

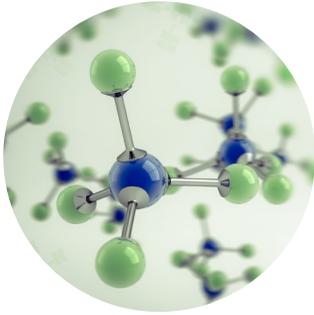
Natural Gas Facts



Natural gas is a safe, dependable and responsible energy choice – and a cornerstone of the Pacific Northwest’s energy, environmental and economic future. Natural gas heats our homes, powers businesses, fuels small and large vehicles and marine vessels, and serves as a key component in many of our most vital industrial processes.

This booklet provides an overview of natural gas and the myriad of benefits that this domestic, clean, safe, low-cost, reliable and abundant energy source offers Pacific Northwest (PNW) consumers. Already, 3.2 million regional natural gas users are enjoying its economic and environmental advantages, but expanding the use and applications of natural gas will help provide an economically feasible, cleaner environment for future generations.

The Northwest Gas Association (NWGA) works to foster greater understanding and informed decision-making on issues related to natural gas among industry participants, opinion leaders and governing officials in the Pacific Northwest, encompassing British Columbia (BC), Washington, Oregon, and Idaho.



https://www.123rf.com/profile_michelangelus / 123RF Stock Photo/a

Natural Gas 101

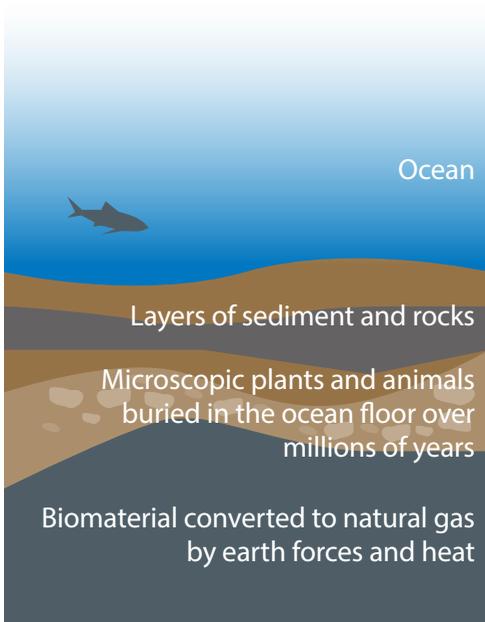
Natural gas is the Earth's cleanest fossil fuel. Created naturally underground by years of pressure and decay, natural gas is composed almost entirely of methane, with trace amounts of other gases, including ethane, propane, butane and pentane. Its molecular makeup is one carbon atom and four hydrogen atoms. Natural gas is a domestic natural resource that is colorless and odorless in its ordinary state.

Origin

Much of the natural gas we find and use today began as microscopic plants and animals living in shallow marine environments millions of years ago. As living organisms, they absorbed energy from the sun, which was stored as carbon molecules in their bodies. When they died, they sank to the bottom of the sea and were covered by layer after layer of sediment. As this organic feedstock became buried deeper in the earth, heat combined with the pressure of compaction converted some of the bio-material into natural gas.

Migration

Once natural gas has been generated in nature, it tends to migrate within the sediments and rocks where it was created using the pore space, fractures and fissures that occur naturally in the subsurface. Some natural gas rises to the surface and shows up in seeps, while other gas molecules travel until they are trapped in impermeable layers of rock, shale, salt or clay. These trapped deposits comprise the reserves where we find natural gas today.

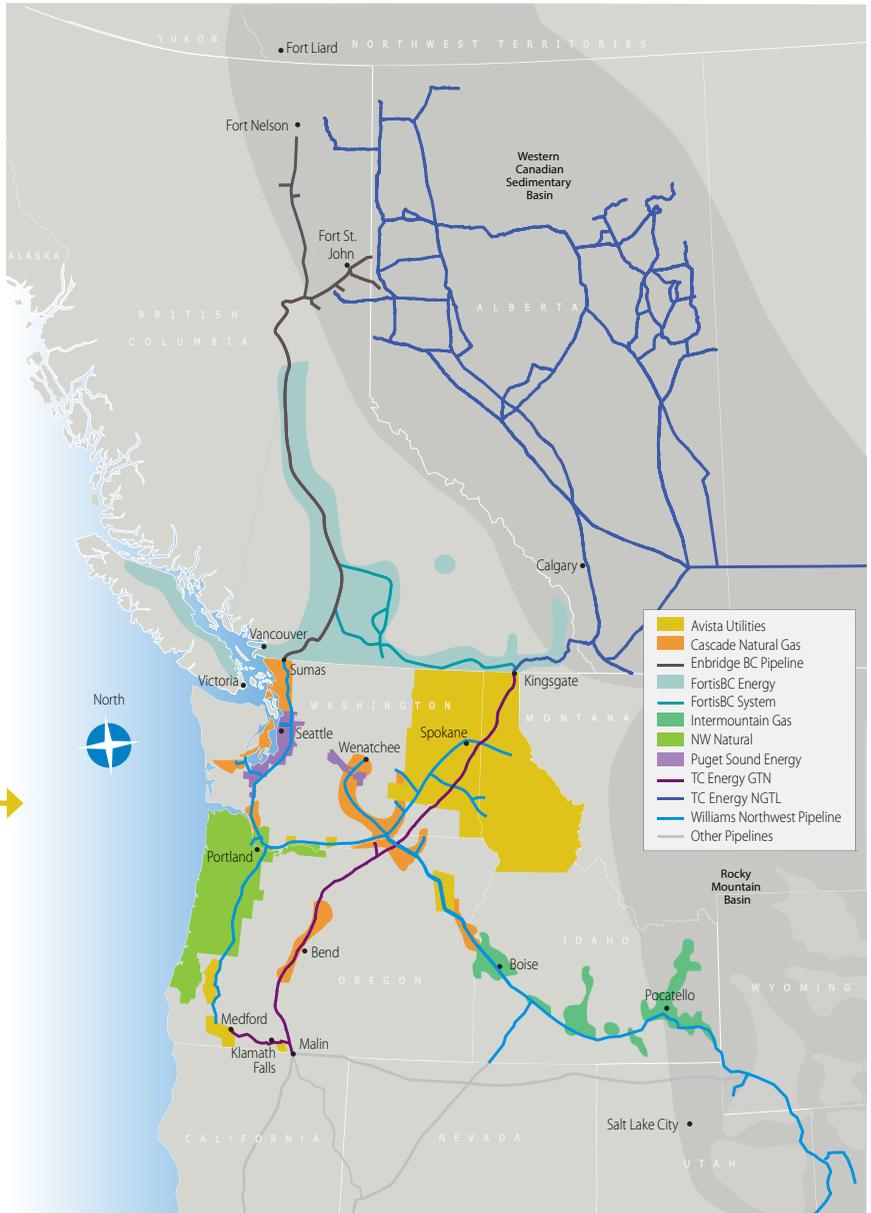


Getting Natural Gas to PNW Consumers

In the PNW, natural gas is delivered to 3.2 million consumers through a network with over 128,000 miles of transmission and distribution pipelines. The pipelines that transport natural gas from production areas in Alberta, BC, and the U.S. Rockies can deliver more than 4 million dekatherms per day (MMDth/day) to the region.

From wells in remote places to homes in your neighborhood, the natural gas industry operates a safe delivery system that is a model for the world.

**In the PNW,
natural gas is
delivered through
a network with
over 128,000
miles of
pipeline**



The Four Segments of the Natural Gas Delivery System

1 Producing Wells

1. Producing Wells (producers) such as Anadarko, BP, Devon, ExxonMobil and others, access natural gas by drilling wells into the rock then using pipes to bring the gas to the surface. In most wells, the pressure of the natural gas is enough to force it to the surface and into the gathering lines that run to central collection points. Where the gas can't flow naturally, advanced drilling technology combined with hydraulic fracturing is used to bring gas to the surface.

2 Processors

2. Processors (midstream companies), like Enbridge, TC Energy and Williams typically connect the various producing wells via a raw-gas-gathering network of small diameter pipelines, and process the gas to transmission pipeline specifications.

