ENERGY BY THE NUMBERS

Energy by the Numbers focuses on the metrics and data available to track how Oregon produces, purchases, and uses various types of energy.

This section includes energy use data on electricity, transportation energy, and direct fuels by resource and by sector. Where possible, data showing how Oregon's energy system has changed over time have been included to provide context and history. We also discuss energy production — where and what kind of energy Oregon produces, where and how we generate electricity, and what direct use and transportation fuels are produced in state.

Readers will find data on what Oregon spends on energy, how some Oregonians experience energy burden, and what the energy industry gives back to Oregon in terms of jobs. The section also demonstrates how energy efficiency continues to serve as an important resource for Oregon. It concludes with highlights on the four end use sectors: residential, commercial, industrial, and transportation, including energy use, expenditures, and GHG emissions – and how each sector uses energy to provide goods and services.

Trends and What's New:

- Oregon has vast energy efficiency potential, but the region hasn't been meeting the Northwest Power and Conservation Council's Power Plan goals for savings in electricity.
- Oregon exports more than half the wind power and over a third of the hydropower the state generates.
- Oregonians used less gasoline and jet fuel over the last two years but saw a small uptick in diesel use. Analysis indicates this is due to less personal travel during the COVID-19 pandemic and an increase in the delivery of goods.
- Oregonians spent less on energy in 2020 than in 2018. The variability in what we spend on energy is driven primarily by transportation fuel costs, which sees the largest swings in price.

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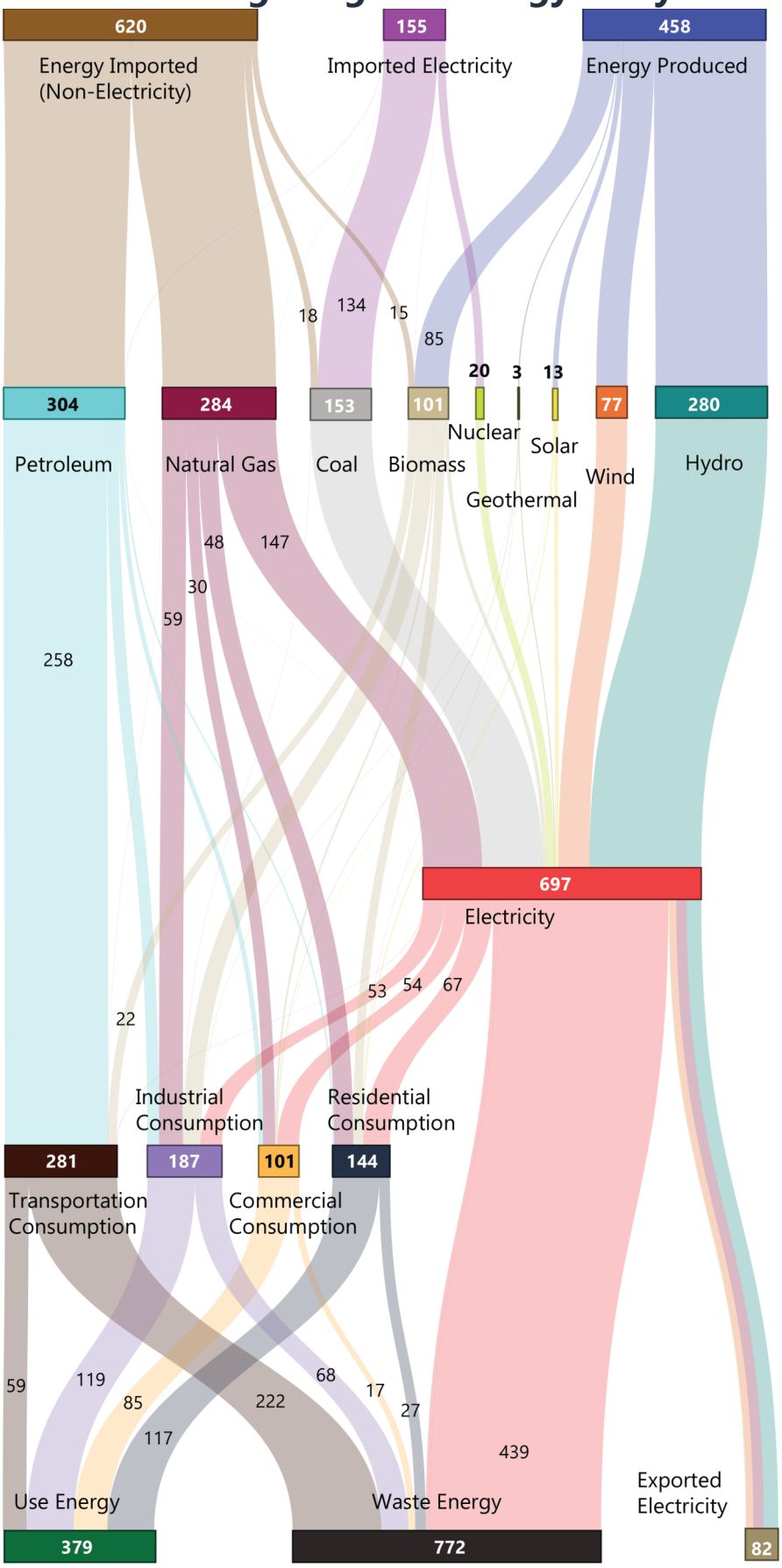
Understanding Oregon's Energy Story



Numbers represent trillions of Btu of energy.

Oregon's energy story has evolved over time to include new technologies, address changes in the availability of different generation resources, and to meet state energy goals. The Pacific Northwest has a long history of using hydropower resources, but 20 years ago, solar- and wind-generated energy was scarce.

Today, Oregon's energy resources are more diverse. In the chart at left, start at the top to see imported energy and energy produced in Oregon. **The numbers represent trillions of Btu of energy.** The energy lines flow through to show the different types of resources we use – including the energy we produce in Oregon and what we import as direct fuels or electricity – and where they end up in Oregon's energy story. The energy we produce and import helps meet various needs, from in-state electricity generation to transportation fuels to the natural gas and electricity that supply homes and businesses. Some energy ultimately goes unused due to system inefficiencies, and some is exported to other states.

Btu A **British Thermal Unit** is a measurement of the heat content of fuels or energy sources. Btu offers a common unit of measurement that can be used to count and compare different energy sources or fuels. Fuels are converted from physical units of measurement, such as weight or volume, into Btu to more easily evaluate data and show changes over time.

The chart provides a macro level look at the energy Oregonians produce, import, consume, and export. **Energy Produced** includes forms of energy that Oregon produces in-state, such as hydroelectric, wind, and biomass energy. **Electricity Imports** includes electricity that is generated in other states and brought in for use in Oregon. **Energy (non-electric) Imports** includes the other forms of energy brought into the state for various uses, such as gas to power transportation and fuels to heat Oregon homes.

The flow to **Waste Energy** includes all the energy that is not harnessed, from the point of extraction to the point of use. This includes energy lost as heat during combustion or transformation into electricity, transmission losses, and many other factors.[i]

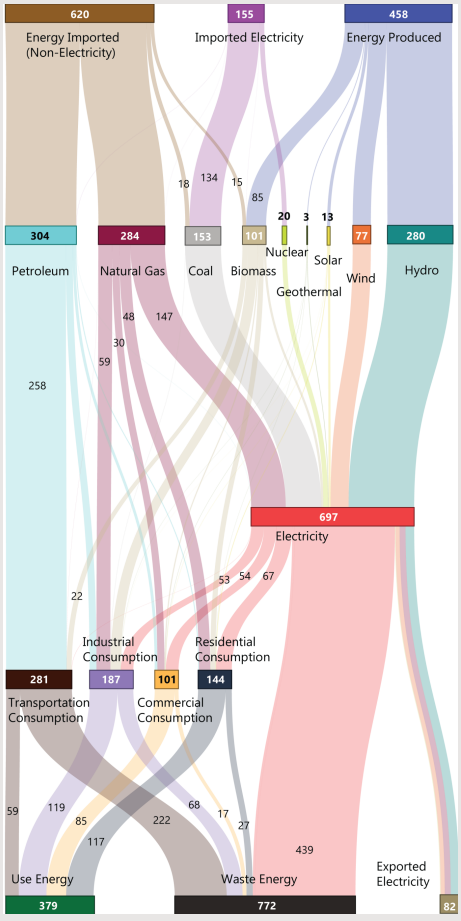
The coronavirus pandemic has affected many aspects of life in Oregon, including how Oregonians use energy. Between 2018 and 2020, the residential and commercial sectors experienced shifts in energy consumption. **Residential** sector energy increased from 141 to 144 trillion Btu, while **commercial** sector energy decreased from 104 to 101 trillion Btu as more people stayed home and many businesses shifted operations to adjust to the pandemic. Meanwhile, **industrial** sector energy consumption increased from 178 to 187 trillion Btu. **Transportation** energy consumption experienced the largest change, decreasing from 316 trillion Btu in 2018 to 281 trillion Btu in 2020, likely due to factors such as increased telecommuting and fewer travel opportunities.

Changes in the Energy Flow Chart Methodology and Design

In this report, Imported Electricity is illustrated as a separate energy flow. This change was made to show more clearly how electricity moves from generation to use (or waste). In the *2020 Biennial Energy Report,* energy related to imported electricity was grouped together with other energy types and labeled as Energy Imported.

Sector-based end-use efficiency estimates for non-electric energy have been updated to match the methodology used by Lawrence Livermore National Laboratory in its development of similar energy flow diagrams.[2] This report uses an end-use efficiency of 65 percent for the residential and commercial sectors, 49 percent for the industrial sector, and 21 percent for the transportation sector.

The electrical system losses associated with exported electricity are now included throughout the energy flows.



[i] Electrical system losses for various generation sources are estimated using methods that match with those used by the United States Energy Information Administration.[1]

Energy Sources Used in Oregon

Solar. Photovoltaic technology converts energy radiating from the sun into electricity. Solar systems are located on homes, businesses, and large utility-scale arrays. From 2012 to 2020, solar generation in Oregon increased from 6,400 megawatt-hours to over 1 million MWh.[3]

Nuclear. Generated electricity from a nuclear reactor where thermal energy is released from the fission of nuclear fuel. Oregon's nuclear power comes from the Columbia Generating Station in Washington State, and the electricity produced is marketed by the Bonneville Power Administration.

Hydropower. Electricity generation harnessed from the flow of water through dams. Oregon has 105 hydropower facilities of varying size, including four federal facilities on the Columbia River that span the Oregon and Washington border, and two facilities that span the Oregon and Idaho border.

Wind. Generation of electricity by the force of wind turning turbines. As of 2020, Oregon has 54 operating facilities in the state with a total capacity of 4,203 MW.[3]

Geothermal. Energy extracted from hot water or steam from natural underground sources can be used for water/space heating or the generation of electricity. Oregon has two geothermal electric generation facilities with a capacity of 24 MW.[3]

Natural gas. Fossil fuel extracted from beneath the earth's surface. Oregon has a single natural gas field located in Mist. Oregon imports most of the natural gas it consumes for electricity and as a direct fuel. There are 13 natural gas electricity generation facilities with a combined capacity of 4,354 MW.[3] Natural gas is used directly for residential, commercial, industrial and transportation uses.

Coal. Combustible rock is burned for industrial processes and to create electricity. Oregon had one coal-fired power plant, the 575-MW Boardman facility, which closed in October 2020 and was demolished in September 2022.[4] The state also imports coal-generated electricity from neighboring states.

Biomass. Includes all renewable biogas and biofuels derived from the energy of plants and animals. Wood and wood waste is Oregon's greatest source of biomass, which is used for space heating, cooking, electricity generation, and transportation. Oregon has 11 biomass and 30 biogas operating facilities converting waste products to electricity.[3] Oregon also produces plant-derived ethanol fuel and biodiesel from used cooking oil to be used as transportation fuels.

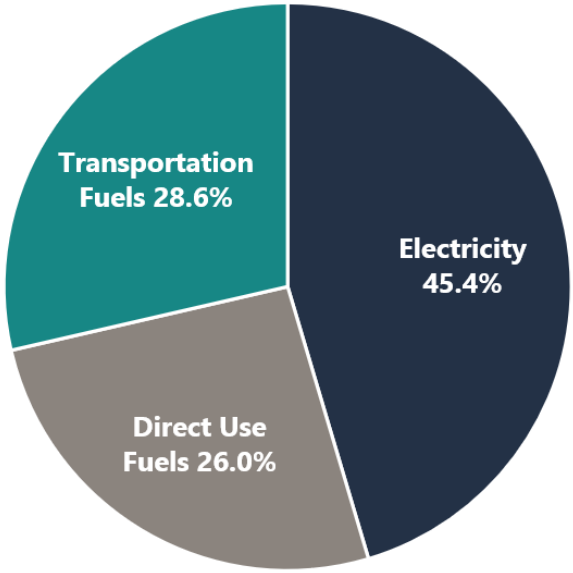
Petroleum. Fossil fuel extracted from beneath the earth's crust that includes gasoline, diesel, heating oil, lubricants, and other fuels we use for space heating, industrial equipment, and transportation. Oregon imports the petroleum that it uses.

Energy Use in Oregon

Consumption by Source

Oregon relies on energy from a variety of resources. We import energy like gasoline, natural gas, propane, and other fuels. We use electricity from both in- and out-of-state sources—including coal, natural gas, nuclear, hydropower, wind, and other renewable resources.[1]

For this introduction to Oregon's energy use, the report sorts energy into three main categories:



45.4%

of Oregon's 2020 energy consumption[2]

Electricity: this is where most people begin when thinking about energy—the critical resource that powers our day-to-day lives. The electricity Oregonians use comes from facilities across the western United States and in Oregon. This percentage also accounts for the energy in fuels that come from out of state, such as natural gas, but generate electricity in-state, as well as the energy losses associated with electricity generation.

26.0%

of Oregon's 2020 energy consumption[2]

Direct Use Fuels: this category includes fuel oil and natural gas used to heat homes and commercial spaces, fuels used for other residential purposes, such as gas stoves, solar thermal heating, and fuels used directly in industrial processes.

28.6%

of Oregon's 2020 energy consumption[2]

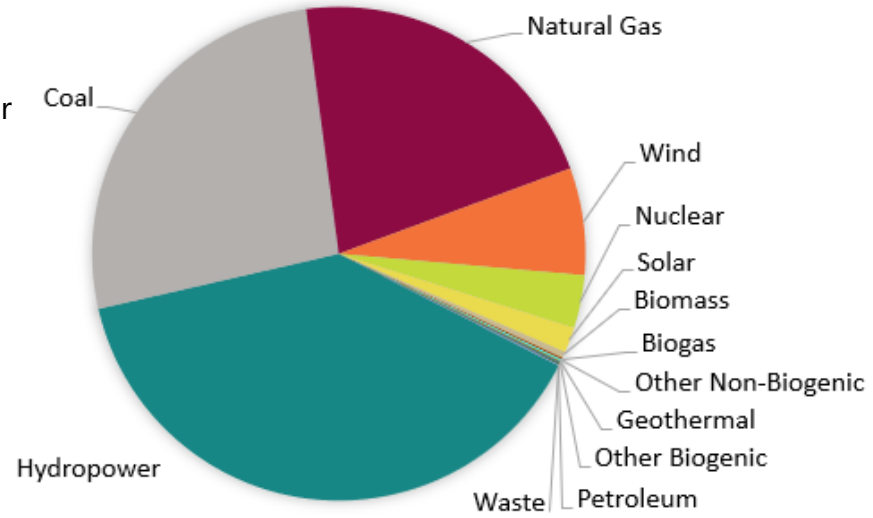
Transportation Fuels: this includes personal, passenger, and commercial vehicles, both on and off the roads, plus airplanes, boats, barges, ships, and trains. Nearly all transportation-related sources of energy are imported from out of state for in-state use.

Electricity

45.4%

of Oregon's 2020 energy consumption

38.9%	Hydropower
26.5%	Coal
21.5%	Natural Gas
7.0%	Wind
3.5%	Nuclear
1.7%	Solar
0.4%	Biomass
0.1%	Geothermal
0.1%	Biogas

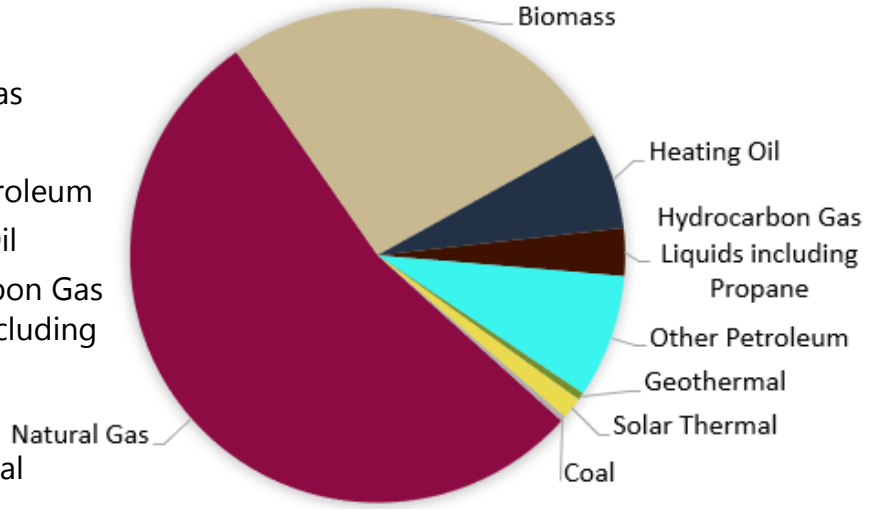


Direct Use Fuels

26.0%

of Oregon's 2020 energy consumption

53.7%	Natural Gas
26.6%	Biomass
8.1%	Other Petroleum
6.3%	Heating Oil
3.1%	Hydrocarbon Gas Liquids Including Propane
0.3%	Coal
0.5%	Geothermal

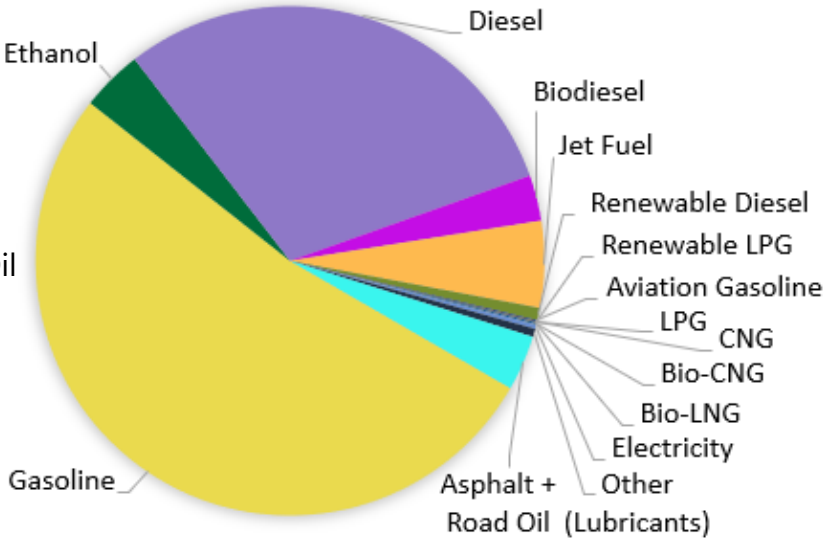


Transportation Fuels

28.6%

of Oregon's 2020 energy consumption

52.3%	Gasoline
30.0%	Diesel
5.5%	Jet Fuel
3.9%	Ethanol
3.5%	Asphalt/Road Oil
2.9%	Biodiesel
0.5%	Lubricants
0.1%	Aviation Gas
0.3%	Electricity



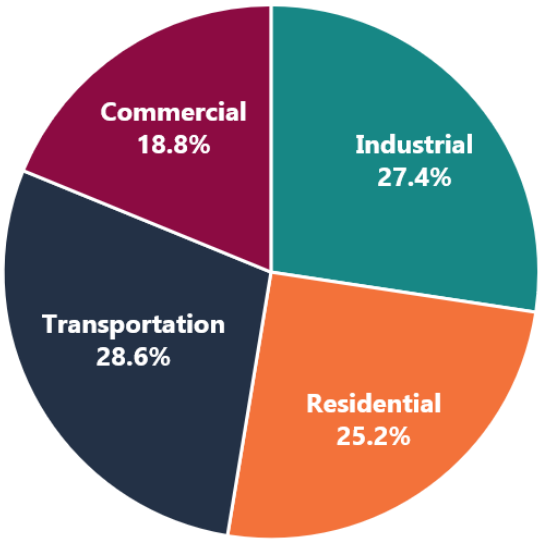
Note to readers: *Fuel percentages are rounded to the nearest tenth and not all are listed.*

Energy Use in Oregon

Consumption by Sector

Energy consumption is also tracked by how it is used among four main end-use sectors: Residential, Commercial, Transportation, and Industrial.

In Oregon in 2020, those four sectors combined consumed 983 trillion Btu of energy,[2 3] including each sector's respective share of electrical system losses,[i] as discussed earlier in *Understanding Oregon's Energy Story.*



25.2%

of Oregon's 2020 energy consumption[2]

Residential: this category includes single family, multi-family, and manufactured homes for Oregonians. Energy is used for lighting, to heat and cool living space, cooking, and appliances. Electricity is the most used energy resource in homes – with heat pumps, electric furnaces, and electric resistance heaters as examples of primary electric heat options.

18.8%

of Oregon's 2020 energy consumption[2]

Commercial: this category includes businesses that provide goods and services, government and office buildings, grocery stores, and shopping malls. Energy is used to heat and cool spaces, power equipment, and illuminate facilities. It is Oregon's smallest energy-consuming sector, supported by the adoption of advanced energy codes, energy efficiency programs, and advancements in equipment and processes.

27.4%

of Oregon's 2020 energy consumption[2]

Industrial: this category includes facilities used to produce, process, and manufacture products – including agriculture, fishing, forestry, manufacturing equipment, mining, and energy production. Energy powers industrial equipment and machinery to manufacture products. This sector has seen contractions in aluminum, forestry, and manufacturing – with improvements in efficiency of industrial facilities and equipment.

28.6%

of Oregon's 2020 energy consumption[2]

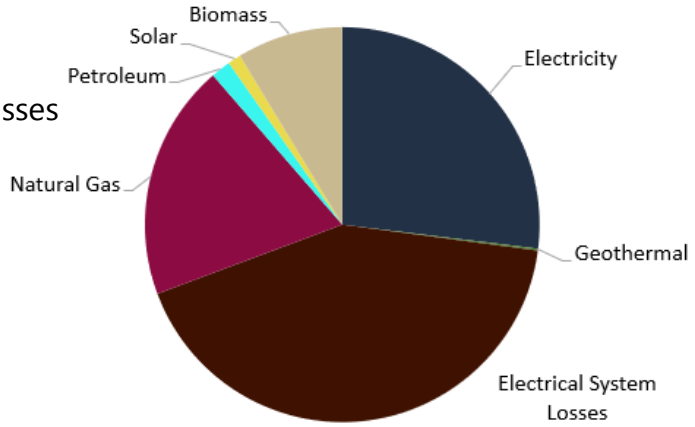
Transportation: Personal cars, fleets, shipments, airline travel, and more make up Oregon's transportation energy use. Petroleum is the most used resource and the largest contributor of greenhouse gas emissions in Oregon. Alternative fuels like electricity and biofuels are a growing part of this sector.

[i] Electricity generation and transmission result in energy losses that are estimated and included in EIA consumption data. Electrical system energy losses account for the amount of energy lost during generation, transmission, and distribution of electricity.

Residential

25.2%
of Oregon's 2020 energy consumption

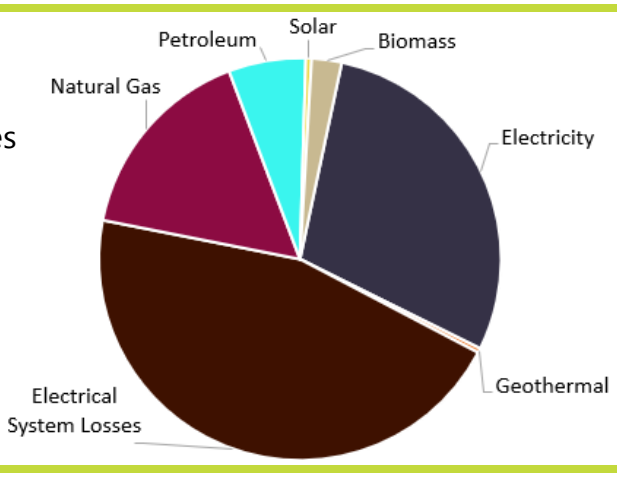
42.2%	Electrical System Losses
26.9%	Electricity
19.3%	Natural Gas
8.7%	Biomass
1.6%	Petroleum
1.1%	Solar
0.2%	Geothermal



Commercial

18.8%
of Oregon's 2020 energy consumption

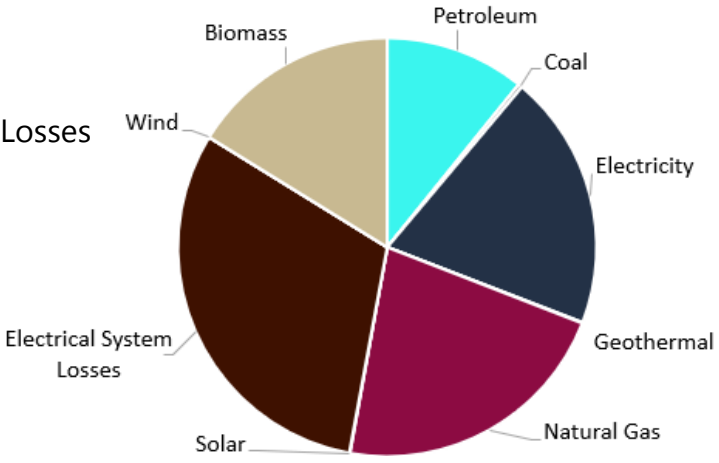
45.4%	Electrical System Losses
29.0%	Electricity
16.2%	Natural Gas
6.2%	Petroleum
2.4%	Biomass
0.4%	Geothermal
0.5%	Solar



Industrial

27.4%
of Oregon's 2020 energy consumption

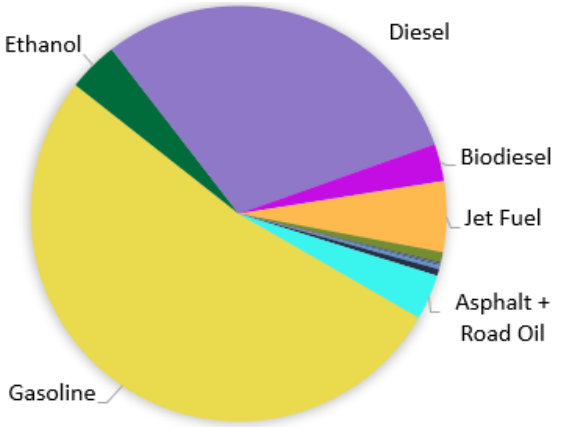
30.9%	Electrical System Losses
21.9%	Natural Gas
19.7%	Electricity
16.2%	Biomass
10.8%	Petroleum
0.3%	Coal
0.1%	Geothermal



Transportation

28.6%
of Oregon's 2020 energy consumption

52.3%	Gasoline
30.0%	Diesel
5.5%	Jet Fuel
3.9%	Ethanol
3.5%	Asphalt + Road Oil
2.9%	Biodiesel



Energy Use in Oregon

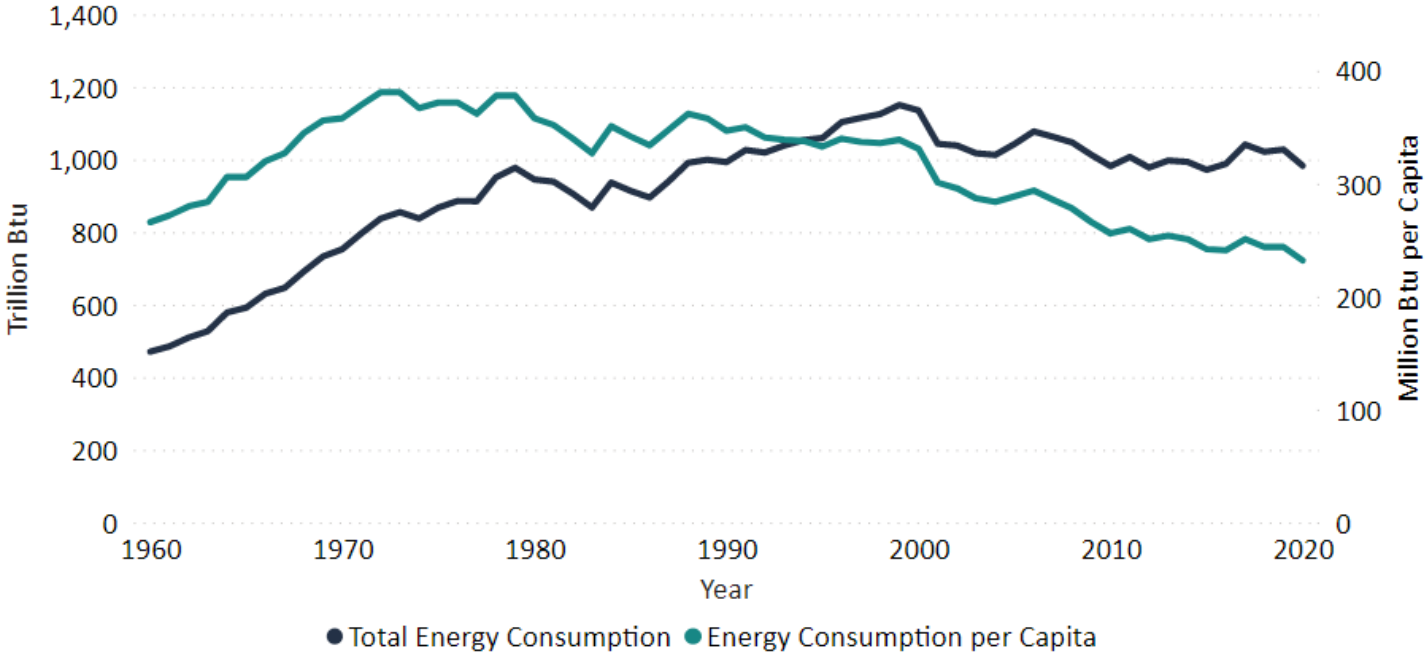
Oregon's Energy Consumption Over Time

15th

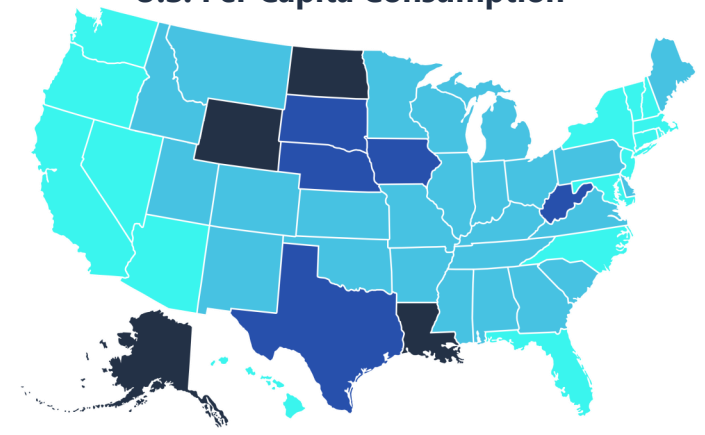
Oregon's rank for lowest per capita energy use among states in 2020.[4]

Oregon saw an overall trend of increased energy use for almost four decades—an average of 3.6 percent growth per year from 1960 to 1999.[2] During that time, the state shifted from a reliance on fuel oil and wood to an increased use of natural gas and electricity in homes and businesses. Oregon reached its highest consumption of energy in 1999 in both stationary and transportation uses. Since then, total energy use has been decreasing. The amount of energy used in Oregon declined by 13.4 percent between 2000 and 2020. Energy consumption per capita does not directly correlate with overall energy use. In the last 20 years, Oregon has had steady population increase during a period of slight decline in overall energy consumption. This translates to a steady decrease in energy consumption per capita.[2]

Oregon's Total Energy Consumption and Per Capita Energy Consumption Over Time[2]



U.S. Per Capita Consumption[4]



≤ 250 Million Btu
250 to <400 Million Btu
400 to <600 Million Btu
≥ 600 Million Btu

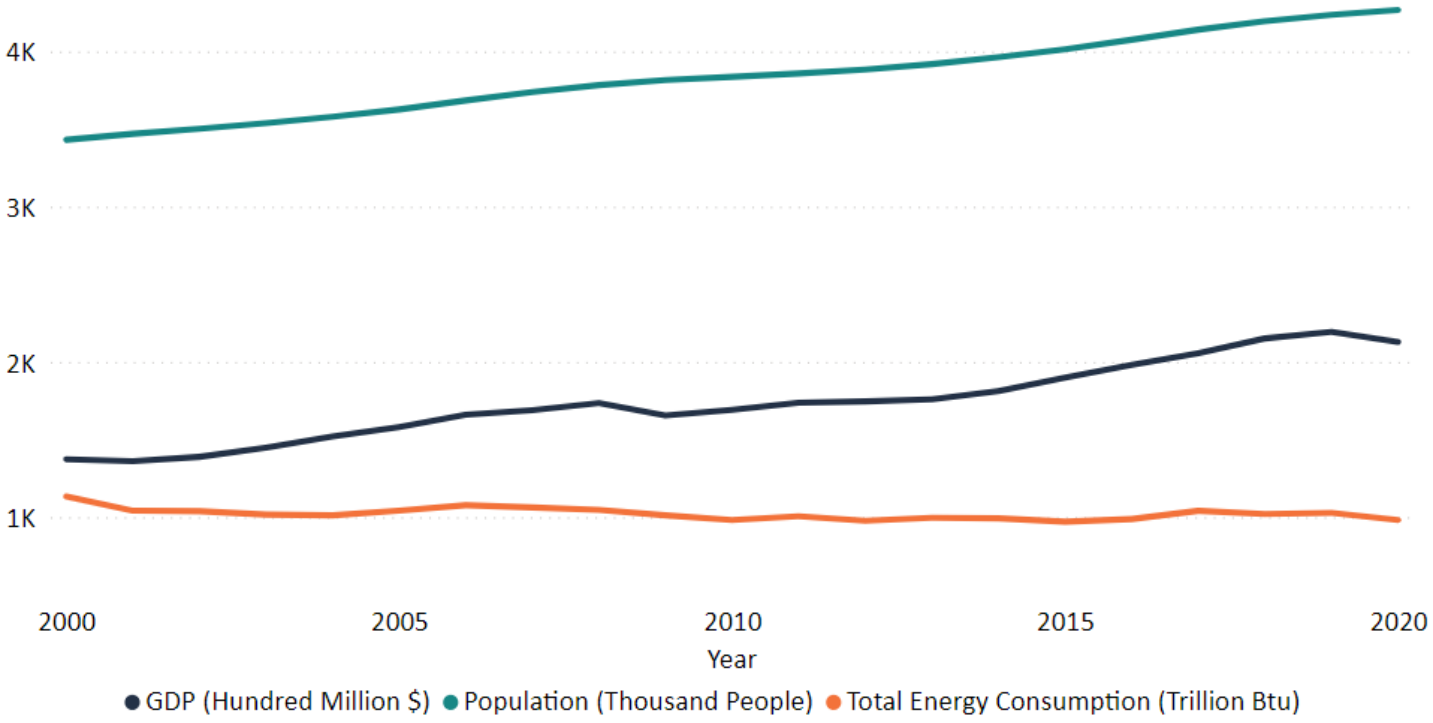
Energy Efficiency

While energy efficiency is not "consumed" like other resources, it is the second largest resource available in Oregon after hydropower. Efforts to increase energy efficiency effectively reduce overall energy consumption. Historically, Oregon has consistently met increased demand for electricity by implementing energy efficiency strategies.

