Issue Brief 7

Buildings and Energy Efficiency

How will megatrends affect energy supply and demand in Washington?

UTC
Washington Utilities and Transportation Commission

SSG

Buildings and Energy Efficiency

Buildings represent one-fifth of Washingtons' annual greenhouse gas emissions.[1] In the coming decades, buildings in Washington are on track to become more energy efficient and electrified. This Briefing Paper outlines key trends and drivers affecting the current and future energy use of buildings in Washington state and the Pacific Northwest.

Key Takeaways

- Energy efficiency and conservation is key to achieving net-zero emission targets by 2050.
- Utilities and power system planning organizations have viewed energy conservation as an important, cost-saving resource since at least the 1970s. Legislation in Washington requires utilities to conserve energy and promote energy efficiency as much as possible.
- Codes and standards at all levels of government are driving increased energy efficiency and conservation in building operations, for both new construction and existing buildings.
- Utilities and their partners offer incentives for customers to purchase equipment and retrofit buildings to use less energy. Emerging technologies, including high-efficiency heat pumps and smart digital devices, have the potential to improve the energy efficiency of building operations.
- The rate of uptake of building efficiency improvements over time will depend on the availability of trained workers and adequate materials. If energy efficiency improvements are not implemented equitably, low-income and rural communities could miss out on potential benefits such as improved comfort of buildings and savings on energy bills.

Energy Conservation and Efficiency

Reduce, Improve, Switch

According to the International Energy Agency, energy efficiency is the key factor that will enable communities to reach targets of net-zero emissions by 2050 even if global populations and economies continue to grow.[2] Modeling by the Intergovernmental Panel on Climate Change indicates that limiting global warming to below 2°C worldwide must involve rapid improvements in energy efficiency along with a quadrupling of zero- and low-carbon energy supplies, such as solar energy, hydro power, and renewable natural gas.[3]

Decarbonization requires prioritizing actions using a "Reduce, Improve, Switch" framework. Reducing energy consumption is the first step, as each kWh of electricity saved through efficiency is a kWh that need not be generated, transmitted, or distributed. In a low-carbon future, better insulated buildings, which retain heat in the winter and stay cooler in the summer, reduce heating and air conditioning use, which, in turn, reduces energy demand. The next steps are to maximize energy efficiency and, finally, switch to low-carbon energy sources for the remaining demand.

Energy efficiency initiatives have contributed to significant reductions in energy use in the US. For example, appliance energy efficiency standards and labeling programs in the US led to an annual fuel savings of around $40 billion in 2020, equivalent to a reduction of $320 in the average household's annual fuel bill.[4] Energy efficiency policies can sometimes unintentionally incentivize more total energy consumption.[5] For example, research suggests that as US homes have gotten more energy efficient, they have also gotten bigger and contain more large appliances, a phenomenon which can cancel out the decrease in energy demand created by energy efficiency.[6,7] Consequently, reducing overall energy consumption prior to upgrading appliances or fuel switching is critical.

Energy Conservation and Utility Planning

Energy conservation has long been, and will continue to be, a key component of regional energy planning and utility resource planning.[8] Modeling by the International Energy Agency indicates that improving energy efficiency could allow the growth of clean energy sources to outpace overall energy demand by 2050. The IEA's net-zero-by-2050 scenario sees the global economy growing by 40% by 2030 but using 7% less energy than in 2019.[9] Policies that spur investment in energy efficiency early in the low-carbon energy transition could create thousands of jobs in Washington via increased spending on building retrofits and more

efficient appliance manufacturing and installation. Such policies would also decrease energy bills and protect customers from energy price volatility.[10] Modeling conducted for the 2021 Washington State Energy Strategy suggests that building electrification and efficiency measures could drive a 13-26% reduction in final energy demand, depending on the amount of natural gas that continues to be used in buildings.[11]

Due to the COVID-19 pandemic, energy efficiency suffered a major setback, improving only 0.5% globally in 2020, compared to an average of 1.3% per year between 2011 and 2016. However, since 2021, governments at all levels have returned their attention and investments to energy efficiency.[12]

Utilities often find it is cheaper to help customers save energy and lower system demand than to build additional power generation and distribution infrastructure, or purchase energy resources. The Northwest Power and Conservation Council prioritizes energy efficiency, recognizing it as the region's second-largest "power resource" after hydropower.[13] Since 1978, utilities, governments, and other groups have invested hundreds of millions of dollars in incentive programs, market transformation initiatives, building stock assessment and improved technologies, achieving more than 7,200 average MW of energy savings in the Pacific Northwest — equivalent to the annual energy consumption of approximately 5.1 million homes. On average, this represents an annual conservation savings rate of 167 MW per year.

