More Savings Ahead: The Potential of Future Appliance Standards

Rachel Margolis and **Joanna Mauer**

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Research Report

ASAP
APPLIANCE STANDARDS AWARENESS PROJECT

ACEEE

About ACEEE

The **American Council for an Energy-Efficient Economy** (ACEEE), a nonprofit research organization, develops policies to reduce energy waste and combat climate change. Its independent analysis advances investments, programs, and behaviors that use energy more effectively and help build an equitable clean energy future.

About ASAP

The **Appliance Standards Awareness Project** (ASAP), based at ACEEE, advocates for appliance, equipment, and lighting standards that cut planet-warming emissions and other air pollution, save water, and reduce economic and environmental burdens for low- and moderate-income households. ASAP's steering committee includes representatives from environmental and efficiency nonprofits, consumer groups, the utility sector, and state government.

About the authors

Rachel Margolis, senior technical advocacy associate at ASAP, works to advocate for improved national efficiency standards for appliances. Prior to joining ASAP, Rachel worked as an advisor at the Rowan University Sustainable Facilities Center in New Jersey. Rachel earned a master of science in earth science from Rice University and a bachelor of arts in physics from the University of Pennsylvania.

Joanna Mauer, deputy director of ASAP, leads advocacy in a range of U.S. Department of Energy regulatory proceedings for residential appliances and commercial equipment. Prior to joining ASAP, Joanna worked at the U.S. Environmental Protection Agency and the Center for Integrative Environmental Research. She also served as a Peace Corps volunteer in the Dominican Republic. Joanna earned a master of public policy from the University of Maryland and a bachelor of science in civil and environmental engineering from Cornell University.

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Data and licensing information

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Executive summary

Key findings

Technological advances mean that stronger appliance and equipment efficiency standards could significantly reduce energy waste.

The next round of updated efficiency standards could save U.S. households an average of nearly $150 annually on their utility bills over two decades (2030–2050). Businesses could collectively save $13.8 billion annually.

As electricity demand grows, policies such as efficiency standards that reduce electricity consumption and peak demand will be increasingly important. By 2040, updated standards could reduce U.S. electricity consumption by an amount equivalent to nearly 5% of projected consumption and reduce peak demand by 32 gigawatts (GW).

Updated standards could reduce cumulative carbon dioxide (CO_2) emissions by close to 1 billion metric tons (BMT) through 2050 while also cutting emissions of nitrogen oxides (NO_X) and sulfur dioxide (SO_2)—two harmful air pollutants.

The U.S. Department of Energy (DOE) is legally required to periodically consider updates to existing energy and water efficiency standards for residential appliances and commercial and industrial equipment. The appliance standards program, which covers approximately 60 product categories, has been saving households and businesses money on utility bills for decades; existing standards are saving the average U.S. household hundreds of dollars each year on utility bills.[i] The Biden administration updated about two dozen standards, which will add to these savings; these recently finalized standards will save a typical household more than $100 on average each year over the next two decades.[ii] However, due to technological advances, opportunities for large cost savings through still-stronger standards remain.

This report estimates the potential savings from the next round of updated standards for 49 product categories (28 residential and 21 commercial and industrial). We assumed final rule dates ranging from 2025–2033, depending on the product category, and associated compliance dates ranging from 2027–2036. For eight products for which DOE has issued a proposed rule that has yet to be finalized, we evaluated savings from new standards equivalent to those in each of the proposed rules. For the remaining products, we generally evaluated standard levels equivalent to the maximum technologically feasible (or "max-tech") level identified by DOE in the most recent rulemaking. We note that we are not endorsing these specific standard levels, but rather are instead quantifying the potential savings that are

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[i] deLaski, Andrew, and Joanna Mauer. 2017. "Energy-Saving States of America: How Every State Benefits from National Appliance Standards." Washington, DC: ACEEE; Boston: ASAP. www.appliance-standards.org/sites/default/files/Appliances%20standards%20white%20paper%202%202-14-17.pdf.

[ii] Dunklin, Jeremy, and Joanna Mauer. 2024. "Reducing Costs across America: New Appliance Standards Save Consumers Money in Every State." Boston: ASAP; Denver: PIRG. www.appliance-standards.org/sites/default/files/reducing-costs-across-america.pdf.

possible given current technology. By law, DOE can adopt only economically justified standards, considering impacts on both consumers and manufacturers. Utility bill savings from improved standards outweigh any increase in purchase price. Altogether, we found that updated standards could reduce a typical household's utility bills by an average of nearly $150 annually and collectively save businesses $13.8 billion in annual operating costs over two decades (2030–2050).

Energy efficiency, including appliance standards, has played an important role in reducing both total energy use and peak electricity demand. For about two decades, U.S. electricity consumption remained relatively constant despite population growth.[iii] But in 2024, electricity consumption increased by 2%, and it is forecasted to continue to grow. While some increase in electricity demand was expected by grid forecasters from building and vehicle electrification, more rapid growth from the proliferation of energy-intensive data centers and increased U.S. manufacturing is now anticipated, challenging grid operators and utilities nationwide. As figure ES-1 shows, updated efficiency standards could reduce annual electricity consumption by 204 and 338 terawatt-hours (TWh) in 2040 and 2050, respectively—equivalent to 4.7% and 7.2% of projected U.S. electricity consumption in those years.

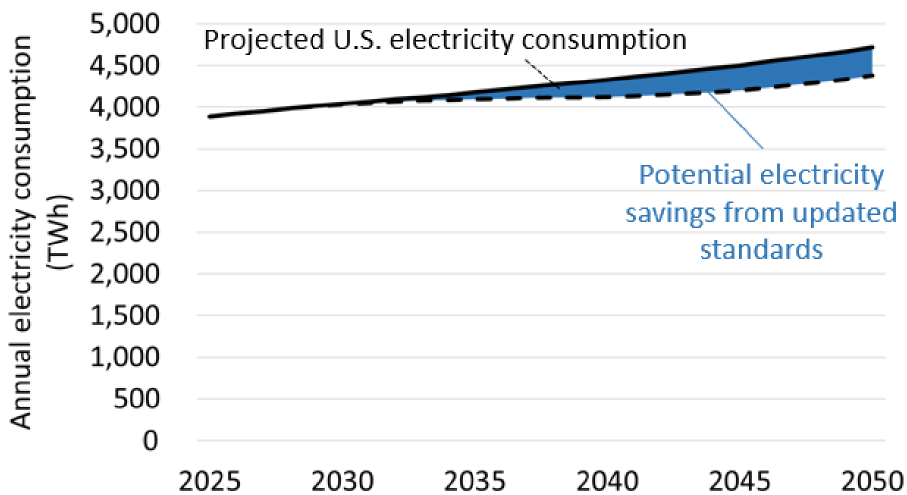


Figure ES-1. Projected U.S. electricity consumption (solid line), and potential electricity savings from updated standards. Source: ASAP tabulations based off of EIA data.[iv]

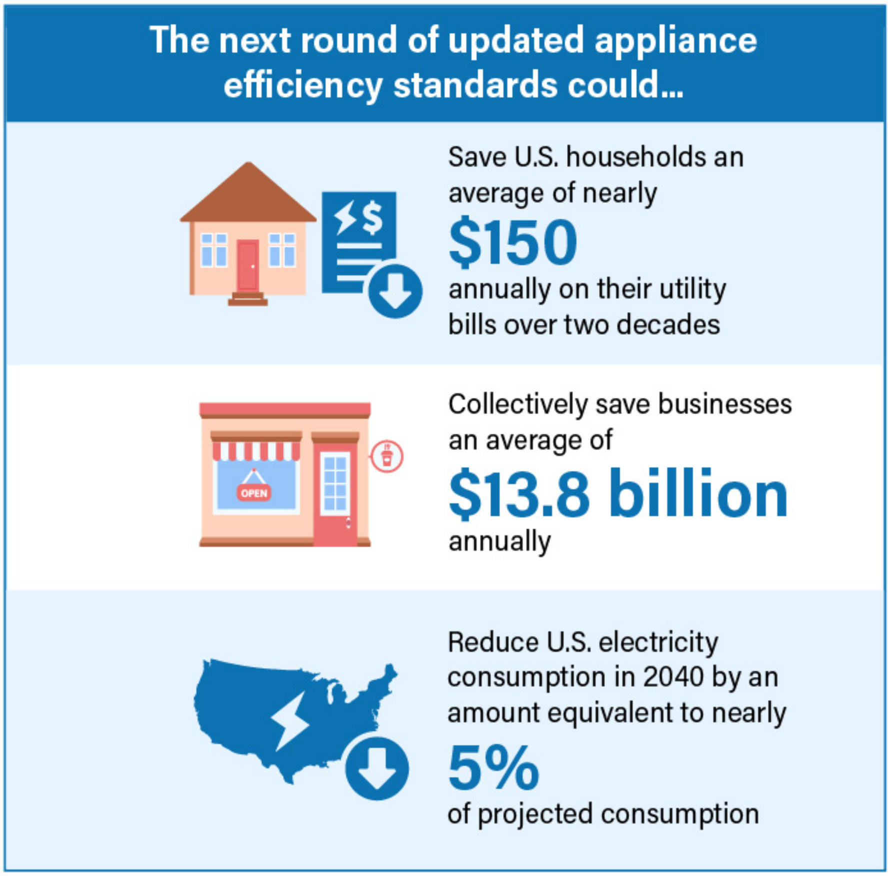
Peak demand—which drives grid infrastructure investments—can also be lowered through efficiency standards. We estimate that updated standards could cut peak demand by 32 GW in 2040 and 50 GW in 2050, which are equivalent to 4.3% and 6.7% of current peak demand, respectively. For comparison, in 2021, the total nameplate capacity of natural gas peaker plants was 190 GW.[v] These peak demand savings could help improve overall affordability for ratepayers.

At the same time, updated standards would reduce air pollution that harms human health. We estimate that updated standards could reduce nitrogen oxides (NO_X) emissions by about 25,900 tons in 2040 and 44,700 tons in 2050, and sulfur dioxide (SO_2) emissions by 10,200 tons in 2040 and 14,000 tons in 2050. Updated standards could also provide large greenhouse gas reductions—we estimate potential

[iii] Energy Information Administration (EIA). 2025. "Short-Term Energy Outlook." www.eia.gov/outlooks/steo/pdf/steo_full.pdf.
[iv] EIA. 2023. "Annual Energy Outlook." www.eia.gov/outlooks/aeo/tables_ref.php.
[v] U.S. Government Accountability Office (GAO). 2024. "Electricity: Information on Peak Demand Power Plants." www.gao.gov/assets/gao-24-106145.pdf.

cumulative reductions in CO_2 emissions of 933 million metric tons (MMT) through 2050. The potential annual CO_2 emissions reductions in 2040 and 2050 of 48 MMT and 78 MMT, respectively, are equivalent to the annual emissions of 126 and 205 typical natural gas power plants.[vi] In addition, we estimate total cumulative water savings through 2050 of 4.8 trillion gallons.

During the first Trump administration, DOE failed to develop and update any efficiency standards, which sacrificed savings for households and businesses. If the current administration chooses not to comply with their legal obligations to consider updates to existing efficiency standards, the administration would again be foregoing an opportunity to reduce costs. Additionally, any congressional or administrative effort to stymie DOE's ability to update standards would similarly block these potential cost savings from being achieved by DOE under a current or future administration.