Energy Consumption and Economic and Population Growth

Energy efficiency and changes in our economy have led to decreases in Oregon's total and per capita energy use over time. Oregon's emphasis on energy efficiency has helped reduce both total and per capita energy use despite an increasing population, thereby avoiding the need to build new electricity generation plants. The graph below shows that since about 2000, economic growth (measured by gross domestic product or GDP) does not correlate with increases in energy consumption. In fact, as the economy and our population have grown, our energy consumption has stayed relatively flat with a slight decline.[2]

Oregon's GDP, Population, and Energy Consumption by Year[2]



This displays all three data sets on the same axis; refer to the legend to find the units for each. This chart allows us to review the overall trends of population, energy consumption, and GDP in comparison to each other. The chart is not adjusted for inflation.

Consumption & Use

In the energy sector, *consumption* typically describes the amount of energy used. *Use* sometimes has the same meaning, but is often specifically applied when talking about the purpose of energy. For example, a home's annual electricity *consumption* goes toward a variety of *uses* like lighting, heating, and appliances. Or a furnace is *used* for heating but *consumes* electricity and natural gas. For this report, consumption and use are included in a wide variety of ways and sometimes interchangeably.

Electricity Use

Resources Used for Oregon's Electricity Mix

In 2020, Oregon used 53.7 million megawatt hours (MWh) of electricity from both in-state and out-of-state sources. Hydropower, coal, and natural gas make up the bulk of Oregon's electricity resources, commonly called the resource mix, although the share of each resource is constantly changing and evolving.

Renewable energy makes up an increasingly larger share of the mix each year. In 2021, the Oregon Legislature passed House Bill 2021, requiring Oregon's largest electric utilities, Portland General Electric and Pacific Power, to reduce greenhouse gas emissions to 80 percent below baseline emissions levels by 2030, 90 percent below by 2035, and 100 percent by 2040. The five largest sources of electricity are labeled below; the other resources not listed in the bubble chart are each under 2 percent.[1]

26%

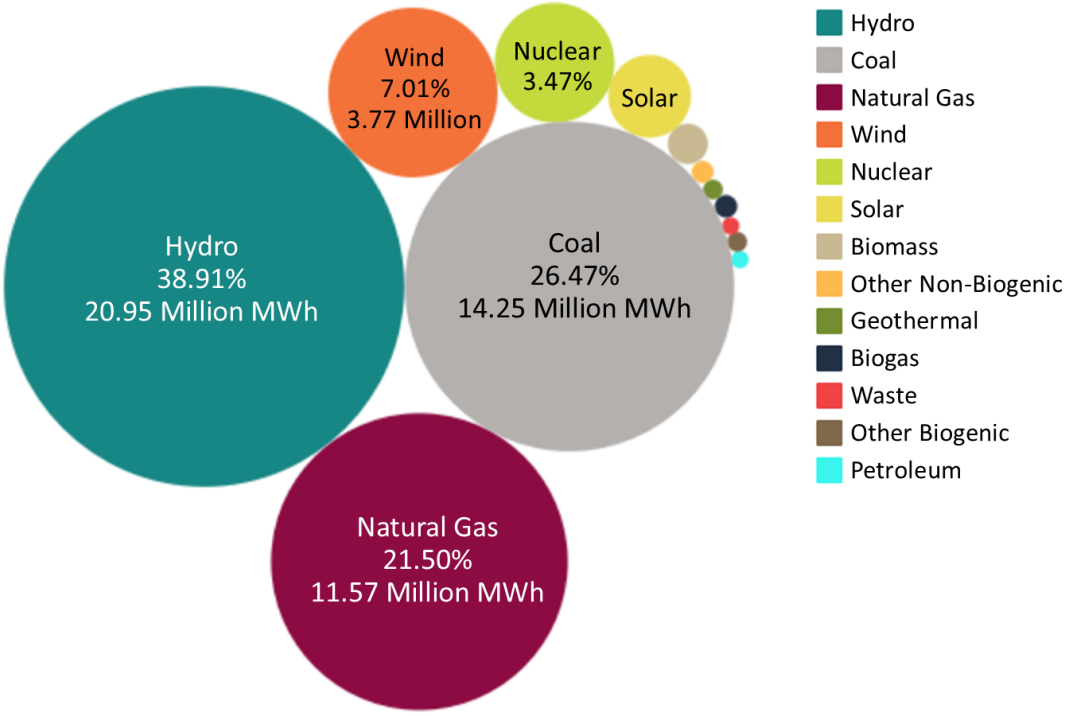
Percentage of Oregon's 2020 electricity mix that came from coal.[1]

2040

Year by which Oregon's two largest utilities and Electricity Service Suppliers will need to reduce emissions for electricity sold in the state by 100 percent below baseline emissions levels.[2]

Resources Used to Generate Oregon's Electricity[1]

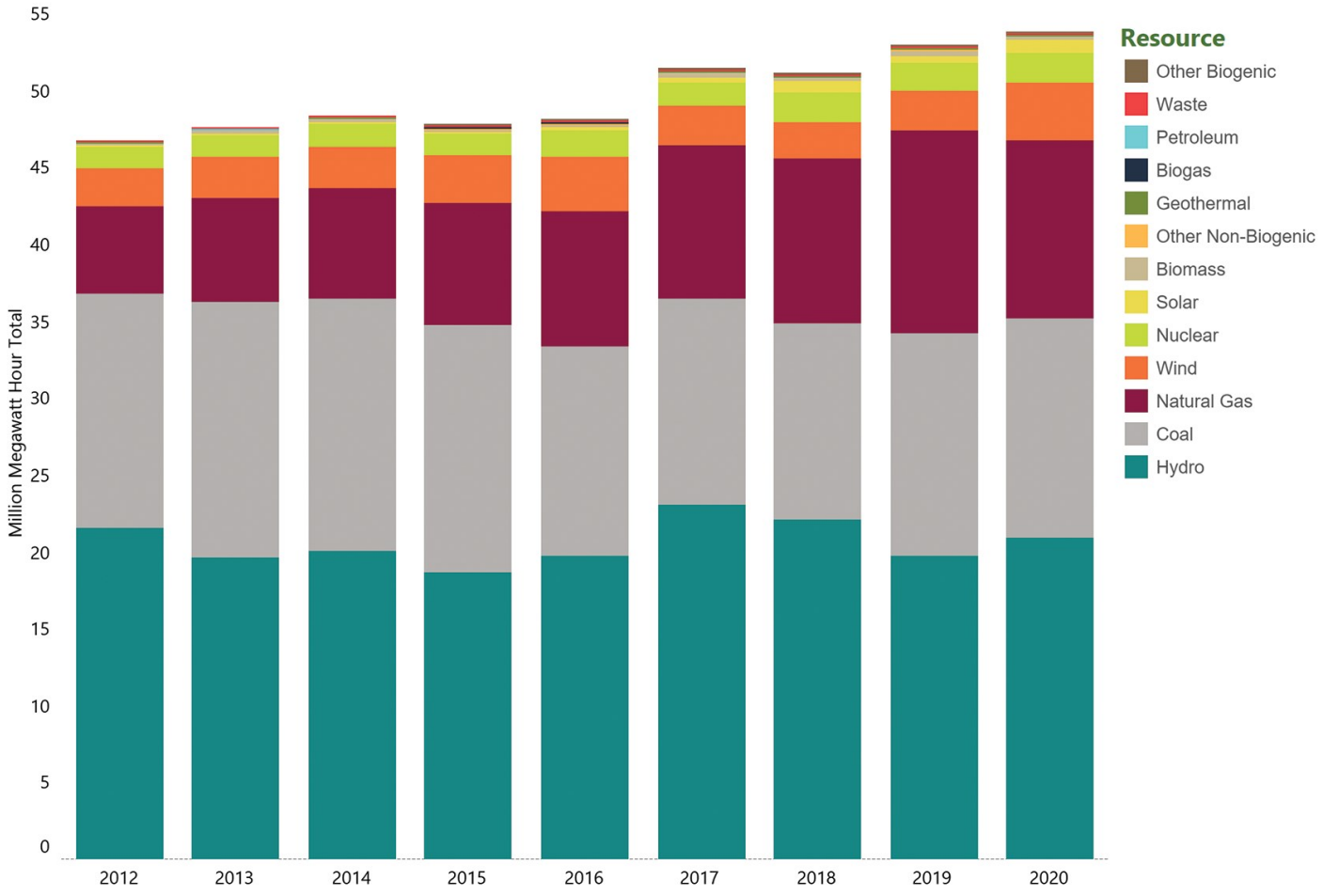
Based on 2020 data, this chart shows the energy resources used to generate the electricity that is sold to Oregon's utility customers.



Electric utilities are privately owned electric companies or consumer-owned utilities that distribute electricity to retail electricity consumers in Oregon. Oregon utilities generate their own electricity, purchase power from wholesale providers like BPA, or enter into short-term or long-term contracts to buy electricity from third-party owned power plants and the market.

Electric utilities in Oregon often generate electricity from plants they own for delivery to retail customers, and in many cases will also purchase electricity from **wholesale electricity providers**. Bonneville Power Administration is a federal power marketing administration that provides a significant amount of wholesale electricity to Oregon utilities, particularly consumer-owned utilities. Utilities also may purchase wholesale power from non-utility owned generators (Independent Power Producers) or directly from other utilities.

Oregon's Electricity Mix Over Time[1]



Oregon's electricity resource mix displays the proportion that each resource (solar, wind, hydropower, etc.) contributes to the total amount of electricity that Oregonians consume each year. The chart above presents Oregon's mix from 2012 to 2020 and shows two notable trends: First, total annual electricity consumption has increased from 47 to 53 million MWh between 2012 to 2020, driven by factors like economic and population growth and increased customer demand. Second, the percentage that each resource contributes to total electricity for Oregon consumption changes year-to-year. For example, between 2012 and 2020, coal's share of electricity consumed in Oregon steadily declined from 32 to 26 percent, while the share of natural gas increased from 12 to 21.5 percent. In the same period, hydropower's share went up and down according to annual precipitation patterns, with a high of 46 percent in 2012 and a low of 37 percent in 2019.

Fluctuations in the sources of electricity consumed in Oregon are the result of several factors, including the regional nature of energy markets, resource availability, market dynamics and utility contracts, public policy, and other factors.[1]

Hydropower availability drives year-to-year fluctuations in Oregon's electricity resource mix. Oregon and the Pacific Northwest are rich in hydropower, which is consistently a low-cost resource. In energy markets, utilities typically prioritize using the lowest cost generating resources, allowing them to meet customer demand at least cost. This often results in prioritization of hydropower, wind, and solar, which have low or zero marginal costs. These types of resources are used first when they are available, and then, if unmet customer demand remains, utilities will look to other types of units, such as natural gas power plants, to meet additional residual demand.

It is worth noting that the availability of renewable resources—such as wind, solar, and hydropower—vary over the course of a day, from season-to-season, and year-to-year based on natural cycles, weather patterns, and changing climate conditions. Utility electricity mixes include real-time supplemental market purchases of electricity that utilities make to meet demand; these purchases are called "unspecified" because the specific resources used to generate the electricity are not tracked nor accounted for in real-time.

Learn more about how Oregon's electricity generation may change as the state moves to a clean energy future in the Policy Briefs section of this report.

Learn more about Oregon's Electricity Resource Mix

The Oregon Department of Energy updates the state's electricity resource mix each year. On the agency's website, find the state's overall mix, a map of generation facilities, electricity mixes by utility, greenhouse gas emissions, and more.

www.tinyurl.com/OregonERM

Electricity Imports and Exports

Oregon is blessed with an abundance of renewable energy resources and is one of the leading producers of renewable energy in the country. This abundance is one of the reasons Oregon can export significant amounts of the renewable electricity it generates — particularly from hydropower.

Oregon imports all its petroleum and coal, and almost all of the natural gas fuels used to generate electricity at in-state facilities. Oregon does not have any coal mines and only extracts small amounts of natural gas at one facility in Oregon.

Oregon also imports electricity from all over the western U.S.; this imported electricity comes from various resources.[3]

Oregon 2020 Exports

57.0% of wind generation

34.4% of hydroelectric generation

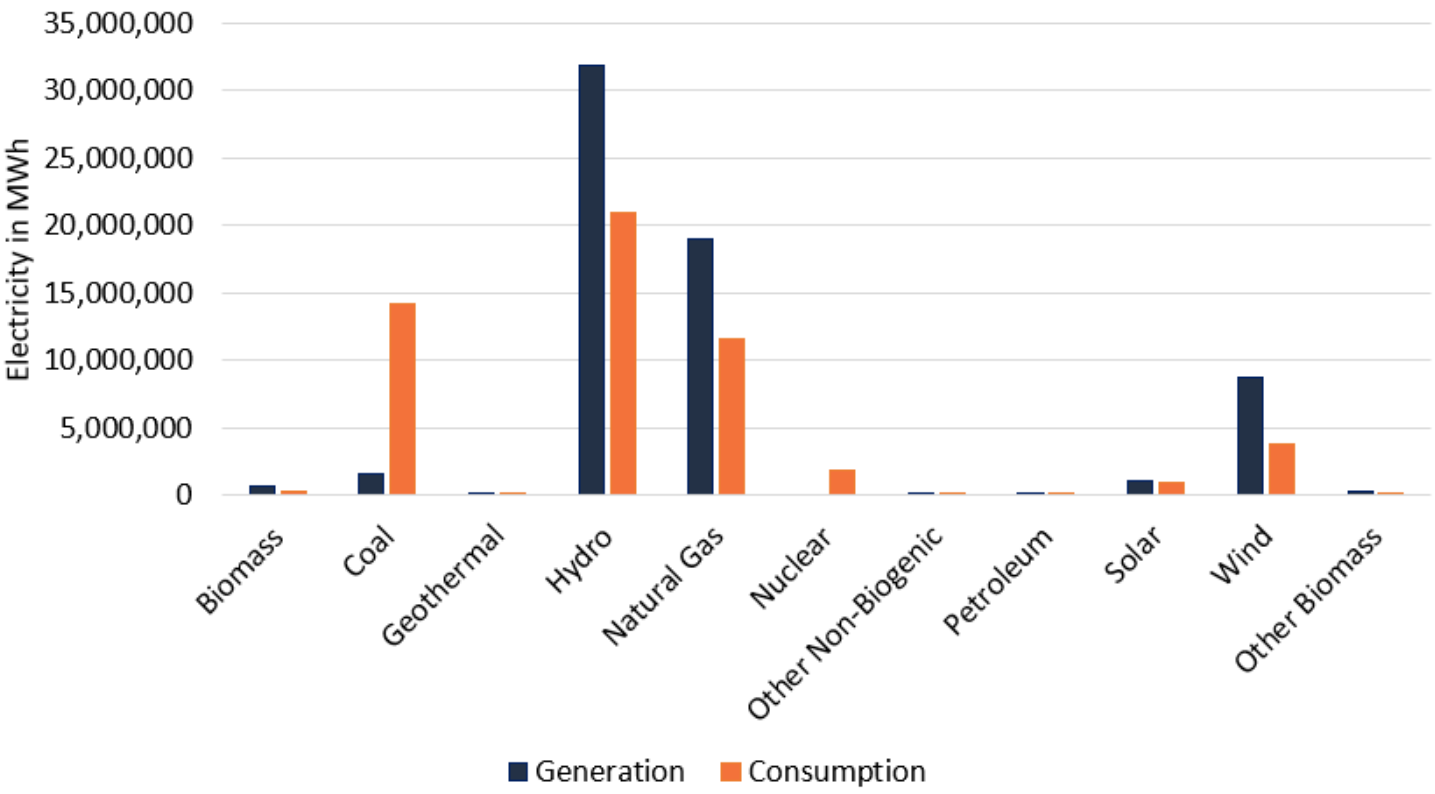
16.7% of solar generation[3]

Oregon 2020 Imports

88.6% of coal based electricity

100% of nuclear electricity

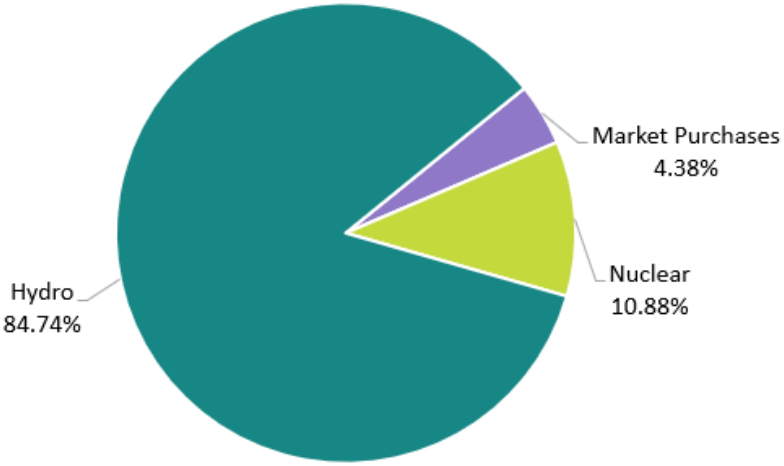
Oregon's Electricity Generation and Consumption (2020)[1 4]



Megawatt (MW): One million watts of electricity capacity—the equivalent of 1,340 horsepower, or enough power to simultaneously illuminate more than 100,000 standard 60-watt-equivalent LED lightbulbs. **Megawatt Hour (MWh):** A unit of measurement for energy output that represents the amount of energy supplied continuously by 1 MW of capacity for one hour. **Average Megawatt (aMW):** Represents 1 MW of energy delivered continuously 24 hours/day for one year, or 8,760 MWh.

Bonneville Power Administration and Market Purchases

Consumer-owned utilities in Oregon purchase most of their electricity from the Bonneville Power Administration, a federal agency that markets wholesale electric power from 31 federal hydroelectric facilities in the Northwest, a non-federal nuclear power plant, and several other small non-federal power plants. The dams generating the hydroelectric power are operated by the U.S. Army Corps of Engineers and the Bureau of Reclamation, while the nuclear facility is operated by Energy Northwest. BPA provides about 28 percent of the electricity used in the Northwest.[1]

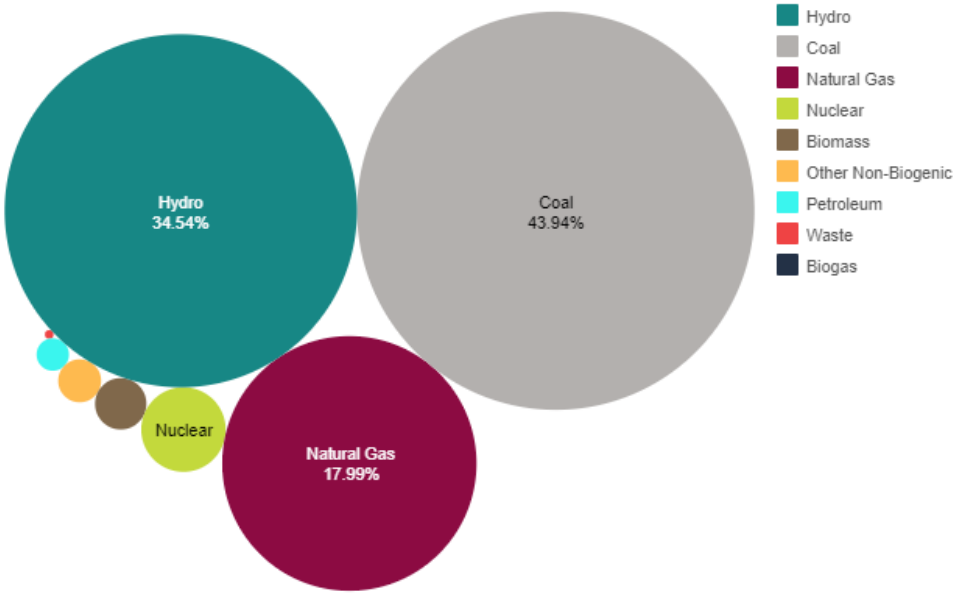


Bonneville Power Administration 2020

Oregon generation facilities sell electricity to Oregon utilities and the regional power market. Oregon electric utilities own facilities that generate power, but they also purchase power from the regional market to meet customer demand. The chart below illustrates the resources of 2020 market purchases.

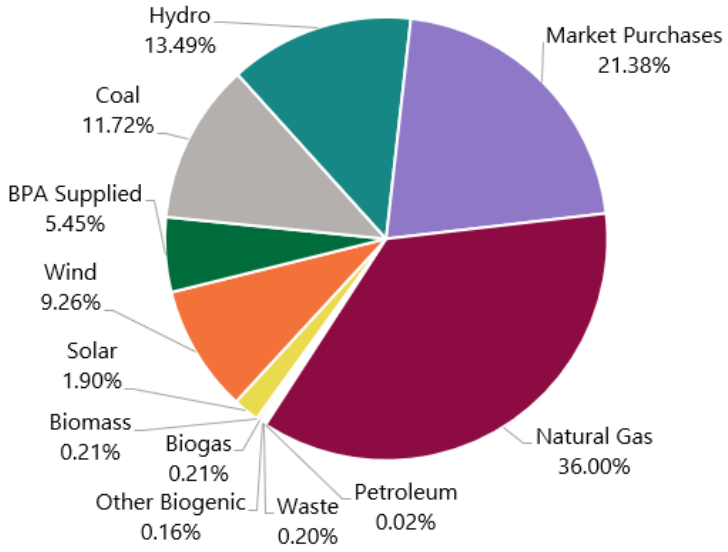
Some utilities make "unspecified" market purchases to meet demand. The utilities purchase the electricity on the power market and may not know the resource or facility that generated it. The mix shown here applies to all unspecified market purchases in Oregon, totaling 11.8 million megawatt hours in 2020.[1] This represents the annualized mix of generating resources available after all contracted use has been accounted for.

Electricity Market Purchases 2020

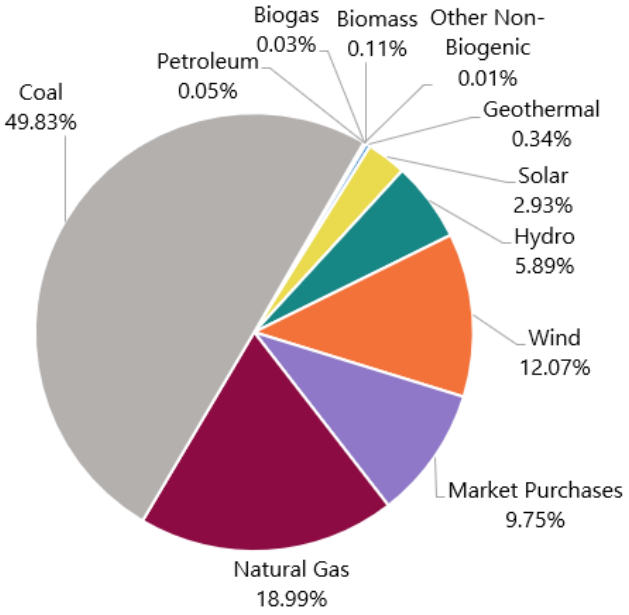


Investor-Owned Utility Resource Mix

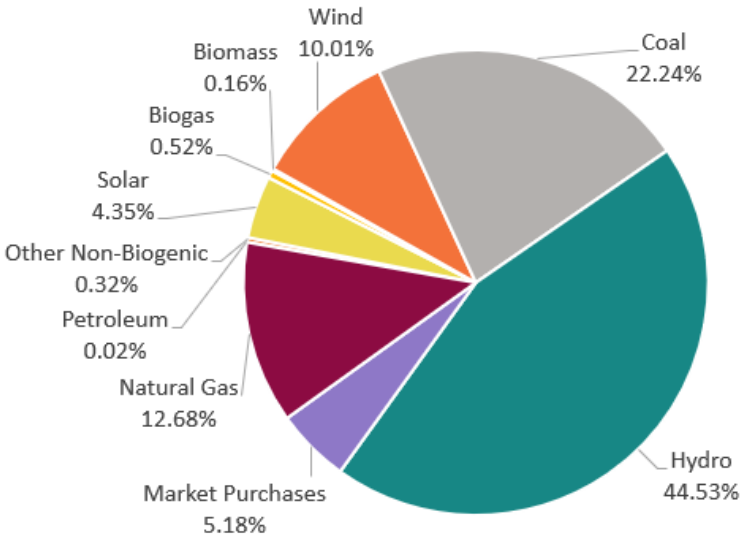
The resources utilities use to generate electricity consumed in Oregon vary depending on the utility provider. The electricity resource mixes for Oregon's three investor-owned utilities are shown below. Only 2020 data is shown for each utility; mixes will fluctuate over the years depending on the availability of certain resources like hydro or, increasingly, solar. The information below includes real-time supplemental market purchases of electricity that utilities make to meet demand.[1]



Portland General Electric 2020



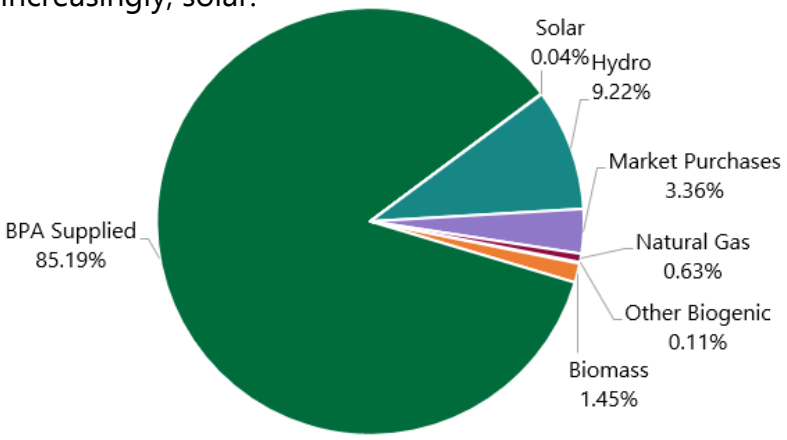
Pacific Power 2020



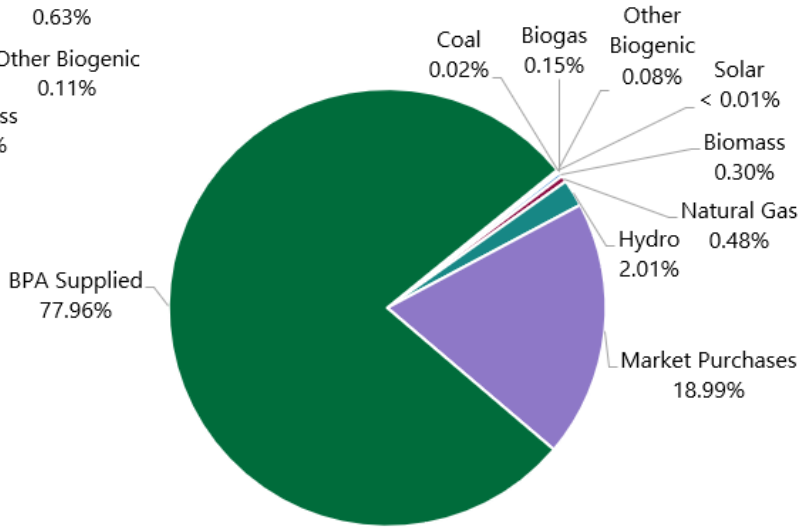
Idaho Power 2020

Consumer-Owned Utility Resource Mix

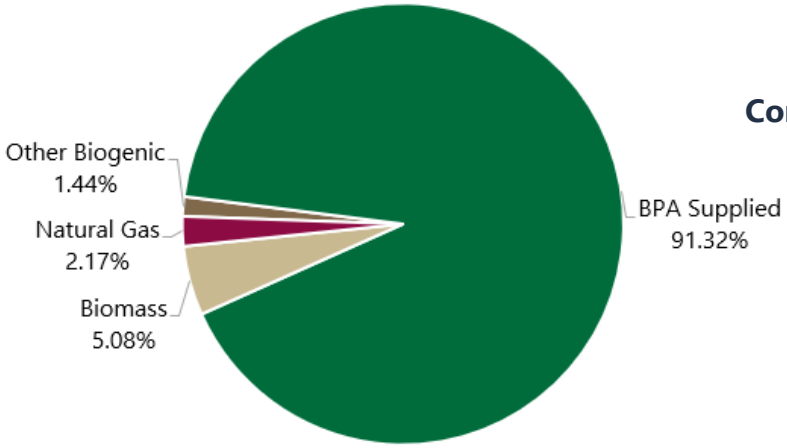
The electricity resource mixes for the Eugene Water & Electric Board (the largest consumer-owned utility by number of customers) and a composite of other COUs operating in Oregon are below. Clatskanie PUD is also included as an example. Only 2020 data is shown for the utilities; mixes fluctuate over the years depending on the availability of certain resources like hydropower or, increasingly, solar.[1]



Eugene Water & Electric Board
2020



Composite of Consumer-Owned Utilities
(not including EWEB)
2020



Clatskanie PUD
2020

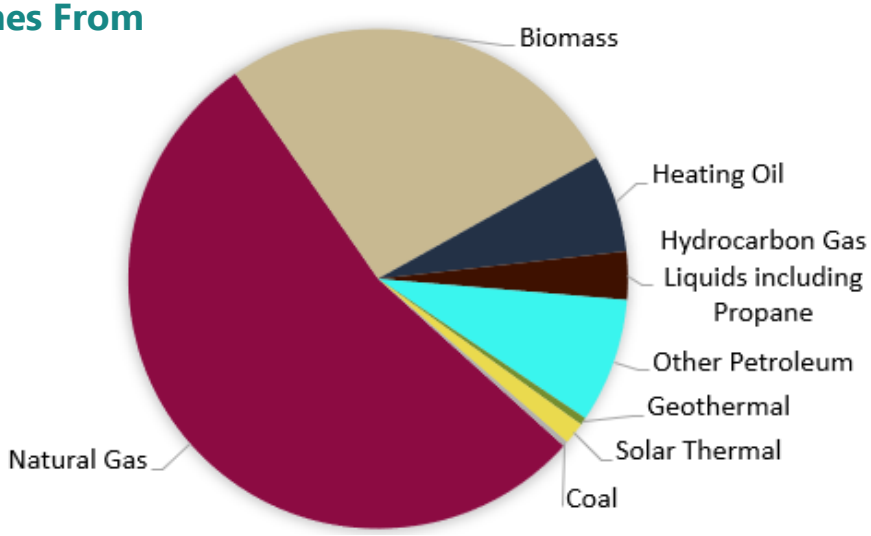
While the majority of power supplied by Oregon's consumer-owned utilities comes from the Bonneville Power Administration, **COUs have also invested in their own energy-generation sources**. For example, Clatskanie PUD supplements the electricity it buys from BPA with purchase agreements for natural gas, biomass, and biogenic facilities. Emerald PUD supplies some of its electricity from solar, biogas, and unspecified purchases from energy markets.

