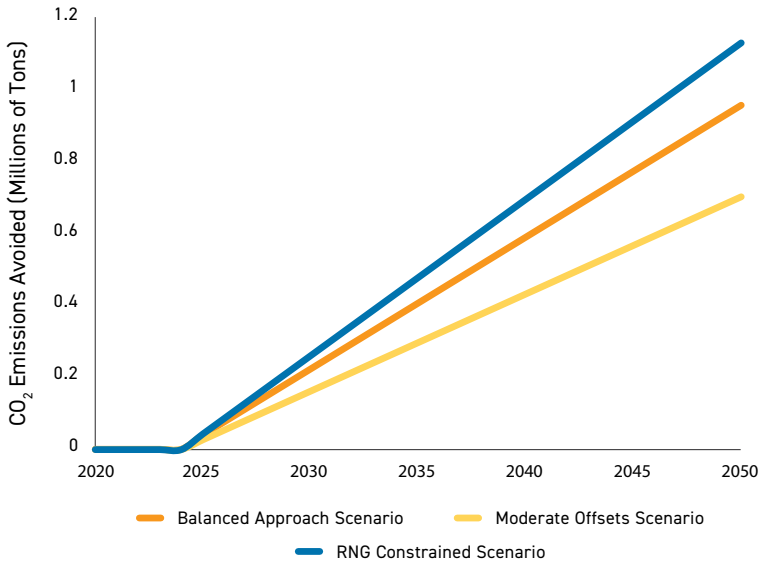
Over the past decade, countries like Germany, France and the Netherlands have funded research, developed policies, and deployed pilot projects that demonstrate new roles for natural gas infrastructure and renewable fuels in a decarbonized energy system. NW Natural and other forward-thinking North American gas utilities have formed working partnerships to apply those lessons at home.

In 2021 we joined the Low-Carbon Resources Initiative, a joint effort by the Electric Power Research Institute and the Gas Technology Institute to accelerate development and demonstration of low- and zero-carbon energy technologies. This five-year initiative, which has surpassed $100 million in funding, is targeting fundamental advances in a variety of low carbon technologies, providing scientific credibility and objectivity to the global decarbonization effort.



Hydrogen pathways can deliver clean energy to multiple industries via pipeline infrastructure

Emissions Reductions from Clean Hydrogen



ELEMENTS OF OUR VISION: DEMAND SIDE

Gas Heat Pumps

Of all the available natural gas technologies, natural gas-powered heat pumps offer the single greatest opportunity to reduce natural gas consumption while maintaining equipment performance in cold weather, a challenge for electric heat pumps.

A 2019 American Gas Foundation report prepared by Enovation Partners indicates that these new technologies have the potential to reduce energy use by 40% or more, while still serving customers' energy needs.

In late 2019, we co-founded the Gas Heat Pump Collaborative with local distribution companies, representing 31% of North American customers, to help reduce carbon through deployment of highly efficient space and water heating equipment.

We are working with nonprofit organizations like the Gas Technology Institute, Low Carbon Resources Initiative, and Northwest Energy Efficiency Alliance to encourage innovation through new products like gas heat pumps and other progressive technologies that use less energy.

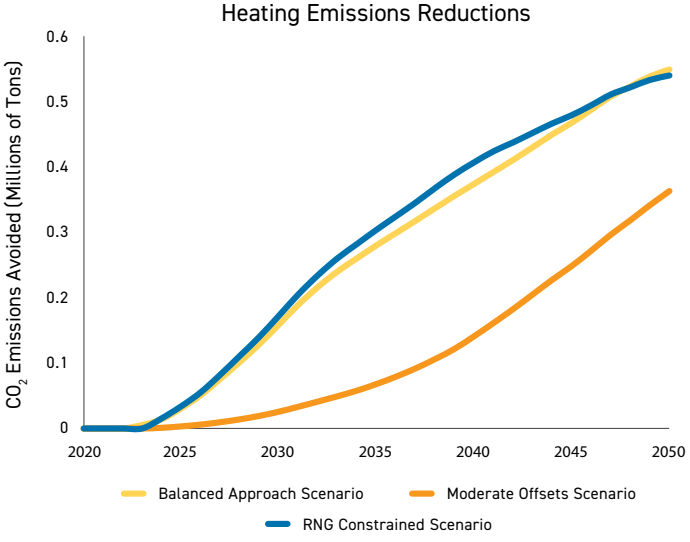
Hybrid Heating Systems (Electric Heat Pump with Gas Furnace)

Hybrid or dual-fuel heating systems rely on an electric heat pump under more moderate temperatures but is supplemented by a natural gas furnace when temperatures fall below a threshold (or a balance point temperature) where the heat pump is unable to serve the building's heating needs effectively or efficiently.