[vi] Environmental Protection Agency (EPA). 2024. "Greenhouse Gases Equivalencies Calculator—Calculations and References." www.epa.gov/energy/greenhouse-gases-equivalencies-calculator-calculations-and-references#gasplant.

Introduction

Appliance standards set minimum efficiency levels for product categories ranging from refrigerators and water heaters to commercial air conditioners (ACs) and electric motors; these standards ensure that all models incorporate up-to-date technology that reduces utility bills. The national appliance standards program, which now covers approximately 60 product categories, is saving households hundreds of dollars each year on utility bills (deLaski and Mauer 2017). By law, DOE can adopt only standard levels that are economically justified. The utility bill savings from more-efficient appliances that meet new standards outweigh any increase in purchase price. The Biden administration updated approximately two dozen standards, which will provide households with additional utility bill savings of more than $100 each year on average over the next two decades (Dunklin and Mauer 2024). However, large savings opportunities still remain.

The utility bill savings from updated efficiency standards would particularly benefit low-income households. High energy costs for these households are correlated with difficulty moving out of poverty, increased stress, and health risks, and they can force households to cut back on or even forego necessities such as food or medicine (Hernández 2023). Low-income households are also more likely than other households to be renters. Of the 42.5 million U.S. households that rent (Census 2024), most pay their own utility bills, yet are often unable to choose their major appliances. For these households, updated standards would help ensure that they have access to efficient, modern technology that lowers their utility bills.

Refrigerators and freezers are among the success stories of appliance standards. A refrigerator sold today uses about one-fourth as much energy on average as a typical refrigerator sold in the early 1970s. This large reduction in energy use—due to the incorporation of better insulation, more-efficient compressors, and other technologies—occurred while the average storage volume grew by approximately 25% (ASAP 2024a).

DOE updated the standards for refrigerators in 2024; this will reduce energy use by another 10–15% compared to models just meeting the current standards. However, DOE's analysis shows that even larger savings could be achieved using today's available technology, including vacuum-insulated panels.

Updated efficiency standards would also free up electricity generation for new uses and curb peak electricity demand in a time of significant load growth. By reducing electricity demand, efficiency standards can help reduce the need for grid infrastructure buildouts; avoiding these large costs can improve overall affordability for ratepayers. At the same time, reducing energy use through updated efficiency standards continues to be an important tool for improving public health and mitigating the worst impacts of climate change. Updated efficiency standards would reduce NO_X and SO_2 emissions, helping to keep the air healthy to breathe. And even as the electricity grid gets cleaner, significant opportunities remain to reduce greenhouse gas emissions through improved standards for both electric and fossil-fuel-powered appliances and equipment.

In this report, we provide estimates of the potential savings from the next round of updated efficiency standards. We first describe our methodology. We then present potential household utility bill savings and savings for businesses; electricity and peak demand savings; carbon dioxide (CO_2) emissions reductions; NO_X and SO_2 emissions reductions; and, finally, water savings.

Methodology

Scope

We estimated potential savings through 2050 from the next round of updated energy and water efficiency standards. As table 1 shows, our analysis included 49 product categories (28 used primarily in residential applications and 21 primarily used in commercial and industrial applications). There are existing national standards for all of these product categories except for portable electric spas, and fans and blowers; for these two categories, we evaluated standards that would represent the first national standards for these products. For all other product categories, we evaluated updates to existing standards. We excluded product categories for which we could not reliably estimate savings due to a lack of information.

Table 1. Product categories included in the analysis

Residential	Commercial and industrial
Air cleaners	Air compressors
Battery chargers	Automatic commercial ice makers
Boilers	Beverage vending machines
Ceiling fans	Commercial boilers
Central ACs and heat pumps	Commercial clothes washers
Circulator pumps	Commercial furnaces
Clothes dryers	Commercial package ACs and heat pumps
Clothes washers	Commercial refrigeration equipment
Cooking products	Commercial three-phase ACs and heat pumps
Dedicated-purpose pool pumps	Commercial water heaters
Dehumidifiers	Distribution transformers
Direct heating equipment	Electric motors
Dishwashers	Expanded scope electric motors
External power supplies	Fans and blowers
Faucets	Packaged terminal ACs and heat pumps
Furnace fans	Pumps
Furnaces	Single-package vertical ACs and heat pumps
Microwave ovens	Small electric motors

Residential	Commercial and industrial
Miscellaneous refrigeration products	Urinals
Pool heaters	Walk-in coolers and freezers
Portable ACs	Water-source heat pumps
Portable electric spas	
Refrigerators and freezers	
Room ACs	
Showerheads	
Toilets	
Uninterruptible power supplies	
Water heaters	

Excluded product categories: direct expansion-dedicated outdoor air systems, computer room ACs, dedicated-purpose pool pump motors, prerinse spray valves, unit heaters, and certain lighting products (ceiling fan light kits, fluorescent lamp ballasts, general service fluorescent lamps, general service lamps, high-intensity discharge lamps, illuminated exit signs, metal halide lamp fixtures, torchiere lighting fixtures, and traffic signals.

Compliance dates

For products for which DOE has issued a proposed rule that has not yet been finalized—that is, for battery chargers, boilers, ceiling fans, dehumidifiers, external power supplies, automatic commercial ice makers, beverage vending machines, and fans and blowers—we assumed that the final rule could be published in the first half of 2025, and our assumed compliance date is based on the product lead time (i.e., the number of years between publication of a final rule and the compliance date). For these product categories, our assumed compliance dates range from 2027 to 2030.

For the remaining product categories (except for the plumbing products), we assumed final rule publication dates and associated compliance dates based on our assessment of the earliest possible dates considering statutory constraints and the time necessary for DOE to complete a rulemaking. For most product categories, the assumed compliance date is six years after the previous compliance date (consistent with the statute's six-year "lockout"). For example, DOE recently updated standards for commercial package ACs and heat pumps that will take effect in 2029; for this analysis, we evaluated updated standards that would take effect in 2035. For other product categories, our assumed compliance date is based on when DOE could reasonably complete a rulemaking. For example, for central ACs and heat pumps, we assumed that DOE could initiate a rulemaking in early 2025 and publish a final rule in 2028 (with an associated compliance date of 2033). For these product categories, our assumed final rule dates range from 2027 to 2033, and the compliance dates range from 2029 to 2036.

For the plumbing products (faucets, showerheads, toilets, and urinals), we assumed updated standards could be finalized in 2028, with the new standards taking effect in 2031.

We note that if the current administration does not move ahead with standards rulemakings despite legal requirements to do so, many of these compliance dates will be delayed.

Efficiency levels

In appliance standards rulemakings, DOE characterizes both the baseline efficiency level (typically reflecting models that just meet the existing standard) and higher efficiency levels, including the maximum technologically feasible ("max-tech") level.

For product categories for which DOE has issued a proposed rule that has not yet been finalized, we considered the savings that would be achieved by finalizing the proposed rule as the potential savings from the "next round" of updated standards. This approach does not account for the additional potential savings beyond the proposed efficiency levels.

For the remaining product categories, except for the plumbing products, we estimated potential energy and water savings from the next round of updated standards based on the max-tech efficiency levels from the most recent DOE rulemaking. For the plumbing products, where we lacked DOE-identified max-tech levels, we evaluated standard levels equivalent to those now in place in California and a number of other states.

We note that in this report, we are not endorsing these specific standard levels but instead are quantifying the potential savings that are possible given current technology.[1] By law, in every standards rulemaking, DOE must adopt the highest efficiency levels that are both technologically feasible and economically justified (42 U.S.C. § 6295). For this analysis, we did not estimate the incremental cost of higher efficiency levels, which is a key component in determining economic justification. For some product categories, DOE may ultimately adopt lower standard levels or no new standards when considering cost effectiveness.

Appendix A includes a complete list of our assumed efficiency levels.

DOE's max-tech levels may not be the limit. Max-tech is not a fixed level over time. Rather, as the following examples illustrate, manufacturer innovations, consideration of new technologies, and improved test procedures can all open up new savings opportunities. This means that for some product categories, there may be greater potential savings than those we have estimated in this report.

Gas instantaneous water heaters: In the 2024 final rule for gas instantaneous water heaters, DOE identified a uniform energy factor (UEF) of 0.96 as max-tech. However, there are models available on the market today with UEF levels of 0.98 (Rinnai n.d.).

Electric motors: The standards for electric motors apply only to polyphase induction motors. Greater savings could be achieved by expanding the scope of these standards to consider advanced, high-efficiency motor technologies such as permanent magnet and synchronous reluctance motors. In addition, the current test procedure for electric motors does not capture the large potential savings from the incorporation of variable speed drives.

Air cleaners: Many air cleaners have an *auto mode*, where the unit automatically adjusts its speed (or turns off) based on air quality conditions; these auto modes have the potential to provide energy savings while ensuring good air quality. However, the current test procedure does not capture these savings.

[1] DOE's max-tech levels are based on technologies currently available on the market or in working prototypes.

Shipments, lifetime, and per-unit savings

Our methodology is based on product sales, average product lifetime, and per-unit energy and/or water savings. For all product categories except plumbing products, we used estimated annual shipments in 2024 based on DOE analyses. For plumbing products, we scaled estimated sales in California from California Energy Commission analyses to approximate national sales. For all product categories, we assumed that shipments and the distribution of efficiency levels in the base case remain constant over the analysis period.

We did not consider potential changes in shipments of products such as space and water heating equipment due to electrification. An increase in sales of electric equipment would increase potential savings from updated standards for some products while decreasing savings for others. For example, for residential space heating, electrification would likely shift sales of gas furnaces to electric heat pumps. Under such a scenario, the potential savings from updated standards for gas furnaces would decrease, while the potential savings from heat pump standards would increase.

For all product categories except the plumbing products, we used estimates of average product lifetime from the most recent DOE analysis. For the plumbing products, we used estimates from California Energy Commission analyses.

We calculated average per-unit energy and water savings taking into account the base case efficiency distribution (i.e., we did not count savings for shipments that would already meet the standard levels we evaluated in the absence of updated standards). For the plumbing products—where we lacked estimates of the base case efficiency distribution—we used models listed in the DOE certification database as a proxy for sales.

Savings estimates

We estimated utility bill savings using national average residential, commercial, and industrial energy prices (electricity, natural gas, and fuel oil) for 2024 from the January 2025 U.S. Energy Information Administration (EIA) short-term energy outlook (EIA 2025) and projected national water and wastewater prices from DOE's April 2024 residential clothes washers final rule analysis. We applied these prices to the estimated electricity, natural gas, fuel oil, and water savings to calculate annual bill savings.

We estimated peak electricity demand reductions based on end-use load profiles (EPRI 2020) and National Renewable Energy Laboratory data (Wilson et al. 2014). While the U.S. grid will likely become winter peaking in the future as more buildings electrify, our analysis assumed that the grid is summer peaking.

