Oregon
Kate Brown, Governor

OREGON DEPARTMENT OF ENERGY

550 Capitol St. NE
Salem, OR 97301
Phone: 503-378-4040
Toll Free: 1-800-221-8035
FAX: 503-373-7806
www.oregon.gov/energy

MEMORANDUM

To: Governor Kate Brown

From: Janine Benner, Director
Oregon Department of Energy

Date: November 14, 2018

Re: Executive Order 17-20
Improved State Standards for Appliances

The Oregon Department of Energy is pleased to submit this report outlining appliance energy efficiency standards in Oregon, including a brief history of state standards, national activity, and potential for new standards in Oregon.

This report is a component *Executive Order 17-20: Accelerating Efficiency in Oregon's Built Environment to Reduce Greenhouse Gas Emissions and Address Climate Change,* issued in November 2017 as a targeted directive to state agencies to address energy and climate impacts of buildings in Oregon. Through EO 17-20, ODOE was directed to identify categories of appliances for improved efficiency standards. This report shows how appliance energy efficiency standards, combined with the other energy efficiency policy directives included in EO 17-20, can help achieve cost-effective energy savings for Oregonians and mitigate the effects of climate change.

To develop this report, ODOE reviewed appliance standards activities of other states, the federal government, industry groups, and efficiency organizations, with a lens toward applicability for Oregon. ODOE also leveraged other agency work, plus industry stakeholder engagement throughout 2018, to inform and shape this report. Implementation of this directive, along with other elements of EO 17-20, has been coordinated and discussed through the Built Environment Efficiency Working Group (BEEWG)[i], which is convened by ODOE.

The Oregon Department of Energy is available to respond to any questions or comments about this report or the broader effort to improve the energy efficiency of the built environment. Our agency will continue to work in partnership with other states and industry stakeholders to evaluate potential appliance standards.

[i] The BEEWG is comprised of other state agencies tasked with EO 17-20 implementation, including the Oregon Public Utility Commission, Oregon Department of Administrative Services, Oregon Housing and Community Services, and the Building Codes Division of the Oregon Department of Consumer and Business Services. For more information, please visit the BEEWG website: https://www.oregon.gov/energy/Get-Involved/Pages/BEEWG.aspx

Oregon Department of **ENERGY**

Executive Order 17-20
Improved State Standards for Appliances

November 2018

OREGON DEPARTMENT OF ENERGY

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I. Executive Summary

On November 6, 2017, Governor Kate Brown issued **Executive Order 17-20**: **Accelerating Efficiency in Oregon's Built Environment to Reduce Greenhouse Gas Emissions and Address Climate Change**[1]. This Executive Order established directives for energy efficiency leadership in state buildings, increasing energy and water efficiency in new construction, and increasing energy efficiency through retrofits of existing buildings. The Executive Order identified appliance standards as a potential strategy to address the state's energy and climate goals, and a specific directive *4.F. Improved State Standards for Appliances* was included.

> ***Excerpt from EO 17-20***
>
> ***4. Increasing Energy and Water Efficiency in New Construction Across the State***
>
> *F. Improved State Standards for Appliances. ODOE is directed to work with appliance industry stakeholders to identify categories of appliances for improved efficiency standards, while considering appliance standards of other states, potential efficiency gains, potential costs, and supply chains for the regional market for appliances. ODOE is directed to provide the Governor with a report of its analysis and identify categories of appliances for improved efficiency by November 1, 2018.*

This report serves to fulfill this directive and provide an outline of categories of appliances that could be considered for improved efficiency standards in Oregon. It also includes a history of Oregon appliance standards and a brief overview of the national appliance standards landscape. EO 17-20 Item 6 (excerpt below) included a cost reduction directive. To comply with this directive, ODOE leveraged existing research from other state agencies and organizations after first reviewing their data, content, and methodology. ODOE also avoided new agency expenditures, and used agency resources efficiently. This section of EO 17-20 also describes a cost analysis tool, which will be developed by December 1, 2019, and was not yet available for this report but will be employed in the future.

> ***Excerpt from EO 17-20***
>
> ***6. Analysis of Cost****. State agencies are expected to implement this Executive Order using the least cost methods available.*

As part of broad outreach to appliance standards stakeholders for a related legislative concept (LC 459), stakeholder engagement was conducted through individual and work group meetings

[1] https://www.oregon.gov/gov/Documents/executive_orders/eo_17-20.pdf

throughout June, July, and August, 2018, as the Oregon Department of Energy contemplated the introduction of a legislative concept that proposed to change the appliance standards process in Oregon. This concept proposed to modify ODOE's rulemaking authority for new appliance standards, transition the standards from statute into rule to streamline the process, and form a technical review panel to advise the agency on appliance standards. ODOE used this stakeholder engagement and feedback to inform the LC development, the research supporting this report, and ongoing work in this area. It is important to note that any further efforts to establish a specific appliance standard at the state level should be accompanied by a comprehensive engagement of industry and affected stakeholders and a detailed analysis of the impact for that specific standard.

A list of potential categories of equipment is presented in Table 1 below, along with an estimate of the energy and water savings and carbon dioxide reductions in Oregon associated with each standard. This list is based on collaboration with other states and an analysis performed by the Appliance Standards Awareness Project (ASAP), but has been modified as appropriate for Oregon-specific factors such as emissions factors. ASAP has performed significant research and conducts ongoing work on appliance energy efficiency standards. This list was created by identifying products that have existing standards (developed through other state work or voluntary market programs) and established efficiency criteria and test procedures that would be referenced in a state standard, and that are not covered by current federal regulation.

Table 1: Oregon Estimated Savings for Potential Categories of Appliances

	Estimated Annual Savings in 2025				
	Electricity [GWh]	Natural Gas [BBtu]	Water [Million gal]	GHG Reduction [MT CO_2]	Utility Bill [million $]
High CRI fluoresent lamps	165.4	-	-	50,000	$14.2
Computers and monitors	133.4	-	-	41,600	$12.6
Faucets	83.9	226	1,546	37,300	$29.4
Showerheads	46.2	124.2	584	20,700	$13.3
Commercial fryers	0.55	243	-	13,000	$3.4
Air purifiers	28.2	-	-	8,700	$3.2
Audio/Visual equipment	12.5	-	-	3,800	$1.4
Commercial dishwashers	2.4	58	80	3,800	$1.9
Pool pump replacement motors	12.5	-	-	3,800	$1.4
Commercial steam cookers	4.4	23	75	2,600	$1.5
Portable electric spas	7.9	-	-	2,400	$0.9
Water coolers	5.0	-	-	1,500	$0.4
Telephones	6.5	-	-	1,400	$0.6
Ventilation fans	4.2	-	-	1,300	$0.5
Total	**513**	**674**	**2,285**	**191,900**	**$84.8**

The savings and reductions in Table 1 were calculated using a scenario in which the new standards become effective in 2020. Further, the scenario takes into account the energy reduction of an efficient product compared to a non-efficient baseline along with estimates for total number of products in-use to determine statewide savings estimates. Additional details on calculation methodology and assumptions are included in Sections VII and VIII of this report. Table 1 presents total statewide reductions estimated to occur in the year 2025 for the following criteria: electricity consumption (in gigawatt-hours), natural gas consumption (in billion Btu), water consumption (in million gallons), greenhouse gas emissions (in metric tonnes of CO_2), and costs for consumers on utility bills (in million dollars). Consumer utility bill costs reductions are based on consumer utility rates in dollars per kilowatt-hour for electricity and dollars per therm for natural gas.

Appliance standards, both state and federal, have historically been an effective method for reducing costs for consumers and saving energy, and many common appliances and products that we use every day have a standard that supports energy efficiency. Voluntary programs have also helped drive the market toward more efficient products and achieve significant savings. In addition to existing standards and programs, there are other opportunities for standards that could lead to more cost effective energy savings. Any new state standards for Oregon should be developed through comprehensive stakeholder engagement that seeks to develop consensus standards that harmonize with other state or national programs, achieve savings for consumers, and minimize compliance burdens on industry.