Thanks to the BPA-supplied power – which is mostly from federally owned dams – and their own resources, COU electricity mixes have very low greenhouse gas emissions.

Direct Use Fuels

What We Use and Where it Comes From

In 2020, Oregon used 255.7 trillion Btu of direct use fuels to cook, heat buildings, and support commercial and industrial processes.[1] Direct use fuels make up about 26 percent of the total energy consumption in Oregon.[2] These fuels are used on-site in the residential, commercial, and industrial sectors. They do not include fuels used to generate electricity or support the transportation sector.



Natural Gas. A gaseous mixture of hydrocarbon compounds, primarily methane, natural gas is a fossil energy source from beneath the earth's surface that is produced abundantly in the United States. Natural gas is used directly for space and water heating, cooking, and many agricultural, commercial, and industrial processes.

In 2020, Oregon used 137.2 trillion Btu of natural gas for direct uses — nearly all of it imported from Canada and the Rocky Mountain states.[1] The Pacific Northwest's only natural gas extraction facility is located outside Mist, Oregon and its resources go to NW Natural, one of three investor-owned gas companies serving the state.[3] The Mist field is primarily used for natural gas storage and produced only 0.34 trillion Btu of natural gas in 2020, representing 0.23 percent of Oregon's annual use.[1]

Natural Gas Consumption by Sector

Commercial Sector | 29.9 trillion Btu
Residential Sector | 48.0 trillion Btu
Industrial Sector | 59.3 trillion Btu[1]

Renewable natural gas, a low carbon-intensity alternative to fossil natural gas, is made by capturing methane biogas emitted from decomposing food waste, agricultural manure, landfills, and wastewater treatment plants. Biogas is processed to remove non-methane elements and can then be added to a pipeline or used onsite as natural gas. Oregon natural gas utilities are investing in RNG projects throughout the state. NW Natural currently has "options to purchase or develop RNG totaling about 3 percent of its annual sales volume in Oregon, enough to serve the gas needs of about 33,000 homes."[4] The Oregon Department of Energy inventoried current and potential RNG production quantities and estimated that 4.5 percent of Oregon's annual natural gas use (including power generation) could be replaced with RNG produced in the state — with the potential of reaching 17.5 percent of annual use with future technological advancements in collection and processing.[5] That additional 17.5 percent could meet about 31 percent of all direct gas use (not including power generation) in Oregon. NW Natural has also built interconnections for three facilities on its system, and at least one other RNG project is currently interconnected onto a large transmission pipeline in the state.

Biomass. Biomass is an organic material that comes from plants and animals that is burned to create energy. Biomass is considered a renewable source of energy, and comes from resources like wood, agricultural crops and waste, food or yard waste, and animal and human waste. Organic waste materials are collected and combusted to make energy that can be used on site or distributed to a facility instead of filling space in a landfill. While some biomass sources are the same as biogas, biomass also commonly refers to end-products such as wood chips, wood pellets, and charcoal that are used for thermal energy.

In 2020, Oregon consumed 70 trillion Btu of biomass as a direct use fuel.[1] Oregon has 15 wood and wood waste biomass-generating facilities. Biomass fuel feedstocks in Oregon are primarily wood and wood waste, but there are also 30 agricultural waste, landfill gas, and wastewater biogas generating facilities.[6] Many industrial facilities in Oregon burn woody biomass to generate electricity using waste products that would normally go to a landfill. Biomass is also used as a thermal energy source at commercial facilities, including schools and hospitals.[7]

Biomass Consumption by Sector

Commercial Sector | 4.5 trillion Btu
Residential Sector | 21.6 trillion Btu
Industrial Sector | 43.7 trillion Btu[1]

Heating Oil. Heating oil is a petroleum distillate fuel that is used primarily to heat buildings; some buildings also use it to heat water. Because space heating is the primary use for heating oil, demand is highly seasonal and affected by the weather. Most Oregon heating oil use occurs during the heating season: October through March.

In 2020, Oregon used 16 trillion Btu of heating oil for direct uses, and 2 percent of Oregon homes use fuel oil for heating.[1] [8] It is also used to heat commercial buildings and for industrial applications. Oregon does not produce any heating oil in the state, so most of Oregon's petroleum supply comes from refineries in Washington.[7]

Biodiesel heating oil is becoming more readily available in Oregon. Biodiesel heating oil is a renewable fuel made from vegetable oils, like soy and canola, that are grown domestically. Biofuels are mixed with regular heating oil at 5 to 20 percent to create a cleaner burning alternative fuel. The mixes can be used by typical oil furnaces in homes, but increasing the portion of vegetable oils in the blends does require adjustments to home oil furnaces.

Heating Oil Consumption by Sector

Commercial Sector | 3.0 trillion Btu
Residential Sector | 1.3 trillion Btu
Industrial Sector | 11.8 trillion Btu[1]

Hydrocarbon Gas Liquids and Propane. HGLs are gases at atmospheric pressure and liquids under higher pressures, which can also be liquefied by cooling. Their versatility and high energy density in liquid form make them useful for many purposes, including as feedstock in petrochemical plants, as fuel for home space and water heating or cooking, and as transportation fuels, additives, or as a diluent. Propane is a hydrocarbon gas liquid that can be used to power farm and industrial equipment, backyard barbeques, and Zamboni machines at ice skating rinks. Propane remains a viable fuel over long periods of storage, making it a common backup fuel for essential facilities like hospitals and a potential resource in response to an emergency. Propane is a byproduct of natural gas production.[9] As U.S. natural gas production has increased, the supply of propane has followed, making it an affordable and attractive option for many Oregonians.[10]

Propane consumed in Oregon is imported. Based on the available data on propane production, imports, exports, and transportation, the Pacific Propane Gas Association estimates that more than 95 percent of the propane consumed in Oregon is sourced from natural gas processing plants in Alberta and British Columbia, Canada.[11]

Oregon consumed 8 trillion Btu of propane in 2020 as a direct use fuel, a 30 percent increase in consumption from 2010 to 2020.[1] Less than 1 percent of Oregon residents use propane to heat their homes; more use it for cooking.[8] While propane use on-road as a transportation fuel is a small segment of the total fuel usage in Oregon, school districts have embraced propane as a fuel for bus fleets.

Hydrocarbon Gas Liquids and Propane Consumption by Sector

Commercial Sector | 3.6 trillion Btu
Residential Sector | 2.6 trillion Btu
Industrial Sector | 1.8 trillion Btu[1]

Other Petroleum. These are petroleum fuels like kerosene or lubricants that are not propane or heating oil, and are used, for the most part, in Oregon's commercial and industrial sectors to fuel machinery and manufacturing processes. In 2020, Oregon consumed almost 20.7 trillion Btu of Other Petroleum fuels.

Other Petroleum Consumption by Sector

Commercial Sector 4.9 trillion Btu
Residential Sector 0.2 trillion Btu
Industrial Sector 15.6 trillion Btu

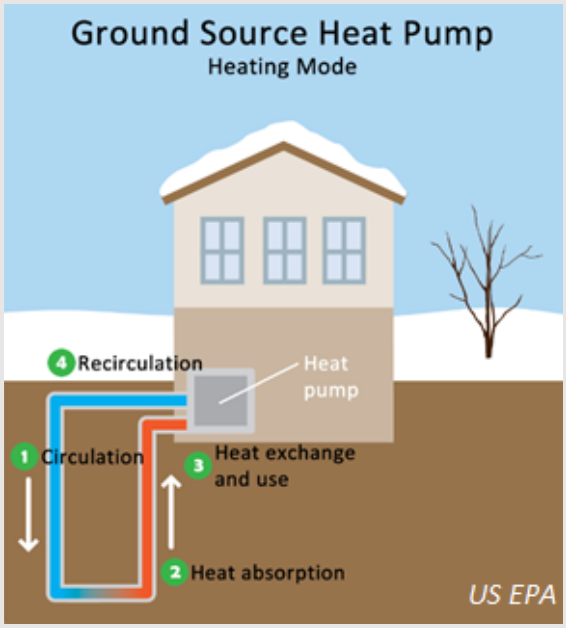
Solar Thermal. Oregon uses sunlight to produce solar energy to heat spaces and water in homes and businesses. Over 3.6 trillion Btu of solar thermal energy was consumed in Oregon in 2020. Solar thermal is most used as a direct use fuel in solar water heating systems in buildings. Solar water heating systems collect and transfer thermal energy to preheat water for the building, which reduces natural gas or electricity consumption.

Solar Thermal Consumption by Sector

Commercial Sector | 0.86 trillion Btu
Residential Sector | 2.65 trillion Btu
Industrial Sector | 0.14 trillion Btu[1]

Geothermal. In 2020, Oregonians consumed 1.2 trillion Btu of geothermal energy for heating and cooling residential, commercial, and industrial spaces.[1] Geothermal energy is a renewable fuel that comes from the internal heat of the earth and is produced in Oregon. While geothermal is often used to generate electricity, it can also be used for thermal energy applications such as heating spaces and keeping bridges and sidewalks from icing over.[12]

Geothermal or ground source heat pumps have been used in the U.S. since the 1940s and unlike air source heat pumps, they use the ground to exchange energy and keep buildings comfortable. A few feet below the earth's surface the ground remains at a relatively constant temperature (45-75 degrees Fahrenheit) even as the air temperature changes from winter to summer. These systems use that constant temperature to heat and cool homes and businesses. In the winter, geothermal heat pumps pull energy from the warm ground to heat buildings. In the summer, the process is reversed and energy from the building is taken and deposited in the ground, cooling the building. Installation prices of geothermal systems are greater than that of an air-source system of the same heating and cooling capacity but they are quieter, last longer, need little maintenance, and do not depend on the temperature of the outside air.[13 14]

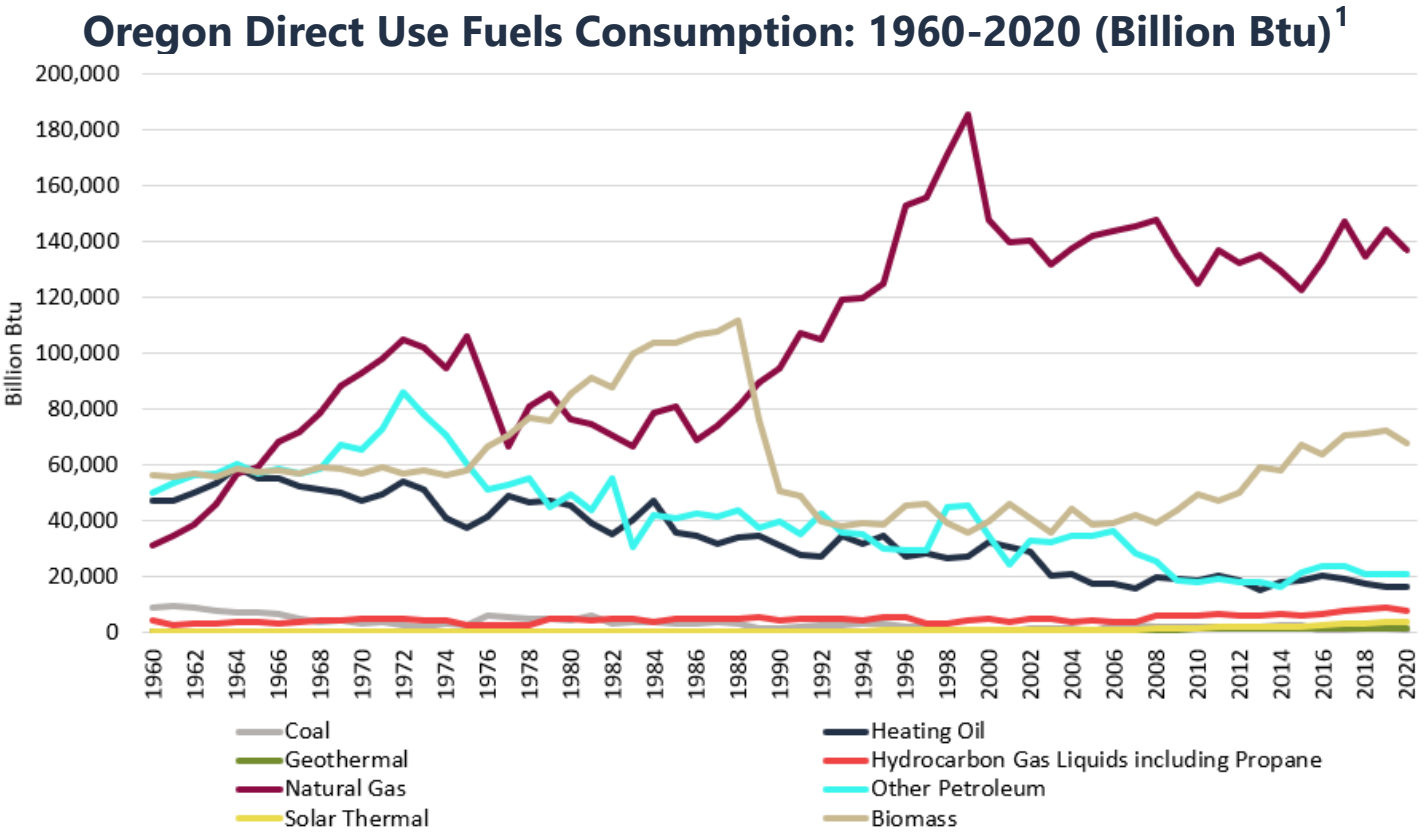


Coal. Coal is imported to Oregon to use as a direct fuel in the industrial sector. Oregon consumed 0.84 trillion Btu of coal from neighboring states in 2020, which does not include the coal used to generate electricity consumed in Oregon. Use of coal as a direct fuel in Oregon has declined by 91 percent since 1960.[1]

Geothermal and coal direct use fuels represent less than 1 percent of Oregon's direct use fuels.[1]

Direct Use Fuels Over Time

Oregon's energy consumption has evolved over time. For direct use fuels, that has meant decreasing wood and fuel oil use and an increase in natural gas. The chart below uses data from the U.S. Energy Information Administration to compare total consumption of direct use fuel types in Oregon's residential, commercial, and industrial sectors from 1960 to 2020. The chart does not include transportation fuels or fuels used to generate electricity used in those sectors.



Natural gas has replaced distillate fuel oil and coal use in many Oregon buildings and industrial processes as a cleaner-burning alternative. Like distillate fuel oil and coal, natural gas exploration, extraction, production, and transportation has a negative effect on the environment. Drilling wells may disturb land, wildlife, and people in the surrounding area with air and potentially water pollution.[15] As Oregon reduces greenhouse gas emissions to meet state targets, the application and use of natural gas and other fossil-based direct use fuels may change as the state seeks lower carbon intensity alternatives. Learn more about the future of conventional gas fuels in the Policy Briefs section of this report.

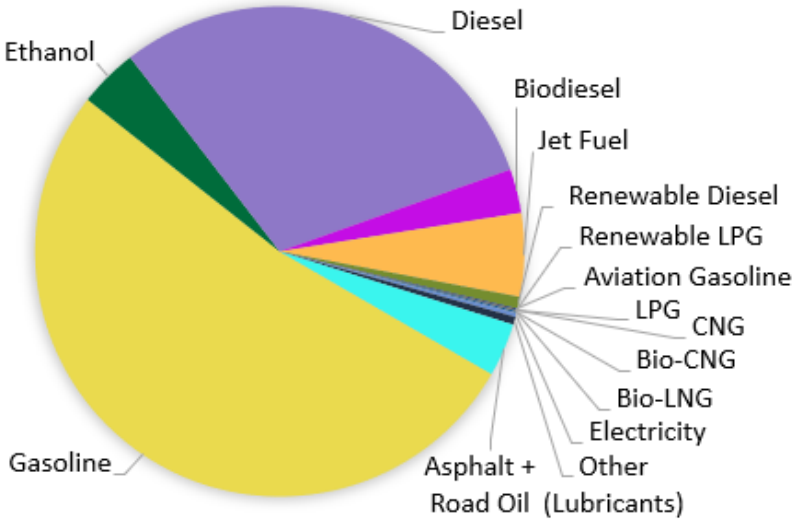
Geothermal consumption is one of the smallest of Oregon's direct use fuels in the chart above. EIA began tracking geothermal consumption in 1989 with 0.38 trillion Btu. In 2020, Oregon consumed over 1.2 trillion Btu of energy from geothermal, an increase of 224 percent over that 30-year period.[1]

Oregon industry consumes a significant amount of biomass energy from secondary waste products, like lumber mill residue, logging slash, and animal manure. Biomass energy consumption has increased steadily since 2002, due almost entirely to increased demand for biofuels. Learn more about biofuels in the Transportation Fuels Energy Resource and Technology Review.

Transportation Fuels

What We Use

In 2020, Oregon's transportation sector used 28.6 percent — or 281 trillion Btu — of the energy consumed in Oregon. Transportation was the largest share of energy use among the sectors in 2020.[1] Oregonians consume many different types of transportation fuels:



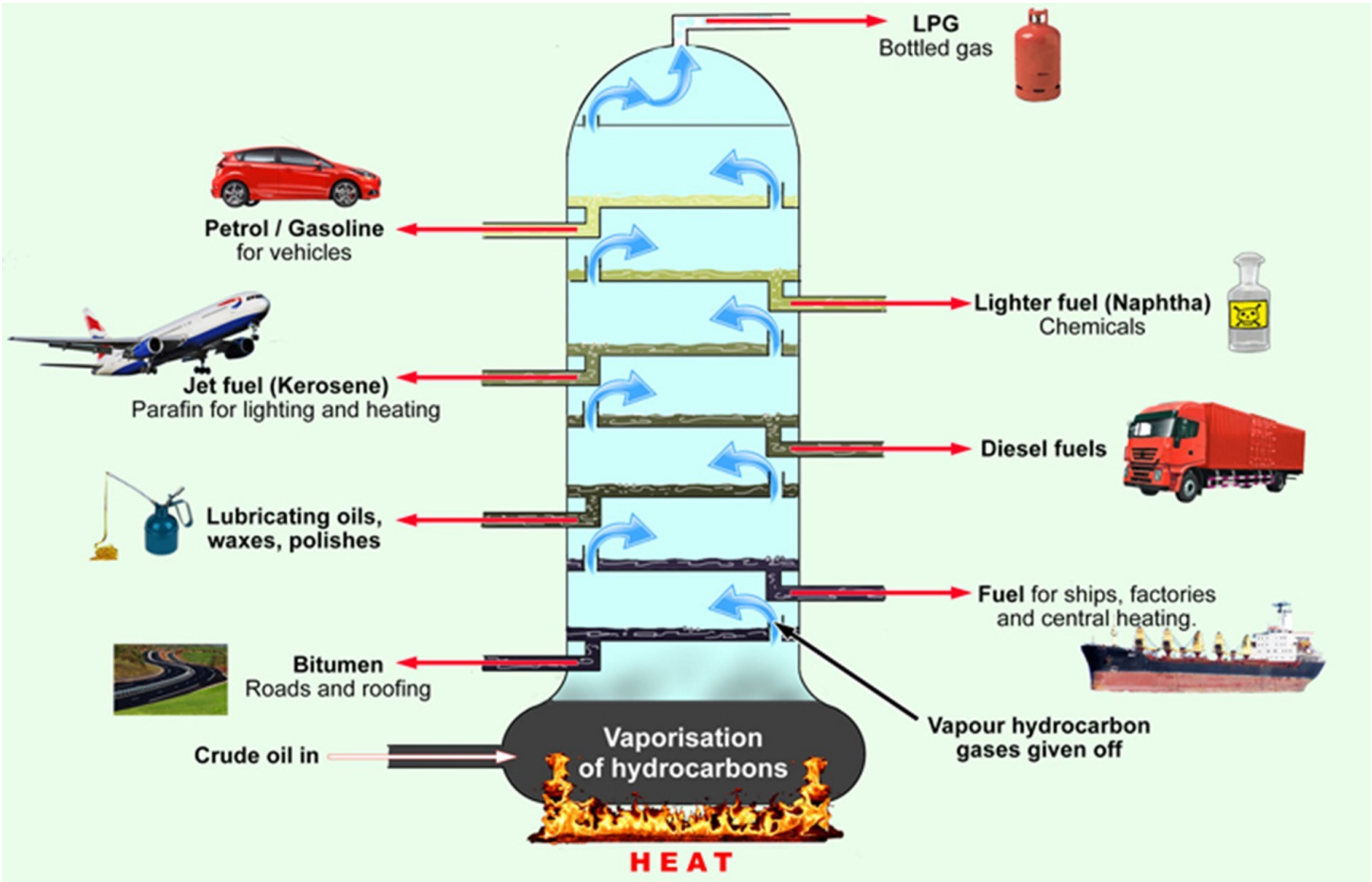
Petroleum-based products make up 92 percent of Oregon's transportation fuel use. They are processed by heating crude oil and separating components by weigh, sometimes referred to as fractionations (of the crude oil).

Gasoline. Lighter distillate of petroleum used by cars, motorcycles, light trucks, airplanes, and boats.

Diesel. Heavier distillate of petroleum used by trucks, buses, trains, boats, and ships.

Propane. A light petroleum hydrocarbon gas liquid fuel used to power cars, buses, trucks, and some non-road vehicles.

Uses for Petroleum Distillates in the Transportation Sector[2]



Alternative fuels (to petroleum) used in Oregon are produced by various means, often involving collection and processing of crops, byproducts, or waste streams.

Ethanol. Fuel produced from agricultural crops or wood that is blended with gasoline and used by cars and trucks.

Biodiesel. Fuel from organic oils and fats that can be blended with diesel fuel (up to 20 percent) and used by trucks, buses, trains, and boats.

Electricity. Fuel that powers some public mass transit systems and electric vehicles.

Natural Gas. Compressed and liquefied natural gas used by cars, buses, trucks, and ships.

Renewable Natural Gas. Biogas from agricultural waste, wastewater, or garbage is collected and refined to power natural gas cars and trucks.

Renewable Diesel. Fuel from organic oils and fats using a different production process than biodiesel to power diesel vehicles.[3,4]

The U.S. Energy Information Administration tracks transportation sector consumption. The Oregon Department of Energy also analyzes data from the Oregon Department of Environmental Quality's Clean Fuels Program and the Department of Transportation's fuel tax program to determine an estimate of the mix of transportation fuels consumed in Oregon. In 2020, petroleum-based products accounted for 92 percent of fuel consumed in the transportation sector; alternative fuels or biofuels like ethanol, biodiesel, and renewable diesel accounted for 8 percent; and electricity and natural gas accounted for 0.3 percent of the fuels consumed.[5]

Could Hydrogen Emerge as a Transportation Fuel in Oregon?

National Renewable Energy Laboratory (CC BY-NC-ND 2.0)

A potential emerging resource in Oregon and beyond is renewable hydrogen, which could be used as a direct transportation fuel, as storage for clean electricity generation, or other uses. The Oregon Department of Energy will publish a study on renewable hydrogen in 2022, including opportunities and challenges for using the resource in the state.

One potential renewable hydrogen use is as fuel for medium– or heavy-duty vehicles. At left, a zero-emission hydrogen fuel cell bus refuels in Irvine, CA.

ODOE's report will be published online:

tinyurl.com/ODOE-RH2-Study

Use Over Time

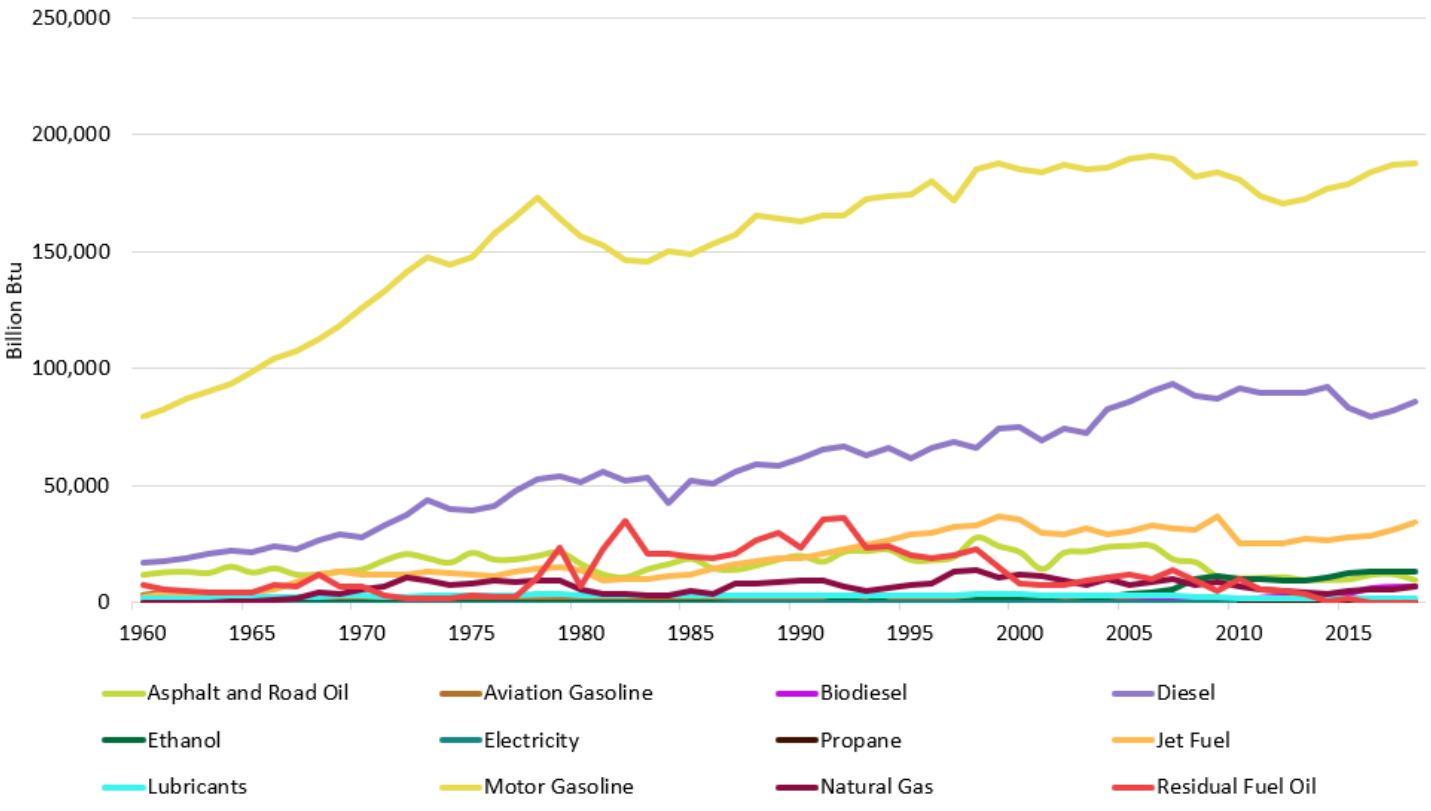
2.5%

Percentage of transportation fuel used in Oregon that was produced in state.[6]

The U.S. Energy Information Administration has tracked national energy consumption and individual state consumption since 1960. In Oregon and nationally, overall transportation consumption increased between 1960 to 2018. In 2019 and 2020 there was a 16 percent reduction in the use of gasoline and a 37 percent reduction in jet fuel, but a 3 percent uptick in the use of diesel. Analysis contributes this to less personal travel and increased delivered goods due to the COVID-19 pandemic. In 2020, Oregon's transportation sector consumed 281 trillion Btu of energy — an 11 percent decrease from 316 trillion Btu in 2018, the peak year of transportation energy consumption in Oregon.[5]

Except for 2019 and 2020, petroleum product consumption has steadily increased over time and still dominates transportation fuel use in Oregon. Nearly all transportation fuels are imported into Oregon. In 2020, just 2.5 percent of transportation fuel used in Oregon was produced in the state, including 8.2 trillion Btu of biodiesel and fuel ethanol.[6] Oregon electric utilities provided 0.75 trillion Btu of electricity to fuel zero-emission vehicles in 2020.[5] Oregon does not have crude oil reserves or refineries to process petroleum, so over 90 percent of the petroleum products delivered to and consumed in Oregon come from four refineries in Washington state.[7] Crude oil used at Washington refineries comes from Alaska, western Canada, and North Dakota.