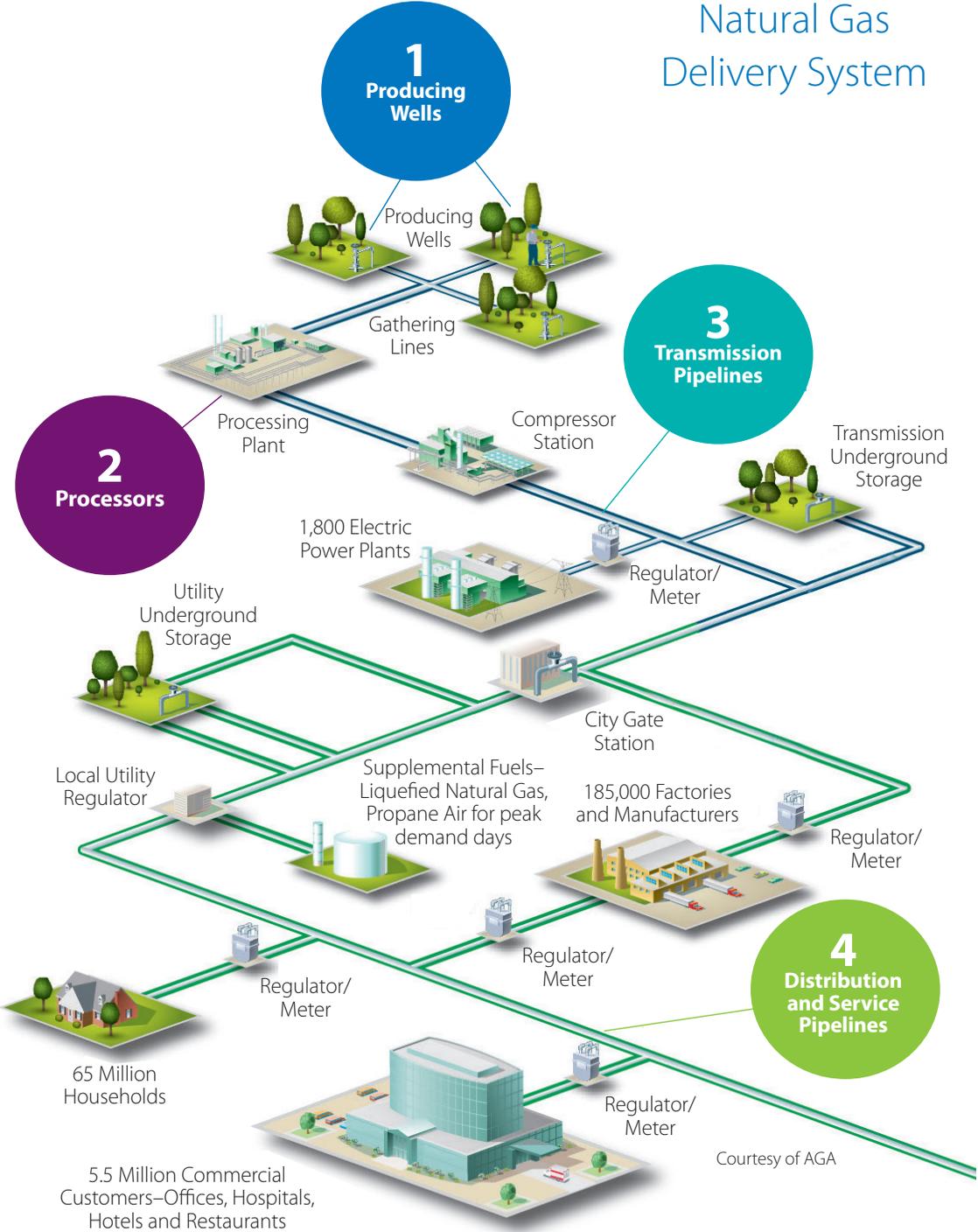
3 Transmission Pipelines

3. Transmission Pipelines, such as Enbridge's BC Pipeline, TC Energy's GTN System and Williams NW Pipeline, act like interstate highways for gas, moving huge amounts of natural gas thousands of miles from production regions to market regions served by local distribution companies. Compressor stations located about every 50 to 60 miles boost pressure to counter what is lost from the friction of gas moving through the pipe.

4 Distribution and Service Pipelines

4. Distribution and Service Pipelines (local distribution companies), such as those operated by Avista, Cascade Natural, FortisBC Energy, Intermountain, NW Natural, and Puget Sound Energy, are where the familiar "rotten egg" smell is added to natural gas before it is delivered to homes and businesses through distribution mains (utility pipelines). Finally, after passing through a meter that measures use, the gas travels to a customer's equipment, appliances and vehicles.

Natural Gas Delivery System



Courtesy of AGA

Measuring Natural Gas

The energy content or heating value from natural gas is measured in a British thermal unit, called a Btu. One Btu is equivalent to the amount of heat needed to raise the temperature of one pound (16 ounces) of water by 1 degree Fahrenheit, or about the amount of energy released by striking a wooden kitchen match. Natural gas is sold from the wellhead to purchasers in standard volume measurements of thousands of cubic feet (Mcf). Consumers are billed for use in therms. One therm is equal to 100 cubic foot.

How Natural Gas is Used in the Pacific Northwest

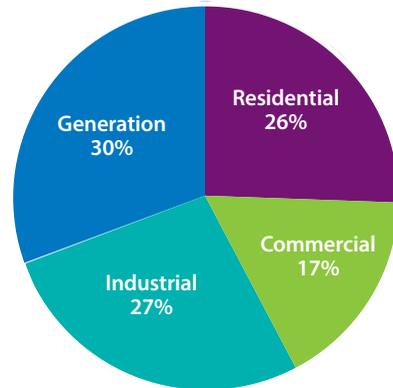
Overall, about 27 percent of natural gas delivered to PNW consumers is used in the industrial sector, providing energy for everything from mining minerals to processing food. Generating electricity consumes about 30 percent (BC uses almost no gas to produce electricity). Another 17 percent is used in the commercial market, for heating and cooling office buildings, hospitals, schools, and for cooking in restaurants. Most of the remaining amount — about 26 percent — is used in the residential market, providing energy for home heating, hot water, cooking, clothes drying and air conditioning.

For more information on natural gas in the PNW, go to www.nwga.org/outlook

Frequently Used Units for Measuring Natural Gas

1 cubic foot (cf)	= 1,028 Btu
100 cubic feet (1 Ccf)	= 1 therm (approximate)
1,000 cubic feet (1 Mcf)	= 1,028,000 Btu (1 MMBtu)
1,000 cubic feet (1 Mcf)	= 1 dekatherm (10 therms)
1 million (1,000,000) cubic feet (1 MMcf)	= 1,028,000 Btu
MMBtu	= 1 million Btu

The PNW's Natural Gas Use by Sector



NWGA Outlook Study

Natural Gas: Safe, Clean, Efficient . . . and the Key to our Future

Natural Gas is Safe

Safety is the core value and top priority of the natural gas industry. The industry spends billions of dollars each year to maintain and improve its infrastructure through safety programs, markers, inspections, material specifications, construction techniques, corrosion and damage control, industry and peer education programs, and public education programs.

The natural gas industry knows that safety is a joint effort and proactively collaborates and engages in partnerships with federal and state regulators, public officials, emergency responders, excavators, consumers, and safety advocates. It is by working together that the industry continues to improve upon its longstanding record of providing natural gas safely, effectively and reliably.

The number one cause of pipeline incidents is third-party damage, such as that caused when excavation contractors or even homeowners inadvertently dig in to a gas line. Concentrated efforts by your local gas company, state and federal regulators and other public agencies, coupled with **8-1-1 Call Before You Dig** number, have helped reduce damages from excavation by 60 percent since 2006. While the industry has multiple safeguards in place to protect consumers, it is important that consumers are actively involved in safety precautions. It's a partnership!

To provide an added layer of safety for leak detection purposes:



Utilities odorize natural gas with Mercaptan . . .



It smells like rotten eggs

Did you know?

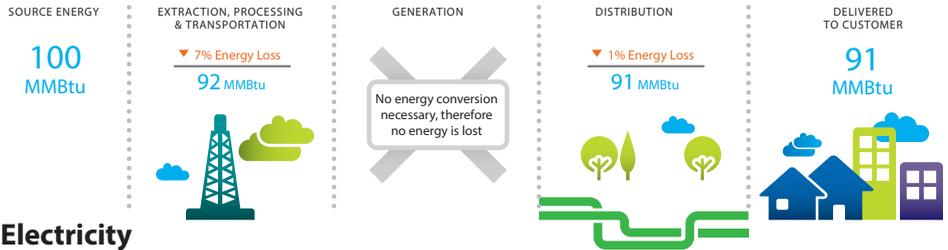
Transportation by pipeline is the safest form of energy delivery in the country.