In its latest Power Plan, the Council recommends that the region (which includes Washington, Oregon, Idaho, and Montana) acquire between 750 and 1,000 average MW of energy efficiency by 2027 and at least 2,400 average MW of energy efficiency by the end of 2041. Achieving these goals requires a similar rate of energy conservation (166 MW per year between 2021 and 2027 and 171 MW per year between 2027 and 2041) as the average of the previous 44 years (1978-2021).

The Council arrived at this recommendation after considering the current and future ability of current energy resources (hydropower, fossil fuel power plants, renewable energy such as wind and solar, etc.) to meet energy demand, the potential reliability of renewable energy during times of high energy demand, government decarbonization requirements and targets, and projected future energy prices. Not achieving this goal, the Council argues, may result in higher system costs and reduce progress towards developing a more equitable energy system. Benefits that could result from increased energy conservation include the creation and maintenance of jobs (particularly in the trades), lower GHG emissions and improved air quality, reduced energy bills for households and businesses, and more resilient and comfortable buildings, particularly during power outages.[14]

Energy Conservation Targets

Utilities have two options for increasing the availability of energy: increasing the supply (through direct power generation or contracts) or decreasing consumer demand. Conserving energy is a very valuable "resource" for utilities. Energy conservation in the form of energy efficiency upgrades and equipment replacement reduces the energy demand of individual customers.

Washington's Energy Independence Act and the UTC's rules require electric and natural gas utilities in Washington to conserve energy and promote efficiency using all available, reliable, and cost-effective measures available while factoring in the social cost of carbon pollution.[15] For measures to be cost-effective, they must be reliable and available at the time they are needed, as well as less expensive (on an incremental cost basis) than alternative available and feasible ways to reduce energy demand.[16]

Initiative I-937, passed by Washington voters in 2006, requires electric utilities serving more than 25,000 customers to undertake conservation and efficiency planning, including setting conservation targets. The following table shows how much energy conservation investor-owned utilities serving Washington consumers achieved in 2021 for electricity and natural gas, relative to total annual energy demand.

Table 1. Utility electricity and gas conservation achievement for the year 2021. Conservation target data comes from each utilities' fuel-specific Annual Conservation Plan.[17] Demand comes from the supplemental reports from each Company Annual Report required to be submitted to the UTC annually.[18]

	Avista Utilities	**Cascade Natural Gas**	**NWNatural**	**Pacific Power (Pacificorp)**	**Puget Sound Energy (PSE)**
2021 Electricity Conservation Achieved (MWh)	50,205	N/A	N/A	43,776	208,965
2021 Annual Electricity Demand (MWh)	7,381,477	N/A	N/A	4,198,961	27,686,476
Conservation as Percentage of Overall Demand	0.68%	N/A	N/A	1.04%	1.04%

Natural Gas Conservation Achieved (therms)	785,347	1,061,827	399,957	N/A	3,389,902
2021 Natural Gas Demand (therms)[19]	330,475,182	246,896,658	80,784,007	N/A	949,958,853
Conservation as a Percentage of Overall Demand	0.24%	0.43%	0.50%	N/A	0.36%

The Clean Buildings for Washington Act, passed in 2019 and in effect as of 2022, requires that gas utilities establish two-year conservation targets that represent the total reductions in energy demand utilities intend to pursue via efficiency programs and incentives. Investor-owned gas utilities in Washington have set their conservation targets for the years 2022 and 2023, with approval from the Utilities and Transportation Commission. Many of the targets are significantly higher than in previous years, in some cases nearly doubling previous conservation commitments.