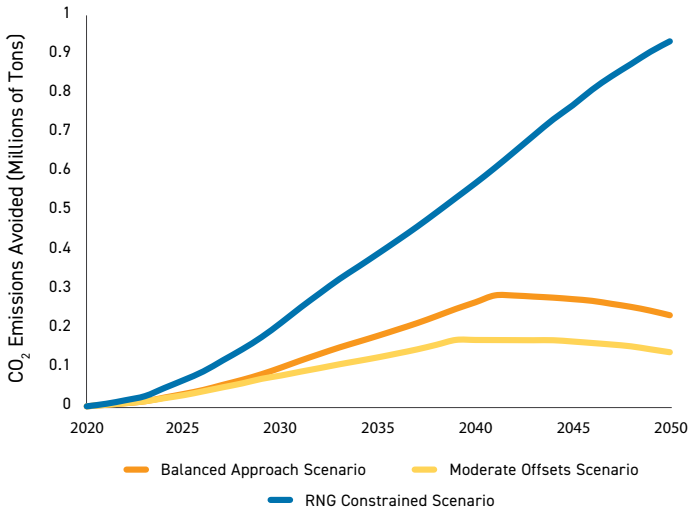
The need for supplemental heating is dependent upon installation practices, the balance point temperature, and climate. For the weather in NW Natural's service territory and the temperatures typically experienced during a heating season, the natural gas component of the hybrid system is estimated to use slightly less than 100 therms per year.

Hybrid systems can provide a cleaner, more comfortable, and cost-effective way to serve colder weather than the typical electric heat pump installation in our region, which relies on inefficient electric resistance as the backup heating source. Hybrid systems also help address the grid capacity shortfall challenges in the Northwest. These hybrid heating systems are

Natural Gas Powered Heat Pump Heating Emissions Reductions



Hybrid Gas-Electric Heating Emissions Reductions



available today in the U.S. and elsewhere. Industry groups and advisers like the Northwest Power Pool and Energy+Environment Economics (E3)[6] have considered these systems an important option to decarbonizing energy in the region.

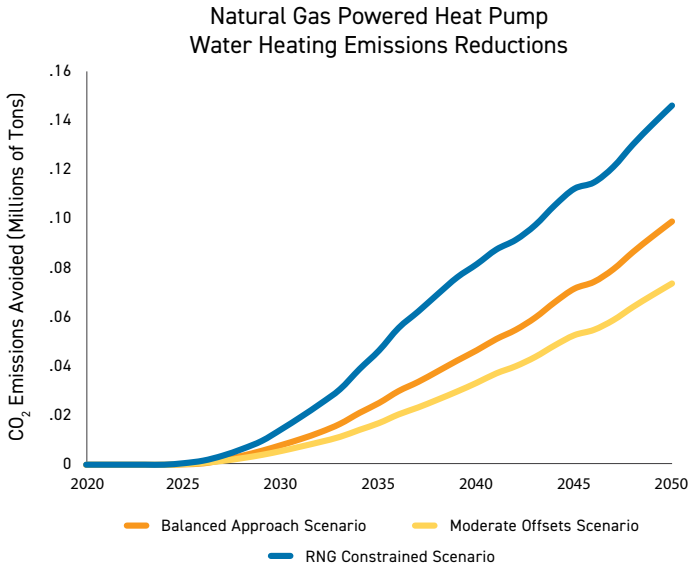
ENABLING POLICY NEED

A hybrid heat system can leverage the strengths of both the gas and electric systems. For example, during periods of peak heating demand, gas service is a lower cost resource than electricity. In many markets, customers pay electric providers a "capacity charge" to ensure that they have power during periods of peak usage, when system operators may rely on more expensive battery storage, standby generation or other ancillary energy services.[7] With hybrid heat, the gas system is basically serving as a low cost, high-performing battery.