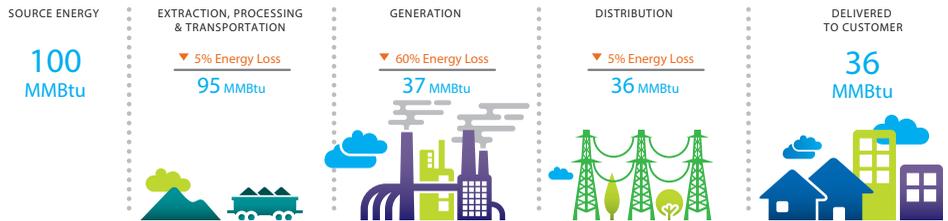
Natural Gas is Efficient

The more energy we save, the lower our impact on the environment. But beyond using energy-efficient products, it's also important to use the best (e.g., most efficient) energy source for the task. On average, a house fueled by natural gas is responsible for about one-third fewer GHG emissions than a comparable all-electric home, according to the American Gas Association (AGA).

Natural Gas



Electricity



Courtesy of AGA

Benefits of Direct Use of Natural Gas

Why? Let's take a look at what's called the full fuel cycle, which accounts for how much energy is retained – or lost – from an energy source until its final use in your water heater, oven or home heating system. With the full fuel cycle in mind, direct use of natural gas comes out a winner in the energy efficiency race. For example, by the time you turn on an electric appliance, 64 percent of the energy value from the original fuel has been lost. That means the full fuel cycle efficiency is about 32 percent. By contrast, the full fuel cycle efficiency of a natural gas appliance is about 91 percent – a substantial difference. More efficient use of a fuel means less energy lost and less that needs to be produced, which reduces GHG emissions.

Natural Gas is also Cost-Effective

Besides gaining efficiency, however, consumers that convert to natural gas also immediately save on their monthly utility bills. Households that directly use natural gas for heating, cooking and clothes drying spend an average of \$874 less per year than homes using electricity for those applications. In fact, low domestic natural gas prices have led to savings of almost \$69 billion for existing residential natural gas customers in the U.S. over the past four years, according to AGA.

Natural Gas is an Environmental Benefit

Gaining a better understanding of greenhouse emissions released from natural gas production and delivery systems helps clarify how the proper deployment of natural gas can deliver significant environmental benefits. Join us in taking a closer look at the numbers.

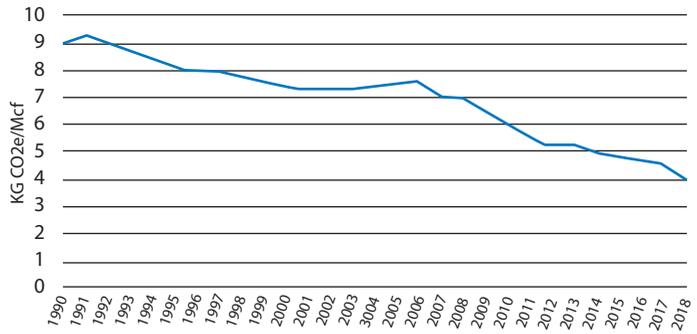
Industry-wide Natural Gas Emissions are Low and Declining

The U.S. Environmental Protection Agency (EPA) made further updates to its estimates of methane emissions in its Inventory of U.S. Greenhouse Gas (GHG) Emissions and Sinks: 1990–2018 (“Inventory”), released in April 2020. The Inventory incorporates new data available from studies on emissions as well as the EPA’s own Greenhouse Gas Reporting Program (GHGRP).

The Inventory found that industry-wide methane emissions¹ as a rate of natural gas production were 1 percent. The ratio of methane emissions per unit of natural gas produced has declined continuously during the past several decades, dropping 48 percent since 1990.

The inventory also confirmed that natural gas distribution systems have a small emissions footprint that continues to decline. Distribution systems emit less than 0.1 percent of produced natural gas annually, a decline of 73 percent from 1990 to 2017 even as U.S. natural gas utility companies added more than 730,000 miles of pipeline to serve 19 million more customers, increases of 50 and 36 percent respectively, and natural gas production increased by 50 percent.

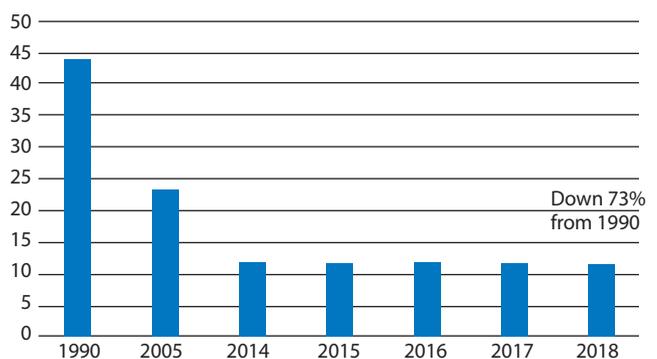
U.S. Methane Emissions per Mcf of Gas Produced²



Methane Emissions per Mcf of Gas Produced (MMT CO₂-EcMdf Gross Withdrawals)
Source: US Environmental Protection Agency, *Inventory of US Greenhouse Emissions and Sinks: 1990-2018*

U.S. Methane Emissions from Natural Gas Distribution Systems

Methane Emissions from Natural Gas Distribution Systems
Million Metric Tons CO₂-e



Source: US Environmental Protection Agency, *Inventory of US Greenhouse Emissions and Sinks: 1990-2018*

¹Industry-wide, or “lifecycle” emissions, as defined by the EPA, include natural gas field production, processing, transmission and storage, and distribution.

²Includes methane emissions from petroleum production based on the natural gas fraction of total energy content produced from oil wells.

Environmental Benefit *continued*

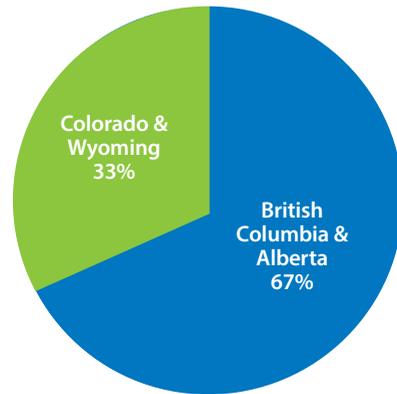
The bottom line: New control technologies, replacement of old cast iron and bare steel pipes, and better industry practices have contributed to significant emissions reductions, even as annual natural gas production and consumption have hit record highs.

Regionally, Emissions are Already Lower and Expected to Decline Even Faster

In the basins from which the Pacific Northwest sources most of its natural gas, policymakers and regulators have taken action to further decrease methane emissions from upstream operations. Effective January 2020 in BC, the source of about two-thirds of our region's natural gas, the BC Oil and Gas Commission (BC OGC) has committed to reduce methane emissions from upstream oil and gas operations by 45 percent by 2025 relative to 2014 levels, targeting everything from compressor seals to storage tanks. The BC approach is expected to reduce methane emissions by 10.9 megatonnes (10.9 million metric tons) of CO2 equivalent over a 10-year period, the equivalent of taking 390,000 cars off the road each year.³ In addition, BC's natural gas transmission sector is expected to reduce its emissions by 40 to 45 percent below 2012 levels by 2050 under the Canadian federal Methane Regulation, which also came into force in January 2020. Like the BC OGC, the federal Methane Regulation is focused on reducing emissions from fugitives and venting.

In 2014, Colorado (which provides much of our region's Rockies' gas, about one-third of our supply overall) approved the first methane regulations in the U.S. requiring energy companies to reduce methane emissions from oil and natural gas operations by routinely checking their oil and natural gas wells—both new and existing—statewide, and immediately addressing any leaks. The regulations go beyond those of the EPA, which apply only to new or modified operations, according to the Environmental Defense Fund, which helped craft Colorado's regulations.

Where the PNW Gets its Natural Gas



³For details from the BC Oil and Gas Commission, see <https://www.bco.gc.ca/public-zone/reducing-methane-emissions>

Environmental Benefit *continued*

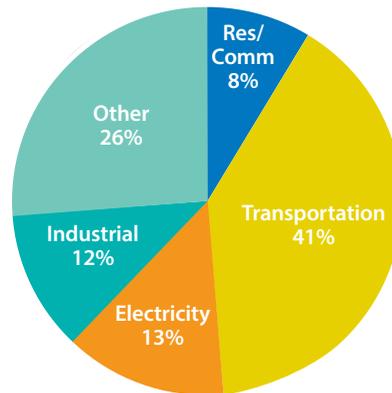
By 2016, field surveys of oil and gas equipment by the Colorado Department of Public Health and Environment (CDPHE) found a 75 percent drop in the number of sites where methane leaks were detected compared to similar surveys conducted prior to the regulations taking effect, said Will Allison, former director of the department's Air Pollution Control Division. By 2018, Garry Kaufman, the division's new director, said, "Colorado's program has reduced emissions of methane and volatile organic compounds from the oil and gas sector by hundreds of thousands of tons per year, while still allowing for growth in this important economic resource for Colorado."

As a result, gas pipelines serving the Northwest have the lowest methane emissions on the continent and will continue to improve.