Codes and Standards

Building, energy, and appliance codes can promote building energy efficiency[20] by including minimum energy performance standards for new buildings and appliances, as well as for existing buildings undergoing significant renovation. Most building codes and minimum efficiency requirements for appliances and equipment are regulated at the federal level, but amended at the state level. To meet zero-carbon ready standards — which means minimizing or eliminating GHG emissions generated while producing building materials and operating buildings — some jurisdictions are designing building and energy codes focused on reducing embodied carbon in building materials and emissions generated during building construction.

Table 1. Building and energy efficiency codes and standards relevant to natural gas utility decarbonization in Washington.

Code or Standard	Potential Impact on Energy Use in Buildings
2021 Washington State Energy Code – Commercial	Reduces space and water heating energy use in new construction of commercial and large multi-family buildings beginning in mid-2023.
2021 Washington State Energy Code - Residential	Reduces space and water heating energy use in new residential construction beginning in mid-2023.
Clean Buildings Performance Standard	Reduces overall energy use of commercial buildings larger than 50,000 square feet; phased program with compliance beginning in 2026.
Updates to existing appliance standards (commercial hot food holding cabinets, portable electric spas, and residential ventilating fans) and creation of new ones (air purifiers, commercial ovens, electric vehicle supply equipment, computers, and monitors)	Reduces energy use from plug use in commercial and residential buildings.

Washington Energy and Appliance Codes

The Washington State Building Code Council — created to develop codes related to building construction, renovation, and operations in Washington state — sets minimum energy standards. These standards are based on bills passed in the legislature. Local governments issue permits and enforce regulations set by the Council. Local governments can set stricter energy codes than state-level codes for commercial and residential buildings four stories or taller, but are prohibited from imposing stricter energy codes on low-rise residential buildings without special authorization from the Council.[21]

In recent years, the Legislature has passed bills focused on shaping the energy code to improve efficiency and reduce energy consumption in new and existing buildings. For example, RCW 19.27A.160, which was passed by the Legislature in 2009, requires the state energy code

to achieve a 70% reduction in annual net energy consumption by 2031, compared to a 2006 code baseline.[22] To realize this target, the State Building Code Council estimates it will need to adopt codes that enable buildings to use 19% less energy on an annual basis during each upcoming three-year code revision cycle.[23] In early 2022, the Washington State Building Code Council adopted the 2021 Washington State Energy Code - Commercial, which regulates the construction of new commercial and multi-family buildings (residential buildings four or more stories tall), additions and major renovations, and efficiency criteria for replacing equipment.

As of July 1, 2023, the Energy Code requires new commercial buildings to be outfitted with all-electric air-source heat pump space heating and fulfill 50% of water heating needs with all electric air-source heat pumps.[24] Exceptions are available for hospitals, research facilities, and other buildings whose space heating needs cannot be practically met with heat pumps. Additionally, manufacturing, industrial, and commercial buildings are only required to meet these standards for offices and similar spaces, and water for the building's occupants, not other business processes. Geographic exceptions based on climate zones are also written into the Code, with large commercial buildings in eastern Washington able to use gas heating as a backup option. The code changes were controversial due to concerns about heat pump availability, contractor and consumer preferences, and the potential impact on affordability of new housing; the Council considered over 6,800 written comments and testimony from more than 100 people at public hearings. Preliminary cost-benefit analysis conducted by the State Building Code Council indicates that the new Code is a significant step towards achieving state energy standards, and will create local jobs, enhance energy security, save money, and speed economic recovery from the pandemic.[25]

In November 2022, the Council passed similar provisions for its update to the residential portion of the Energy Code, requiring the use of heat pumps (air-source, water-source, ground source/geothermal, and electric or natural gas powered) as the primary space and water heating source in new residential construction. The code update also allows for supplementary space and water heating with gas appliances. The new Code also requires improvements in the energy efficiency of building envelopes, such as increasing the thermal performance of roofs and windows, in new residential construction and major renovations.