We estimated NO_X and SO_2 reductions using emissions factors for electricity based on the 2023 Annual Energy Outlook (AEO) reference case (EIA 2023a) and values for the combustion of natural gas and fuel oil from two sources: the U.S. Environmental Protection Agency (EPA 1998, 2010) and the DOE's July 2023 boiler notice of proposed rulemaking analysis. We similarly calculated CO_2 emissions reductions using the carbon intensity of electricity from the 2023 AEO reference case and CO_2 emissions factors for fossil fuel combustion from EIA (EIA 2023b).

Appendix A offers further details on our methodology.

Saving households money on utility bills

We estimate that the next round of updated efficiency standards could save households an average of $149 annually over two decades (2030–2050). Total potential cumulative household bill savings through 2050 are $429 billion. Figure 1 shows the 10 residential product categories that represent the largest potential cumulative bill savings for households. For faucets and showerheads, roughly three-quarters of the total bill savings are from water savings due to relatively high water and wastewater prices.

In the following, we discuss the opportunity with updated standards for the five product categories that represent the largest potential household bill savings: central ACs and heat pumps, faucets, water heaters, clothes dryers, and showerheads.

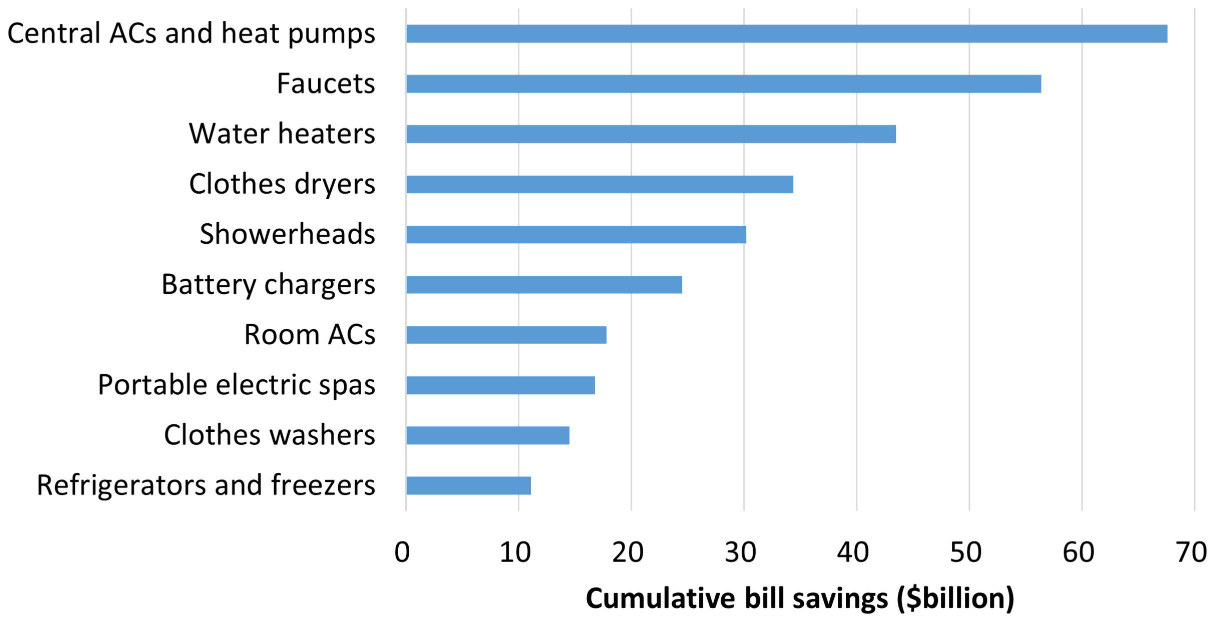


Figure 1. Top 10 residential product categories by potential cumulative household bill savings

Central ACs and heat pumps

Space conditioning (heating and cooling) is the largest energy end use in homes (EIA 2023c). For homes with existing central ACs, installing more-efficient equipment reduces cooling bills, while homes with existing central heat pumps save on both cooling and heating bills. DOE finalized the current standards for central ACs and heat pumps in 2017; the standards took effect in 2023. We evaluated updated standards that would reduce energy use by approximately 10–25% relative to the current standards for central ACs, depending on the equipment type and region, and by 7–16% relative to the current standards for heat pumps. More-efficient central AC and heat pump models incorporate two-stage or variable speed compressors and have improved indoor blower and outdoor fan motors.

Faucets

Faucets that consume less water reduce water and wastewater bills while also saving energy from reduced hot-water use. The federal faucet standards, which specify a maximum flow rate of 2.2 gallons per minute (gpm), have never been updated since Congress established them in 1992. In 2010, DOE waived federal preemption for plumbing products (including faucets), which permitted states to adopt more stringent standards than the national standards (DOE 2010); to date, 13 states and the District of Columbia have done so (ASAP 2024b). However, many kitchen faucet and some lavatory faucet models remain on the market that meet only the outdated federal standards. We evaluated standard levels for residential lavatory faucets and kitchen faucets of 1.2 gpm and 1.8 gpm, respectively, which are equivalent to many of the existing state standards.

Water heaters

Water heaters are typically the second largest energy user in homes. In 2024, DOE finalized new efficiency standards for all major water heater types. For electric storage water heaters, the new standards will shift the market away from inefficient electric resistance technology; DOE estimates that, by 2030, about 60% of electric storage water heaters sold will incorporate heat pump technology, which cuts energy use by at least half. However, the required efficiency improvements for gas storage water heaters are more modest, representing energy savings of about 9%. There is a significant opportunity to reduce the energy use of gas storage water heaters by adopting condensing technology; the max-tech levels would provide gas savings of nearly 25% relative to the standards in the 2024 final rule. In addition, for electric storage water heaters, the recently finalized standards increase a typical baseline model's efficiency from a UEF of 0.92 (which is typical of inefficient electric resistance technology) to 2.3 UEF; however, the max-tech levels, which reflect higher-efficiency heat pump water heaters, are 3.7–3.87 UEF for the most common tank sizes (e.g., 40- and 50-gallon tanks). For gas instantaneous water heaters, the 2024 final rule set new standards at UEF levels of 0.91 and 0.93 for the medium and high draw patterns, respectively; we evaluated UEF levels of 0.93 and 0.96.

Clothes dryers

Clothes dryers are another large energy end use in homes. In 2024, DOE finalized updated standards for clothes dryers that will reduce the energy use of standard-size electric and gas models by about 40% relative to the least-efficient models on the market. However, significantly greater savings are possible, especially for electric dryers, which make up about 80% of the market. We evaluated standard levels for standard-size electric and gas dryers that would reduce energy use by 44% and 8%, respectively, relative to the standards in the 2024 final rule; these levels could be achieved using heat pump technology for electric dryers and inlet air preheat for gas dryers.

Showerheads

As with the faucet standards, the federal showerhead standards have not been updated since Congress established the initial standards in 1992. Since 2010, when DOE waived federal preemption for plumbing products, 13 states and the District of Columbia have adopted showerhead standards that are more stringent than the national standards (ASAP 2024b). The federal standards specify a maximum flow rate of 2.5 gpm; we evaluated a standard level of 1.8 gpm, which is equivalent to many of the existing state standards.

Appendix B shows the potential cumulative utility bill savings for each residential product category.

Lowering operating costs for businesses

Businesses of all sizes save on operating costs when they use more-efficient equipment. We estimate that U.S. businesses could collectively save an average of $13.8 billion annually over two decades (2030–

2050) from the next round of updated standards. The potential cumulative savings through 2050 are $291 billion. Figure 2 shows the 10 commercial and industrial product categories that represent the largest potential bill savings for businesses. In the following, we discuss opportunities with updated standards for the top five categories: fans and blowers, two categories of electric motors, commercial package ACs and heat pumps, and distribution transformers.

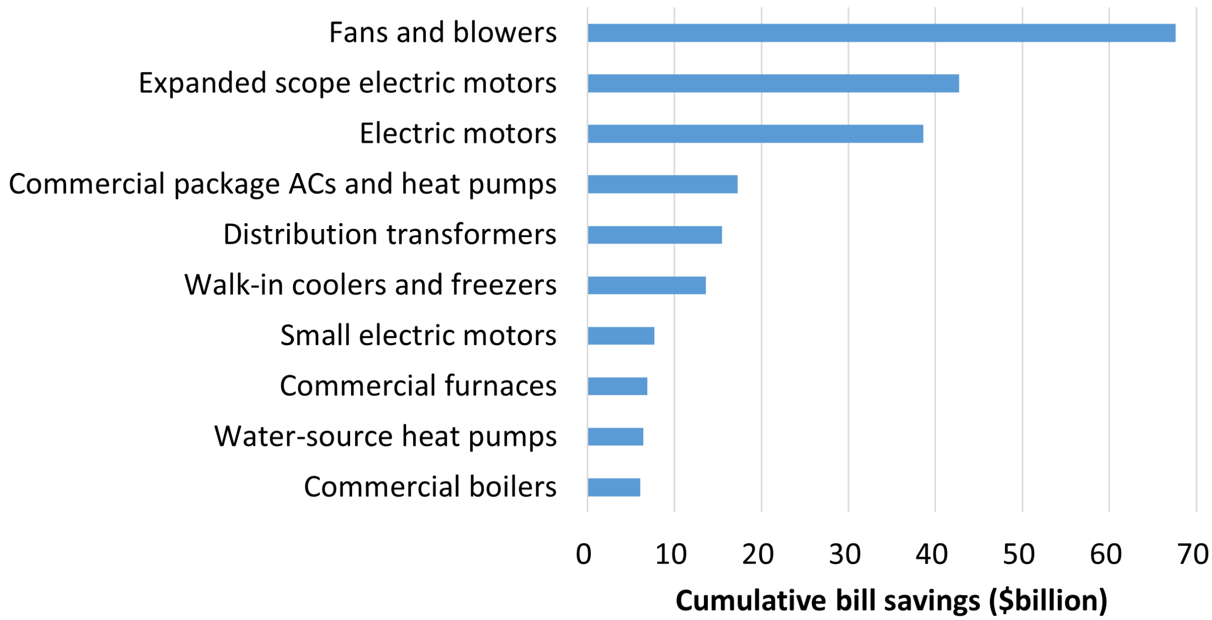


Figure 2. Top 10 commercial and industrial product categories by potential cumulative bill savings for businesses

Fans and blowers

Fans and blowers are used in various applications, including commercial building heating and cooling equipment, commercial kitchen exhaust systems, and agricultural ventilation. There are no existing national standards for fans and blowers, but in 2024, DOE proposed new standards. We evaluated standard levels equivalent to those in the 2024 proposed rule. For general fans and blowers, the proposed standards are expressed as minimum fan energy index (FEI) levels that would apply to the fan's full operating range, with the goal of improving fan selection to reduce energy use. For air circulating fans, which are typically used for personnel cooling (e.g., to cool factory workers), the proposed standards could be met using more-efficient motors and improved aerodynamic design.

Expanded scope electric motors

Expanded scope electric motors (ESEMs) include certain types of small electric motors that are used in an array of equipment, including fans, pumps, and compressors. There are no ESEM standards in effect today, but in early 2025, DOE issued a final rule establishing the first national standards, with compliance required beginning in 2029. We evaluated standard levels that would reduce energy use by 7–22%, depending on the motor type, relative to the standards in the recent final rule.