II. Appliance Standards History in Oregon

The Oregon Legislature has historically enacted appliance standards as a method for achieving consumer energy savings. As new buildings become more efficient, appliance standards are an effective energy saving tool since an increasing share of energy consumption in buildings comes from the products and appliances that are "plugged in" or movable. These products are often referred to as "plug load" or "unregulated load." Residential and commercial building energy codes have traditionally regulated indoor environment heating and cooling, water heating, and the building envelope, but not appliances that are part of a building's plug load. Additionally, appliance efficiency provides an opportunity for energy and cost savings in existing homes and buildings by reducing their plug loads.

Many categories of appliances are subject to federal energy efficiency standards. Federal standards, once established, generally preempt states from adopting standards for the same products. Often, federal standards are modeled after standards that were first enacted at the state level. California has been the most active state in developing and adopting efficiency standards for appliance categories that are not federally preempted, and Oregon's standards for appliances have largely been based on similar standards developed for the large California market. During past legislative sessions, the state has almost exclusively looked to previously-developed California market standards as the basis for new Oregon standards.

Since the State of Oregon first established energy efficiency standards for 11 product categories in 2005, several legislative changes were adopted to establish new standards for additional products, update ODOE's administrative processes and correct errors and omissions found in statute. Currently, Oregon statutes include minimum energy efficiency standards for 20 product categories; in some cases, Oregon and other states set the stage for federal standards which have since preempted Oregon's state standards. The Oregon Revised Statute (ORS) sections associated with past legislation are ORS 469.229 through ORS 469.261. A brief history of Oregon legislation is included below in Table 2.

Table 2: Oregon Legislative History of Appliance Standards

Bill: HB 3363	**Session Year:** 2005

Summary

Established efficiency standards for 11 product categories and provided ODOE with authority to update or create new standards by rule if specific criteria are met. This bill also directed ODOE to periodically review the standards and report to the Legislative Assembly if the standards need to be updated. This bill included the requirement for legislation to be introduced at the next legislative session to conform the statutory minimum energy efficiency standards and operative dates to the minimum energy efficiency standards and operative dates adopted by ODOE in rule.

New Products

1. Ice cube machines (P)
2. Commercial clothes washers (P)
3. Commercial pre-rinse spray valves (P)
4. Commercial refrigerators and freezers(P)
5. Illuminated exit signs (P)
6. Metal halide lamp fixtures (P)
7. Single voltage external AC to DC power supplies (P)
8. Incandescent reflector lamps (P)
9. Torchieres (P)
10. Traffic signal modules (P)
11. Unit heaters (P)

(P) = has been preempted by federal standard since time of Oregon adoption

Bill: SB 375	**Session Year:** 2007

Summary
Established efficiency standards for six additional product categories, re-organized the language around ODOE rulemaking authority, and introduced a one-year delay for a new rule to become effective. SB 375 removed the requirement for a report to the Legislative Assembly that had previously been established under HB 3363. The introduction of legislation, based on ODOE rulemaking, remained a statutory requirement.

New Products
12. Bottle-type water dispensers
13. Commercial hot food holding cabinets
14. Compact audio products
15. Digital versatile disc players and recorders
16. Portable electric spas
17. Walk-in refrigerators and freezers (P)

(P) = has been preempted by federal standard since time of Oregon adoption

Bill: SB 692	**Session Year:** 2013

Summary
Established efficiency standards for three additional product categories.

New Products
18. Televisions
19. Battery charger systems (partially preempted, P)
20. Double-ended quartz halogen lamps

(P) = has been preempted by federal standard since time of Oregon adoption

Bill: SB 20	**Session Year:** 2015

Summary
Revised effective dates and titles for previously-defined product categories to clarify language from previous bills. This bill also added a "+" sign to an energy efficiency equation that had been inadvertently omitted from the text of previous bills.

New Products
N/A

Bill: HB 3025	**Session Year:** 2017

Summary

Amended the definition for small battery chargers to address an industry concern regarding an inadvertent consequence from the passage of previous legislation, and to align the definition of covered products with recent similar changes in California.

New Products

N/A

III. Federal Appliance Standard Activity and Impact on Oregon

The federal government has set standards for appliances since the 1970s. Beginning with the Energy Policy and Conservation Act in 1975, the United States Department of Energy (US DOE) has developed test procedures, standards, and labeling requirements for consumer products. The National Appliance Energy Conservation Act of 1987 established standards for many common appliances and directed US DOE to review and update these standards. The Energy Policy Act of 2005 established new standards for 16 products at the national level, and directed US DOE to set standards for an additional five. In 2007, the Energy Independence and Security Act provided new or updated standards for 13 products.[2]

Overall, the federal government has set standards for more than 60 products[3] across various categories of residential, commercial, and industrial appliances, lighting, and plumbing products. Federal standards were estimated to save consumers $80 billion nationally in 2015, with $850 million attributed to Oregon in that same year.[4]

The Appliance Standards Awareness Project[5] maintains a comprehensive summary of all federal standards, initial legislation, publication dates, effective dates, and future schedules.

Federal appliance standards generally preempt state standards. Once the federal government creates a standard and it becomes effective, the federal standard applies to all states, and states may not establish a standard for that product that is different than the federal standard. For products that do not have national standards, states may create and enforce standards. If the federal government enacts standards for products that already have state-specific standards, states may only enforce their standards until the federal standards become effective. As noted in the previous section, many of Oregon's previously adopted standards have since been preempted by federal standards.

Other federal activity includes voluntary, market-based programs such as the Environmental Protection Agency's ENERGY STAR® program,[6] which spans a variety of technologies to recognize manufacturers that are voluntarily driving energy efficiency through their products and helps consumers make informed decisions upon purchase. Voluntary programs such as ENERGY STAR® can help transform the market and inform state and federal standards.

[2] https://www.energy.gov/eere/buildings/history-and-impacts
[3] https://www.energy.gov/sites/prod/files/2017/01/f34/Appliance%20and%20Equipment%20Standards%20Fact%20Sheet-011917_0.pdf
[4] https://aceee.org/white-paper/energy-saving-states-america
[5] https://appliance-standards.org/
[6] https://www.energystar.gov/about

IV. Other States' Appliance Standard Activities

Various states have actively set energy efficiency standards for appliances and equipment, with California engaging in the majority of the appliance standards activity among the states. Many standards adopted by the states over the past approximately two decades have subsequently been adopted by the federal government. There are a number of standards still on the books at the state level, and states continue to individually set new standards.

In early 2018 Vermont enacted legislation to establish new standards for many types of appliances and equipment, including high CRI fluorescent lamps, computers, computer monitors, commercial fryers, commercial dishwashers, commercial steam cookers, faucets, showerheads, and urinals, among others. These new standards will become effective over the next few years. California continues to move forward with new appliance standards, and other states, including Washington, have recently pursued new standards at the legislative level and look to continue on that path.

The following states have at least one current state standard in effect: Arizona, California, Colorado, Connecticut, Georgia, Maryland, New Hampshire, Oregon, Rhode Island, Texas, and Washington[7] (with Vermont coming soon in the next few years as recently enacted standards become effective).

V. Industry Stakeholder Feedback

Setting new appliance standards should involve technical and policy personnel across a wide variety of stakeholders, including equipment manufacturers, consumers, utilities, trade associations, retailers, installers, and distributors, among others. New standards should promote cost-effective energy conservation for consumers, while avoiding substantial hardships on manufacturers, retailers, or the public.

During the summer of 2018, ODOE engaged in a stakeholder process around a legislative concept, LC 459, which proposed to change the appliance standards process in Oregon. This concept proposed to modify ODOE's existing rulemaking authority for new appliance standards, transition the standards from statute into rule to streamline the process, and form a technical review panel to advise the agency on appliance standards. To inform the development of LC 459 and EO Directive 4.F., ODOE conducted a series of stakeholder communications:

- Agency email communication to broad stakeholder list regarding appliance standards background brief, LC purpose and need statement, and an overview of statutory components. The purpose of this communication was to provide stakeholders with a history of appliance standards in Oregon and to provide an introduction to concepts that ODOE was considering to improve the appliance standards process and make it more robust and streamlined.

