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WUTC DOCKET: 190334
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BEFORE THE WASHINGTON UTILITIES AND TRANSPORTATION COMMISSION

DOCKET NO. UE-19_____

DOCKET NO. UG-19_____

EXH. HLR-3

HEATHER L. ROSENTRATER

REPRESENTING AVISTA CORPORATION

Avista Utilities

Natural Gas Infrastructure Plan

2019

Thanks & Acknowledgements

Brian Schultz – Gas Safety Programs
Bruce Howard – Environmental Impacts Advisor
David Schafer – Customer Programs
Dawn Donahoo – Customer Engagement
Grant Forsyth – Economics, Customer Information, Editing
James Gall - Analysis
Jeff Webb – Foundational Materials, Editing, Expertise, Guidance
Jody Morehouse – Writing, Editing, Expertise
Michael Whitby – Aldyl A Pipeline Expertise
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Special thanks to Mike Faulkenberry and Jeff Webb for their tenacity in getting this report completed, including excellent editing and guidance!

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Introduction to Natural Gas

What is Natural Gas?

Natural gas is a fossil fuel that largely consists of methane gas and other flammable hydrocarbons including ethane, propane, and butane. It, along with coal and oil, occurs when plant and animal remains, sand and silt, have built up far below the earth's surface over several centuries. These elements decay and accumulate in thick layers. The heat and pressure of the earth turns some of these remains into coal, some into oil (petroleum), and some into natural gas. Though coal and oil tend to be found in layers or pools, natural gas seeps into cracks and spaces and even into the tiny pores within shale, sandstone, and other sedimentary rock. If it is held in these fairly solid materials it is referred to as shale gas or tight gas. Natural gas is also occasionally found in coal deposits. This type of natural gas is known as coalbed methane.

Geologists locate natural gas by searching for the type of rock that is likely to contain natural gas deposits either on land or under the ocean floor. They sometimes use vibrations to find places where it appears there may be pockets of natural gas. If they find one, an exploratory well is drilled and tested. If the geologists are right, the well will produce natural gas. At times oil wells or coal mines produce natural gas as a byproduct. Natural gas is also produced directly from the rocks containing natural gas within their pores. This is done by forcing water, chemicals, and sand down a well. The pressure this creates releases the natural gas from the rock and it flows to the surface.

Natural gas sometimes percolates out of the ground

The History of Using Natural Gas

Natural gas is one of the oldest forms of energy. Before people knew what it was, occasionally lightning strikes would ignite natural gas that was seeping up to the surface of the earth, creating what seemed to the people of that time like a magical fire of divine origin. In fact, the Greeks built a temple on the site of one such flame, the Oracle of Delphi, in about the 1000 B.C. By about 500 B.C. the Chinese discovered that these fires and their associated gas had useful applications. They built crude bamboo pipelines to carry the natural gas to primitive refining stations close to the sea, where they used the gas to boil sea water to remove the salt and create drinkable water.[1]

The Oracle of Delphi Ruins in Central Greece

[1] For more details about the history of natural gas, see: http://naturalgas.org/overview/history/

However, for centuries the value of natural gas was largely ignored. A few inventive individuals studied its properties and explored its potential, but scientists prior to the mid-1700s saw little use for it. Then in about 1785 a man in Britain named William Murdoch began to experiment with natural gas. He extracted the gas from coal,[2] using it to light street lamps and a few buildings. People were amazed by the improvements in safety offered by bright streetlights and by the increased production (and the resulting economic benefits) provided by good lighting in homes and factories. The concept quickly caught on. By the early 1800s France and Russia began using natural gas for their street lights. Its use spread rapidly across Europe.

During this time William Hart, known as the "Father of Natural Gas," began to dig natural gas wells around the Great Lakes region. He formed the first commercial gas lighting company in the U.S. However, most of the natural gas at this time was extracted from coal rather than coming from a well, and there was no pipeline infrastructure to enable it to be widely used by the general population. In addition, no technology existed that allowed it to be used for heating and cooking. It wasn't until the late 1800s that the Bunsen burner was invented, a device that mixed natural gas and oxygen in the right proportions to allow its use for cooking and heating. This invention opened the door to widespread demand for natural gas around the world. More new gas-related inventions quickly appeared, allowing its use in a wide range of applications from household appliances to manufacturing and processing, heating boilers and creating electricity.

Once effective pipelines were built, gas usage and new applications expanded exponentially. The first major pipeline in the United States was constructed in 1891. It was 120 miles long and carried natural gas from its source in central Indiana to Chicago. Following World War II, new welding techniques and advances in metallurgy improved pipeline reliability. This created a construction boom through the 1960s that created thousands of miles of natural gas infrastructure. Currently the United States has the largest network of energy pipelines in the world, with more than 2.4 million miles of pipe, over 300,000 miles of which is interstate and intrastate natural gas transmission pipeline.[3] Natural gas now supplies nearly one quarter of all of the energy used in the United States, with over 69 million residential, five million commercial, and nearly 200,000 industrial customers.[4]

U.S. NATURAL GAS PIPELINE STATISTICS 2018

- ***More than 210 natural gas pipeline systems.***
- ***305,000 miles of interstate and intrastate transmission pipelines.***
- ***More than 1,400 compressor stations that maintain pressure on the natural gas pipeline network and assure continuous forward movement of supplies.***
- ***More than 11,000 delivery points, 5,000 receipt points, and 1,400 interconnection points that provide for the transfer of natural gas throughout the United States.***
- ***24 hubs or market centers that provide additional interconnections.***
- ***400 underground natural gas storage facilities.***
- ***49 locations where natural gas can be imported or exported via pipelines.***
- ***8 LNG (liquefied natural gas) import facilities and 100 LNG peaking facilities.***

[2] Interestingly, some called this gas the "spirit" of coal. https://en.wikipedia.org/wiki/Gas_lighting
[3] Pipeline 101, http://www.pipeline101.org/Why-Do-We-Need-Pipelines
[4] U.S. Energy Information Administration, https://www.eia.gov/dnav/ng/ng_cons_num_dcu_nus_a.htm

Types of Natural Gas

There are two basic types of natural gas depending upon what else is contained in the gas when it is drawn from the wellhead. Dry gas is fairly pure natural gas made up primarily of methane, which is the chief component of end-use natural gas. This type of gas requires minimal processing in order to be "pipeline quality," meaning it can be sent to consumers for use. Wet gas contains other liquids like ethane, propane, butane, and natural gasoline that must be separated from the methane to ensure that the gas sent to customers is pure and has a consistent BTU content. These additional components have values of their own, so wet gas is typically more valuable in the marketplace even though it is more expensive to produce due to the extra processing it requires.[5]

NATURAL GAS PRODUCTS

- ***Natural Gas Liquids*** *(NGL's) are heavier hydrocarbons such as ethane, propane and butane and gasoline suspended in the produced natural gas as it comes from the well. These hydrocarbons are separated as liquids near the production field in a processing plant.*
- ***Liquefied Natural Gas*** *(LNG) is natural gas that has been liquefied by reducing its temperature to -260 degrees Fahrenheit. Once converted into liquid form, it is ready for shipment on specialized insulated tankers to areas of high demand throughout the world. At the receiving terminal, regasification plants are used to convert the liquid back to a gas. This allows the gas to be injected into the existing natural gas pipeline infrastructure.*
- ***Compressed Natural Gas*** *(CNG) is natural gas that is compressed to a pressure at or above 2,400 pounds per square inch and stored in special high-pressure containers. It can be used as a very clean burning substitute for gasoline to fuel vehicles.*
- ***Gas-to-Liquids*** *(GTL) conversion is a complex set of processes that combines the carbon and hydrogen elements in natural gas molecules to make synthetic liquid petroleum products such as diesel fuel for automotive use.*

Compressed Natural Gas Tank

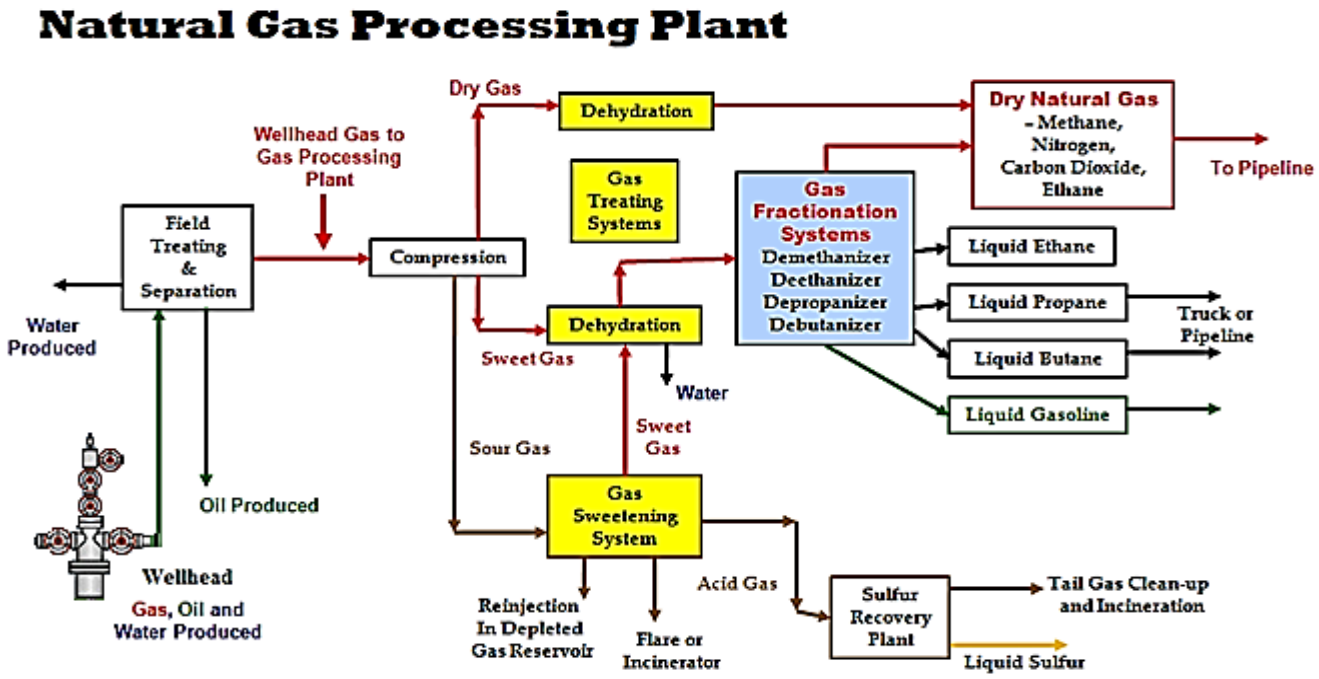
There are other defining characteristics of dry or wet gas as well. If the gas contains a high amount of sulfur, it is known as sour gas, which is extremely corrosive. The sulfur must be removed with extra processing. Sweet gas either does not contain sulfur or the sulfur has been removed. The gas can also contain acid gases that must be removed, such as CO_2. Acid gas is not only corrosive and damaging to pipelines and infrastructure, it is also extremely poisonous. These acid gas elements must be removed before the gas is usable.

Processing

The first thing that takes place after the natural gas leaves the wellhead is to clean it. This cleaning takes place in specialized processing plants either close to the wellhead (field processing) or in processing stations just prior to the gas entering the transmission pipeline system. The amount and type of cleaning needed is quite variable.

[5] Dry gas is 95% or more methane, wet gas is defined as less than 95% methane.

Natural gas from oil wells, often called associated gas, is either floating above the oil or dissolved in the crude oil so must be processed or separated with specialized equipment,[6] leaving natural gas that will still require additional cleaning. Natural gas from gas wells can also contain elements that are undesirable for natural gas usage which must be removed with specialized processing.



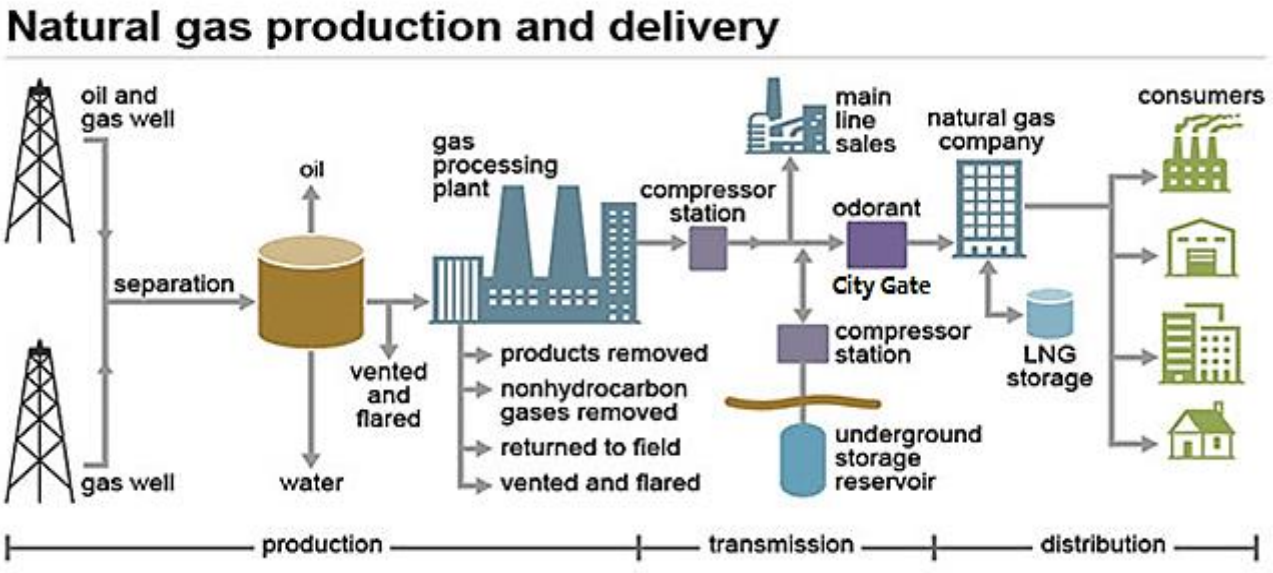
Almost all natural gas must be scrubbed in order to be useful. This consists of separating all of the hydrocarbons and fluids from the pure natural gas until it is "pipeline quality." Excess fluids such as water must be removed through a dehydration process using adsorption or absorption.[7] During this process the fluid is heated to keep the temperature of the gas high enough that it doesn't form crystals from any water present, as crystals may impede the flow of the gas through the pipeline and affect the gas quality. Hydrocarbons such as butane, propane, ethane and natural gasoline are also separated from the natural gas and from each other, as each are valuable in their own right. Methane is the primary component of natural gas and is separated from the other components in order to be used in the natural gas system. Processing plants also use scrubbers to remove sand and other large particle impurities. Once the gas has been processed and it is nearly pure methane, it is acceptable for usage in a natural gas distribution system.[8]

The processed gas, called dry or consumer-grade natural gas, is sent through pipelines and/or stored in underground fields or piped to distribution companies that send the gas on to consumers.

[6] Typically this is done by heating and cooling the composite so the natural gas separates from the oil.
[7] Adsorption is accomplished through a dehydrating agent; absorption occurs when the water vapor is condensed and collected on the surface of the natural gas.
[8] For more information about the processing of natural gas, please see: "Processing Natural Gas" from NaturalGas.org at http://naturalgas.org/naturalgas/processing-ng/

Supply and Delivery

Natural gas is moved from the wellhead to the customer through an elaborate system. There are three major types of pipelines in this system: gathering, transmission (interstate and intrastate), and distribution lines. The gathering system consists of small, low-pressure pipes that transfer the raw gas from the wellhead to the processing plant where it is cleaned and purified. From this point, the gas is injected into larger transmission pipelines that are either intrastate (within a state) or interstate (cross state lines). Transportation pipelines are like a system of highways that travel throughout the U.S. The gas travels through these lines at high pressures of 200 to 1500 pounds per square inch (psi) to both propel the gas and because higher pressure reduces the volume of the gas, allowing more gas to move through the system. These large pipelines, typically made of strong carbon steel, are usually 6 to 48 inches in diameter, depending on their application and how much gas they need to move. There are over 300,000 miles of transmission pipeline in the U.S.[9] Some large industrial, commercial, and electric utility customers receive their natural gas directly from transmission lines, but most customers receive this service through distribution pipelines. The place where the transmission line delivers the natural gas to a local gas utility for transference onto distribution lines is called a city gate, which functions much like a substation in the electric system.

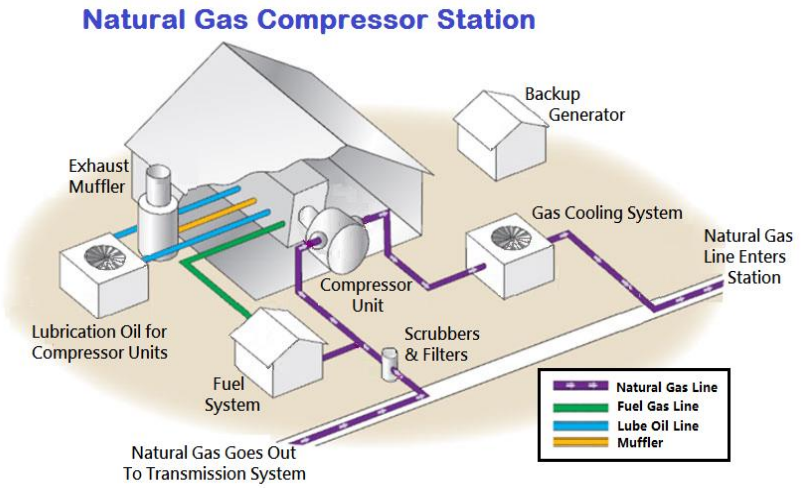


The city gate reduces the pressure in the line, meters the gas for billing purposes, and may perform another filter and scrub of the natural gas. At this point an odorant, usually a blend of chemicals including mercaptan[10] which is the source of the familiar rotten egg smell in natural gas, is also added so leaks can be detected. The gas is then placed into the distribution pipelines. These are typically either coated steel pipelines for strength or highly advanced plastic for flexibility, versatility, and ease

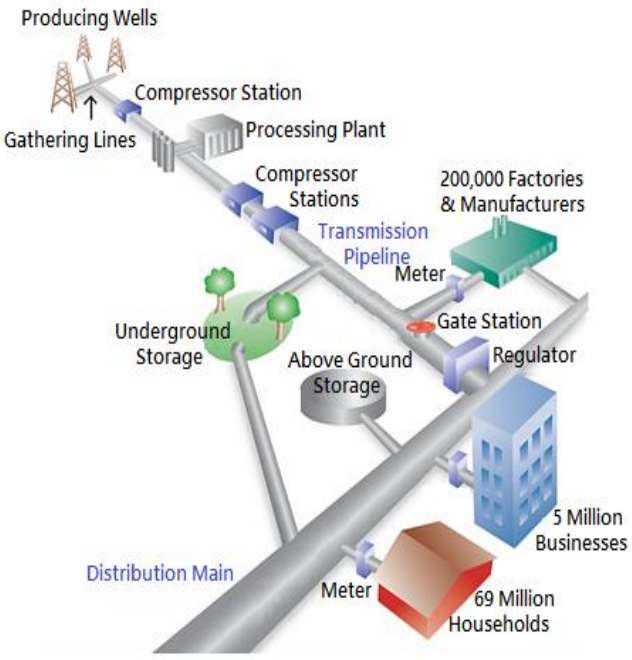
[9] Pipeline 101: http://www.pipeline101.com/why-do-we-need-pipelines/natural-gas-pipelines

[10] Mercaptan is a harmless but pungent-smelling gas made of carbon, hydrogen and sulphur, and is found naturally in living organisms, including the human body where it is a waste product of normal metabolism. It is one of the chemicals responsible for the foul smell of bad breath and flatulence. It is also the distinctive smell experienced after eating asparagus.

of placement. In the U.S. there are about 2.4 million miles of underground distribution pipes.[11] These lines are comprised of mains that carry the gas to towns and neighborhoods, and service lines that carry the gas from the mains into homes and businesses. The natural gas traveling through these lines requires as little as 3 psi of pressure and can be as low as ¼ psi at the customer's meter.



Compressor stations are usually placed about every 50 miles along the gas transmission lines, depending upon the region and the conditions. The compressors are powered by electric or natural gas-fired engines that compress incoming gas to reduce its volume and push it out through the transmission lines.[12] These stations keep the gas moving as the gas flows from an area of high pressure to an area of lower pressure. Compressor stations typically include additional scrubbers, strainers, and filters to remove liquids, dirt, and other impurities from the natural gas, because even though the gas has been processed, water and other hydrocarbons condense out of the gas as it travels and must be removed. These stations also meter the amount of gas in the lines so pipeline companies can track it as it moves through the system.



The entire pipeline system also includes a great number of valves. These valves work like gateways, directing where the gas will flow or stopping the flow completely. Valves allow sections of the pipeline to be separated from the system for maintenance or replacement. Valves can be manually operated, remotely operated, or set to automatically open or close upon meeting specific conditions.