Regional Natural Gas Emissions are Small Relative to Other Sectors

Overall, direct use of natural gas for space and water heating in homes and commercial buildings in the Pacific Northwest accounts for just 8 percent of total regional GHG emissions (see pie chart). The transportation sector (trucking, fleets, personal vehicles, public transit, etc.) produces the largest share of regional emissions (41 percent). The "other" category in the chart includes agriculture, forest practices, waste streams (landfills, wastewater treatment), building heat from fuels other than natural gas, oil and gas extraction (BC only), and industrial emissions not related to natural gas combustion.

The PNW's Natural Gas Emissions by Sector



The Future of Natural Gas

The Potential for Renewable Natural Gas

What is RNG?

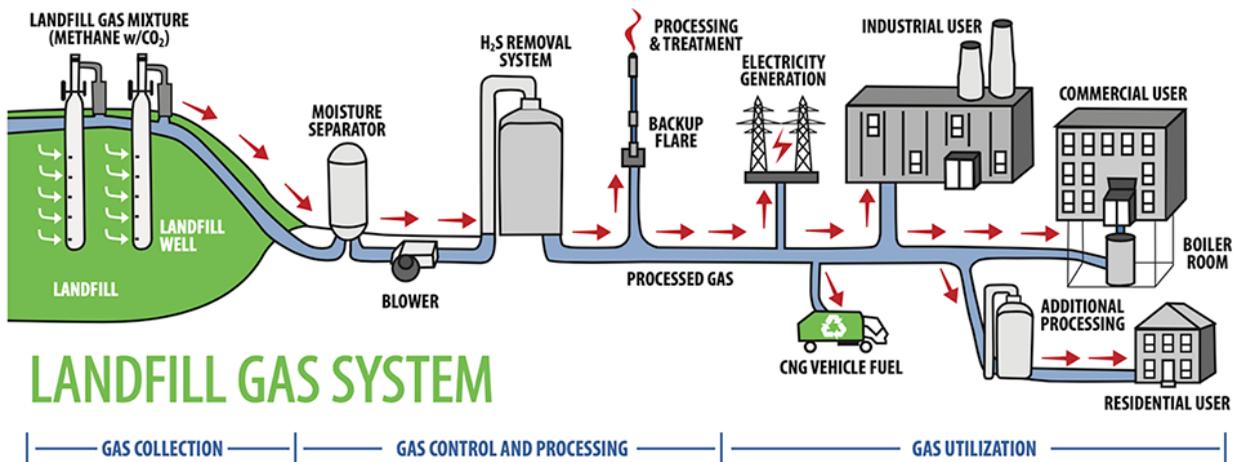
It is an ultra-clean, ultra-low-carbon natural gas alternative. As organic waste decomposes it emits methane gas, called biogas. RNG is sometimes referred to as 'biomethane,' a related term. Biomethane or RNG is simply biogas that has been cleaned up to remove impurities and match the quality of pipeline gas such that it may blend with, or substitute for, conventional natural gas.

Regional gas utilities and pipelines continue to work with farmers, developers, and local governments to capture and purify biogas that can be cleaned up to pipeline quality gas and injected into existing natural gas systems. In addition, new policies are being enacted across our region to promote and accelerate further development and adoption of RNG. Here are a few examples from across the region:

British Columbia

There are five operating biogas projects using agricultural waste, landfill waste, and curbside organic waste to generate about 250,000 Gigajoules (GJ) (equivalent to 237,000 Dth) of RNG annually. FortisBC already purchases and injects RNG into its existing system, as well as investing in and operating biogas upgrading equipment, and is building another RNG-producing facility at the Vancouver Landfill. When the facility begins operation in late 2021, it will double BC's existing expected RNG supply.

On the customer side, FortisBC was one of North America's first utilities to introduce a voluntary participation RNG Program in 2011. FortisBC customers can designate between 5 and 100 percent of their natural gas use as RNG and pay a premium on their bill. FortisBC then injects an equivalent amount of RNG into the FortisBC distribution system. Today, more than 10,500 BC homes and businesses are enrolled in the RNG program.



The Future of Natural Gas, *continued*

The provincial CleanBC plan, enacted in 2018, set an ambitious target of 15 percent RNG blend by 2030. Though not yet in force, it represents a major shift in how FortisBC needs to look at its gas supply. Ultimately, FortisBC expects to use a number of tools to reach this objective, but if required to fill the gap with RNG, this represents a greater than 30-fold increase in its current supply levels.

Washington

The state legislature passed a law in 2019 that requires each gas local distribution company (LDC) to offer RNG to its customers and gives those entities the ability to introduce RNG into their standard supply portfolios, provided the cost of RNG does not increase customer costs by more than 5 percent. Washington gas utilities are currently working with Washington Utilities and Transportation Commission (WUTC) staff and other interested parties to develop RNG cost recovery rules, RNG program limitations, and RNG gas quality requirements.

Currently, there are five projects producing or soon-to-begin producing RNG in Washington state – two landfills and one multi-farm dairy-waste digester connected to Williams Northwest Pipeline and two wastewater treatment facilities connected to Puget Sound Energy's (PSE) distribution system. These facilities are currently all committed to serving the vehicle fuel market, primarily in California. As the vehicle fuel market matures and reaches saturation, however, it is expected that landfill- and wastewater-sourced RNG will be redeployed to serve local utility demand.

PSE has held preliminary discussions with numerous developers seeking to complete RNG projects in western and central Washington and with various municipal and regional wastewater treatment plants and landfills that seek to create additional revenue streams and reduce their own carbon footprint. PSE is engaged in the physical and economic feasibility analyses necessary to interconnect approximately 12 viable RNG projects. PSE recently acquired the RNG produced and upgraded at the large regional Roosevelt landfill in order to serve its gas customers with a clean and renewable resource.

Other Washington utilities are also considering potential supply sources, and some believe they may be able to offer RNG directly to retail customers through opt-in programs by late 2020 or mid-2021. By 2025, as much as 2 percent of Washington gas use could be sourced from renewable sources, with a potential of 5 percent by 2030.

The Future of Natural Gas, *continued*

PSE has held preliminary discussions with numerous developers seeking to complete RNG projects in western and central Washington and with various municipal and regional wastewater treatment plants and landfills that seek to create additional revenue streams and reduce their own carbon footprint. PSE is engaged in the physical and economic feasibility analyses necessary to interconnect approximately 12 viable RNG projects. PSE recently acquired the RNG produced and upgraded at the large regional Roosevelt landfill in order to serve its gas customers with a clean and renewable resource.

Oregon

Similar to Washington, a law passed in 2019 requires the Public Utility Commission to adopt RNG programs for both large and small gas utilities, enabling them to fully recover costs of integrating RNG into their systems. Up to 5 percent of a utility's revenue requirement may be used to cover the incremental costs of RNG. The law also outlines goals for adding as much as 30 percent RNG into the state's pipeline system by 2050. A 2017 study by Oregon's Department of Energy showed a technical potential of recovering some 48 billion cubic feet (Bcf) of RNG within the state annually, an amount that could supply every home using natural gas in Oregon today with a local, renewable energy source.¹

RNG development could reduce U.S. GHG emissions between 101-235 million metric tons (MMT) by 2040 – the equivalent of reducing GHG emissions from average annual residential natural gas use by 95 percent from levels observed over the last 10 years.⁴

Oregon's first gas-grid-connected RNG facility, Threemile Canyon Farms in Boardman, began production in 2019, with a tie into

the Williams Pipeline system. Three more projects have announced plans to interconnect to NW Natural's pipeline distribution system, beginning with the City of Portland's Columbia Boulevard Wastewater Treatment Plant and Shell New Energies' Junction City projects in 2020, and the Metropolitan Wastewater Management Commission project in Eugene-Springfield in 2021. Like RNG producers in Washington state, these projects are earmarked to supply the California vehicle market for now, although some of the Portland RNG will power city trucks at a natural gas fueling station to be built at the treatment plant.

Idaho

Idaho is entering the RNG game too. IGC has already integrated RNG produced from three separate dairy farms and is looking to bring others online as feasible.

Renewable natural gas is a unique resource. It allows us to capture streams of methane from the decomposition of human and agricultural waste that would otherwise be emitted directly into the atmosphere, clean it up, and put it to beneficial use. RNG significantly reduces greenhouse gas emissions. Furthermore, it allows for optimizing the use of the existing 128,000 miles of energy delivery infrastructure that provides warmth and comfort to about 10 million people who live in the Pacific Northwest while also producing energy for almost 350,000 businesses here.