[7] https://appliance-standards.org/states

- Two separate stakeholder meetings, in which topics included: an overview of the LC development process, history of Oregon standards, review of LC 459 purpose and need, discussion of proposed legislative changes, federal preemptions, review of LC options, and discussion and feedback on the EO directive to identify categories of appliances for improved efficiency standards.
- Agency follow-up email communication to broad stakeholder list, subsequent to stakeholder meetings, regarding revised proposals for product list based on industry feedback. The purpose of this communication was to document and respond to the good ideas and feedback the agency received through the stakeholder process.
- Various phone calls and meetings with industry representatives and staff to discuss the appliance standards process in Oregon and the legislative concept.

LC 459 will not be moving forward in the 2019 Legislative Session, but through the stakeholder process to develop the legislative concept, the agency received valuable feedback from stakeholders and industry representatives that is directly applicable to the analysis completed under EO 17-20 directives, as well as to any future work on energy efficiency standards for appliances and equipment. Stakeholder feedback included:

- Industry manufacturers share Oregon's interest in improving energy efficiency.
- Voluntary standards can be effective methods for achieving energy savings, and many industries have recognized significant savings through voluntary agreements.
- Consideration should be given to the effect that other regional standards and national voluntary standards have on Oregon equipment sales, and the percentage of marketplace sales in Oregon that already meet high efficiency targets absent a state standard, to properly account for realized savings for Oregonians.
- If standards are set for Oregon, alignment and harmonization with other state and voluntary standards programs is important to reduce the industry and in-state resources needed to comply with and administer the standards.
- Standards should not hinder innovation or economic growth.
- Process for establishment of new standards should include stakeholder involvement.
- Any authority and process around creating new standards should be clear.
- State standard adoption should include an Oregon specific cost-benefit analysis, and not simply look to duplicate other state standards.
- Industries have a record of achieving gains in product energy efficiency through investments in superior technologies and innovation.

VI. Potential New Standards for Oregon

Background

As previously noted, standards for many appliances are set at the federal level. There are also products that do not have a national standard but for which a state standard could achieve meaningful energy and water savings. For the purposes of this report, the Oregon Department of Energy leveraged existing resources to identify state-specific opportunities for new appliance standards. In particular, ODOE looked at the work of other states, the Appliance Standards Awareness Project (ASAP), American Council for an Energy-Efficient Economy (ACEEE), the Northwest Energy Efficiency Alliance (NEEA), and the Pacific Coast Collaborative (which includes California, Oregon, Washington, and British Columbia), to provide a high-level review of the Oregon opportunities. We coupled this review with broad outreach to engage stakeholders and industry representatives in discussions about Oregon's process for adopting and reviewing appliance standards. ODOE also reviewed existing research, information, analysis, and methodology, which we modified where appropriate to consider Oregon-specific variables such as emissions rates.

ODOE used existing market research and resources on appliance standards opportunities to minimize the cost of our analysis to comply with the EO, although the agency recognizes that any proposals for specific new appliance standards in Oregon should include a detailed study of specific market conditions, performed in partnership with stakeholders. Similar to the outreach that was done to inform ODOE's recent appliance standards legislative concept, this analysis should involve input from industry stakeholders including but not limited to equipment manufacturers, trade associations, consumers, utilities, market transformation organizations, retailers, and other states.

The Appliance Standards Awareness Project is an organization that works to advance new appliance, equipment, and lighting standards to deliver energy, water, financial savings, and environmental benefits. In July 2017 ASAP, in partnership with the ACEEE, released a report titled: "States Go First: How States Can Save Consumers Money, Reduce Energy and Water Waste, and Protect the Environment with New Appliance Standards" (the SGF). [8] The report provides estimations on cost, energy, water, and greenhouse gas reductions based on the adoption of 21 new appliance standards for recommended products. The report provided both national savings estimates as well as state-by-state estimates for each recommended standard. The standards proposed in the report are based on products that have an existing standard, efficiency metric, and test procedure that could be referenced and utilized in the near term for states, and would not require significant additional development. Many of the recommended standards are based on existing efficiency levels and test procedures of national voluntary programs, such as ENERGY STAR ® or WaterSense®; have been considered and developed by the US DOE but not yet approved; or are the work of other states.

[8] https://appliance-standards.org/sites/default/files/States%20Go%20First.pdf (Joanna Mauer, Andrew deLaski, and Marianne DiMascio)

The SGF report analyzed opportunities for improved state standards for appliances. ODOE reviewed the methodology and sources used to generate the estimated savings in the report and concluded the report's authors performed a thorough examination of available data sources. When faced with multiple sources and methods, the report authors selected more conservative options in their analysis. Based on this finding, the report is likely to provide a lower and more conservative savings estimate than what may actually be observed when a standard is adopted. Also, NEEA engaged an independent third party, and their review confirmed the report's savings and cost estimates. As previously mentioned, ODOE adjusted some of the values, such as emissions rates, to make the results Oregon-specific.

However, since ASAP is an advocacy organization for appliance standards, should Oregon pursue a standard-setting rulemaking or legislation, ODOE would recommend we conduct a specific detailed analysis, and broad stakeholder outreach, on specific proposed standards to provide an update of savings opportunities.

In the sub-sections below, the recommended standards from the SGF report are summarized along with the estimated Oregon savings. This is followed by a description of the methodology used to determine savings, and an analysis of the sources of uncertainty in the data and assumptions.

Savings From New Potential Appliance Standards

Estimated savings from adopting new recommended standards can come from consuming less electricity, natural gas, and/or water, as a direct result of purchasing the more efficient product. A summary of these potential estimated savings is provided in Table 3, and includes the estimated electricity, natural gas, and water savings, as well as greenhouse gas or CO_2 emission reductions, for both 2025 and 2035, as well as the cumulative savings and reductions from 2020 through 2035. The table is sorted by reduction of 2025 CO_2 emissions. The CO_2 emission reduction estimates do not include any estimates from reduced water consumption which could increase savings due to reduced need for energy used for pumping and water treatment. In total, by 2025 implementation of the standards in this report would result in an estimated 513 gigawatt-hours of electricity savings (or 513 million kWhs), 674 billion Btu of natural gas savings, and would reduce approximately 191,000 metric tonnes of CO_2. Savings and reductions would continue into the future as long as the standards remain in place.

Table 3: Oregon Estimated Savings for Recommended Standards

	Estimated Annual Savings in 2025					Estimated Annual Savings in 2035					Estimated Cumulative Savings from 2020 to 2035			
	Electricity [GWh]	Natural Gas [BBtu]	Water [Million gal]	GHG Reduction [MT CO_2]	Utility Bill [million $]	Electricity [GWh]	Natural Gas [BBtu]	Water [Mgal]	CO2 [metric tonne]	Utility Bill [million $]	Electricity [GWh]	Natural Gas [BBtu]	Water [Mgal]	CO2 [metric tonne]
High CRI fluoresent lamps	165.4	-	-	50,000	$14.2	54.3	-	-	6,300	$4.8	1720	-	-	441,000
Computers and monitors	133.4	-	-	41,600	$12.6	149.4	-	-	16,900	$14.3	1932	-	-	454,000
Faucets	83.9	226	1,546	37,300	$29.4	152.6	397	2,778	38,800	$60.2	1678	4,400	30,700	602,000
Showerheads	46.2	124.2	584	20,700	$13.3	84.0	226	1,060	21,500	$27.4	924	2,484	11,674	335,000
Commercial fryers	0.55	243	-	13,000	$3.4	1.2	530	-	28,200	$9.2	12	5,267	-	283,000
Air purifiers	28.2	-	-	8,700	$3.2	46.2	-	-	5,300	$5.6	532	-	-	119,000
Audio/Visual equipment	12.5	-	-	3,800	$1.4	12.5	-	-	1,400	$1.5	166	-	-	38,325
Commercial dishwashers	2.4	58	80	3,800	$1.9	5.9	139	194	8,000	$5.3	55	1,300	1,800	82,300
Pool pump replacement motors	12.5	-	-	3,800	$1.4	0	-	-	0	$0.0	126	-	-	29,300
Commercial steam cookers	4.4	23	75	2,600	$1.5	9.6	51	164	3,800	$3.7	96	500	1,600	50,100
Portable electric spas	7.9	-	-	2,400	$0.9	14.3	-	-	1,600	$1.7	158	-	-	36,400
Water coolers	5.0	-	-	1,500	$0.4	9.1	-	-	1,000	$0.8	100	-	-	23,700
Telephones	6.5	-	-	1,400	$0.6	6.5	-	-	500	$0.6	86	-	-	20,500
Ventilation fans	4.2	-	-	1,300	$0.5	9.2	-	-	1,000	$1.1	91	-	-	21,100
Total	**513**	**674**	**2,285**	**191,900**	**$84.8**	**555**	**1343**	**4,196**	**134,300**	**$136.2**	**7,676**	**13,951**	**45,774**	**2,535,725**