Electric motors

Electric motors include three-phase induction motors from 1–750 horsepower. DOE most recently updated the standards for electric motors in 2023, with compliance required beginning in 2027. Electric motors account for 43% and 69% of total electricity use in the commercial and industrial sectors, respectively (Rao et al. 2021); given this, even small percentage savings can lead to large national electricity savings. We evaluated standard levels that would reduce electricity use by 1–3% relative to the standards in the 2023 final rule.

Commercial package ACs and heat pumps

Commercial package ACs and heat pumps, also called rooftop units, are typically used to cool small- to mid-sized commercial buildings, such as schools, restaurants, big-box stores, and small office buildings. In 2024, DOE finalized updated standards for this equipment, with compliance beginning in 2029. Currently, the rooftop unit market is dominated by ACs; for this equipment, we evaluated standard levels that would reduce energy use by 15% on average relative to the standards in the recent final rule. More-efficient rooftop units incorporate technologies such as multiple compressor staging, heat exchangers with more surface area, and more-efficient fans.

Distribution transformers

Distribution transformers reduce electricity voltage from the high voltage used in electricity distribution lines to the lower voltages used by equipment in homes, businesses, and factories. Since virtually all the electricity consumed in the United States passes through distribution transformers, even small improvements in transformer efficiency can yield large energy savings. Energy losses in transformers can be significantly reduced by using amorphous metal for the transformer steel core in place of conventional grain-oriented electrical steel. In 2024, DOE finalized updated standards for distribution transformers; however, at the standard levels adopted, DOE estimated that only 25% of the market will need to use amorphous metal (DOE 2024a). We analyzed standards for distribution transformers that would shift the remaining portion of the market to amorphous metal.

Appendix C shows the potential cumulative utility bill savings for each of the commercial and industrial product categories.

Electricity and peak demand savings

Efficiency standards reduce total electricity consumption and lower peak demand during the hours when the grid is strained. After nearly two decades of stable demand, U.S. electricity consumption grew in 2024 (EIA 2025) and is projected to continue to grow. While forecasts vary (E&E 2025), DOE anticipates total annual electricity consumption to grow by up to 20% in the next decade (DOE 2024b). A large portion of projected growth is attributed to the proliferation of data centers (DOE 2024b). A 2024 Lawrence Berkeley National Laboratory report found that U.S. data center energy use increased from 60 terawatt-hours (TWh) in 2016 to 176 TWh in 2023. By 2028, the authors expect between 325 and 580 TWh of data center energy consumption (LBNL 2024). For comparison, total U.S. electricity consumption in 2028 is projected to be 3,986 TWh (EIA 2023a).

Peak demand, which is the power required when the hourly demand for electricity is highest—and what grid operators need to accommodate to prevent electricity service interruptions—is similarly expected to grow. One energy consulting firm forecasts that by 2029, peak demand will increase by 16% (Wilson, Zimmerman, and Gramlich 2024). Lowering peak demand from appliances and equipment in homes and businesses would leave more room for large loads such as data centers and growing domestic manufacturing to tap into existing grid infrastructure or reduce the need for expensive buildouts of new grid infrastructure—including generation, transmission, and distribution—which put upward pressure on rates.

In 2040 and 2050, we estimate that updated efficiency standards could reduce electricity consumption by 204 TWh and 338 TWh, respectively, which are equivalent to 4.7% and 7.2% of projected U.S. electricity consumption in those years (EIA 2023a). Figure 3 shows projected U.S. electricity consumption, along with the potential savings from updated standards.

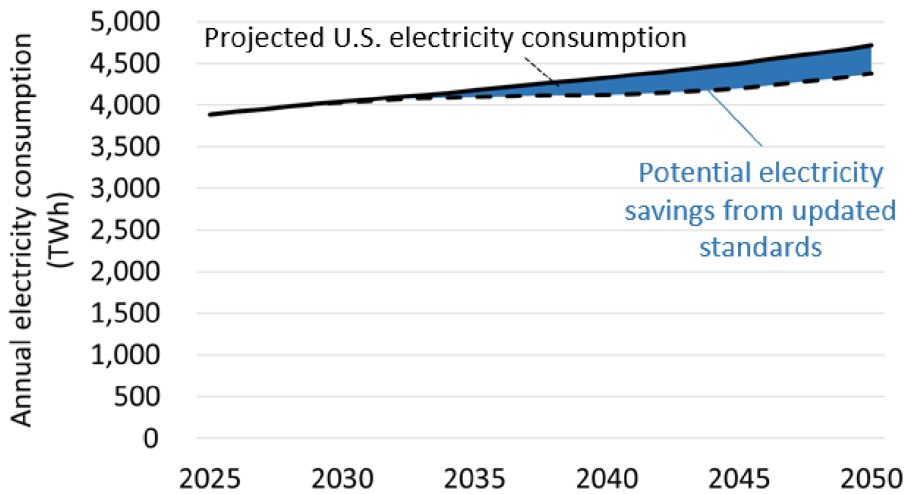


Figure 3. Projected U.S. electricity consumption (solid line), and potential electricity savings from updated standards. Source: ASAP tabulations based on EIA data (EIA 2023a).

We also estimate that updated efficiency standards could reduce peak demand by 32 GW in 2040 and 50 GW in 2050. These reductions are equivalent to 4.3% and 6.7%, respectively, of the 2024 summer peak demand (EIA 2024).[2] Such reductions are meaningful; for comparison, the total nameplate capacity of natural gas peaker plants in 2021 was 190 GW (GAO 2024). The potential peak demand reductions are similar in scale to U.S. grid-scale battery storage, which is expected to grow from 22 GW in August 2024 to 38 GW by the end of 2025 (Denholm, Duraes de Faria, and Frost 2024).

Appendix D shows the potential electricity and peak demand savings by product category.

Cutting carbon emissions

Efficiency standards cut energy waste, which reduces CO_2 emissions if the energy is generated from fossil fuels. We estimate that the next round of updated standards could reduce CO_2 emissions by 933 MMT cumulatively through 2050. The potential annual CO_2 emissions reductions in 2040 and 2050 of 48 MMT and 78 MMT, respectively, are equivalent to the annual emissions of 126 and 205 typical natural gas power plants (EPA 2024a).

Figure 4 shows the top 10 product categories in terms of potential cumulative CO_2 emissions reductions. These categories are water heaters, fans and blowers, expanded scope electric motors, central ACs and heat pumps, electric motors, commercial furnaces, pool heaters, clothes dryers, battery chargers, and

[2] U.S. hourly peak electricity demand in the lower 48 states was 745 GW.

commercial boilers. Importantly, the potential emissions reductions from the 39 other product categories (indicated by the orange bar), are more than twice as large as the potential reductions from the top product category (water heaters). In other words, while the product categories outside the top 10 each represent smaller potential CO_2 emissions reductions, their combined emissions reduction potential is large.

For the top 10 product categories, almost two-thirds (62%) of the combined potential emissions reductions result from lower electricity consumption, with the remaining reductions coming from reduced on-site gas and oil consumption. For the top product—water heaters—most of the potential CO_2 emissions reductions (89%) are from fossil fuel savings. Across all 49 product categories, about 70% of the total potential CO_2 emissions reductions are due to lower electricity consumption.

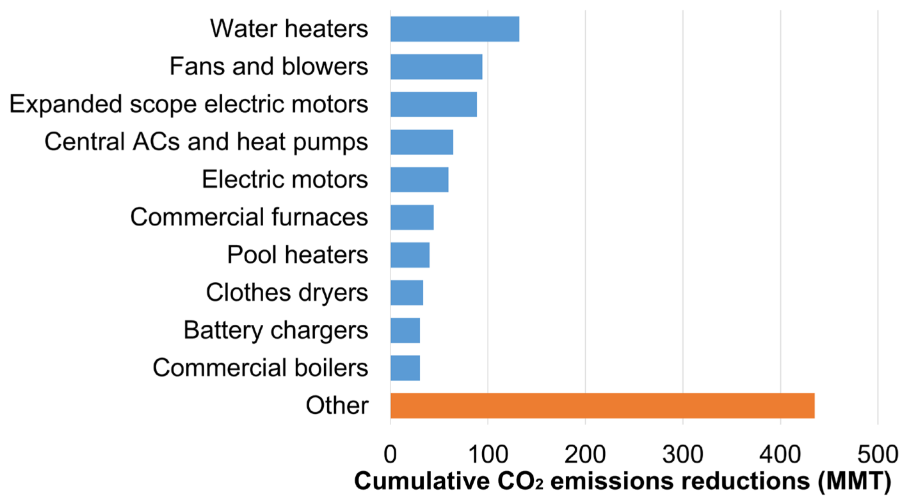


Figure 4. Potential cumulative CO_2 reductions (in MMTs) through 2050 for the top 10 product categories and for the 39 other product categories combined

Appendix E shows the potential cumulative and annual (in 2040 and 2050) CO_2 emissions reductions by product category.

Improving public health

NO_X and SO_2 are two harmful air pollutants that result from the combustion of hydrocarbons at power plants and, for appliances that directly combust fossil fuel, on site in homes and businesses.

NO_X, as a combustion by-product, includes 90–95% nitric oxide (NO) and 5–10% nitrogen dioxide (NO_2) (Jarvis et al. 2010). NO_2, a pollutant of concern regulated by the EPA, is a respiratory system irritant that can lead to coughing, wheezing, and increased asthma attacks (ALA 2023). In the atmosphere, NO_X reacts with other chemical components in the air and can form particulate matter, ozone, and acid rain (EPA 2024b). Particulate matter (PM), which is often observed as haze, is associated with the greatest proportion of adverse health effects related to air pollution in the United States and globally (CARB 2024). SO_2, another pollutant of concern, can also make breathing difficult, especially for children and people with asthma.

By reducing energy consumption, efficiency standards result in lower emissions of these harmful air pollutants. We estimate that updated standards could reduce NO_X emissions by 25,900 tons in 2040 and

44,700 tons in 2050. The annual 2040 NO_X emissions reductions are equivalent to the annual tailpipe emissions of 380,000 diesel school buses. We estimate that updated standards could also reduce SO_2 emissions by 10,200 tons in 2040 and 14,000 tons in 2050. While our analysis did not attempt to quantify the monetary benefits of avoided air pollution emissions, we expect that they would be significant.

Appendix F shows the potential NO_X and SO_2 emissions reductions by product category.

Conserving water

Efficiency standards for certain products also save water, which is especially important in drought-prone regions of the United States. DOE has periodically updated standards for residential and commercial clothes washers and residential dishwashers. We estimate that updating the water conservation standards for these product categories could save 0.8 trillion gallons of water cumulatively through 2050.

DOE could also adopt updated water efficiency standards for four plumbing products: faucets, showerheads, toilets, and urinals. As noted earlier, the initial federal standards for these products have never been updated. In the absence of updated federal standards—and with DOE waiving federal preemption—some states have set more stringent water efficiency standards for these products. We estimate that updating the standards for the four plumbing products could save an additional 4.0 trillion gallons of water cumulatively through 2050 (for a total of almost 4.9 trillion gallons across all product categories). For comparison, the largest U.S. reservoir—Lake Mead in Arizona and Nevada—can hold 9.3 trillion gallons of water; it dropped to 27% capacity, or approximately 2.5 trillion gallons, during the 2022 drought (NASA 2022).