⁴<https://www.gasfoundation.org/2019/12/18/renewable-sources-of-natural-gas/>

Natural Gas as a Transportation Fuel

Natural Gas can Reduce Vehicle Emissions

Natural gas is widely available and reliably used by millions of consumers across our continent. Utilizing it to fuel vehicles represents a significant and as yet virtually untapped opportunity to lower transportation costs, reduce pollution and play a role in securing North American energy independence.

The transportation sector is a substantial source of greenhouse gas emissions (GHGs), producing upwards of 40 percent of overall GHG emissions in the PNW. Large diesel-powered trucks and buses are a big part of the problem, driving through neighborhoods and communities and idling in traffic.

GHG emissions from natural gas engines are 20-30 percent lower than diesel and gasoline engines. Even when compared to electric vehicles, natural gas vehicles (NGVs) come out ahead, with fewer total GHG emissions from energy production to end use (also called full fuel cycle).

When it comes to other harmful pollutants like nitrous oxides (NOx), sulfur oxides (SOx) and particulate matter (PM), natural gas does even better. Recent studies found that natural gas engines produce dramatically lower smog-causing NOx emissions than the cleanest diesel and electric engines, while emitting almost no asthma-inducing SOx or PM.

In heavily-used fleet applications (think United Parcel Service, waste haulers, etc.), natural gas vehicles can be deployed in greater numbers, providing the most pollution reduction for the dollars spent. Over time, NGV trucks offer lower operating costs than even the newest diesel trucks because of lower operating, fuel and maintenance costs.

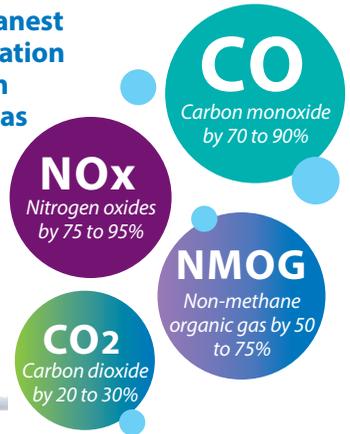
In the U.S. today, NGVs are already serving 40 major airports, comprise 20 percent of transit buses and 60 percent of new garbage-hauling trucks ordered, and are being adopted in the long-haul trucking market, rail industry and by marine shippers. Still, the potential for natural gas to serve the transportation market has barely been tapped. Because natural gas is abundant domestically, cost-effective and already used in nearly all classes of vehicles, it makes sense to pursue wider deployment of NGVs for both environmental and economic reasons.

For more information on NGV's emissions, go to www.nwga.org

Natural gas is the cleanest alternative transportation fuel available and can reduce greenhouse gas emissions by 20% to 30% compared to diesel and gasoline.



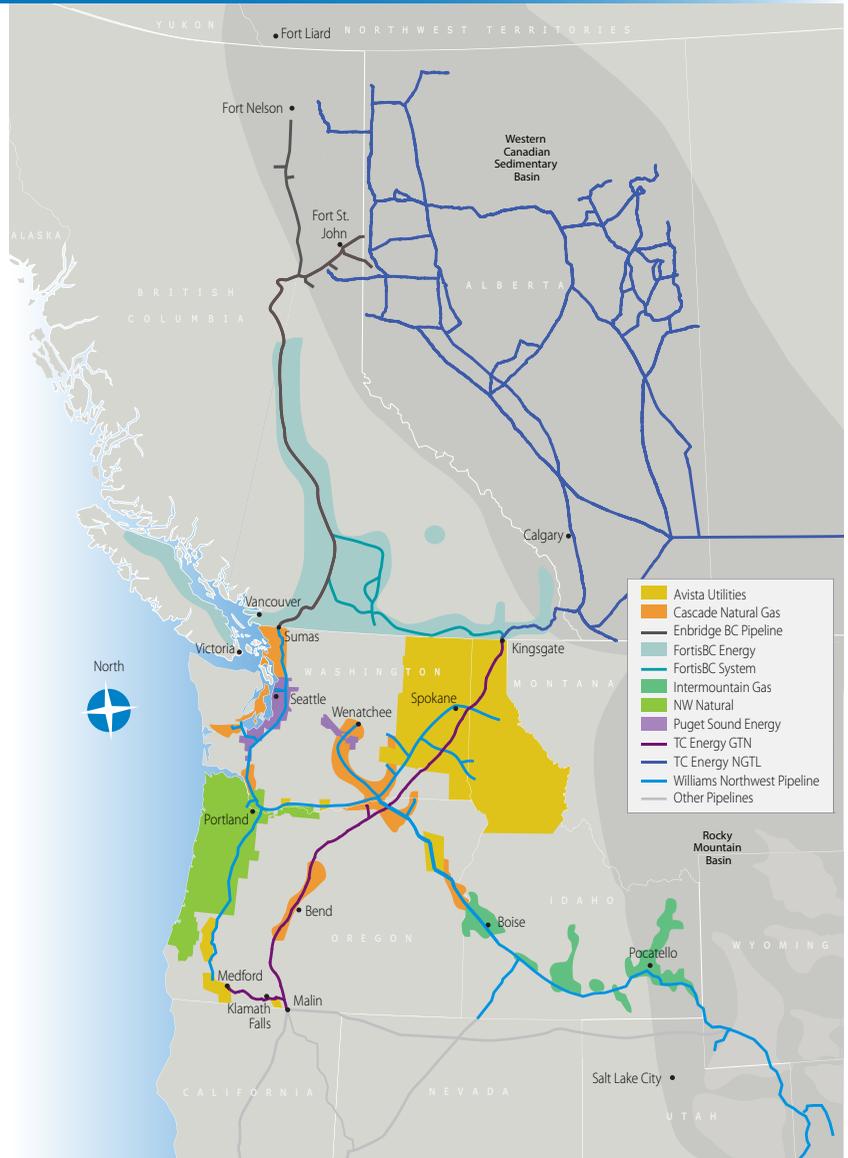
Courtesy of AGA



About the Northwest Gas Association

The Northwest Gas Association (NWGA) is a bi-national trade organization of the Pacific Northwest natural gas industry. Our members include natural gas utilities serving communities in the Northwest and interstate pipelines that move natural gas from supply basins into and through the region. NWGA members deliver or distribute all the natural gas consumed in the Pacific Northwest.

NWGA's mission is to promote the use of natural gas as a solution to the region's energy, economic and environmental goals. The NWGA accomplishes its mission by telling the compelling natural gas story; by advocating for its members' interests and by producing timely and regionally relevant information relating to natural gas.



Dan S. Kirschner
Executive Director

Judy A. Adair
Manager
Business and Operations



Northwest Gas Association

1914 Willamette Falls Drive, Suite 260
West Linn, OR 97068
503.344.6637

Website

www.nwga.org

Avista

For over 120 years Avista has served the businesses and communities of the Pacific Northwest with reliable service and value.

Avista Utilities, the company's utility operating division, serves 375,000 electric and 336,000 natural gas customers. Its service territory covers 30,000 square miles in eastern Washington, northern Idaho and parts of southern and eastern Oregon, with a population of 1.6 million. Transmission and distribution operations include energy delivery, generation, and resource assets. Operations also include the purchase, transmission, distribution, and sale of electric energy on both retail and wholesale basis. The company also purchases, transports, distributes, and sells natural gas.

Avista's stock is traded under the ticker symbol "AVA." For more information about Avista, please visit www.avistacorp.com or www.avistautilities.com.



Avista Corporation

P O Box 3727
Spokane, WA 99220
800.227.9187

Website

www.avistacorp.com
www.avistautilities.com

Cascade Natural Gas Corp.

Founded in 1953, Cascade Natural Gas Corporation is an investor-owned natural gas utility that serves residential, commercial, and industrial customers in 96 communities in Oregon and Washington.

Customers are served from three regions comprised of 12 districts* and 15 operations offices: Northwest Region – including Bellingham*, Mount Vernon*, Bremerton*, Aberdeen* and Longview*; Central Region – including Yakima*, Wenatchee*, Moses Lake, Kennewick* and Walla Walla*; Southern Region – including Bend*, Ontario*, Baker City, Pendleton* and Hermiston.

During 2020, Cascade delivered nearly 1.4 billion therms (1.32 billion cubic feet) of natural gas to an average of approximately 301,000 customers. In 2020, 78 percent of gas throughput was for industrial use, with commercial and residential segments using about 10 percent and 12 percent, respectively. In 2020, the number of natural gas customers grew by 2 percent. Cascade owns and operates approximately 10,730 miles of transmission laterals, distribution lines, and services.

Cascade's headquarters are located in Kennewick, Washington. Cascade Natural Gas Corporation is a subsidiary of MDU Resources, Inc.



Cascade Natural Gas Company

Corporate Office:
8113 W. Grandridge Blvd.
Kennewick, WA 99336
1.888.522.1130

Website

www.cngc.com

* Indicates Districts

Enbridge

Since 1957, Enbridge's BC Pipeline has formed the backbone of the natural gas sector in the province of British Columbia (B.C.).

