CHAPTER 6: ENERGY EFFICIENCY

Energy efficiency – doing the same work while using less energy – is the cornerstone of Oregon energy policy. In 2017, Oregon utility and public benefits programs invested more than $182 million dollars in efficiency measures, including $12.7 million in low-income energy efficiency programs.

Oregon ranks seventh in the nation for energy efficiency, and has been ranked by the American Council for an Energy Efficient Economy as a top ten state for 12 consecutive years.

KEY TAKEAWAYS

- **Oregon is a national leader** in electric and natural gas efficiency programs, and we have a long track record of cost-effectively acquiring energy efficiency.[1]
- Energy efficiency has been the least cost and most environmentally benign electricity resource for the region and Oregon, making it our second largest electricity resource behind hydroelectricity. In most cases electric **energy efficiency costs less** than wind, solar, coal, nuclear and natural gas electricity generation.
- Energy efficiency is the priority resource to meet **future load growth**. It is relied on heavily in utility integrated resource planning, and is expected to cover about 85 percent of all regional load growth through 2030.[2,3]
- Oregon's efforts include a wide variety of methods to acquire energy efficiency.[3] Working together on state programs, utility programs, codes, standards, and market transformation efforts will allow us to continue to deliver savings at lower costs. An increased focus on climate action, equity, and resiliency will enable us to better coordinate all available efficiency acquisition mechanisms; and prompt us to **develop new** efficiency funding and delivery channels.

Introduction

Energy efficiency – doing the same work while using less energy – is the cornerstone of Oregon energy policy. In 2017, Oregon utility and public benefits programs invested more than $182 million in efficiency measures, including $12.7 million in low-income energy efficiency programs. Electric savings exceeded 574,000 MWh, and gas savings were 6.8 million therms – 1.2 percent of the electricity and 0.7 percent of all natural gas retail sales in 2017. Oregon ranks seventh in the nation for energy efficiency, and has been ranked by the American Council for an Energy Efficient Economy as a top ten state for 12 consecutive years.[1]

This chapter discusses policies that promote energy efficiency in Oregon, how efficiency is acquired through programs and incentives, and how Oregon is performing in its energy efficiency activities. Finally, this chapter looks forward to the actions Oregon can take to achieve further energy efficiency. While this chapter discusses electricity and natural gas efficiency, efficiency in transportation – the sector that uses the largest amount of energy in Oregon – is discussed in Chapter 4. In this chapter, energy efficiency is distinct from conservation, such as driving fewer miles or turning down thermostats, which curtails energy use through changing practices or behaviors.

Meeting Load Growth with Efficiency

Oregon's national leadership in energy efficiency is guided by policies dating back to the 1970s. In 1975, Oregon policymakers declared that the goal of Oregon's energy policy was "to promote the efficient use of energy resources and to develop permanently sustainable energy resources" (ORS 469.010).[4]

Pacific Northwest Electric Power Planning and Conservation Act

In 1980, Congress passed the Pacific Northwest Electric Power Planning and Conservation Act[5] (also known as the Northwest Power Act) and created the Northwest Power and Conservation Council (NWPCC) to guide electricity planning and electric energy efficiency acquisition in the Northwest.

1980 NORTHWEST POWER ACT

In addition to establishing the NWPCC, the Act directed the Council to adopt a regional energy conservation and electric power plan, as well as a program to protect, mitigate and enhance fish and wildlife affected by hydropower on the Columbia River and its tributaries. The Act also set forth provisions that the BPA Administrator must follow in selling power, acquiring resources, implementing energy conservation measures, and setting rates for the sale and disposition of electric energy.

The Act directed the Council to give first priority in resource acquisition to cost-effective energy efficiency, followed by cost-effective renewable resources. This was the "first time in history that energy efficiency was deemed to be a legitimate source of energy, on par with generating resources."[6] It also introduced Integrated Resource Planning (IRP). IRP differed from traditional utility resource planning in that it identified all potential resource options, both demand-side and supply-side resources, to meet future loads. This meant considering energy efficiency as a resource and including it in the development of the optimal mix of resources that would meet future system needs while minimizing costs. This approach allowed utilities to pass along the cost of efficiency to their customers, since it cost less than the cost of new generation.

As part of NWPCC's 2016 Seventh Power Plan,[7] the Council identified energy efficiency and conservation as the priority resource for the region and expects that it will cover about 85 percent of all load growth through 2030. The Seventh Power Plan calls upon the region to aggressively develop energy efficiency with a goal of acquiring 1,400 average megawatts (aMW) by 2021; 3,000 aMW by 2026; and 4,300 aMW by 2035. An aMW is equivalent to the energy produced by the continuous operation of one MW of capacity over one year, or 8,760 MWhs. The Plan states that energy efficiency is by far the least-expensive resource available to the region. It avoids risks of volatile fuel prices and financial risks associated with developing new large-scale resources. Efficiency also helps mitigate the potential cost associated with carbon emission reduction policies because energy "generated" by efficiency is carbon-neutral. In addition, energy efficiency resources not only provide annual energy savings, but contribute significantly to meeting the region's future needs for capacity by reducing both winter and summer peak demands. Finally, energy efficiency boosts resiliency because efficient buildings have lower energy demands, which increases reliability during times of stress on the electric system and helps maintain temperatures so residents can stay cool or warm in times of emergency.[8]

Integrated Resource Planning

In 1989, the Oregon Public Utility Commission's (OPUC) Order No. 89-507 (UM 180) required investor-owned utilities to treat energy efficiency as an energy resource when developing their IRPs and create a roadmap for acquisition of all cost effective energy efficiency. Large consumer-owned utilities in Oregon also develop individual Integrated Resource Plans.[9]

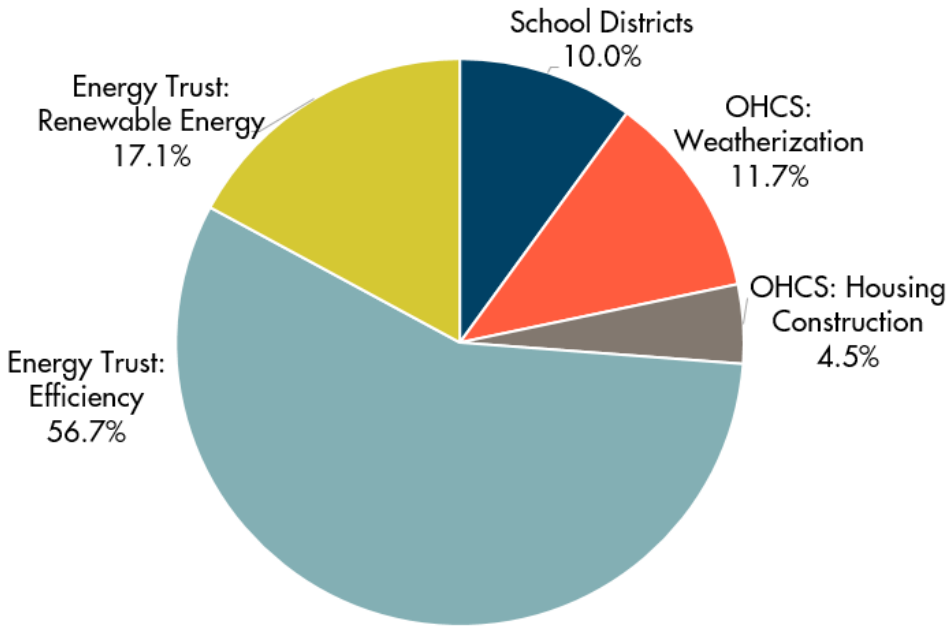
The current integrated resource plans for Portland General Electric and Pacific Power identify cost-effective energy efficiency as a main resource to meet their future load growth. Oregon's natural gas utilities, NW Natural, Cascade Natural Gas, and Avista, also call for significant energy efficiency savings. NW Natural's 2018 IRP[11] also relies heavily on energy efficiency, planning for a 15 percent reduction in annual natural gas load by 2038 over what would be expected absent the energy efficiency programs. These efficiency goals are developed with the Public Utility Commission, electric and natural gas utilities, and Energy Trust of Oregon.[10]

ENERGY TRUST OF OREGON

Oregon nonprofit Energy Trust of Oregon was selected by the Oregon Public Utility Commission in 2002 to administer energy efficiency and renewable energy programs for investor-owned electric utilities, Pacific Power and Portland General Electric, and natural gas utilities Avista, Cascade, and NW Natural. In its current long-range strategic plan, ETO set energy savings goals of 240 average megawatts and 24 million annual therms of natural gas for 2015 through 2019. These goals include savings from market transformation programs.

Before 2002, investor-owned utilities offered utility-operated energy efficiency programs that were funded through rates. For investor-owned electric utilities, Oregon's 1999 restructuring law, SB 1149,[36] established a public purpose charge equal to three percent of electric investor owned utilities' total revenues to fund energy efficiency and renewable energy resource acquisition. The law stipulated that the first 10 percent of the funds should go to public schools for energy efficiency projects, facilitated by Oregon Department of Energy. The remaining funds are allocated to acquiring energy efficiency (56.7 percent) and renewable energy (17.1 percent) which are administered by Energy Trust of Oregon; low-income programs including construction of new housing (4.5 percent) and weatherization (11.7 percent) are administered by Oregon Housing and Community Services and local Community Action Partners.

Figure 6.1: Activities Funded by the Public Purpose Charge



In 2002[10] the OPUC reached a settlement agreement with NW Natural in a decoupling docket which led to the funding of Energy Trust to deliver natural gas efficiency programs. Similar agreements with Oregon's other two natural gas investor-owned utilities went into place over the next several years.

In 2007, SB 838[13] extended the sunset for the Public Purpose Charge from 2012 to the end of 2025. It also allowed investor-owned utilities to collect funds in addition to the Public Purpose Charge through rates for electric energy efficiency. Energy Trust of Oregon develops savings estimates, types of measures, and expenditures targets with the utilities and the OPUC. This funding was about 70 percent of Energy Trust's 2017 electric energy efficiency budget.[12]

How Oregon Acquires Energy Efficiency

Some states have targets for how much is spent on energy efficiency. In these states, utility planners and regulators agree that a certain amount of energy revenues should be directed toward efficiency, which determines the amount of efficiency that is acquired. In Oregon, it's a more aggressive policy – public utilities are advised by the NWPCC's Power Plan and investor-owned utilities are directed by the OPUC and legislature to acquire all cost-effective efficiency.