The savings and reductions in this table were calculated using the scenario of new standards that become effective in 2020 and taking into account the energy reduction of an efficient product compared to a non-efficient baseline. The calculation also included estimates for total number of products in-use to determine statewide savings estimates. Details on calculation methodology and assumptions are included in Sections VII and VIII of this report. Table 3 presents total statewide reductions estimated to occur for the following criteria: electricity consumption (in gigawatt-hours), natural gas consumption (in billion Btu), water consumption (in million gallons), greenhouse gas emissions (in metric tonnes of CO_2), and costs for consumers on utility bills (in million dollars). Consumer utility bill costs reductions are based on consumer utility rates in dollars per kilowatt-hour for electricity and dollars per therm for natural gas, using the following rate projections which are based on the prices used in the ASAP *States Go First* report, which used price projections from EIA's 2017 Annual Energy Outlook.

Table 4: Utility Rates Used in Analysis

	Electricity ($/kWh)			Natural Gas ($/million Btu)	
	Residential	**Commercial**	**Industrial**	**Residential**	**Commercial**
2025	$0.113	$0.085	$0.059	$13.01	$13.70
2035	$0.121	$0.082	$0.057	$16.48	$17.23

Descriptions of Potential Equipment and Standards

The equipment categories described in this section include mostly consumer products along with a few commercial products. For each piece of equipment listed, there is a brief description of its category, the source of the referenced standard, and test procedures that could be referenced. For example, standards can reference existing efficiency performance criteria that align with programs such as US EPA ENERGY STAR®, WaterSense®, or criteria established by other states. Test procedures can reference established procedures that are contained in the US Code of Federal Regulations, ENERGY STAR® requirements, or industry-developed standard procedures. These performance criteria and test procedures form the basis for state appliance standards regulations.

High CRI (Color Rendering Index) Fluorescent Lamps

Description of category: This category applies to linear fluorescent tube-shaped lamps that are common in commercial spaces such as offices and warehouses. There is currently a national energy efficiency standard for fluorescent lamps. At the time of development of national standards, high-CRI lamps represented a specialty niche market and were provided as an exception in the national standard. This high-CRI market segment has grown however. State standards for high-CRI lamps would require that all linear fluorescent lamps, including those with high-CRI, meet minimum efficiency standards that are based on the current national standard for linear fluorescent lamps. This would essentially expand the coverage of the fluorescent lighting standard to include high-CRI lamps at the state level. This state-level standard would require high-CRI lamps to also comply with the efficiency standard, and utilize the same test procedure as other linear fluorescent lamps.

Basis for Referenced Standard and Test Procedure:
Standard: US DOE 10 CFR 430.32(n)
Test procedure: US DOE 10 CFR 430.23 Subpart B Appendix R

Computers and Monitors

Description of category: This standard would set a minimum efficiency requirement for computers and monitors. Computers include desktops, notebooks (laptops), small-scale servers, and workstations. Savings for the sub-categories of desktop computers (through reducing energy consumption during idle periods) and monitors (through display screen energy improvements) constitute the majority of savings opportunities in this category. California has an existing standard for computers and monitors that was adopted in 2016 and is set to become effective in 2019.

Basis for Referenced Standard and Test Procedure:
Standard: California Code of Regulations 1605.3(v)

Test procedures: California Code of Regulations 1604(v), which are based on *ENERGY STAR®* program requirements. For computers, this is the *ENERGY STAR® Program Requirements for Computers, Final Test Method for Computers (revised March 2016),* and for monitors this the *ENERGY STAR® Program Requirements for Displays, Final Test Method (September 2015)*

Faucets

Description of category: This category applies to faucets and replacement aerators that are common in commercial and residential lavatories and kitchens. The current national standard for faucets has not been updated since 1992. This national standard for faucets requires that flow rates do not exceed 2.2 gallons per minute (gpm). Unlike other federal standards, however, current faucet standards do not preempt states from setting state-level standards. This is due to a provision that required DOE to waive preemption authority for faucets (and showerheads) if the federal standard was not updated in a specific time frame. This requirement was not met, and federal preemption has been waived. Accordingly, states may now establish specific efficiency standards for faucets, and some have done so (e.g., California and Colorado).

A potential state standard for faucets would be based on the California standard, which requires 1.2 gpm for lavatory faucets, 0.5 gpm for commercial/public lavatory faucets, and 1.8 gpm for kitchen faucets. By adopting these standards, not only will water savings be realized, but reduced hot water consumption will also result in energy savings.

Basis for Referenced Standard and Test Procedure:
Standard: California Code of Regulations 1605.3(h)(2)

Test Procedure: 10 CFR 430.23 Subpart B Appendix S

Showerheads

Description of category: This category applies to common residential and commercial showerheads. Similar to faucets, a national standard for showerheads exists, but preemption has been waived. The current national standard is 2.5 gallons per minute (gpm).

A potential state standard for showerheads would be based on the EPA WaterSense standard, which sets a maximum flow rate of 2.0 gpm. Colorado has set a standard at this level, and California has adopted a tiered approach that first required a flow rate of 2.0 gpm, but has been ratcheted down to 1.8 gpm currently. The standard analyzed through this report is based on the WaterSense 2.0 gpm performance level. This standard saves energy by reducing the flow rate, and thus the amount of hot water (and the associated energy used to heat the water) that is consumed during a shower.

Basis for Referenced Standard and Test Procedure:
Standard: EPA WaterSense Specification for Showerheads, Version 1.1 (2018)

Test Procedure: 10 C.F.R. section 430.23(t) (Appendix S to subpart B of part 430), which is based on ASME A112.18.1-2012 / CSA B125.1-2012

Commercial Fryers

Description of category: This category includes both electric and gas fryers that are commonly used across the food and restaurant industry, and includes both standard size fryers and large vat fryers. Energy efficiency is achieved in this product category through advanced burner and heat exchanger designs that reduce energy consumption during both cooking and idle periods. Commercial kitchen products are relatively small in terms of sales numbers, yet they are large consumers of energy and therefore can contribute to significant overall energy savings.

A potential standard for commercial fryers would align with the ENERGY STAR® standard that already exists in the marketplace. Vermont is the only other state that has set a standard for commercial fryers, doing so in 2018.

Basis for Referenced Standard and Test Procedure:
Standard: ENERGY STAR® Program Requirements for Commercial Fryers, Version 2.0

Test Procedures: ASTM F1361-07 and ASTM F2144-09

Air Purifiers / Room Air Cleaners

Description of category: Air purifiers/room air cleaners remove air particulates from indoor air. The recommended standard is based on ENERGY STAR® version 1.2, which has been in place since 2004. The standard is based on energy performance in standby mode as well as clean air delivery energy efficiency.