BC Pipeline's natural gas transmission system includes 1800-miles of pipeline that connects B.C.'s natural gas exploration and production industry with millions of consumers in B.C., Alberta and the U.S. Pacific Northwest.

The southern portion of the BC Pipeline system is capable of transporting 1.7 Bcf/d of Western Canadian Sedimentary Basin natural gas to the U.S./ Canadian border at Sumas, Washington where it connects to Williams Northwest Pipeline.

This natural gas is used to heat homes, hospitals, businesses and schools. It is also used as a fuel for electric power generation and is a staple in a number of industrial and manufacturing processes that create hundreds of products that improve our daily lives.



Enbridge

425 1st Street SW
Calgary, AB T2P 3L8
1-888-992-0997

Website

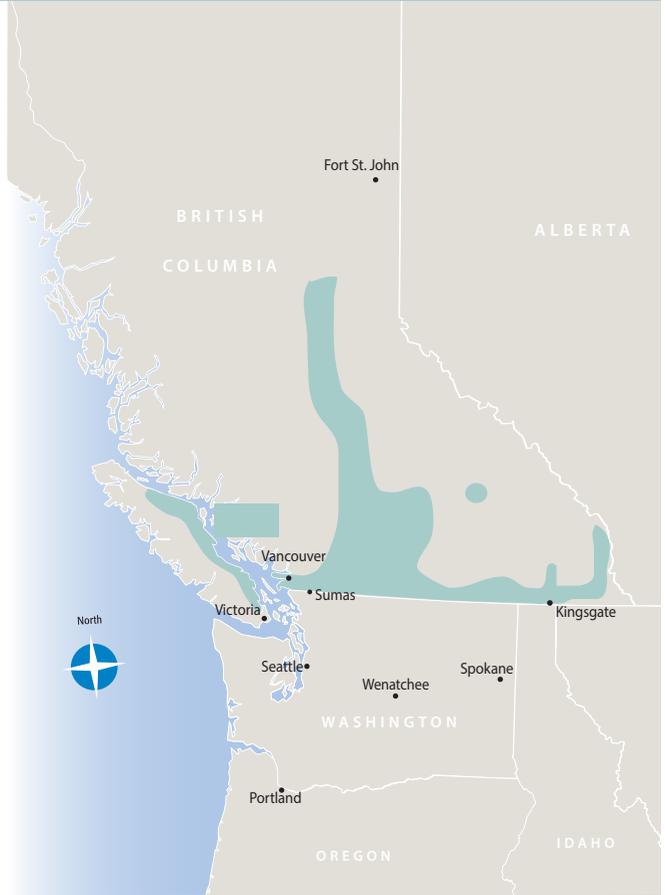
www.enbridge.com

FortisBC

FortisBC delivers approximately 21 percent of the total energy consumed in British Columbia, which is the most energy delivered by any utility in the province. Whether delivering electricity, natural gas, or propane, our more than 2,400 employees serve approximately 1.2 million customers in 135 communities.

FortisBC owns and operates approximately 50,000 kilometres of natural gas transmission and distribution pipelines and approximately 7,300 kilometres of transmission and distribution power lines. Under our regulated utility operations, we also own and operate two liquefied natural gas (LNG) storage facilities and four hydroelectric generating plants.

FortisBC Inc. and FortisBC Energy Inc. do business as FortisBC. We are indirectly wholly owned by our parent company, Fortis Inc., a leader in the North American electric and gas utility business. Through its subsidiaries, Fortis Inc. serves more than 3 million natural gas and electricity customers.



FORTIS BC™

FortisBC

16705 Fraser Highway
Surrey, B.C. V4N 0E8
800.773.7001

Website

www.fortisbc.com

Intermountain

Incorporated in 1950 and beginning operations in 1956, Intermountain Gas Company is a natural gas utility serving southern Idaho in an area that includes 76 cities and 23 counties, with a population of about 1,400,000. The company is based in Boise, Idaho.

Intermountain serves 138 industrial customers. Potato and other food processing, dairy and meat processing, chemical and fertilizer production, and electronics manufacturing are the largest market segments. In 2020, 49 percent of gas throughput was for industrial use, with commercial and residential segments using about 17 percent and 34 percent, respectively.

Intermountain owns and operates a 6-million therm (7.3 million gallon) liquefied natural gas (LNG) storage facility near Nampa, Idaho, and a satellite LNG facility near Rexburg, Idaho.

During 2020, Intermountain delivered 755 million therms (72 billion cubic feet) of natural gas to an average of 382,000 customers. In 2020, the number of natural gas customers grew by 3.2 percent. Intermountain owns and operates approximately 13,320 miles of transmission laterals, distribution lines, and services.

The company is a subsidiary of MDU Resources Group, Inc., of Bismarck, North Dakota.



Intermountain Gas Company

P O Box 7608
Boise, ID 83707
208.377.6000

Website

www.intgas.com

NW Natural

NW Natural, a 162 year-old company with approximately 1,200 employees, is headquartered in Portland, Oregon. It is one of the fastest-growing natural gas local distribution companies in the country. NW Natural serves more than 770,000 customers in Oregon and SW Washington. Its service area includes the Portland-Vancouver metropolitan area, the populous Willamette Valley, parts of the Oregon coast and portions of the Columbia River Gorge.

NW Natural purchases gas for its core market from a variety of suppliers in the Western United States and Canada. The company operates an underground gas storage facility developed from depleted natural gas reservoirs near Mist in Columbia County, Oregon, and sells storage services from the facility into the interstate market. In addition, the company operates two liquefied natural gas storage facilities in Oregon.

In keeping with its steady growth, its parent company, NW Natural Holding Company has increased annual dividends paid to shareholders every year for 65 consecutive years, one of only a handful of companies to achieve such a dividend record. NW Natural Holdings common stock is traded on the New York Stock Exchange (NYSE: NWN).



NW Natural

250 SW Taylor Street
Portland, OR 97204
503.226.4211

Website

www.nwnatural.com

Puget Sound Energy

Puget Sound Energy (PSE) is Washington state's oldest and largest energy utility, serving 1.1 million electric customers and nearly 900,000 natural gas customers, primarily in the Puget Sound region. PSE meets the energy needs of its growing customer base through incremental, cost-effective energy efficiency, low-cost procurement of sustainable energy resources, and far-sighted investment in the energy-delivery infrastructure.

Within close proximity to the utility's service area is the Jackson Prairie Underground Natural Gas Storage Project, operated by PSE and jointly owned with Avista Utilities and Williams-Northwest Pipeline. Since its first day of operation in 1964, the Jackson Prairie Storage facility has grown to meet increasing demands on the Pacific Northwest gas supply system—currently enough to heat almost 1.2 million homes on a cold winter day.

In early 2021, PSE will also begin operating a new liquefied natural gas facility in the Port of Tacoma. With its 8-million gallon, full-containment LNG storage tank, the facility will ensure continued natural gas service for PSE's residential and commercial customers during times of peak demand. Additionally, as the first LNG bunkering terminal on the west coast of North America, it will meet the fuel supply needs of TOTE Maritime Alaska and other potential transportation customers.

PSE, the utility subsidiary of Puget Energy, is regulated by the Washington Utilities and Transportation Commission.



**PUGET
SOUND
ENERGY**

Puget Sound Energy

P O Box 97034
Bellevue, WA 98009

Website

www.pse.com

TC Energy

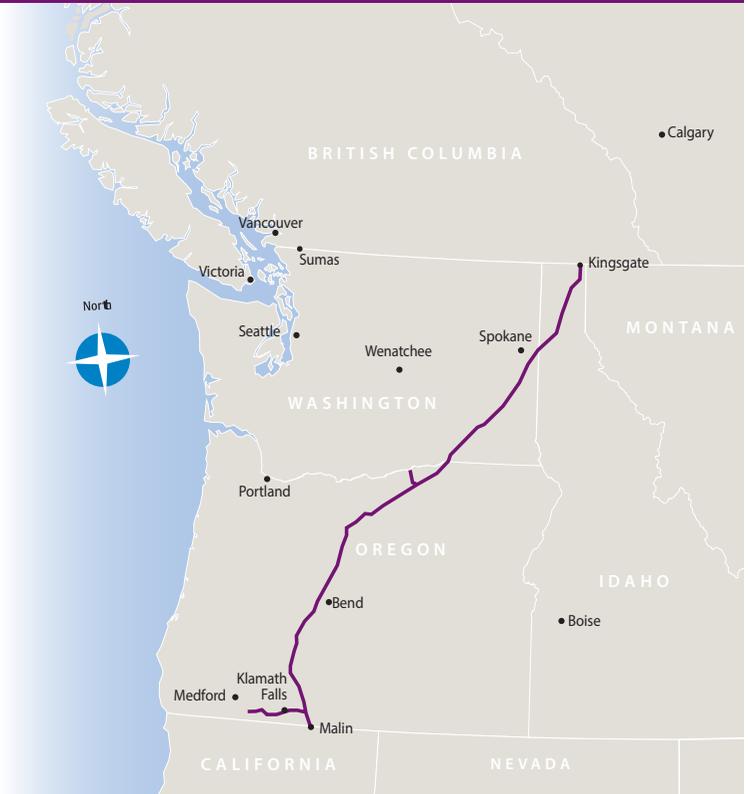
TC Energy is one of the largest U.S. transporters of Canadian natural gas. GTN's 612-mile, 36- and 42-inch-diameter pipeline system is the primary path for Western Canada Sedimentary Basin natural gas to reach markets in the Pacific Northwest, California, Nevada, and the rest of the U.S. West. GTN's strategic value derives from its position downstream of TC Energy's Alberta and British Columbia pipeline systems.