Cost-Effectiveness

Determining the cost-effectiveness of energy efficiency as an energy resource is accomplished through a comparison to the cost of delivered electricity or gas from generation plants or new natural gas supplies. If the energy efficiency can be obtained for less than a new generation plant or energy supply, it should be acquired. Acquiring the lowest cost energy efficiency resources ensures that the total cost of the energy resources we need to serve our loads will be as low as possible.

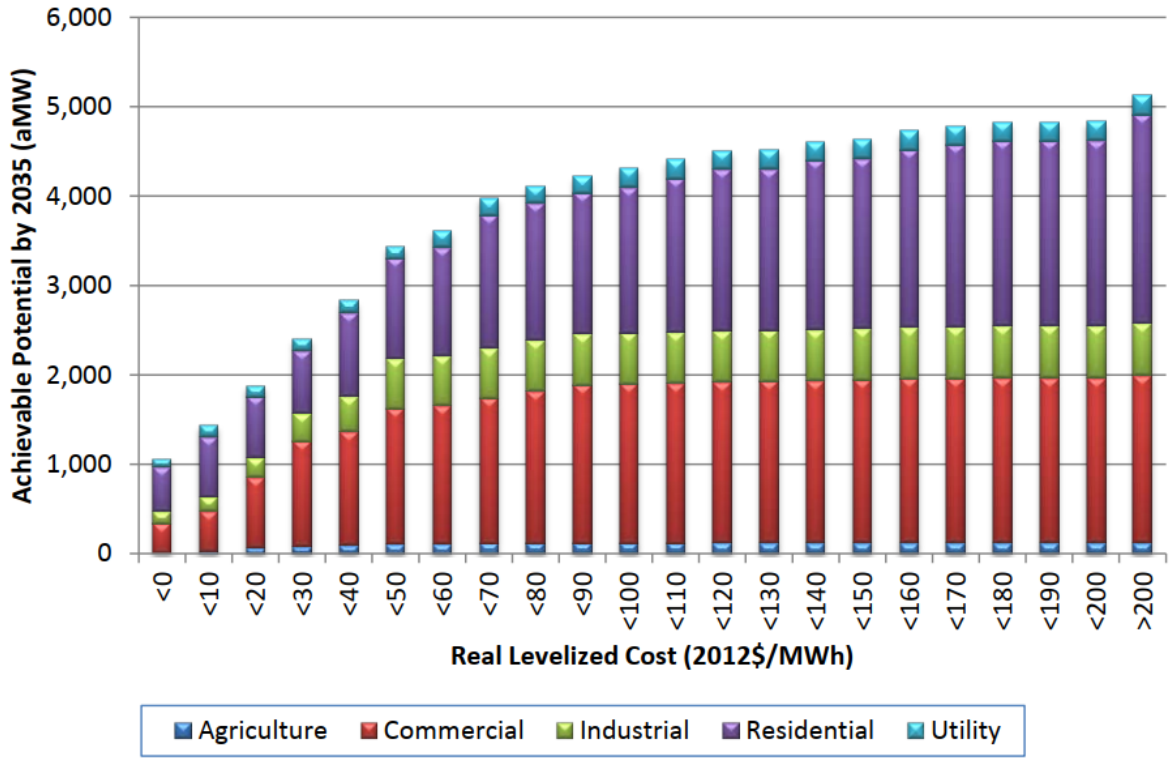
Utility regulators allow certain efficiency measures that do not meet all cost effectiveness tests as exceptions, where the economic calculation may be overridden by non-qualitative factors.

A utility acquires all cost-effective energy efficiency up to the cost of the next most cost-effective generation resource that could be acquired – otherwise known as the "marginal resource cost." Therefore the amount of energy efficiency that can be acquired is directly quantified and included in this test. The test also includes a 10 percent advantage for efficiency to consider benefits that cannot be quantified. The OPUC can create exceptions to this test for reasons specified in Docket UM 551.[14] This last provision does not apply to consumer-owned utilities

Under the primary cost-effectiveness test, the cost that is considered is the whole cost of the efficiency resources to the utility and the consumer. Where possible, benefits beyond energy savings from the measures are related to this marginal cost of resources. Benefit/cost tests employ a present value scheme to compare costs and benefits.

Efficiency costs are compared to forecasts of generation and gas costs, plus adjustments for avoided distribution capital cost, avoided power system losses, and an adjustment for risk. As the forecasted cost of future electricity and gas costs rises, so does the amount of energy efficiency that can be acquired. This is illustrated in Figure 6.2, using the simplified metric of real levelized cost.[14]

Figure 6.2: Achievable Energy Efficiency Potential by Sector and Levelized Cost by 2035[14]



National Energy Efficiency Valuation Efforts

In 2017, the National Efficiency Screening Project produced the National Standard Practice Manual[15] for assessing cost-effectiveness of energy efficiency resources. This manual assessed methods used by all states

with efficiency programs, then created a framework for future energy planning and analysis that includes new value considerations, including GHG reduction and non-energy benefits.

The National Energy Efficiency Registry (NEER)[16] is creating a method for energy efficiency savings to be tracked and potentially used as a trading instrument. The NEER was developed for the 2014 national Clean Power Plan, which was never finalized. States that are using energy efficiency as part of their climate change actions can use the NEER to track savings efforts. The Oregon Department of Energy helped inform the development of NEER by convening stakeholder input workshops and developing guidance language with the NEER project team.

Energy Trust recognizes the opportunity for energy efficiency to contribute to state, regional and national climate and carbon reduction goals, noting in its 2015-2019 Strategic Plan that climate policies "are likely to influence demand for energy efficiency and renewable energy, helping push innovation in clean energy and creating new opportunities for Energy Trust to reach and serve customers through collaborative efforts with others."[10]

Incentives and Consumer Education

The foundation of Oregon's energy efficiency acquisition is influencing customers to choose greater efficiency. Utilities and implementers use funding from utility rates, federal and state tax credits, and federal and local weatherization assistance for low-income households to develop efficiency programs.

Creating awareness about energy efficiency starts with consumer education. Early energy efficiency programs used advertising and outreach through materials in customers' energy bills to deliver the efficiency message. Energy specialists from utilities and community agencies advised customers and recommended efficiency improvements. Contractors offering efficiency services such as insulation or equipment upgrades marketed directly to consumers.

When energy efficiency became recognized as a resource, utilities were allowed to use ratepayer funds to accelerate energy efficiency in the market. Limited only by a cost-effectiveness test that required efficiency to be less costly than other new resources, direct incentives to consumers became a key mechanism to acquire energy efficiency.

Customer education, information and training have always been important components of programs. The information is targeted to the scope and timing that maximizes customer action. Energy Trust, consultants, and utilities have also developed programs that drive savings primarily through information, such as Strategic Energy Management.

Incentives are usually designed to provide a portion of the incremental cost of an energy efficient improvement. As an example, a customer replacing a furnace that is worn out is already prepared to pay for the replacement. An efficiency

SAVE ENERGY

We often talk about energy efficiency and weatherization with a broad perspective – describing various program requirements or cumulative statewide energy savings. But it's worth remembering that these programs make meaningful improvements to people's lives, where families save energy and money, have an easier time paying their energy bills, improve the value of their homes, and are more comfortable.

Case studies from **Northern Wasco County People's Utility District** illustrate the power of these real-life benefits:

https://go.usa.gov/xPAfu

program might offer an incentive that covers the incremental cost of buying a more efficient model. Incentives can come from many sources and be combined to further lower costs to consumers. Federal tax credits can be combined with state tax credits and utility incentives to help persuade customers to invest in efficiency. Incentives by themselves don't always work because, with some important exceptions, customers are usually required to make a capital investment in energy efficiency, and therefore rebates or incentives rarely cover 100 percent of the cost. Some Energy Trust programs such as manufactured home sealing, lighting and water heating kits, and lighting direct installation provide 100 percent payment for measures where this is cost-effective and the most efficient market strategy. For consumers of modest means, this up-front investment can be a barrier. Federal funding can bridge the gap between utility cost-effectiveness and project costs – and can enable the delivery of efficiency improvements at no cost to low-income customers.

In addition to utility cost-effectiveness limits, many other considerations affect incentive design. To spread the funding the furthest to reach the most customers, incentive programs look for the "right" amount of incentive that will capture all the savings. As the program evolves and costs change, an incentive might be increased or reduced to maintain its effectiveness and achieve results at the lowest cost possible.

Equity of Energy Efficiency in the Residential Sector

Energy efficiency investments in all sectors have significant value to all utility customers because they reduce the overall system costs. In the residential sector, efficiency program implementers are also mindful that benefits and access to incentives and promotion of energy efficiency products and practices should be available for all energy customers. The Seventh Power Plan[7] acknowledges this concern and recommends that in the pursuit of all cost-effective energy efficiency "all customer segments should participate in programs." The Plan states, "The Northwest Power Act has required that the Bonneville Power Administration distribute the benefits of its resource programs equitably throughout the region.[5] Bonneville and the regional utilities should determine how to improve participation in cost-effective programs from any underserved segments. Although low-income customers are often an underserved segment, other hard-to-reach (HTR) segments may include: moderate income customers, customers in rural regions, small businesses owners, commercial tenants, multifamily tenants, manufactured home dwellers, and industrial customers. Ideally, the customers in the HTR segment should participate in similar proportion to non-HTR customers, assuming similar savings potential." BPA, its utility customers, and community action partners continue to look at how to better address the needs of consumers who may lack the means to participate in utility incentive programs but who may have significant opportunities for energy efficiency in their homes.

A recent NWPCC study[17] examined participation of various types of households in efficiency programs to look at the initial results of actions to ensure that programs reach "all segments of the population in a proportional manner." The study found that in general, utilities have paid attention to the variety of markets within their territories and they customize programs to target specific markets. But the study also determined that some of the segments could be reached "more strongly or consistently."