To enable hybrid heating solutions, NW Natural and others are contemplating the policy implications. We know that the gas system in the Pacific Northwest has far greater capacity to deliver energy than the electric system—which means leveraging it in new ways provides a faster climate solution with a significant cost savings for rate payers.

Water Heating Equipment

The projected greenhouse gas savings from use of natural gas heat pumps for water heating can be seen in the below chart for Balanced Approach, Moderate Offsets and RNG Constrained scenarios.



[6] This E3 report discusses the emissions-reduction potential for dual-fuel systems and the lack of alignment with climate reduction goals under current market conditions, pp. 81-83: https://www.ethree.com/wp-content/uploads/2020/11/E3-EFI_Report-New-England-Reliability-Under-Deep-Decarbonization_Full-Report_November_2020.pdf.

[7] For a discussion on the use of battery storage as an ancillary service, see this U.S. Energy Information Administration article, "Battery storage applications have shifted as more batteries are added to the grid," https://www.eia.gov/electricity/monthly/update/archive/september2021/.

Enhanced Building Shell Energy Efficiency Measures

Through Energy Trust of Oregon, NW Natural supports energy-efficiency improvements such as cost-effective equipment upgrades, insulation and building improvements that last for many years.

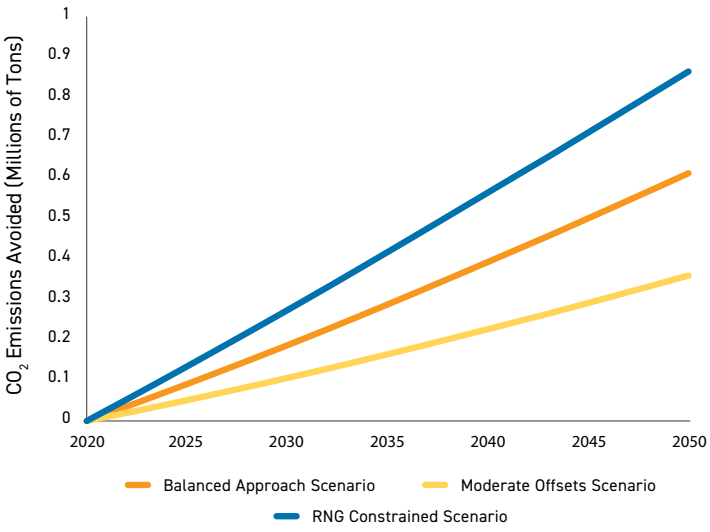
More than half of the gas sold to NW Natural's customers is used for space heating. Buildings with better insulation, windows, and other shell improvements require less energy to heat and cool, thus reducing energy consumption and emissions for both gas and electricity. Building shell improvements for new construction are continually progressing, with structures becoming increasingly efficient.

Retrofits of existing buildings can deliver greater savings at lower costs by addressing multiple opportunities that might not prove cost-effective as a stand-alone measure. A project that begins with plans to replace a large boiler may incorporate a suite of additional improvements as part of a whole-building assessment: sealing ducts to prevent the loss of conditioned air, improving exterior shell insulation, upgrading windows to double- or triple-pane, and installing advanced heating controls.

These improvements can deliver benefits beyond energy cost savings, including increased occupant comfort, building marketability, and a lower carbon footprint overall.

For the Vision 2050 scenarios, we considered efficiency gains beyond Energy Trust's projections, focused on building shell improvements and industry-sector efficiency measures in new and existing structures. These are additional to assumptions for space and water heating equipment upgrades. Note, however, that building shell retrofits and equipment upgrades have an interactive effect, combining to reduce overall energy demand. Below are the projected greenhouse gas emissions avoided through building shell improvements in the three scenarios analyzed.

Building Shell Improvement Emissions Reductions



Valley Milling and Lumber, courtesy of Energy Trust of Oregon

Industrial energy efficiency supports strategic growth for Eugene company

Valley Milling & Lumber is one NW Natural customer that's already seeing the benefits of industrial energy efficiency. The Eugene-based company and its 30 employees produces wood stakes for multiple industries, manufactures building materials, and processes large, exposed timbers for ceilings, lodges and bridge work. In 2020 the company purchased a new kiln, as part of a strategic business decision to increase its in-house production capacity and add more services to its material processing for customers.