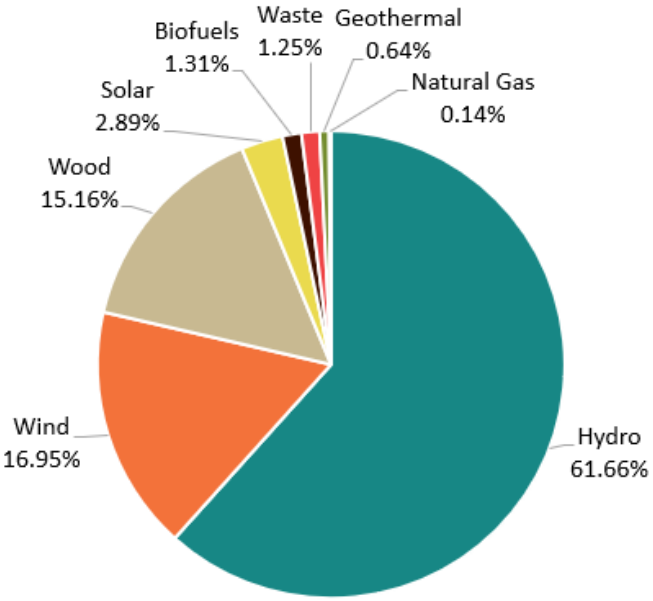
Oregon Transportation Sector Consumption: 1960-2020 (Billion Btu)



Energy Production

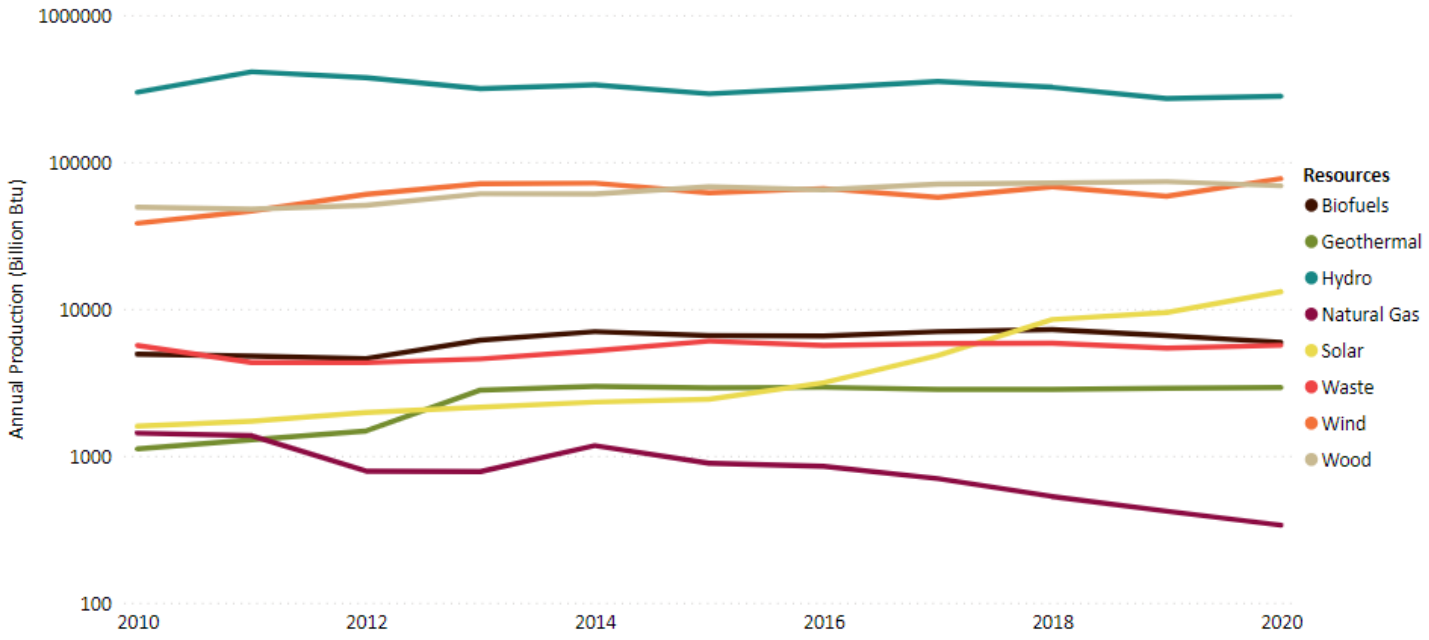
Overview

Energy production focuses on primary and secondary energy produced in Oregon. *Primary* energy represents energy that is collected from Oregon's natural resources — it does not include energy that is imported for consumption or electricity generated in Oregon. *Secondary* energy is consumed in real time, like electricity, or may be stored for later use, like wood pellets. This section includes consumption data and energy production context — such as how much of the electricity generated in Oregon comes from hydroelectric, wind, and solar compared to imported natural gas.



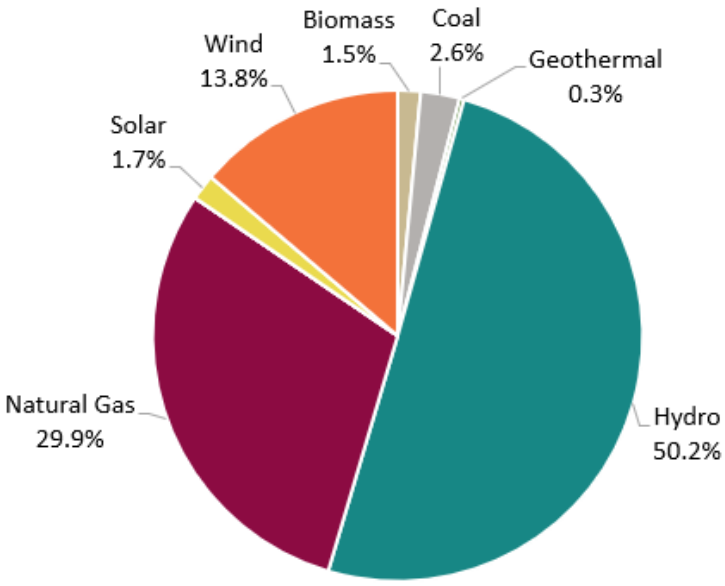
The chart above shows primary energy production in Oregon in 2020. Almost all the solar, wind, geothermal, and hydro primary energy is converted to *secondary* energy as electricity. Some of the biomass is used to make a variety of renewable fuels and some is combusted to produce heat and electricity.[1]

Oregon Primary Annual Energy Production Over Time[1]



The chart above uses a logarithmic scale to compare energy production. Without the logarithmic scale, the smallest contributors like natural gas and geothermal would be hard to see, as they would show along the bottom of the chart, and hydroelectric would dwarf all others except for wind. Hydro has been the largest primary energy source in Oregon over the chart's time period. Solar power has been steadily increasing since 2012, with faster increases starting in 2015. Wind energy has grown over the period at a slower rate, and in 2020 is now the second largest category. Since 2014, natural gas production has slowly been declining.[2]

Electricity



Oregon generates electricity from a variety of resources — hydropower, natural gas, and wind are the largest. In 2020, half of Oregon's electricity generation came from hydroelectric facilities.[1] Oregon has 105 hydro facilities.[3] The state's four largest electricity generating facilities are federally owned and operated dams on the Columbia River. They account for two-thirds of the generating capacity from the 10 largest power plants in the state.[4] Oregon is the second largest producer of hydroelectric power in the U.S. after Washington.[4]

Oregon's abundance of renewable electricity can be used in Oregon or sold on the energy market to utilities in other states. In 2020, 34 percent of Oregon's hydropower and 57 percent of its wind generation were exported.[5] Sixty-eight percent of electricity generated in Oregon in 2020 came from renewable resources. [1] Hydroelectric, wind and solar generation varies diurnally (over the course of a day) and seasonally.

Natural gas represented 30 percent of Oregon's 2020 electric generation. A little less than 3 percent[1] of electricity came from the Boardman coal plant, which shut down in October 2020.[1] Oregon natural gas facilities import all but a very small fraction of the natural gas they use. Oregon has a single site in Mist that produces natural gas, but is used primarily for natural gas storage. Oregon has no coal or petroleum resource extraction facilities.

Utility-Scale Solar in Oregon

In February 2018, Oregon's Energy Facility Siting Council approved its first EFSC-jurisdictional solar energy facility, the 75-megawatt Boardman Solar Energy Facility.

As of September 2022, there are more than a dozen EFSC-jurisdiction solar facilities under review, under construction, or operating in Oregon. The largest proposed facility to date is the 1,250-megawatt Echo Solar Project in Morrow County.

63.6 Million

Megawatt hours of electricity generated in Oregon in 2020.[1]

53.8 Million

Megawatt hours of electricity consumed in Oregon in 2020.[5]

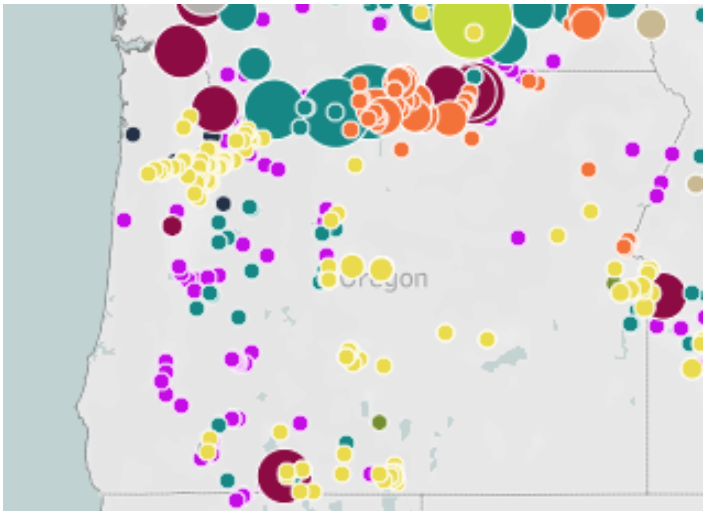
68%

Percentage of Oregon's electricity generation that comes from renewable resources.[5]

62%

Percentage of Oregon's electricity generation that is used in-state.[5]

Electric Facilities

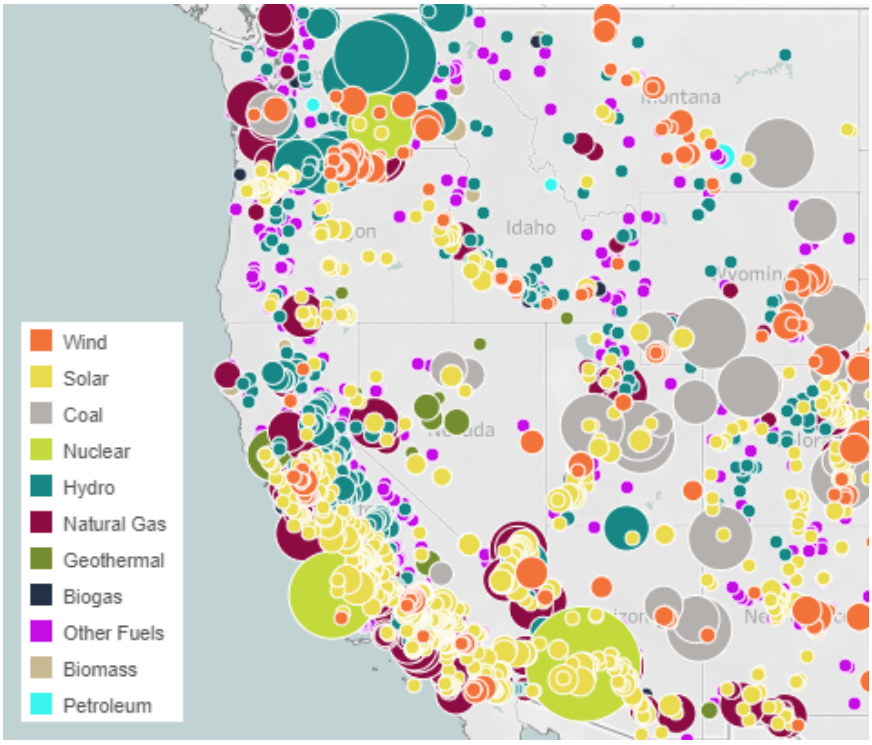


The map of Oregon at right shows where electricity generation sites are in the state. Facilities owned by Oregon utilities are included, as are third-party owned facilities, which can contract with utilities to provide power to Oregon consumers or sell their electricity on the open energy market. Note that the color of the circles corresponds to the resource used to generate electricity (see below), and the size of the circle is in relation to generation capacity of that facility.

Electricity used by Oregonians can come from facilities across the western United States. We rely on hydroelectric power produced on the Columbia River, nuclear power from the Columbia Generating Station in Washington, wind from turbines along the Columbia River Plateau, and electricity generated at coal-powered facilities located in several western states.[7]

The map below shows the various electricity generation sources in the Western Electricity Coordinating Council. The WECC is a nonprofit organization that focuses on systemwide electricity reliability and security across a geographic region known as the Western Interconnection. This diverse region includes Oregon and most of the intermountain west and parts of Canada.[6]

The map uses data from the U.S. Energy Information Administration and includes facilities with a nameplate capacity of 1 megawatt or greater.[7] According to the EIA, generator nameplate capacity is defined as the maximum rated output of a generator, prime mover, or other electric power production equipment under specific conditions designated by the manufacturer. Installed generator nameplate capacity is commonly expressed in megawatts (MW) and is usually indicated on a nameplate physically attached to the generator. Not all resources or facilities shown on the map contribute to Oregon's overall fuel mix, but many are available when Oregon utilities purchase electricity on the open market.

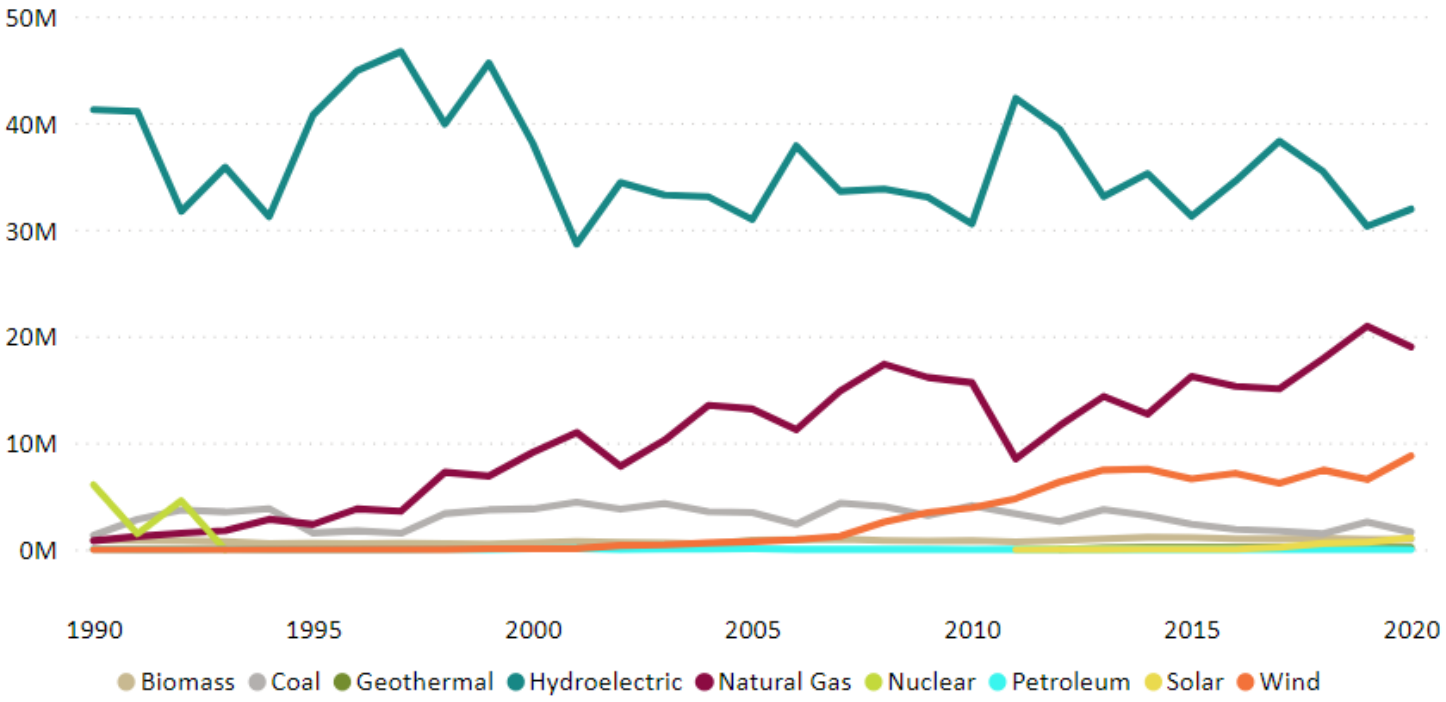


In the same way, electricity generated in Oregon may be sold through the energy market to support electricity needs in other states.

Electricity Over Time

Oregon's electricity generation has changed over the years. Hydropower, which is Oregon's largest electricity resource, varies year-over-year based on precipitation. Oregon hydropower reached a generation high of 46.7 million MWh in 1997. Wind and natural gas have both seen a gradual increase in generation over time. In 2020, natural gas is the second largest share of Oregon's electricity generation, at 19.0 million MWh. Coal generation has been steadily declining since 2010 and had declined to only 1.6 million MWh in 2020 when Oregon's last coal generating plant was closed.[1] Solar has increased each year since 2011, and is expected to continue growing with several proposed facilities in planning and review stages.[8]

Oregon Electricity Generation: 1990-2020 (MWh)[1]



Wind + Solar + Storage

As Oregon makes progress toward its clean electricity targets, the state will need more renewable energy resources to power Oregon homes and businesses.

Some renewable resources, like wind and solar, are variable since the sun doesn't always shine and the wind doesn't always blow. Adding utility-scale battery storage to renewable energy facilities allows renewable power to be generated and stored for later use on the electric grid. In 2022, Portland General Electric celebrated the completion of its Wheatridge Energy Facilities, which combine renewable wind and solar alongside battery storage in Morrow County.

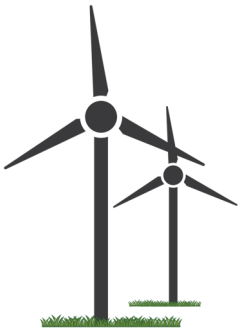
Renewable Electricity

Renewable electricity generated in Oregon has grown due to customer demand, dramatic reductions in costs, and clean energy policies, like Renewable Portfolio Standards and HB 2021's 100 percent clean electricity by 2040 target. Demand for clean energy in California also spurred prior wind development in Oregon – 57 percent of wind energy in 2020 was exported.[5]

2012 Generation	2016 Generation	2020 Generation
6,400 MWh	40,900 MWh	1,077,900 MWh

17% of Oregon's solar generation was exported in 2020.[5]

Oregon has 726 MW of utility-scale solar facilities and 156 MW of net-metered solar installations on homes and businesses.



2012 Generation	2016 Generation	2020 Generation
6.3 Million MWh	7.2 Million MWh	8.8 Million MWh

57% of Oregon's wind generation was exported in 2020.[5]

Oregon has 4,203 MW of wind facilities in operation, with ODOE overseeing even more projects: 194 MW under construction, 421 MW approved but not yet built, and 340 MW under review.[8]

2012 Generation	2016 Generation	2020 Generation
39.4 Million MWh	34.6 Million MWh	31.9 Million MWh

34% of Oregon's hydropower generation was exported in 2020.[1]

In some Oregon utility territories, hydropower provides over 90% of consumers' electricity.[7]

Oregon's hydropower fluctuates from year-to-year due to changing precipitation and water conditions.

Direct Use Fuels

Aside from biomass produced in Oregon, most direct fuels – used in the residential, commercial, and industrial sectors – are imported from out of state. In 2020, Oregon used 255.7 trillion Btu of direct use fuels, representing about 25 percent of the total energy consumed in Oregon.[1] The majority of Oregon's primary energy production comes from energy sources like hydropower, wind, and solar used in electrical generation, but Oregon also produces some direct use fuels.

The table below shows the direct use fuels that are produced in Oregon in comparison to how much is consumed by the residential, commercial, and industrial sectors. If energy is produced in Oregon and not consumed in state, the assumption is that the energy was exported to support neighboring states' energy systems. Where more energy was consumed than produced, that means it was imported into the state for consumption.

Biomass is the most-produced direct use fuel in Oregon. In 2020, Oregon produced over 74 trillion Btu of energy from biomass while consuming an estimated 68 trillion Btu[1] and exporting 6 trillion Btu. The U.S. Energy Information Administration collects and shares these high-level energy production and consumption estimates to inform Oregon's understanding of state and federal energy systems — but the data does not show where each Btu of energy is consumed.

100%

Percentage of Oregon geothermal energy consumption that is produced in-state.[1]

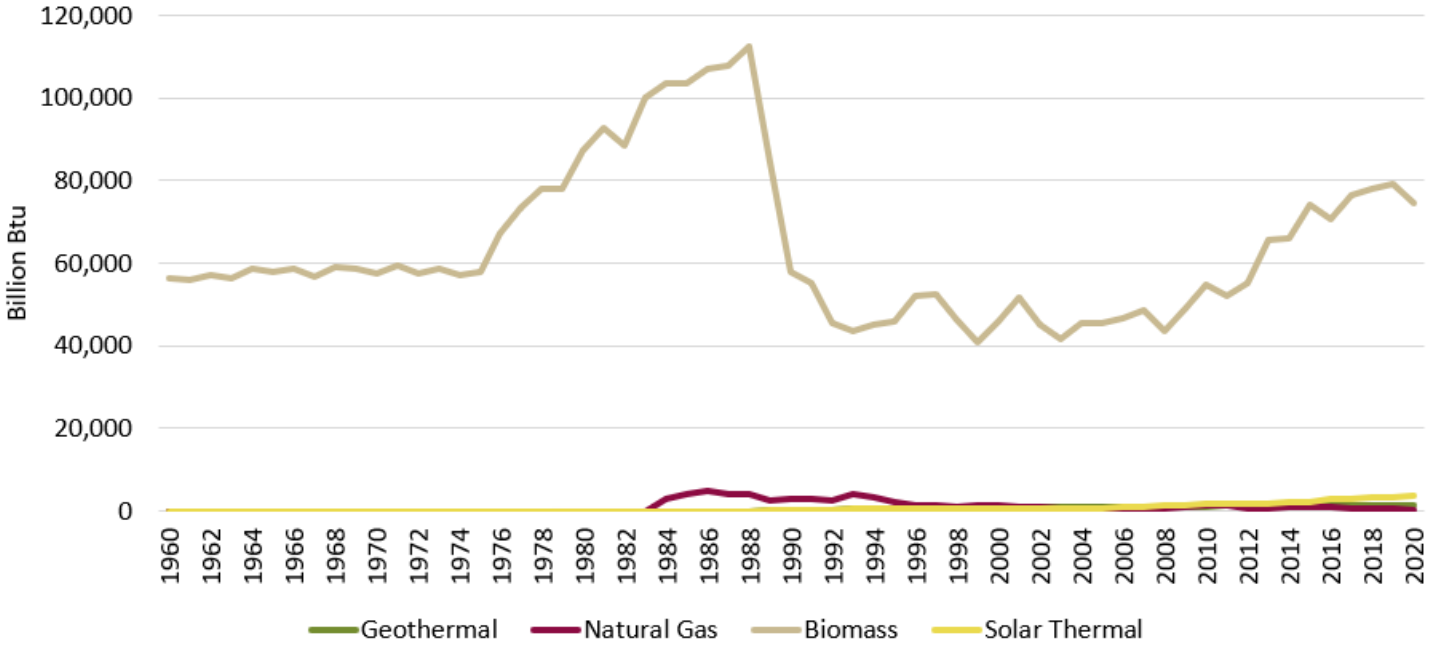
32%

Percentage of Oregon overall direct use fuels consumption that is produced in-state.[1]

Production & Consumption of Direct Use Fuels in 2020 (trillion Btu)

Resource	Consumption in Oregon	Oregon Production	Imported	% of Consumption Produced in Oregon
Geothermal	1.2	1.2	0	100%
Natural Gas	137.2	0.3	136.9	0%
Biomass	68.0	74.5	-6.5	110%
Other Petroleum	20.7	0	20.7	0%
Heating Oil	16.1	0	16.1	0%
Hydrocarbon Gas & Liquids/ Propane	7.9	0	7.9	0%
Solar Thermal	3.7	3.7	0	100%
Coal	0.8	0	0.8	0%
Totals	**255.7**	**79.8**	**175.9**	**31%**

Direct Use Fuel Energy Production in Oregon, 1960-2020[1] (billion Btu)



Natural Gas. In 2020, Oregon's residential, commercial, and industrial sectors consumed 51 percent of total[1] natural gas consumption as direct use fuels while the rest went to electricity generation. Oregon imports nearly all natural gas used, mostly from Canada and the Rocky Mountain states. The Pacific Northwest's only natural gas production is located outside Mist, northwest of Portland, and is owned and operated by NW Natural, one of three investor-owned gas companies serving the state. The Mist field produced about 320 million cubic feet of natural gas or 0.34 trillion Btu of energy in 2020, representing 0.2 percent of Oregon's natural gas used that year.[1] The facility hit a production peak of 4.7 trillion Btu in 1986.[1] The Mist facility is also used to store natural gas produced from outside of Oregon, for use in electricity generation as well as for customers within the natural gas distribution system. NW Natural pumps natural gas into the underground rock formations to store for later use during cold weather events, help balance additions and withdrawals to its pipeline system, and minimize costs for customers by purchasing gas at favorable prices throughout the year.

Renewable Natural Gas. RNG is biogas that has been purified to be a substitute for natural gas, often to meet specifications required for injection into a natural gas distribution pipeline. Biogas is collected from landfills where it is produced from decaying municipal waste streams like food and garbage, from anaerobic digesters at wastewater treatment plants (waste and food), and at agricultural sites that process waste streams like manure.

Four RNG projects are operational in Oregon with the capability to inject RNG into natural gas pipelines. Nine additional RNG projects are in development in Oregon.[11] In 2018, the Oregon Department of Energy conducted an inventory of current and potential RNG facilities and estimated 4.5 percent of Oregon's total annual natural gas use could be replaced with RNG produced in the state. Production capacity could reach as high as 17.5 percent of annual use with future technical advancements in collection and processing.[12] In November 2021, the Metropolitan Wastewater Management Commission in Lane County became the first public agency in Oregon to collect and inject RNG into NW Natural's gas line. The biogas was collected and processed from a regional wastewater treatment plant in Eugene, Oregon.[13]

Solar Thermal. In addition to solar radiation used to generate photovoltaic electricity, solar thermal energy is a resource used directly to provide heat in Oregon homes and businesses. Solar thermal systems capture energy from the sun to provide water heating and space heating in buildings. Most systems installed in Oregon are solar water heating systems that provide supplemental energy to residential water heaters, which can reduce water heating bills by 50 to 80 percent according to Energy.gov's Energy Saver.[14] In the last 10 years, residential solar water heating system installations have declined as photovoltaic systems have become less expensive and energy efficient heat pump water heaters have joined the market. It has become more cost effective for most homes to install a photovoltaic system with a heat pump water heater.

Geothermal Energy. Direct use geothermal energy uses hot water or steam from reservoirs below the earth's surface piped to end users for water or space heating. Oregon produced 2.9 trillion Btu of geothermal energy in 2020, and 1.2 trillion Btu of it was consumed as a direct use fuel.[1] For decades, the city of Klamath Falls has used geothermal heat sources to heat buildings, residences, pools, and even sidewalks. Schools and hospitals in Lakeview use a geothermal well system to heat some buildings.

This Klamath Falls greenhouse uses geothermal heat to keep plants warm.

Other examples of direct use of geothermal heat in the state include drying agricultural products, aquaculture (raising fish), heating greenhouses, and heating swimming pools. There are more than 2,000 thermal wells and springs delivering direct heat to buildings, communities, and other facilities in Oregon.[15]

Biomass, Wood Pellets, and Charcoal Briquettes. Biomass energy is from plants and plant-derived materials, including wood, wood waste, wood pellets, and charcoal briquettes. Residual material or waste from forest harvest and mill operations is converted into useful retail products. Wood and wood waste biomass has been Oregon's largest direct fuel production source since 1960. In 1988, wood and wood waste production hit a high of 113 trillion Btu. Thirty years later, Oregon's production was 75 trillion Btu — a 34 percent decrease.[1] In Oregon, the industrial sector is the largest producer and consumer of biomass energy. Eleven woody biomass facilities provide power in Oregon, primarily in the wood-products industry.[9] Wood is also produced and consumed as cordwood to heat homes – after industrial, the residential sector is the second largest consumer of wood energy in Oregon.[1]

Wood pellets are manufactured from timber waste and used for residential and commercial heating. Biomass Magazine lists six wood pellet plants in Oregon, producing 280,000 metric tons per year.[16] Charcoal briquettes and cooking pellets also use timber waste to create a fuel source for cooking; wood waste is burned in the manufacturing process as the products are heated up to remove moisture. Springfield, Oregon is home to one of Kingsford's five manufacturing plants in the U.S.[17]

Transportation Fuels

About 2.5 percent of the 281 trillion Btu of energy Oregonians consumed for transportation in 2020 was produced in state.[18] Oregon produces 34 percent of the biofuels the transportation sector uses, which makes up 7 percent of the state's total consumption of transportation fuels.[1]

Though still a small fraction of the total transportation fuels, electricity use for transportation is growing in Oregon. The state consumed 0.75 trillion Btu of electricity in 2020 or about 0.3 percent of total transportation consumption.[1]

5%

Biodiesel blend is used in nearly all heavy-duty vehicles both on and off the highway.

10%

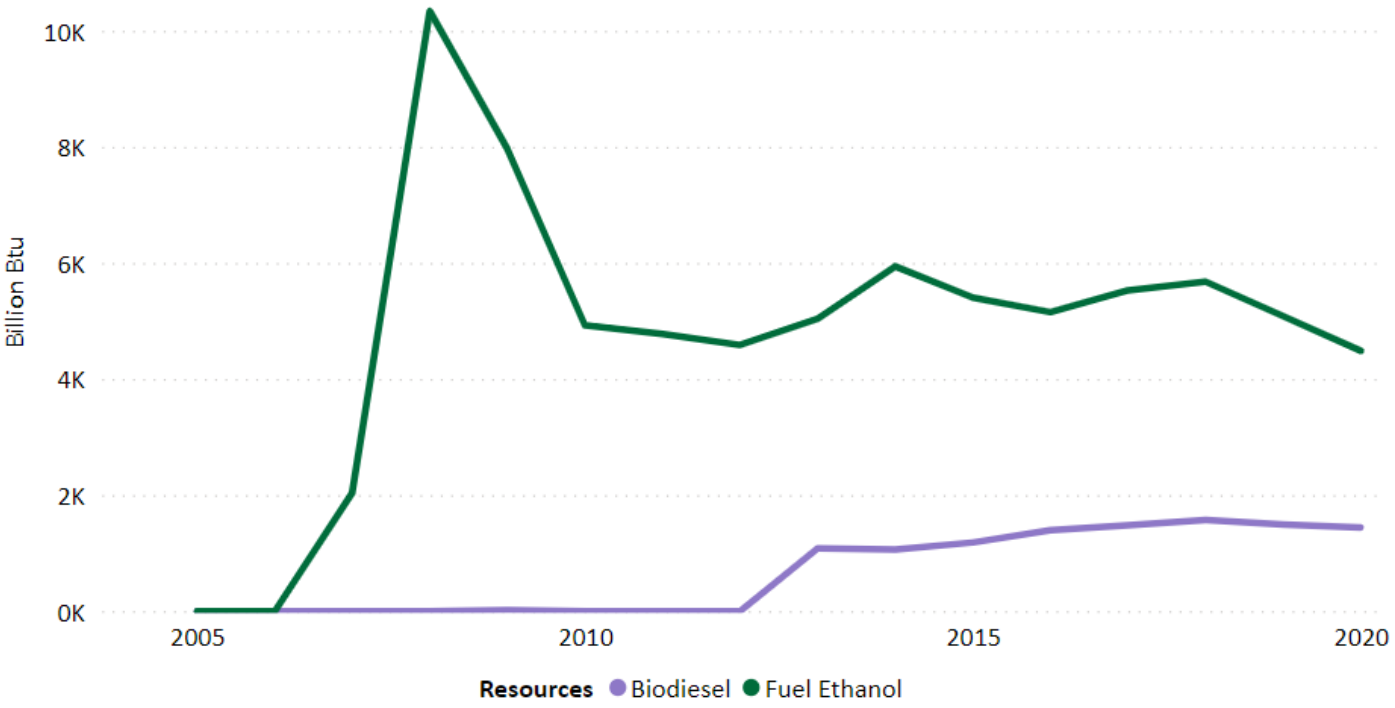
Ethanol blend fuel is used in a majority of light-duty vehicles in Oregon.

Production & Consumption of Transportation Fuels in 2020 (trillion Btu)

Resource	Consumption in Oregon	Oregon Production	Imported	% of Consumption Produced in Oregon
Biodiesel	8.16	1.495	6.67	18%
Fuel Ethanol	10.95	4.999	5.95	46%
Gasoline	146.90	0	146.90	0%
Diesel	84.35	0	84.35	0%
Jet Fuel	15.43	0	15.43	0%
Asphalt & Road Oil	9.85	0	9.85	0%
Lubricants	1.44	0	1.44	0%
Aviation Gasoline	0.30	0	0.30	0%
Electricity* (gge)	0.75	0.586	0.17	78%
LPG/Propane	0.06	0	0.06	0%
Compressed Natural Gas	0.05	0	0.05	0%
Bio-CNG	0.34	0	0.34	0%
Renewable Diesel	2.16	0	2.16	0%
LNG (Fossil)	0.00	0	0.00	0%
Totals	**280.75**	**7.08**	**273.67**	**2.5%**

**Specific electricity production is not known at the transportation level. The percentage used here is based on the ratio of electricity produced to electricity imported for 2020.*

Transportation Energy Production in Oregon, 2005-2020 (billion Btu)[1]



Ethanol. Oregon began producing fuel ethanol in 2007 and had its largest production year in 2008 with 10.3 trillion Btu of energy created. In 2020, Oregon produced 5.0 trillion Btu of ethanol.[1] Oregon has one commercial ethanol producer — Alto Ingredients' Columbia Dry Mill and Distillery in Boardman (previously known as Pacific Ethanol). Carbon dioxide emissions from the plant are captured and used by the food and beverage industry, turning emissions into a beverage-grade liquid used to carbonate soft drinks and make dry ice.[7]

Biodiesel. The U.S. Energy Information Administration began tracking Oregon biodiesel production in 2013. In 2020, Oregon produced 1.5 trillion Btu of biodiesel. SeQuential Pacific Biodiesel produces biodiesel from used cooking oil from local restaurants and businesses and is the second largest source of transportation fuels produced in Oregon (after ethanol).[19]

Renewable Natural Gas. This emerging biofuel that captures methane from waste streams has potential to displace some fossil transportation fuels in Oregon.