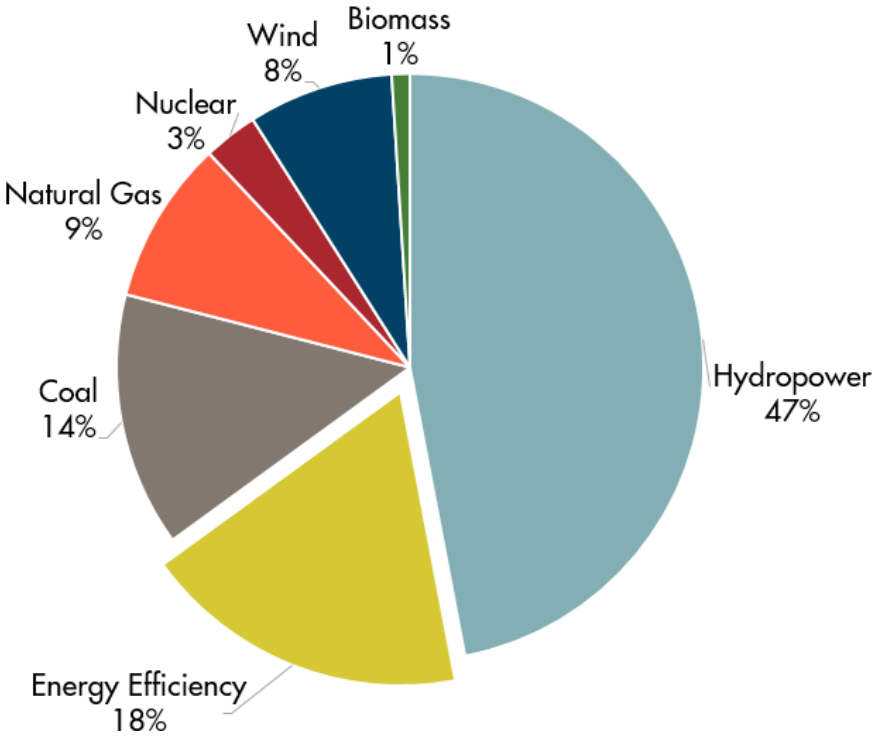
Numerous programs in Oregon target low-income and HTR customers. Energy efficiency for affordable housing has always been a part of Oregon's energy efficiency efforts, with programs supported by utility, state, and federal funding. Upstream market transformation initiatives lower costs of efficient products at the retail level. In addition, energy bill payment assistance with federal and local dollars can help people pay their energy bills, easing part of the energy cost burden experienced by some homeowners and renters.

Direct delivery programs like weatherization are delivered to low-income customers through community action partnerships. Energy Trust has offered higher incentives for weatherization and heating equipment in moderate income homes, has higher incentives for furnaces in rental homes, and has offered free efficient lights and water-using devices through multiple channels. Consumer-owned utilities and gas utilities also offer a variety of services for limited-income customers. Other programs are geared toward helping with home repairs and making sure housing meets health and safety standards. Local programs, such as Oregon Energy Fund, connects households struggling with energy costs with resources and programs. The equity aspects of energy efficiency are explored more fully in Chapter 7.

Energy Efficiency Achievements

Efficiency is an important part of the mix of resources that contribute to the electricity load in the region — it's the largest electricity resource after hydropower. Since 1980, the region has met more than half its electricity load growth through efficiency. See a more detailed view of where Oregon's electricity generation comes from in Chapter 1.

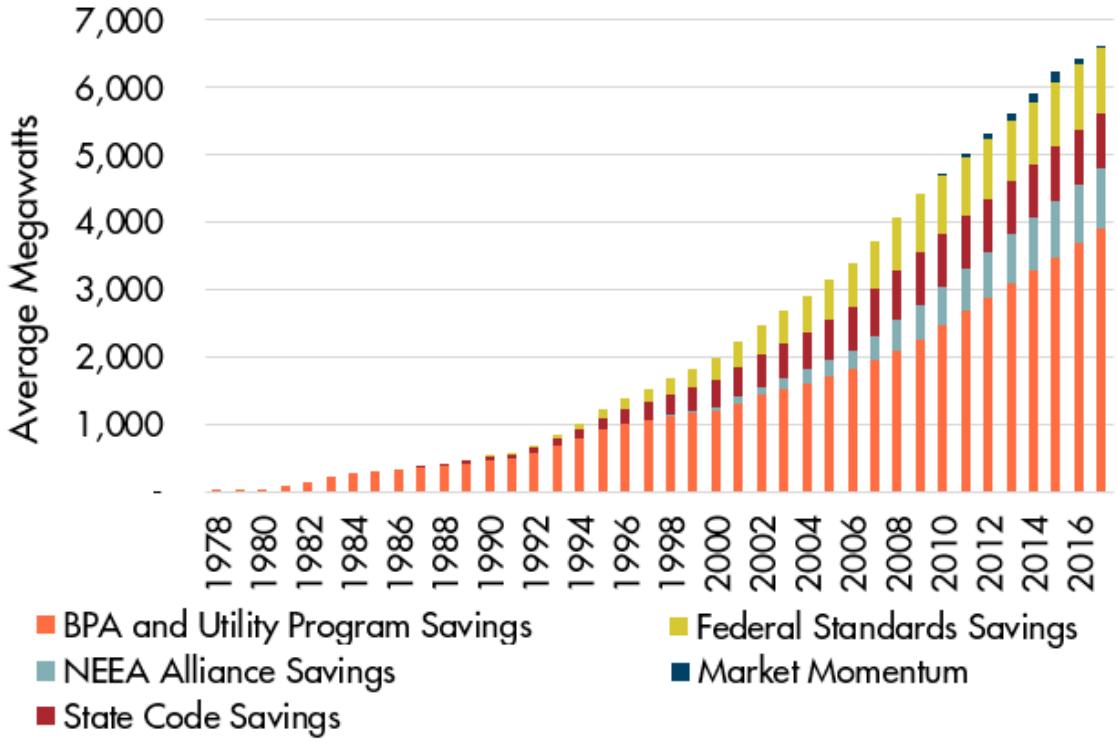
Figure 6.3: Electricity Resources in the Region, Including Efficiency[3]



The Northwest Power and Conservation Council (NWPCC) estimates that the combined efforts of all efficiency activities in the region from 1980 to 2017 provide more than 6,600 average megawatts of savings. Oregon's contribution to the region's energy efficiency gains is about 1,900 average megawatts – enough to power more than a million Oregon homes for a year. Efficiency is the also the most environmentally benign electric resource.

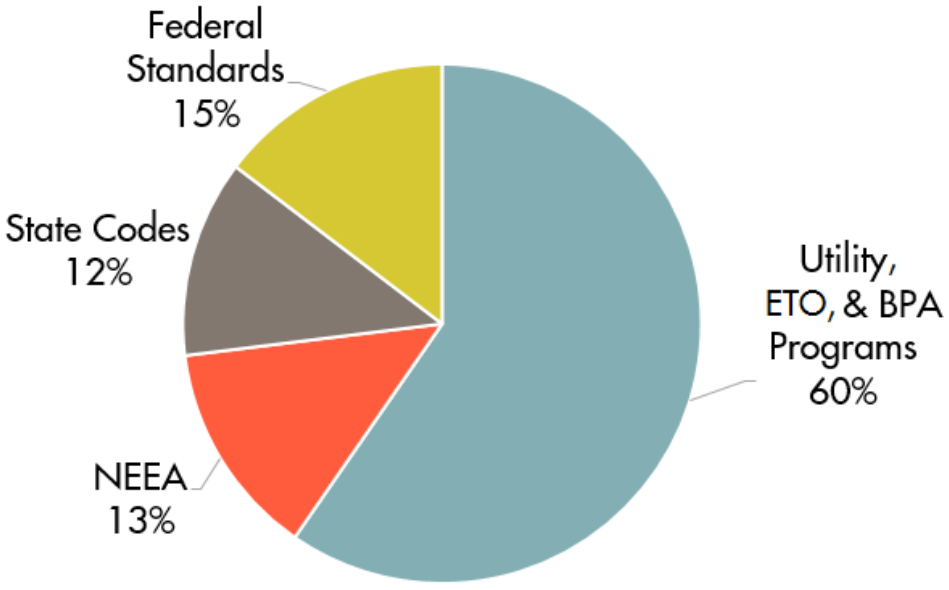
Figure 6.4 shows the cumulative regional savings to 2017 by category: Utility and BPA programs, Northwest Energy Efficiency Alliance market transformation activities, federal appliance standards, and state building codes. Each is explained in detail below. Until recently, the NWPCC only tracked regional savings, so there is no breakdown of category savings for Oregon.

Figure 6.4: Cumulative Regional Savings from All Mechanisms — 6,623 average MW through 2017



Of the 6,623 aMW of electric energy efficiency the Pacific Northwest has achieved since 1978, 60 percent comes from utility, Energy Trust, and BPA programs; the remainder is split between federal standards, state codes, and Northwest Energy Efficiency Alliance market transformation efforts.

Figure 6.5: Energy Efficiency Achievements by Category



Utility and BPA Programs (cumulative savings of 3,918 aMW)

Perhaps the most familiar category for many customers is the energy efficiency programs offered by utilities. Consumer-owned utilities served by BPA offer efficiency programs and services to their customers with funding from BPA and their own local utility funding. IOU electric and natural gas energy efficiency programs are administered by Energy Trust of Oregon.

AVERAGE MEGAWATT (aMW)

Represents one MW of energy delivered continuously 24 hours/day for one year.

Northwest Energy Efficiency Alliance (cumulative savings of 885 aMW)

"Market Transformation" is a process which uses a combined program of technology refinement, delivery system refinement, education, promotion, and incentives to permanently change behavior and practices to enhance efficiency. This helps bridge the gap between the development of new technology and market acceptance. After the market has adopted these new efficiency measures and products, in many markets codes and standards make them mandatory.

The Northwest Energy Efficiency Alliance (NEEA) is an alliance of more than 140 Northwest utilities and energy efficiency organizations working on behalf of more than 13 million energy consumers, BPA, Energy Trust, and utilities. Their focus on transforming the energy efficiency marketplace includes electric and natural gas market transformation efforts. For example, NEEA has led regional market transformation at the retail level by helping to establish efficiency specifications and tests, enticing manufacturers into offering improved products, promoting products, encouraging product placement in stores, providing rebates, and paying retailers incentives to reduce the retail prices of energy efficient products. Because of these efforts customers get used to buying the more efficient product, and as the demand for the product increases the price decreases. When the market is "transformed," the lower prices, buying habits, and availability of the more efficient product can allow the incentives to be reduced or discontinued.

Programs that bridge the gap between federal or state standards and market readiness include nationwide efforts like ENERGY STAR and regional offerings from the NEEA. Federal standards often follow state adoption and market experience, so state standards help pave the way for efficiency nationwide. For this reason, appliance standards are an important part of Oregon's energy efficiency portfolio.

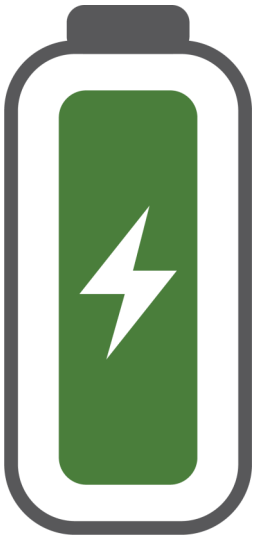
State Building Codes (cumulative savings of 808 aMW)

The cumulative regional code savings are from energy codes in Oregon, Washington, Idaho and Montana. Oregon's share of those savings comes from residential and commercial codes.