To meet the kiln's energy needs, the company installed a new natural gas boiler and added piping insulation for improved efficiency. Incentives from Energy Trust of Oregon helped to offset nearly 70% of the cost of the boiler upgrade. The company expects to save more than 64,000 therms annually (a $49,000 value), thanks to those incentives and technical assistance. Working with its local electric provider, the mill also invested in variable controls for the kiln fan motors for additional energy savings. Today, Valley Milling and Lumber is building on its legacy in an environmentally sustainable way.

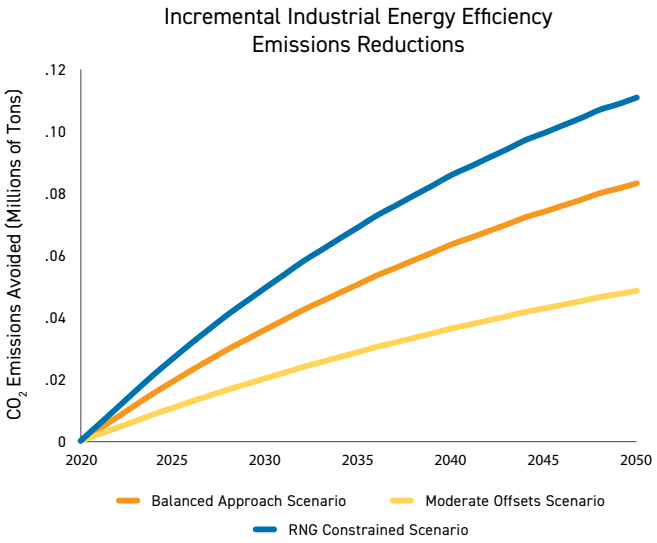
Learn more: **https://blog.energytrust.org/wood-products-manufacturer-heats-up-energy-savings/**

Industrial Energy Efficiency

Another opportunity to realize additional natural gas savings can be found in the industrial sector. Many deep decarbonization studies assume industrial gas efficiency gains as high as 30% by mid-century. It's a group that, though small in number, comprises roughly half of NW Natural's gas delivery volumes annually. These types of essential sectors and organizations include pulp and paper, semiconductors, university campuses and hospitals.

When successful, efficiency investments for industrial use can deliver large energy savings while also enabling companies to expand and pursue new growth strategies.

In assessing the potential for these scenarios, NW Natural subject matter experts balanced the opportunity for savings against the specific and relatively complex nature of equipment used by companies across sectors, as well as the significant capital investments required. Below are the projected greenhouse gas emissions avoided through industrial energy efficiency in the three scenarios analyzed.



ELEMENTS OF OUR VISION: OFFSETS, CARBON CAPTURE AND NEGATIVE EMISSIONS TECHNOLOGIES

Reducing greenhouse gas emissions to net-zero will require deploying new technologies, policies and approaches that cut across regional economies and industry sectors. Carbon capture, utilization, and storage (CCUS), direct air capture, carbon offsets, and other approaches all have the potential to deliver real reductions.

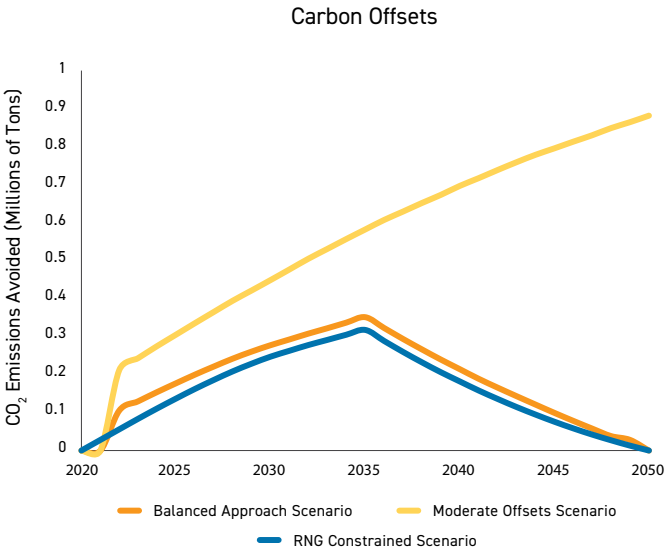
Uncertainties exist with respect to timeframes to deployment, policy frameworks needed, costs and market structures, and technology options. However, much of this work will require the safe and reliable capture, storage and movement of a resource from one place to another—something that aligns well with the natural gas workforce, knowledge base, skill set and infrastructure.