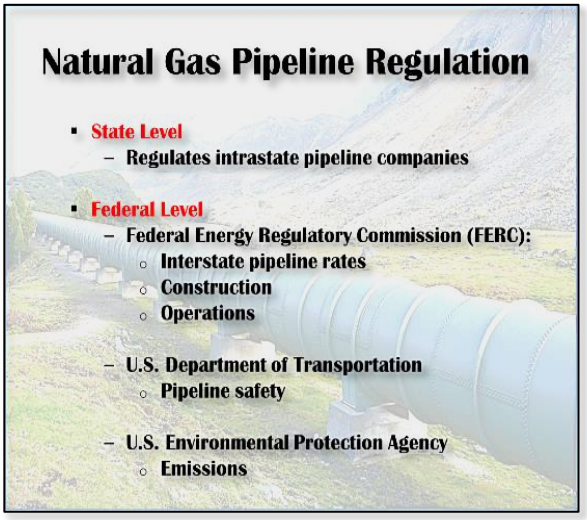
Another critical element in the gas delivery system is storage. One of the benefits of natural gas is that it can be stored for an indefinite amount of time. This allows it to be used to meet utility load variations or to be purchased during low price periods (such as in the summer) for use by

[11] Pipeline 101: http://www.pipeline101.com/why-do-we-need-pipelines/natural-gas-pipelines
[12] Some gathering systems do not need compressors because the pressure of the gas coming out of the wells is high enough to move the gas through the gathering lines.

customers in high price periods (such as in the winter). Gas storage systems have additional benefits in helping balance the flow in pipelines, leveling the amount of gas produced with the amount of gas consumed, reducing price volatility, and providing additional supply availability in unexpected circumstances. Avista recognized the benefits of gas storage to customers very early in the game, helping to develop the Jackson Prairie underground storage facility in 1964. This facility is discussed in detail later in the report.

Regulation of Gas Sales

In the mid-1800s natural gas was typically manufactured from coal and used in the same area in which it was produced, as no delivery systems were in place. Local governments, seeing increasing use of natural gas by the general public, began imposing regulations to ensure that the natural monopolistic tendencies of the industry did not create opportunities for abuse of market power. In the early 1900s the first interstate pipelines were built, and it was no longer appropriate for local governments to set the rules. It became apparent that state level government regulations were needed. Public utility commissions began to spring up around the United States, responsible for the regulation of both gas and electricity within their state boundaries. Between 1910 and 1920, twenty nine states created such commissions.[13]



As the gas industry expanded and new technologies allowed long distance transportation of natural gas, the federal government stepped in to the regulatory arena. Just as local governments were unable to regulate utilities beyond their direct jurisdiction, the U.S. Supreme Court determined that state regulation of utilities that extended beyond their state lines violated the interstate commerce clause of the U.S. Constitution.[14] In 1935 President Roosevelt signed into law oversight of interstate electric transmission lines to the Federal Power Commission (FPC); in 1938 he signed a law designating this same oversight for natural gas pipelines. The 1938 law, the Natural Gas Act,[15] had the goal of protecting consumers by imposing regulations and restrictions on natural gas pricing.

This law applied to all interstate natural gas sales. Unfortunately the regulations did not apply to natural gas producers or pipeline operators. So though this Act was designed to protect customers, its

[13] Edward L. Glaeser and Claudia Goldin, "Corruption and Reform: Lessons from America's Economic History," page 262, https://www.nber.org/chapters/c9986.pdf
[14] Via a series of decisions, the Supreme Court determined that, essentially, electric and natural gas transactions that are exclusively interstate in nature are beyond the power of the states under the Commerce Clause of the U.S. Constitution. For more information, please see: Frank R. Lindh, "Federal Preemption of State Regulation in the Field of Electricity and Natural Gas: A Supreme Court Chronicle," https://www.eba-net.org/assets/1/6/23_10EnergyLJ277(1989).pdf, page 285.
[15] The Natural Gas Act of June 21, 1938: https://legcounsel.house.gov/Comps/Natural%20Gas%20Act.pdf

associated requirements and lack of industry-wide oversight eventually led to a disaster for the gas industry.

First, the implementation of the new law overwhelmed the FPC, which was unable to effectively regulate gas markets, local distributors, and the various regions in the United States. At that time, each area had individual infrastructure issues and different access levels to natural gas, making the creation of a national "guideline" nearly impossible. The FPC then tried to deal with producers on an individual basis, but this was administratively unfeasible and led to a huge rate case backlog. For example, in 1959 there were 1,265 rate case applications but only 240 cases were acted upon.[16]

The Commission also reacted to their new authority by establishing national market prices for consumers. Unfortunately the price levels they selected were artificially low, encouraging increased consumer usage but discouraging natural gas production and thus limiting supplies. At the same time, they had no authority over gas producers or pipeline operators, whose prices were unregulated and driven by what the market could bear. Natural gas wells have vastly different production costs even within the same geographic area, so pricing structures for natural gas prices at the wellhead and as delivered by pipeline operators varied greatly within local areas and across the nation. This led to lawsuits throughout the 1940's and 1950's regarding unfair pricing practices. Finally in 1954 the U.S. Supreme Court determined that all elements of the natural gas system would be placed under the jurisdiction of the FPC, who immediately implemented rates for producers based on the cost of providing service rather than market price, thinking this would be an effective pricing strategy.

However, just like before, the FPC was overwhelmed by these new obligations and was unable to create an effective and fair pricing strategy. All through the 1960's and 1970's the agency tried many different methodologies to handle the complexities of the gas industry, from national price ceilings (which ended up being far lower than the market value of the natural gas) to separating the rates by geographical area (which just added to their already overwhelming work load and, again, the variability of production costs made this concept impractical). Backlogs of rate cases continued to grow, reaching the point that in the mid 1970's many areas of the country still had natural gas prices frozen at 1959 levels.

This situation and all of the price systems the FPC tried had a disastrous effect on the natural gas industry. Producer prices dropped so low that they no longer had an incentive to search for and develop new gas sources. Supplies began to dry up. In addition, the regulations, pricing policies, and restrictions discouraged producers from using interstate pipelines to ship gas to consumers across state lines.[17] This created a great situation for states that had natural gas reserves; for those without them, it was a catastrophe. Schools and factories across the Midwest were forced to close due to a shortage of natural gas to heat or operate their facilities. Things were falling apart. The FPC acted

[16] "The History of Regulation," NaturalGas.org, http://naturalgas.org/regulation/history/

[17] The FPC only regulated interstate prices, so natural gas prices within states were relatively free of regulation, allowing producers to sell at a much higher price within their own states and avoid being regulated by the prices ceilings dictated by the FPC that were triggered when natural gas was shipped across state lines.

again, again making things worse, by setting up artificial precedence policies that allowed suppliers to curtail supplies to 'low priority' customers.[18] This lack of equity in the market again resulted in numerous lawsuits.

Realizing something must be done to reduce the constant price changes, supply shortages, demand surges, and customer and supplier frustration, Congress passed the Natural Gas Policy Act (NGPA)[19] in 1978 at the peak of the natural gas shortages, as part of the broader National Energy Act.[20] The NGPA had three main goals:

1) Create a single national gas energy market;
2) Equalize gas supply with gas demand;
3) Allow market forces to determine the wellhead price of natural gas.

As part of this effort, the Federal Power Commission was "updated" to the Federal Energy Regulatory Commission (FERC). The FERC worked to break down the regulatory barriers that caused producers to avoid using pipelines and shipping across state lines, making natural gas more equally available to everyone. The new Commission also revised the outdated pricing concepts of the FPC, setting price ceilings that were intended to be both fair to consumers and to incentivize producers to continue to search for and develop new gas reserves.

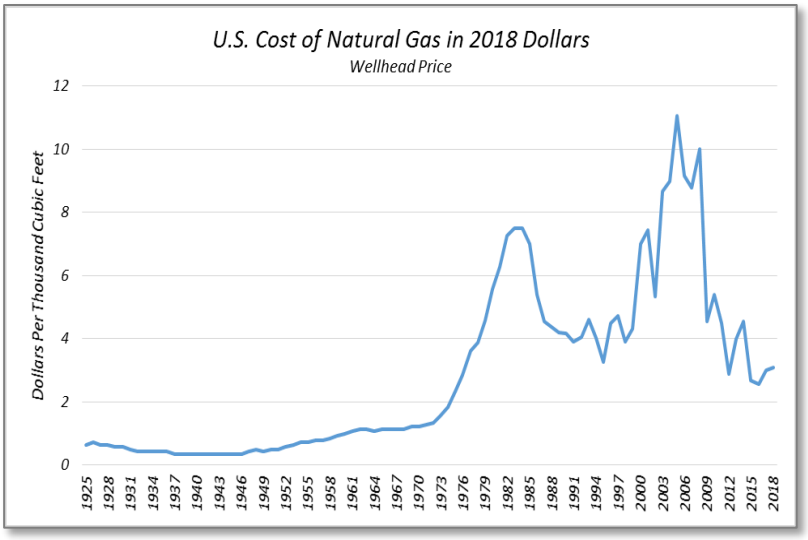


Figure 1. Historic U.S. Natural Gas Wellhead Prices

Unfortunately the new prices, though they promoted fairness among the parties, were a disincentive to consumers, who reduced their demand while producers were increasing the supply of natural gas, leading to an oversupply. In some parts of the country, the pricing signals encouraged industrial and electric generation customers to begin switching from natural gas to other fuels (such as coal). Producers reacted to that by offering special contracts[21] that allowed these customers to purchase gas directly from producers.

[18] "Low Priority Customers" included industrial and commercial boiler fuel users, utilities, or customers who had the option to switch to an alternative fuel. Many interstate pipeline companies skirted around this rule by making "emergency purchases" to continue to serve their low priority customers, creating temporary shortages in the natural gas supply that led to curtailments in all customer classes. https://www.gao.gov/products/EMD-78-10

[19] "National Gas Policy Act of 1978," Ballotpedia, https://ballotpedia.org/Natural_Gas_Policy_Act_of_1978

[20] "Summary of the Energy Policy Act," The U.S. Environmental Protection Agency, https://www.epa.gov/laws-regulations/summary-energy-policy-act

[21] Called "Special Marketing Programs (SMPs)" these contracts involve the direct sale of producer gas that has previously been committed to a pipeline or distribution company. In these contracts, the gas is released by specific pipeline or by a specific distribution company and the producer sells the released gas to an end-user or distribution company at a price below the original contract price in order to be competitive. Transportation of the gas is typically provided by the releasing it from the pipeline at a rate which contributes to full fixed cost recovery. The FERC intended for the SMP to act as a mechanism for gas producers to make necessary price concessions in order to market their production. https://www.aga.org/natural-gas/glossary/r/ "Rate Design – Special Marketing Programs (SMP's)

Courts ruled that this practice was discriminatory and banned it. This was another stumble in the nation's move toward natural gas.

Finally in 1985 the tide began to turn when the FERC issued Order 436, also known as the "Open Access Order,"[22] with the goal of changing the way interstate pipelines were regulated. Rather than allowing only certain customers to purchase gas from producers, this Order changed the role of pipelines from merchant-based to transporters only. Rather than offering the bundled services of product and transportation, pipelines offered "space" in their pipelines to everyone on a first-come-first-served basis without discrimination. Transportation fee minimum and maximum values were set by the Commission and pipeline providers could work within those boundaries to offer prices to customers.

After FERC mitigated the issues associated with the special contracts that existed prior to this Order,[23] the Order began to have a number of effects on the natural gas industry. A natural gas marketplace started to emerge, offering a variety of services, purchasing options, pricing and a variety of transportation patterns. The end user had many more choices and they liked it. Gas consumption once more increased.[24]

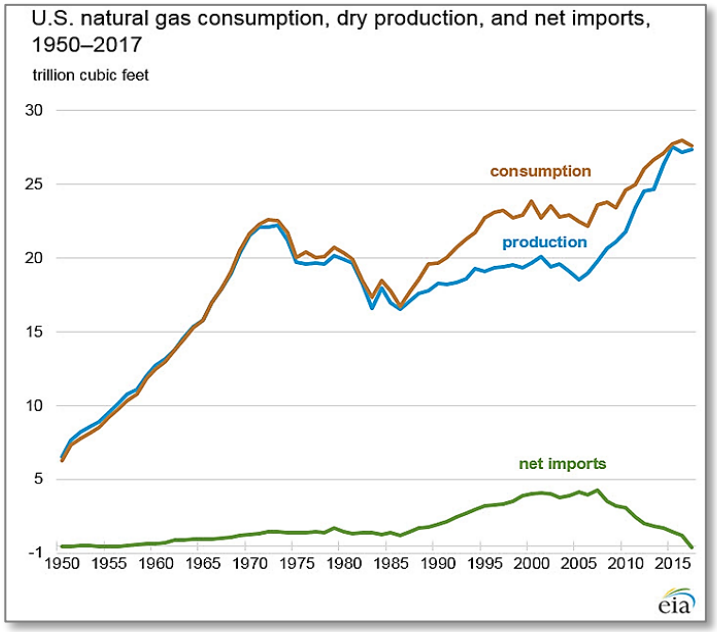


Figure 2. U.S. Natural Gas Consumption, Production & Imports [24]

In order to complete the process they started in separating gas pipelines from marketers, FERC then passed Order 636.[25] This is often called "The Final Restructuring Rule" because it was the culmination of all of the deregulation that had taken place in the gas industry since regulation began in 1938. This Order requires pipeline owners to separate their transportation and marketing services so that all pipeline customers have a choice in selecting their gas sales, transportation, and storage services from any provider in any quantity that is available. With this Order, pipelines could no longer engage in merchant gas sales or sell any products as a bundled service (such as the gas itself plus transportation or storage). It required the restructuring of the interstate pipeline industry so the production and marketing branches were now arms-length affiliates. These affiliates, under Order 636, could in no way have an advantage (in terms of price, volume, or timing of gas transportation) over any other potential user of the pipeline. It gave all gas sellers the equal ability to move gas from the wellhead to the end user.

[22] United States Federal Energy Regulatory Commission, Docket PL05-10-000, https://www.ferc.gov/whats-new/comm-meet/2007/021507/G-1.pdf
[23] This was dealt with via FERC Order 500 which encouraged pipelines to buy out their old contracts – allowing them to pass this cost along to customers – so they could level the playing field and get this new pipeline pricing methodology implemented.
[24] U.S. Energy Information Administration, "Monthly Energy Review," March 2018, Table 4.1, page 84, https://www.eia.gov/totalenergy/data/monthly/archive/00351803.pdf
[25] United States Federal Energy Regulatory Commission, 18 CRR Part 284, https://www.ferc.gov/legal/maj-ord-reg/land-docs/rm91-11-000.txt

Order 636 also required pipelines to provide services that ensured the efficient and reliable delivery of natural gas to customers, including access to storage, flexibility in delivery and receipt locations, and the ability to increase their demand on the pipeline to meet peaks without penalty. Pipeline available capacity must be posted on electronic bulletin boards so all customers have access to this information and the ability to purchase this capacity on an equal basis.

Under the current system of regulation, pipelines and local distribution companies are directly regulated by their state utility commissions with respect to their services, including rates and construction. Interstate pipeline companies are regulated as to the rates they charge, the access they offer to their pipelines, and the siting and construction of new pipelines by the FERC. Producers and marketers are not directly regulated by FERC, but must operate within the confines of local and federal laws related to issues like permitting. Their prices are regulated by the market rather than a state or federal agency.

Natural Gas Pipeline Regulation

Federal Energy Regulatory Commission (FERC)

- Natural Gas Pricing
- Liquid Natural Gas Import/Export Terminals
- Interstate Pipelines

U.S. Department of Transportation

- Pipeline & Hazardous Material Safety Administration (PHMSA) Manages Pipeline Safety Regulations

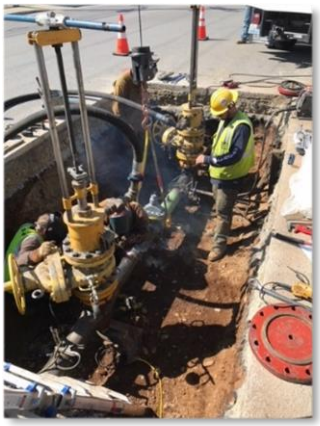
Three State Public Utility Commissions

- 12-15 Audits Per Year

WASHINGTON UTC UTILITIES AND TRANSPORTATION COMMISSION

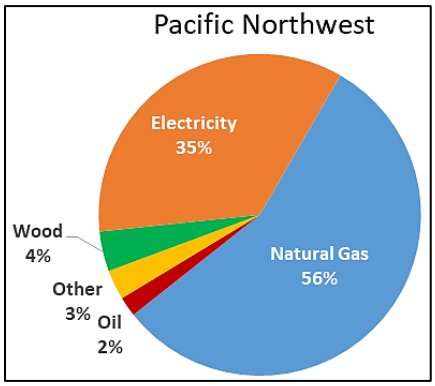
IDAHO PUBLIC UTILITIES COMMISSION

Oregon Public Utility Commission



Natural Gas Usage

Over half of American households use natural gas for heating versus about 36% who rely on electricity to provide heat.[26] Natural gas currently serves nearly 69 million homes, five million businesses and almost 200,000 factories across the United States.[27] In the Northwest, nearly 56% of residential customers rely on natural gas for space heating.[28]



Natural gas tends to be significantly less expensive than electricity for space heating, water heating, cooking, and clothes drying, as shown in the table on the right. In 2017, the average customer with a 100% efficient electric heater would expect to pay about $34 per MBTU as compared to a customer with a 78% efficient (the standard) natural gas furnace, which would cost about $14 per MBTU.[29]

Natural gas was also the largest source of electricity production in the United States in 2016, and although the U.S. has been the world's largest producer of natural gas since 2009,[31] it has become a foundational energy resource around the world,[32] and production continues to increase due to new technologies.[33] Currently more than 99% of the gas used in the United States is drilled in North America[34] and the supply appears to be significant. The U.S. Energy

Appliance	Typical Annual Cost	Lifetime Cost
Space Heating Standard Efficiency		
Natural Gas	$574	$8,606
Heating Oil	$1,238	$18,576
Propane	$1,912	$28,674
Electric Furnace	$1,965	$29,482
Electric Heat Pump	$838	$12,566
Space Heating High Efficiency		
Natural Gas	$499	$7,486
Heating Oil	$1,077	$16,153
Propane	$1,662	$24,934
Electric Heat Pump	$787	$11,798
Water Heating Standard Efficiency		
Natural Gas	$164	$2,128
Heating Oil	$353	$4,594
Propane	$546	$7,092
Electric	$437	$5,676
Water Heating High Efficiency		
Natural Gas	$102	$1,322
Heating Oil	$224	$2,914
Propane	$346	$4,499
Electric	$414	$5,377
Cooking		
Natural Gas	$46	$460
Electric	$101	$1,012
Clothes Drying		
Natural Gas	$37	$342
Electric	$124	$1,239

Natural Gas Costs vs. Other Energy Options [30]

[26] U.S. Energy Information Administration, https://www.eia.gov/todayinenergy/detail.php?id=30672&src=‹ Consumption Residential Energy Consumption Survey (RECS)-f2
[27] "Natural Gas Facts," https://www.peoplesgas.com/company/ournaturalgassystem/naturalgasfactslinks/
[28] "Impact of Electrifying: The Direct Use of Natural Gas in the PNW," NW Natural and Pacific Northwest Utilities Conference Committee, June 8, 2018, http://www.pnucc.org/sites/default/files/June%202018%20NWNatural.pdf. Also the source of the pie chart.
[29] Emily Beach, "Comparing Cost: Gas Furnace vs. Electric Heater," SF Gate HomeGuides, July 18, 2017, https://homeguides.sfgate.com/comparing-cost-gas-furnace-vs-electric-heater-61395.html. Note that natural gas furnaces also tend to have lower maintenance costs than electric furnaces.
[30] Washington Gas Cost Savings Comparison, https://www.washingtongas.com/home-owners/savings/cost-savings
[31] Note that Russia was previously the world's largest natural gas producer. Also, though the U.S. leads the world in natural gas production, it is only fifth in terms of amount of natural gas reserves.
[32] Natural gas accounts for the largest increase in world primary energy consumption. https://www.eia.gov/outlooks/ieo/pdf/nat_gas.pdf
[33] "What You Need to Know About Energy," The National Academies of Sciences, Engineering, and Medicine, http://needtoknow.nas.edu/energy/energy-sources/fossil-fuels/natural-gas/
[34] "A Brief History of Natural Gas," American Public Gas Association, https://www.apga.org/apgamainsite/aboutus/facts/history-of-natural-gas

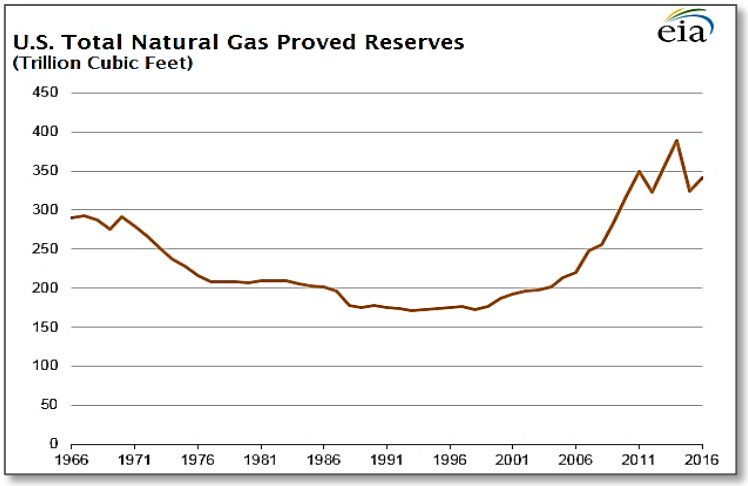


Figure 3. U.S. Natural Gas Proved Reserves [35]

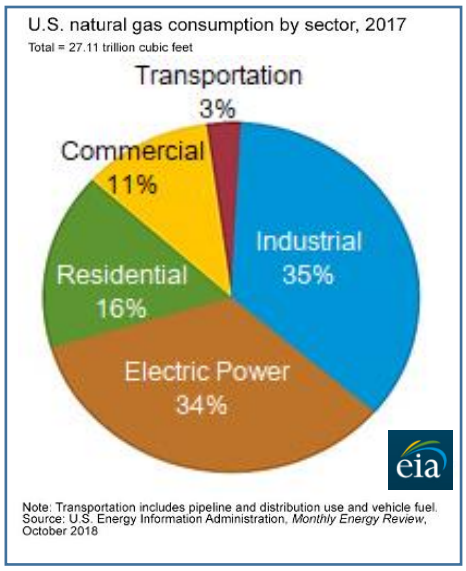


Figure 4. U.S. Natural Gas Usage [37]

Information Administration (EIA) estimates that proved[35] natural gas reserves have doubled since 1993, from about 174 trillion cubic feet to 341.1 trillion cubic feet, primarily due to shale reserves.[36] This has created downward pricing pressure, encouraging significant growth in the use of natural gas nationwide.