Oregon has a statewide code for all new and remodeled residential and commercial buildings. Oregon's codes have led the nation in efficiency, and the commercial and residential codes are among the most efficient of all states.

Oregon's codes are reviewed every three years by Oregon's Buildings Codes Division of the Department of Consumer and Business Services in consultation with the Oregon Department of Energy and an extensive public process. Governor Kate Brown's Executive Order 17-20[32] (discussed in more detail below) sets specific targets for increasing the commercial and residential codes by 2022 and 2023.

Federal and State Standards (cumulative savings of 963 aMW)



Federal standards set a minimum level of efficiency for equipment and products, whether they are installed as part of construction of a new building or purchased as a replacement. For example, when replacing an old furnace, the new equipment cannot be less efficient than the federal standard.

States may not adopt standards that are more stringent than federal standards, but not all products have federal standards. Oregon, along with a dozen other states, adopts standards for energy efficient appliances where no federal standards exists. For example, in 2013 Oregon set new standards for three products: televisions, battery chargers, and double-ended quartz halogen bulbs. State efficiency standards are promulgated by ODOE under guidelines established by Oregon Administrative Rules.

Oregon's standards coincide with standards set in larger markets, such as California, so manufacturers that meet California standards will also meet Oregon's. This broadens the market and helps build momentum and market acceptance that supports efforts to upgrade federal standards. Oregon passed legislation for energy efficiency standards in 2005 and 2007, creating standards for 17 products, in ORS 469.229 through 469.261.[4] A By January 1, 2010, thirteen of these were preempted by federal standards mandated by the Energy Policy Act of 2005 and the Energy Independence Act of 2007. Savings from those federal standards are what is included here.

Oregon continues to be an active member in the Pacific Coast Collaborative (PCC) Codes and Standards group, along with California, Washington, and British Columbia. The PCC group conducts monthly calls to share information and coordinate appliance standards activity across the region. ODOE closely monitors action on standards at the federal level, and works with stakeholders to ensure strong state standards remain in place.

Market Momentum (cumulative savings of 52 aMW)

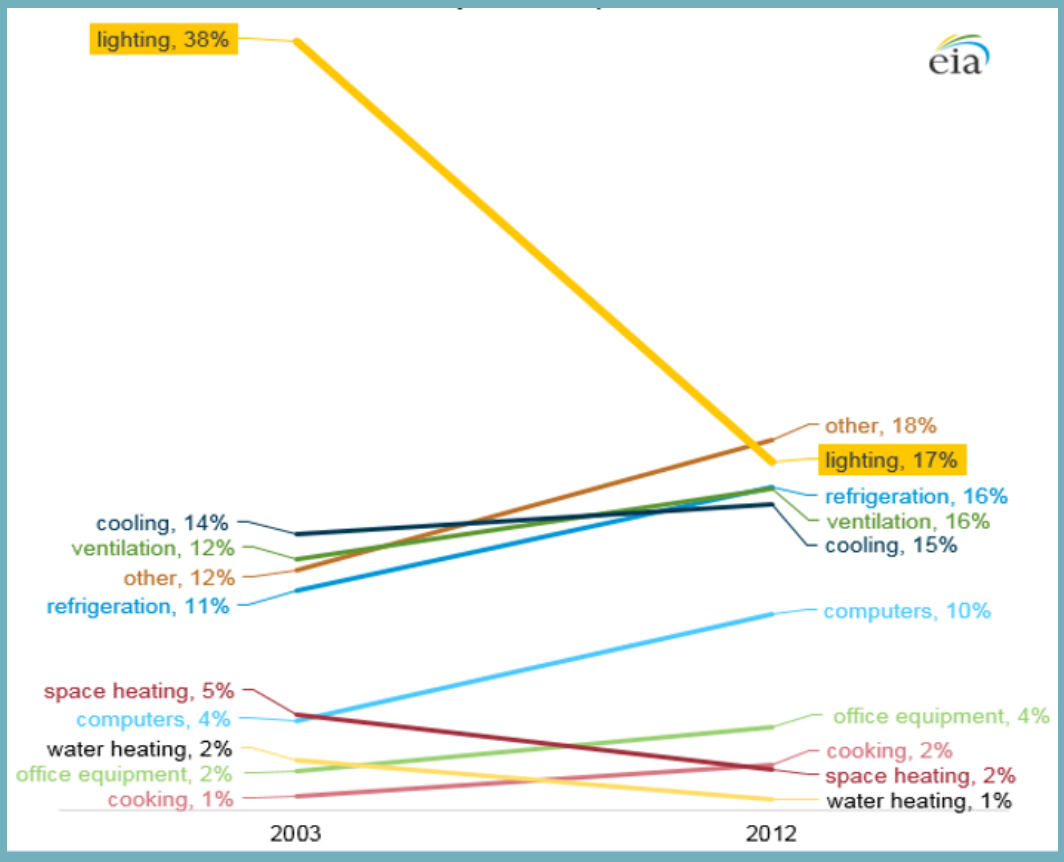
A new and additional category is market momentum, which is savings not tied directly to a utility, implementer, or incentive program. This occurs, for example, when a customer chooses to buy an appliance that is more efficient when shopping for a replacement but does not receive a rebate or other incentive. Another example is Energy Services Companies (ESCOs), which offer financing and guaranteed savings on energy efficiency measures without an incentive other than the savings from a reduced energy bill. This category may also include savings that were influenced by a program where the influence is difficult to trace. In both cases the region still benefits from the energy efficiency choices.

FEDERAL STANDARDS: LIGHTING

Increasing lighting efficiency has been a focus of many programs conducted by both governmental entities and electric utilities. At the federal level, two major pieces of legislation have had a significant impact on lighting efficiency - the Energy Policy Act of 2005 (EPAct 2005),[18] which provided tax credits for some commercial lighting, and the Energy Independence and Security Act (EISA) of 2007,[19] which incrementally increased efficiency in light bulbs with high efficiency fluorescents or light emitting diode bulbs.

The Commercial Buildings Energy Consumption Survey,[20] conducted by USDOE, collects data about lighting installed under the new standards. The data shows that since 2003, distribution of lighting types has changed, resulting in reduced lighting demand in commercial building spaces. Because of these federal standards, lighting as a percent of overall commercial building energy use has been cut in half from 38 percent of a typical commercial building in 2003 to about 17 percent by 2012. These standards have been possible because local efficiency programs have created large-volume markets for efficient products which have led to higher reliability, lower prices and more consumer acceptance. Evaluation and market research associated with local programs, particularly those in the Northwest, also provide much of the data on savings and market acceptance used in Federal standard setting processes.

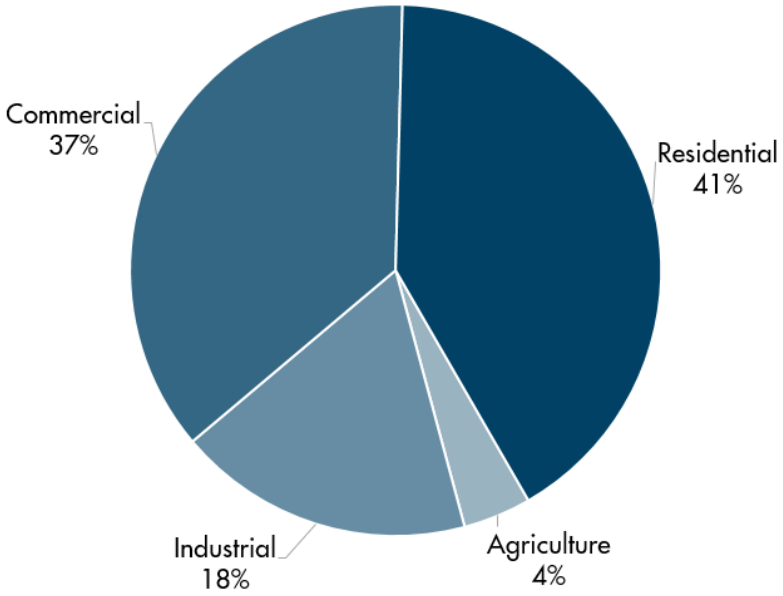
Figure 6.6: Share of Electricity Consumption, 2003 to 2012[14]



Sector Energy Efficiency

These views of sector energy efficiency achieved in the region are provided by the Northwest Power and Conservation Council.[3] NWPCC estimates savings at a sector level for the region, but not currently for individual states. These following figures illustrate sector contributions to overall energy efficiency for the 2010-2014 period, which is the most recent sector level data available. Forty-one percent of the region's electricity energy efficiency savings comes from the residential sector, followed by the commercial sector (37 percent), then the industrial sector (18 percent), and the agriculture sector (four percent).

Figure 6.7: Energy Efficiency Across Sectors

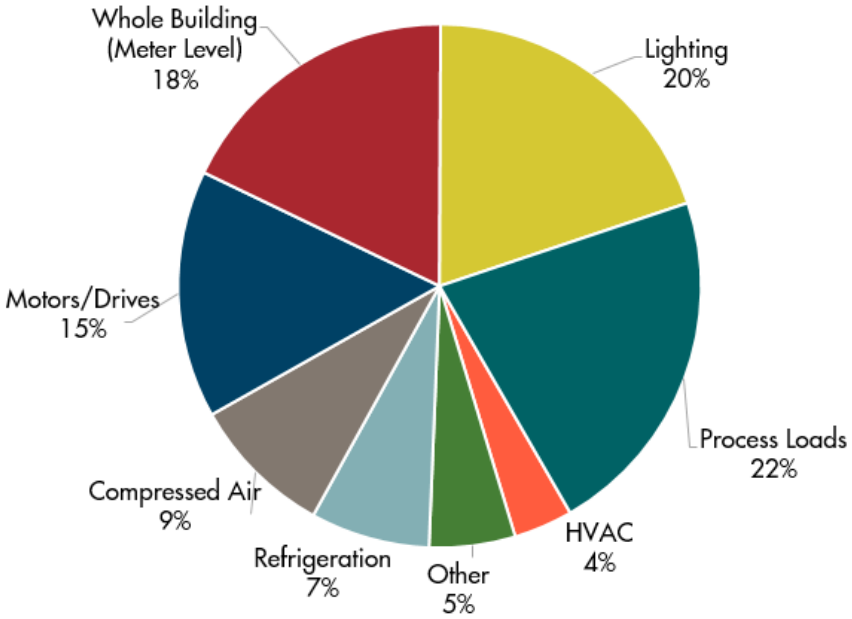


Industrial Energy Efficiency

Industry is always looking for ways to improve production and lower costs. Operators of industrial facilities have learned that many energy upgrades pay for themselves in energy savings in a relatively short period of time, which helps the price of their products and their bottom line.