We've reflected this in our Vision 2050 work with two components: verified carbon offsets and a new carbon capture technology currently in the pilot phase, which serves as a useful proxy as this category matures.

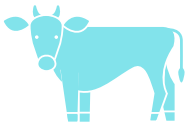
Carbon Offsets

Carbon offsets offer another mechanism for lowering carbon emissions. An offset certificate represents one metric ton of carbon dioxide emissions that has been eliminated. Offsets can be generated in a variety of methods from a variety of projects.

NW Natural's approach to date has been an emphasis on projects in our region tailored to reduce methane emissions. Since 2007, NW Natural has offered customers a voluntary carbon offset program called Smart Energy that enables them to offset some or all the emissions associated with their natural gas consumption.



Making carbon offsets at a dairy farm



1. Manure from dairy cows can release methane, a greenhouse gas 25 times more potent than CO_2, into the atmosphere.

2. The dairy farm diverts manure to an anaerobic digester, where methane is captured and prevented from entering the atmosphere.

3. Captured methane can be used as an on-demand renewable energy source to heat and operate homes and businesses.

The Smart Energy program has purchased offsets from 14 innovative projects across the Pacific Northwest, California and Utah. These include projects like biodigesters on family-owned dairy farms that capture methane from cow manure, keeping this potent greenhouse gas from entering the atmosphere and harnessing it as a renewable energy source.

These offsets are a valuable tool to effectively lower emissions and are verified by The Climate Trust to ensure that only high-quality offsets are purchased and retired for the Smart Energy program. Since its inception, the program has funded over 1.5 million metric tons of emissions reductions. Today, over 67,000 customers are enrolled.

We believe that carbon offsets have a useful role as an interim tool and economical option to reduce emissions. To that end, carbon offset projections increase over time in our Balanced Approach and RNG Constrained scenarios. Offset use peaks in 2035 and is then gradually phased out by 2050.

Carbon Capture Equipment

Emerging technologies can play a role in decarbonizing non-renewable gas supplies through the direct capture of carbon dioxide at the point of combustion. These emissions can be sequestered or utilized, giving rise to the category of CCUS.

We've represented a modest savings potential from CCUS, using a market-ready technology now in the pilot phase of deployment among a handful of natural gas utilities, including NW Natural.

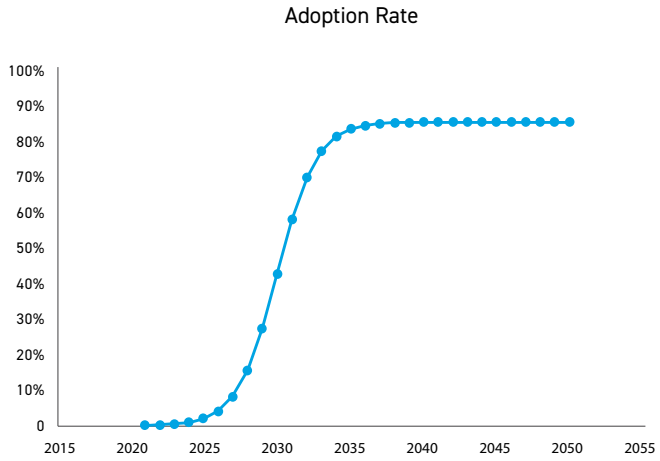
The CarbinX unit, manufactured by the Canadian-based CleanO2 firm, draws a fraction of the flue gas from natural gas-fired appliances, and mixes that gas with potassium hydroxide to produce potassium carbonate.