We have not estimated the embedded energy savings from reduced water consumption. However, using less water translates to less energy required for pumping and water treatment. According to EPA, water and wastewater systems account for 2% of total U.S. energy consumption (EPA 2025).

Appendix G shows the potential water savings for each of the water-using products.

Conclusion

The next round of updated efficiency standards could add to the significant savings from existing standards, continuing to cut costs for U.S. households and businesses. In total, updated standards for 49 product categories could reduce household utility bills by an average of almost $150 annually, and they could collectively save businesses $13.8 billion in annual operating costs over two decades. The electricity and peak demand savings from updated standards would help free up capacity on the electric grid; this would allow growing industries that rely on data centers and increased domestic manufacturing to use grid resources and help reduce the need for expensive buildouts of new grid infrastructure. Updated standards could reduce U.S. electricity consumption by 4.7% and 7.2% of the projected electricity consumption in 2040 and 2050, respectively, and reduce peak demand in those years by 32 GW and 50 GW. These updated standards would also reduce emissions of harmful air pollutants and greenhouse gases, and conserve water.

References

AHRI (Air-Conditioning, Heating, and Refrigeration Institute). 2025. "Directory of Certified Product Performance." Accessed October 2024. www.ahridirectory.org/.

ALA (American Lung Association). 2023. "The Health Impact of Combustion in Homes." www.lung.org/getmedia/da394c1a-200e-4c89-9947-7ecb1a26571a/The-Health-Impact-of-Combustion-in-Homes.pdf.

ASAP (Appliance Standards Awareness Project). 2024a. "Average Household Refrigerator Energy Use, Volume, and Price over Time." www.appliance-standards.org/sites/default/files/refrigerator_graph_April_2024.pdf.

_____. 2024b. "State Standards." Accessed January 2025. www.appliance-standards.org/state-standards.

BTS (Bureau of Transportation Statistics). 2024. "Estimated U.S. Average Vehicle Emissions Rates per Vehicle by Vehicle Type Using Gasoline and Diesel." Accessed September 2024. www.bts.gov/content/estimated-national-average-vehicle-emissions-rates-vehicle-vehicle-type-using-gasoline-and.

CARB (California Air Resources Board). 2024. "Inhalable Particulate Matter and Health (PM2.5 and PM10)." Accessed December 2024. www2.arb.ca.gov/resources/inhalable-particulate-matter-and-health#:~:text=In%20addition%2C%20of%20all%20of,Global%20Burden%20of%20Disease%20Project.

CEC (California Energy Commission). 2023. "Final Staff Report for Pool Controls." Sacramento, CA: CEC. www.efiling.energy.ca.gov/GetDocument.aspx?tn=248922&DocumentContentId=83469.

Census (U.S. Census Bureau). 2024. "Nearly Half of Renter Households Are Cost-Burdened, Proportions Differ by Race." www.census.gov/newsroom/press-releases/2024/renter-households-cost-burdened-race.html.

_____. 2025. "U.S. Census Bureau QuickFacts. California; United States" Accessed February 2025. www.census.gov/quickfacts/fact/table/CA,US/HSD410223.

deLaski, Andrew, and Joanna Mauer. 2017. "Energy-Saving States of America: How Every State Benefits from National Appliance Standards." Washington, DC: ACEEE; Boston: ASAP. www.appliance-standards.org/sites/default/files/Appliances%20standards%20white%20paper%202%202-14-17.pdf.

Denholm, Paul, Victor Duraes de Faria, and Jason Frost. 2024. "How the U.S. Power Grid Kept the Lights on in Summer 2024." Golden, CO: National Renewable Energy Laboratory. NREL/TP-6A40-91517. www.nrel.gov/docs/fy25osti/91517.pdf.

DOE (Department of Energy). 2010. "Energy Efficiency Program for Consumer Products: Waiver of Federal Preemption of State Regulations Concerning the Water Use or Water Efficiency of Showerheads, Faucets, Water Closets and Urinals." 75 Federal Register (FR) 80289. www.govinfo.gov/content/pkg/FR-2010-12-22/pdf/2010-32116.pdf.

_____. 2023. "2023-07 Technical Support Document: Energy Efficiency Program for Consumer Products and Commercial and Industrial Equipment: Consumer Boilers (NOPR)." Washington, DC: DOE. www.regulations.gov/document/EERE-2019-BT-STD-0036-0043.

_____. 2024a. "DOE Finalizes Energy Efficiency Standards for Distribution Transformers That Protect Domestic Supply Chains and Jobs, Strengthen Grid Reliability, and Deliver Billions in Energy Savings."

Accessed November 2024. www.energy.gov/articles/doe-finalizes-energy-efficiency-standards-distribution-transformers-protect-domestic.

______. 2024b. “Clean Energy Resources to Meet Data Center Electricity Demand.” Accessed September 2024. www.energy.gov/policy/articles/clean-energy-resources-meet-data-center-electricity-demand.

______. 2024d. “Average Annual Vehicle Miles Traveled by Major Vehicle Category.” Accessed September 2024. www.afdc.energy.gov/data/widgets/10309.

Dunklin, Jeremy, and Joanna Mauer. 2024. “Reducing Costs across America: New Appliance Standards Save Consumers Money in Every State.” Boston: ASAP; Denver: PIRG. www.appliance-standards.org/sites/default/files/reducing-costs-across-america.pdf.

E&E News. “Can Electricity Forecasts Be Trusted in the Age of AI?” Accessed January 2025. subscriber.politicopro.com/article/eenews/2025/01/28/can-electricity-forecasts-be-trusted-in-the-new-age-of-ai-00196136.

EIA (Energy Information Administration). 2023a. “Annual Energy Outlook.” www.eia.gov/outlooks/aeo/tables_ref.php.

______. 2023b. “Carbon Dioxide Emissions Coefficients.” Accessed September 2024. www.eia.gov/environment/emissions/co2_vol_mass.php.

______. 2023c. “Use of Energy Explained—Energy Use in Homes.” Accessed October 2024. www.eia.gov/energyexplained/use-of-energy/homes.php.

______. 2024. “U.S. Hourly Electricity Demand Peaked in July with Widespread Heatwaves.” Accessed February 2025. www.eia.gov/todayinenergy/detail.php?id=63445#.

______. 2025. “Short-Term Energy Outlook.” Washington, DC: EIA. www.eia.gov/outlooks/steo/pdf/steo_full.pdf.

EPA (Environmental Protection Agency). 1998. “AP-42: Compilation of Air Emissions Factors from Stationary Sources, Section 1.4 Natural Gas Combustion, Final Section Supplement D.” www.epa.gov/sites/default/files/2020-09/documents/1.4_natural_gas_combustion.pdf.

______. 2010. “AP-42: Compilation of Air Emissions Factors from Stationary Sources, Section 1.3 Fuel Oil Combustion, Final Section Supplement E.” www.epa.gov/sites/default/files/2020-09/documents/1.3_fuel_oil_combustion.pdf.

______. 2024a. “Greenhouse Gases Equivalencies Calculator—Calculations and References.” Accessed July 2024. www.epa.gov/energy/greenhouse-gases-equivalencies-calculator-calculations-and-references#gasplant.

______. 2024b. “Basic Information about NO_2.” Accessed July 2024. www.epa.gov/no2-pollution/basic-information-about-no2#Effects.

______. 2025. “Energy Efficiency for Water Utilities.” Accessed February 2025. www.epa.gov/sustainable-water-infrastructure/energy-efficiency-water-utilities.

EPRI (Electric Power Research Institute). 2020. “Load Shape Library 8.0.” Accessed July 2024. www.loadshape.epri.com/.

GAO (U.S. Government Accountability Office). 2024. "Electricity: Information on Peak Demand Power Plants." www.gao.gov/assets/gao-24-106145.pdf.

Hernández, Diana. 2023. "Energy Insecurity and Health: America's Hidden Hardship." *Health Affairs Health Policy Brief*, June 29. www.healthaffairs.org/do/10.1377/hpb20230518.472953/.

Jarvis, Debbie J., Gary Adamkiewicz, Marie-Eve Heroux, Regula Rapp, and Frank J. Kelly. 2010. *WHO Guidelines for Indoor Air Quality: Selected Pollutants*. Geneva: World Health Organization. www.ncbi.nlm.nih.gov/books/NBK138707/.

LBNL (Lawrence Berkely National Laboratory). 2024. "2024 United States Data Center Energy Usage Report." Berkeley, CA: LBNL. www.eta-publications.lbl.gov/sites/default/files/2024-12/lbnl-2024-united-states-data-center-energy-usage-report.pdf.

NASA (National Aeronautics and Space Administration). 2022. "Lake Mead Keeps Dropping." Accessed December 2024. www.earthobservatory.nasa.gov/images/150111/lake-mead-keeps-dropping.

Rao, Prakesh, Paul Sheaffer, Yuting Chen, Miriam Goldberg, Benjamin Jones, Jeff Cropp, and Jordan Hester. 2021. "U.S. Industrial and Commercial Motor System Market Assessment Report, Volume 1: Characteristics of the Installed Base." Berkeley, CA: LBNL. www.eta-publications.lbl.gov/sites/default/files/u.s._industrial_and_commercial_motor_system_market_assessment_report_volume_1-_characteristics_of_the_installed_base_p_rao.pdf.

Rinnai. n.d. "SENSEI® RX Models." Accessed January 2025. www.rinnai.us/residential/sensei-rx.

Wilson, E., C. Engebrecht Metzger, S. Horowitz, and R. Hendron. 2014. "2014 Building America House Simulation Protocols." Washington, DC: NREL. www.energy.gov/sites/prod/files/2014/03/f13/house_simulation_protocols_2014.pdf.

Wilson, John D., Zach Zimmerman, and Rob Gramlich. 2024. "Strategic Industries Surging: Driving US Power Demand." Washington, DC: Grid Strategies. www.gridstrategiesllc.com/wp-content/uploads/National-Load-Growth-Report-2024.pdf.

Appendix A: Methodology

Assumed final rule and compliance dates

Table A1 shows the lead time—that is, the number of years between a final rule publication and its compliance date—assumed in our analysis (in most cases, the following correspond to lead times specified by statute).

Table A1. Lead time by product category

Lead time	Residential	Commercial and industrial
2 years	Battery chargers External power supplies	None
3 years	All other residential product categories	All other commercial and industrial product categories
5 years	Air cleaners Boilers Central ACs and heat pumps Direct heating equipment Furnaces Furnace fans Miscellaneous refrigeration equipment Pool heaters Portable ACs Portable electric spas Water heaters	Air compressors Fans and blowers Small electric motors

Tables A2 and A3 show our assumed compliance dates for residential and for commercial and industrial product categories, respectively.