Process loads refer to energy consumption for industry-specific machinery used to process, manufacture, or assemble a product and to operate the industrial facility. Equipment can range from heating and drying of materials to conveying and assembly machinery.

Figure 6.8: Industrial Energy Efficiency



Industrial energy efficiency can include lighting upgrades, originally from incandescent to fluorescent lighting and now incorporating more applications of using light-emitting diode (LED) lights. Lighting efficiency contributes about 20 percent of electric savings in industrial facilities.

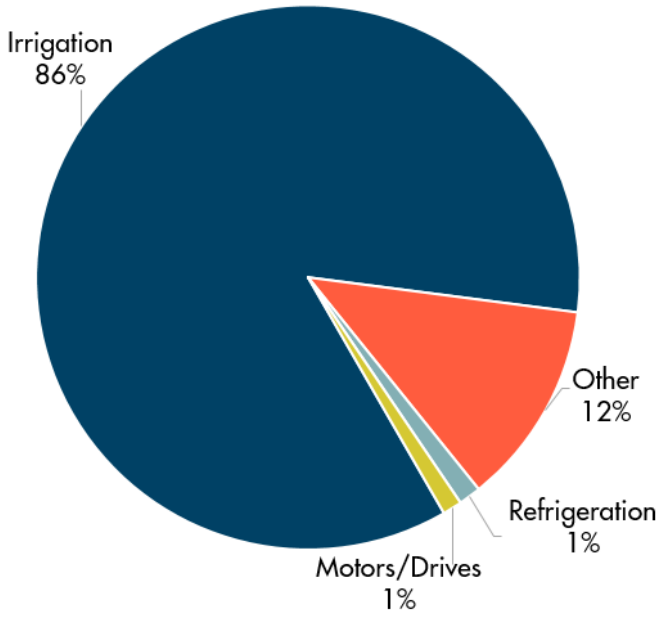
Facilities can realize energy savings with motors/drives by installing more efficient, right-sized motors,

installing variable frequency drives (VFDs) which save energy through tighter control matched to process requirements, and by simply turning motors off when not in use.

Compressed air is used to drive a variety of industrial processes, e.g., power tools or to atomize paint. Typical efficiency measures include installation of equipment that allow air compression systems to more closely match the loads or system requirements, as well as comprehensive air leak detection and repair. Refrigeration includes frozen food and cold storage for food. Efficiency opportunities range from installing more sophisticated controls to installing VFDs on refrigeration compressors that run at partial load.

Agriculture Energy Efficiency

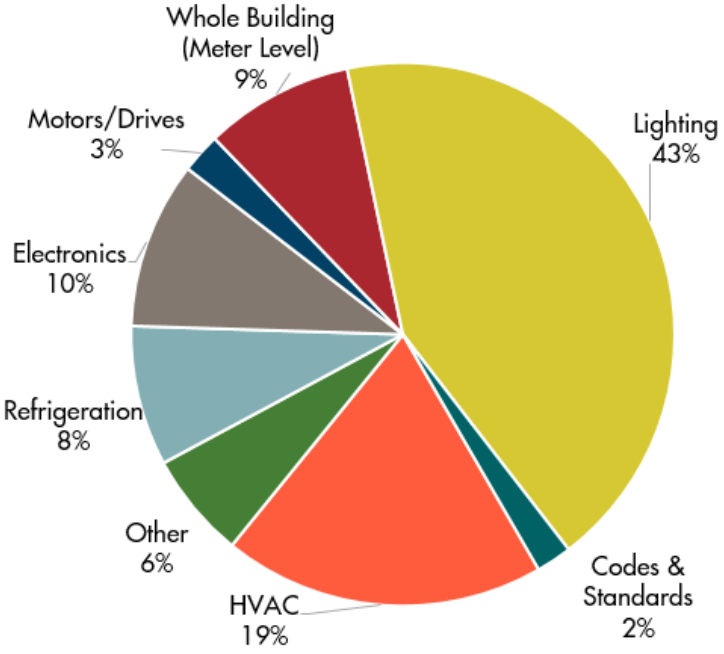
Figure 6.9: Agriculture Energy Efficiency



The bulk of agricultural savings though energy efficiency programs are in water pumping for irrigation. Examples include equipment that allows farmers to more precisely control the amount of water they pump and apply to their fields, such as variable frequency drive (VFD) pump motors and new sprinkler fittings, and irrigation controls that monitor weather conditions and soil moisture levels. Piping and pressurizing formerly open irrigation canals are also important irrigation efficiency improvements. Piped systems are pressurized by gravity and can eliminate pumping from the canal to field sprinklers. An added benefit from pipe systems is the opportunity for small hydroelectric generators to be installed in the piped canal. Other significant energy savings in the agricultural sector come from lighting, dairy barn ventilation fans, and energy-free stock watering tanks.

Commercial Energy Efficiency

Figure 6.10: Commercial Energy Efficiency



In addition to leaps forward in efficiency for commercial lighting with LEDs, commercial building operators continue to improve their heating and cooling systems, reduce refrigeration energy loss by installing closed product refrigerators and freezers, and commission buildings for efficiency by fine-tuning lighting and equipment.

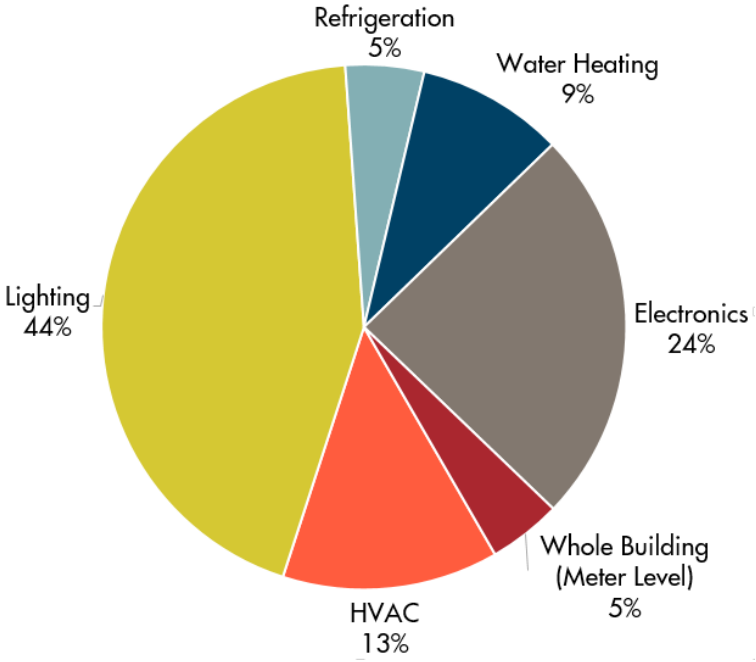
According to the 7th Power Plan, the largest contributor to commercial savings potential remains upgrading lighting and lighting controls. This includes outdoor lighting, such as street and roadway lighting. Lighting will continue to be the

biggest contributor of savings in the commercial sector because we still have a great deal of retrofits left to do and due to innovations in technology. LEDs are the latest generation of new lighting technology to take hold. Advancements in heating, ventilating and air conditioning equipment (HVAC) such as variable refrigerant flow, ductless heat pumps and controls are gaining acceptance in the commercial sector.

Residential Energy Efficiency

Energy efficiency in homes continues to be a savings opportunity as new technology is adopted and homeowners renovate older homes. Insulation, air sealing, and new windows remain popular. Two promising technologies are gaining acceptance in the marketplace. Ductless heat pumps and heat pump water heaters reduce heating and cooling or water heating energy use by 50 percent. Adoption of high efficiency lighting has grown with more choices in the market for lighting that is efficient, attractive, and affordable.

Figure 6.11: Residential Energy Efficiency



DUCTLESS HEAT PUMPS

Ductless heat pumps, sometimes called mini-split heat pumps, move warm or cool air without needing ductwork. These heat pumps are an efficient option for homes with electric resistance heating, or as an add-on to an existing ducted system to serve specific areas. The portion of the device that is outside the home is about half the size of earlier whole-house heat pumps. Refrigerant lines from the outdoor component supply heating and cooling to the indoor unit, which is usually mounted high on a wall where it can distribute and circulate conditioned air without causing drafts on the occupants. Heat pumps can reduce heating- and cooling-related energy use 50 percent or more.

The 7th Power Plan[22] identifies about two-thirds of achievable potential savings in the residential sector to come from "lost-opportunity measures," making sure that the most efficient new technology replaces old worn-out equipment. The replacement of water heaters, heat pumps, lighting, and clothes washers are often examples of lost-opportunity measures.

Figure 6.12: Conservation Potential in All Sectors[22]

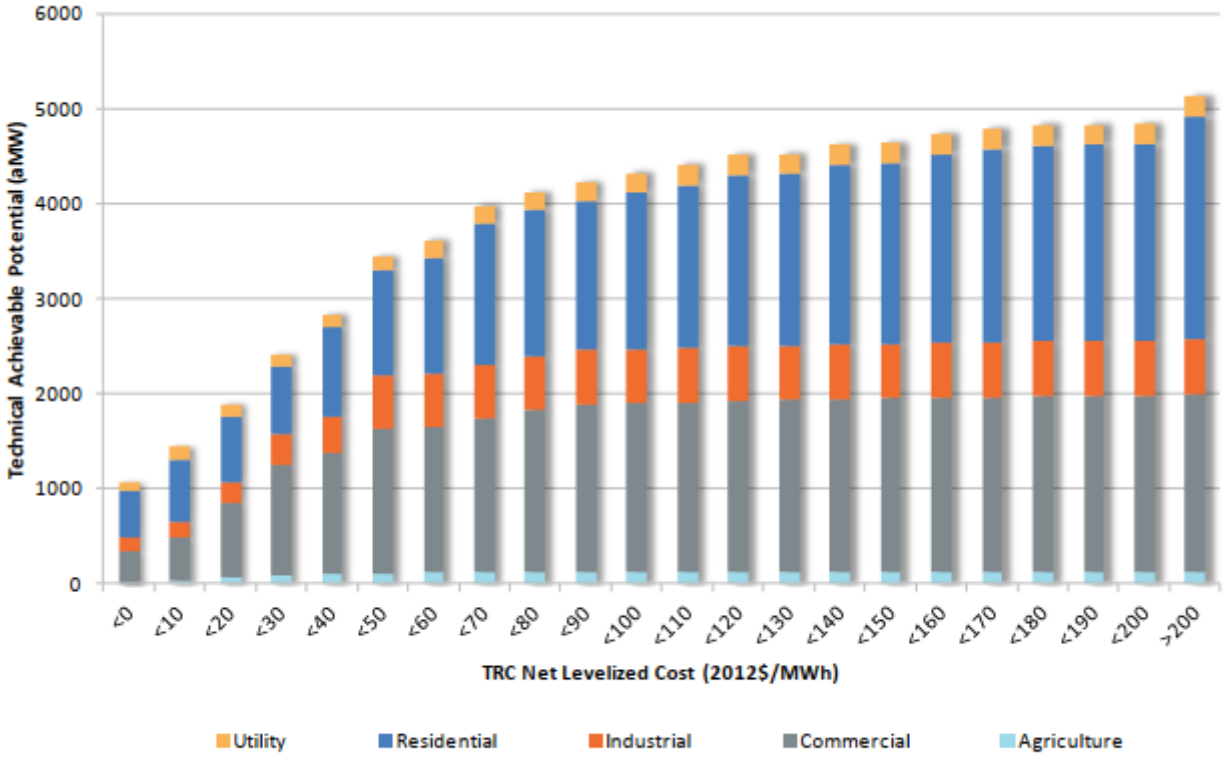


Figure 6.12, from the 7th Power Plan,[22] shows each of the sectors, including "Utility" efficiency improvements that are made in utility infrastructure, such as voltage control in the utility distribution system.