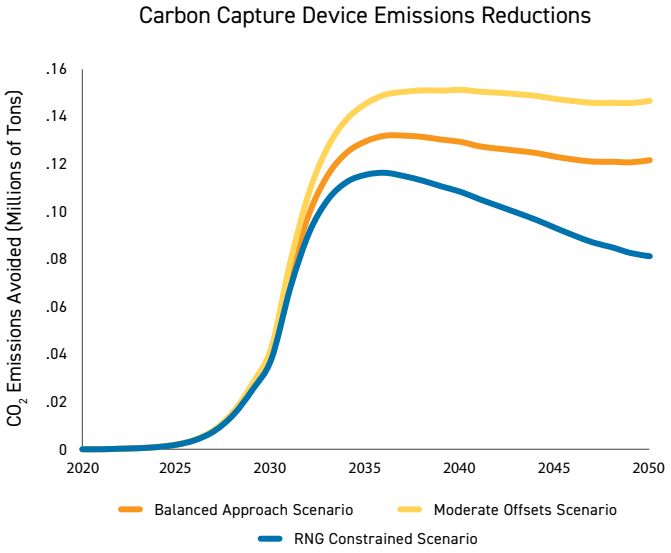
Several other direct capture technologies are approaching commercialization as the business case for carbon capture evolves. We've considered the CarbinX as a useful proxy for this market segment, based on applicability and capture effectiveness.

Assumptions were also developed on the CarbinX's ability to capture CO_2 in the coming years. The initial model is expected to capture 20% of the CO_2 in the flue stream and eventually rise to 100% in 2030. For a more conservative estimate, we discounted these rates by 25%, so the effective capture rates modeled start at 15% in 2021, rising to 75% by 2030.

The CarbinX device is best suited for a customer whose gas consumption falls within a certain range and remains relatively constant throughout the year. Examples include indoor aquatic and recreation centers, or hotels with on-site laundry—larger facilities that use relatively stable amounts of natural gas. That is, facilities that have a load factor of at least 75% (ratio of peak demand compared to average demand) and use at least 65,000 therms of natural gas annually.

We assumed that 85% of customers who fit this profile would eventually install this technology, following a typical S-curve of adoption rates shown in the graph. While early in the curve we have a small number of first-movers and a slower rate of adoption, later in the decade the rate ramps up as more users become familiar with the technology and its benefits.





The graph shows volumes of natural gas combusted, with emissions captured by the device. We assumed the same adoption rate across all scenarios. In the case of the RNG Constrained scenario, increased energy efficiency and adoption of hybrid heating equipment is assumed to result in lower volumes of gas consumed overall, and in turn, lower volumes of gas captured by carbon capture units.

Most of the carbon captured here comes from conventional natural gas. However, as the remaining conventional supplies are replaced by renewable natural gas, the carbon captured by the units will be from biogenic (organic) sources. At this point, this equipment begins to lower overall atmospheric carbon levels, creating a carbon-negative pathway.

IMPLICATIONS AND ACTIONS: WHERE WE GO FROM HERE

This report illustrates a range of potential carbon reduction scenarios for NW Natural to use as we strive towards our vision of becoming a carbon-neutral utility by 2050. These models have not been optimized for cost or risk, nor a particular preference from a resource planning perspective.

What these scenarios do reflect are those technologies and measures that could be implemented today. Most of these have been incorporated into NW Natural's current operations, resource plans, or market-transformation investment initiatives.

Just as our 2016 Low Carbon Pathway helped articulate a need for renewable natural gas and the potential for clean hydrogen, this analysis highlights near-term actions required to enable progress on the measures identified.

We firmly believe the right answer for a net-zero future is renewable electrons in the wires overhead paired with renewable molecules running through the pipes underground—and joint energy system planning to find the best solutions.

This type of approach would be a leap forward toward realizing Oregon and Washington's climate goals and it's within reach. We just need to think and plan differently.

Advancing Policy and New Innovations

NW Natural has initiated progress on multiple fronts in support of this vision.

We're pursuing solutions like gas heat pumps, efficient furnaces and water heaters that don't require electric ignition, hybrid systems and hydrogen-ready appliances and processing equipment.