Most U.S. natural gas use is for heating buildings and generating electricity. Electricity generation is currently the largest consumer of natural gas and that usage is growing. In 2005, natural gas generated 18% of U.S. electricity. By 2017 that number had risen to 34%. This growth is spurred by the low price of natural gas, the pressure to reduce greenhouse gas emissions, and because natural gas-fired power generation is relatively inexpensive to build and can be designed to ramp up and down quickly to meet changing load conditions, complementing intermittent resources such as wind and solar.

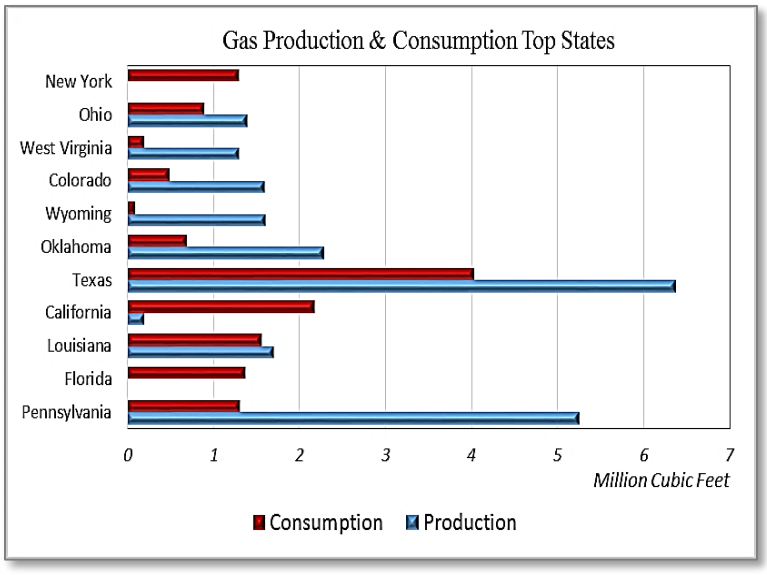
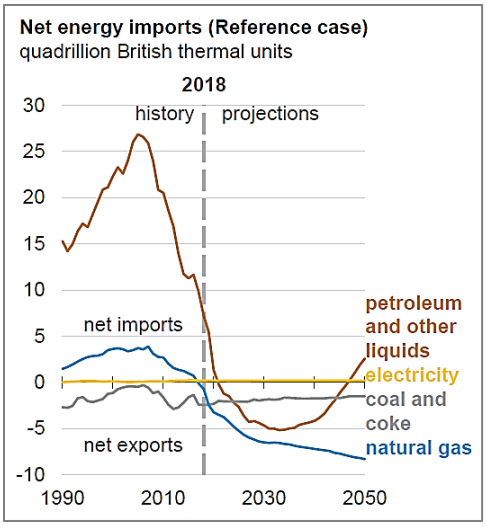


Figure 5. Top U.S. States for Natural Gas Production & Consumption

Five states in the U.S. produce 65% of the natural gas here: Texas, Louisiana, Wyoming, Oklahoma, and Colorado.[38] Interestingly, though Alaska is the second leading natural gas producer in America, most of its production is not brought to market (thus it does not appear in Figure 5) because the production volumes far exceed local demand and the limited available

[35] Proved reserves are the volumes of natural gas known to exist with reasonable certainty (a probability of 90% or greater), based on exploration and development operations.
[36] U. S. Energy Information Administration, February 2018, https://www.eia.gov/naturalgas/crudeoilreserves/#1
[37] U. S. Energy Information Administration, "Natural Gas Explained," https://www.eia.gov/energyexplained/index.php?page=natural_gas_use
[38] U.S. Energy Information Administration, https://www.eia.gov/todayinenergy/detail.php?id=6030



Net Energy Imports from EIA[41]

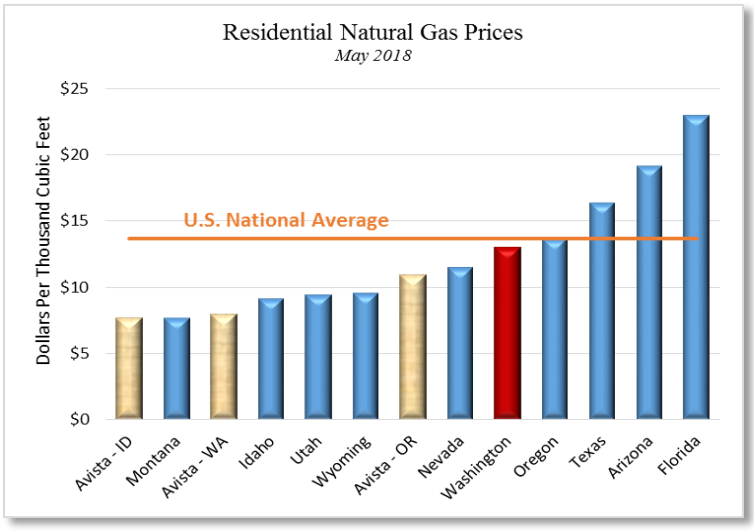


Figure 6. U.S. Natural Gas Prices in 2018

pipeline capacity to ship the product to the continental United States.[39] Though natural gas is used throughout the country, five states account for 38% of total U.S. natural gas consumption: Texas (14.7%), California (7.9%), Louisiana (5.7%), New York (5%) and Florida (4.8%).[40]

In Washington State about 37% of residential customers currently use natural gas for space and water heating.[42] These numbers are growing, especially with the continued decline in natural gas prices.[43] Figure 7 indicates the primary residential energy fuels in Washington State and their usage rates, showing the steady increase in the use of natural gas.[44] Currently Avista's Oregon natural gas direct residential customer rates are below the national average, and Avista rates for Washington and Idaho are about half of the national average as shown in Figure 6.[45]

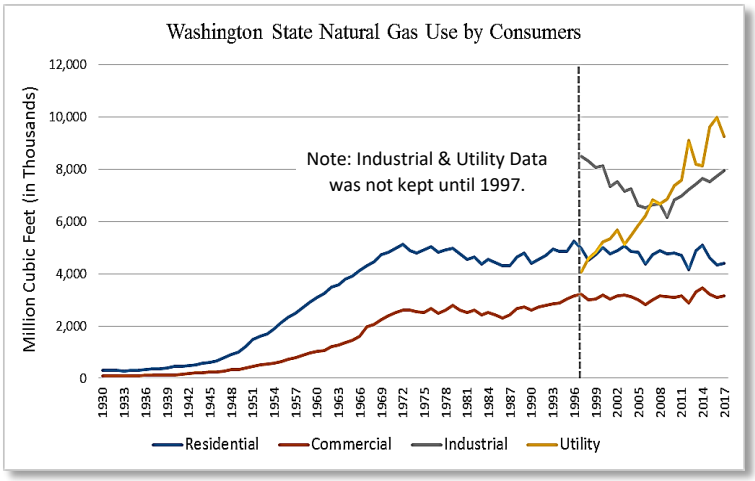


Figure 7. Washington State Natural Gas Usage

The Northwest has access to two prolific supply sources: Canada and the U.S. Rocky Mountain area, which together produce nearly 30% of North America's entire gas supply and provide Avista customers with options for supply.[46]

[39] Most of Alaska's natural gas is reinjected into existing oil fields to pressurize wells used for oil production.
[40] U.S. Energy Information Administration, https://www.eia.gov/energyexplained/index.php?page=natural_gas_use
[41] "Annual Energy Outlook 2018," U.S. Energy Information Administration, February 6, 2018, https://www.eia.gov/outlooks/aeo/pdf/AEO2018.pdf
[42] Not every customer in Washington has access to natural gas, especially in outlying areas.
[43] "2017 Biennial Energy Report and State Energy Strategy Update," Washington Department of Commerce, December 2016, http://www.commerce.wa.gov/wp-content/uploads/2017/01/Commerce-Biennial-Energy-Report-2017.pdf
[44] Source: U.S. Energy Information Administration, https://www.eia.gov/state/seds/sep_use/res/pdf/use_res_WA.pdf
[45] U.S. Energy Information Administration, https://www.eia.gov/dnav/ng/ng_pri_sum_a_EPG0_PRS_DMcf_m.htm.
[46] "Natural Gas Supplies in the Pacific Northwest," NWGA, 2016, https://www.nwga.org/natural-gas-supplies-pacific-northwest/

Avista's Natural Gas Business

In the late 1800s the use of manufactured gas for heating, lighting, and cooking was spreading across the U.S., but it was still difficult to transport and many considered it dangerous to use. Electricity had made its way into Spokane by 1885, but it too was viewed with skepticism. A Farm Journal article at the time claimed that "electric light costs about twice as much as kerosene" and that electric lights were "hard on the eyes."[47]

Washington Water Power Promoting the Use of Natural Gas – Note "Dandy Blue Flame" in the background

Gradually the public came to accept natural gas as an energy source, but Avista, Washington Water Power (WWP) at that time, was committed to providing this energy via electricity made with hydropower. WWP built fourteen hydro projects in the Spokane area by 1930.[48] The Company was successful in promoting this newfangled electricity, and loads grew to match the constant building of additional sources of electric power. It wasn't until 1958 that natural gas-fired generation entered the resource portfolio when the Company purchased a competitor for customers, the Spokane Natural Gas Company. The Company then began promoting the use of natural gas and started expanding its gas system. In the 1960s and 1970s an average of two new communities per year were added to the Company's gas network.[49] In 1973 the Company purchased Columbia Natural Gas, which served the Ritzville area, and in 1991 purchased CP National's gas business which was serving over 63,000 customers in Oregon. The CP National purchase expanded Avista's natural gas customer base by 64 percent.[50] Adding the gas business to Avista's portfolio was quite successful. Between 1989 and 1995, in just six years, the number of gas customers grew from 85,000 to 230,000.

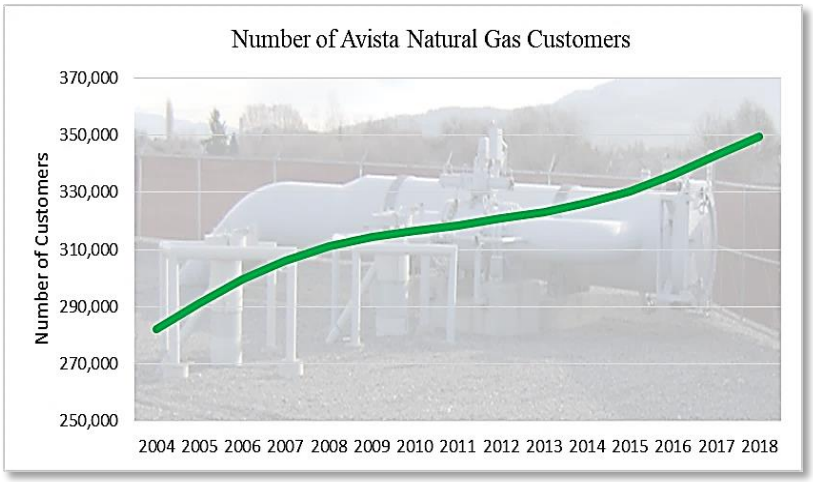


Figure 8. Avista Number of Natural Gas Customers

[47] John E. Kennedy, "Breathing Lampback in the Country," Farm Journal, October 1906, Volume 32, Issue 10. Available from Google Books.
[48] Steve Blewett, "A History of the Washington Water Power Company 1889-1989," https://www.avistalegacy.com/home/company-history/the-stories-of-wwpavista/, page 21.
[49] Ibid, page 51.
[50] "125 Years and Counting," https://www.avistalegacy.com/assets/SidebarPDFs/125thAnnivBook.pdf, page 15.

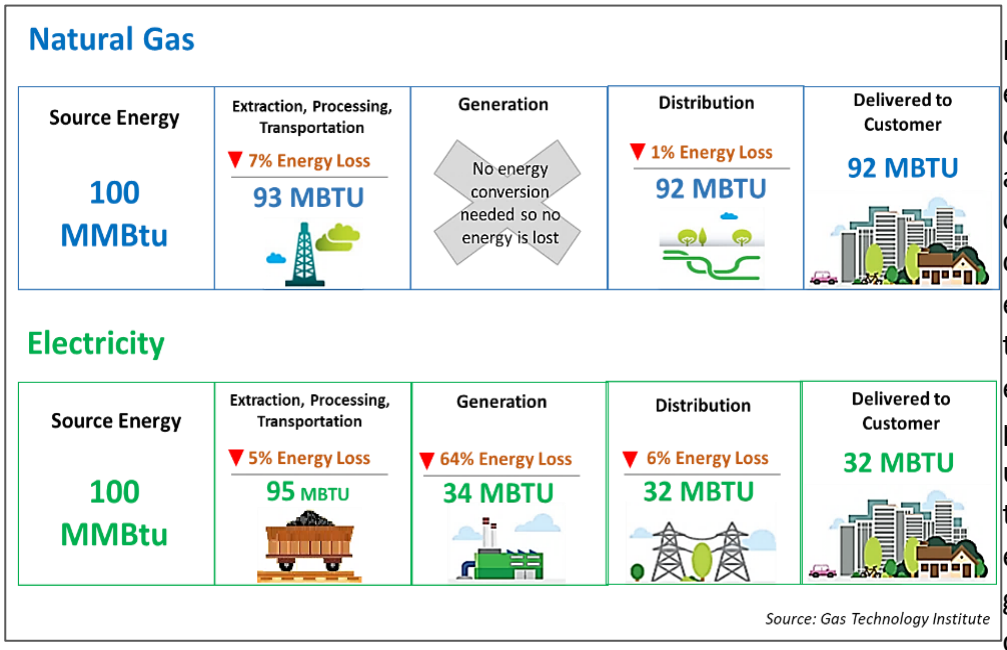
The Company has experienced steady growth in natural gas customers, increasing the customer base nearly 20% since 2004. Today Avista owns and operates 7,800 miles of natural gas distribution mains serving about 350,000 customers across Washington, Idaho, and Oregon.[51] The natural gas Avista purchases can be transported via six connected pipelines on which the Company holds first contractual transportation rights, with access to both U.S. and Canadian supplies.[52] In 2018 the Company delivered over 367 million therms of retail natural gas and over 545 million therms of wholesale natural gas, generating revenues of approximately $330 million dollars.[53] Avista's electric generation mix is also heavily dependent upon natural gas-fired generation. In a typical year, the Company's electricity portfolio is comprised of about 49% hydro, 9.5% coal, 2% biomass, 4.5% wind, and 35% natural gas-fired generation. Natural gas is a significant part of our business on both the electric and the gas side, allowing us to serve our customers energy needs in diverse and cost effective ways.

Natural Gas Direct Customers

When used directly by homes and businesses, natural gas achieves up to 98% energy efficiency versus between 32% and 60% efficiency for heating with electricity generated by natural gas-fired power plants.[54] The difference in efficiency is due to a number of factors, primarily the losses in energy due to the generation process. Both direct use applications and electric generation processes lose some efficiency in processing, but natural gas-fired electric generation loses a significant amount of energy in the generation process, primarily in heat losses when the gas ignites. Even in a high efficiency

[51] Based upon historical data and Company projections.
[52] Oregon Public Utility Commission UG-325, Direct Testimony of Scott L. Morris, page 3, https://edocs.puc.state.or.us/efdocs/HTB/ug325htb154322.pdf. Note that typically approximately 25% of the Company's supply comes from the U.S. with the remaining 75% coming from Canadian sources.
[53] From Avista's 2018 Quick Facts. Note that electric revenues were nearly $900 million during the same time period.
[54] Simple cycle natural gas plants typically range between 32% and 38% efficiency; combined cycle plants can be as high as 60%. Source: "Direct Use of Natural Gas," NW Natural, https://www.nwnatural.com/AboutNWNatural/EnvironmentalStewardship/BetterCleanerMoreDependable

combined cycle unit a great deal of energy is lost. Another 6% is lost in transmitting the electricity across transmission lines to the load source versus only 1% loss in transferring natural gas via pipelines.



Natural gas as a direct energy source is known as one of the most affordable choices for consumer heating and cooking. It is highly efficient and is, in fact, up to three times more efficient than electricity in providing energy for end-use applications. While up to 90 percent of the energy content of natural gas is delivered to customers as useful energy, typically less than a third of the energy used in the production of electricity reaches homes and businesses.[55] Natural gas appliances are also highly efficient, between 78% and up to 98%, which reduce total energy costs for consumers. Residential customers, for example, can reduce their energy usage by up to 30% when they replace electric furnaces and boilers with efficient natural gas appliances.[56] The financial cost of heating a home with a natural gas furnace versus an electric resistance furnace is also dramatically different, up to $1500 in savings per year for an average customer.[57]

> *"The Council recognizes that there are applications in which it is more energy efficient to use natural gas directly than to generate electricity from natural gas and then use the electricity in the end-use application. The Council also recognizes that in many cases the direct use of natural gas can be more economically efficient."*
>
> *Northwest Power & Conservation Council*

After space heating, gas water heaters are typically the second largest energy-related expense for American consumers. The Department of Energy estimates that these appliances account for 14% to 18% of an average utility bill.[58] Gas water heaters can initially cost slightly more than electric heaters to purchase, but can also cost significantly less to operate. The Department of Energy estimated that U.S. consumers pay an average of about $170 per year to operate a standard efficiency gas water heater versus over $400 per year for a comparable standard efficiency electric water heater.[59] It is estimated that if a consumer switches from an electric to a gas water heater, they will recoup the cost

[55] This, of course, varies with the generation source. Large scale hydro can be up to 95% efficient, but excluding that resource, average electricity generation is about 32% efficient.
[56] "Energy Efficiency – Natural Gas Utilities," American Gas Association, https://www.aga.org/policy/environment/energy-efficiency-natural-gas-utilities/
[57] "Cost Savings Comparison," Washington Gas, https://www.washingtongas.com/home-owners/savings/cost-savings
[58] U.S. Department of Energy, https://www.energy.gov/articles/new-infographic-and-projects-keep-your-energy-bills-out-hot-water
[59] American Council for an Energy-Efficient Economy, https://aceee.org/blog/2015/02/water-heaters-get-efficiency-makeover

in about a year.[60] Many customers also prefer cooking with gas and, according to the California Energy Commission, a gas stove typically costs customers less than half as much to operate as an electric stove even though their purchase prices are similar.[61] Interestingly, natural gas consumption in the residential sector is projected to be relatively flat even as more customers are choosing natural gas due to the low price for this energy source. This is due primarily to increasing efficiency levels of natural gas appliances.[62]

Avista Gas Customers	Total (as of 2018)	Percentage
Commercial	35,422	10.07%
Industrial	250	0.07%
Interruptible	45	0.01%
Misc	173	0.05%
Residential	315,734	89.74%
Transportation	212	0.06%
Grand Total	351,836	100%

Avista has three primary categories of natural gas direct customers: commercial, industrial, and residential, plus a small category of transportation customers and a few miscellaneous customers (which include company-use gas). One other small class of natural gas customers are interruptible, which are customers who have agreed to a lower rate in exchange for the Company being able to interrupt their natural gas supply during peak times or when unusual supply issues arise. The Company currently has nearly 352,000 gas customers, over 89% of which are residential, 10% being commercial and less than 1% comprising the remainder of this customer base.