These changes build on significant energy efficiency measures in the 2018 Washington State Energy Code - Residential. To meet the residential code's minimum energy requirements, builders were required to choose among various conservation options, such as building envelope construction methods and equipment using either electricity or natural gas. Analysis conducted by the Northwest Energy Efficiency Alliance found that the 2018 code facilitated a

major shift to electric space heating and water heating: 88% of permits from a sample of builders across the state showed a form of electric space heat (the vast majority of which were electric heat pumps), while 12% selected natural gas heating. Around 87% of new homes were equipped with electric water heating. Under the previous code, only 20% of permits indicated primary electric space heating, and 44% electric water heating.[26]

Appliance Standards

Appliance standards are another important tool for reducing energy demand. Beginning in 1975 with the passage of the Energy Policy and Conservation Act, the federal government passed laws establishing minimum energy conservation standards for consumer products and commercial and industrial equipment. Currently, energy efficiency standards apply to nearly 60 categories of appliances and equipment representing 90% of home energy use, 60% of commercial building energy use, and 30% of industrial energy use.[27] According to the US Department of Energy, these standards saved American consumers $63 million in energy costs in 2015.[28] The DOE also supports the voluntary ENERGY STAR® program which certifies and labels highly energy efficient appliances, homes, and buildings, to encourage consumer and commercial purchases.

States are allowed to establish minimum efficiency and testing standards for products that are not covered by federal appliance efficiency regulations. In 2022, the Washington State Legislature made three of Washington's existing appliance standards (commercial hot food holding cabinets, portable electric spas, and residential ventilating fans) more stringent than the federal ones and created three new ones (air purifiers, commercial ovens, and electric vehicle supply equipment). These changes build on new state standards passed in the 2019 session, which included updates for computers and monitors. The Department of Commerce estimates that the new standards will save residents and businesses $2 billion in energy and water costs.[29] Many of these standards are consistent with those in other Western states, such as California and Oregon, allowing for a uniform market for manufacturers.

Clean Buildings Performance Standard

In addition to requiring gas utilities to set energy conservation targets, the Clean Buildings Performance Standard (Chapter 285, Laws 2019) requires existing commercial buildings with over 50,000 square feet of floor space to meet energy use intensity targets starting in 2026.[30] The state's largest buildings (220,000 square feet and larger) must be in compliance by June

2026, while buildings between 90,000 and 219,999 square feet have until June 2027, and buildings between 50,000 and 89,999 square feet have until June 2028. These are collectively defined as Tier 1 buildings by the Washington State Department of Commerce.

To enforce the standard, Commerce adopted the American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE) Standard 100-2018 as a base, and established energy use intensity targets (EUIts) for different building types. The new targets represent a 15% reduction in energy use from the 2009-2018 annual averages for commercial buildings in Washington. As of October 2021, the Department of Commerce has notified all Tier 1 building owners about the standard and is supporting them in complying with the required energy management plan and operations and maintenance program for each building. An Early Adopter Incentive Program with a total of $75 million gives eligible building owners who demonstrate early compliance with the program $0.85 per gross square foot of floor area (excluding parking, unconditioned, or semi-conditioned spaces).

In March 2022, the Legislature expanded the Clean Buildings Performance Standard by adding commercial buildings 20,000 square feet or larger, as well as residential buildings 50,000 square feet or larger, to the program, collectively referred to as Tier 2 buildings. The expansion does not set specific performance standards for Tier 2 buildings, but requires benchmarking, energy management plans, and operation and maintenance programs. The Department of Commerce will begin notifying building owners in 2025, with benchmarking reporting beginning in 2027. Performance standards will be developed in 2030, with adoption in 2031 or later, pending approval from the legislature. An incentive program with a total of $150 million of funding to support Tier 2 building compliance is also in development.[31]

Local and Regional Trends

Washington's new and updated codes and standards reflect national and regional trends. They are similar to California's new building code, also going into effect in 2023, that requires new homes to either be equipped with high-efficiency heat pumps for space or water heating, or comply with higher energy efficiency requirements.[32] These movements align Washington with other west coast states, enabling the development of a common market for energy-saving technologies and installation services to support code implementation.