Our RNG procurement is ramping up following finalization of legislation and rulemaking in 2020. Through November 2021, we've signed options or agreements for approximately 3% of our total supply portfolio, and sightlines to reaching 10% over the next several years. We're pleased with this early progress. To put it into perspective, wind and solar generation now supply 11% of our nation's electricity—with more than two decades of active development and enabling policies.

NW Natural is also actively supporting the development of clean hydrogen in the Pacific Northwest. We've joined with utilities, research universities and industry partners to develop standards and practices for safely blending hydrogen into our natural gas pipeline network. At our Sherwood Operations and Training Center we're testing how different blends of hydrogen and natural gas work in our equipment and various types of appliances.

In our pursuit of these advancements, we believe in the opportunity found in new ideas and the value in diverse perspectives. As we face decisions about the future of our energy system and our environment, it's critical that customers, communities, and other stakeholders take part in those discussions and decisions. In this report we've shared a vision for how NW Natural intends to contribute to this common future.

Building on 162 years of success, we are looking forward—channeling the advantages of our modern infrastructure, our expertise, and our innovative spirit toward what's next: Destination Zero.

Learn more: **www.nwnatural.com/destinationzero**.

Forward-Looking Statements

This report and other materials prepared by NW Natural Holdings and NW Natural from time to time, may contain forward-looking statements within the meaning of the U.S. Private Securities Litigation Reform Act of 1995, which are subject to the safe harbors created by such Act. Forward-looking statements can be identified by words such as "anticipates," "intends," "plans," "seeks," "believes," "estimates," "expects" and similar references to future periods. Examples of forward-looking statements include, but are not limited to, statements regarding the following: plans, objectives, estimates, assumptions, timing, goals, strategies, future events, projections, expectations, outlooks, commitments, intentions, acquisitions and timing, completion and integration thereof, infrastructure investments, safety and implementation of safety initiatives, system modernization, improvements and reliability, infrastructure resiliency, risk management programs, commodity costs and sourcing, competitive advantage, marketing, service territory, customer service, customer and business growth, customer satisfaction ratings, weather, customer rates, customer preference, business risk, efficiency of business operations, business development and new business initiatives, financial positions and performance, economic and housing market trends and performance, capital expenditures, technological innovations and investments, strategic goals and visions, environmental initiatives, decarbonization and the role of natural gas and the gas delivery system, including use of renewables, carbon emissions, targets, reductions, and savings, timelines for implementing decarbonization strategies and achieving goals, renewable natural gas projects or investments and timing and completion thereof, renewable hydrogen projects and programs, procurement of renewable natural gas for customers, energy efficiency initiatives, carbon offset projects, investments and funding, energy usage and savings, adoption of demand-side technologies including gas heat pumps, hybrid heating systems and building improvements, industrial energy efficiency measures, carbon capture technology and adoption, the regulatory environment, timing or effects of future regulatory proceedings or future regulatory approvals, effects of legislation and changes in laws and regulations, including but not limited to carbon, renewable natural gas and renewable hydrogen regulations, effects, extent, severity and duration of the COVID-19 pandemic and resulting economic disruption, the impact of efforts to mitigate risks posed the spread of COVID-19, ability of our workforce, customers or suppliers to operate or conduct business, reopening and remote work plans, governmental actions and timing thereof including actions to reopen the economy, and other statements that are other than statements of historical facts.

The forward-looking statements contained in this report are provided for the general information of our stakeholders and are not intended to induce any sales or purchases of securities or to be used in connection therewith for any investment purposes. Forward-looking statements are based on our current expectations and assumptions regarding our business, the economy and other future conditions. Because forward-looking statements relate to the future, they are subject to inherent uncertainties, risks and changes in circumstances that are difficult to predict. Our actual results may differ materially from those contemplated by the forward-looking statements, so we caution you against relying on any of these forward-looking statements. They are neither statements of historical fact nor guarantees or assurances of future performance. Important factors that could cause actual results to differ materially from those in the forward-looking statements are discussed by reference to the factors described in Part I, Item 1A "Risk Factors," and Part II, Item 7 and Item 7A "Management's Discussion and Analysis of Financial Condition and Results of Operations," and "Quantitative and Qualitative Disclosure about Market Risk" in the Company's most recent Annual Report on Form 10-K, and in Part I, Items 2 and 3 "Management's Discussion and Analysis of Financial Condition and Results of Operations" and "Quantitative and Qualitative Disclosures About Market Risk", and Part II, Item 1A, "Risk Factors", in the Company's quarterly reports filed thereafter.