Table A2. Assumed compliance dates for residential product categories

Product category	Assumed compliance date
Air cleaners	2032
Battery chargers	2027
Boilers	2030
Ceiling fans	2028
Central ACs and heat pumps	2033
Circulator pumps	2034
Clothes dryers	2034

Product category	Assumed compliance date
Clothes washers	2034
Cooking products	2034
Dedicated-purpose pool pumps	2029
Dehumidifiers	2028
Direct heating equipment	2032
Dishwashers	2033
External power supplies	2027
Faucets	2031
Furnaces	2035
Furnace fans	2032
Microwave ovens	2032
Miscellaneous refrigeration equipment	2035
Pool heaters	2034
Portable ACs	2033
Portable electric spas	2031
Refrigerators and freezers	2036
Room ACs	2032
Showerheads	2031
Toilets	2031
Uninterruptible power supplies	2030
Water heaters	2035

Table A3. Assumed compliance dates for commercial and industrial product categories

Product category	Assumed compliance date
Air compressors	2033
Automatic commercial ice makers	2028
Beverage vending machines	2028
Commercial boilers	2030
Commercial clothes washers	2030
Commercial furnaces	2030
Commercial package ACs and heat pumps	2035
Commercial refrigeration equipment	2034
Commercial three-phase ACs and heat pumps	2031

Product category	Assumed compliance date
Commercial water heaters	2033
Distribution transformers	2035
Electric motors	2033
Expanded scope electric motors	2035
Fans and blowers	2030
Packaged terminal ACs and heat pumps	2030
Pumps	2030
Single-package vertical ACs and heat pumps	2030
Small electric motors	2032
Urinals	2031
Walk-in coolers and freezers	2034
Water-source heat pumps	2030

Assumed standard levels

Tables A4 and A5 show the energy and water efficiency levels we evaluated for residential and for commercial and industrial product categories, respectively. Where assumed standard levels are listed as percentage savings, the savings are relative to a product just meeting the most recently finalized standard (unless otherwise noted). A range of savings percentages indicates the minimum and maximum savings across a product category's various product classes.

Table A4. Assumed standard levels for residential product categories

Product category	Assumed standard level
Air cleaners	5.4/12.8/7.4 $PM_{2.5}$CADR/W (small/medium/large)
Battery chargers	Residential applications: 17–46% savings (relative to base case)
	Commercial applications: 16–47% savings (relative to base case)
Boilers	Gas-fired, hot water: 95% AFUE
	Gas-fired, steam: 82% AFUE
	Oil-fired, hot water: 88% AFUE
	Oil-fired, steam: 86% AFUE
Ceiling fans	Standard: 83/90/131 CFM/W (44/52/60 inch)
	Hugger: 73/79/121 CFM/W (44/52/60 inch)
	High-speed belt-driven: 1.89 CFEI100
	Large-diameter: 1.22 CFEI100 and 1.31 CFEI40
Central ACs and heat pumps	Split central AC <30 kBtu/h: 17 SEER (16.2 SEER2)

Product category	Assumed standard level
	Split central AC ≥30 kBtu/h: 16.5 SEER (15.7 SEER2)
	Package central AC: 17.5 SEER (16.8 SEER2)
	Split heat pump <45 kBtu/h: 19 SEER (18.1 SEER2), 9.9 HSPF (8.5 HSPF2)
	Split heat pump ≥45 kBtu/h: 17.5 SEER (16.7 SEER2), 9.4 HSPF (8.1 HSPF2)
	Package heat pump: 15 SEER (14.4 SEER2), 8.2 HSPF (7.0 HSPF2)
Circulator pumps	66% savings
Clothes dryers	Standard-size electric dryers: 7.39 CEF
	Standard vented gas dryers: 3.83 CEF
Clothes washers	Standard-size top-loading: 5.37 EER, 0.67 WER
	Ultra-compact top-loading: 3.79 EER, 0.29 WER
	Standard-size front-loading: 5.97 EER, 0.85 WER
	Compact front-loading: 5.97 EER, 0.8 WER
	Semiautomatic: 2.51 EER, 0.36 WER
Cooking products	Electric coil cooktops: 0% electricity savings
	Electric smooth cooktops: 14% electricity savings
	Gas cooktops: 25% gas savings
	Standard electric ovens: 21% electricity savings
	Self-clean electric ovens: 17% electricity savings
	Standard gas ovens: 7% gas savings
	Self-clean gas ovens: 6% gas savings
Dedicated-purpose pool pumps	Standard-size, self-priming pool filter pump, 1 horsepower: 12% savings
	Standard-size, self-priming pool filter pump, 3 horsepower: 18% savings
	Standard-size, non-self-priming pool filter pump: 71% savings
	Pressure cleaner booster pump: 27% savings
Dehumidifiers	≤25 pints/day: 1.70 IEF
	>25 and ≤50 pints/day: 2.01 IEF
	>50 pints/day: 3.10 IEF
	Whole-home (≤8 ft^3): 2.22 IEF
	Whole-home (>8 ft^3): 3.81 IEF
Direct heating equipment	Gas wall fan: 90% AFUE
	Gas wall gravity: 70% AFUE
	Gas floor: 58% AFUE

Product category	Assumed standard level
	Gas room: 83% AFUE
Dishwashers	Standard-size: 193 kWh/yr, 2.4 gal./cycle
	Compact: 124 kWh/yr, 1.6 gal./cycle
External power supplies	Single-voltage, AC-DC, basic voltage:
	2.5 W: 73.22% efficiency, 0.075 W no-load power
	12 W: 83.26% efficiency, 0.075 W no-load power
	24 W: 86.8% efficiency, 0.075 W no-load power
	60 W: 89% efficiency, 0.15 W no-load power
	120 W: 89% efficiency, 0.15 W no-load power
Faucets	Residential lavatory: 1.2 gpm
	Kitchen: 1.8 gpm
Furnaces	Non-weatherized gas: 98% AFUE
	Mobile home gas: 96% AFUE
Furnace fans	Non-weatherized gas furnace, non-condensing: 12% electricity savings
	Non-weatherized gas furnace, condensing: 12% electricity savings
	Weatherized gas furnace, non-condensing: 14% electricity savings
	Non-weatherized electric furnace /modular blower: 12% electricity savings
Microwave ovens	Countertop: 0.4 W
	Over-the-range: 0.5 W
Miscellaneous refrigeration equipment	Compact free-standing coolers: 28–42% savings
	Standard-size freestanding coolers: 10% savings
Pool heaters	Gas-fired: 94.7% integrated thermal efficiency
	Electric: 595% integrated thermal efficiency
Portable ACs	10.73 CEER
Portable electric spas	Hard-sided: 78–79% savings
	Inflatable: 51% savings
Refrigerators and freezers	Standard-size refrigerators: 7–15% savings
	Standard-size freezers: 12–23% savings
	Compact refrigerators: 20% savings
	Compact freezers: 11–17% savings
Room ACs	w/o reverse cycle, with louvered sides, <6,000 Btu/h: 20.2 CEER

Product category	Assumed standard level
	w/o reverse cycle, with louvered sides, 6,000–7,999 Btu/h: 21.2 CEER
	w/o reverse cycle, with louvered sides, 8,000–13,999 Btu/h: 21.9 CEER
Showerheads	1.8 gpm
Toilets	1.28 gpf
Uninterruptible power supplies	Voltage and frequency dependent (VFD): 62% savings
	Voltage independent (VI): 56% savings
	Voltage and frequency independent (VFI): 35% savings
Water heaters	Electric storage, ≤55 gallons, medium draw pattern: 3.75 UEF
	Gas-fired storage, 38-gallon, medium draw pattern: 0.81 UEF
	Gas-fired storage, 48-gallon, high draw pattern: 0.88 UEF
	Gas-fired instantaneous, medium draw pattern: 0.93 UEF
	Gas-fired instantaneous, high draw pattern: 0.96 UEF
	Oil-fired storage, 30-gallon, high draw pattern: 0.68 UEF

[1]Btu is British thermal unit; kWh is kilowatt-hour

The residential product efficiency metrics are as follows:

- AFUE: annual fuel utilization efficiency
- CEER: combined energy efficiency ratio
- CEF: combined energy factor
- EER: energy efficiency ratio
- gpf: gallons per flush
- gpm: gallons per minute
- HSPF and HSPF2: heating seasonal performance factor
- IEF: integrated energy factor
- $PM_{2.5}$CADR/W: particulate matter (2.5-micron) clean air delivery rate per watt
- SEER and SEER2: seasonal energy efficiency ratio; the most recent DOE analysis was based upon SEER, while the current standard, in effect since 2023, is based on SEER2.[3]
- UEF: uniform energy factor
- WER: water efficiency ratio

[3] Updated central AC and heat pump standards would likely be based on the metrics seasonal cooling and off-mode rating efficiency (SCORE) and seasonal heating and off-mode rating efficiency (SHORE), which were finalized in 2024.

Table A5. Assumed standard levels for commercial and industrial product categories

Product category	Assumed standard level
Air compressors	8–18% savings
Automatic commercial ice makers	Ice-making head: 0–17% savings
	Remote condensing: 3–9% savings
	Self-contained: 0–12% savings
	Low-capacity: 4–11% savings
Beverage vending machines	Class A: 37% savings
	Class B: 35% savings
	Combo A: 30% savings
	Combo B: 45% savings
Commercial packaged boilers	Gas-fired, hot-water, small: 99% TE
	Gas-fired, hot-water, large: 97% TE
Commercial clothes washers	Top-loading: 1.6 MEF, 5.5 IWF
	Front-loading: 2.3 MEF, 3.8 IWF
Commercial warm air furnace	Gas-fired: 92% TE
	Oil-fired: 92% TE
Commercial unitary ACs and heat pumps	≥65,000 and <135,000 Btu/h AC: 18.7 IVEC (22.4 IEER)
	≥135,000 and <240,000 Btu/h AC: 19.5 IVEC (20.1 IEER)
	≥240,000 and <760,000 Btu/h AC: 18.3 IVEC (18.5 IEER)
Commercial refrigeration equipment	0–21% savings
Commercial three-phase ACs and heat pumps	ACs: 19 SEER
	Heat pumps: 18 SEER
Commercial water heaters	Commercial gas-fired storage: 99% TE
	Residential-duty gas-fired storage: 0.93 UEF
Distribution transformers	Liquid-immersed: 99.37–99.71% efficiency
	Low-voltage dry-type: 99.00–99.41% efficiency
	Medium-voltage dry-type: 99.14–99.63% efficiency
Electric motors	0.5–3% savings
Expanded scope electric motors	7–22% savings
Fans and blowers	General fans and blowers: 0.85–1.48 FEI
	Air circulating fans: 12.2–21.5 CFM/W

Product category	Assumed standard level
Packaged terminal ACs and heat pumps	<7,000 Btu/h: 13.8 EER
	≥7,000 and ≤15,000 Btu/h: 13.1 EER
	>15,000 Btu/h: 11.0 EER
Pumps	70% efficiency percentile
Single-package vertical ACs and heat pumps	<65,000 Btu/h: 16.1 IEER
	≥65,000 and <135,000 Btu/h: 11.2 IEER
Small electric motors	5–9% savings
Urinals	0.125 gpf
Walk-in coolers and freezers	Refrigeration systems: up to 24% savings
	Display doors: 9–14% savings
	Non-display doors: 52–60% savings
	Panels: 27–66% savings
Water-source heat pumps	<17,000 Btu/h: 18.8 EER
	≥17,000 and <65,000 Btu/h: 21.6 EER
	≥65,000 and <135,000 Btu/h: 17.2 EER

The commercial and industrial product efficiency metrics are as follows:

- EER: energy efficiency ratio
- FEI: fan energy index
- gpf: gallons per flush
- IVEC: Integrated Ventilating, Economizer and Cooling Efficiency; IEER: integrated energy efficiency ratio
- MEF: modified energy factor; IWF: integrated water factor
- SEER: seasonal energy efficiency ratio
- TE: thermal efficiency
- UEF: uniform energy factor

Assumed per-unit savings, shipments, and lifetimes

For each product category, we quantified the per-unit annual energy and water savings at the standard levels we evaluated relative to the base case. The base case incorporates the distribution of efficiency levels in the absence of amended standards, including the market share of shipments above the baseline efficiency level, which is equivalent to the standard level in the most recent DOE final rule. For product categories for which a final rule has been published but is not yet in effect, the baseline efficiency level in our analysis is not equivalent to the current standard but rather reflects the standard in the most recent final rule.