Natural Gas for Electric Generation

Besides directly serving natural gas customers across the service territory, Avista has capitalized on the opportunity to build power generation stations that utilize this resource. Gas-fired power plants tend to be less expensive to build than a comparable coal-fired or hydroelectric plant[63] and can be highly flexible in operations. Natural gas plants can be built for use in baseload, peaking or both, as they can be designed to come online and adjust their output quickly. Currently natural gas comprises about 35% of Avista's electric energy supply. The Company owns five natural gas power plants capable of generating up to 547 megawatts, one of which is baseload and others with generation that can be varied to meet changing load or system conditions.

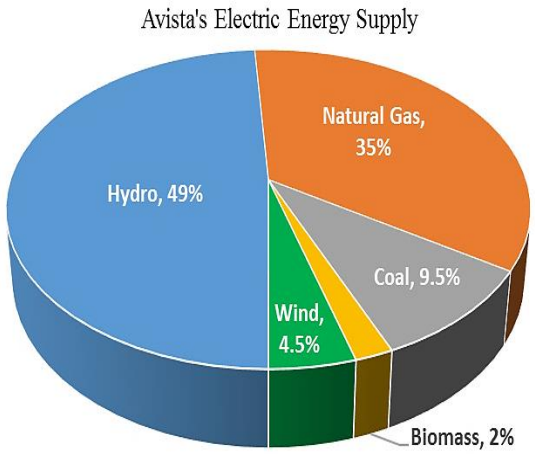


Figure 9. Avista's Typical Electric Energy Supply

Avista's baseload gas-fired plant is the Coyote Springs plant in Boardman, Oregon. This plant was built in 2003 and can generate up to 287 megawatts.[64] Baseload power plants operate at a constant rate of

[60] Houselogic "Water Heater Buying Guide: Gas vs. Electric Water Heater," https://www.houselogic.com/organize-maintain/home-maintenance-tips/hot-water-heater-buyers-guide/
[61] Stephanie Watson, "Gas vs. Electric Stoves: Which One is Really More Efficient?" HowStuffWorks, https://home.howstuffworks.com/gas-vs-electric-stoves.htm
[62] Chart and info from "Annual Energy Outlook 2018," U.S. Energy Information Administration, February 6, 2018, page 13, https://www.eia.gov/outlooks/aeo/pdf/AEO2018.pdf
[63] Energy Information Administration, https://www.eia.gov/todayinenergy/detail.php?id=26532
[64] New technology is being explored for this plant that will allow it to have more flexibility in operations and in meeting load or resource fluctuations.

output. Since these plants tend to be low cost facilities if they are run at the flat production levels for which they were intended,[65] they are typically operated at an output rate based upon load expectations as well as cost, efficiency, and safety. These plants tend to have high fixed costs and high plant load factors,[66] but very low marginal costs. They are not typically designed to be ramped up and down quickly. In fact, it can take several hours to change the production level of baseload units.

Project Name	Fuel Type	Plant Type	Location	Start Date	Summer Maximum Capacity (MW)	Winter Maximum Capacity (MW)
Rathdrum	Natural Gas	Peaking	Rathdrum, ID	1995	130.0	166.5
Northeast	Natural Gas	Peaking	Spokane, WA	1978	42.0	61.2
Boulder Park	Natural Gas	Peaking	Spokane Valley, WA	2002	24.6	24.6
Coyote Springs	Natural Gas	Baseload	Boardman, OR	2003	286.0	287.3
Kettle Falls CT	Natural Gas	Peaking	Kettle Falls, WA	2002	8.0	7.5
Total					**490.6**	**547.1**

The Company also has natural gas-fired plants specifically intended for peaking or reserve capability. These facilities can be brought online and synchronized quickly to the grid, providing the capability to make up the difference between base load and peak load as needed. They are also used to provide operating reserve margins,[67] allowing them to respond as needed to changing conditions on the grid, such as the unexpected loss of a generating unit or a transmission line. They are instrumental in integrating Avista's intermittent wind and solar facilities, as they can respond instantly to changes in the output from these resources.

Above: Rathdrum peaking facility

Right: Lancaster Natural Gas Plant

Avista's largest natural gas-fired peaking facility is the Rathdrum plant, located in Rathdrum, Idaho. This plant has approximately 166 megawatts of winter capacity, 130 megawatts of summer capacity.[68] The Company also owns a peaking facility in Spokane Valley called Boulder Park, which is a 24.6 megawatt capacity plant built in 2002. Another is the Northeast Plant located in North Spokane. This older plant, completed in 1978, is used primarily as a reserve energy resource but can generate up to 61 megawatts when called upon. Finally, in 2003 the Company added a natural-gas fired combustion turbine at Kettle Falls, Avista's biomass power plant. This addition is a natural

[65] Note that the plants have low maintenance costs when run at consistent levels. Going against their design and fluctuating their output outside a limited band can lead to stress on the equipment and higher maintenance costs as well as risk of failure.
[66] Load factor is the measure of output of a power plant compared to the maximum amount it is capable of producing. Most baseload plants are at their efficiency peak if operated close to their maximum capability at a relatively flat rate.
[67] Reserve margin is extra capacity set aside (such as running a generator below its maximum potential output or keeping a unit in "ready mode" on standby) in case of unexpected outages such as when a unit goes offline unexpectedly, a transmission line fails, loads differ from what was expected, etc.
[68] The efficiency of thermal power plants is higher in winter than in summer because in winter the steam condenses at a much lower temperature and pressure, creating more expansion in the steam and increasing the potential of the turbine. https://www.quora.com/Why-is-the-efficiency-of-a-thermal-power-plant-higher-in-the-winter-than-the-summer

gas-fired turbine that can be operated in simple cycle or combined cycle modes depending on energy supply needs. This unit can add up to 8 megawatts of generating capacity to the Kettle Falls facility. Avista also contracted to supply fuel for the Lancaster natural gas combined-cycle plant and take the subsequent output from the plant.[69] The contract for output from this plant extends through 2026. This plant provides up to 270 megawatts of generation. Although the plant is owned by a third party, Avista dispatches it just as they do their other generating resources and operates it primarily as a baseload resource.

Natural Gas Storage and Acquisition

Natural Gas Procurement Plan

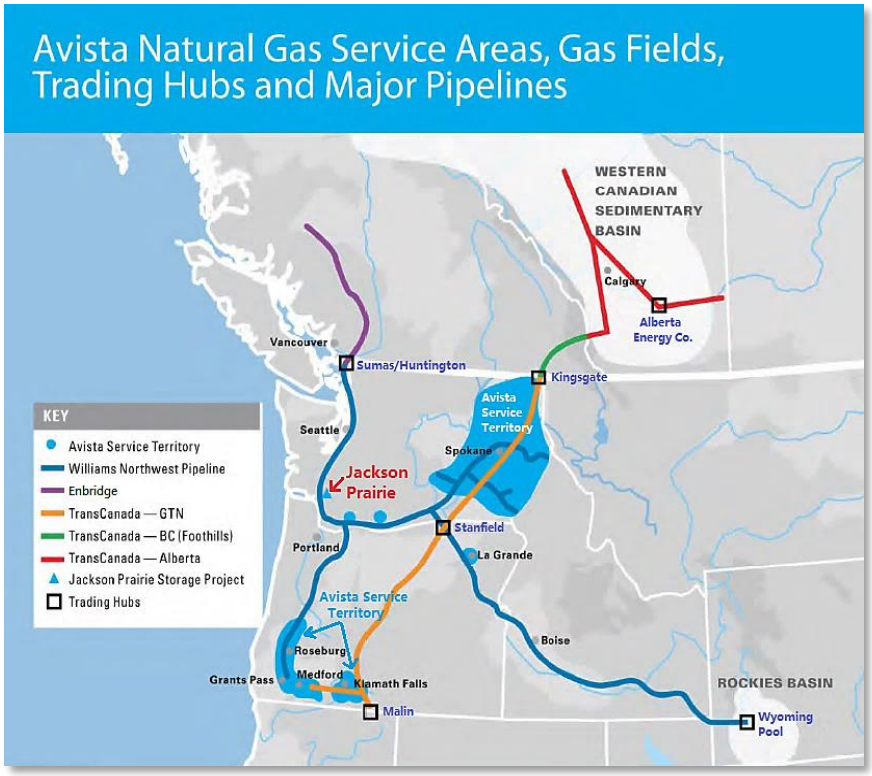
Avista's Natural Gas Procurement Plan has the goal of acquiring low price natural gas while reducing the Company's exposure to price risk and customer load variations. The gas market is volatile. The Company attempts to mitigate the risk associated with this volatility using a plan that includes long and short term price hedging, storage utilization, and index purchases. Market prices, analysis, and experience also play a role, as well as load forecasting by area, customer class and day/weather. All of these complex elements are blended together along with considerations of storage constraints and requirements, storage fill schedules, peak day load requirements, transportation capacity limits, and deliverability, all in an effort to keep customer prices low and supply stable and adequate to meet loads. The Company utilizes three primary tools in managing this complexity.

Jackson Prairie Underground Storage Facility

One of the three key components of this Plan is the Company's Jackson Prairie Storage Facility. This underground facility, discussed in greater detail below, has over 25 million cubic feet of storage capacity, enabling the Company to take advantage of natural gas price spreads, improve the reliability and flexibility of its gas supply, and mitigate peak demand price spikes. It provides numerous economic benefits for our customers. The Company tracks real time market data to guide the purchase and sale of natural gas storage transactions. Company experts use these insights to purchase natural gas in a low cost time periods, storing it at Jackson Prairie, then using the low-cost natural gas to serve customers during high price periods or even selling any additional supply on the market to make a profit, which directly offsets customer costs. Although Jackson Prairie provides the primary storage capability in our gas system, the Company also utilizes pipeline transportation capacity

[69] This type of contract is referred to as a "tolling agreement" which means that one company (Avista) is paying another company (Lancaster Power) by buying the fuel and receiving the energy from the plant in return.

that is not required to serve load. Natural gas can be purchased during low price periods then transported or stored in the pipelines then sold into higher priced markets or used to serve customer loads during peak price periods. All of these carefully considered decisions have the primary purpose of keeping prices low for customers.



Another key component of the Company's natural gas price purchasing and selling strategy is called the Dynamic Window Hedge Mechanism. This tool is designed to reduce cost risk for natural gas purchases and maximize the value of natural gas market sales. Hedging involves taking a position in the natural gas market to secure a purchase or sales price for natural gas at some point in the future. The hope is to buy low and sell high, securing the lowest cost natural gas to serve customers by predicting market prices going forward. Avista's strategic hedging methodology is used to help the Company buy and sell gas in ways that keep customer costs as low as possible while securing the amount of natural gas needed to serve all of our customers with some level of price certainty, thus reducing risk. Hedging reduces exposure to extreme price hikes in a rising market and allows the Company to lock in lower prices in a declining market, keeping Avista customers natural gas prices as low as possible.

The third component in Avista's plan is called indexing, which involves more short term purchases usually associated with daily pricing. These purchases are typically used to make up the difference between forecasted demand, hedge transactions, and actual customer loads.

All of these components, Jackson Prairie Storage, hedging, and indexing work together to ensure that the Company constantly and very actively keeps its finger on the pulse of the gas markets, maximizing value for our customers and insuring we have adequate supply to meet customer demands.

Jackson Prairie Storage Facility

In 1962 Avista formed a partnership with Puget Sound Energy and Williams Gas Pipelines to explore gas storage possibilities. They discovered an ideal site in Southwest Washington State near Chehalis. This site was originally considered for a natural gas well, but the well was dry. Fortunately it was found to be perfect for natural gas storage. It has over 25 million cubic feet of storage capacity and is the

largest natural gas storage site in the Pacific Northwest. Jackson Prairie holds 25% of the entire region's peak-day supply.[70]

Jackson Prairie consists of a series of deep underground reservoirs, basically thick porous sandstone deposits that can hold large volumes of natural gas. It has 104 wells, 45 of which are used for injection or withdrawal. Natural gas is injected into pockets up to 2,000 feet deep, where layers of sediment and sand naturally cap the deposits and keep it underground. Avista owns over 8.5 million dekatherms of working gas capacity (1/3 of the total) at Jackson Prairie.

This storage facility is a tremendous financial benefit for Avista customers. Most utility customers receive their gas supply directly from a network of interstate pipelines and local gas lines and must pay the going rate for their usage. A storage facility such as Jackson Prairie allows Avista to purchase gas at the lowest price periods (typically summertime), store it, and utilize it during the wintertime when gas usage is peaking and prices are highest.

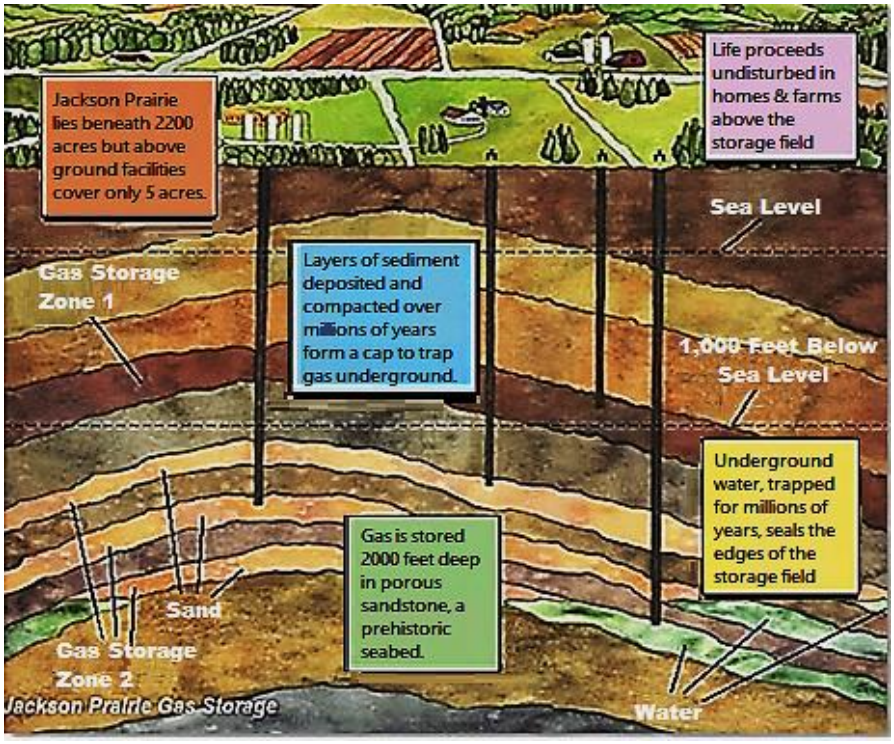


Diagram Courtesy of the Washington State Utilities & Transportation Commission Citizens Committee on Pipeline Safety [71]

Jackson Prairie supplements the interstate gas pipeline supply during customer peak times and ensures that there is adequate natural gas available to serve all customers at any time of day or year. It also helps stabilize energy prices by reducing the need to purchase gas supply during high cost times, reduces dependence upon a sometimes volatile gas market, and provides reliable, cost-effective natural gas to meet customer needs.[72] The stored gas at this facility can also be used to alleviate load imbalances on associated pipelines that sometimes occur when there is a significant difference between the gas that flows into and the gas that flows out of the pipeline. Jackson Prairie allows the Company to occasionally take advantage of market conditions to sell gas stored at Jackson Prairie at a premium and then refill it when prices are down. All of these capabilities directly benefit customers by keeping gas prices low and relatively stable as well as directly offsetting expenses via profits made in the gas marketplace.

[70] "Jackson Prairie Gas Storage," https://www.utc.wa.gov/publicSafety/Documents/PSE%20Presentation%20on%20Jackson%20Prairie%20Operation.pdf
[71] Ibid.
[72] For more information, see "Jackson Prairie Underground Natural Gas Storage Facility" from Puget Sound Energy, https://pse.com/aboutpse/PseNewsroom/MediaKit/052_Jackson_Prairie.pdf

AVISTA'S NATURAL GAS CAPITAL INVESTMENTS

CLASSIFICATION OF INFRASTRUCTURE NEED BY "INVESTMENT DRIVERS"

As a way to create more clarity around the particular needs being addressed with each capital investment, as well as simplifying the organization and understanding of our corporate capital spending, the Company has organized its capital infrastructure investments by the classification of need or "Investment Driver." The need for investments associated with each investment driver is briefly defined below, and in greater detail in the body of this report.

1. ***Customer Requested*** – This category is set aside primarily for connecting new customers or enhancing their service as requested. Typical projects include installing gas facilities in new housing or commercial development or moving equipment at a customer's request, for instance if they are building a deck or addition that conflicts with the current location of their gas meter.

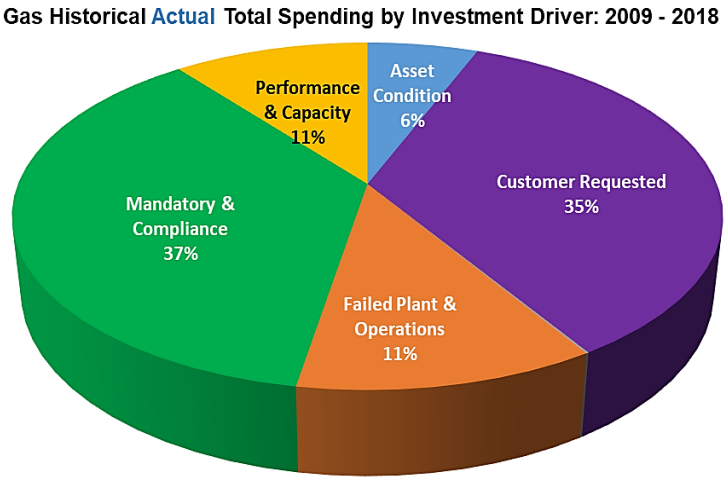


Figure 10. Avista Total Historic Actual Capital Spending by Investment Driver 2009 - 2018

2. ***Customer Service Quality & Reliability*** – This category of spending helps Avista meet our customers' expectations for quality of service and reliability. Programs in this category include the Washington and Idaho advanced gas meter infrastructure (AMI) programs to enhance customer and Company access to information. There are no specific funds set aside in the gas business unit for this category in the current budget cycle.

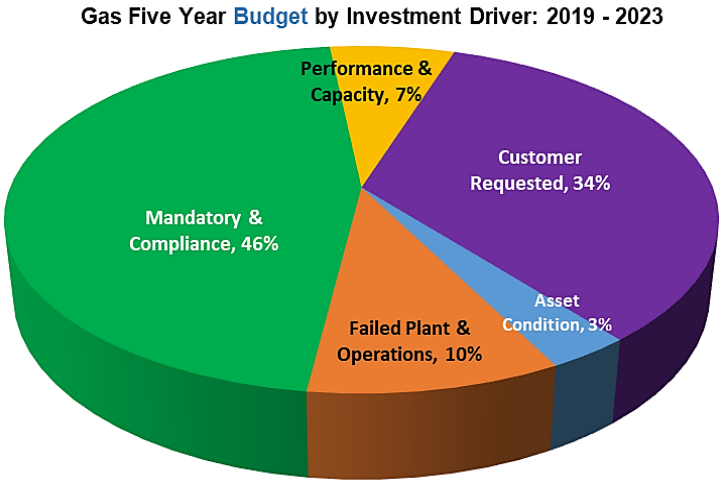


Figure 11. Avista Projected Total Budget Gas Capital Expenditures by Investment Driver 2019 – 2023

3. ***Mandatory & Compliance*** – This is a driver related directly to compliance with laws, regulations and agreements, areas for which the Company has little or no discretion in spending. Avista also develops and maintains multiple standards related to operating our facilities safely as well as following national safety codes and standards. Projects in the Mandatory and Compliance category include the obligation to relocate facilities based on road construction projects, environmental compliance, and replacement of identified at-risk Aldyl A

pipeline. Compliance category are often related to safety. The Gas group's laser focus on safety and compliance leads this to be a primary spending category.

4. ***Performance & Capacity*** – This driver helps ensure that our assets satisfy business needs and meet performance and reliability standards. In the gas business, many of the projects in this category are related to reinforcing gas service as customer loads grow and change. The goal of these programs is to ensure that customers have an adequate supply of natural gas to keep them warm on the coldest days through effectively managing the gas delivery system. This category also includes technology that allows monitoring and controlling the system more proficiently.

5. ***Asset Condition*** – This driver is focused on replacing assets at the end of their useful service life. Avista uses an analytical approach to asset replacement which includes asset criticality, inspections, and optimization of life cycle costs. Gas pipeline condition (and associated equipment) is directly related to customer and employee safety, so the equipment is carefully monitored and replaced as necessary. Laws and regulations are also a factor. For example, regulator stations are required by the U.S. Department of Transportation Pipeline and Hazardous Materials Safety Administration to be kept in very specific condition.[73] Federal Code also requires that Avista maintain an active program related to asset condition, including evaluating risk related to gas facilities and mitigating any such risks, such as unconventional or obsolete pipe, deteriorated pipe or associated equipment, or corrosion issues.