A Sequential Pacific Biodiesel truck fills up in Salem, OR.

Energy Facility Siting in Oregon

Oregon's Energy Facility Siting Council is a governor-appointed body that oversees the siting of energy facilities in the state, and is staffed by the Oregon Department of Energy. The types and sizes of energy projects subject to EFSC jurisdiction have changed over time. While the bulk of applications have been for electric generation projects, EFSC has also reviewed site certificate applications for electrical energy transmission, pipelines, nuclear research reactors, ethanol production, liquified natural gas storage, and many others. More recently, EFSC has reviewed battery storage as part of other energy projects, even though battery storage is not by itself state jurisdictional. EFSC also has ongoing responsibility for approved sites, including monitoring projects going into construction and operation, and reviewing site certificate amendment requests.

56

Total number of site certificates issued by EFSC — **40** are current.

19.5 Gigawatts

Capacity of EFSC-approved electricity facilities. Nearly **5.7 GW** is renewable.

7.4 Gigawatts

Capacity of renewable electricity generation under review, approved to begin construction, under construction, or operating.

Site Certificate — under ORS 469.300(26) — means the binding agreement between the State of Oregon and the applicant, authorizing the applicant to construct and operate a facility on an approved site, incorporating all conditions imposed by EFSC on the applicant.

Renewable Electricity EFSC Projects Summary (Megawatts)

Status	Wind	Solar	Geothermal	Hydro	Battery	Total MW
			Active			
Operational	2,719	50	-	-	5	2,774
In Construction	194	362	-	-	-	556
Approved	421	812	-	-	463	1,696
Under Review	340	2,505	-	-	2,340	5,185
Subtotal	**3,674**	**3,729**	**-**	**-**	**2,809**	**10,211***
			Inactive			
Approval Expired	640	-	35	-	-	675
Decommissioned	-	-	-	-	-	-
Denied	-	-	-	80	-	80
Withdrawn	2,445	300	180	200	1,100	4,225
Subtotal	**3,085**	**300**	**215**	**280**	**1,100**	**4,980**
TOTAL MW	**6,759**	**4,029**	**215**	**280**	**3,908**	**15,191**

**10,211/10,212 difference due to rounding.*

Non-Renewable Electricity EFSC Projects Summary (Megawatts)

Status	Coal	Nuclear	Natural Gas	Other	Total MW
			Active		
Operational	-	-	3,237	51	3,288
In Construction	-	-	-	-	-
Approved	-	-	-	-	-
Under Review	-	-	-	-	-
Subtotal	**550**	**-**	**3,237**	**51**	**3,288**
			Inactive		
Approval Expired	109	5,040	3,221	38	8,408
Decommissioned	550	1,130	415	-	2,095
Denied	-	-	-	-	-
Withdrawn	431	-	5,147	109	5,687
Subtotal	**1,090**	**6,170**	**8,783**	**147**	**16,190**
TOTAL MW	**1,090**	**6,170**	**12,020**	**198**	**19,478**

Non-Electricity Generation EFSC Projects Summary (Number) — Part 1

Status	Research Reactors & ISFSI*	Electric Transmission Line	Natural Gas Storage	Liquefied NG Storage	Total Projects
			Active		
Operational	3	1	1	-	5
Approved	-	1	-	-	1
Under Review	-	1**	-	-	1
Subtotal	**3**	**3**	**1**	**-**	**7**
			Inactive		
Withdrawn	-	1	-	2	3
Subtotal	**-**	**1**	**-**	**2**	**3**
Total MW	**3**	**4**	**1**	**2**	**10**

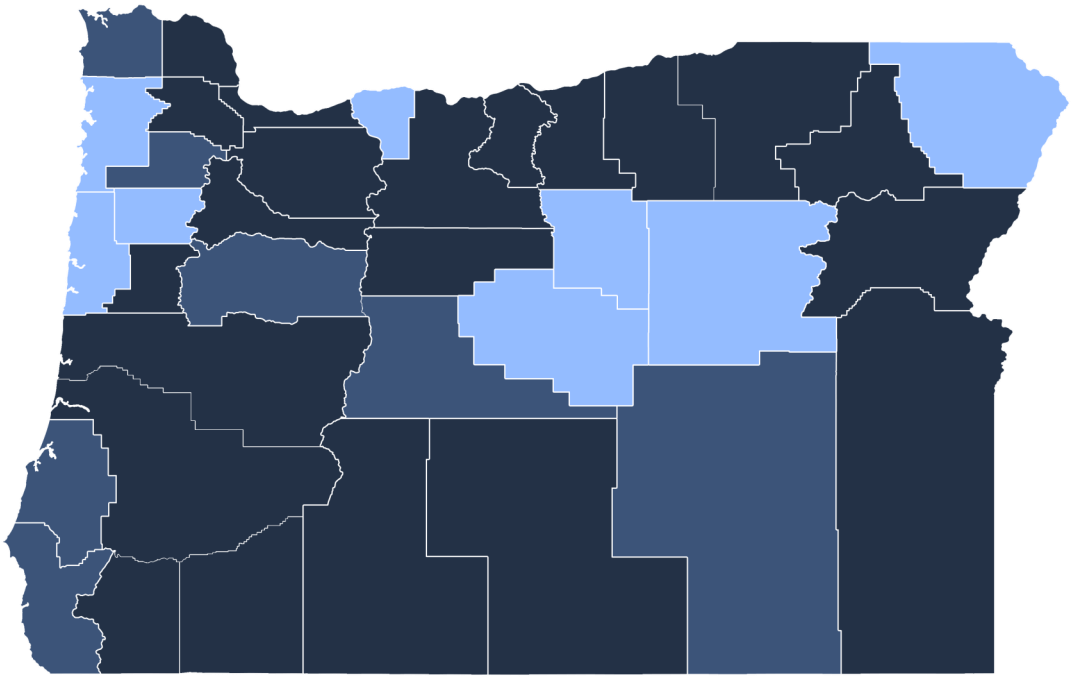
**Portland General Electric's Independent Spent Fuel Storage Installation Facility at decommissioned Trojan Power Plant.*
***This is an amendment to the existing in-service Eugene to Medford 500 kV transmission line.*

Non-Electricity Generation EFSC Projects Summary (Number) — Part 2

Status	Natural Gas Pipeline	Ethanol Production	Total Projects
Active			
Operational	2	1	3
Approved	-	-	-
Under Review	-	-	0
Subtotal	**2**	**1**	**3**
Inactive			
Withdrawn	-	1	1
Subtotal	**-**	**1**	**1**
Total MW	**2**	**2**	**4**

Total Projects (Parts 1 and 2)	**14**

Oregon Counties with State Jurisdictional Energy Projects



Counties with existing site certificates and/or applications

Counties with prior but not current site certificates and/or applications

Counties with no current or prior site certificates and/or applications

More information on Oregon's state-jurisdictional energy projects is available online:

tinyurl.com/EFSC-projects

Energy Costs & Economy

What We Spend

In 2020, Oregon spent $12.1 billion on energy, a drop from the recent peak of $14.2 billion in 2018.[1] This includes electricity and fuel for homes and businesses, industrial energy uses, and petroleum used in the transportation sector. Transportation accounts for about half of our state's energy expenditures and sees the largest swings in price. The variability in what we spend on energy is driven primarily by transportation fuel costs. In 2020, Oregonians sent about $5.7 billion in transportation dollars to other states and countries where extraction, processing, and refining of transportation fuels occurs.[2]

$12.1 billion

Oregonians spent on energy in 2020.[1]

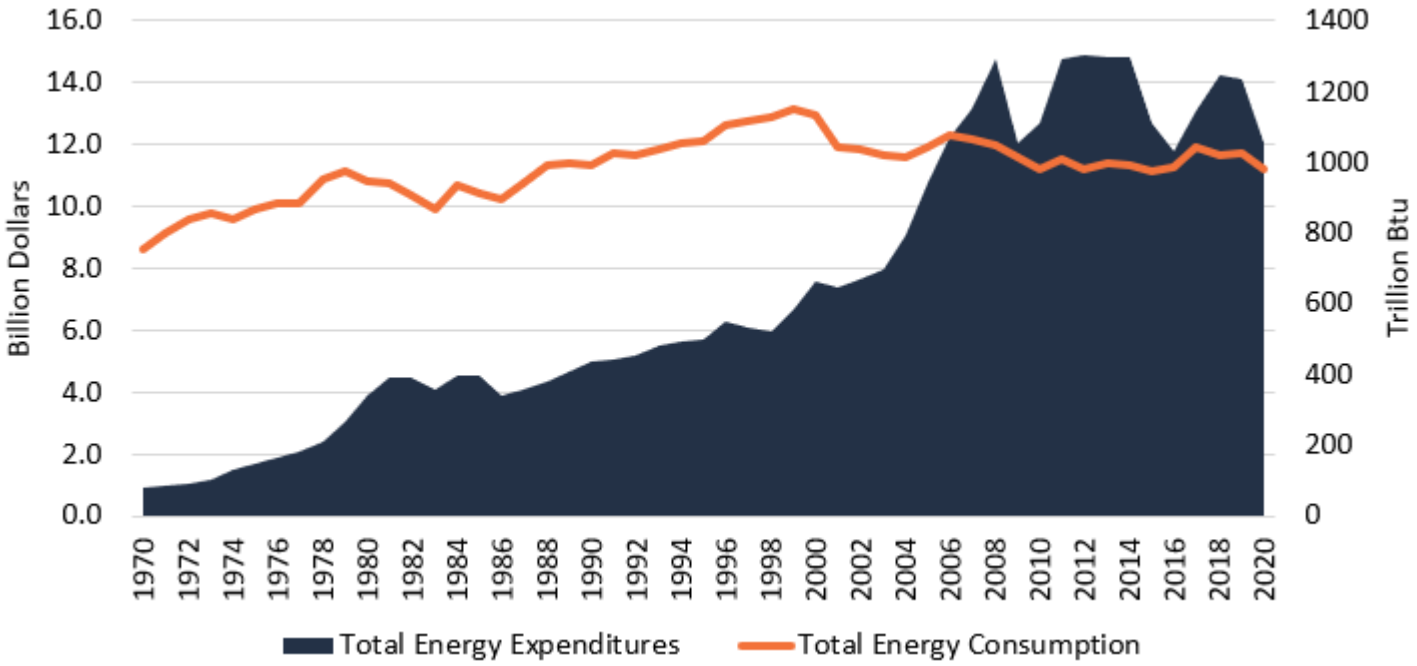
11.31 cents

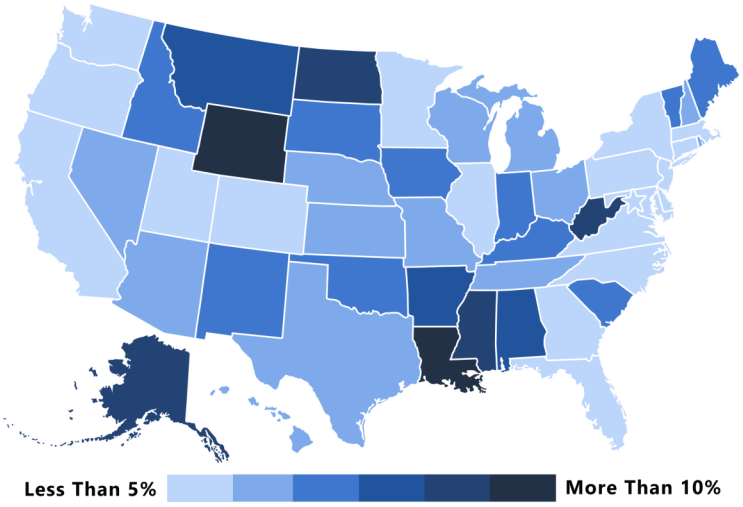
Oregon's average residential retail price per kilowatt hour of electricity for 2020.[14]

4.95%

Percentage of Oregon's GDP spent on energy in 2020.[1]

Oregon's Total Energy Expenditures vs. Total Energy Consumption[1]



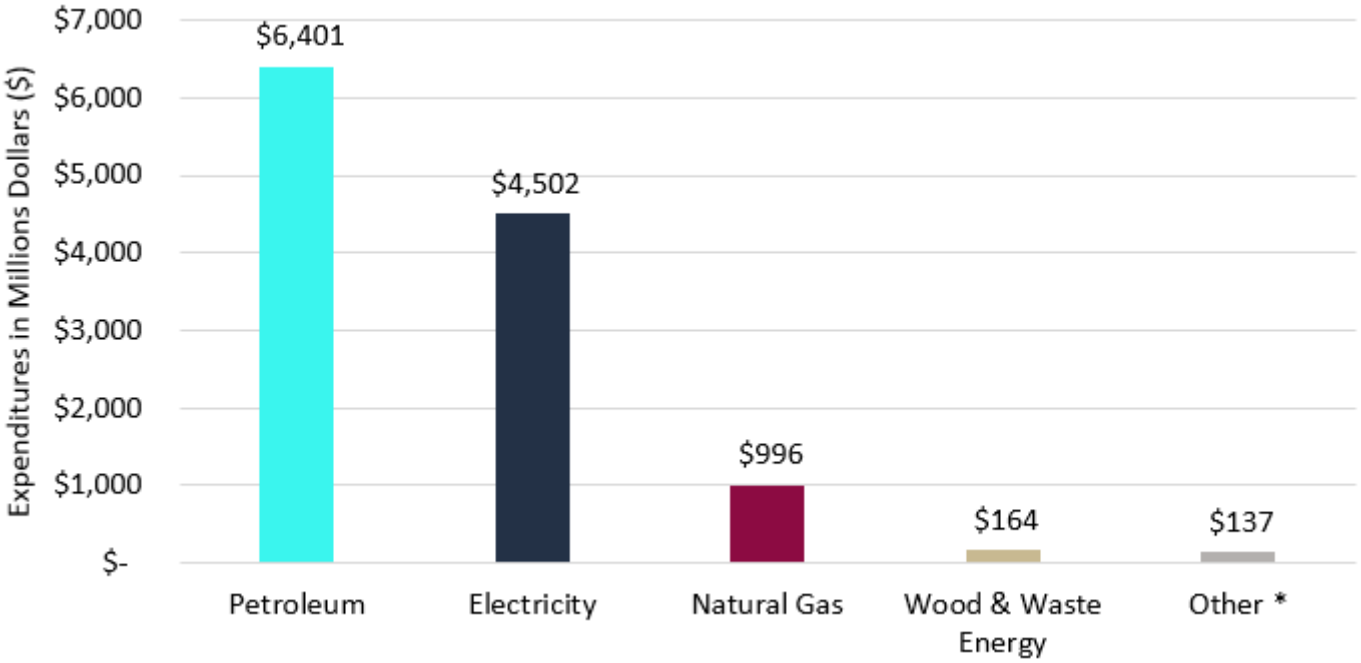


State Total Energy Expenditures as a Percentage of State Gross Domestic Product (2020)[1]

Oregon Energy Expenditures by Source

Oregon's industrial, commercial, residential, and transportation sectors spent over $12.1 billion on energy from petroleum, electricity, natural gas, wood, waste, and some coal.[1]

2020 Oregon Energy Expenditures by Source[1]

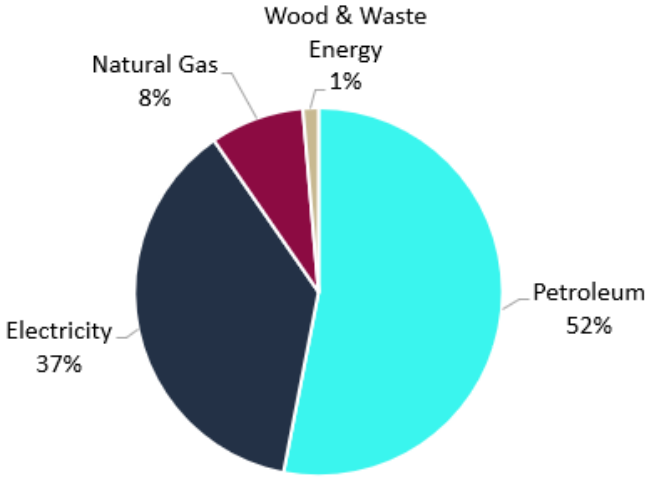


**Other* includes coal. *Other* is not included in the pie chart below, as it rounds to 0%.

The petroleum products category is dominated by transportation fuels. The transportation sector accounts for $5.7 billion in expenditures and includes some natural gas and electricity expenditures. As shown in the sector-based comparison later in this section, transportation energy use is the largest portion of Oregon's overall energy use.

The price of electricity has remained stable primarily because of the regulation of retail rates by the Oregon PUC and local governing boards of COUs. Natural gas retail prices are also regulated by the OPUC, and overall constitute a smaller portion of total consumer energy expenditures in Oregon. Petroleum product prices, however, are unregulated and experience a high level of price volatility with impacts from global market pressures and from localized taxes and storage and distribution costs. Despite a small drop in price per unit of energy in petroleum products in 2020, the petroleum category maintains an outsized portion of the annual energy expenditures.[1]

Share of Energy Expenditures by Source in Oregon (2020)[1]



Energy Burden

Home energy burden is the percent of household income spent on home energy bills. Energy bills include electricity, natural gas, and other home heating fuels, and are compared to the total income of the people in that household. If a household is spending more than 6 percent of its income on home energy costs, it is considered burdened.[4] The energy affordability gap is the difference between a household's actual energy costs and an "affordable" energy burden level (6 percent of the household's income). With so many low-income Oregonians facing significant energy burden, Oregon's energy affordability gap is estimated to be about $289 million per year, or eight times the federal funding Oregon receives for energy assistance.[5]

The Oregon Department of Housing and Community Services has assembled county profiles for Oregon that provide a detailed look at population, poverty, income, homeownership, rental housing, and houselessness, which can provide additional context when discussing energy burden. See the dashboard online: **https://tinyurl.com/OHCS-County-Profiles**

3x

Nationally, low-income households spend three times more of their income on energy costs compared to the median spending of non low-income households.[4]

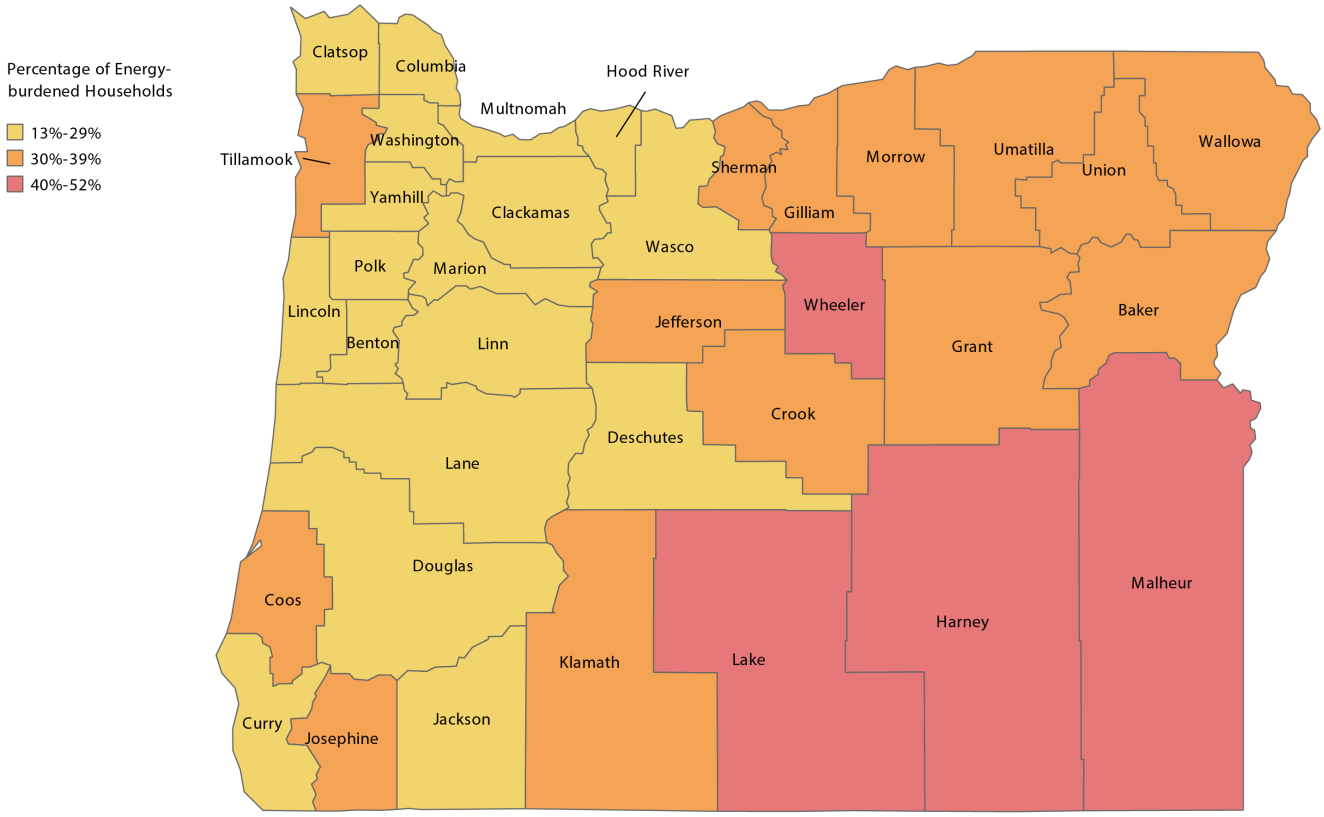
370,797

Number of Oregon households that were energy burdened in 2020, a small decrease from 2019.[5]

23%

Percentage of all Oregon households that were energy burdened in 2020,[5] a 2% decrease from 2019.

Percentage of Oregon Households Considered Energy Burdened and Earning 200 Percent or Below Federal Poverty Level by County[6]



Transportation burden represents the total annual transportation costs of households in comparison to income of the household.[7] Home and transportation energy burdens are combined to discuss the whole energy burden of a household — and both are important indicators of affordability for Oregonians.

The Housing + Transportation Affordability Index was last updated in 2017 and provides more information on transportation energy burden by town: **htaindex.cnt.org/map/**

The Oregon Department of Transportation is developing public transportation solutions to increase the affordability for Oregon communities. Learn more about ODOT's innovative solutions in its Oregon Public Transportation Plan: **tinyurl.com/ODOT-OPTP**

Global Events Affect Energy Costs for Oregonians

Disruptions in demand for energy and price swings for petroleum products caused by the COVID-19 pandemic, record setting heat waves, and the war in Ukraine have contributed to a quickly changing and very challenging economic situation for all Oregonians — but especially for low-income households. Rising inflation and demand have contributed to shortages of certain goods, and many Oregonians struggled to pay for housing costs and utilities during the pandemic.


OREGONLIVE
The Oregonian

Oregon gas prices soar to all-time high amid Ukraine invasion, possible Russian oil ban

Updated: Mar. 07, 2022, 11:24 a.m. | Published: Mar. 07, 2022, 11:06 a.m.

Gas prices hit a record Monday in Oregon amid concerns about the impact of a possible ban on Russian oil imports and the ongoing war in Ukraine. (File/The Oregonian) Faith Cathcart/The Oregonian

State and local jurisdictions have been working hard to ensure Oregon recovers from these challenges. For example, the Oregon Public Utility Commission and Oregon utilities came together to plan on making accommodations to ensure Oregonians and small businesses affected by the pandemic would still have access to electricity as they recovered.[8] Advocates are calling for utility assistance programs to operate year-round, rather than only during the winter due to life threatening heat waves.[9] The Oregon Legislature passed HB 2475, which allows the Public Utility Commission to consider energy burden and other factors affecting energy affordability in the rate making process. This allows for mitigation of energy burden through bill reduction measure or other programs like weatherization.[10]

The 2024 edition of this report will have access to 2021 and 2022 data that will provide further insight on how well Oregon navigated these challenges and whether any groups have been further disadvantaged.

Energy Jobs

Oregonians hold a number of jobs in the energy industry — from energy utility workers to wind turbine technicians to solar installers.

Energy employment is often sorted into energy efficiency, traditional energy, and motor vehicles jobs. In Oregon, most energy-industry employees work in energy efficiency, including high-efficiency and traditional HVAC, renewable heating and cooling firms, and others. Traditional energy jobs include energy extraction, as well as power generation, transmission, distribution, and storage. Motor vehicles jobs include both the manufacture and distribution of parts and vehicles for all industries from large scale industrial vehicles to small recreational vehicles such as golf carts.

90,543

Number of Oregonians employed in the energy industry in 2021.[11]

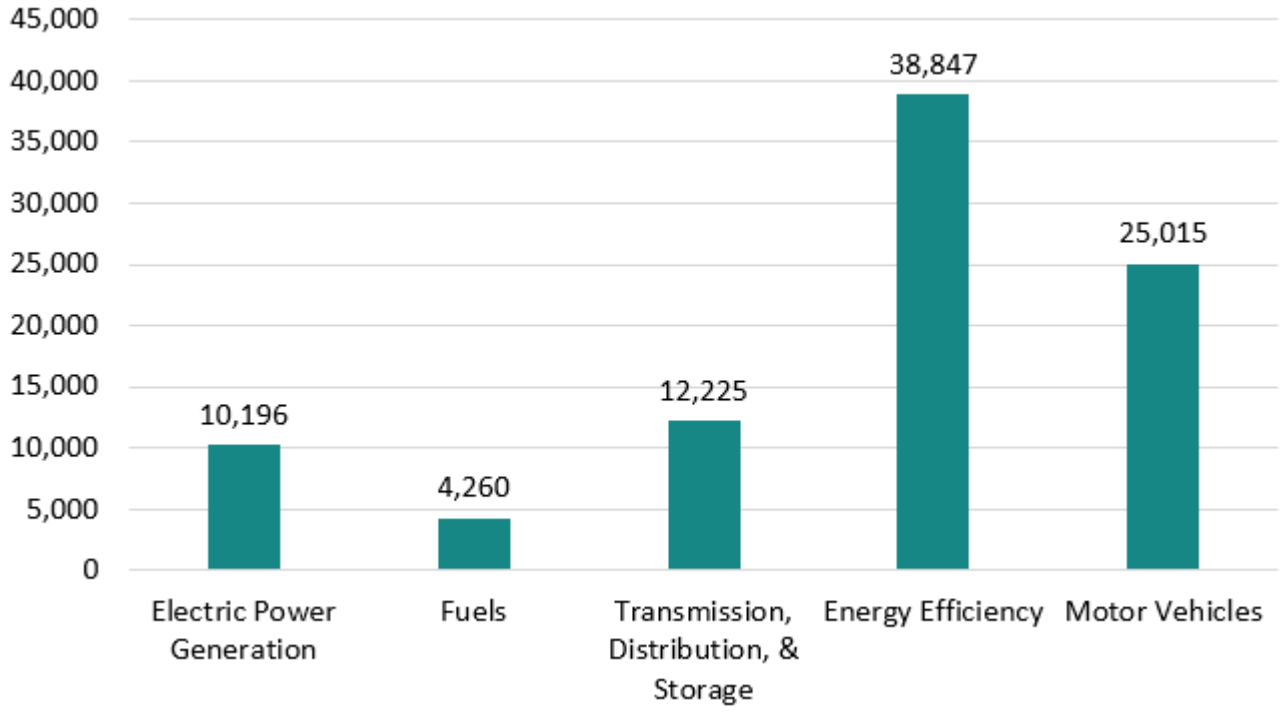
50,562

Number of clean energy jobs in Oregon in December 2020, a loss of 6,055 jobs during the pandemic.[12]

3,414

Number of clean energy jobs added in Oregon since May 2022 following the COVID-19 economic downturn.[12]

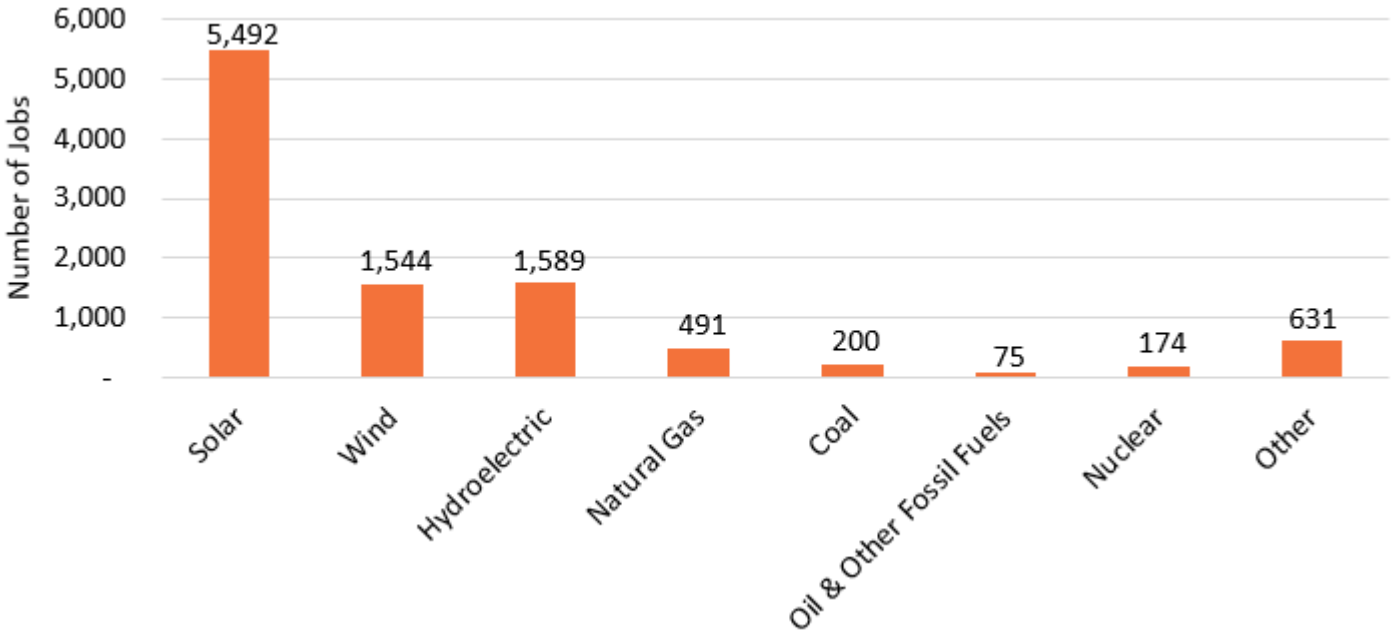
Number of Energy Jobs in Oregon by Type (2021)[11]



Nationally, 255,037 people work in the solar industry; Oregon makes up about 2.2 percent of those jobs, with 166 solar companies operating in the state. In 2021, 5,492 Oregonians worked on solar projects. The industry lost 267 solar jobs in Oregon in 2020.[13]