Basis for Referenced Standard and Test Procedure:
Standard: ENERGY STAR® Program Requirements Product Specification for Room Air Cleaners, Version 1.2

Test Procedures:
Clean Air Delivery per Watt (CADR/Watt)

- ANSI/AHAM AC-1-2006: Method of Measuring the Performance of Portable Household Electric Room Air Cleaners

Ozone Generation

- UL 867 Ed. 4.0 Electrostatic Air Cleaners

Standby Power

- IEC 62301 Ed. 1.0 Household electrical appliances - Measurement of standby power

Audio/Video (A/V) Equipment

Description of category: Audio/Video equipment standards cover products such as sound systems and Blu-ray players, and apply to products that offer audio amplification and/or optical disc player functions. Oregon's 2004 standard for DVD players and compact audio equipment requires a maximum power use of 3 and 2 watts, respectively, when in standby mode. The recommended standard, which is based on more recent ENERGY STAR® criteria, requires 1 or 2 watts depending on the setup. This standard achieves energy savings through more efficient operation across "on," "idle," and "sleep" modes, as well as automated power-down features after inactivity. Because Oregon has an existing, less efficient standard for audio/video equipment, potential savings identified in the ASAP report have been decreased by 25 percent to consider more conservative savings potential from an Oregon market that is likely more efficient than the national average.

Basis for Referenced Standard and Test Procedure:
Standard: ENERGY STAR® Program Requirements Product Specification for Audio/Video Version 3.0

Test Procedure: ENERGY STAR® Test Method for Audio/Video (Rev. July 2012)

Commercial Dishwashers

Description of category: Commercial dishwashers are commonly used in the food preparation and service industry, including establishments such as cafeterias, restaurants, bars, and schools. The standard includes an idle energy rate requirement and a water efficiency measure which reduces water consumption, both of which contribute to energy savings.

Basis for Referenced Standard and Test Procedure:
Standard: ENERGY STAR® Program Requirements Product Specification for Commercial Dishwashers Version 2.0

Test Procedure: ENERGY STAR® Test Method for Commercial Dishwashers (Rev. May 2012)

Pool Pump Replacement Motors

Description of category: This category applies to replacement motors for pool pumps, which are used in the circulation and filtration process for in-ground swimming pools. In 2017, DOE finalized a national standard on required weighted energy factor targets based on the pool pump type and horsepower. The US DOE standard will become effective in 2021 but it does not apply to replacement motors; therefore, the recommendation is to adopt a standard requiring replacement motors to meet the same standard as new motors. This standard would achieve savings in the interim

period before national standards become effective and before the existing stock of pool pumps are replaced, resulting in a relatively short time period of potential savings that will reduce to zero after national standards become effective and the market is turned over. Savings in this report and the ASAP *States Go First* report reflect a 2021 effective date. Savings through this standard are achieved through implementation of variable-speed motor/pump control and a better match of pumping energy with system demand.

Basis for Referenced Standard and Test Procedure:
Standard: 10 CFR 431.465

Test Procedure: 10 CFR 431 Appendix B to Subpart Y

Commercial Steam Cookers

Description of category: Commercial steam cookers are used in commercial kitchens, and can use either electricity or gas as an energy source. Units that meet the potential standard conserve energy through reduced heat loss, improved cooking efficiency, idle energy consumption limits, shorter cook times, and reduced water consumption.

Basis for Referenced Standard and Test Procedure:
Standard: ENERGY STAR® Program Requirements for Commercial Steam Cooker Version 1.2

Test Procedure: ENERGY STAR® Program Requirements for Commercial Steam Cookers, which is based on ASTM Standard F1484-99, Test Method for the Performance of Steam Cookers

Portable Electric Spas

Description of category: This category refers to electric spas (hot tubs) that are free-standing and have electric heat. Oregon has a current standard on portable electric spas (adopted in 2007), but an updated industry standard has been developed that could be adopted to update Oregon's current standard. Oregon's current standard is very close to the non-efficient models in today's market and therefore would not significantly impact savings estimates. The standard achieves energy savings by reducing the amount of allowable standby energy consumption, based on spa volume.

Basis for Referenced Standard and Test Procedure:
Standard: ANSI/APSP/ICC 14-2014

Test Procedure: ANSI/APSP/ICC 14-2014

Water Coolers

Description of category: Water coolers are used in residential and commercial applications to store and dispense drinking water. Units that dispense both hot and cold

water, as well as cold-only units, are included within the scope of this standard. Water coolers that meet this standard achieve energy savings through reduced energy consumption during stand-by periods (on-mode without power draw).

Oregon already has a water cooler standard, although it is based on an older version of ENERGY STAR® criteria. The potential standard could update Oregon's standard to reference a more recent version of ENERGY STAR® criteria that requires reduced stand-by energy consumption for combination hot/cold units.

Basis for Referenced Standard and Test Procedure:
Standard: ENERGY STAR® Program Requirements Product Specification for Water Coolers Eligibility Criteria Version 2.0

Test Procedure: ENERGY STAR® Test Method for Water Coolers (Rev. May-2013)

Telephones

Description of category: This category applies to traditional desktop analog phones, as well as more recent technology that utilizes Voice over Internet Protocol (VoIP). Cell phones are not included in the scope of this standard. Products that meet this standard achieve energy savings through reduced "partial on-mode power," which must meet certain criteria based on the type of phone.

Basis for Referenced Standard and Test Procedure:
Standard: ENERGY STAR® Product Specification for Telephony Eligibility Criteria Version 3.0 Rev. Oct-2014

Test Procedure: ENERGY STAR® Test Method for Telephony Rev. November-2013

Ventilation Fans

Description of category:
This category applies to residential ventilation fans that are commonly found in bath rooms, kitchens, and utility rooms. The fans are used to exhaust air to the outside environment. Efficiency is measured based on energy consumption associated with a given airflow, and more efficient units save energy by moving more air at the same or reduced power. Energy efficient units must also meet sound requirements to ensure quiet operation.

Basis for Referenced Standard and Test Procedure:
Standard: ENERGY STAR® Program Requirements Product Specification for Residential Ventilating Fans Eligibility Criteria Version 3.2

Test Procedures:

Airflow rating

ANSI/AMCA 210-07 “Laboratory Methods of Testing Fans for Aerodynamic Performance Rating

HVI 916-09 “Airflow Test Procedure”

Sound rating

ANSI/AMCA STANDARD 300-08 “Reverberant Room Method for Sound Testing of Fans

AMCA Publication 311-05 “Certified Ratings Program – Product Rating Manual for Fan Sound Performance

HVI 915-06 “Procedures for Loudness Rating of Residential Fans

VII. Overview of Savings Calculation Methodology

This section provides an overview of the elements, key criteria, and sources for calculating and determining annual energy savings associated with each product category.

Determining Total Annual Savings for Products in Oregon

To determine total annual savings in a given year, calculations can account for the new additional standard compliant products sold in the current year as well as continuing savings from standard-compliant products sold in previous years since the standard was adopted. The variables that impact and determine annual savings include:

- Annual sales of a given product.
- Percent of products already compliant with potential standard (credit cannot be given for the percentage of the market that would have met efficiency criteria even in the absence of a standard).
- Product lifetime (how long, on average, a product remains in use).
- Per-unit savings (energy savings for an efficient product when compared to an average less-efficient product that does not meet the standard).

A calculation for total annual savings in a given year can be done with the variables above and the following equation:

> *Annual Savings = (Number of Units in Use) x (100% - Pre-Standard Compliant Product Penetration %) x (Per-Unit Savings)*

The ASAP report provided an overall methodology for determining savings for most standards, but exceptions were made depending on the data sources and the nature of the product. This summarizes the basic methodology used and how savings were allocated to the state of Oregon.

Estimating Number of Units In-Use and Market Penetration of Efficient Products (Nationally and In Oregon)

To account for savings when adopting new standards this report estimates the number of new additional standard-compliant products purchased due to the adopted standard for the years 2020 through 2035. By only counting the additional standard compliant products it prevents counting savings for efficient products that would have been purchased regardless of adopting a standard.

To determine the number of new additional standard-compliant products, the total annual sales of compliant and non-compliant products was estimated using available market data along with the penetration percentage of products currently meeting the standard. This data was used to determine the estimated sales number of non-standard compliant products that

would be replaced if a standard was adopted. For simplification, an assumption was made that total non-standard-compliant product sales would remain constant from 2020 to 2035. This assumption was made since both total annual sales (for efficient and non-efficient products) and the penetration percentage of efficient products both generally increase from year-to-year, and the net result is a relatively constant level of non-efficient products in the marketplace, in the absence of a standard. This assumption was used for many of the products in this report, although some particular products (such as high-CRI lamps) utilized more market specific projections for sales, where the data exists.