6. ***Failed Plant & Operations*** – This category of spending replaces failed equipment, typically related to storm damage or the unexpected failures of capital assets. In Gas, this funding is under a program called Non-Revenue, which tends to be reactionary work such as responding to leaks, damaged equipment, dig-ins, etc.

Currently Planned Capital Investments in Natural Gas 2019 – 2023

For the next five-year planning horizon Avista expects to spend nearly $372 million in capital dollars allocated across five of the six investment drivers described above. Avista's programs for gas infrastructure investments are summarized by investment driver below. Those related to our safety programs are discussed in more detail later in this report.

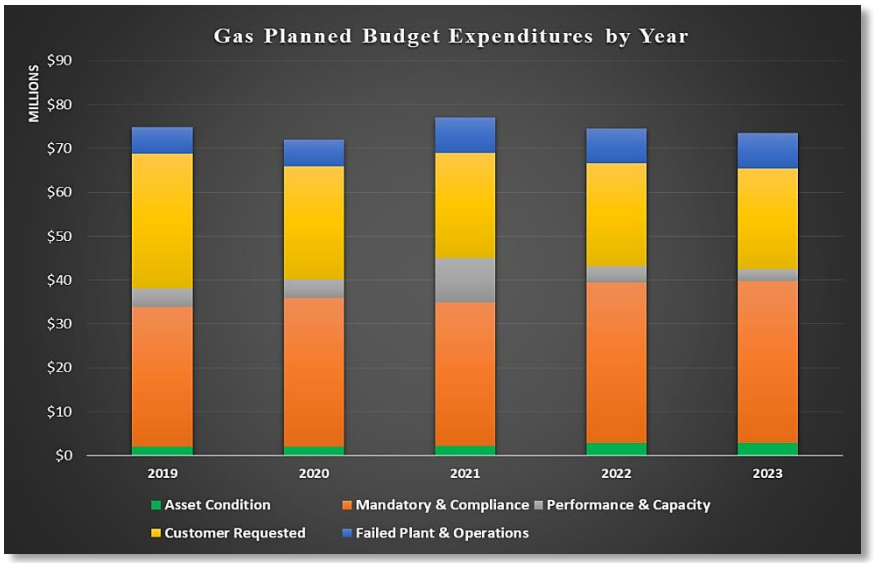


Figure 12. Avista Projected Capital Budget Expenditures by Year 2019-2023

[73] DOT Code of Federal Regulations Title 49 Transportation 192.739, https://www.gpo.gov/fdsys/pkg/CFR-2017-title49-vol3/xml/CFR-2017-title49-vol3-sec192-739.xml

Expenditures by Investment Driver	2019	2020	2021	2022	2023
Customer Requested	$30,685,397	$25,737,168	$23,966,378	$23,450,265	$23,071,607
Mandatory & Compliance	$31,943,892	$33,893,892	$32,643,892	$36,649,089	$36,842,918
Performance & Capacity	$4,200,000	$4,300,000	$10,200,000	$3,700,000	$2,700,000
Asset Condition	$2,000,000	$2,000,000	$2,200,000	$2,800,000	$2,870,000
Failed Plant & Operations	$6,000,000	$6,000,000	$8,000,000	$8,000,000	$8,000,000
Total	$74,829,289	$71,931,060	$77,010,270	$74,599,354	$73,484,525

Table 1. Avista Gas Planned Capital Expenditures by Driver

Customer Requested

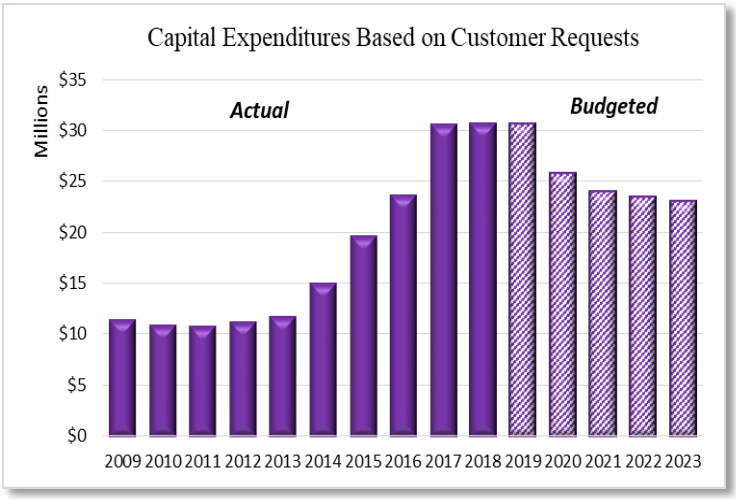
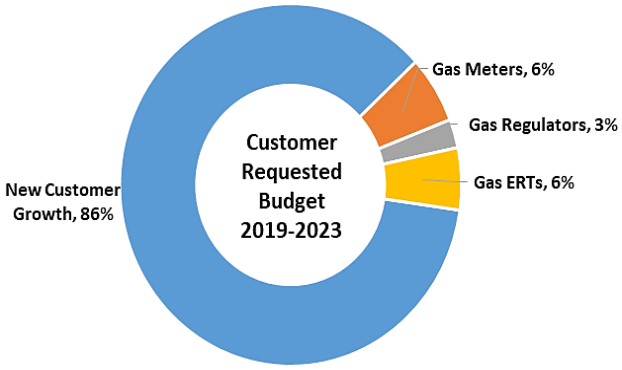


Figure 13. Capital Expenditures Based on Customer Requests

Avista defines these investments as "*customer requests for new service connections, extensions, or system changes or enhancements requested by customers*." We often refer to new service connects as "growth," as in growth in the number of customers, however, these investments are beyond the control of the Company, and as such they do not reflect a plan or strategy on the part of Avista. Responding quickly to these customer requests is a requirement of providing utility service. Customer requested activities in the gas side of the business may include hooking up new customers or adding meters, regulators, and/or electronic transmitting devices to read meters. Growth in our natural gas customer base has been steady, averaging 1.5% over the past 15 years, thus most of the expenditures in this category tend to be related to customer growth.

Avista Gas Customers	Total (as of 2018)	Percentage
Commercial	35,422	10.07%
Industrial	250	0.07%
Interruptible	45	0.01%
Misc	173	0.05%
Residential	315,734	89.74%
Transportation	212	0.06%
Grand Total	351,836	100%



Customer Requested	2019	2020	2021	2022	2023
Gas New Revenue	$26,033,602	$21,518,178	$20,987,490	$20,433,006	$20,013,116
Gas Meters	$1,874,545	$1,784,106	$1,321,373	$1,332,993	$1,345,901
Gas Regulators	$801,154	$750,974	$558,972	$563,765	$569,104
Gas ERTs	$1,976,096	$1,683,910	$1,098,543	$1,120,501	$1,143,486
Total	$30,685,397	$25,737,168	$23,966,378	$23,450,265	$23,071,607

Table 2. Avista Gas Planned Customer Requested Capital Expenditures

Mandatory & Compliance

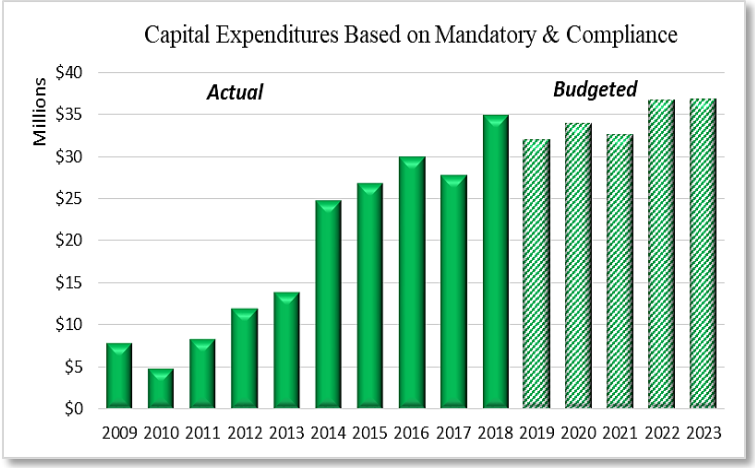
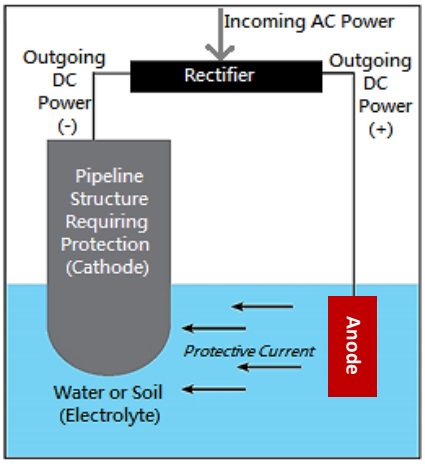


Figure 14. Capital Expenditures Based on Mandatory & Compliance

This category of capital spending includes "*investments driven typically by compliance with laws, rules, and contract requirements that are external to the Company.*" Avista operates within a complex regulatory and business framework and must adhere to state and federal laws, agency rules and regulations, and county, city, and municipal ordinances. Compliance with these rules, as well as contracts and settlement agreements, represent obligations that are generally required by others and largely outside of our control. The types of gas investments that fall into this driver include our obligation to relocate our facilities to accommodate state, county and municipal infrastructure projects, (frequently transportation related) and our compliance with pipeline safety and environmental regulations. Regulations are increasing and becoming progressively more expensive to implement, as indicated by the increasing budget for this category. Note that a primary driver for gas related mandatory and compliance expenditures is safety, as indicated by the projects below.

Cathodic Protection Capital Expenditures

The purpose of the Cathodic Protection (CP) program is to protect Avista's buried steel pipe from the effects of natural corrosion. Corrosion is the result of an electro-chemical reaction of a metal surface to its environment (such as the air or water) which causes a loss of metal from the surface, reducing the integrity of the pipeline. This can be seen as rust. The mechanism of cathodic protection is to make the pipeline part of an electric circuit by energizing the pipe with direct current, often provided by a device called a rectifier. The rectifier transforms the voltage level from the alternating current that it receives from the incoming power line into direct current (DC) that is used to electrify the pipe. The DC current is connected via a cable to a "sacrificial" metal anode that is easier to corrode than the pipe itself. This forced electrochemical process directs the corrosion process to the sacrificial metal, which protects the pipeline itself from corroding. In most cases the pipe also has a high-dielectric strength special coating in conjunction with the use of a CP system.



For this process to be effective, the circuit and power source must be properly maintained. The U.S. Department of Transportation Pipeline and Hazardous Materials Safety Administration requires that

gas pipelines installed after July of 1971 must have CP systems in place and that the performance must be closely monitored and tested at least once a year. If a rectifier is used, it must be checked six times a year.[74] Failure of these systems is especially difficult to predict or determine because most of the pipelines are buried underground so deterioration is not immediately visible. Some of Avista's CP systems have already exceeded their useful life and thus have increasing risk of failure. These old systems must be replaced. Besides compromising the corrosive protection for Avista's infrastructure, they create the potential for the Company to be at risk of non-compliance as well as increase safety concerns for employees and the public.

Priority Aldyl A Pipe Replacement Program

The U.S. Department of Transportation Pipeline and Hazardous Materials Safety Administration requires pipeline operators to identify and mitigate the highest risks in their gas distribution systems. For Avista, a high risk is the bending stress that occurs on Aldyl A[75] service pipe where it connects to a steel main pipe. Over time the industry discovered that the certain resins used in Aldyl A pipe may become brittle, causing leaking and failure. It is the Company's position that this issue creates unacceptable risk. Even above the mandatory requirements, the Priority Aldyl A Pipe Replacement Program is designed to protect public safety and property by proactively replacing all of this type of pipe existing within Avista's service territory.

This program replaces at-risk pipe sections over a 20 year time period starting with the highest risk areas via a program endorsed by the Washington Utilities and Transportation Commission.[76] The Company identified approximately 737 miles of priority Aldyl A main pipe (1¼" through 4" in size) manufactured prior to 1985 and about 16,000 transition tees which need to be replaced. Transition tees connect the service lines to the main lines. The Company used a risk consequence model to try to predict where leaks are most likely to occur then folds in information on customer density in these areas, specifically focusing on areas of congregation such as schools, hospitals, and apartment complexes. The replacement program began in 2012 and is estimated to be completed within twenty years. It costs about $69 to $110 per foot depending upon conditions.[77] For example, replacing pipeline under a roadway requires mitigation such as repaving the street and replacing associated infrastructure like trees and sidewalks, which is more expensive than work in a rural area. The Company makes every attempt to minimize the impact of this work on the public and public infrastructure.[78]

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[74] U.S. Department of Transportation Pipeline and Hazardous Materials Safety Administration, Cathodic Protection Requirements, https://primis.phmsa.dot.gov/comm/FactSheets/FSCathodicProtection.htm

[75] Aldyl A pipe is a polyethylene pipe made by DuPont before 1984 and widely used throughout the gas industry. Over time it was discovered that this pipe can become brittle and prone to leaking, which can create safety risks.

[76] WUTC UG-14089 https://www.utc.wa.gov/_layouts/15/CasesPublicWebsite/GetDocument.ashx?docID=256&year=2014&docketNumber=140189

[77] Before the Washington Utilities and Transportation Commission, Testimony of Don Kopczynski, page 12, https://www.utc.wa.gov/_layouts/15/CasesPublicWebsite/GetDocument.ashx?docID=258&year=2014&docketNumber=14nk0189

[78] For a great summary of this program, see Michael B. Whitby and Dan Gigler, "Gas Facility Replacement Program," https://www.utc.wa.gov/regulatedIndustries/transportation/TransportationDocuments/Avista%20-%20Aldyl%20A%20Replacement%20Program.pdf

High Pressure Pipeline Remediation Program

The Pipeline and Hazardous Materials Safety Administration (PHMSA)[79] is in the process of passing a new rule requiring "traceable, verifiable, and complete" Maximum Allowable Operating Pressure (MAOP)[80] testing practices and recordkeeping for high pressure pipelines including those Avista uses in serving its natural gas customers. Unfortunately for Avista and for most gas utilities, these records were not required in the past and associated data was not typically collected. This was true both for Avista and for the companies from which it bought many of its gas facilities. Though the official rule has not yet been enacted, the PHMSA has made it clear that any pipelines lacking this information will have to be replaced or otherwise mitigated in addition to potential fines and penalties. They are encouraging gas utilities to get busy and get this resolved. Avista has known this rule was coming for a few years and has proactively worked to develop testing and data collection methodologies, and has even replaced pipeline preemptively as appropriate. These actions should be in line with what will be required, but until the rule is formalized, the exact level of effort (and therefore spending) for this program cannot be precisely determined.

Isolated Steel Replacement Program

The program identifies and documents buried or submerged isolated steel pipe sections, including isolated risers,[81] installed after July 31, 1971 with the goal of insuring they are either adequately protected against corrosion or are replaced.[82] Avista protects all of the buried steel pipes in their system from corrosion using cathodic protection with large, centrally located anode beds. In order to protect the pipeline, this systems relies on all the steel pipe in a section to be directly connected together to form one big electrical circuit directly connected to the anode bed. Unfortunately some of these circuits of steel pipe have been broken up with plastic pipe as pipeline has been replaced over time. A section of steel pipe that is not directly connected to the larger system is considered 'isolated.' The anodes cannot protect this pipe because they aren't electrically connected to it anymore, so it is no longer adequately protected from corrosion.[83] Federal and state regulations require at least 10% of the Company's isolated steel sections of pipeline be inspected each year. When

[79] The Pipeline and Hazardous Materials Safety Administration (PHMSA) is the branch of the U.S. Department of Transportation Pipeline and Hazardous Materials Safety Administration that is responsible for insuring the safe, reliable, and environmentally sound operation of the natural gas pipeline transportation system in the United States.
[80] For a complete definition of MAOP, please see https://psc.nd.gov/jurisdiction/damageprev/docs/2014PipelineSafetyOperatorTraining/MAOP%20Uprating%2010-13.pdf
[81] Risers are the part of the pipe that transitions the pipe from underground to the surface and, in some cases, from plastic to steel.
[82] 49 CFR 192.455 and 49 CFR 192.457 - External corrosion control for buried or submerged pipelines per United States Code. https://www.gpo.gov/fdsys/granule/CFR-2010-title49-vol3/CFR-2010-title49-vol3-sec192-455 and https://www.gpo.gov/fdsys/pkg/CFR-2017-title49-vol3/pdf/CFR-2017-title49-vol3-sec192-457.pdf
[83] Note that Natural gas transmission pipelines are far more susceptible to external corrosive attack than similar operating oil pipelines. In fact, the internal liquid content of the natural gas transmission pipeline may actually promote corrosive chemical reactions on the outside steel surface of the pipeline. Miles Haukeness, "Natural Gas Pipeline Corrosion- Steel," December 18, 2017, https://innopipe.com/wp-content/uploads/2017/09/compressed_Corrosion-Gas-Pipelines-003.pdf

these sections are identified, if they are not adequately cathodically protected and are thus at risk of corrosion, they must be replaced. With this program, the Company is replacing 10% of the isolated steel risers and short sections of isolate steel main within one year of their discovery. This work is stipulated in an agreement between Avista and the Washington Commission.[84]

Overbuilt Pipe Capital Replacement Program

The Federal Code of Regulations requires utilities to remove customer-installed encroachments or "overbuilds" that interfere with or prohibit the ability to safely operate the gas system. Typically an overbuild situation occurs when a structure is erected over the top of preexisting natural gas facilities. These structures or barriers prevent mandatory maintenance such as leak surveys, which are typically performed by walking directly above the gas pipeline while operating the leak detection equipment. Overbuilds also increase the Company's operating costs due to the need to return to the overbuild location multiple times to complete leak surveys and perform other maintenance tasks.

Buildings over a pipeline that are not properly vented also create the possibility of natural gas leaking inside, which creates safety hazards. Avista's Overbuilt Pipe Capital Program is designed to identify and remediate overbuild issues. The work tends to be focused on overbuilds in mobile home parks. Due to the dynamic nature of these parks, they represent areas of high risk because the dwellings can be easily sited over buried facilities. Of course these are not the only structures built over pipelines. Fences, sheds, patios, parking lots, roads, and more can cause problems. When these situations arise, the Company handles them on a case-by-case basis to protect the interests of both Avista and the other involved party. This program funds the capital costs of relocating facilities to ensure adequate access to the pipeline and to safeguard customer safety.

Planned Meter Change-Out (PMC) Program

Accuracy in measuring customer usage is critical to both the customer and the Company. To ensure that meters are functioning correctly, Avista performs statistical meter samples based on manufactured year, meter model and size. If analytics determine that a "meter family" is no longer taking precise measurements, the entire group of meters within that category are replaced. Conversely, if the analytics determine that the meters are testing well, the sample size for that group is reduced. This analytics-based methodology makes certain that meters that are problematic are

[84] "Isolated Steel Settlement Agreement Report, Docket PG-100049, https://www.utc.wa.gov/_layouts/15/CasesPublicWebsite/GetDocument.ashx?docID=66&year=2010&docketNumber=100049

identified and replaced quickly while maximizing the efficiency of the sampling process, reducing costs.[85]

Gas Replacement Street and Highway Program

Virtually all of Avista's pipelines are located in public utility easements which are controlled by local jurisdictional franchise agreements. When local authorities request relocation, Avista is mandated to do so and usually at the Company's expense. Unfortunately the expenditures in this category are difficult to predict. Most often the impacted utilities (natural gas, electric, phone, cable, etc.) are notified of projects requiring relocation in the spring after budgets are developed. Avista typically utilizes prior year's expenditures to estimate what might be required in this spending category.

Gas Line Relocated for Road Work

Mandatory & Compliance	2019	2020	2021	2022	2023
Gas Cathodic Protection Program	$600,000	$600,000	$600,000	$700,000	$700,000
Aldyl A Pipe Replacement	$24,043,892	$24,043,892	$24,043,892	$26,749,089	$27,342,918
Gas HP Pipeline Remediation Program	$50,000	$2,000,000	$2,000,000	$3,000,000	$3,000,000
Gas Isolated Steel Replacement Program	$1,400,000	$1,400,000	$1,400,000	$1,600,000	$1,600,000
Gas Overbuilt Pipe Replacement Program	$400,000	$400,000	$400,000	$400,000	$0
Gas PMC Program	$2,750,000	$2,750,000	$1,200,000	$1,200,000	$1,200,000
Gas Replacement Street & Highway Program	$2,700,000	$2,700,000	$3,000,000	$3,000,000	$3,000,000
Total	$31,943,892	$33,893,892	$32,643,892	$36,649,089	$36,842,918

Table 3. Avista Gas Mandatory & Compliance Capital Expenditures

Performance & Capacity

Avista's projects and programs grouped in this category of need include "a range of investments that address the capability of assets to meet defined performance standards, typically developed by the Company, or to maintain or enhance the performance level of assets based on a demonstrated need or financial analysis." In addition to the need to comply with prudent operating standards, Avista is also attentive to investment opportunities to improve the performance of our gas distribution system

[85] This program ensures that the Company is in compliance with Oregon's OAC 860-023-0015 "Testing Gas and Electric Meters" Tariff Rule #18 https://secure.sos.state.or.us/oard/viewSingleRule.action?ruleVrsnRsn=221169 and Idaho's IDAPA 31.31.01.151 through .157 "Standards for Service" https://adminrules.idaho.gov/rules/current/31/313101.pdf and Washington's WAC Chapter 480-90-333 through -348 "Gas companies – Operations" Tariff Rule #170 http://apps.leg.wa.gov/wac/default.aspx?cite=480-90

when supported by a study or analysis that demonstrates the cost-effectiveness of the benefits achieved for our customers. The programs below fall into this category.