We accounted for the impact of recently finalized water heater standards on the potential hot-water savings from updated standards for faucets and showerheads (i.e., we took into account that the average per-unit electricity and natural gas savings from faucets and showerheads will decline over time as more of the water heater stock is replaced with more-efficient models). In calculating total potential savings, we also accounted for the interaction between updated standards for water heaters and faucets and showerheads (i.e., updated faucet and showerhead standards that lower hot-water use will decrease the potential savings from updated water heater standards, and vice versa). The total potential savings are therefore smaller than the sum of the individual products.

We assumed that both annual shipments and the distribution of efficiency levels in the base case (absent amended standards) will remain constant through 2050. For all product categories except the plumbing products, we used estimated annual shipments in 2024 from the most recent DOE analysis; for product categories for which 2024 shipments were not directly available, we interpolated or extrapolated using shipments from other years. We used the base case efficiency distribution from the most recent DOE analysis and assigned any market share below the baseline in our analysis (equivalent to the most recently finalized standard) to the baseline efficiency level.

For faucets, showerheads, and toilets, we scaled shipments in California to approximate U.S. shipments based on the ratio of U.S. households to California households; for urinals, we scaled shipments in California based on population (Census 2025). Because we lacked data on the efficiency distribution of current sales for the plumbing products, we used models in the DOE certification database as a proxy, using the average efficiency of the listed models as our base case efficiency level. This approach attempts to account for the many models that are on the market today that are more efficient than the federal standards, including a large portion that already meet the standard levels we evaluated. For the standards case, we assumed that any model listed in the database with a rated water consumption greater than the standard level we evaluated would be replaced by a model that just meets the standard. We then recalculated the average efficiency of all the models using this roll-up scenario to represent our “standards case.”

For most product categories, we calculated shipment-weighted average lifetimes based on annual shipments and the average lifetime for each product class from the most recent DOE rulemaking. For electric motors, which have greater variation in product lifetimes, we grouped products into shorter-lived and longer-lived equipment and used the resulting shipment-weighted lifetimes for each group.

We used equation A1 to calculate the annual energy or water savings in year(*N*):

Annual savings in year(*N*) = Number of sales impacted by the assumed standard in year(*N*) * per-unit savings relative to the base case efficiency distribution [equation A1]

The number of sales impacted by the assumed standard increases over time as the stock turns over; this is shown in equation A2, where the compliance date is year(*M*):

Number of sales impacted by the assumed standard in year(*N*) =

{0; if *N* is before the compliance date

Annual shipments * (*N*–*M* + 0.5); if *N* is before stock turnover

*Annual shipments * (product lifetime);* if *N* is the year of or after stock turnover} [equation A2]

Here, *0.5* indicates a half-year of sales, reflecting one-half year of savings on average from products purchased in a given year.

Tables A6 and A7 show the estimated annual shipments, average lifetime, and average per-unit savings relative to the base case efficiency distribution for residential and for commercial and industrial product categories, respectively. The per-unit energy and water savings and equipment lifetimes are shipment-weighted over the product classes for each product category.

Note that for products that consume both fossil fuels and electricity, higher efficiency levels are sometimes associated with a slight increase in electricity consumption due, for example, to higher fan energy consumption (as indicated by a negative savings value in tables A6 and A7). Similarly, as furnace fans become more efficient, they radiate less useful heat into the space, which slightly increases fossil fuel consumption at higher efficiency levels.

Table A6. Assumptions for annual shipments, average lifetime, and average annual per-unit savings for residential product categories

			Average annual per-unit savings relative to base-case efficiency distribution		
Product category	**2024 annual shipments (million)**	**Average lifetime (years)**	**Electricity (kWh)**	**Fossil fuel (MMBtu)**	**Water (gallons)**
Air cleaners	8.2	--	--	--	--
Residential	4.9	9.0	40	--	--
Commercial	3.3	9.0	84	--	--
Battery chargers	648	--	--	--	--
Residential	589	4.7	3	--	--
Commercial	59	4.7	5	--	--
Boilers	0.4	--	--	--	--
Gas-fired, hot water	0.27	26.9	–18	4	--
Gas-fired, steam	0.03	23.7	0	0	--
Oil-fired, hot water	0.05	25.6	4	1	--
Oil-fired, steam	0.005	19.6	3	1	--
Ceiling fans	21	--	--	--	--
Standard	9.1	14.6	11	--	--
Hugger	11.5	14.6	15	--	--
High-speed belt driven	0.001	14.5	503	--	--
Large-diameter	0.04	14.6	41	--	--
Central ACs and heat pumps	8.1	--	--	--	
Air conditioners	5.0	21.2	221	--	--
Heat pumps	3.1	15.3	479	--	--
Circulator pumps	2.1	10.5	104	--	--

Product category	2024 annual shipments (million)	Average lifetime (years)	Average annual per-unit savings relative to base-case efficiency distribution: Electricity (kWh)	Fossil fuel (MMBtu)	Water (gallons)
Clothes dryers	8.6	--	--	--	
Electric	7.1	14.0	206	--	--
Gas	1.5	14.0	9	0.1	--
Clothes washers	11.8	--	--	--	--
Standard-size top-loading	8.1	13.4	30	0.12	181
Ultra-compact top-loading	0.07	13.4	0	0	0
Standard-size front-loading	3.3	13.4	17	0.02	242
Compact front-loading	0.2	13.4	29	0.01	157
Semi-automatic	0.2	13.4	32	0.06	561
Cooking products	16.2	--	--	--	--
Cooktops	8.1	15.9	9	0.1	--
Ovens	9.0	15.9	28	0.01	--
Dedicated-purpose pool pumps	1.6	6.5	167	--	--
Dehumidifiers	2.4	10.0	59	--	--
Direct heating equipment	0.14	15.0	–26	4	--
Dishwashers	8.7	--	--	--	--
Standard	8.5	15.2	13	0.1	177
Compact	0.2	15.2	21	0.1	255
External power supplies	738	--	--	--	--
Residential	654	4.4	0.3	--	--
Commercial	85	4.4	0.6	--	--
Faucets	47.6	--	--	--	--
Residential lavatory	32.2	10.0	3	0.02	99
Kitchen	16.4	10.0	22	0.1	661
Furnaces	3.3	--	--	--	
Non-weatherized gas	3.2	21.5	–35	1.4	--
Mobile home	0.11	21.5	0	0.3	--
Furnace fans	4.5	--	--	--	--
Residential	4.4	21.3	60	-0.2	--

			Average annual per-unit savings relative to base-case efficiency distribution		
Product category	2024 annual shipments (million)	Average lifetime (years)	Electricity (kWh)	Fossil fuel (MMBtu)	Water (gallons)
Commercial	0.1	21.3	114	-0.3	--
Microwave ovens	11.9	10.8	2	--	--
Miscellaneous refrigeration products	1.6	--	--	--	
Standard	0.3	14.5	27	--	--
Compact	1.4	10.6	43	--	--
Pool heaters	0.4	--	--	--	--
Electric, residential	0.1	11.0	69	--	--
Electric, commercial	0.01	11.0	664	--	--
Gas-fired, residential	0.3	11.0	29	4	--
Gas-fired, commercial	0.04	11.0	–12	134	--
Portable ACs	1.4	--	--	--	--
Residential	1.2	10.5	194	--	--
Commercial	0.2	10.5	487	--	--
Portable electric spas	0.6	--	--	--	--
Hard-sided	0.3	9.3	2,454	--	--
Inflatable	0.3	3.0	614	--	--
Refrigerators and freezers	17.1	--	--	--	--
Standard-size refrigerators	12.0	14.5	50	--	--
Standard-size freezers	2.3	18.5	58	--	--
Compact refrigerators	2.0	8.9	40	--	--
Compact freezers	0.7	11.5	33	--	--
Room ACs	7.4	--	--	--	--
Residential	6.4	9.3	127	--	--
Commercial	1.0	9.3	165	--	--
Showerheads	17.1	10.0	19	0.1	399
Toilets	17.5	--	--	--	--
Residential	13.8	25.0	--	--	184
Commercial	3.7	12.0	--	--	251
Uninterruptible power supplies	11.6	--	--	--	--

Product category	2024 annual shipments (million)	Average lifetime (years)	Average annual per-unit savings relative to base-case efficiency distribution		
			Electricity (kWh)	Fossil fuel (MMBtu)	Water (gallons)
Residential	1.2	6.1	62	--	--
Commercial	10.5	6.1	62	--	--
Water heaters	10.1	--	--	--	--
Gas-fired storage, residential	4.3	14.5	–45	4	--
Electric storage, residential	4.0	15.1	217	--	--
Oil-fired storage, residential	<0.01	15.5	0	0	--
Gas-fired instantaneous, residential	1.3	20	11	0.3	--
Gas-fired storage, commercial	0.09	14.5	–64	6	--
Electric storage, commercial	0.45	15.1	256	--	--
Oil-fired storage, commercial	0	15.5	0	0	--
Gas-fired instantaneous, commercial	0.1	20	15	0.7	--

Table A7. Assumptions for annual shipments, average lifetime, and average annual per-unit savings for commercial and industrial product categories

			Average annual per-unit savings relative to base-case efficiency distribution		
Product category	2024 annual shipments (million)	Average lifetime (years)	Electricity (kWh)	Fossil Fuel (MMBtu)	Water (gallons)
Air compressors	0.03	--	--	--	--
Commercial	0.001	12.9	3,822	--	--
Industrial	0.03	12.9	10,712	--	--
Automatic commercial ice makers	1.1	--	--	--	--
High-capacity	0.3	8.5	210	--	--
Low-capacity	0.8	7.5	11	--	--
Beverage vending machines	0.07	--	--	--	--
Class A	0.04	13.4	398	--	--
Class B	0.02	13.4	267	--	--
Combo A	0.01	13.4	201	--	--
Combo B	0.01	13.4	427	--	--
Commercial packaged boilers	0.03	--	--	--	--
Gas-fired	0.03	24.8	–34	82	--
Oil-fired	<0.01	24.8	–121	68	--
Commercial clothes washers	0.2	10.7	66	0.3	6,112
Commercial furnaces	0.23	--	--	--	--
Gas-fired	0.23	23.0	–221	17	--
Oil-fired	<0.01	23.0	–246	9	--
Commercial package ACs and heat pumps	0.33	--	--	--	--
Air conditioners	0.31	22.2	3,183	--	--
Heat pumps	0.03	21.6	2,563	--	--
Commercial refrigeration equipment	1.3	13.4	172	--	--
Commercial three-phase ACs and heat pumps	0.25	--	--	--	--
Air conditioners	0.2	19.0	373	--	--
Heat pumps	0.05	16.2	385	--	--