After estimating annual sales, the number of units in use becomes the number of new unit sales in a given year, plus the units sold in previous years that are still within their expected useful life. This calculation can be expressed as:

> *Number of Units in Use = (Annual Sales) x (minimum[Number of years after compliance date - 0.5, Average product lifetime])*

This calculation has been developed in a way that "averages out" new sales in a given year by taking credit for only one-half of the products sold throughout the course of a year. The specific sale date of a product within a year is generally not known, as some purchases occur at the beginning of a year and some occur towards the end. By only accounting for savings of one half year, the calculation effectively assumes that products were purchased, on average, halfway through a year. A generic example of how this equation works is shown in Figure . The figure shows a generic product with a three year average lifespan and depicts the savings over a five year period. In the first year, only one-half of the annual savings for purchased products is counted. This is done as products are bought throughout the entire year and therefore are assumed to have an average purchase date in the middle of year 1.

Figure 1: Generic example of calculated savings for a product with a 3 year lifespan, adopting a recommended standard over a period of 5 years. Total cumulative savings over the 5 year period is 10.5 times the annual purchased product savings.

In year 2, the products purchased during the year again only account for half of the annual purchased products. Since products purchased in year 1 continue to be in use, all of the annual purchased products in year 1 are now included. This results in total products in use for year 2 to be 1.5 times the annual purchased product count. Year 3 is similar to year 2, only with an additional year of product sales added, making total products in use 2.5 times the annual purchased product count.

For year 4, the average product lifetime of three years has been reached for the products purchased in year 1. As products are expected to be replaced throughout year 4, the average decommission date is assumed be at the midpoint of the year. This means only one half of the annual purchased product savings is counted for year 1, bringing the total savings in year 4 to three times the annual purchased product savings. Now that the product lifetime has been reached, subsequent years will maintain the same annual savings for each year as older products are replaced with new products as shown in year 5.

The total annual savings for each year is shown on the right-hand side of Figure , and by summing each of the year's savings, a total savings over the five-year span can be obtained. For the generic case in Figure , the total savings is 10.5 times the annual purchased product savings.

The methodology above is first applied on a national level, and is then scaled down to estimate the total product sales and savings at the state level. This can be done by scaling based on percentage of Oregon households, population, or sector energy consumption, depending on the factor more appropriate for a given product. This top-down method used by the SGF report was done as sales and standard compliant penetration data was typically only available at the national level. A summary of the scaling ratio used for Oregon for each product is included in Table 5 below.

Table 5: ASAP OR Savings Allocation Methods Used for Recommended Standards

Recommended Standard		OR State Allocation Method	Allocation Sources
High CRI Fluorescent Lamps			
	Residential Sales	(US Residential Sales) * (OR Residential Electricity Usage)/(US Residential Electricity Usage)	[1],[3],[4]
	Commercial Sales	(US Commercial Sales) * (CBECS West Region Electricity Consumption %) * (OR Commercial Electricity Usage)/(West Region Commercial Electricity Usage)	[1],[3],[4]
Computers and Monitors			
	Residential Sales	(US Residential Sales) * (OR Households) / (US Households)	[1]
	Commercial Sales	(US Commercial Sales) * (CBECS West Region Electricity Consumption %) * (OR Commercial Electricity Usage)/(West Region Commercial Electricity Usage)	[1],[3],[4]
Faucets		(US Sales) * (OR Households) / (US Households)	[1]
Showerheads		(US Sales) * (OR Households) / (US Households)	[1]
Commercial Fryers		(US Sales) * (OR Population)/(US Population)	[1]
Air Purifiers		(US Sales) * (OR Households) / (US Households)	[1]
A/V Equipment		(US Sales) * (OR Households) / (US Households)	[1]
Commercial Dishwashers		(US Sales) * (OR Population)/(US Population)	[1]
Pool Pump Replacement Motors		(US Sales) * (RECS State Equipment Saturation %)	[2]
Commercial Steam Cookers		(US Sales) * (OR Population)/(US Population)	[1]
Portable Electric Spas		(US Sales) * (RECS State Equipment Saturation %)	[2]
Water Coolers		(US Sales) * (OR Commercial Electricity Usage)/(US Commercial Electricity Usage)	[4]
Telephones		(US Sales) * (OR Commercial Electricity Usage)/(US Commercial Electricity Usage)	[4]
Ventilation Fans		(US Sales) * (OR Households) / (US Households)	[1]

[1] Census Bureau. 2017. "QuickFacts United States." www.census.gov/quickfacts.

[2] EIA (Energy Information Administration). 2011. "Residential Energy Consumption Survey (RECS): 2009 RECS Survey Data." www.eia.gov/consumption/residential/data/2009/.

[3] EIA (Energy Information Administration). 2015. "Commercial Buildings Energy Consumption Survey (CBECS): 2012 CBECS Survey Data." www.eia.gov/consumption/commercial/data/2012/.

[4] EIA (Energy Information Administration). 2017. "Retail Sales of Electricity by State by Sector by Provider (EIA-861)." www.eia.gov/electricity/data/state/.

Acronyms:
CBECS: Commercial Building Energy Consumption Survey
RECS: Residential Energy Consumption Survey

In addition to allocating US sales to each state, the per-unit savings were adjusted state-by-state for plumbing fixtures (faucets and showerheads). The adjustments were made based on the difference of the state's mix of gas/oil and electric water heaters as well as the average number of people in each household compared to the US average.

Estimating Per Unit Savings

Per-unit savings represent the energy savings of an individual product when comparing the annual energy consumption, on average, of a product that does not meet a specific standard with the annual energy consumption of a product that complies with that specific standard. Energy consumption in both cases is dependent upon a number of factors, including frequency of use, power when in-use, power when idle, and various other operating characteristics. Per-unit savings were estimated in this report by referencing various existing analyses (typically by other states, industry, or *ENERGY STAR®*) as used in the ASAP report, regarding the savings potential of the products covered in the report. These specific sources are identified in the following sections for the key product categories.

Estimating Carbon Dioxide Emissions Reductions of Standard Compliant Products

Using the energy savings for both natural gas and electricity, the associated carbon dioxide emissions reductions can also be calculated using emissions factors for each energy type. For electricity production this was done by using utility average emissions factor projections for the Oregon electricity market for each year through 2035. For natural gas, this is done by using a standard emissions factor of 53.06 kg carbon dioxide per million Btu (or 117 lbs CO_2 per million Btu) [9].

Assumptions and Limitations to Analysis

As is common with projections for savings into the future, there is some uncertainty underlying the savings estimations in this report and in the ASAP report; efforts have been made to reduce the potential issues and to utilize more conservative estimates when available. The following is a list of the potential sources of uncertainty in the savings estimates:

- Assumed constant sales of non-efficient products through the lifetime of the analysis. This was based on the assumption that efficient product penetration increases along with total product sales over time, which would effectively cancel each other out.
- Assumed national penetration percentage of products currently adhering to recommended standards is an appropriate proxy for Oregon, unless otherwise noted. Higher current state-specific market penetration of efficient products would result in reduced savings opportunities associated with implementation of a standard, and lower current market penetration would result in higher savings opportunities. Oregon-specific market penetration data was not available for this report. ODOE will continue to seek this data and use it to refine savings estimates, and this will be critical information, as part of a broad stakeholder process, in the event that any specific standard is pursued.
- Sales were determined nationwide and then allocated to states based on specific methods outlined in Table 5. While the methods used are considered a good proxy for estimating state sales there is some uncertainty inherent in scaling national sales based on population, households, energy consumption, etc.

[9] United States Code of Federal Regulations, Table C-1 to Subpart C of Part 98—Default CO2 Emission Factors and High Heat Values for Various Types of Fuel

- The calculation methodology assumes full compliance with standards after they become effective. If consumers have a method for purchasing non-compliant products after standards are in place, then savings estimates in future years would be reduced.
- Sales estimates from the *ENERGY STAR*® Market Penetration Report only report sales from manufacturers that responded to the survey. This means sales numbers are likely lower than what is reported, and overall savings could be under-represented, leading to a more conservative estimate.