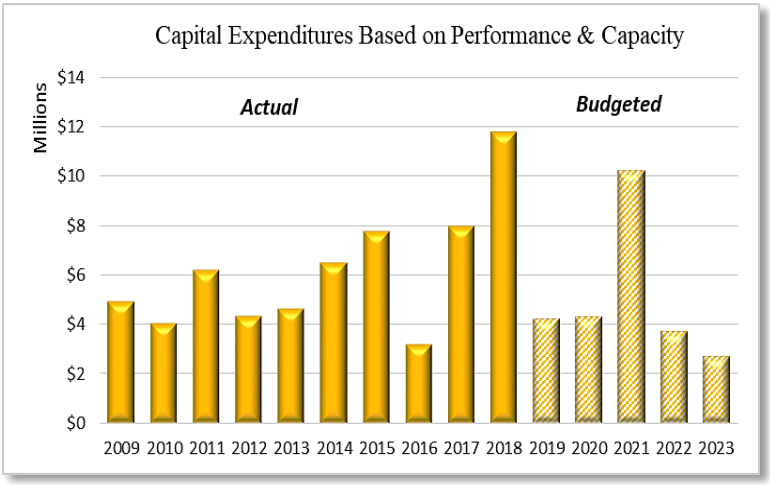


Figure 15. Capital Expenditures Based on Performance & Capacity [86]

Cheney High Pressure Reinforcement Project

The Gas Planning department routinely runs a load study on Avista's gas distribution system to identify areas of the system with insufficient capacity to serve existing firm customer loads based on "design conditions," which refers to the projected system demand for a "coldest day on record" weather event. Avista attempts to ensure that our system is adequate to serve customer load in extreme weather conditions when customers need service the most. Identified deficient areas are given a priority level based on the severity of the risk associated with insufficient system capacity. This condition exists in the high pressure pipeline that feeds the town of Cheney, creating concern that the existing pipeline system will be insufficient to serve customer demands on cold weather days. There are a couple of additional circumstances with this pipeline that must be noted:

- It was built between 1957 and 1965 so was not built to current guidelines and specifications.
- A large industrial customer on this pipeline has submitted plans to increase their gas requirements beyond what the current system can provide.

This program will address these multiple concerns with one effective solution.

Pullman High Pressure Reinforcement Project

Load growth in the Pullman area has exceeded the capacity of the existing Pullman Gate Station.[87] The contracted capacity at this gate is 786,000 cubic feet per hour (cfh) but the projected need for design condition is 916,000 cubic feet per hour, which puts approximately 1,300 customers at risk of losing gas service when temperatures plunge. This project proposes installing a gas main between the Moscow Gate Station and the Pullman Gate Station (approximately 3 miles of pipeline) to balance the

[86] Note that the increase in 2021 is due to the high pressure reinforcement program in Warden, described in this report on page 61.
[87] A gate station is the supply point into Avista's system. It takes high pressure gas from a larger pipeline, reduces the pressure, and moves it onto a distribution pipeline.

loads, create a more reliable looped system,[88] to allow for projected area load growth, and to make sure that no customers are at risk of losing gas service on cold winter days.

Gas Intermediate Pressure Reinforcement Program

There are continual changes in customer growth and load patterns throughout Avista's intermediate pressure pipeline system as, for example, new subdivisions are built or businesses open, close, or expand. The Company has an obligation to serve firm customers by providing adequate capacity every day, including the coldest days of the year. In order to do this, the service territory and associated gas system is constantly monitored to identify areas where new customers are being added or where load patterns have changed. The Gas Reinforcement Program focuses on maintaining adequate gas system capacity by upsizing existing gas mains, looping supply lines to provide back-up service capability, and other reinforcement or upgrades that may be needed to provide dependable, reliable service to customers. Projects are evaluated and sorted by priority to maximize the value of the funding in this program.

Schweitzer Mountain Road High Pressure Reinforcement

Load growth in the Sandpoint area has exceeded the capacity of the existing gas distribution system, especially during cold periods, and it gets very cold in Sandpoint. Avista plans to reinforce this system by installing 1.3 miles of 6" steel gas main pipeline and an associated regulator station on Schweitzer Mountain Road to alleviate this constraint. This project is planned to be completed in 2023.

Warden High Pressure Reinforcement

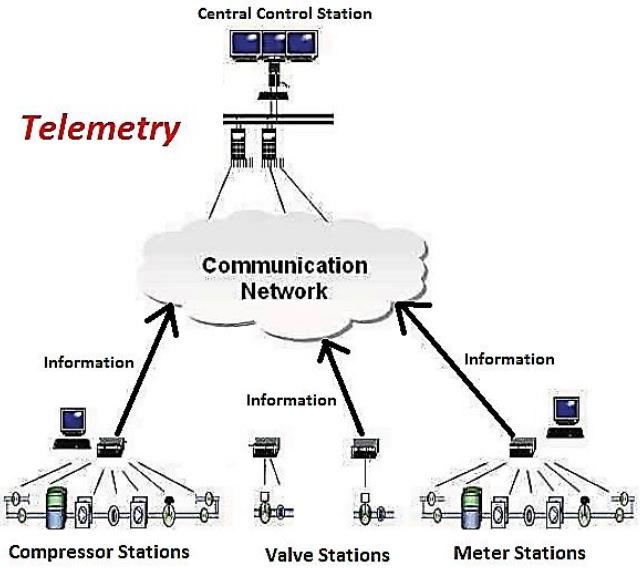
Warden, Washington, currently has two concerns associated with capacity. The first is that the town is supplied with gas from the fully-subscribed and capacity-constrained Moses Lake Lateral[89] (owned by Williams NWP). Secondly the high pressure supply line coming into town has reached its capacity. As a result of current capacity/supply constraints, industrial gas growth opportunities are hampered within the Port of Warden Industrial Park as well as other sites in the area. Grant County Economic Development Council and the Port of Warden have contacted Avista several times related to different commercial ventures

[88] A looped system means that customers can be served from more than one pipeline so if a pipeline has a failure or is out of service for maintenance, customers can be served from a different pipeline without experiencing an outage.
[89] Lateral pipelines deliver natural gas to or from the mainline and are typically between 6 and 16 inches in diameter.

interested in the Port site and are pressing for additional natural gas supply for the area. Schedule and timing are critical aspects of this project. To address this supply problem, the Company plans to install a new gate station and approximately 3.2 miles of 6" high pressure distribution pipeline by the end of 2021.

Gas Telemetry Program

Gas telemetry is equipment that remotely monitors system pressures, volumes, and flows across the gas pipeline system. It allows the Company to see what is happening, for example, at gate and regulator stations, with large industrial customer usage, and at interconnection points. Avista attempts to replace this equipment at the end of its useful life or as it fails. Another goal is to keep the technology current, as this equipment is critical in identifying problem areas in the pipeline such as a lack of pressure to serve customers or other abnormal situations that must be corrected in order to provide safe, reliable service. The current funding level adds about five new telemetry sites and upgrades or replaces an additional 15 sites per year based on the Company's experience and expectations.



Performance & Capacity	2019	2020	2021	2022	2023
Gas Cheney HP Reinforcement	$3,000,000	$3,000,000	$3,000,000	$0	$0
Gas Pullman HP Reinforcement Project	$0	$0	$100,000	$2,400,000	$0
Gas Intermediate Pressure Reinforcement Program	$1,000,000	$1,000,000	$1,000,000	$1,000,000	$1,000,000
Gas Schweitzer Mtn Rd HP Reinforcement	$0	$0	$0	$100,000	$1,500,000
Gas Warden HP Reinforcement	$0	$100,000	$5,900,000	$0	$0
Gas Telemetry Program	$200,000	$200,000	$200,000	$200,000	$200,000
Total	$4,200,000	$4,300,000	$10,200,000	$3,700,000	$2,700,000

Table 4. Avista Gas Performance & Capacity Capital Expenditures

Asset Condition

Assets of every type will degrade with age, usage and other factors, and must be replaced or substantially rebuilt at some point in order to ensure the reliable and acceptable continuation of service. Projects or programs in this category of need are defined as: "*investments to replace assets based on established asset management principles and systematic programs adopted by the Company which are designed to optimize the overall lifecycle value of the investment for our customers*."

The replacement of assets based on condition is essentially the practice of removing them from service and replacing them at the end of their useful life. Across the utility industry, and likewise for Avista, the

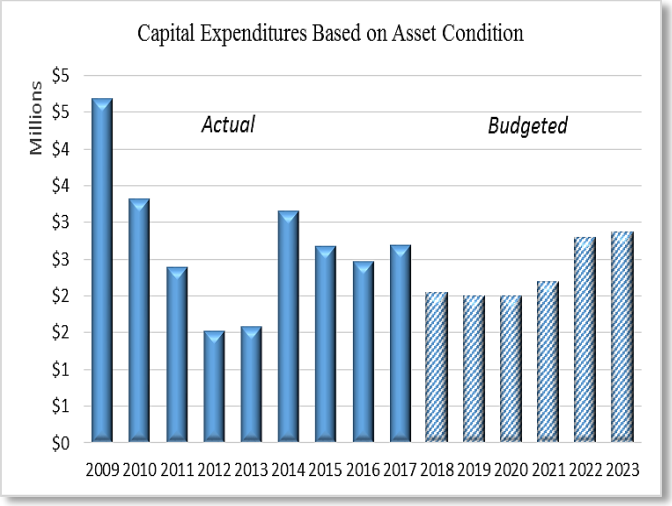


Figure 16. Capital Expenditures Based on Asset Condition

replacement of assets based on condition constitutes a substantial portion of the infrastructure investments made each year. At Avista, we aim to manage our assets in a manner that optimizes their overall value over the lifecycle of each particular class of asset.

We say that asset replacement strategies are "optimized" in the sense that a given approach may not achieve the overall lowest possible lifecycle cost, but rather the lowest cost that allows us to meet a variety of important performance objectives, such as reliability or the efficient use of employee crews. Because failure of critical assets is unacceptable, they must be replaced near the end of their useful life even though they are still providing reliable service. In other instances it may be reasonable to wait until an asset fails before it is replaced, a strategy known as "run to failure." The Company's primary replacement programs based on asset condition are described below.

Deteriorated Steel Pipe Replacement Program

Multiple factors impact risk and the replacement of facilities including things like material failures, environmental impacts, increased leak frequency, unconventional/obsolete pipe sizes, no protective coating (bare steel) and/or problems with protective coating on pipe. This program is intended to address and remedy these issues. Pipe is regularly inspected across the service territory and deteriorated pipe is identified then ranked by risk factor. The Company believes that replacing deteriorated pipe prior to failure will not only increase the safety of the system and our customers but is also more cost effective than responding to emergency situations. The Deteriorated Steel Pipe Replacement Program is designed to specifically target and prioritize pipeline that may affect safety and system reliability. Avista believes that systematically replacing facilities on a planned basis reduces risk and increases the efficiency and effectiveness of expenditures over time.

Encoder Receiver Transmitter (ERT) Replacement Program

An ERT or Encoder Receiver Transmitter is a device that automatically records gas usage then sends the data to a remote data collector. These devices contain batteries. When these batteries fail, the customer's usage is not recorded so it is estimated and entered manually. Customers do not like to have their usage estimated due to the potential for billing errors, and these estimates often result in a high number of complaints. The Company currently has about 106,000 ERT units in Oregon, meaning there are a lot of batteries out there. The batteries are sealed inside the ERT for protection against weather and other environmental elements. It has been found to be more cost effective to replace the entire ERT rather than try to open them, replace the battery, and adequately reseal them. The average battery life is 16 years. The Company proposed a measured and levelized approach to this battery issue, developing a systematic replacement program of 7,000 ERTs per year beginning with the oldest units. This program will be primarily focused in Oregon, as the replacement of the ERTs in Washington and Idaho will take place under the Advanced Metering Infrastructure (AMI) program.

Itron's Natural Gas Encoder Receiver Transmitter Device

Regulator Station Replacement Program

Regulator stations reduce and regulate the pressure in gas pipes and include equipment such as controls, valves, and regulators. These stations and their associated equipment are critical to the successful operation of the gas system and must be replaced when they no longer meet standards or have reached the end of their service life. At times they are at an age where replacement equipment is no longer available. The maintenance and operation of these stations is regulated by U.S. Transportation Code.[90] Avista's program is in full compliance with this Code and further is designed to improve system operating performance, enhance safety, replace inadequate or antiquated equipment that is no longer supported, and ensure the reliable operation of metering and regulating equipment. The goal of this program is to replace the highest priority projects every year, though new ones are being continually added.

Natural Gas Regulator Station

Asset Condition	2019	2020	2021	2022	2023
Gas Deteriorated Steel Pipe Replacement Program	$1,000,000	$1,000,000	$1,000,000	$1,600,000	$1,600,000
Gas ERT Replacement Program	$200,000	$200,000	$200,000	$200,000	$270,000
Gas Regulator Station Replacement Program	$800,000	$800,000	$1,000,000	$1,000,000	$1,000,000
Total	$2,000,000	$2,000,000	$2,200,000	$2,800,000	$2,870,000

Table 5. Avista Gas Asset Condition Capital Expenditures

[90] 49 CFR 192.739 - Pressure limiting and regulating stations: Inspection and testing https://www.law.cornell.edu/cfr/text/49/192.739

Failed Plant & Operations

The replacement and capital repair of equipment failures constitute "*requirements to replace assets that have failed and which must be replaced in order to provide continuity and adequacy of service to our customers*." In addition to outage response, Avista's nominal operations involve repair and replacement of facilities under a variety of circumstances. This is called the Non-Revenue Program.

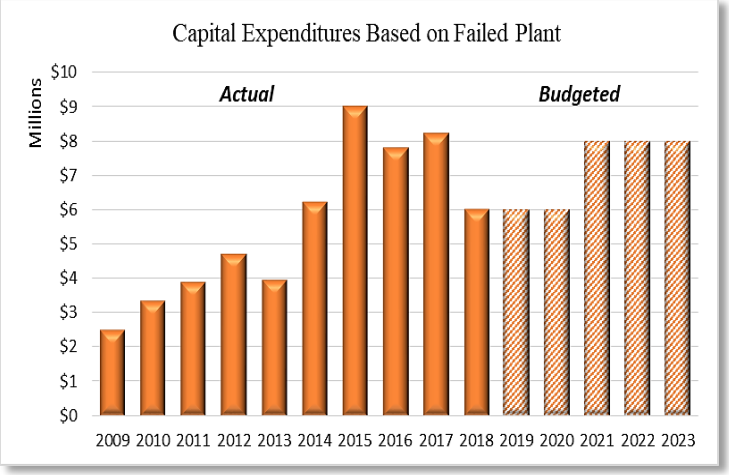


Figure 17. Capital Expenditures Based on Failed Plant & Operations

Non-Revenue Program

Gas Leak to be repaired

Gas Meter Barrier

This program covers customer requested work or unexpected work that comes up. Funding for this type of work is very hard to predict, as it tends to be reactionary, such as relocations requested by customers (other than roadway relocations), leak repairs, pipeline that is found to be too shallow,[91] or other such issues. If the work is large enough to warrant significant capital expenditures, it is prioritized and ranked against other Company capital projects, but smaller projects are funded through this program. Note that if customers request relocation of our gas facilities, Avista is bound by tariff language to do so at the customer's expense. However, if the Company sees such a relocation as the chance to improve or update the gas system at the same time, the additional costs are expensed to this category. Another common expenditure under this program are single-service taps off the supply main to serve a small group of customers versus a full distribution tap, which provides a more affordable option for customers if they fit this profile.[92] Meter barricades also fall under this category. These are installed if vehicles may get too close to existing meters to protect them from damage.[93] This program basically covers unforeseen work the Company performs to satisfy customers and maintain the safety, reliability and integrity of the system.

Failed Plant & Operations	2019	2020	2021	2022	2023
Gas Non-Revenue Program	$6,000,000	$6,000,000	$8,000,000	$8,000,000	$8,000,000

Table 6. Avista Gas Failed Plant & Operations Capital Expenditures

[91] Note that federal rules may not require lowering shallow gas mains, but Avista finds it to be a safe and prudent practice when such mains are identified. Often grade changes or other shifts create this particular problem rather than improper installment.
[92] These small taps are called Single Service Farm Taps (SSFT), and many of Avista's SSFTs are reaching the end of their service life at this time.
[93] These barricades are required by federal mandates and greatly improve the safety of the system.

Avista's Natural Gas O & M Investments

Avista's Natural Gas employee tasks are highly varied and involve everything from technical construction and maintenance activities to customer service. They perform a significant amount of regulatory-related work that necessitates a high level of documentation required by the federal, state, local, and Commission governance over gas operations. Most importantly, their work is directly related to the safety of lives and property. Specialized training is required for these employees in order to perform their work, especially related to safety. They receive extensive education on gas system safety procedures, regulations, and legal requirements.

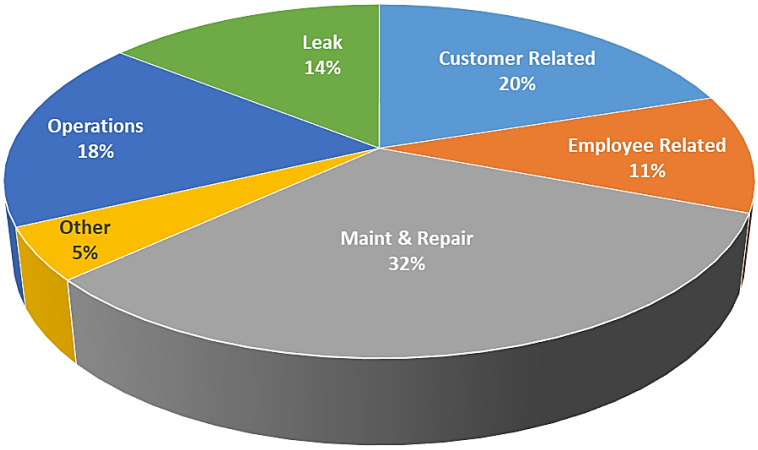


Figure 18. Historical Avista Gas Actual O&M Expenses 2009-2018

O&M expenditures allow the Company to maintain and operate the gas system in the most safe, reliable, efficient way possible. These expenditures permit the Company to respond when damage occurs from weather, vehicles or dig-ins, maintain facilities, answer customer requests for locating underground pipelines, read meters, and a host of other issues that arise in this complex system, all under the auspices of keeping the natural gas safely and efficiently flowing to customers and to power plants.

Avista employees are dispatched to customer homes and businesses to address safety concerns as well as being first responders to make safe and/or repair damaged or leaking gas facilities. Another operations function is leak-related work such as responding to gas odor reports, surveying the pipeline system to identify leaks, and performing the repairs needed to fix them. If anyone calls Avista to report that they smell gas, a gas serviceman is dispatched with a service order to investigate the concern. Strict standards are in place around the amount of time in which the Company must respond to these kinds of orders. If a leak is found, it is dealt with on a priority basis.

As might be expected, the largest group of O&M expenditures are related to maintaining and repairing equipment. Most of Avista's natural gas pipeline was laid in the 1950s and 1960s. Our oldest pipe was installed in the 1930s. Avista performs preventative maintenance or repair of mains, regulators, meters and meter reading transmitters, regulator stations and gate stations. The Company also responds to dig-ins related to our pipelines and other damage to stations, pipelines, and equipment created by vehicles, earth movement, construction, etc. Often

assets are replaced because they are damaged by weather or storms, but that is only one component of the investments needed to keep the gas system operating safely, effectively, and efficiently. Equipment wears out or quits performing as intended and must be replaced. In the natural gas realm, equipment failures can have serious safety consequences. Adequate maintenance is critical. Equipment failure can also lead to loss of supply, leaving customers without heat and power plants without fuel to generate electricity. Leaking pipelines with a path of underground migration to structures can cause gas explosions and serious property damage or even loss of life. Maintenance of this system is even more important with older facilities, as is the case with much of Avista's system. Older equipment requires more maintenance so naturally the associated costs will continue to rise.