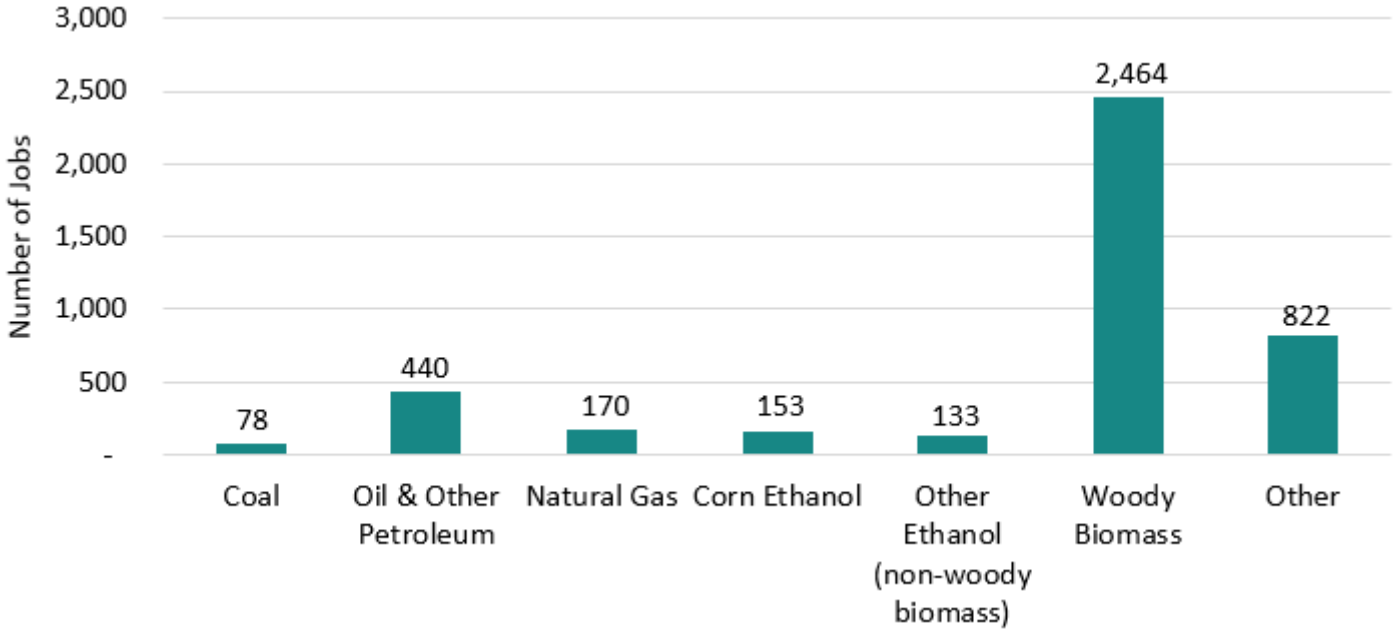
The electric power generation sector in Oregon employed 10,196 workers in 2021, and added 545 jobs over the previous year.[11]

Electric Power Generation Jobs in Oregon by Technology (2021)[11]



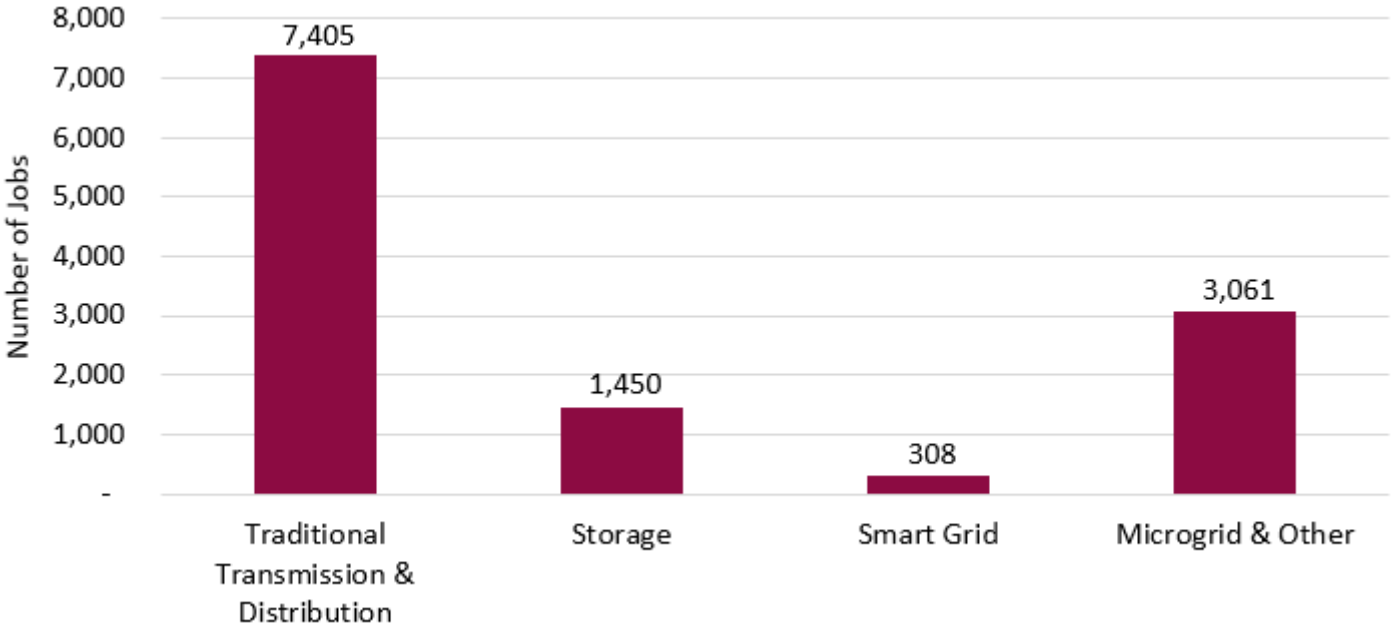
The fuels sector in Oregon employed 4,260 workers in 2021, and added 146 jobs over the previous year.[11]

Fuels Jobs in Oregon by Resource (2021)[11]



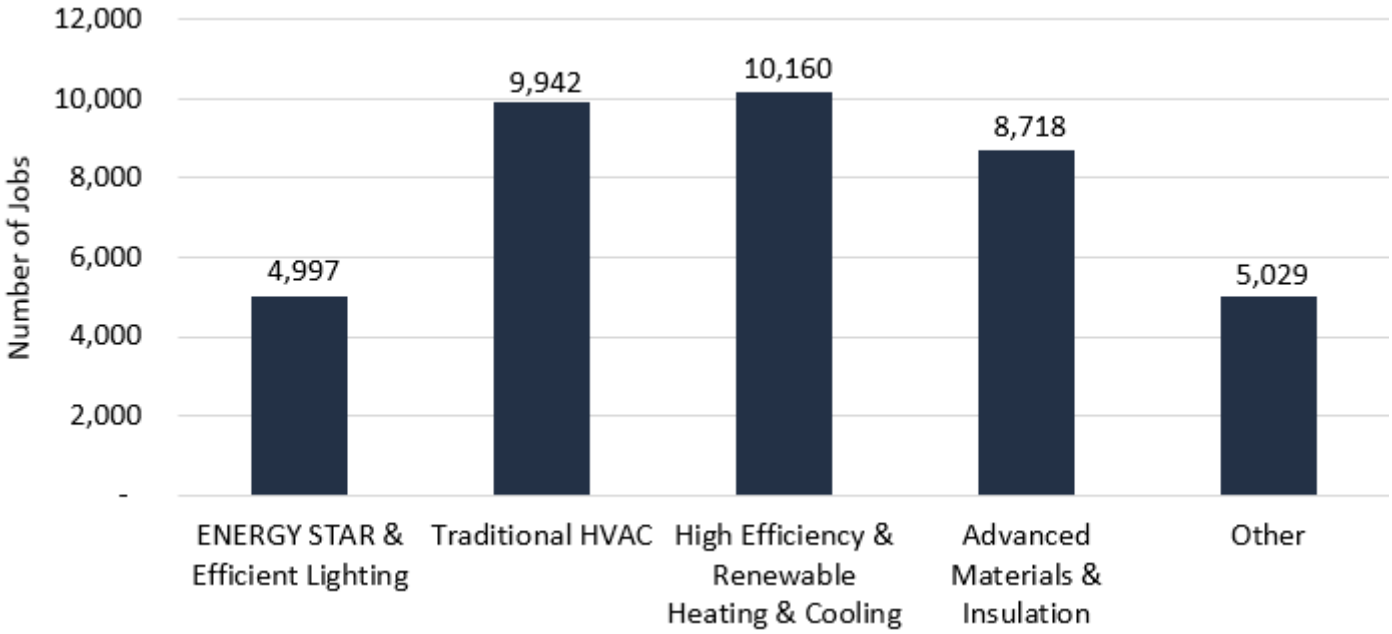
The transmission, distribution, and storage sector in Oregon employed 12,225 workers in 2021, a decrease of 661 jobs from the previous year.[11]

Transmission, Distribution, and Storage Jobs in Oregon (2021)[11]



The energy efficiency sector in Oregon employed 38,847 workers in 2021, and added 585 jobs from the previous year.[11]

Energy Efficiency Jobs in Oregon by Technology (2021)[11]



Turn to the Policy Briefs section of this report to learn more about local perspectives on Oregon's energy workforce and supply chain.

Energy Efficiency

Oregon's Second Largest Resource

Energy efficiency, the use of less energy to perform the same task or produce the same result,[1] plays a critical role in Oregon. It remains the second largest resource in the state after hydropower, and Oregon has consistently met increased demand for electricity by implementing energy efficiency strategies. The Northwest Power & Conservation Council reports that since 1978, the Pacific Northwest has produced about 7,200 average megawatts (aMW) of savings through efficiency programs and improvements.[2] That's more electricity than the whole state of Oregon uses in a year.

9th

Oregon's 2020 rank among U.S. states for energy efficiency by the American Council for an Energy Efficient Economy.[3]

14

Years in a row that Oregon has landed in the top 10 most energy efficient states.[3]

Over the past decade, Oregon reduced per capita energy use despite our state population growing, and energy efficiency is one reason why. Oregon's gains in energy efficiency have been helped by federal appliance standards, state policies and programs, natural gas and electric utility programs, Energy Trust of Oregon utility programs, and other nongovernmental organizations. For the region's cumulative savings, 60 percent comes from utility and Bonneville Power Administration programs.[2] Energy efficiency gains are cumulative and continue paying dividends for our region over time.

Energy Efficient Wildfire Recovery

In 2020, more than 5,000 structures and over 1 million acres were burned in 21 wildfires that devastated Oregon communities over the Labor Day weekend. Communities across Oregon lost homes and businesses under sky that was darkened by ash and smoke.

To help Oregonians recover, the Oregon Legislature allocated $10.8 million to the Oregon Department of Energy to incentivize energy-efficient rebuilding efforts. Building and homeowners can receive incentives to build to current building code or above code — incorporating these energy efficiency improvements help make buildings more comfortable and support long-term affordability thanks to lower energy bills. ODOE rolled out the program in early 2022.

Learn more**: www.oregon.gov/energy/Incentives/Pages/EEWR.aspx**

Oregon Electricity Savings

7,200

Average megawatts of regional electricity savings from energy efficiency (1978-2020).[2]

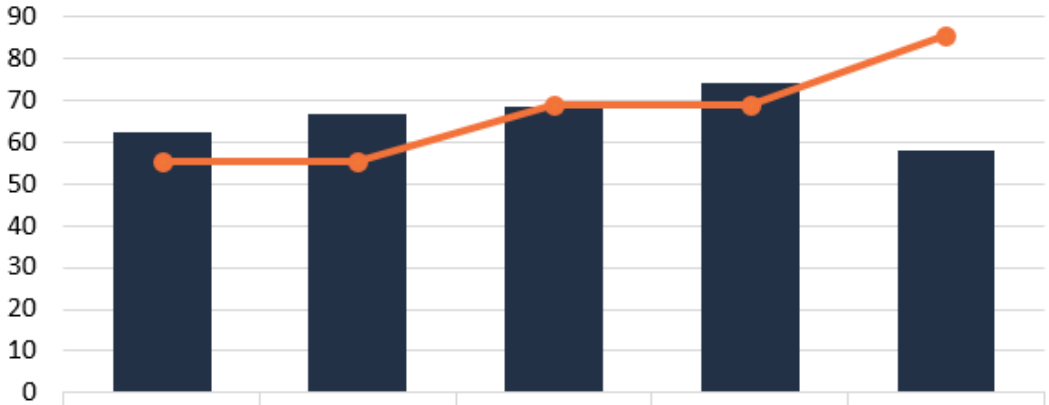
2,300

Average megawatts of Oregon electricity savings from energy efficiency (1978-2020).[2]

The Northwest Power & Conservation Council's 2021 Northwest Power Plan, published in March 2022, concludes that cost-effective efficiency can meet a large amount of new load growth in the region – allowing Oregon to grow without needing significant new electricity resources. The plan calls on the region to develop new energy efficiency programs equivalent to acquiring 2,400 average megawatts of power by the end of 2041.[2] Integrated Resource Plans from Oregon's large electric utilities also identify energy efficiency as a key strategy they will use to meet demand over their planning horizons.

The Regional Conservation Progress Report to the Northwest Power and Conservation Council in September 2020, however, demonstrates that there is significant cost-effective energy efficiency in the electric sector still available, but that regional energy efficiency achievement in the electric sector is on a downward trend – this means that each subsequent year of the Plan will deliver fewer savings. The COVID-19 pandemic affected the savings achievement in 2020 but was not the only factor. Program expenditures have been flat to declining over the last four years and the cost of savings has been increasing from $2 per aMW in 2016 to $2.75 per aMW in 2020.[4]

Oregon Electricity Savings & Estimated Share of Seventh Power Plan Goal (aMW)[2]



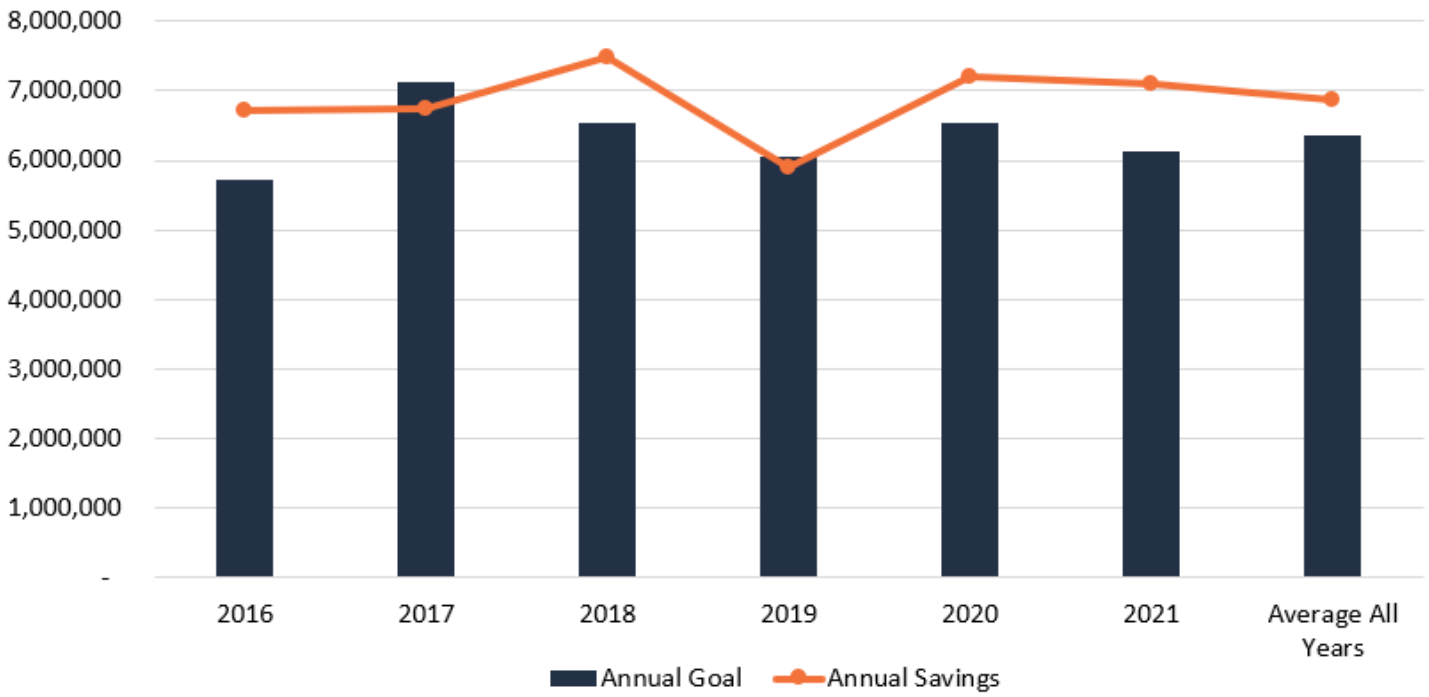
	2016	2017	2018	2019	2020
Energy Trust of Oregon	58.4	62.2	50.0	51.8	39.9
BPA	9.3	5.7	8.1	8.9	3.9
COU Utility Self-Funded	1.1	0.6	2.6	3.3	0.3
NEEA	9.0	7.9	12.4	16.8	15.0
Codes and Standards	0.0	0.5	1.9	2.4	3.4
Momentum	3.2	8.2	0.0	0.0	0.0
Market Adjustment	-18.7	-18.2	-6.6	-9.0	-4.6
Total Oregon Savings	62.37	66.85	68.38	74.24	57.81
Estimated Oregon Share of Goal	56	56	69	69	86

Oregon Natural Gas Savings

Natural gas efficiency goals are developed in each natural gas utility's Integrated Resource Plan submitted to the Oregon Public Utility Commission. The utilities' savings exceeded goals from 2016 and 2018 with a slight decline in 2019, then continued to exceed goals in 2020 and 2021.[5] Energy Trust of Oregon implements energy efficiency programs for natural gas utilities. Programs are funded by customer rates, and cost effectiveness tests of natural gas measures ensures that efficiency investments cost less than building new natural gas resources.

For more about cost-effectiveness, see Chapter 6 of the *2018 Biennial Energy Report.*

Oregon Natural Gas Savings Compared to Goals (Million Therms)[5]



Integrated Resource Planning

From the Oregon Public Utility Commission's website:

Oregon was one of the first states to require utilities to file integrated resource plans (IRPs). The IRP presents a utility's current plan to meet the future energy and capacity needs of its customers through a "least-cost, least-risk" combination of energy generation and demand reduction. The plan includes estimates of those future energy needs, analysis of the resources available to meet those needs, and the activities required to secure those resources. What began thirty years ago as a simple report by each utility has grown into a large, stakeholder-driven process that results in a comprehensive and strategic document that drives utility investments, programs, and activities.

Learn more: **www.oregon.gov/puc/utilities/Pages/Energy-Planning.aspx**

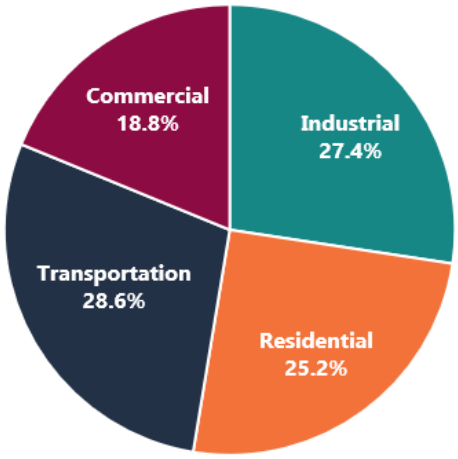
Energy End Use Sectors

Consumption

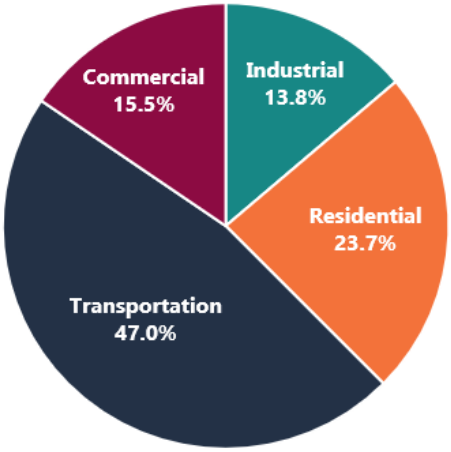
As noted earlier in this section, energy metrics are commonly divided into four end-use sectors: residential, commercial, industrial, and transportation.

Consumption and cost of energy vary across the sectors. In 2020, transportation accounted for 28.6 percent of energy consumption and 47 percent of expenditures due to higher per-unit cost of transportation fuels. The industrial sector used 27.4 percent of the total energy but accounted for only 14 percent of expenditures due to cheaper per-unit costs relative to the other sectors.[1]

Oregon Consumption by End-Use Sector (2020)[2 3]

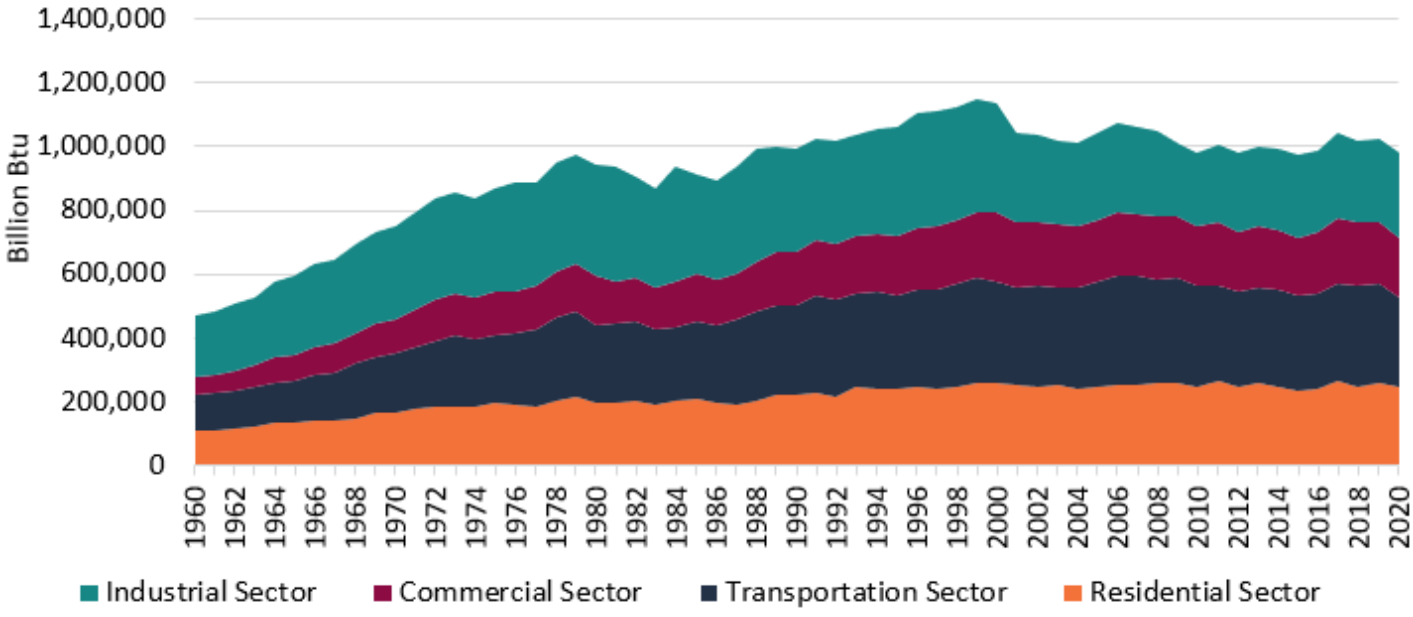


Oregon Expenditures by End-Use Sector (2020)[2 3]



Energy consumption across all sectors has remained relatively steady in recent years. Increased population, GDP, and vehicle miles traveled—which all increase energy use—have been offset by efficiency gains and a shift toward less energy-intensive industries, demonstrated in the downward trend of energy use in recent decades.

Oregon Consumption by Sector Over Time (Billion Btu)[2]



Expenditures

Oregonians' 2020 energy expenditures can be separated by sector. The transportation sector accounts for more than half of expenditures due to the much higher per-unit cost of transportation fuels. Because nearly all Oregon's transportation fuel is imported, most of this money goes out of state. While Oregon's residential, commercial, and industrial sectors have experienced gradual increases in spending through 2018, transportation sector expenditures reflect both increasing consumption and price volatility in the transportation fuels market. The variability in what Oregonians spend on energy is driven primarily by transportation fuel costs. Recent data show a drop in expenditures across all sectors for 2019 and 2020—a sharp drop in transportation and slight decreases in each of the other sectors. The start of the pandemic likely affected energy use and prices during this time frame, with individuals reducing their transportation use and increases in transportation of goods.

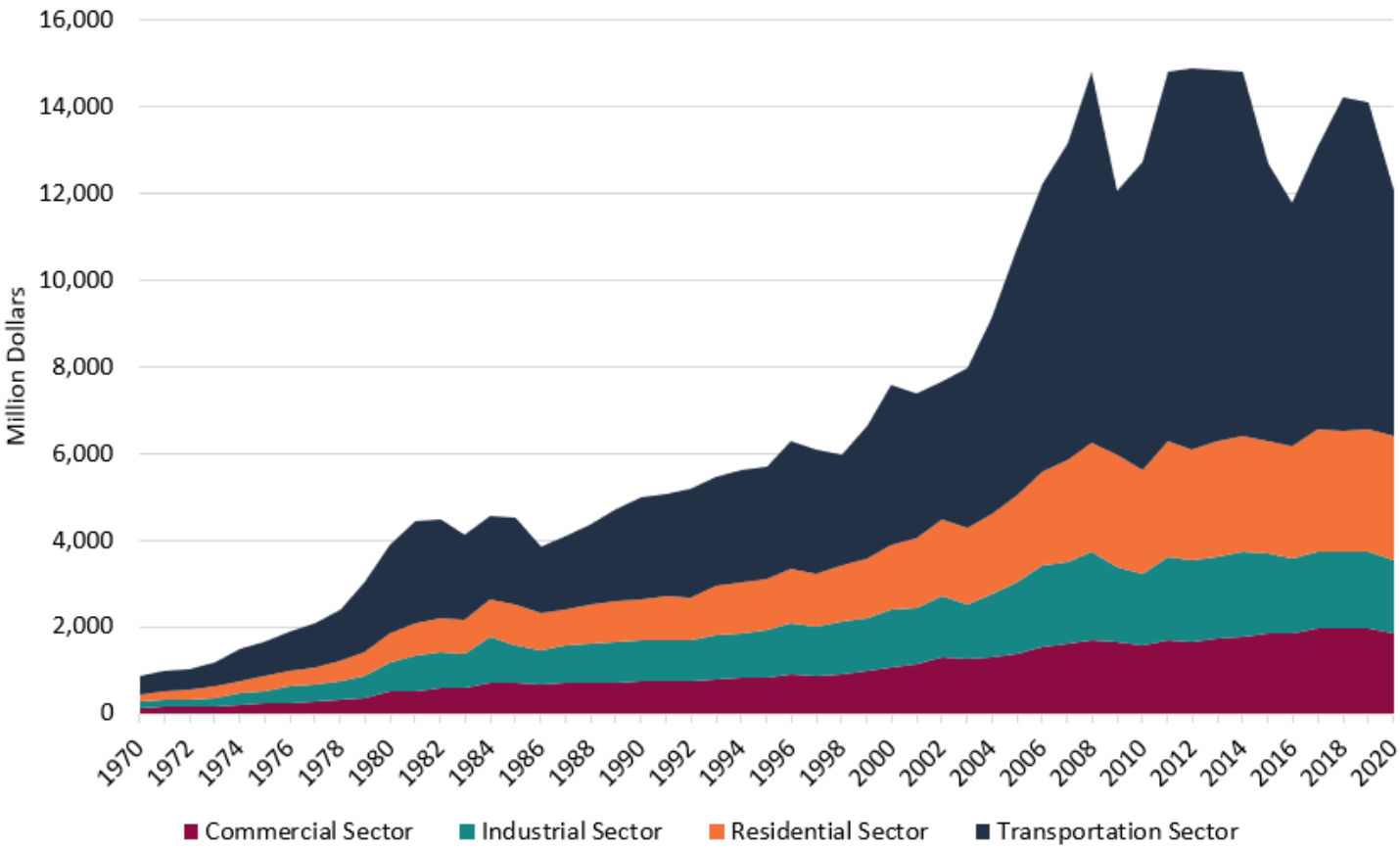
$2,845

Per capita (per person) energy expenditures in Oregon in 2020. The amount has dropped by 16% since 2018.[4]

39th

Oregon's rank in the U.S. for per capita energy expenditures.[4]

Oregon's Total Energy Expenditures by Sector Over Time[2]



The U.S. EIA reports prices in current dollars per million Btu and expenditures in current dollars — the chart is not adjusted for inflation.
Learn more: https://www.eia.gov/state/seds/

Greenhouse Gas Emissions

Most of Oregon's greenhouse gas emissions come from the energy we use every day. These GHG emissions contribute to climate change.

The Oregon Department of Environmental Quality (DEQ) collects data on GHG emissions in Oregon. DEQ publishes the data and uses it to create a sector-based GHG emissions inventory, which is updated annually. The data presented in this section is based on the emissions inventory.

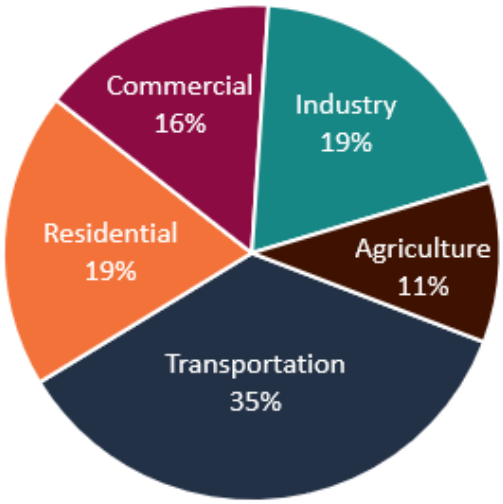
Greenhouse gas emissions can be categorized in multiple ways—by the productive use that creates emissions, by the sector that use falls within, and by the source of the emissions. DEQ provides a mixture of this data, As a result, when analyzing the data, various methods of categorization can reveal new insights. In this section, the data is first presented based on end-use sector, then by source, and then by a mixture of sector and source – presenting DEQ's usual sector-based inventory depiction and an expanded depiction based on further analysis of the data.

GHGs by Sector

Earlier in this report, data is broken out into four end-use sectors — transportation, residential, commercial, and industrial. For greenhouse gas emissions, data can also be broken out for the agriculture sector (in this report agriculture is included in industrial, unless it is shown separately, like here).

Each of the sectors' GHG emissions are summarized below and the pie chart shows the breakdown of emissions between sectors for 2019 – the latest data available. As seen in the chart, the transportation sector accounts for the most emissions.

Greenhouse Gas Emissions by Sector (2019)[5]



Agriculture GHGs. These emissions come from waste streams like methane and nitrogen-based fertilizers for soil management. This sector is distinct because emissions primarily come from methane and nitrous oxide, versus carbon dioxide.

Industrial GHGs. In addition to emissions from electricity generation and natural gas direct use, GHG emissions in the industrial sector come primarily from non-transportation petroleum combustion, industrial waste and wastewater, and manufacturing.

Commercial & Residential GHGs. In addition to emissions from electricity generation and natural gas direct use, GHG emissions in this sector stem primarily from fuel oil for heating and emissions from waste and wastewater.

Transportation GHGs. Transportation is the state's largest single source of GHG emissions, primarily from direct combustion of petroleum products, including emissions from on- and off-highway vehicles (like vehicles used in the industrial, agricultural, or commercial sectors). Of the emissions generated, about 55 percent are from gasoline used mostly in passenger vehicles, and about 35 percent are from medium- and heavy-duty diesel vehicle consumption.[3]

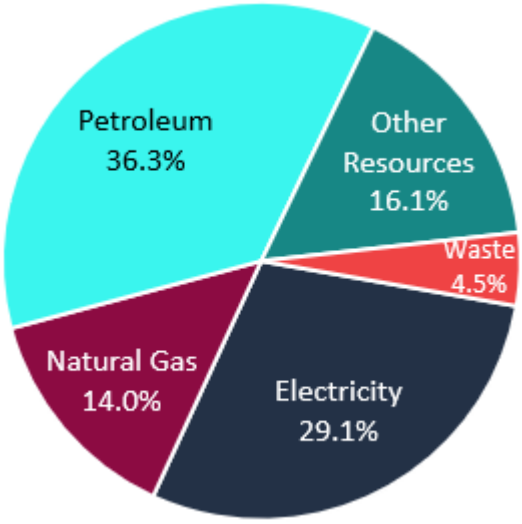
GHGs by Source

GHG emissions data can also be shown by source. Doing so can help illustrate the contribution of energy use to GHG emissions.