VIII. Inputs for Savings Calculations for Key Products

Tables 6 and 7 provide documentation of the key variables that accompany the savings calculations for the products that comprise the majority of the savings potential opportunity for Oregon. Upon reviewing the standards opportunities in Oregon and sorting based on potential savings, the majority of the savings and GHG reduction potential comes from a smaller subset of products. These products include faucets, showerheads, computers and monitors, high CRI fluorescent lamps, air purifiers, and commercial fryers. These products warranted more in-depth focus, confirmation of assumptions, and adjustments where necessary, in this report. This is reflected in the results presented in Tables 1 and 3. For the remainder of the products, ODOE utilized variables and references as presented in the Appliance Standards Awareness Project / American Council for an Energy Efficient Economy *States Go First* report. ODOE also made adjustments to all categories, where appropriate, from the totals in the *States Go First* report to account for updated market data for penetration of efficient products (when the result was a more conservative estimate) and Oregon-specific CO_2 emissions factors.

Table 6: Assumptions for Key Products

	Methods and Assumptions				
Product	State Sales Estimation Method millions, US Sales	Baseline Efficient Product Penetration	Per-unit Annual Savings	Efficiency level of analyzed standard	Product Lifetime [year]
High CRI Fluorescent Lamps	Commercial Portion: (US Sales) * (CBECS %) * (State Commercial Elec.)/(US Commercial Elec.) Residential Portion: (US Sales) * (100% - CBECS %) * (State Commercial Elec.)/(US Commercial Elec.) -Assumes sales of T12 lamps will decline each year Res: 7.1 Comm: 36.6	0% (standard would cover all high-CRI lamps that do not meet current efficiency standards)	Res: 16 kWh Comm: 97 kWh	Equivalent to the current national standard for general service fluorescent lamps, as listed at 10 CFR 431.32 paragraph (n).	Res: 15.0 Comm: 4.9
Computers and Monitors	**RES Sales:** (US Sales) * (households in each state) / (total households) **COMM Sales:** (US Sales) * (CBECS %) * (State Commercial Elec.)/(US Commercial Elec.) Desktop: 19.4 Notebooks: 45.4 Small-scale servers: 0.5 Workstations: 1.5 Monitors: 20.9	Assumed 0% as the per-unit savings is the average energy use savings from a baseline containing both non-compliant and compliant products	Desktop tier 1: 30.4 kWh Desktop tier 2: 18.7 kWh (incremental) Notebooks: 3.6 kWh Small-scale servers: 24 kWh Workstations: 37.4 kWh Monitors: 27.75 kWh	California's Title 20 standards	Desktop: 5 Notebook: 4 Server: 5 Workstation: 5 Monitor: 7

Table 6: Assumptions for Key Products (continued)

	Methods and Assumptions				
Product	State Sales Estimation Method millions, US Sales	Baseline Efficient Product Penetration	Per-unit Annual Savings	Efficiency level of analyzed standard	Product Lifetime [year]
Faucets	(US Sales) * (households in each state) / (total households) * (state household size adjustment) Total: 48.3 Res Lav: 29.7 Res Kitchen: 15.2	Res Lav: 76% Res Kitchen: 55% Public: 95% Values are the percentage of models meeting the CA standard certified to DOE, this is a proxy for market	**Res Lav:** 32 kWh 0.23 MMBtu 931 gal **Res Kitchen:**	Lavatory Faucet: 1.2 gpm Public Faucet: 0.5 gpm Kitchen Faucet: 1.8 gpm	Res Lav: 10 Res Kitchen: 10 Public: 3
Showerheads	(US Sales) * (households in each state) / (total households) * (state household size adjustment) 16.3	76% Values are the percentage of models meeting the WaterSense standard of 2.0 gpm certified to DOE, this is a proxy for market penetration	1018 kWh 0.8MMBtu 2179 gal based on WaterSense standard of 2.0 gpm. CA has standard of 1.8 gpm	2.0 gpm	10
Commercial Fryers	(US Sales) * (State Pop.)/(US Pop.) 0.1	21%	Elec: 3,126 kWh (standard fryer) Gas: 508 therms (standard fryer)	ENERGY STAR Version 2.0 is recommended. Version 3.0 has been in place since 2016. The most significant difference between version 2.0 and 3.0 is for standard electric fryers increasing heavy load cooking energy efficiency from >= 80% to 83% and idle energy rate lowered to <= 800 W from 1000 W	12
Air Purifiers	(US Sales) * (households in each state) / (total households) 4.6	60% - Used percentage of models that are Energy-Star compliant rather than sales penetration which the 2015 energy star report has at 29%, for a more conservative savings estimate. This was done based on information from ASAP consultant stating the ENERGY Star Report is likely underrepresenting penetration [G-5]	214 kWh	Standby Power Consumption ≤ 2.0 Watts Performance ≥ 2.O (Clean Air Delivery Rate)/Watt Maximum Ozone Production ≤ 50 parts per billion (ppb)	9

Table 7: Sources for Key Product Assumptions

	Sources			
Product	Sales Estimation	Baseline Efficient Product Penetration	Per-unit Annual Savings	Product Lifetime
Faucets	[F-2] pg 15, CA scaled to OR based on households using US Census Data [G-6]	[G-4], in ASAP Report	Calculation using inputs/assumptions from [F-1] Appendix B, with adjustment for gas/electric savings based on % of electric vs. gas water heaters [G-7]	[F-1] pg B-1
Showerheads	[S-2] pg 15, CA scaled to OR based on households using US Census Data [G-6]	[G-4], in ASAP Report, with ODOE adjustment to account for WaterSense in new construction (2017 Oregon Code)	Calculation using inputs/assumptions from [S-1] Appendix A, with adjustment for gas/electric savings based on % of electric vs. gas water heaters [G-7]	[S-1] pg A-1
Computers and Monitors	Desktops, Computers, and Monitors: [G-1] Servers and Workstations: [C-2] pg 24 (California sales scaled to Oregon based on population)	[C-1] - Penetration assumed to be 0% as the baseline was taken to be the average energy consumption of all products currently in the marketplace.	Desktops, Notebooks, Small Scale Servers, and Workstations: [C-1] pg 51, 52 Monitors: [C-1] pg. 97	Desktops, Notebooks, Small Scale Servers, and Workstations: [C-1] pg 51, 52 Monitors: [C-1] pg. 97
High CRI Fluorescent Lamps	[L-2, L-4], calculation based on declining sales from these sources. The High CRI lamp loophole has been found in T8 products as well, which this metric conservatively does not capture.	[L-2,L-4]	Calculation based on lamp wattages from [L-3] and operating hours from [L-1] pg 6-4	Residential: [L-1] pg 8-20 Commercial: [L-1], calculation based on annual operating hours on pg 6-4 and rated lifetime hours on pg 7-4, 7-5
Air Purifiers	[G-1] Sales of 4.2 million, adjusted for GDP growth up to 2020	[A-1]	[G-3]	[G-3]
Commercial Fryers	[G-1]	[G-1]	[K-1]	[K-1]

Source References for Table 7

General	
G-1	EPA, ENERGY STAR Unit Shipment and Market Penetration Report: Calendar Year 2015 Summary (Washington, DC: EPA, 2015) and Calendar Year 2017 Summary (Washington, DC: EPA, 2017).
G-2	EPA, ENERGY STAR Unit Shipment and Market Penetration Report: Calendar Year 2011 Summary (Washington, DC: EPA, 2011). www.energystar.gov/ia/partners/downloads/unit_shipment_data/2011_USD_Summary_Report.pdf?6665-cb7e.
G-3	Xcel Energy, Retail Products Platform: Product Analysis (Minneapolis: Xcel Energy, 2015). www.xcelenergy.com/staticfiles/xe/PDF/Regulatory/CO-Rates-and-RegsDSM-Cadmus-RPP-Product-Analysis-August-2015.pdf.
G-4	DOE (Department of Energy) . 2017. "Compliance Certification Database." Accessed March. www.regulations.doe.gov/certification-data/#q=Product_Group_s%3A.
G-5	Mauer, J. (2018, 8/1). Phone interview
G-6	2017 US Census: https://www.census.gov/quickfacts/
G-7	EIA (Energy Information Administration). 2011. "Residential Energy Consumption Survey (RECS): 2009 RECS Survey Data." www.eia.gov/consumption/residential/data/2009/.