TC Energy's Alberta system is the primary transmission pipeline serving the WCSB providing physical access to 15.7 Bcf/d of gas production in Western Canada, and to Nova Inventory Transfer (NIT), one of the most liquid markets in North America, as natural gas originating from this system has access to multiple downstream markets including U.S. markets in the Pacific Northwest, California, the Midwest and Northeast via connectivity to key U.S. pipeline systems.

GTN transports up to 2.7 Bcf/d of Canadian and domestic natural gas to serve western U.S. markets. The pipeline system commences at the U.S./Canadian border, near Kingsgate, British Columbia, and terminates near Malin, Oregon, where it connects to Pacific Gas & Electric Co's California Gas Transmission System and to Tuscarora Gas Transmission.

GTN's customers are principally local retail gas distribution utilities, electric generators, natural gas marketing companies, natural gas producers, and industrial companies.

GTN also operates North Baja Pipeline System (NBP) which is owned by TC PipeLines, LP. The NBP system has the ability to flow in both north-to-south and south-to-north directions, but the predominate flow, due to increasing domestic natural gas production, is north-to-south. The 86-mile North Baja Pipeline system can deliver natural gas produced from West Texas and the Rocky Mountain region to markets in both the Western U.S. and Mexico.



Gas Transmission Northwest

700 Louisiana Street
Houston, TX 77002
503.833.4000

Website

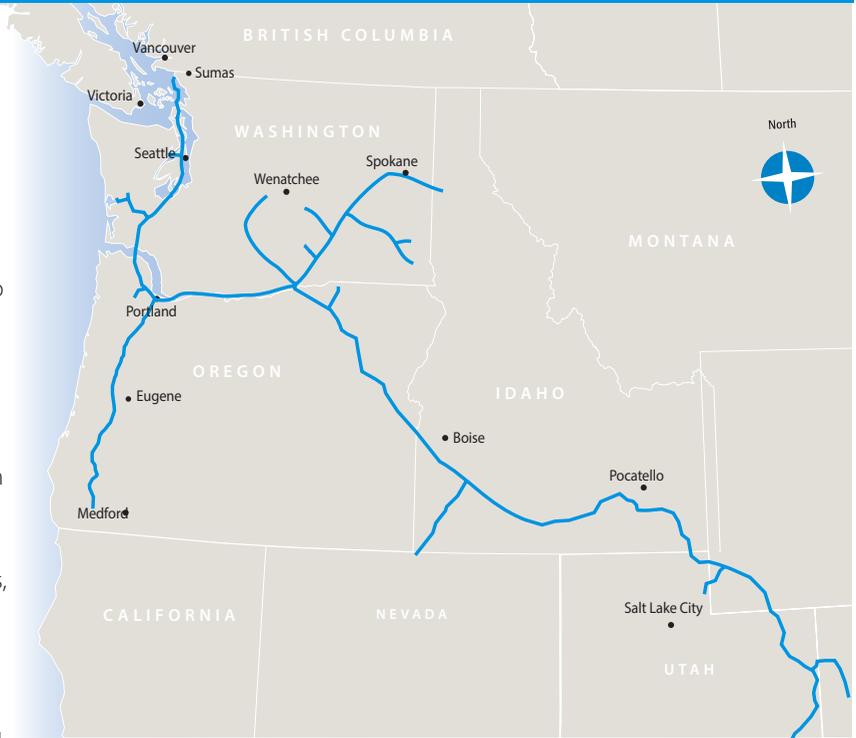
www.gastransmissionnw.com

Williams Northwest Pipeline

Williams Northwest Pipeline (Northwest) has provided safe and reliable transportation of natural gas to the Pacific Northwest and Intermountain region for more than 60 years. With initial pipeline facilities constructed in 1956, Northwest has upgraded and expanded its system significantly over the years in order to meet the regions increasing demand for natural gas. Northwest's natural gas transmission system includes 3,900 miles of pipeline and extends from the Colorado/New Mexico state border to the U.S./Canadian border in the state of Washington.

Northwest's wide customer base includes local distribution companies, marketers, producers, electric generators and various industrial users. Its transmission system serves customers with long-term firm transportation agreements, including peak service, with an aggregate capacity of 3.8 million dekatherms per day of natural gas.

Northwest's bi-directional system provides access to abundant natural gas supplies in the Rocky Mountain region, the San Juan Basin and the Western Canadian Sedimentary Basin, including British Columbia and Alberta. This offers customers supply diversity and choice. For added flexibility and reliability, Northwest provides its customers access to approximately 120 billion cubic feet of storage capacity on its system. It owns and operates a liquefied natural gas peak storage facility at Plymouth, Washington, owns one-third of the underground storage facilities at Jackson Prairie near Chehalis, Washington, and contracts underground storage at Clay Basin in northeastern Utah. Northwest's gas control center in Houston, Texas, oversees operations 24 hours per day using real-time tracking to monitor pressure and flow rates through its network of computers and satellites.



Williams' Northwest Pipeline

2800 Post Oak Blvd
Houston, TX 77056
713.215.6301

Website

www.williams.com

Glossary

Alternate Fuel

Other fuels that can be substituted for the fuel in use to generate power or run equipment. In the case of natural gas, the most common alternative fuels are distillate fuel oils, residual fuel oils, coal and wood.

Btu

British thermal unit, a measure of the energy content of a fuel. The heat required to raise the temperature of one pound of water by one degree Fahrenheit at a specified temperature and pressure. One Btu equals 252 calories, 778 foot-pounds, 1,055 joules or 0.293 watt hours. One cubic foot of natural gas contains about 1,027 Btus.

Burner Tip

A generic term referring to the ultimate point of consumption for natural gas. Also, an attachment for a burner head which forms a burner port modified for a specific application.

Capacity

Maximum gas throughput a pipeline can deliver over a given period of time generally stated in MMcf/day. Also used to refer to contract volumes by held by shippers: "XYZ Shipper holds 100 MMcf/day of firm capacity on ABC Pipeline."

Capacity Release

A mechanism to establish a secondary market for firm transportation capacity. Each pipeline must offer capacity release through which holders of firm capacity can voluntarily resell all or part of their firm transportation capacity rights for a short or long period to any person who wants to obtain that capacity by contracting with the pipeline. Released capacity must be traded via electronic bulletin board, through a bidding process. Capacity released for a calendar month or less, or at maximum rate, does not have to be bid (all prearranged rate).

Cathodic Protection

A technique to prevent the corrosion of a metal surface by making that surface the cathode of an electrochemical cell.

Cogeneration

The use of a single prime fuel source to generate both electrical and thermal energy in order to optimize the efficiency of the fuel used. Usually the dominant demand is for thermal energy with excess electrical energy, if any, being transmitted into the local power supply company's lines.

Compressor Station

Locations along the interstate pipeline at which large (thousands of horsepower) natural gas-powered engines increase the pressure of the natural gas stream flowing through the station by compression.

Convergence

Describes the innovative combination of gas and electric services usually through a merger or acquisition between gas and electric companies. Also used to describe increasing dependence upon natural gas for electrical generation.

Core Customers

Residential/commercial customers who rely on traditional distributor-bundled service of sales and transport.

Curtailement

A method to balance natural gas requirements with available supply. Usually there is a hierarchy of customers for the curtailment plan. A customer may be required to partially cut back or totally eliminate his take of gas depending on the severity of the shortfall between gas supply and demand and the customer's position in the hierarchy.

Decline Rate

The rate by which natural gas production slows as a natural gas well is drawn down (depleted) over time.

Direct-Connect Customers

Usually very large industrial customers connected directly to an interstate pipeline system. These customers purchase their own gas supplies and contract directly with the pipeline for transportation, thereby bypassing the bundled services typically offered by local distribution companies.