State of Oregon Programs and Initiatives

In addition to policies that encourage energy efficiency by utilities, Oregon has a long history of lead-by-example state policies for our public buildings and agencies. Oregon government leads by example with numerous programs and initiatives requiring public buildings and fleets to be energy efficient, benchmarking of building energy use, promoting home energy scoring, adopting appliance efficiency standards, providing guidance on energy savings performance contracts, and conducting research and development on new technologies and energy efficiency measures. Each of these programs is explained in more detail below.

Statewide Building Code and Energy Code

The 2008 Oregon Code exceeded the national Model Code at the time by about 15 percent,[23] paving the way for the pursuit of the energy efficiency improvements called for in Executive Order 17-20, described later in this chapter. In effect, the 2008 Oregon code was equivalent to the national ENERGY STAR voluntary program, making all new homes in Oregon as efficient as an ENERGY STAR home.

In 2009, SB 79[24] established numerous goals and considerations for Oregon's Residential Specialty Code energy requirements. The resulting law required that the Building Codes Division of the Department of Consumer and Business Services periodically review and update the state building code to ensure it keeps

pace with advancements in energy efficiency. It established a Reach Code which is "a set of statewide optional construction standards and methods that are economically and technically feasible, including any published generally accepted codes and standards newly developed for construction or for the installation of products, equipment and devices." The Reach Code is a pathway to subsequent code improvements, allowing an opportunity to assess whether any of the standards and methods contained in the Reach Code should be in the state building code. Also, development of the Reach Code or any statewide alternative method that targets increased efficiency should address federal, state, and local financial incentives and advances in construction methods, standards and technologies, and consider changes proposed by the Architecture 2030 challenge, a national initiative to improve energy conservation standards.

By 2017, Oregon's residential code exceeded the most recent 2018 national Model Code standard by about 7.5 percent, among the most efficient codes in the country.[25]

Oregon's code process assesses the national Model Code standard and adds amendments that strengthen our code. It also creates option pathways for energy improvements. For example, there is a federal standard for furnace efficiency. A state code may not require a higher efficiency furnace, but Oregon allows builders to voluntarily choose a more efficient furnace as part of the options paths, as long as it meets the minimum requirements of the federal code. This popular choice means more high-efficiency furnaces operating in the state.

State Energy Efficient Design Program

The State Energy Efficient Design Program (SEED) was established in 1991 by ORS 276.900-915.[26] This law directs state agencies to work with the Oregon Department of Energy to ensure cost-effective energy conservation measures are included in new and renovated public buildings. The program requires that all state facilities constructed on or after June 30, 2001, exceed the energy conservation provisions of the Oregon State Building Code by at least 20 percent.

Existing buildings were required, by June 2015, to reduce energy use by 20 percent compared to the building's baseline energy use in 2000. State buildings reached that goal ahead of schedule in 2012. Building on Energy Trust program and incentive support, the largest state agencies have implemented two-year Strategic Energy Management initiatives, with an emphasis on building-level data to effectively prioritize retrofits.

The law establishing the SEED program also requires new state facilities to be designed, constructed, renovated, and operated so as to minimize the use of nonrenewable energy resources and to serve as models of energy efficiency.

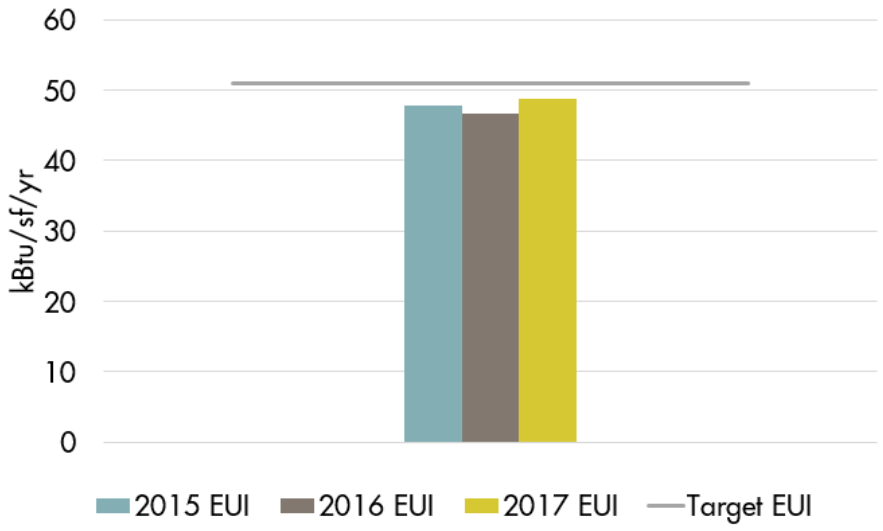
Benchmarking Building Energy Performance

The Oregon Department of Administrative Services directs state agencies to report their energy use to the Oregon Department of Energy. Agencies can compare their current energy use with that of the base year (2000), or any year of their choosing, and can compare energy use indices and check whether mandatory energy savings have been achieved. State-owned facilities over 5,000 square feet, state buildings, and public schools voluntarily disclose energy use via the Portfolio Manager online program. ODOE uses this data to benchmark facilities' energy use and identify potential future energy efficiency investments. The state also

conducts outreach, training, and resources to local jurisdictions that are interested in commercial building benchmarking policies and ordinances. So far, ODOE has benchmarked and is collecting ongoing data in Portfolio Manager on 303 state buildings with over 18.3 million square feet.

ODOE also pulls reports from the database to prepare a biennial State Energy Efficient Design report to the State Legislature as required by ORS 276.915(9).

Figure 6.12: Average Energy Use Index for State of Oregon-owned Offices



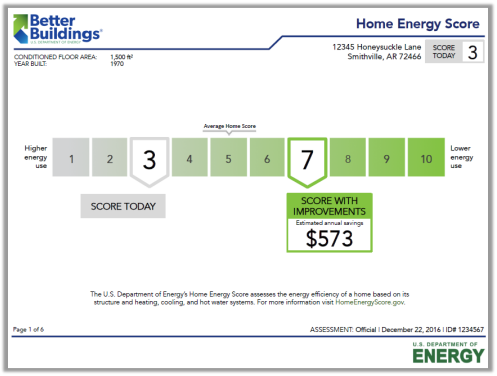
ENERGY USE INDEX

Energy per square foot per year, calculated by dividing the total energy consumed in a building in a year by its total floor area.

The lower the number, the better!

Home Energy Scores

A home energy score is based on a standard assessment of energy-related assets to compare energy use across the housing market. In 2010, Oregon was the first state to develop administrative rules that specify how home energy scores can be created and deployed across the state. Though scoring is not mandatory statewide, the administrative rules guide local efforts and keep the market consistent when scoring entities want to operate in Oregon.



The Eugene Water and Electric Board was the first utility to provide Home Energy Scores under the administrative rule. EWEB provides scores to residential owners and tenants to help them better understand energy and water usage in their properties and possibly lower their monthly energy bills. Working closely with national scoring staff at U.S. Department of Energy, as well as ODOE, EWEB developed a professional assessor network using University of Oregon students and produced more than 150 scores in 2017.

The rules also served as a foundation for the Portland Home Energy Scoring ordinance that went into effect in 2018. Under this City of Portland ordinance, all homes listed for sale must obtain a home energy score, and real estate professionals can post home scores to real estate listings. Portland is expected to produce 14,000 home scores in 2018. This valuable consumer-information effort is expected to spur retrofits of homes on the market, improve efficiency of homes, and contribute to Portland's climate change goals through reduced energy use. Homes receive a 1 to 10 rating and estimates of future energy use. Local energy prices and the local greenhouse gas content of electricity are also required on the label.

Energy Efficient Schools

The passage of SB 1149, mentioned previously in the chapter, created a three percent public purpose charge, first assessed in 2002, on Portland General Electric and Pacific Power customers. School districts in these utilities' service territories receive 10 percent of the funds, which may be used to conduct energy audits or implement energy efficiency measures such as lighting, insulation, or heating system retrofits. Over the last five years, school districts have spent an average $3.8 million a year of public purpose charge funds on energy efficiency measures. In 2017, ten school districts completed more than 60 projects that cost more than $7 million, with $2.7 million coming from the district's public purpose charge funds.

The administration of the school public purpose charge funds is facilitated by the Oregon Department of Energy in cooperation with individual school districts. Public Purpose Charge (SB 1149) Schools Program Guidelines were first developed in March 2002 to assist eligible K-12 school districts in the implementation of cost-effective energy efficiency improvements. Public purpose charge funds must first be used for energy audits, then on approved energy efficient measures recommended by those audits. The Oregon Department of Energy provides business and technical oversight for the energy audits and projects to ensure consistency with the program guidelines.

For schools outside PGE and Pacific Power territory, consumer-owned utilities provide technical assistance and incentives for efficiency upgrades at schools. ODOE provides technical assistance and training for school staff and contractors on constructing highly efficient and environmentally sound buildings. ODOE provides lists of qualified energy auditors and commissioning agents to facilitate contracting for energy efficiency improvements in schools that face challenges in keeping aging facilities operating.

A BRIGHT ENERGY FUTURE FOR SALEM-KEIZER SCHOOLS

The Salem-Keizer School District is educating the next generation of Oregonians in the mid-Willamette Valley. The state's second largest school district, with more than 40,000 young Oregonians attending 65 schools, is more energy-efficient than ever. The District has completed more than 250 energy efficient measures in more than 50 schools.