Earlier in this Biennial Energy Report, data is broken out into three main categories of energy — electricity, direct use fuels, and transportation fuels. For greenhouse gas emissions, data is broken out a little differently due to data availability and historical presentation practice. As a result, it is important to understand the categories detailed out below. In addition to energy-related items, a category on waste has also been called out as it is a substantial, identifiable source across the sectors.

As can be seen in the pie chart, petroleum products are the largest source of emissions. This correlates to transportation representing the largest sector source of Oregon's GHG emissions.

Greenhouse Gas Emissions by Source (2019)[5]



Petroleum. This represents transportation fuels including diesel, gasoline, and propane for on- and off-highway use, equipment use, and jet fuels.

Electricity. This accounts for electricity used in all sectors, which includes emissions associated with generation of electricity used in the state, regardless of where it is generated. Emissions from electricity generated in Oregon but used out of state are not included.

Natural Gas. This includes direct use of natural gas in all sectors, plus fugitive emissions from distribution. It does not include emissions associated with natural gas-fired power plants.

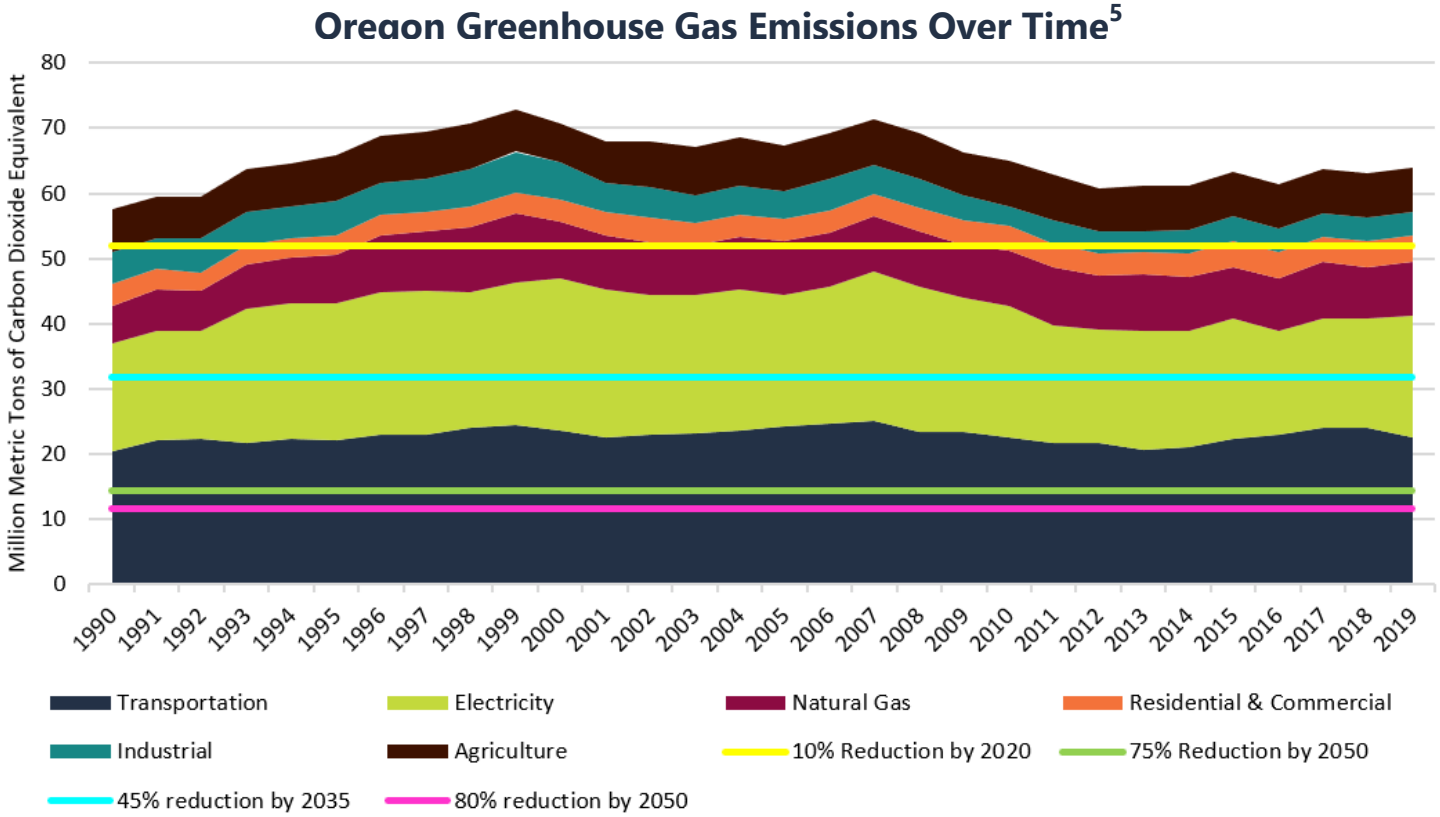
Other. This category includes uses specific to a sector's activity, such as fertilizer, cement and soda ash production and consumption, semiconductor manufacturing, use of refrigerants and solvents, etc.

Waste. This includes treatment of waste products from the various sectors, including landfill waste and agricultural waste. Some of these emissions result from the combustion of waste.

GHGs by Sector and Source

Whether something is classified as a sector or a source can sometimes be blurred in GHG emissions data. For example, electricity can sometimes be considered a sector or source depending on who is doing the categorization. The sector and source distinction is not as important as the stories the presentation of the data can tell – particularly over time.

The chart below mirrors the sector-based inventory graphic DEQ provides. As can be seen, it includes six emissions wedges, including one for each of the sectors outlined earlier (residential and commercial are combined here), as well as ones for electricity and natural gas.



Emissions from natural gas values include distribution and production losses, which differs slightly from DEQ methodology that only includes emissions from combustion in natural gas .

The values for the Electricity and Natural Gas wedges include use for each of the end use sectors: Transportation, Industrial, and Residential & Commercial (the data for the Agriculture sector does not specify electricity and natural gas use). The GHG emissions associated with each sector are lower in this emissions profile because that use is accounted for in the Natural Gas and Electricity Use values.

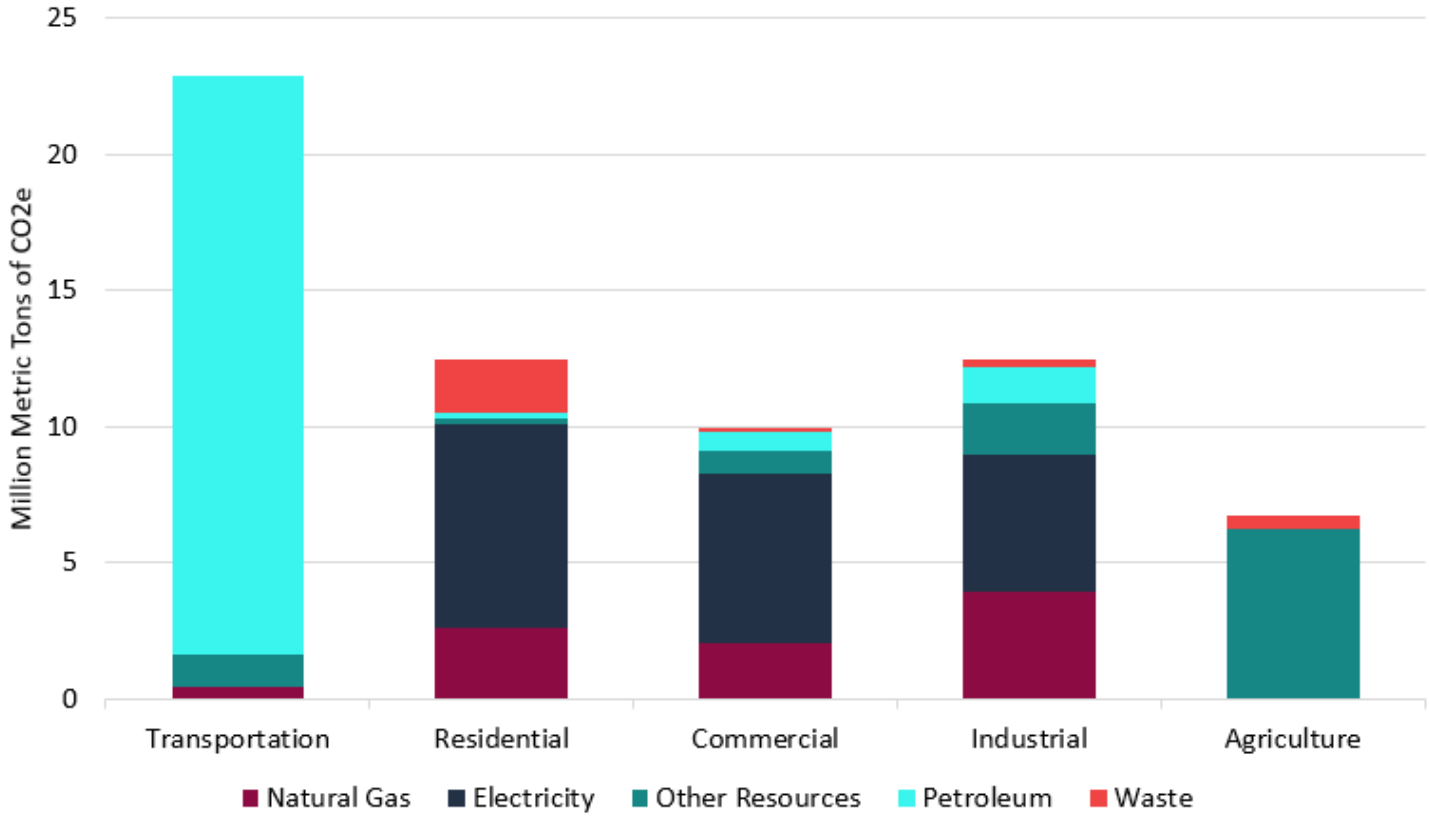
A look at the emissions over time, as provided in this chart, can be helpful in identifying trends. Electricity emissions increased from 1990 through about 2007, and then declined through 2016 and then trended back up. Transportation emissions have grown as a share of Oregon's statewide total GHG emissions in recent years, but the preliminary 2019 data indicates a decrease in transportation emissions. While total transportation emissions have fluctuated over the years, GHG emissions per vehicle have gone down thanks to improved fuel efficiency.[3]

The Oregon Global Warming Commission and others have used DEQ's sector-based inventory to track progress toward the state's greenhouse gas reduction goals. These goals are indicated by the horizontal lines on the chart on the previous page. As the chart shows, Oregon did not achieve its goal of 10 percent below 1990 levels by 2020 (yellow line). Oregon also has a statutory goal of 75 percent below 1990 levels by 2050 (green line).

In 2020, Governor Brown issued Executive Order 20-04, which established an updated 2050 goal of at least 80 percent below 1990 levels by 2050 (pink line) and a more near-term goal of at least 45 percent below 1990 levels by 2035 (light blue line). Recent analysis done by the Oregon Global Warming Commission indicates that the state may be able to meet the 2035 goal if the state is able to implement its current bold climate policies and programs.[6]

Using data from DEQ's Greenhouse Gas Inventory, ODOE assessed different breakdowns of the data and developed the following graphs – one showing only 2019 data and another with breakouts over time. These charts follow more of a bright line between sector and source as delineated earlier. These charts distinguish between residential and commercial and include more detail than just electricity and natural gas. In doing so, one can more clearly see the role that electricity, natural gas, petroleum, and other sources play in each of the sectors.

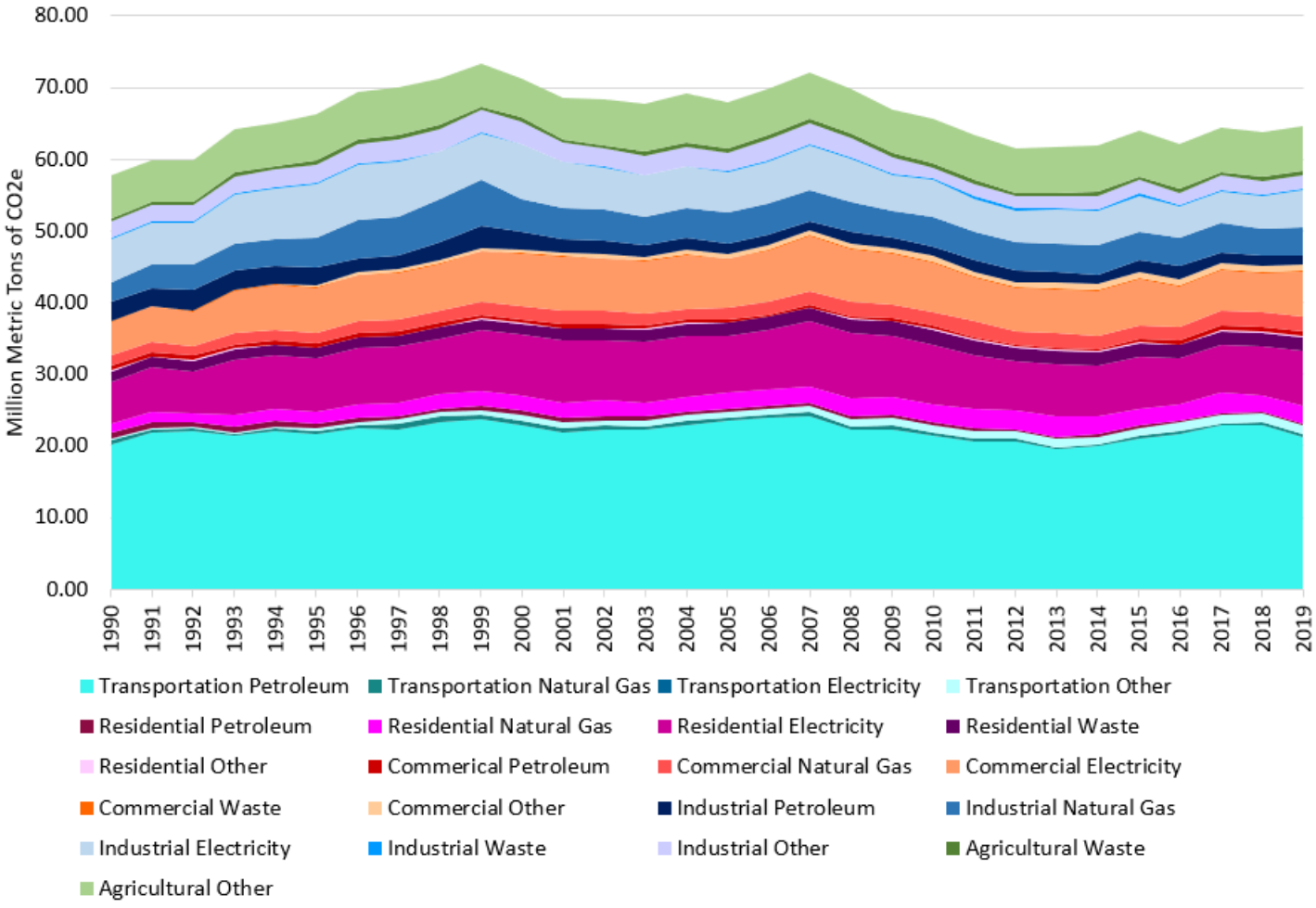
Oregon Greenhouse Gas Emissions by Sector and Source (2019)[5]



Viewing this data over time results in a complex chart that shows the variety of emission sources. This level of analysis can help policy makers identify the types of emissions and sectors to target that will most effectively meet emission reduction goals.

Data is grouped by sector, and then similarly shaded colors within those sectors identify the sources. For example, in the commercial, residential, and industrial sectors, electricity is the largest resource.

Oregon Greenhouse Gas Emissions by Sector and Resource Over Time[5]



The Social Cost of Carbon

Carbon dioxide and other harmful greenhouse gases that contribute to climate change also create costs for society, including economic damages that result from harming human health, interrupting business operations, damaging infrastructure and environmental resources, affecting agricultural production, and more. This *social cost of carbon* is an important consideration as Oregon continues its efforts to reduce GHG emissions and fight climate change. Learn more:

www.tinyurl.com/CostOfCarbon

Sector Profiles

Residential

The residential sector consists of both single- and multi-family occupancies. Common uses of energy associated with this sector include space heating, water heating, air conditioning, lighting, refrigeration, cooking, and appliances. Residential energy use is closely tied to weather, housing vintage (decade a home is built), and type of housing.

25.2%

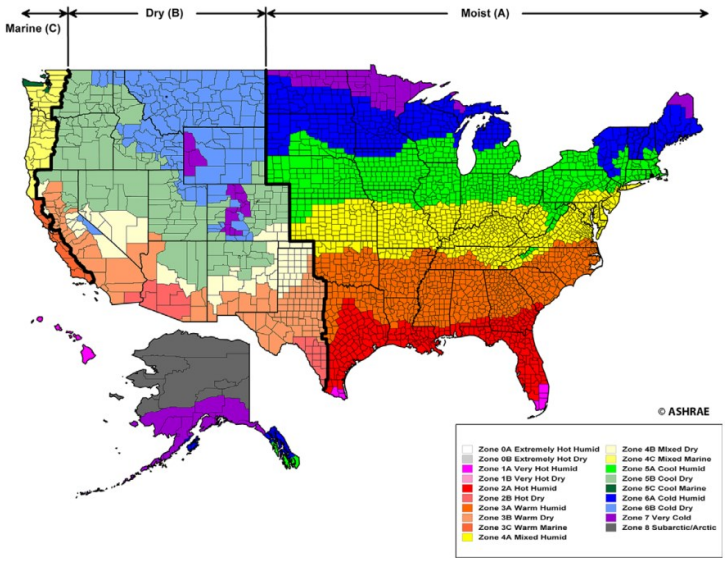
Residential sector's share of Oregon's energy use in 2020.[1]

1.6 Million

Number of occupied housing units in Oregon in 2020.[1]

Weather

Oregon is divided by two climate zones with different energy needs and weather patterns. The map to the right demonstrates the climates zones in the U.S.[3] In Oregon, west of the Cascade mountain range is a temperate mixed marine climate zone in yellow. East of the Cascade Mountain range in green, is a cool dry climate with more heating and cooling days, requiring more heating and cooling energy use. Buildings in Eastern Oregon have a higher average energy use index, meaning they typically use more energy per square foot.

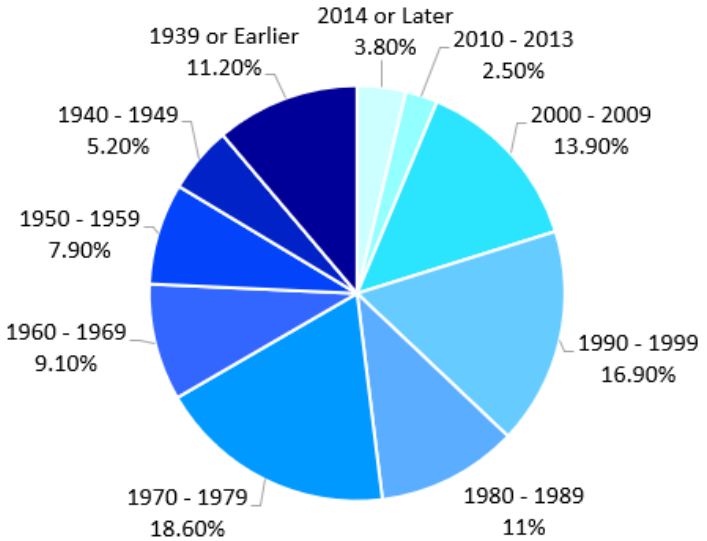


Vintage

The residential sector includes new construction and existing construction — and energy use can be very different between them, especially when comparing a newly built home to a decades-old home. Oregon's residential energy code has made significant performance increases since Oregon's first energy code in 1974.

Older homes with less insulation and older equipment use more energy for heating and cooling than newer, more efficient homes. Home vintage can indicate opportunities for updating heating and cooling equipment, water heating, insulation, windows, and house weatherization. About 63 percent of all homes in Oregon were built before 1990.[2]

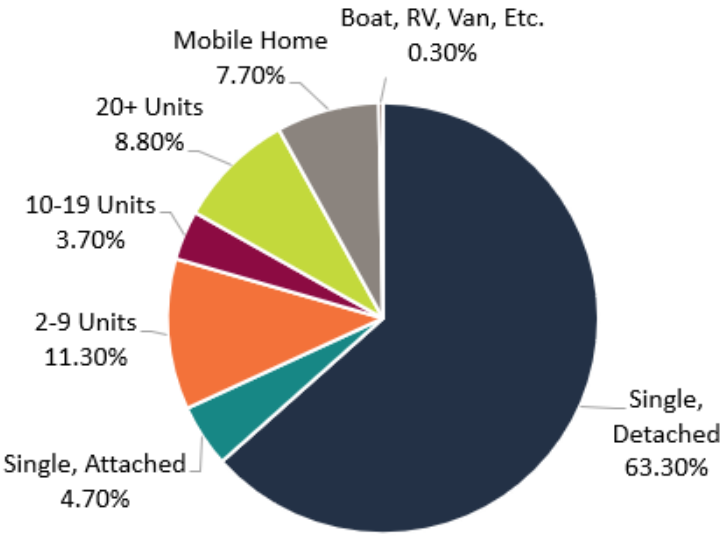
Oregon Homes by Vintage[4]



Type of Housing

Most housing in Oregon (63 percent) is detached single-family. Multifamily complexes with 20 or more units represent 8.8 percent of all housing, followed by mobile/manufactured homes at 7.7 percent. Other multifamily units (like those with fewer than 20 units) comprise the remainder.[2]

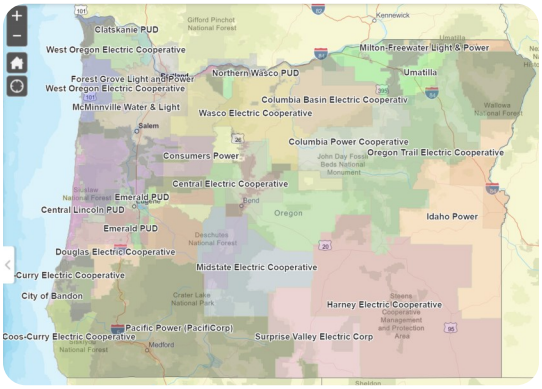
Oregon Housing Types[4]



Ownership and Vintage

Another way to look at housing stock in Oregon is by ownership and vintage across the region. Northwest Oregon has the most housing units, as well as the highest percentage of rental units. The distribution also shows nearly 80 percent of housing units were built prior to year 2000, with half being built prior to 1980.[2]

Region	Total Occupied Housing Units	Share of Units That Are Rental Properties	Share of Units That Are Pre-1980 Homes	Share of Units That Are Pre-2000 Homes
East Oregon	208,718	31%	51%	86%
NW Oregon	1,222,517	36%	53%	80%
SW Oregon	211,344	30%	52%	81%
All of Oregon	1,642,579	34%	52%	80%



Looking for your local utility? Use the Oregon Department of Energy's online lookup tool: **www.tinyurl.com/FindYourUtility**

Residential Energy Efficiency

Oregon's energy efficiency programs and policies save residential customers energy and money while increasing household comfort. The Northwest Power and Conservation Council estimates a total technical potential of 2,441 aMW across the regional residential sector in energy conservation in the 2021 Power Plan, representing about 27 percent of the projected 2041 residential sector load.

While there's been significant progress in residential energy efficiency, there is room for improvement when it comes to energy saving opportunities for homes. The NW Power and Conservation Council's 2021 Annual Regional Conservation Progress Report outlines opportunities:

Lighting. Lighting has historically been a significant energy efficiency opportunity, and the region has made great progress. Energy-efficient LED bulbs have increased from less than 1 percent of all installed bulbs eight years ago to nearly 70 percent.[4]

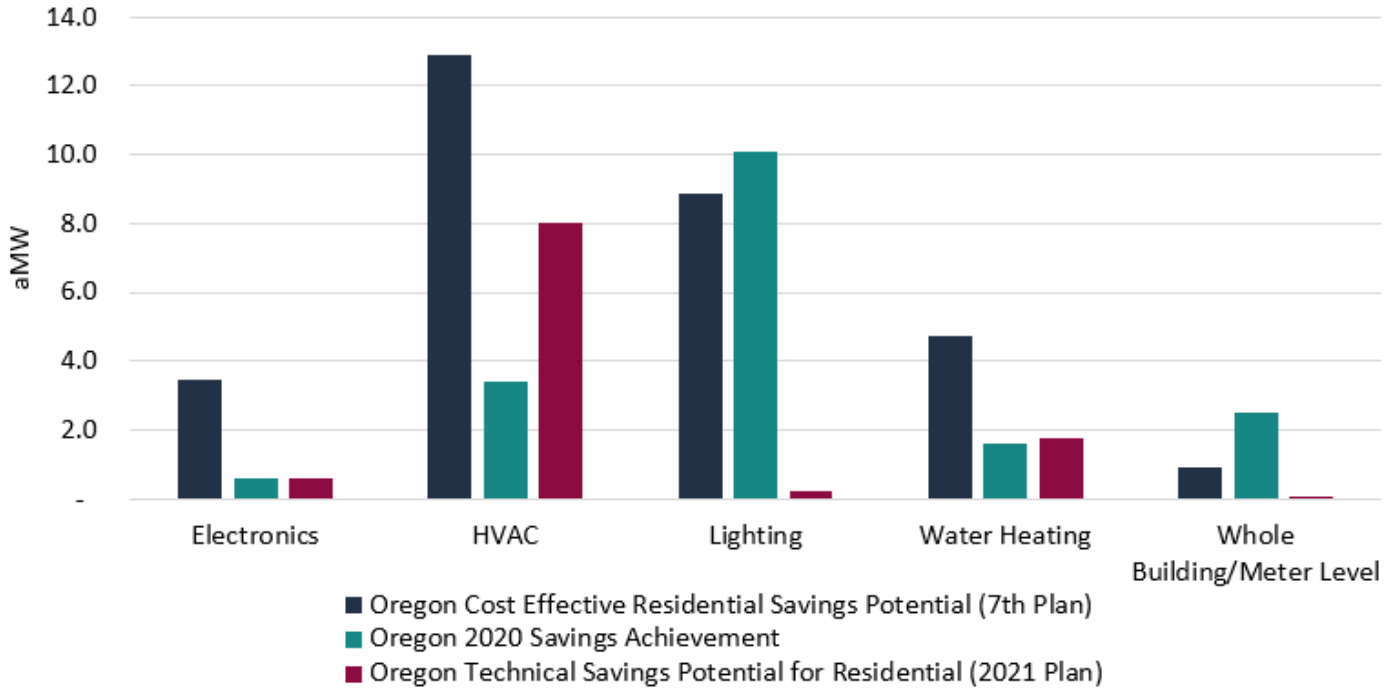
Heating, Ventilation and Air Conditioning. Upgrading an electric furnace to a heat pump can cut heating electricity use in half.

Electronics. Homes have a lot of electronic devices, and most of them are plugged in all the time. Simple controls that turn off equipment when nobody is in the room can significantly reduce energy use.

Water Heating. Just 2 percent of homes in the region have upgraded to a heat pump water heater, which can reduce the electricity used to heat water by half or better.[5]

The chart below shows residential savings potential in Oregon in average megawatts from the 7th Power Plan compared with achievements reported for 2020 and projected technical savings potential from the 2021 Power Plan.[6] [7] The chart shows a shift in potential savings, reduced across all categories and shifting away from lighting as the majority of light bulb sales are now LED.

Oregon Residential Savings Potential (aMW)
Change from NWPCC Seventh Power Plan to 2021 Power Plan[6] [7]



Residential Heating and Cooling

More than half of Oregon homes heat with electricity.[2] [8] Cooling types vary among Oregon homes, and the percentage of homes using air conditioning increased from 42 to 57 percent between 2012 and 2017.[8]

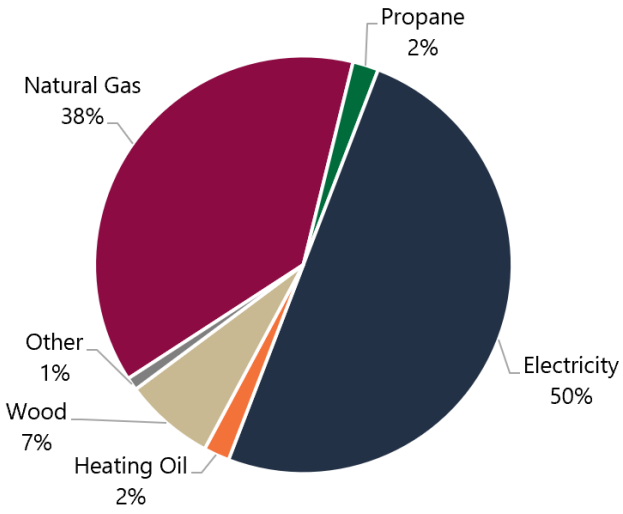
Average electricity use has increased slightly from 10,829 kWh in 2018 to 10,964 in 2020.[10] Average residential electricity use in consumer-owned utility territory is typically higher than in investor-owned territory. In 2020, the average annual COU customer use was 12,885 kWh, while for IOUs it was 10,304 kWh.[9] This may be partially due to higher prevalence of electric heating in more rural COU territories, and more homes that use gas as a heat source in urban IOU areas.

10,964 kWh

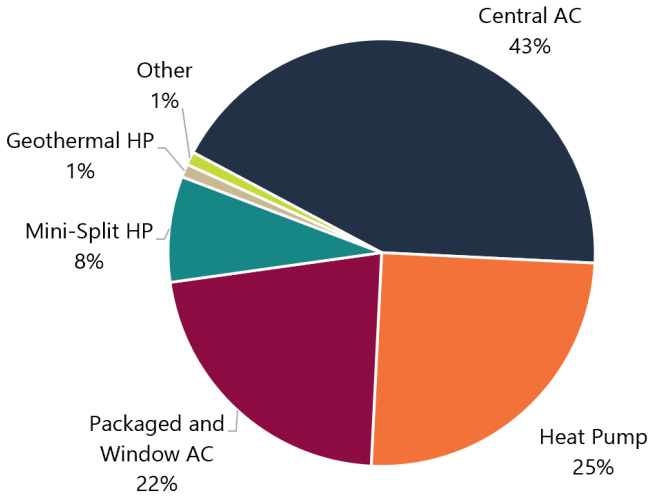
Average annual residential electricity use in Oregon in 2020.[9]

619 therms

Average annual residential natural gas use in Oregon in 2020, a slight increase from 605 therms in 2018.[11]



Average Heating Types Across Oregon Homes[12]



Average Cooling Types Across Oregon Homes[8]

Oregon County Profiles

The *2020 Biennial Energy Report* included county-by-county energy information in the web-based version of the report. Data used to populate the county profiles has not been updated since the 2020 report, but the profiles remains helpful for understanding how Oregon county energy use differs, including energy and transportation burden. View the 2020 profiles online:

energyinfo.oregon.gov/ber

Note: The data source for electricity (kWh) and natural gas (therm) use per residential customer has been updated to reference the Oregon Public Utility Commission "Oregon Utility Statistics" report. Previous versions of the Biennial Energy Report referenced a different data source, so values may not align between versions.