Deliverability

Maximum rate at which natural gas can be extracted from a supply well, transported through a pipeline or withdrawn from a storage well over a given period of time.

Demand Side Management (DSM)

Utility activities designed to influence the amount and timing of customer demand, producing changes to the overall demand. Conservation programs are a DSM technique.

Dig-in

When buried gas facilities (or other underground utilities) are damaged by excavation.

Displacement

Method by which one company trades a like amount of gas to another, even though the gas itself does not move.

Dual-Fuel Capability

Ability of an energy-burning facility to alternately utilize more than one kind of fuel, usually gas and oil.

Firm Service

Service offered to customers under schedules or contracts which anticipate no interruptions. The period of service may be for only a specified part of the year as in Off-Peak Service. Certain firm service contracts may contain clauses which permit unexpected interruption in case the supply to residential customers is threatened during an emergency.

Fixed Costs

Costs which relate entirely or predominantly to the capital outlay necessary to provide the system capacity plus operating expenses which do not vary materially with the quantity of gas transported through the pipeline system.

Force Majeure

A superior force, "act of God" or unexpected and disruptive event, which may serve to relieve a party from a contract or obligation.

Forward or Futures Contract

Contract for future delivery of a commodity such as natural gas at a price determined in advance.

Fuel Switching

Act of an end-user with dual-fuel capability switching fuel types if one type of fuel becomes more economical or reliable than the other.

Gasification

The process during which liquefied natural gas (LNG) is returned to its vapor or gaseous state through an increase in temperature and a decrease in pressure.

Hedging

Any method of minimizing the risk of price change.

Henry Hub

A pipeline interchange located in Louisiana which serves as the delivery point of NYMEX natural gas futures contracts. Henry Hub is one of the most active natural gas trading points in North America and is commonly used as an index against which prices at other trading points are compared.

Hydrostatic Test

A strength test of equipment (pipe) in which the item is filled with liquid, subjected to suitable pressure, and then shut in, and the pressure monitored.

Integrated Resource Planning

A utility planning method whereby alternative resource mixes, including demand-side and supply-side options, are evaluated in order to determine which resource plan minimizes the overall cost of service, subject to reliability and various other constraints.

Interruptible Service

A transportation service similar to firm service in operation, but a lower priority for scheduling, subject to interruption if capacity is required for firm service. Interruptible customers trade the risk of occasional and temporary supply interruptions in return for a lower service rate.

Line Pack

Natural gas occupying all pressurized sections of the pipeline network. Introduction of new gas at a receipt point "packs" or adds pressure to the line. Removal of gas at a delivery point lowers the pressure (unpicks the line).

Liquefied Natural Gas (LNG)

Natural gas which has been liquefied by reducing its temperature to minus 260 degrees Fahrenheit at atmospheric pressure (i.e. liquefaction). In volume, it occupies 1/600 of that of the vapor at standard conditions, making long distance shipping feasible.

Load/Load Balancing/Load Factor

The Load is the amount of gas delivered or required at any specified point or points on a system; load originates primarily at the gas consuming equipment (burner tip) of the customers. Load balancing is the process by which a pipeline uses line pack and storage capabilities to equalize system gas pressures. The load factor represents the percentage of total capacity that is utilized in a given period of time.

Local Distribution Company (LDC)

Company engaged primarily in the purchase and distribution of natural gas to end-users. Closely regulated at the state level, LDCs do not profit from the resale of natural gas (see purchased gas adjustment). They are allowed to earn a return on the investments necessary to distribute the gas to end users.

Looping

Increasing the capacity of a transmission system by installing an additional pipeline alongside the original.

Main

A distribution line that serves as a common source of supply for more than one service line.

Market Hub

Point of interconnection between two or more pipelines, gas processors or storage facilities where the transfer of gas and related service takes place, coordinated by the operator of the hub.

Marketer

Entity that links customers and gas companies by providing services such as accounting, supply aggregation and sales, and arranging for transportation.

Mileage-Based Rates

Rates designed to reflect the difference in pipeline costs based on the distance between supply sources and delivery points.

Odorant

Any material added to natural or LP gas in small concentrations to impart a distinctive odor. Odorants in common use include various mercaptans, organic sulfides, and blends of these.

Open Season

Period during which a pipeline company consults with market participants seeking customers for a pipeline expansion.

Operational Flow Order (OFO)

An order issued by a pipeline prescribing specific actions to be taken by shippers to alleviate conditions that threaten or could threaten safe operations or pipeline integrity.

Peak Day/Shaving

A peak day is the one day (24 hours) of maximum system deliveries of gas during a year. Peak shaving is a load management technique where supplemental supplies, such as LNG or storage gas, are used to accommodate seasonal periods of peak customer demand.

Pig

A device used to clean and/or inspect the internal surface of a pipeline. They are inserted into the pipeline by means of a device called a pig-trap and pushed through the line by pressure of the flowing fluid, usually gas.

Pilot

A small flame which is utilized to ignite the gas at the main burner(s).

Postage-Stamp Rate

Flat rates charged for natural gas transportation service without regard to distance.

Price Signals

Commodity prices help market participants interpret the status of the marketplace. For example, low natural gas prices signal an abundance of gas, low demand, increased supply competition or some combination thereof.

Producer

Any party owning, controlling, managing, or leasing any gas well and/or party who produces in any manner natural gas by taking it from the earth or waters.

Proved Reserves

An estimated quantity of natural gas deemed to be recoverable in the future from known oil and gas reservoirs under anticipated economic and current operating conditions. Reservoirs that have demonstrated the ability to produce by either actual production or conclusive formation test are considered proved.

Purchased Gas Adjustment

A provision approved by a regulatory agency allowing a company to make filings to change its rates reflecting its cost of purchased gas. If actual purchased gas costs were lower than anticipated during the previous period, customers may experience a rate decrease. The reverse is true if actual purchased gas costs were higher than anticipated.

Spot Market/Price

A market characterized by short-term, interruptible contracts for specified volumes of gas. Participants may be any of the elements of the gas industry - producer, transporter, distributor, or end user. Brokers may also be utilized. The Spot Price is a current one-time purchase price.

Storage Facility

A subsurface geologic formation suitable for and used to store natural gas for the purpose of fuller utilization of pipeline facilities and effective market delivery or load management.

Stress Crack

Internal or external crack in a material caused by tensile or shear stresses less than that normally required for mechanical failure in air. The development of such cracks is frequently related to and accelerated by the environment to which the material is exposed. More often than not, the environment does not visibly attach, soften, or dissolve the surface. The stresses may be internal, external, or a combination of both.

Sweet/Sour Gas

Sweet Gas in its natural state can be used without purifying. Sour Gas contains enough sulfur in its natural state to make it impractical to use without purifying.

Transportation

The act of moving gas from a designated receipt point to a designated delivery point pursuant to the terms of a contract between the transporter and the shipper. Generally it is the shipper's own gas which is being moved.

Unbundling

The separation of the various components of gas sales, storage, transmission, delivery, etc., turned into an a la carte menu of services, allows customers to choose only those desired services, is an aspect of a deregulated market.

Unconventional Gas

Natural gas that can not be economically produced using current technology.

Variable Costs

Operating costs which, in the aggregate, vary either directly or indirectly in relation to any change in the volume of gas sold and/or transported; i.e., compressor station fuel and expenses.

Wellhead/Wellhead Price

The wellhead is the point at which gas flows from the ground. The wellhead price is the price of gas flowing from the wellhead, exclusive of gathering, treating, or transportation charges.

Working Gas

Gas in storage which is available for withdrawal during a normal injection and withdrawal cycle.

Common Conversion

Fuel	Common Unit	BTU Content
Natural Gas	Therm	100,000
Diesel (light)	Gallon	140,000
PS300	Gallon	150,000
Bunker C (heavy)	Barrel (42 gal)	6,400,000
Propane	Gallon	92,500
Electricity	KWH	3,413
LNG	Gallon	85,800

1 Ton A/C = 12,000 BTU

1 Boiler HP = 42,000 BTU Input

100 Boiler HP = 42 Therms

100 lb steam = 1 Therm

1 engine HP = 10,000 BTU Input

1 BTU = 1 lb water raised 1 F

1 Cu Ft natural gas = 1000 BTU

Boiler efficiency = 80%

Water Heater Efficiency = 75%

BTU = British Thermal Unit

KW = 1000 Watts

1 Therm = 29.3 KWH

Demand charge - not applicable with natural gas



1914 Willamette Falls Drive, Suite 260
 West Linn, OR 97068
 t: 503.344.6637 f: 503.344.6693
www.nwga.org
 Twitter: @NWGas