Maintenance work in the natural gas area includes monitoring and adjusting pipeline pressure as needed to maintain reliability. It also includes periodic meter replacement, cathodic protection, meter, main, and other infrastructure work, construction, dispatch, gas supply activities, truck and equipment expenses, and the field employees who perform the repairs and maintain the system. Additional tasks include sustaining the property related to our equipment such as maintaining the grounds around buildings and regulating stations, maintaining heating, cooling, and electrical systems, providing adequate security, and general supplies. Large repairs and maintenance tasks are performed by Company crews occasionally supplemented by contractors, and O&M expense.

Pipeline Leak Detection

Avista monitors the gas system very closely to guarantee that critical equipment remains functional and the system is fully intact. They achieve this target in great part by observing prescriptive maintenance schedules of key operating components of the gas system and repairing or replacing equipment as needed. Avista manages its gas infrastructure maintenance work with "reliability forecasting" which uses historical operating data, estimated data from subject matter experts, and industry standards where historical data isn't available or is insufficient, as well as maintenance cost and risk cost data. With this input, probability curves of expected failure rates over time are developed that enable us to make effective decisions in managing the gas system. However, maintaining the natural gas system is not without its challenges. Being located in the Northwest, much of Avista's gas service equipment experiences winter weather that does not permit year round maintenance or construction, limiting the timeframes for getting the work done. Unfortunately the jurisdictions in which we must perform the work are becoming increasingly demanding

Pipeline Repair Work in Downtown Spokane

in their requirements, including calling for additional work as a condition of construction, requiring excessive and extensive re-paving and/or landscaping, and even hiring additional flaggers, all of which increase costs in both capital and O&M budgets.

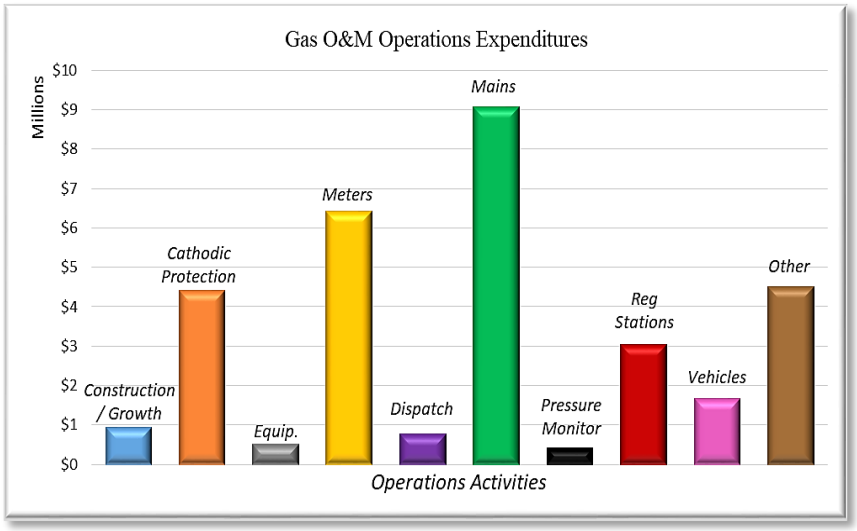


Figure 19. O&M Actual Operations-Related Expenses 2009-2017 [95]

Adding additional complexity, the gas business has been particularly hard hit by workforce issues. The industry is experiencing challenges in attracting and retaining the experienced workforce needed for gas construction work. As mentioned, this business requires very specialized skills. Over the past few years, lower gas prices led to the layoff of thousands of employees who have moved on to other industries.[94] Qualified workers are hard to come by across the industry. Avista and its contractors are facing this problem as well. Not only is it difficult to attract workers to this business, it is difficult to keep them, and the cost of doing so continues to rise. Increasing competency requirements and regulatory obligations are also causing workers to move to other types of construction activities where these requirements don't exist and the work is easier.

Avista attempts to manage through these issues by developing O&M programs that meet customer and regulatory requirements while attempting to be as cost effective and efficient as possible. Their primary focus is always safety, as there is nothing more important to the gas industry than the safety of customers, employees, and the communities served.

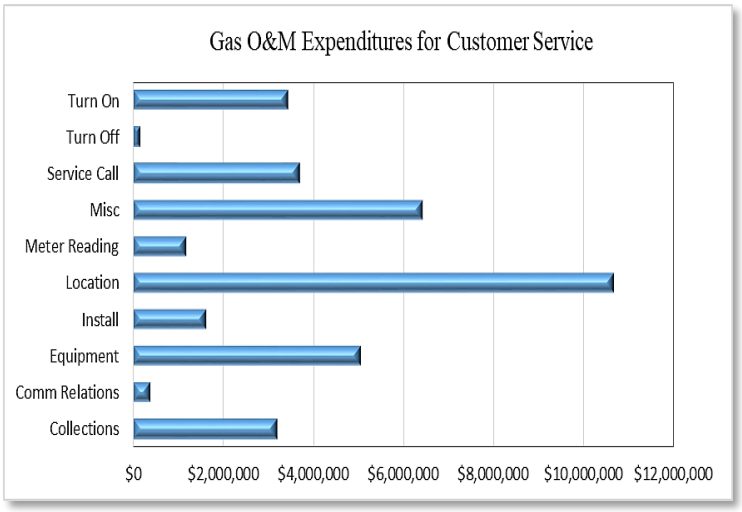


Figure 20. O&M Actual Customer Related Expenses 2009-2017

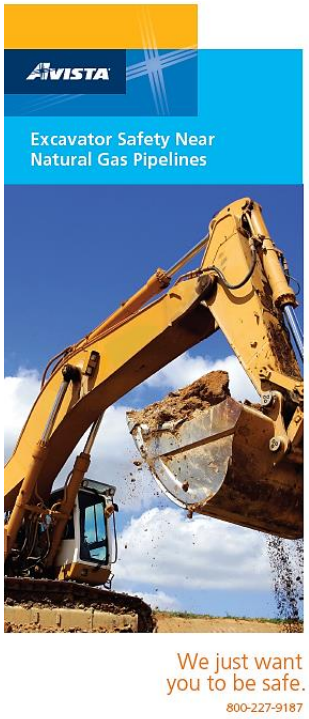
Besides maintenance activities, customer service related expenditures are also a significant portion of gas operations. Gas employees perform customer-requested maintenance, read meters, handle general service calls, manage service customer turn off/on, and handle collections when required. The gas group also deals with customer concerns about equipment, even lighting pilot lights for people

[94] Since 2014 more than 440,000 jobs were lost in the oil and gas industry. Irina Slav, "Recovery? The Oil and Gas Industry is Hiring Again," USA Today, November 2, 2017, https://www.usatoday.com/story/money/energy/2017/11/02/recovery-oil-and-gas-industry-hiring-again/819773001/

[95] Note that operations expenditures tend to be about 18% of total gas business expenditures.

who need extra help. Avista's Gas employees are also very engaged in community relations and in educating the public about gas and safety. The Public Safety Outreach Program has identified four primary stakeholder groups our employees interact with regularly:

1) Affected Public (those impacted by an action such as a gas line location or impacted places of congregation such as hospitals, schools, churches, and apartment buildings)
2) Public Officials
3) Emergency Responders (police officers, firefighters)
4) Excavators and Contractors

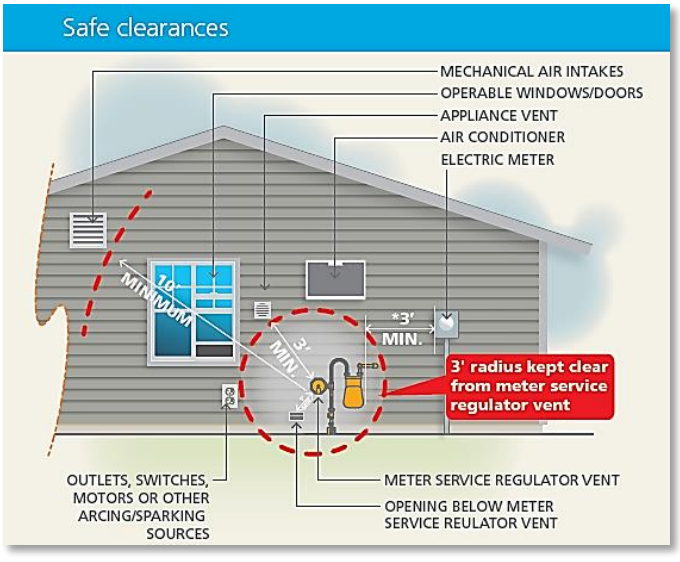


A variety of communications techniques are used to get the gas safety message out to the public, including use of radio, online banners, brochures and flyers, physical and digital mailings, customer bill inserts, and the Company website. Avista also coordinates and combines efforts with public and contractor organizations to increase partnership and visibility.

811 Know what's below. Call before you dig.

Gas employees respond to police and fire department requests for assistance in gas situations as well as providing training for them on how to handle these situations. The Company offers a locating service either using their own employees or a contractor to identify where buried pipelines are located to help prevent accidental dig-ins. Avista also actively promotes natural gas safety through the "811 Call Before You Dig" campaign.

In addition, the Company developed popular natural gas safety videos and special programs for children and schools.[96] Avista's public safety program for schools reaches over 400 classrooms per year within the service territory and offers a special website with information for children and young people.



The Company is very actively engaged in their communities, committed to educating as many people as possible about gas and electric safety.[97]

[96] Gas Safety videos can be found on myavista.com. Children's programs can be found on Avista.kids.com and Avista.e-smartonline.net, both found on myavista.com under safety then under Kid's Center. Information is also available in Spanish. These programs are so popular that other utilities have requested permission to use them.

[97] For more information about pipelines and pipeline safety in Washington State, please see: "Pipeline Safety in Washington State," Pipeline Safety Trust, 2018, https://www.myavista.com/safety/natural-gas-safety or pipelinesafetytrust.org

Avista's Natural Gas Safety Programs

Avista's natural gas system consists of complex infrastructure that is designed, operated, and built by the Company in order to serve customers reliably and safely. Avista, like all natural gas distribution utilities, is subject to many federal and state safety regulations, industry standards and practices, as well as its own imposed operating requirements. While these regulations, rules, and standards are designed to achieve multiple objectives, the safety of citizens, customers, and employees is a primary focus. The Company has implemented several safety programs to meet regulatory requirements and its own safety initiatives.

Distribution Integrity Management Plan (DIMP)

The Distribution Integrity Management Plan (DIMP) is a regulation of the U.S. Department of Transportation's Pipeline and Hazardous Materials Safety Administration. It requires distribution pipeline operators to develop and implement written integrity management programs with the purpose of identifying and prioritizing potential integrity risks in the gas distribution system.[98] The purpose of the DIMP is to encourage continuous improvement by proactively identifying and investing in risk control measures.

AVISTA'S DIMP EMPHASIS

- Industry Knowledge & Experience
- Company Knowledge & Experience
- Identification of Risk(s)
- Evaluating Risk Levels
- Ranking Risk & Criticality
- Risk Remediation
- Proactively Identifying & Remedying Issues
- Measuring Performance
- Monitoring & Evaluating Results
- Testing for Effectiveness
- Applying Lessons Learned to Improve Performance

Avista's DIMP emphasizes several key elements as shown in the text box on the right. The focus includes utilizing industry knowledge and experience, identifying potential threats, issues, and risks, developing effective means of mitigating issues, measuring performance and results, continuous testing to insure that the program remains effective, and applying the lessons learned through time and experience to future performance. It also includes specifically identifying areas of potential improvement.

One of the outcomes of Avista's DIMP focus on improvement is a concerted effort to maintain both type and quality of data on natural gas leaks. This has enabled the Company to begin developing a more quantitative risk analysis algorithm that will eventually replace the current primarily qualitative one, insuring that data drives the outcomes of the risk analysis and limiting the opportunity for qualitative bias to influence the results. The results are reported to all stakeholders to promote transparency.

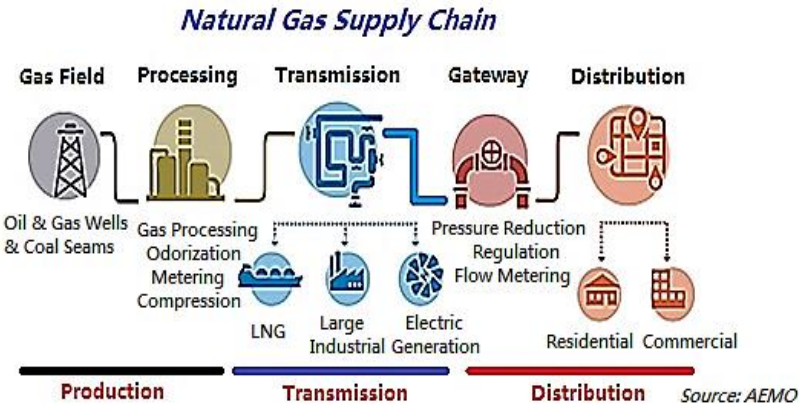
Avista's data shows that the most critical risks to the gas system involve excavation damage, external

[98] U.S. Department of Transportation's Pipeline and Hazardous Materials Safety Administration, Pipeline Technical Resources, https://primis.phmsa.dot.gov/dimp/

corrosion, material failure (i.e. Aldyl A pipe), welds and joints, and weather related issues. In response, DIMP efforts tend to focus on these critical areas. The DIMP helps provide the necessary framework for Avista to assess and mitigate risks in order to reduce both the likelihood and consequences of pipeline failures. It allows the Company to effectively allocate resources to appropriate prevention, detection, and mitigation activities that will result in improved integrity and safety.

Transmission Integrity Management Plan (TIMP)

The Pipeline and Hazardous Materials Safety Administration also requires an integrity management plan for transmission pipeline.[99] The Transmission Integrity Management Plan (TIMP) is focused on transmission lines that transport the gas from the storage facility to the distribution center, as opposed to gas distribution lines, which are typically smaller in size and deliver gas to homes and businesses. Avista has approximately 76.6 miles of natural gas high pressure transmission level pipeline in eastern Washington and Northern Idaho, and about 14.7 miles of this pipeline in southwest Oregon.[100]



The purpose of Avista's TIMP is to ensure the safe, reliable, and cost effective transportation of natural gas to our customers without adverse effects on the public, our customers, our employees and the environment. Avista's TIMP takes a comprehensive approach to managing all the various risks involved in designing, operating, and maintaining our natural gas transmission pipelines. The TIMP especially focuses on areas around the pipeline that we define as High Consequence Areas or HCA's. An HCA is an area near a transmission pipeline where many people can be gathered at one time, such as a school, hospital, or large apartment building. In these areas, this plan focuses much of its attention on supervising construction activities close to the pipeline, checking for gas leaks multiple times a year, confirming nearby emergency response is trained, adequate and effective, and monitoring the condition of the pipeline itself to help ensure it can continue to operate safely.

The Company also performs regular assessments to help identify the greatest risks to the integrity of the pipeline. These assessments allow the Company to proactively take any necessary steps to lower the risk of an adverse event occurring along the pipeline. Avista is actively engaged in improving their data collection and management systems in order to more effectively track project and maintenance history data, such as the condition of pipeline equipment and materials. This information helps

[99] U.S. Department of Transportation's Pipeline and Hazardous Materials Safety Administration, Pipeline Technical Resources, https://primis.phmsa.dot.gov/gasimp/faqs.htm#top2
[100] 2016 Avista Natural Gas Integrated Resource Plan, August 31, 2016, page 16, http://www.puc.idaho.gov/fileroom/cases/gas/AVU/AVUG1603/20160901AVISTA 2016 NATURAL GAS IRP.PDF

improve planning and analysis. A set of performance measures have also been developed that will best serve the need for monitoring and evaluating the effectiveness of the integrity management program. All of the results acquired are shared with stakeholders to ensure transparency.

Excavation Damage Prevention Program

The number one threat to the Company's natural gas system is accidental dig-ins by third parties excavating in the vicinity of our buried pipelines.[101] Avista developed the Excavation Damage Prevention Program to increase awareness and thus the safety of the public and Company employees, with the goal of reducing the number of hazardous excavation damages to Avista's natural gas (and electric) facilities. Avista actively participates in the "811" or "Call Before You Dig" program, an industry-wide effort to actively combat accidental contact with underground utilities.

Avista also collaborates with a number of organizations to spread the public safety message, to educate, inform, and protect our customers and employees. The Company provides standby oversight during excavation near critical pipelines to ensure workers are adequately protected and supervised. When the Company utilizes contractors to do pipeline locates or excavations, strict quality control measures are enforced. All employees are thoroughly trained on how to locate pipelines, safe excavating techniques, and emergency procedures.

Avista Safety Collaborations:

- *Government Agencies*
- *Emergency Responders*
- *Schools*
- *Media Sources*
- *Other Utilities*
- *Contractors*
- *Engineers*
- *Customers*
- *General Public*

In addition to education and outreach, this program has compliance elements to ensure adherence to federal and state regulations as well as to Avista's own standards, policies, and procedures. The Company continually reevaluates standards and procedures for damage prevention, pipeline locating techniques, tracking of damages, and training that may need to be updated or clarified so this program is continually improving.

Cathodic Protection Safety Program

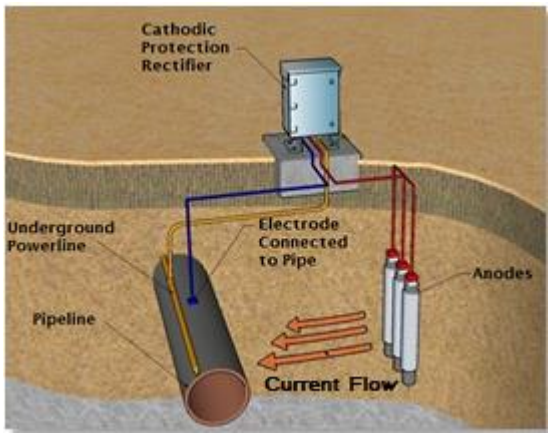
As mentioned earlier, cathodic protection helps prevent corrosion of steel pipe. While the pipe is coated with protective materials that are effective in preventing corrosion, the cathodic protection system provides a safety net in the event this protective coating is compromised. Cathodic protection systems are mandatory as required by the Code of Federal Regulations.[102] This program is an important

[101] "Avista Utilities Natural Gas Safety Project Plan for Oregon," filed for the Oregon Public Utilities Commission, March 2018, page 10, https://apps.puc.state.or.us/edockets/docket.asp?DocketID=21041

[102] Code of Federal Regulations CFR 192.463, https://www.gpo.gov/fdsys/granule/CFR-2010-title49-vol3/CFR-2010-title49-vol3-sec192-463

element of Avista's focus on reducing the second priority threat to the integrity of our system, external corrosion, which can lead to significant safety issues.

The Company's cathodic protection technicians are responsible in certifying Avista's compliance with regulations, to see that these systems are performing properly, and to take the lead in implementing corrective actions when problems are found. Avista manages 174 cathodic protection zones across our three-state service territory. Isolation fittings are used to electrically isolate each zone. This means that electric current is prevented from flowing between any adjacent zones so maintenance activities in one zone do not impact another zone. The size of these zones is monitored and managed each year, resulting in zone boundaries being maintained, divided or consolidated as appropriate.



In addition to zone management, the Company's cathodic protection technicians also monitor pipe casings which often used to sleeve pipelines under roadways. These casings are designed to offer additional protection to the pipeline caused by the weight of the road and the traffic it carries. Avista's experts make sure there is no contact between the pipeline and the casing that would compromise the cathodic protection. They also confirm that all of the equipment that is part of the cathodic protection system is in proper working order. Under federal and state regulatory rules, cathodic protection programs are subject to mandated inspections. Avista has found during these inspections that about one or two anode sets need to be replaced each year due to corrosion (sacrificing themselves to save the pipeline). The Company is installing technology to the cathodic protection systems throughout its service territory to allow technicians to remotely monitor the condition of the system and keep a closer eye on equipment condition.

Atmospheric Corrosion Inspection Program

A second part of the Company's response to the potential for external corrosion is the Atmospheric Corrosion Inspection Program. This program is also a requirement of federal regulations which direct pipeline operators to inspect above ground natural gas infrastructure exposed to the atmosphere for evidence of corrosion at least once every three years.[103] The Company conducts their atmospheric corrosion program systematically, by state and by operations district in each three-year cycle. Field inspections are completed by a contractor that specializes in this type of inspection.

[103] Code of Federal Regulations CFR 49 CFR 192.481, https://www.gpo.gov/fdsys/granule/CFR-2010-title49-vol3/CFR-2010-title49-vol3-sec192-481

When inspections result in identification of "abnormal operating conditions" which are conditions outside standard operation requirements, Avista field personnel remediate these conditions on a pre-determined compliance timeline. Some examples of abnormal conditions include buried meters and service valves, corroded risers and risers in need of protective wrap (protecting the riser from soil). In addition, Avista monitors, identifies and mitigates several "continuing surveillance" items under the this program such as settled meter sets, overbuilt or inaccessible meters, and meters in need of barrier protection from potential vehicle damage.