Salem-Keizer's Highland Elementary.

The estimated annual savings total $575,000, but over the life of these systems, these savings will continue to add up and save the district money — which can be put back into their facilities.

Large Electric Consumer Public Purposes Program

Also funded by the Public Purpose Charge, the Large Electric Consumer Public Purpose Program (LECPPP) allows large electric customers to retain their Public Purpose Charge efficiency fees and invest in improvements at their own sites. The customers self-direct their project rather than receive incentives from utility programs. The Oregon Department of Energy administers the transactions with the utilities to credit the Public Purpose Charge to the customers. ODOE also provides technical oversight to projects and reviews project proposals to track energy savings. In 2016, these large customers contributed more than 1.5 million kWh of energy savings through self-directed projects, ranging from lighting and process equipment upgrades to complex manufacturing and assembly line energy efficiency improvements.

Small-Scale Energy Loan Program

The Small-Scale Energy Loan Program (SELP) provides public, private, and tribal stakeholders access to energy project capital. SELP issues fixed-rate long-term loans for qualified Oregon energy projects that invest in energy conservation, renewable energy, and alternative fuels, or that create products from recycled materials. Over SELP's 35-plus-year history, the program has issued more than 900 loans, with an associated $612 million in financing, to recipients located across all 36 Oregon counties. SELP loans for energy efficiency have been issued across the spectrum of public bodies:

School Loans: SELP loans have gone to a number of school districts as part of the High Performance Schools pilot project. The goal of the pilot was to install cost-saving energy measures and controls that allow students to be cool in the summer and warm in the winter thereby improving their learning environment. The resulting energy savings from installed measures reduce the overall cost of the improvements to the school districts. For example, the Newberg School District received a loan for $1 million to finance energy efficient improvements to their lighting, boiler and HVAC systems that save the district nearly 149,000 kWh of electricity and 11,555 therms of natural gas annually.

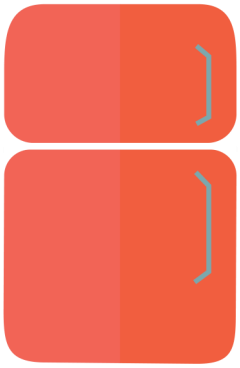
Higher Education Loans: SELP loans support Oregon university system projects. For example, Southern Oregon University received a loan for $2.7 million to finance an energy efficient retrofit to Churchill Hall that is anticipated to save 48,756 KWh of electricity annually.

County Loans: In 2014, SELP loaned $2.08 million to Lane County to finance renovations and upgrades to its data center in Eugene. It is anticipated that this project will save 506,457 kWh of electricity annually.

Business Energy Tax Credit Program

The Business Energy Tax Credit (BETC) program, which was administered by ODOE and reached its sunset in 2014, helped schools, tribes, nonprofits, businesses, industries, farms and ranches save energy and invest in renewable energy. From 1979 to the sunset of the program, BETC awarded 24,738 final certificates for projects that leveraged nearly $3 billion in certified project costs for energy investments in Oregon. Many city, county, state, tribal and federally owned buildings were awarded tax credits under the program.

Residential Energy Tax Credit



The Residential Energy Tax Credit (RETC) program was also administered by ODOE from 1978 until it sunset in 2017. Eligible energy efficiency measures under the program included more than 120,000 heating, ventilation and air conditioning upgrades; 15,000 water heaters; and nearly 50,000 refrigerators. By 2017 nearly 562,000 credits were approved for a total of $135.9 million.

State Home Oil Weatherization Program

The State Home Oil Weatherization program began in 1981 and has granted more than 12,000 incentives for efficiency measures on oil-heated homes. On average, the SHOW Program provides about $200,000 per year in funding to community action partners for low-income, oil-heated homes.

Energy Savings Performance Contracting

An Energy Savings Performance Contract (ESPC) is an agreement between a building owner and a qualified Energy Service Company (ESCO) to install energy efficiency measures and guarantee the energy savings or performance. ESCOs work with local governments, schools, public agencies, and private entities to identify, evaluate, recommend, and design the energy efficiency projects. State agencies that want to use an ESPC for energy savings measures must use a firm on a pre-qualified list of ESCOs. ODOE maintains the qualified ESCO list, as well as an ESPC web page that contains several tools to guide choices including: a calculator, an audit guide, and an ESPC Contracting Guidebook.

Research and Development in Oregon

While most research and development on energy efficiency is done at the federal level by the U.S. Department of Energy and its associated national laboratories, innovative research and development does take place in Oregon at both public and private institutions. Some examples:

- **The Oregon VertueLab,** formerly the Built Environment and Sustainable Technologies Center (BEST), is an independent nonprofit organization established by the Oregon Legislature to help Oregon businesses compete globally by transforming and commercializing university research into new technologies, services, products, and companies. VertueLab provides energy efficiency research grants and has research facilities for the study of energy efficient buildings.[27]

- **The University of Oregon Energy Studies in Building Laboratory** conducts research on buildings and related transportation to develop strategies for maximum energy efficiency in new materials, components, assemblies, and whole buildings.[28]

- **The Baker Lighting Lab at University of Oregon** provides support and opportunities for the exploration of light design ideas. Among other facets, it studies daylighting and the control of lighting systems.[29]

- **Bonneville Power Administration Technology Innovation** research includes a focus on energy efficiency. Recent Technology Innovation Projects include demand response and end use efficiency, waste water heat pump design and pilot and occupancy controlled outdoor lighting.[30]

- **Northwest Energy Efficiency Alliance (NEEA)** is dedicated to accelerating both electric and gas energy efficiency, leveraging its regional partnerships to advance the adoption of energy-efficient products, services and practices. Energy Trust, regional utilities, and the Bonneville Power Administration co-fund NEEA on behalf of Oregon's consumer-owned utilities.

Executive Order 17-20: Accelerating Efficiency in Oregon's Built Environment to Reduce Greenhouse Gas Emissions and Address Climate Change.

Oregon leaders have long recognized that energy efficiency is an important tool for reducing energy costs to consumers and realizing environmental benefits such as greenhouse gas reductions. Executive Order 17-20 (EO),[32] signed in November 2017, by Governor Kate Brown, connects energy efficiency and climate change, noting "energy efficiency leads to significant greenhouse gas reductions that are essential to meeting our state greenhouse gas reduction goals and addressing climate change."

The State of Oregon's "550" Building has electric vehicle chargers and a 8,300 watt solar array.

Energy Efficiency Leadership in State Buildings

To increase energy efficiency in state buildings, the EO creates high performance energy targets for existing state buildings, requires carbon neutral operations for new state buildings, requires the development of a plug-load strategy to reduce energy uses not regulated by codes and standards, and directs agencies to purchase equipment that meets high-efficiency energy and water use specifications. In addition, the EO directs ODOE to analyze state building lifecycle energy and water use costs and savings when state building upgrades are considered. ODOE is then directed to work with DAS to develop analysis tools to inform the high performance energy use targets and carbon neutral requirements for state buildings.

Increasing Energy and Water Efficiency in New Construction

The EO requires higher energy and water efficiency in new construction by calling for revised building codes that require all newly constructed residential and commercial buildings to be solar ready, electric-vehicle ready, and zero-energy ready; the EO also calls for the building code to increase energy efficiency in commercial construction. The EO calls on ODOE and BCD to identify key high-energy use industries that are stable or growing and that have the potential to realize significant cost and energy savings through building code revisions. Finally, the EO directs ODOE to work with stakeholders to determine the potential for new efficiency standards for appliances and water fixtures.

Increasing Energy Efficiency through Retrofits of Existing Buildings

To increase efficiency at existing buildings throughout Oregon, the EO directs the OPUC to work with the Energy Trust of Oregon on meter-based energy savings pilot programs that focus on buildings that are significantly below current code requirements. It also prioritizes energy efficiency in affordable housing projects to reduce utility bills. ODOE and OPUC are directed to work with private sector partners on data sharing to help show projected energy use reductions in the region, and evaluate the state's distributed energy resources which can help Oregon be more resilient.

Cost Analysis

The EO makes clear that state agencies are expected to implement this executive order using the least-cost methods available. It directs state agencies to develop and adopt a cost analysis tool to determine whether any directive in the executive order should be deferred for a time due to significant cost at the time of implementation of that directive.

Implementation

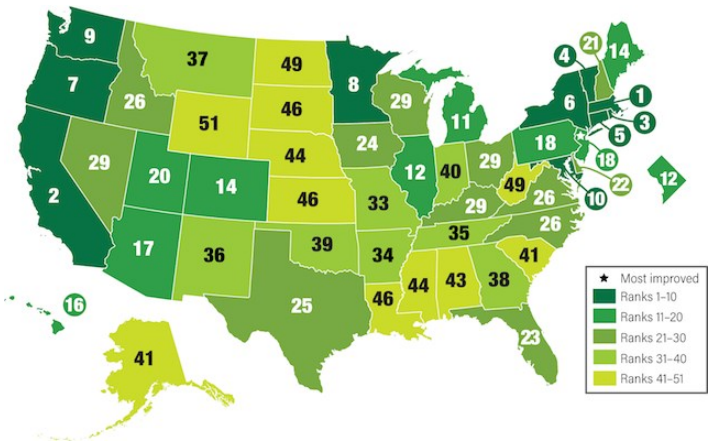
The state has created the Built Environment Efficiency Working Group (BEEWG) to implement the EO. The BEEWG is a collaborative of state agencies including ODOE as the work group leader, Department of Administrative Services, Building Codes Division, Public Utility Commission, and Oregon Housing & Community Services. The group also works with stakeholders across the state as it implements the EO.

Oregon's National Standing in Energy Efficiency

ACEEE National Scoring and Ranking

For the twelfth year in a row, Oregon ranks in the top 10 of the most energy efficient states in the country, according to the American Council for an Energy-Efficient Economy (ACEEE).[1] ACEEE's 2018 scorecard ranks Oregon at number seven. Oregon is joined in the top 10 by its west coast neighbors, with California in second and Washington at number nine.