Air Purifiers	
A-1	AHAM, "The AHAM Verification Program for Portable Electric Room Air Cleaners" (2017). Accessed March. www.ahamdir.com/aham_cm/site/pages/index.html?code=r.rac.AboutThisProgram.

Faucets	
F-1	H. Singh, K. Rider, and T. Ngo, Staff Analysis of Water Efficiency Standards for Toilets, Urinals, and Faucets (Sacramento: CEC, 2015). docketpublic.energy.ca.gov/PublicDocuments/15-AAER01/TN203718_20150220T141432_Staff_Analysis_of_Water_Efficiency_Standards_for_Toilets_Urinal.pdf.

F-2	E. Guy, H. Hauenstein, S. Schneider, T. Quinn, and E. Osann, Faucets: Codes and Standards Enhancement (CASE) Initiative for PY 2013: Title 20 Standards Development: Analysis of Standards Proposal for Residential Faucets and Faucet Accessories, Prepared for Pacific Gas and Electric Company, Southern California Edison, San Diego Gas & Electric, and Southern California Gas Company (San Francisco: CPUC, 2013).. https://www.energy.ca.gov/appliances/2013rulemaking/documents/proposals/12-AAER-2C_Water_Appliances/California_IOUs_and_Natural_Resources_defense_Councils_Response_to_the_Invitation_for_Standards_Proposals_for_Faucets_-_Updated_2013-08-05_TN-71810.pdf
F-3	Faucets and Showerheads spreadsheet from ASAP

Showerheads	
S-1	S. Steffensen, Staff Analysis of Water Efficiency Standards for Showerheads (Sacramento: CEC, 2015). www.energy.ca.gov/business_meetings/2015_packets/2015-08-12/Item_06/Item_6_Showerhead_Staff_Report_8-6-15.pdf.
S-2	H. Hauenstein and C. Richter, Showerheads: Codes and Standards Enhancement (CASE) Initiative for PY 2015: Title 20 Standards Development: Analysis of Standards Proposal for Showerheads, Prepared for Pacific Gas and Electric Company, Southern California Edison, San Diego Gas & Electric, and Southern California Gas Company (San Francisco: CPUC, 2015). docketpublic.energy.ca.gov/PublicDocuments/15-AAER-05/TN205606_20150731T141501_Sarah_Schneider_Energy_Solutions_on_behalf_of_California_IOUs_C.pdf.
S-3	Faucets and Showerheads spreadsheet from ASAP

Computers and Computer Monitors	
C-1	H. Singh, S. Pasha, and K. Rider, Final Analysis of Computers, Computer Monitors, and Signage Displays (Sacramento: CEC, 2016).

	https://efiling.energy.ca.gov/URLRedirectPage.aspx?TN=TN213573_20160909T135214_Energy_Savings_Calculations_for_Desktops.xlsx
C-2	Computers: Codes and Standards Enhancement (CASE) Initiative for PY 2013: Title 20 Standards Development: Analysis of Standards Proposal for Computers, Prepared for Pacific Gas and Electric Company, Southern California Edison, San Diego Gas & Electric, and Southern California Gas Company (San Francisco: CPUC, 2013). www.energy.ca.gov/appliances/2013rulemaking/documents/proposals/1 2-AAER-2A_Consumer_Electronics/California_IOUs_Standards_Proposal_Computers_UPDATED_2013-08-06_TN-71813.pdf.

Lighting	
L-1	DOE, Technical Support Document: Energy Efficiency Program for Consumer Products and Commercial and Industrial Equipment: General Service Fluorescent Lamps and Incandescent Reflector Lamps (Washington, DC: DOE, 2014). www.regulations.gov/document?D=EERE2011-BT-STD-0006-0066.
L-2	NEMA, "Linear Fluorescent Lamp Indexes Continue to Decline in the Third Quarter of 2016" (Rosslyn, VA: NEMA, 2017). www.nema.org/news/Pages/Linear-Fluorescent-Lamp-IndexesContinue-to-Decline-in-the-Third-Quarter-of-2016.aspx
L-3	Xcel Energy, Lighting Efficiency Input Wattage Guide (Minneapolis: Xcel Energy, 2004). www.xcelenergy.com/staticfiles/xe/Marketing/Lighting-Wattage-Guide.pdf.
L-4	DOE, 2014 National Impacts Analysis and Shipments Analysis for DOE's Final Rule Analysis for GSFL and IRL (Final Rule) (Washington, DC: DOE, 2014). www.regulations.gov/document?D=EERE-2011-BT-STD-0006- 0062.

Commercial Kitchen	
K-1	EPA, Savings Calculator for ENERGY STAR Certified Commercial Kitchen Equipment (Washington, DC: EPA, 2016). www.energystar.gov/sites/default/files/asset/document/commercial_kitchen_equipment_calculator_0.xlsx.

IX. Other Potential Appliance Standards Opportunities for Future Consideration

The previous sections of this report identify a series of potential standards opportunities for which an established efficiency metric and test method exists, and which could feasibly be adopted as a state standard with relatively little additional technical development. Other potential standards, identified below, could also provide opportunities at the state level in the future, and ODOE will continue to monitor the landscape and review potential applicability for Oregon. Some of these standards require additional development of a test procedure or efficiency metric, while some are on-hold at the federal level and states could look to adopt standards if no movement occurs nationally. Potential water efficiency standards are also included below. These standards provide only water savings for the consumer, but no direct energy savings. The water efficiency related standards presented previously in this report (showerheads, faucets) have a significant direct energy savings for the consumer. While the water efficiency standards below do not have a direct energy savings component, indirect embedded energy required for water treatment and distribution could be reduced, and some states have adopted water fixture standards in addition to and to complement energy efficiency standards.

Standards On Hold At The Federal Level

Many states, including Oregon, have brought an ongoing legal action against the US DOE to publish and finalize these standards:

1) Portable air conditioners
2) Compressors
3) Uninterruptible power supplies

Water Efficiency Standards

These standards represent potential water savings opportunities, and are listed even though the scope of this report is focused primarily on energy efficiency standards. Water standards can lead to indirect energy savings through reductions in upstream and downstream embedded energy from treatment and distribution. These standards include:

4) Toilets
5) Urinals
6) Lawn spray sprinklers
7) Landscape irrigation controllers

Other Standards Opportunities That Need Additional Technical Development

These categories, some identified in the *States Go First* report, represent products that are common in the market and could have potential for additional savings or standardization. Some of these products have received formal attention and discussion from other states (i.e., California) or the federal government, but will require additional development. They include:

8) Commercial clothes dryers

9) Commercial and industrial fans
10) Imaging equipment (copiers, printers, scanners, fax machines, and multi-function devices)
11) LED tubes and lamps
12) Servers and data storage equipment
13) Televisions and signage displays (potential updates to existing standard and test procedure)
14) Grid-enabled water heaters (for demand response)
15) Gas fireplaces / hearth products

X. Conclusion

Appliance standards, both state-level and national, have helped Oregonians save energy and money. Oregon has traditionally leveraged the work of other states and organizations to adopt new standards legislatively. Oregon has a continuing opportunity for new potential state standards that utilize established efficiency metrics and testing criteria. New state standards for Oregon should be developed through comprehensive stakeholder engagement that seeks to develop consensus standards that harmonize with other state or national programs, achieve savings for consumers, and minimize compliance burdens on industry. This report highlights numerous potential opportunities for appliance standards that could lead to energy and financial savings for Oregonians, and that achieve some of the policy goals of Executive Order 17-20: Accelerating Efficiency in Oregon's Built Environment to Reduce Greenhouse Gas Emissions and Address Climate Change.