Atmospheric Corrosion

Leak Survey Program

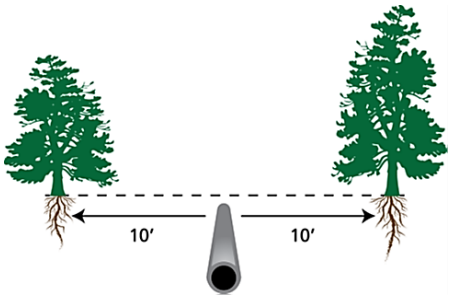
The Company's leak survey program is also required and monitored by federal regulation which requires the utility to survey its system for potential leaks on a specified time scale.[104] The specialized equipment used can detect even trace amounts of natural gas far below that which can be detected by the sense of smell.

There are two primary leak survey areas identified by the federal regulation: business district areas and those outside of business districts. Business district leak surveys must include tests of the atmosphere in any location that may provide an opportunity to find gas leaks, including manholes and even cracks in pavement and sidewalks. These surveys must take place at least once each calendar year at intervals not exceeding 15 months. In areas other than business districts, leak surveys must take place at least every five calendar years at intervals not to exceed 63 months. Cathodically unprotected lines must be inspected more frequently, at least once every three years.

The regulation states that the utility may also survey natural gas facilities on a more frequent basis. Avista's leak survey strategy emphasizes customer safety, so in areas where there are identified safety concerns such as that related to the Aldyl A pipeline, Avista conducts leak surveys each year. Avista surveys its natural gas facilities in business districts, high occupancy structures and high occupancy areas each year as well. In residential areas, the goal is to survey 20 percent (one fifth) of its residential operations areas each year. All of Avista's residential natural gas facilities are surveyed at least every five calendar years. Avista field personnel prioritize detected leaks based on the severity of the leak and the required compliance timeline to insure that potential safety issues are resolved in a prioritized manner.

[104] Code of Federal Regulations 49 CFR 192.723, https://www.gpo.gov/fdsys/granule/CFR-2010-title49-vol3/CFR-2010-title49-vol3-sec192-723..

Right-of-Way Clearing Program



Another one of Avista's safety programs involves the removal of trees, shrubs, and other large vegetation from the rights-of-way of its buried lines. Tree roots can wrap around natural gas pipes and can damage protective coatings, interfere with cathodic protection systems, and increase the risk of potential pipe failure and leaks. The zone of clearance for vegetation measures ten feet on either side of the pipeline for a total clear zone of 20 feet. The Company surveys rights-of-way for its high-pressure pipelines regularly and identifies where vegetation needs to be cleared, notifying customers well in advance if corrective work must be done.

Tree Root Damage

In addition to maintaining rights of way, Avista works with customers to encourage them to avoid planting trees in clearance zones, using the opportunity to reinforce public awareness of pipeline safety, particularly with the need to call for utility locates before doing any digging or excavation.

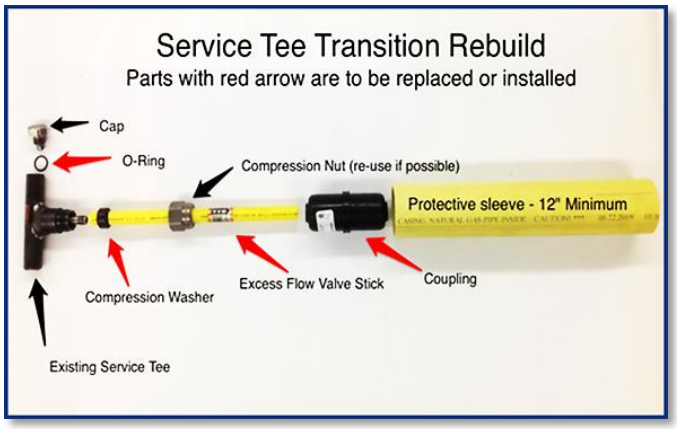
Natural Gas Pipe Overbuilt Safety Program

Overbuilds occur when customer-constructed improvements such as sheds, decks, homes, or other structures are built over existing pipeline segments, restricting Company access to the pipeline for repairs or maintenance as well as leak surveys, which are taken by walking directly above the gas lines while operating leak detection equipment. These encroachments make it difficult or impossible to test for leaks or maintain the pipeline, and can also violate federal code related to proper venting, as leaks can become trapped within buildings and cause safety issues.

Interestingly, one of the highest risk areas are mobile home parks, as they tend to have a lot of flux and because they are living quarters so safety of the residents is a primary concern. Each of these encroachment situations is unique, so Avista handles them that way, working with the customer to find a solution that works for both parties.

This program is designed to proactively identify and replace sections of pipe that can no longer be operated safely due to encroachments, prioritizing the need for action based upon the highest risk level to customers. The Company believes that identifying these issues before they become safety hazards and developing a plan around the work needed is the most effective and efficient way of managing the funds assigned to this program. It is also the best way to protect customer safety and property.

Aldyl A Pipe Safety Program



Project Summary

As mentioned earlier, the U.S. Department of Transportation Pipeline and Hazardous Materials Safety Administration requires pipeline operators to identify and mitigate the highest risks in their gas distribution systems. For Avista, one high risk is related to Aldyl A pipe manufactured from the 1960s through the early 1980s and installed in our system.[105] Widely used for decades throughout the natural gas industry, over time it was discovered that certain resins used in these early generations of Aldyl A pipe may become brittle, causing leaking and failures, especially where the Aldyl A service pipe connects to the steel main pipe (transition tee). It is the Company's position that this situation creates unacceptable risk. To actively address this risk, Avista developed the Aldyl A Pipe Safety Program in coordination with the Washington Utilities and Transportation Commission.[106] Avista's program replaces at-risk pipe sections over a 20 year time frame, starting with the highest risk areas. Even beyond the mandatory requirements in Washington, this program is designed to protect public safety and property by proactively replacing all of this pipe throughout the entire service territory.

The Company identified approximately 737 miles of priority Aldyl A main pipe (1¼" through 4" pipe) manufactured prior to 1984 and about 18,000 transition tees that need to be replaced. The Company used a risk consequence model to identify and prioritize areas with the highest potential for leaks. The replacement program began in 2012 and the Company is very actively engaged in it.

Nature of the Risk

Early vintages of Aldyl A pipe produced for natural gas service from the 1960s through the early 1980s are subject to "premature brittle-like cracking." This failure process results from a loss of ductility or flexibility in the pipe material. Ductility is a fundamentally-important property of polyethylene piping, as it allows the pipeline to tolerate small amounts of earth movement, the presence of rocks or gravel, pressure surges in the pipeline, and other common stresses. The loss of ductility allows these routine stresses to create small cracks on the inner wall of the pipe, which eventually propagate through the pipe wall resulting in a leak. This tendency to fail increases as the pipeline ages. Newer generation polyethylene pipe does not have this tendency for brittleness and cracking.

In an effort to address this issue, the Company instituted a systematic 20-year replacement program

[105] Avista Utilities Natural Gas Safety Project Plan for Oregon, March 2018, https://edocs.puc.state.or.us/efdocs/HAS/um1898has9275.pdf
[106] Washington Utilities and Transportation Commission Order PG-131837, https://www.utc.wa.gov/docs/Pages/DocketLookup.aspx?FilingID=131837

for 737 miles of Aldyl A pipe identified in our system.[107] Avista also observed increasing failure rates of the plastic service pipe at connection points to steel service tees. Avista identified nearly 18,000 service tees with steel to plastic piping transitions (transition tees) and began a process of replacing these sections as well. The overall program cost to replace the plastic main and transition pipe at the identified steel tees is currently estimated to cost $350 million, with the plan of spending approximately $20 to $22 million per year in this effort.

The facilities targeted for replacement are interspersed throughout the service territory, so a strategic approach was developed in 2012 to prioritize the replacements. The majority of the work is done using contract crews and equipment since this effort is intensive, specialized, subject to seasonal constraints in some areas, and would add significantly to both the normal workload and staffing levels required for ongoing natural gas operations if Avista staff were used. The contract approach has been found to be much more cost effective.

Since 2013 Avista's primary contractor for performing its Aldyl A main pipe replacement and rebuilding service tee transitions is NPL.[108] NPL's proven expertise and mastery of specialized construction techniques has been a real asset in the effort to get the Aldyl A work done on time and within budget. Avista also partners with NPL to refine construction technologies, allowing us to improve our efficiency and cost effectiveness over time. As an example, this partnership implemented a new technology to minimize damage to pavement when rebuilding service tees. Called "keyhole" technology, this method of accessing and restoring thousands of point projects is often referred to as "urban micro surgery." This method cuts a 24" diameter asphalt core from the road, vacuum excavates down to the tee, rebuilds the assembly, and then essentially glues the 24" diameter asphalt core back into the road. This water tight reinstatement performs as if the roadway has never been cut. It is far superior to conventional cut-and-patch methods, as those patches cannot be made water tight, causing them to act independently of the existing roadway, eventually settling and becoming potholes. This highly effective methodology has resulted in avoided road restoration costs of $6.4 million since 2013 compared to the cost of the conventional cut-and-patch road restoration method. Avista and NPL actively work together to maximize the use of trenchless

Above: Using keyhole technology to minimize road damage
Left: The replaced keyhole core showing minimal road damage

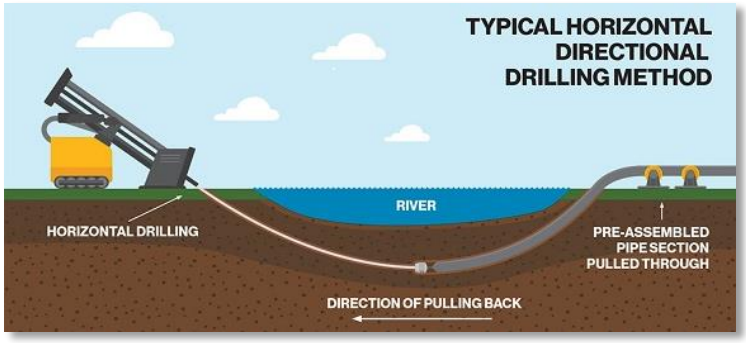
[107] This work is accomplished by our Gas Facilities Replacement Program, which is responsible for developing and managing the overall project. Avista's Master Plan for this program, titled "Protocol for Managing Select Aldyl A Pipe in Avista's Natural Gas System," provides the background on this pipe, the vintages and types of pipe slated for replacement, as well as the rationale for the proposed twenty-year replacement program. This program can be found at https://www.utc.wa.gov/_layouts/15/CasesPublicWebsite/GetDocument.ashx?docID=913&year=2015&docketNumber=150204

[108] NPL, formerly known as Northern Pipeline Construction Company, is a fifty year old company with a national reputation for safe, high quality and cost-effective construction services, including the installation or replacement of over ten million feet of pipe and other underground facilities each year across the United States.

Split-and-pull pipeline replacement technique

technologies as well, including cost-saving horizontal directional drilling (HDD)[109] and split-and-pull[110] pipe replacement techniques.

At the time the Company developed its Aldyl A replacement plan, its experience was exclusively focused on main extensions for *new* construction projects, which is generally limited to trenching in unpaved areas in open soil, installing piping, and back-filling the open ditch. Replacing *existing* natural gas facilities decades after the initial installation, and after the subsequent development of these areas, turns out to be another matter entirely. Replacement pipe must now be installed in fully developed and occupied areas that consist of numerous below ground facilities and utilities, paved streets, sidewalks and arterials, landscaped residential neighborhoods, and hard-surfaced commercial developments teeming with daily traffic and other activity.



Though new main pipe is most often installed by either horizontal drilling or open trenching, and while horizontal drilling is far less invasive, both methods require cutting into existing pavement or other hard surfaces. Care must be taken to plan and locate other existing underground facilities to avoid damaging them, new service lines must be ditched into landscaped yards, etc., and all of these features must be restored to unblemished condition once the installation is complete. These complexities have played a large role in the time required and the cost of the Aldyl A Pipe Safety Program.

Open trenching is often required to install new gas pipeline

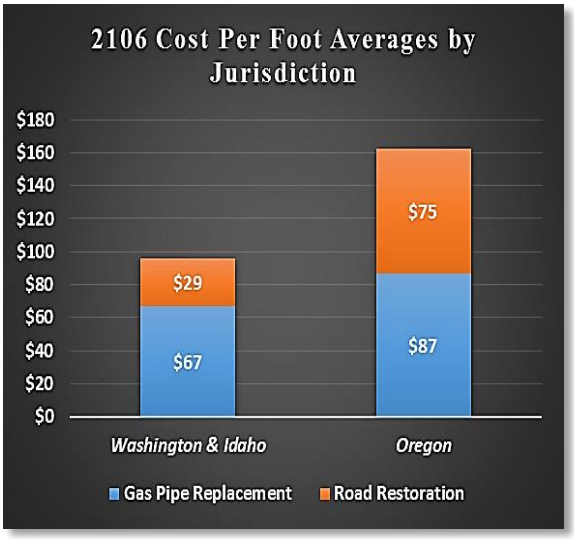


Figure 21. Pipeline Replacement Cost Per Foot by Jurisdictional Area

[109] Horizontal directional drilling involves drilling a pilot borehole then pulling the pipeline into place through that borehole, creating very little environmental impact. This is used frequently to install pipeline under waterways or sensitive sites like roadways, airports, parks, etc.

[110] Split-and-pull is a trenchless technology where the existing pipe is slit longitudinally while at the same time the new pipe of the same or larger diameter is drawn in from behind. It is a big time saver because the old pipeline is destroyed and the new pipe installed in one step without the need for open trenching.

During the first two years of the program Avista reported average per foot replacement costs ranging from $69 to $122 per foot. In 2016 those costs had risen to from $96 to $162 per foot. [111] These costs included pipe replacement in hard-surfaced areas as well as areas of exposed soil, such as the shoulder of rural roadways (with no other adjacent facilities). Replacing pipeline under a roadway requires mitigation such as backfill and compaction requirements, repaving of the street and replacing associated infrastructure like turf, landscaping, trees and sidewalks. The mitigation measures required vary significantly depending upon site conditions and jurisdictional requirements.

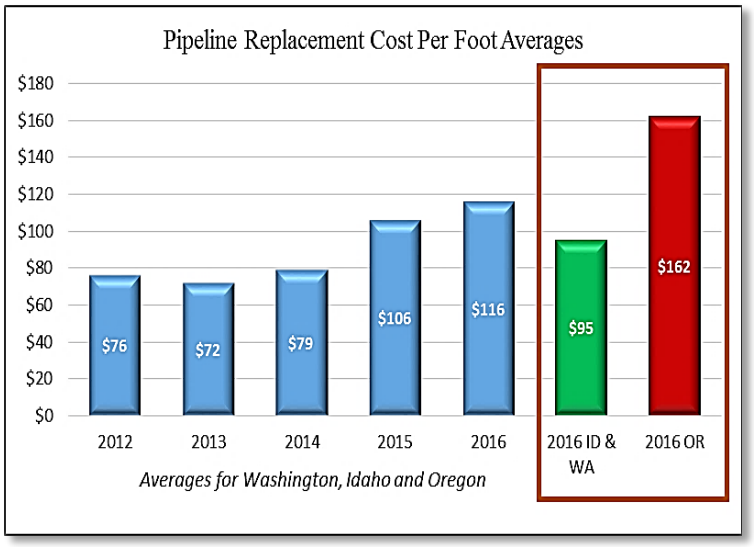


Figure 22. Pipeline Average Replacement Cost Compared by Jurisdiction

The Company makes every attempt to minimize the impact of this work on the public and public infrastructure, however we have experienced a trend on the part of municipalities toward more restrictive and expensive roadway restoration requirements. Over the past several years pavement cutting and remediation policies of local jurisdictions have had a significant impact on the scheduling, logistics, operational methods, extent of the area to be repaved, and the ultimate cost of pipe replacement. In Avista's experience, this continuing trend to enforce more restrictive moratoria on cutting into newer arterials and streets, to require more stringent requirements for backfill and compaction and for patching or repaving of streets cut for pipe replacement, and traffic control requirements have all had a substantial impact on our installation costs. These requirements include rules on the export and import of trench backfill materials, significant soil compaction, and the width of pavement restoration, which averages four feet but can range from two feet up to eight feet for segments of a project.

In an effort to understand, control, and document project costs, part of this program has included tracking system-wide cost data including cost per foot averages since the program's inception in 2012. The Company has found that work in areas with existing infrastructure can total up to three times the cost of new installation.[112] In Avista's experience, this continuing trend to enforce more restrictive requirements related to trenching under arterials and streets has had a substantial impact on our installation costs.[113] These costs are continually rising, as can be seen in Figures 32 and 33. This is especially true in our Oregon service territory where costs are escalating quickly as a direct result of

[111] In direct testimony provided by Avista in rates proceedings in multiple jurisdictions, including Oregon. See "Avista Utilities Natural Gas Safety Project Plan for Oregon," https://edocs.puc.state.or.us/efdocs/HAS/um1898has9275.pdf
[112] Washington Utilities and Transportation Commission dockets UE-150204 and UG-150205, https://www.utc.wa.gov/_layouts/15/CasesPublicWebsite/GetDocument.ashx?docID=913&year=2015&docketNumber=150204
[113] "Avista Utilities Natural Gas Safety Project Plan for Oregon," March 2018, page 27, https://apps.puc.state.or.us/edockets/docket.asp?DocketID=21041

the municipally-driven road restoration requirements in Oregon. The additional expenses are significant, as can be seen, and are beyond the Company's direct control.

Pipe Replacement Technology

A horizontal drilling machine being used to replace main pipe

Given the high unit costs associated with open trenching and roadway restoration, the Company has continued to work with NPL to optimize the use of trenchless technologies, including the horizontal drilling and split-and-pull technologies mentioned earlier. Not all projects, however, are suitable for using these technologies. In some situations safety issues exist due to the presence of multiple underground utilites. In other cases, the affected area has only one source of natural gas supply. The latter case requires the coordination and logistics of an all-day customer outage and the ability to perform the procedure quickly enough to allow for restoration of customer service the same day. Other prohibitive conditions include the presence of subsurface rock (solid rock or heavy cobble) and the lack of sufficient clearance along the pipe path to provide for adequate separation of utilities. Where conditions are favorable however, horizontal drilling can provide a cost-effective alternative to open trench construction because the restoration footprint is significantly reduced.

New main pipe be installed in the borehole created by the horizontal drilling

Since 2015, the Company has increased the use of horizontal drilling. In 2017, 88% of the main pipe in Avista's system was installed using horizontal drilling, leaving only 12% being installed by conventional open trench methods.[114]

Annual Leak Survey – Aldyl A Pipeline

One of the key pieces of the Aldyl A Pipeline Safety Program is the annual leak survey. The Company has continued to conduct annual leak surveys on Priority Aldyl A main pipe since 2011, even though this practice is much more costly than the conventional frequency of five years. Our chosen one year inspection program, however, provides our employees and the public with a prudent margin of added protection in alignment with our corporate focus on safety.

Risk Consequence Modeling

A key tool developed by the Company for better managing the risks associated with its Priority Aldyl A piping is its risk consequence model which identifies high occupancy facilities such as apartment buildings, schools, hospitals, commercial areas, etc. This model predicts areas in the system where

[114] "Avista Utilities Natural Gas Safety Project Plan for Oregon," March 2018, https://apps.puc.state.or.us/edockets/docket.asp?DocketID=21041

leaks are most likely to occur and then incorporates information on the density of development to assess relative priorities for pipe replacement.

In 2014, Avista updated its model to distinguish schools and daycare facilities from other types of developments. These were identified as sites that would be difficult to evacuate in the event of a natural gas emergency. Though these sites were already included in designated high-consequence high-density areas, this new additional designation provides them an additional layer of priority. The model also highlights those instances where the Company has Aldyl A facilities within close proximity to facilities that can sometimes encompass outdoor play areas or other areas of congregation such as churches and nursing homes. Avista is continuing to list and map other potential sites to determine whether they might warrant this higher-level prioritization.

Isolated Steel Pipe Replacement

Steel Pipe Corrosion Damage

Steel pipe that is not cathodically protected is subject to corrosion depending on pipe coating, the type or composition of the pipe, pipe general condition, soil type and acidity, ground moisture, the presence of foreign utilities, and other factors. Corrosion causes the loss of metal from the pipe wall, which over time can result in a gas leak. As mandated by federal and state regulations, Avista monitors isolated steel sections of pipeline main less than 100 feet in length as well as the associated isolated services and risers at a frequency of ten percent per year. The Company replaces steel sections that are not cathodically protected. This preemptive effort helps reduce the potential for corrosion and subsequent leaks, thereby increasing the safety and reliability of Avista's natural gas system.

Summary of Safety Programs

As is evident, Avista takes the safety of our customers and our employees very seriously. Our safety programs are robust, proactive, and designed to ensure that our systems are as safe as they can possibly be while providing the level of service and cost effectiveness that our customers and regulators expect. These programs are continually reviewed to insure that they are meeting their goals and objectives. Data is collected to track program progress and to provide the basis for analysis of program effectiveness and to ensure that all identified issues are mitigated and resolved.

Avista crews constant diligence in identifying safety issues helps protect our customers