Figure 6.13: ACEEE 2018 Energy Efficiency Scores[1]

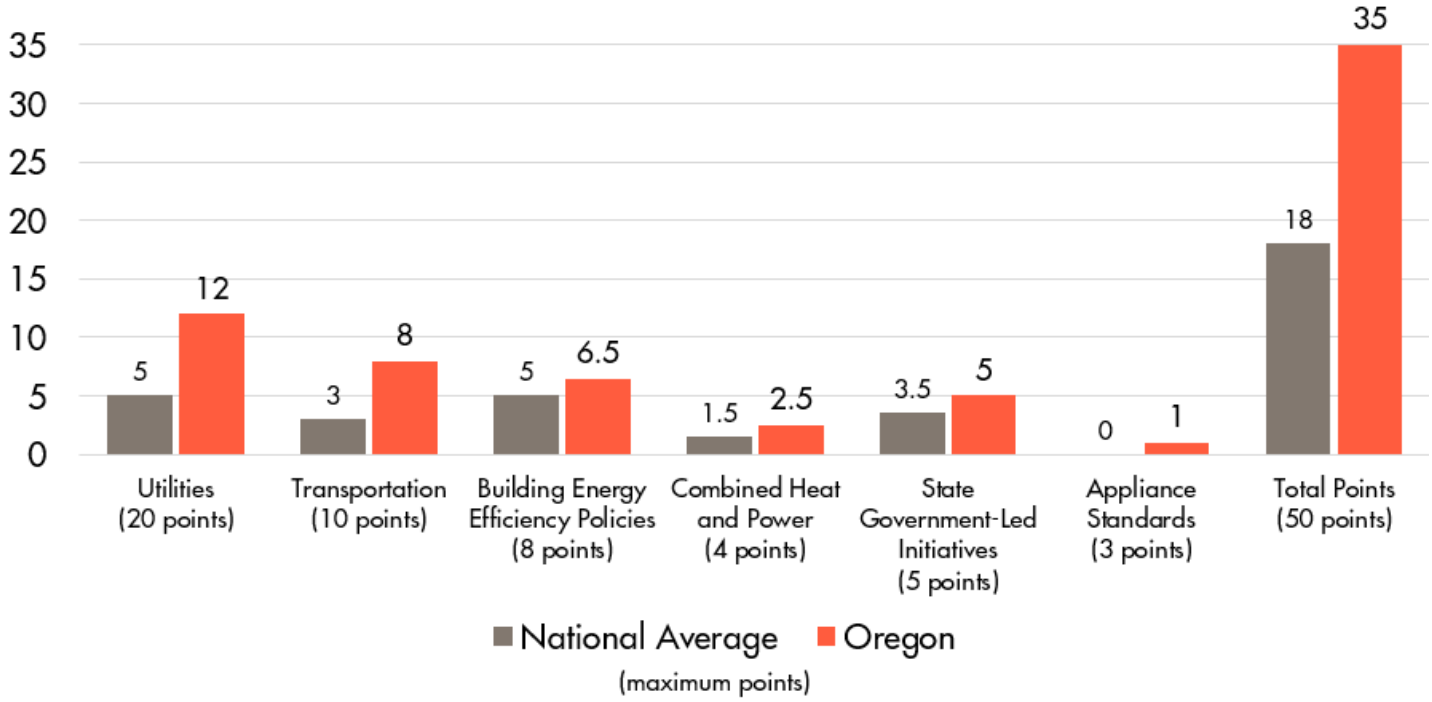


Each year, the ACEEE releases its *State Energy Efficiency Scorecard*, which compares states based on six categories: utility and public benefit programs and policies, transportation policies, building energy codes, combined heat and power policies, state government-led initiatives around energy efficiency, and appliance and equipment standards. For the most part, scores are unaffected by legacy or prior activities, and each year is considered for the accomplishments in that year. In 2018, ACEEE notes that Oregon's "state government leads by example by requiring energy-efficient public buildings and fleets, benchmarking energy

use, and encouraging energy savings performance contracts. Research focused on energy efficiency takes place at several institutions in the state."

In particular, the Scorecard awards Oregon the maximum points for government-led energy initiatives like the State Energy Efficient Design (SEED) Program, which outlines energy requirements and benchmarking procedures for public buildings. Oregon is also recognized for Governor Brown's EO 17-21[32] on energy efficiency and electric vehicles, its strong building energy code programs which includes a voluntary home energy scoring system, and a transportation/land-use system that reduces vehicle miles traveled.

Figure 6.14: ACEEE State Energy Efficiency Scorecard Results — Oregon Points vs. National Average[1]



ACEEE noted in its scoring that "Oregon's third-party efficiency administrator, Energy Trust of Oregon, offers a comprehensive portfolio of electricity and natural gas efficiency programs that consistently report savings exceeding the national average. Electricity savings edged upwards in 2017 and the state continues to prioritize outreach to moderate-income, rural, and under-represented customers through a variety of efficiency efforts. The Bonneville Power Administration and the Northwest Energy Efficiency Alliance also work with utilities to generate energy savings within the state. An energy efficiency resource standard is in place that sets long-term energy savings targets."

Energy Efficiency Jobs in Oregon

In addition to reducing greenhouse gas emissions and saving Oregonians money, the energy efficiency sector employs Oregonians around the state and contributes to economic development. The "2018 U.S. Energy and Employment Report" (USEER),[33] a project of the National Association of State Energy Agencies and the Energy Futures Initiative, estimates that 41,958 Oregonians are employed in energy efficiency jobs, which are those involved in the production and installation of energy efficiency products. These jobs can be found in every county in Oregon, and 20 percent of the efficiency jobs (8,511) are in rural Oregon. Over a quarter of all construction jobs work in energy efficiency, and 14 percent of energy efficiency workers are veterans. Similar

to the nation, 74 percent of jobs are at firms of fewer than 20 employees, and 96 percent from firms of fewer than 100 employees.

Nationally, the USEER found that there are 2.25 million American workers in energy efficiency, and 11 percent of these jobs are held by veterans. Energy efficiency added more new jobs in 2017 than any other part of the energy sector, and today there are twice as many jobs in energy efficiency than all the fossil fuel sectors combined. More than 300,000 of these jobs are in rural America. There are more than 350,000 energy efficiency businesses in the U.S.; nearly 80 percent of jobs are in businesses of less than 20 employees, and 96 percent in firms of less than 100 employees. Nearly 60 percent of these jobs are in construction (1.27 million), with the remaining jobs in manufacturing, professional services, and sales.

Figure 6.15: Oregon Energy Employment, 2017[33]

Energy Efficiency

The 41,958 Energy Efficiency jobs in Oregon represent 1.9 percent of all U.S. Energy Efficiency jobs. The largest number of these employees work in high efficiency HVAC and renewable heating and cooling firms, followed by traditional HVAC. Energy Efficiency employment is primarily found in the construction industry.

Figure OR-8.
Energy Efficiency Employment by Detailed Technology Application

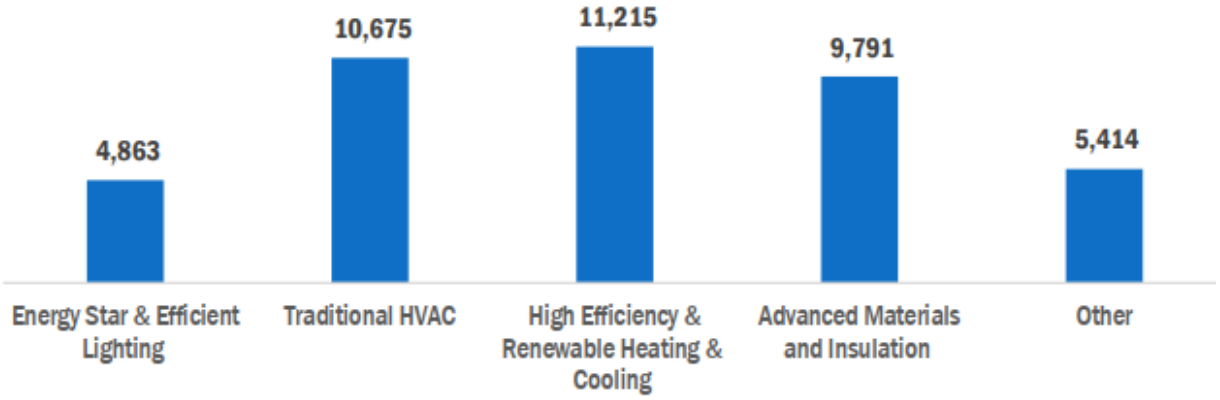
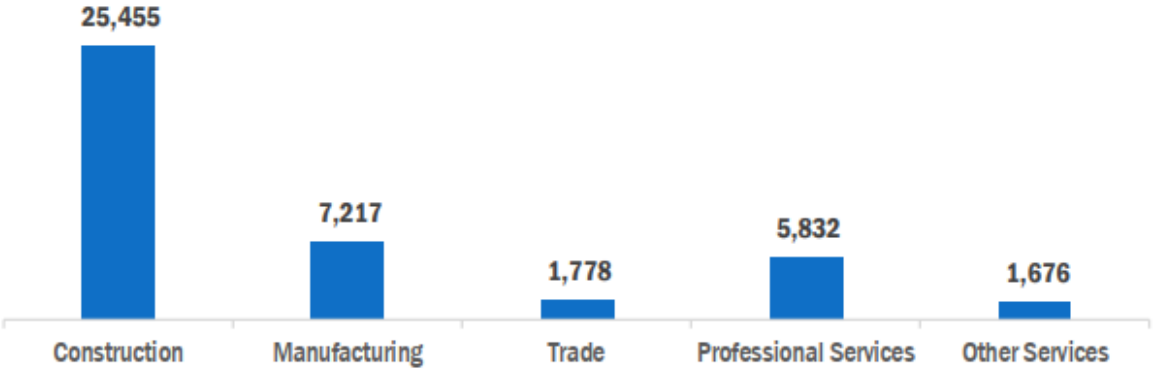


Figure OR-9.
Energy Efficiency Employment by Industry Sector



CONCLUSIONS

Oregon is a **national leader in electric and natural gas efficiency programs**, and the state has a long track record of cost-effectively acquiring energy efficiency. Oregon's and the region's legacy is a portfolio of 6,600 average MW of energy efficiency measures (1,900 aMW from Oregon), which is the second largest resource behind hydroelectricity. According to the NWPCC's 7th Power Plan, the region needs to acquire another 4,300 aMW by 2035. We know how to cost-effectively pursue energy efficiency measures, and existing and new programs in place will enable continued acquisition.

Working together on state programs, utility programs, codes, standards, and market transformation efforts will allow us to continue to deliver cost-effective savings.

With an increased focus on **climate action, equity, and resilience,** the state has an opportunity to better coordinate all available efficiency acquisition mechanisms. These outcomes should prompt us to consider new efficiency funding and delivery channels. This could include assessing our methodology for determining the inputs we use to set the cost-effectiveness threshold for acquiring energy efficiency. This additional value could lead to expanded energy efficiency accomplishments that address climate change, improve the equitable allocation of benefits of efficiency programs, and enhance community resilience.

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