Within Washington, multiple communities, such as Seattle, Bellingham, Shoreline, and Tacoma, have moved to restrict natural gas use in new construction.[33] Seattle's ordinance, which bans the use of natural gas for space heating in commercial and multi-family buildings (four stories tall or higher), as well as the use of natural gas for water heating in new hotels and large

apartment buildings, went into effect in late 2021. Seattle's Energy Code also requires large buildings to have more energy-efficient windows, insulation, lighting, and ventilation systems than were required under the 2018 State Energy Code.[34]

In many Washington jurisdictions, public buildings must exceed the minimum energy efficiency requirements. Major state facility projects funded in the state capital budget must achieve LEED silver certification, which requires using less energy than typical comparable buildings, among other provisions.[35] Likewise, in Seattle, all public buildings 5,000 square feet or larger must achieve LEED silver certification.[36] Seattle's Green Building Permit Incentives program rewards builders that meet aggressive energy and water conservation targets with additional height and floor area, or faster building permit approval tol help the city achieve its climate goals.[37]

Incentive Programs

Since 1978, utility conservation and incentive programs have enabled over half of energy savings in the Pacific Northwest region (Washington, Oregon, Montana, and Idaho), which totaled 7,200 average MW.[38] These savings are equal to half of the region's growth in demand for electricity over the same time period, or enough power for five cities the size of Seattle.[39]

Each investor-owned utility in Washington manages and/or supports programs to increase energy efficiency among residential, commercial, and industrial consumers, as well as for existing buildings and new construction. Utilities offer incentives for customers to purchase new equipment or upgrade existing equipment to newer, higher-efficiency models of both electric and gas appliances.[40] Utilities also fund programs and initiatives that support energy efficiency market transformation[41] and weatherizing and/or retrofitting existing buildings, such as those led by the Energy Trust of Oregon, the Northwest Energy Efficiency Alliance, and Washington State University's Community Energy Efficiency Program. These incentive programs and efficiency initiatives track with national trends.[42]

Achieving energy conservation targets equitably can be difficult. Utility energy efficiency programs tend to be easier to implement in urban areas and higher-income households. Cities have more contractors and suppliers, as well as customers, than rural areas. Rural areas also tend to have fewer skilled suppliers, lower income populations, and more significant energy inefficiency challenges, such as a prevalence of older, less efficient homes. Regardless of geography, lower-income households have fewer resources to invest in energy efficiency than wealthier ones, even though they stand to benefit more from reduced energy bills. Efforts to decrease this divide are limited—only 16% of U.S. electric energy efficiency spending in 2019

included programs specifically aimed at or restricted to low-income households.[43] To address these issues, Washington investor-owned utilities have incentive programs specifically aimed at assisting low- and moderate-income households and residents of manufactured housing with improving energy efficiency.

Emerging Technologies and Demand Response

Improvements in Technologies

New technologies are emerging to increase efficiency and reduce energy use in alignment with new codes and standards. These include upgraded versions of common appliances — such as those for heating and cooling buildings, heating water, dishwashing, cooking, and laundry — as well as devices that allow buildings to optimize power consumption, particularly during times of peak demand.

Deployment of new technologies that reduce energy use is supported by regional associations such as the Northwest Energy Efficiency Alliance, an alliance of utilities and energy efficiency organizations such as the Bonneville Power Administration, EnergyTrust of Oregon, and Washington's investor-owned utilities Avista, Cascade Natural Gas, NW Natural, Pacific Power, and Puget Sound Energy. NEEA supports the development of energy efficiency products and services by testing and validating products, setting product performance specifications, providing training and best practices, and conducting market research.

Heat pumps are a prominent example of a new technology that is rapidly becoming more available and more efficient, particularly in colder climates such as Washington's. Nationally, heat-pump deployment is up, with heat pumps representing around 40% of heating systems installed in new single-family homes between 2014 and 2020.[44] Heat-pump research, development, and availability is expected to increase dramatically in response to President Biden's June 2022 Memorandum authorizing the use of the Defense Production Act of 1950 to produce electric heat pumps.[45] By invoking the Defense Production Act, the Biden administration is guaranteeing to manufacturers that the government will purchase heat pumps that the market might not otherwise support on its own; these heat pumps may be resold or given away for free to low-income communities and communities most severely affected by climate change.