All forward-looking statements made in this report and all subsequent forward-looking statements, whether written or oral and whether made by or on behalf of the Company, are expressly qualified by these cautionary statements. Any forward-looking statement speaks only as of the date on which such statement is made, and we undertake no obligation to publicly update any forward-looking statement, whether as a result of new information, future developments or otherwise, except as may be required by law.

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- EIA Weekly Natural Gas Storage Report - Withdrawals are calculated and aggregated from a weekly regional report. This understates the total volumes withdrawals if data was available for daily withdrawals from individual storage facility.
- To convert natural gas volumes to MWh for comparison, this figure uses a national average heat content of 1036 btu/cf and a direct energy conversion of 0.29307 MWh/MMBtu.

SYSTEM SAFETY AND EMISSIONS p. 8-9

- NW Natural's reporting of fugitive methane emissions from our pipeline network to EPA via Subpart W reporting shows that roughly 0.08% of our total gas deliveries is emitted as fugitive methane from our system. Northwest Natural Holding Company SASB Disclosures, year ending Dec. 31, 2020, https://www.nwnatural.com/-/media/nwnatural/pdfs/esgreport2020finalv3.pdf?la=en&hash=2D091D294C7F037D2B904F34866DB466.

UTILITY SCALE BATTERY COSTS AND STORAGE p. 9

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GAS-FIRED HEAT PUMPS AND WATER HEATERS p. 18-19

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- Glanville, P. et al. (2019) Demonstration and Simulation of Gas Heat Pump-Driven Residential Combination Space and Water Heating System Performance, ASHRAE Transactions; Vol. 125 264-272.
- Glanville, P. (2020) Innovative Applications of Thermal Heat Pumps in Multifamily Buildings and Restaurants, Presented at the ACEEE 2020 Hot Water Forum.
- Note: Energy efficiencies are greater than 100% where the output heating energy is greater than the input energy to the appliance. This is accomplished by using the input appliance energy to move heat rather than simply create it.

HYBRID HEATING EQUIPMENT p. 18-19

- This E3 report discusses the emissions-reduction potential for dual-fuel systems and the lack of alignment with climate reduction goals under current market conditions, pp. 81-83: https://www.ethree.com/wp-content/uploads/2020/11/E3-EFI_Report-New-England-Reliability-Under-Deep-Decarbonization_Full-Report_November_2020.pdf

ENERGY EFFICIENCY, BUILDING CODES AND STANDARDS p. 20-21

- Northwest Energy Efficiency Alliance | Codes and Standards: https://neea.org/resources-reports/browse?resourceType=emerging-tech-reports
- Northwest Energy Efficiency Alliance | Industrial Facilities Site Assessment: https://neea.org/data/industrial-facilties-site-assessment
- Energy Trust of Oregon: 2020 Annual Report and Savings Data: https://energytrust.org/2020-annual-report/

CARBON OFFSETS AND SMART ENERGY p. 22

- Today nearly 9% of our customers—over 67,000—are enrolled in the Smart energy program. In 2020, they funded approximately 174,000 metric tons in emission reductions, equivalent to removing about 38,000 cars from the road. Since its inception, the Smart Energy program has funded over 1.5 million metric tons of CO_2e emissions reductions. https://www.nwnatural.com/about-us/carbon-offset-program/smart-energy-projects
- The Climate Trust employs the following criteria to ensure that Smart Energy dollars are going to credible projects that have a positive impact on the climate: https://climatetrust.org/.

CARBON CAPTURE UTILIZATION AND STORAGE (CCUS) p. 23

- CARBiN-X is a carbon capture, sequestration and reuse technology manufactured by Canadian-based CleanO2: https://cleano2.ca/pages/carbinx.
- Additional data provided via interviews with representatives at three utilities running pilot projects: CenterPoint Energy (Minneapolis), ATCO (Alberta) and Fortis (Vancouver, BC)
- Additional reports produced by University of British Columbia and Gas Technology Institute.