Commercial

The commercial sector is diverse and includes buildings of various types and sizes, such as offices and businesses; government, schools, and other public buildings; hospitals and care facilities; hotels; malls; warehouses; restaurants; and places of worship and public assembly. Total floor area of common commercial space types in the region is approximately 3.4 billion square feet, with an average annual growth of approximately 1.9 percent since 1990.[13] The commercial sector is distributed across buildings of various sizes, with buildings less than 5,000 square feet accounting for nearly as much total area as buildings greater than 100,000 square feet.[13]

18.8%

Commercial sector's share of Oregon's energy use in 2020.[1]

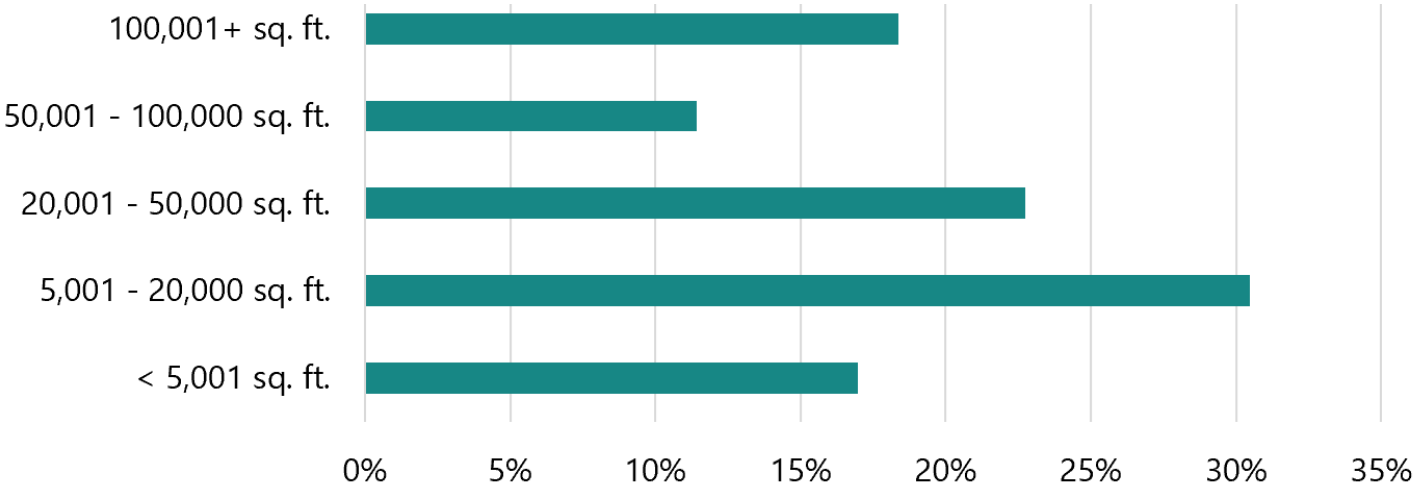
12.6%

Percent reduction in energy use by the sector since 2000.[1]

64%

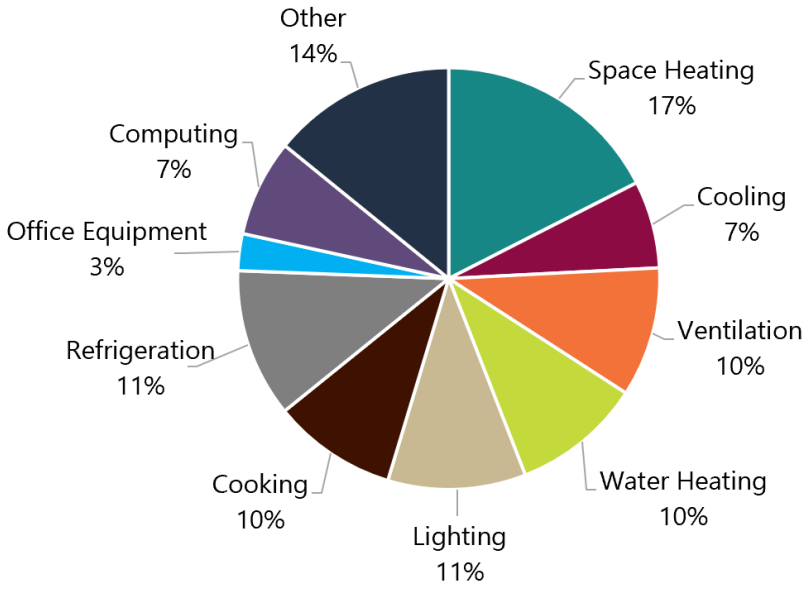
Percentage of northwest buildings that were built before 1990.[13]

Distribution of Regional Floor Space by Building Size in the Northwest



Regional Commercial Energy End Uses

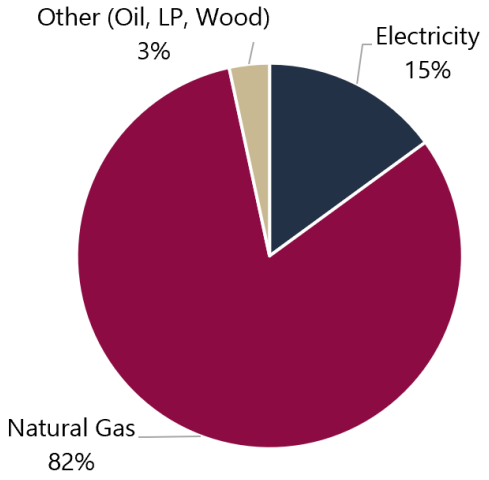
In the Pacific NW, energy — from all sources, including electricity, natural gas, or other fuels — is used for HVAC, lighting, computing, and other commercial needs.[5]



Energy Use

Heating, cooling, and ventilation, which are responsible for the largest share of electricity and natural gas use in a commercial building, are provided through central systems, individual units, or a combination of both. The majority of commercial spaces in our region continue to use natural gas as a fuel source; however, recent studies suggest a shift toward a greater percentage of electrically heated spaces in new construction.[13] Ninety -seven percent of commercial buildings use electricity or natural gas for heating.

Oregon Commercial Building Primary Heating System Type[6]



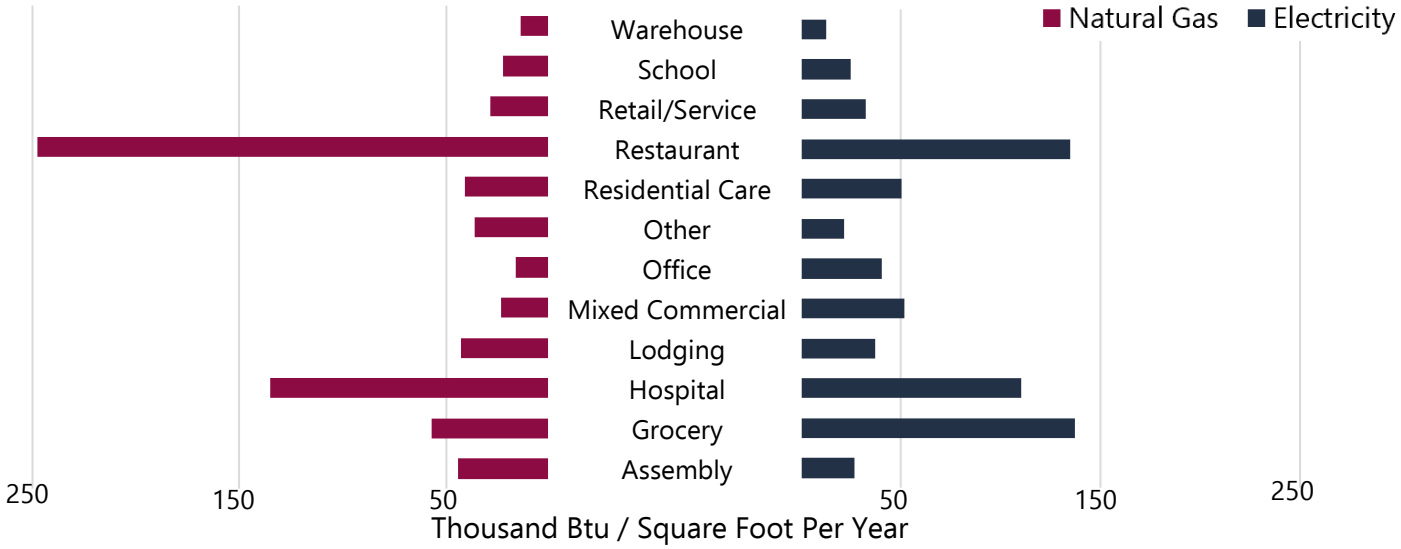
Lighting is the third largest share of energy use for commercial buildings. Efficiency and type of lighting are evolving as incandescent and fluorescent lighting is replaced with energy-efficient LEDs. Refrigeration and cooking use a lot of energy, with refrigeration accounting for about 18 percent of overall electricity use and cooking accounting for about 25 percent of natural gas use in commercial buildings in the Northwest.[15] [16]

Energy Performance

Energy Performance is often measured by comparing a building's annual energy use to its size, and depends on a building's construction, equipment efficiency, operation, and location. This metric combines all energy consumption (like electricity and natural gas) into common units that are normalized to building area, and commonly uses units of kBtu (1,000 Btu) per square foot per year. This is often referred to as a building's EUI, or Energy Use Intensity. In commercial buildings, floor space, the type of building, and its activities drive energy use.

Financial incentives, improved building code and appliance standards, and energy efficiency programs are helping commercial buildings improve energy performance. The Portland Commercial Energy Performance Reporting policy requires buildings to benchmark and report annual energy.[17]

Energy Use Intensity by Building Type[13]



Industrial

27.4%

Industrial sector's share of Oregon's energy use in 2020.[1]

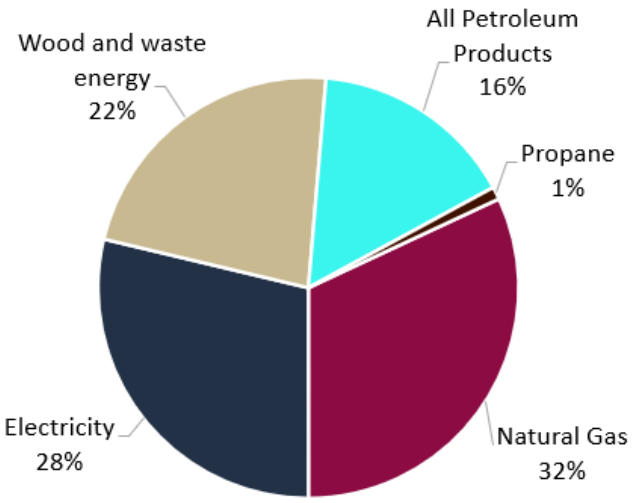
The industrial sector includes all facilities and equipment used for producing, processing, or assembling goods. The U.S. Energy Information Administration defines the industrial sector to include manufacturing, agriculture (including fishing and forestry), construction, and mining (which includes oil and natural gas extraction).[18]

At 81 percent in 2020, manufacturing uses by far the largest share of energy of any of the industrial subsectors nationally. The bulk chemical industry (the largest industrial consumer of energy), petroleum refining, and paper production use the largest shares of energy among the manufacturing segments and in 2018 represented a combined 70 percent, the latest year for which data was available.[19] Oregon's industrial manufacturing subsector includes paper and food processing, along with wood products, and computers and electronics.

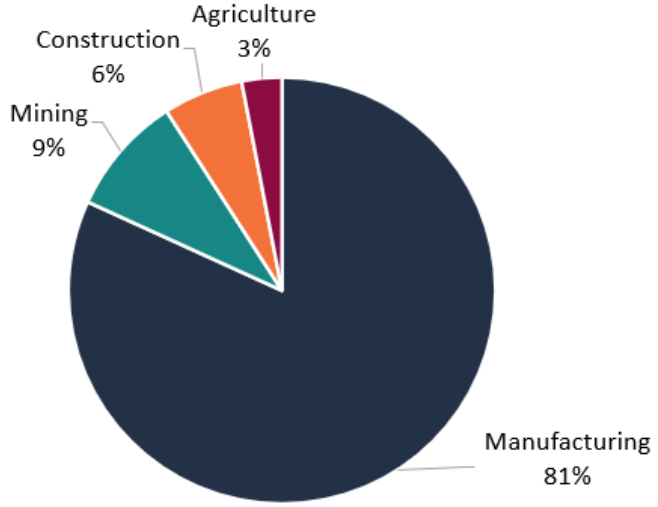
The industrial sector uses electricity to operate machine drives (motors), lights, computers and office equipment, and equipment for facility heating, cooling, and ventilation. Machine drives are the largest use of electricity by U.S. manufacturers.[20] Industry uses fossil fuels and renewable energy sources for heat in industrial processes and space heating in buildings, boiler fuel to generate steam or hot water for process heating and generating electricity, and feedstocks (raw materials) to make products like plastics and chemicals.[19]

According to the U.S. EIA, "Although the state's agriculture, food processing, and forestry activities, including the manufacture of forest products, are energy-intensive, most of Oregon's gross domestic product (GDP) comes from non-energy-intensive businesses. Computers and electronic products accounted for almost half of the state's manufacturing GDP in 2020, and Oregon's industrial sector per capita energy consumption is less than in two-thirds of the states."[21] Computer and electronic manufacturing have low energy intensity, especially relative to their high value. Many forest products/paper operations in Oregon offset natural gas for heat and electricity from the grid by using residual woody biomass/black liquor for cogeneration of electricity and steam for process heat.

2020 Oregon Industrial Energy Consumption by Fuel[1]



2020 U.S. Industrial Sector Energy Use Subsector Shares[1]



Transportation

The transportation sector covers the movement of goods, services, and people—including passenger and commercial vehicles, trains, aircraft, boats, barges, and ships. Fuel, mostly in the form of petroleum products, is used directly for transportation vehicles and to fuel equipment.

Transportation fuel costs tend to be higher in Oregon because of the region's distance from fuel supplies and refineries. The largest portion of the transportation sector's energy use comes from passenger vehicles — and in Oregon, passenger vehicles are older than the national average. The percentage of SUVs and pickup trucks registered in Oregon is greater than national average.

28.6%

Transportation sector's share of Oregon's energy use in 2020.[1]

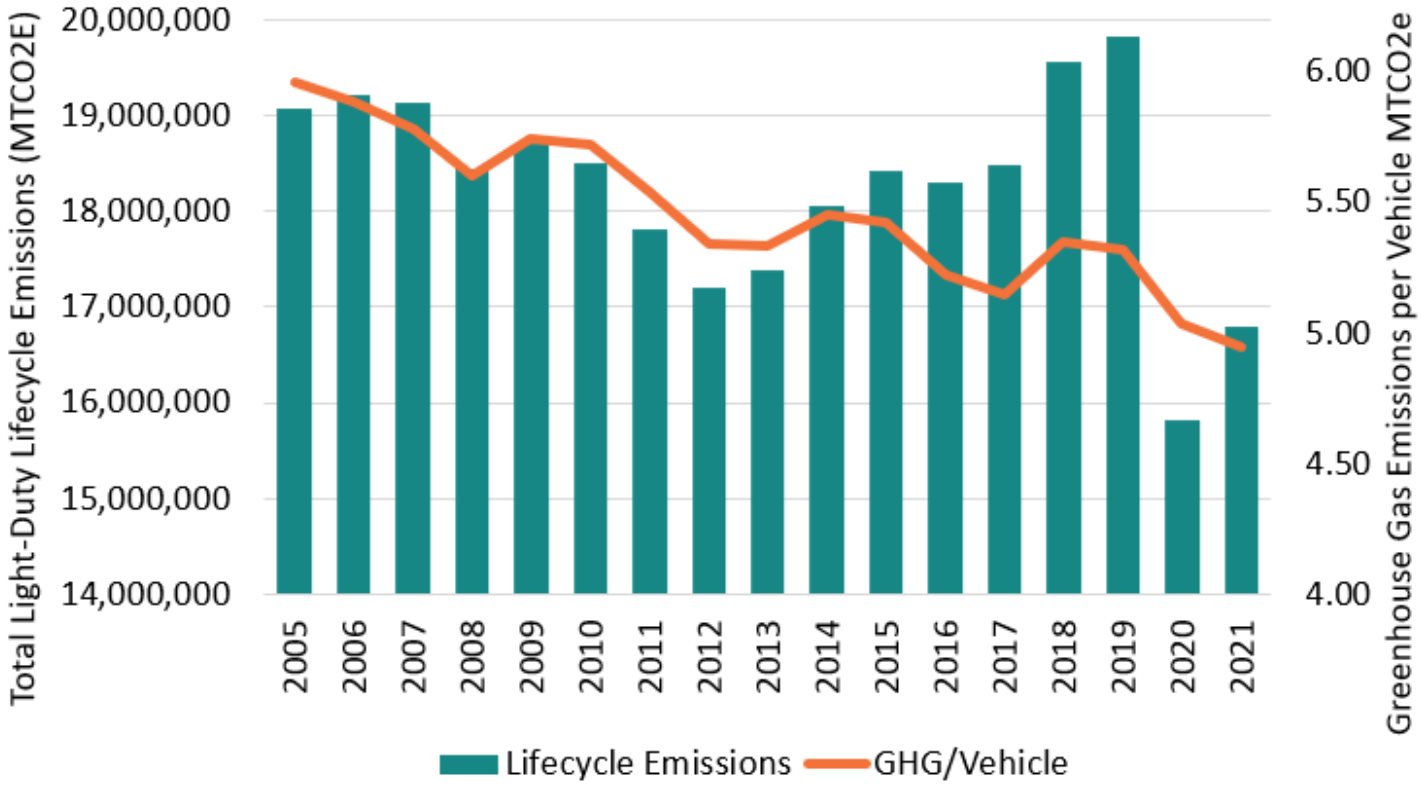
493 Gallons

Amount of fuel used by a 2005 typical model vehicle. It also emits about 5.93 metric tons of CO2 equivalent per year.[1]

425 Gallons

Amount of fuel used by a 2021 typical model vehicle. It also emits about 4.94 metric tons of CO2 equivalent per year.[1]

GHG Emissions Per Vehicle and Total Passenger Vehicle GHG Emissions in Oregon (Metric Tons of Carbon Dioxide Equivalent)[1]



Reader's Note: Lifecycle Emissions axis and Per Vehicle axis do not start at zero.

Of the transportation fuels used in Oregon, gasoline creates the largest amount of greenhouse gas emissions — over 15.5 million metric tons of carbon dioxide equivalent in 2020. Diesel is the second largest contributor of emissions at almost 9.8 million metric tons of CO2e.[22] Increased consumption of lower-emitting and renewable fuel sources such as electricity, biodiesel, renewable natural gas, and renewable diesel present an opportunity to reduce emissions from the transportation sector.

Transportation Fast Facts

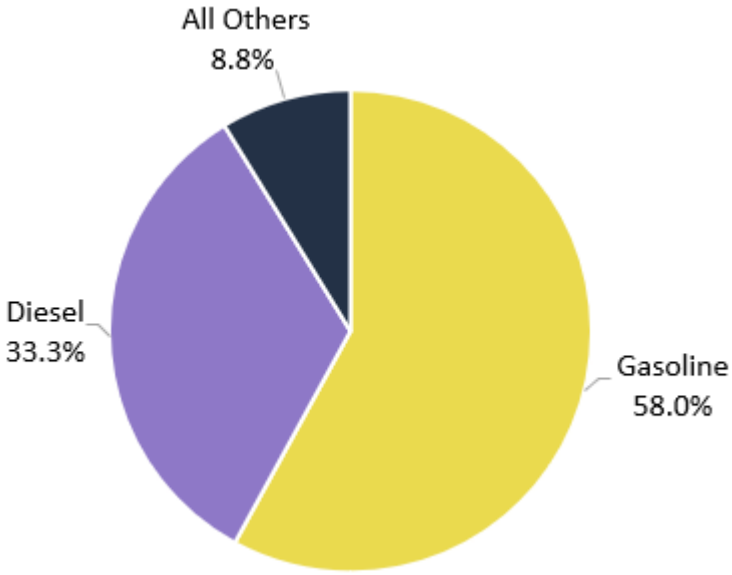
In 2020, nearly 1.3 billion gallons of gasoline powered vehicles on Oregon roads.[22]

That's over 296 gallons per Oregonian.

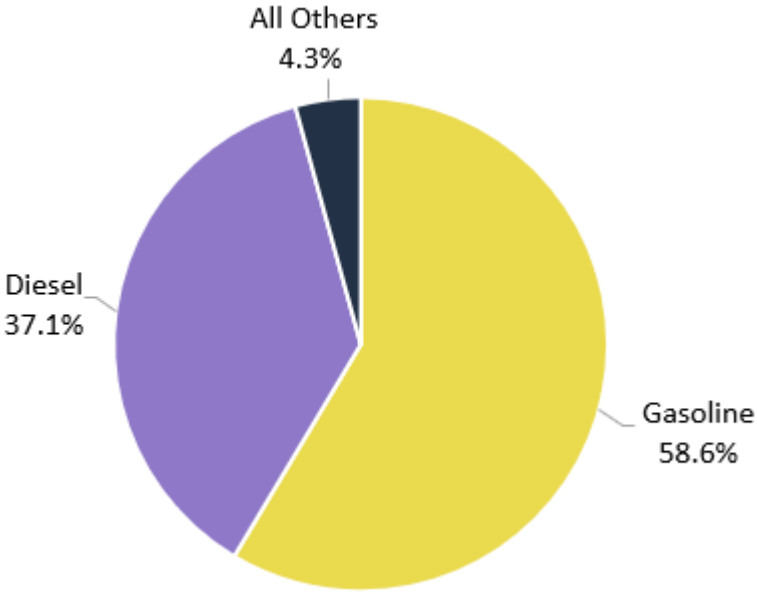
The typical Oregon household has at least two cars.

For electric vehicle drivers, no matter where a car is fueled in Oregon, drivers are reducing greenhouse gas emissions by 50 to 95 percent by fueling with electricity.[23]

Percent of On-Highway Consumption in Oregon (2020)[22]



Percent of On-Highway GHG Emissions Among Fuel Types (2020)[22]



Learn more about transportation in Oregon in the Technology Review section of this report.

Electric Vehicles

January 2011: **672 registered EVs**

May 2022: **52,033 registered EVs**[24]

More than 50,000 EVs added in just over a decade

Oregon EVs by the Numbers

3,602,301 registered passenger vehicles[25]

52,033 registered electric vehicles

1.44% of registered vehicles are EVs

33,381 are battery EVs

18,172 are plug-in hybrid EVs

Oregon's Zero Emission Vehicle Targets (Senate Bill 1044)

- 50,000 registered ZEVs on Oregon roads by 2020
- 250,000 registered ZEVs on Oregon roads by 2025
- At least 25 percent of registered vehicles and at least half of the new vehicles sold annually are ZEVs by 2030
- At least 90 percent of new vehicles sold annually are ZEVs by 2035.
- On Oregon, ZEVs are electric vehicles or EVs. Someday, other ZEVs could be on Oregon roads, such as clean hydrogen cars.

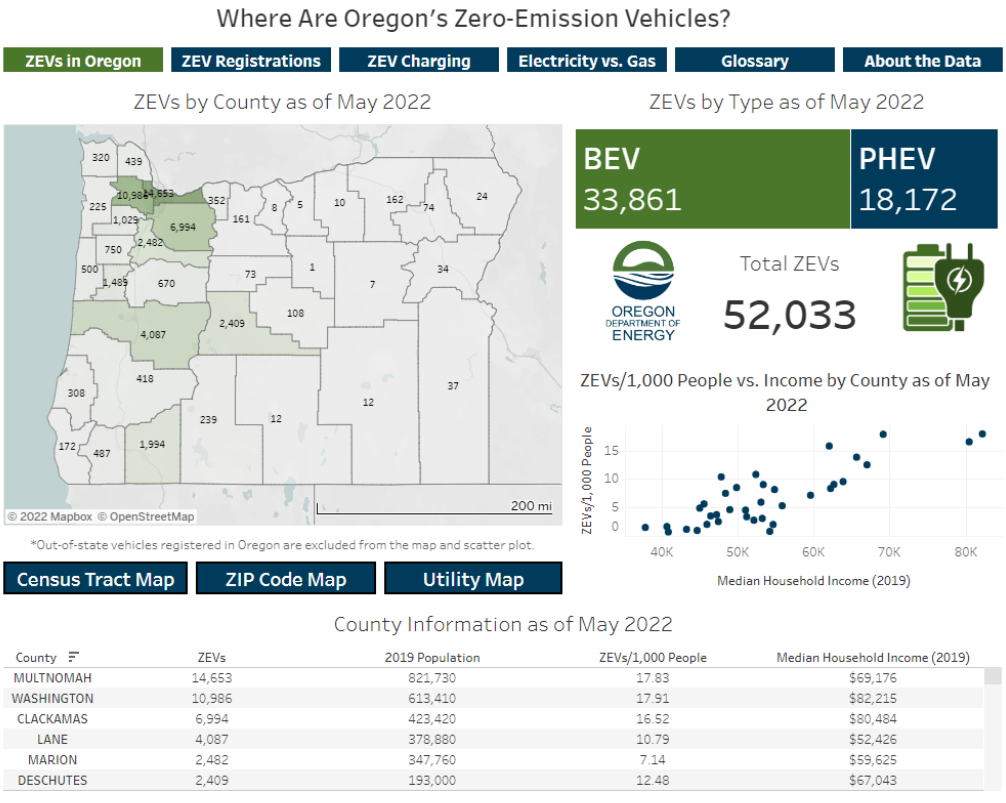
Oregon's EV Charging

9 charging networks[26]

2,171 public EV chargers

917 charging locations

Oregon Electric Vehicle Dashboard



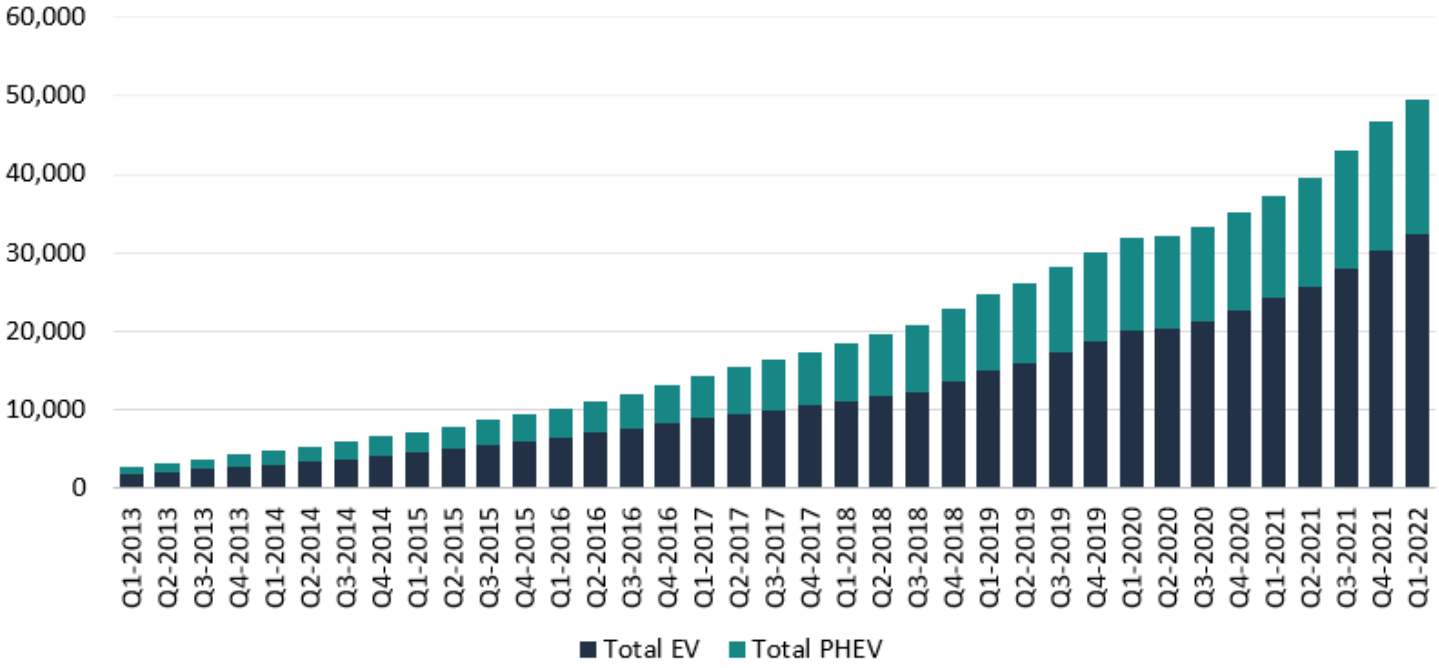
County	ZEVs	2019 Population	ZEVs/1,000 People	Median Household Income (2019)
MULTNOMAH	14,653	821,730	17.83	$69,176
WASHINGTON	10,986	613,410	17.91	$82,215
CLACKAMAS	6,994	423,420	16.52	$80,484
LANE	4,087	378,880	10.79	$52,426
MARION	2,482	347,760	7.14	$59,625
DESCHUTES	2,409	193,000	12.48	$67,043

www.tinyurl.com/OregonEVDashboard

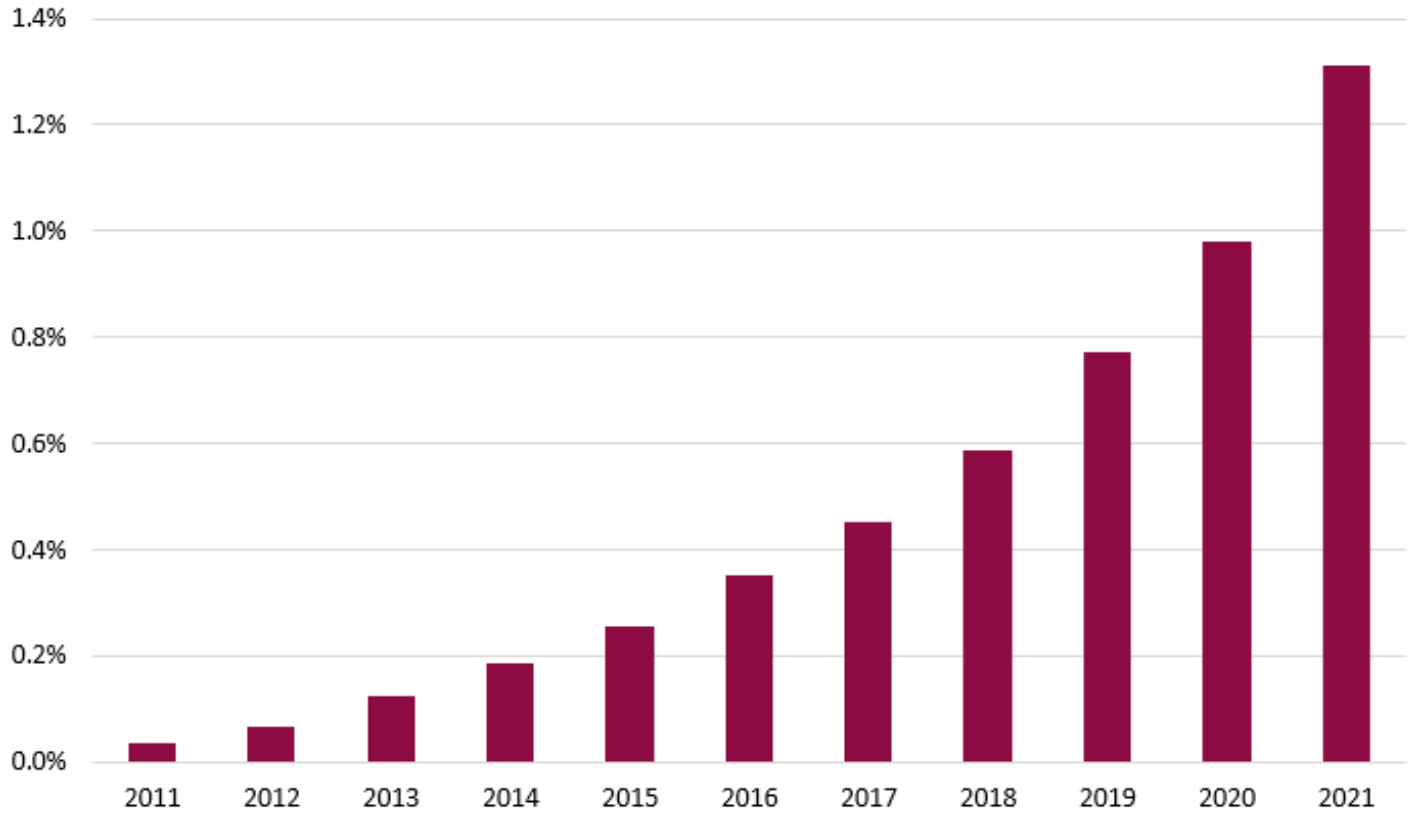
The Oregon Department of Energy developed an interactive Electric Vehicle Dashboard, which shows county-by-county EV adoption information, popular EV models, and other data. The dashboard also includes a calculator to show Oregonians estimated savings by making the switch to an EV.

Cumulative Oregon EVs and Plug-in Hybrid EVs by Quarter Year

(2013—Q1 2022)



EVs and PHEVs as a Percent of Total Fleet by Year



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