New heat pumps are being developed and manufactured to meet the challenges of colder climates. The Northeast Energy Efficiency Partnership (NEEP) maintains a database of nearly 40,000 Cold Climate Air Source Heat Pump products indicating a wide variety of types to meet various building space conditioning needs.[46] Participants in the Cold Climate Heat Pump Technology Challenge, led by the U.S. Department of Energy (DOE), have developed next-generation electric heat pumps that can more effectively heat homes in northern climates compared to today's models. A prototype developed for the Challenge and verified by the DOE delivers high efficiency heating even at temperatures as low as -10ºF.[47] NEEA is currently partnering with NEEP to provide a pre-screened list of ductless heat pumps that meet specifications for operating in the colder climates of the Pacific Northwest, such as east of the Cascade mountains where winter temperatures can go near or below 5ºF; this list is available for utilities and their partners to use in heating system replacement programs.[48]

Demand Response and Grid-Integrated Buildings

Demand response is when electricity users voluntarily and temporarily shift or reduce the amount of electricity they use during periods when the power system is stressed.[49] Power systems become stressed when there is a rapid increase in electricity demand, for example when there is an extreme weather event affecting a broad area that causes an increase in the use of heating or cooling systems, and the power system may struggle to adequately meet the demand in the time required. Demand response often involves using financial incentives to move power use to another time of day, such as charging different prices based on the time of day or during periods of peak demand. Some demand response programs include mechanisms for utilities to directly control customer electricity demand by cycling air conditioners and water heaters on and off during periods of peak demand, in exchange for a financial incentive and lower electricity bills.[50]

Rapid improvements in internet-connected "smart" devices (digitally connected thermostats, rooftop solar PV, batteries, electric vehicle chargers, meters, appliances, plugs, lighting, etc.) can assist in optimizing power consumption in both residential and commercial buildings. These devices enable energy efficiency through improved measurement and enhanced control, as well as offering building occupants greater insight and command over their energy use. This information can encourage them to save even more energy.[51] [52]

Buildings equipped with such devices, known as Grid-interactive Efficient Buildings (GEBs), continuously optimize energy use in alignment with occupant needs and preferences (such as lighting intensity and thermal comfort and reduced energy costs) as well as on-site energy production (such as solar panels).[53] The U.S. Department of Energy has an ambitious national

goal to triple the energy efficiency and demand flexibility of the buildings sector by 2030, relative to 2020 levels. National adoption of measures to increase the number of GEBs could result in between $100-200 billion in electric power system cost savings and reduce CO_2 emissions by 80 million tons per year by 2030, which is equivalent to the annual emissions of 17 million cars or 50 medium-sized coal plants.[54]

The use of connected appliances, devices, and sensors has grown by an average of 33% per year worldwide, according to the International Energy Agency, and is not showing signs of slowing down; however, challenges related to privacy and the cost of installing smart technologies in existing buildings must be addressed for widespread deployment.[55] In existing, retrofitted buildings, installing devices to enable demand response and flexibility can be a significant infrastructural challenge. Additionally, the full value of using these technologies once they are installed does not match existing incentives and rebates, inhibiting their widespread adoption. Another challenge is ensuring that devices of various types and purposes can operate smoothly together to manage flows of power while maintaining cybersecurity and privacy. Communication standards and regulations for these devices, which communicate with grid operators over public internet channels, are limited.[56]

Due to these challenges, many utilities and regional balancing authorities are skeptical of the potential performance of demand response and flexibility, seeing it as a risky, high-cost, and low-yield resource in comparison to traditional generating infrastructure or energy efficiency measures. Equity challenges are also important considerations; demand-response devices and programs require internet access and sufficient money to purchase the technologies. People who rent their homes may lack the authority to install such devices, even though they are often responsible for paying energy bills, and their landlords have little incentive to install them, resulting in challenges to potential uptake. Even so, Washington's investor-owned utilities intend to dramatically increase their demand-response programs to control energy demand at hourly and annual timescales, as described in their Clean Energy Implementation Plans.

Conclusion

Washington's governments and utilities have made improving energy efficiency—which is critical to achieving Washington's emissions targets—a top priority. New commercial and residential energy codes, as well as appliance standards, will help to drive down the energy demand of new buildings. Incentive programs run by utilities and regional associations will help to retrofit existing buildings and replace existing equipment by bringing new energy saving technologies to market. Advances in technologies and their interconnectedness will help drive down energy use, particularly during times of high demand. The trends in these areas, nationally and within the region, suggests that energy efficiency will continue to contribute to significantly reducing overall energy demand in the state in the decades to come.

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