Product category	2024 annual shipments (million)	Average lifetime (years)	Average annual per-unit savings relative to base-case efficiency distribution		
			Electricity (kWh)	Fossil Fuel (MMBtu)	Water (gallons)
Commercial water heaters	0.13	12.2	5	5	--
Distribution transformers	1.5	32.0	610	--	--
Electric motors	5.5	--	--	--	--
Shorter life	5.3	11.9	351	--	--
Longer life	0.2	33.1	3,251	--	--
Expanded scope electric motors	27.4	9.3	196	--	--
Fans and blowers	2.2	--	--	--	--
General fans and blowers	1.2	16.0	1,915	--	--
Air circulating fans	0.9	6.3	935	--	--
Packaged terminal ACs and heat pumps	0.64	--	--	--	--
Air conditioners	0.35	8.0	90	--	--
Heat pumps	0.29	8.0	89	--	--
Pumps	0.5	13.2	581	--	--
Single-package vertical ACs and heat pumps	0.07	--	--	--	--
Air conditioners	0.05	15.1	849	--	--
Heat pumps	0.02	15.1	1,562	--	--
Small electric motors	5.0	--	--	--	--
Capacitor start capacitor run	4.2	7.0	154	--	--
Polyphase	0.9	8.7	88	--	--
Urinals	0.9	12.0	--	--	1,711
Walk-in coolers and freezers	--	--	--	--	--
Refrigeration systems	0.4	8.5	1,867	--	--
Display doors	0.3	12.0	86	--	--
Non-display doors	0.3	8.0	440	--	--
Panels	140 (million ft^2)	12.0	0.6	--	--
Water-source heat pumps	0.24	19.0	963	--	--

[1]For walk-in cooler and freezer panels, the annual shipments are in units of million square feet and the per-unit savings are in units of kWh/million square feet.

Assumed energy and water prices

We calculated utility bill savings by multiplying annual electricity, natural gas, fuel oil, and water savings by the respective average prices. For electricity, natural gas, and fuel oil prices, we assumed constant prices over our analysis period equivalent to the 2024 EIA short-term energy outlook prices published in 2025. For water and wastewater prices, we used projected prices from DOE's April 2024 residential clothes washers final rule analysis, which we converted to 2024 dollars.

Table A8 shows our assumptions for energy prices, and table A9 shows our assumptions for water and wastewater prices.

Table A8. Assumptions for energy prices

Electricity price (2024$/kWh)	
Residential	0.164
Commercial	0.129
Industrial	0.081
Natural gas price (2024$/MMBtu)	
Residential	14.15
Commercial	9.62
Fuel oil price (2024$/MMBtu)	26.20

Table A9. Assumptions for water and wastewater prices

	2025	2030	2035	2040	2045	2050
Water and wastewater price (2024$/thous. gal.)	16.15	17.50	18.85	20.04	21.39	22.73

Calculation of average annual per-household savings

We used equation A3 to calculate the average annual per-household savings,

Average annual per-household savings = (∑Annual household utility bill savings (2030–2050))/ (21 years * number of U.S. households in 2030) [equation A3]

Here, the projected number of U.S. households in 2030 is 136 million (EIA 2023a).

Peak demand calculation methodology

For most product categories, we used the Electric Power Research Institute's end-use load shapes (EPRI 2020) to estimate potential peak electricity demand reductions. For ceiling fans and cooking products, load shapes were unavailable, so we used National Renewable Energy Laboratory data (Wilson et al. 2014). We estimated peak demand savings by calculating peak load factors (PLFs) and applying these to the annual electricity savings that we calculated for each product. We assumed the peak load hour to be between 5 and 6 p.m. in the summer. While the grid will likely become winter peaking in the future as more buildings electrify, our analysis assumes a summer peaking grid.

We used equation A4 to calculate PLFs for 15 electricity end uses. PLF is the ratio of the electricity use during the grid peak hour to the average hourly electricity use over the year (annual electricity use divided by 8,760 hours).

$PLF = \frac{peak\ hour\ electricity\ use}{average\ hourly\ electricity\ use}$ [equation A4]

Here, we discuss examples of end uses with PLFs of greater than 1, 1, and less than 1. For cooling (commercial and residential), most electricity use is during the peak season. During the off-peak season, the average hourly electricity use is significantly lower than the peak season's peak hour electricity use. The average hourly electricity use reflects all of the different operating profiles over the year in a single number, including low- or no-usage hours. In this example, the peak hour electricity use is significantly greater than the average hourly electricity use, yielding a PLF of greater than 1. For commercial ventilation, the load is fairly flat, and because the average hourly electricity use is similar to the peak hour electricity use, the PLF is close to 1. For residential water heating, the average hourly electricity use is greater than the peak hour electricity use since hot-water usage is greater in the morning than during the peak hour; this yields a PLF of less than 1. A PLF of 0 would mean that there are no peak demand savings, while any PLF greater than 0 reflects some amount of peak demand savings.

For certain products, we adjusted the PLF values before applying them to the electricity savings. Specifically, for air-conditioning product categories that have efficiency metrics based on seasonal efficiency—that is, central ACs and heat pumps, room ACs, and commercial package ACs and heat pumps)—we took into account that an improvement in seasonal efficiency does not translate directly to an increase in peak efficiency because different equipment designs can result in a range of peak load efficiency for a given seasonal efficiency. Typically, the smaller the equipment's physical size, the less surface area of the heat exchanger; this can result in low peak load efficiencies, even if the seasonal efficiency is high.

We used equation A5 to calculate the PLF adjustment factor for cooling end uses as follows.

$PLF\ adjustment\ factor = \frac{EER(max-tech)-EER(base\ case)}{EER(max-tech)} / \frac{electricity(base\ case)-electricity(max-tech)}{electricity(base\ case)}$
[equation A5]

Here, EER(max- tech) and EER(base case) are the EERs that correspond to the max-tech and base case seasonal efficiency, respectively, and electricity(max-tech) and electricity(base case) are the electricity consumption that corresponds to the max-tech and base case seasonal efficiency, respectively.

The PLF adjustment factors increment or decrement the PLF we apply to calculate the expected peak load savings based on the annual electricity savings. For example, if electricity savings of 20% are associated with peak load savings of 10%, the PLF adjustment factor would be 50% (i.e., our estimated peak demand savings would be half as large compared to using the unadjusted PLF).

We estimated peak load efficiency associated with the max-tech levels by examining the relationship between seasonal efficiency and peak efficiency for models in the Air-Conditioning, Heating, and Refrigeration Institute (AHRI) directory of certified product performance (AHRI 2025). We developed linear fits for values spanning the range between the baseline efficiency level and our assumed standard level for each product type—for central ACs and heat pumps, this was seasonal energy efficiency ratio

(SEER2) and energy efficiency ratio (EER2), and for commercial package ACs and heat pumps, this was integrated energy efficiency ratio (IEER) and EER.

For split central ACs and heat pumps, we found no clear correlation between SEER2 and EER2; therefore, we assumed there would be no peak load benefit from improved seasonal efficiency, and we applied a PLF adjustment factor of 0 for the cooling end use for central split systems. For package central ACs, there is a strong relationship between SEER2 and EER2, and we used the linear fit from the data. We calculated a PLF adjustment for package central ACs of approximately 0.5. The PLF for residential cooling is 7.78, resulting in an adjusted PLF for package central ACs of 4.2. For package central heat pumps, we found a reasonable linear fit between SEER2 and EER2, and we therefore used the linear fit. We applied the PLF adjustment of 0.9 for central heat pump cooling, resulting in an adjusted PLF of 6.8.

For commercial package ACs and heat pumps, we similarly adjusted the PLF for commercial cooling (4.26) based on the linear fit of EER versus IEER for each equipment size (based on cooling capacity: small ≥ 65,000 and < 135,000 Btu/h; large ≥ 135,000 and < 240,000 Btu/h; very large ≥ 240,000 and < 760,000 Btu/h). We calculated a shipment-weighted PLF adjustment of about 0.3, resulting in an adjusted PLF of 1.5. For all commercial package heat pumps, we used the unadjusted PLF for heating.

For room ACs with cooling capacities of 8,000 Btu/h or greater—for which recent standards finalized by DOE are based on variable-speed compressor use—we did not adjust the PLF because the assumed technology options to reach the max-tech efficiency level relative to the recently adopted DOE standards would generally improve full-load efficiency. For room ACs with cooling capacities less than 8,000 Btu/h, which can meet the recent DOE standards with single-speed compressors, we applied the PLF (unadjusted) to the portion of the electricity savings that reflect going from the efficiency level corresponding to current variable-speed units to the max-tech level.

Table A10 shows each of the electricity end uses and associated PLF (and, in some cases, adjusted PLFs) along with the applicable product categories. For products with multiple operating modes (e.g., cooling and heating), we applied the relevant PLF to the portion of electricity savings from operation in that mode.

Table A10. Assumptions for peak load factors by end use

Electricity end use	Peak load factor or adjusted PLF	Applicable product categories
Residential cooling	Central AC and heat pump 4.2/6.8 (package) Central AC/heat pump 0/0 (split) All other equipment: 7.78	Central ACs and heat pumps (cooling mode); furnace fans (residential applications, cooling mode); portable ACs (residential applications); room ACs (residential applications)
Residential heating	0.01	Boilers; central heat pumps (heating mode); circulator pumps (heating applications); direct heating equipment; gas furnaces; furnace fans (residential applications, heating mode)
Residential clothes dryers	1.06	Clothes dryers

Electricity end use	Peak load factor or adjusted PLF	Applicable product categories
Residential clothes washers	1.06	Clothes washers; commercial clothes washers
Residential dishwashers	1.12	Dishwashers
Residential refrigerators	1.22	Miscellaneous refrigeration products; refrigerators and freezers
Residential water heating	0.86	Circulator pumps (hot-water recirculation applications); faucets; showerheads; water heaters
Commercial cooling	Commercial package AC and heat pump: 1.5 All other equipment: 4.26	Commercial package ACs and heat pumps (cooling mode); commercial three-phase ACs and heat pumps (cooling mode); furnace fans (commercial applications, cooling mode); portable ACs (commercial applications); packaged terminal ACs and heat pumps; room ACs (commercial applications); single-package vertical ACs and heat pumps (cooling mode); water-source heat pumps (cooling mode)
Commercial heating	0.01	Boilers (commercial); commercial furnaces; commercial packaged boilers; commercial package heat pumps; furnace fans (commercial applications, heating mode); single-package vertical heat pumps (heating mode); water-source heat pumps (heating mode)
Commercial refrigeration	1.19	Automatic commercial ice makers; commercial refrigeration equipment; beverage vending machines; walk-in coolers and freezers
Commercial ventilation	1.0	Commercial package ACs and heat pumps (ventilation mode); fans and blowers
Commercial water heating	0.94	Commercial water heaters; water heaters (commercial applications)
Industrial machine drives	1.17	Air compressors; electric motors; expanded scope electric motors; pumps; small electric motors
Ceiling fans	1.71	Ceiling fans
Ranges and ovens	3.6	Cooking products; microwaves

We assumed a PLF of 1 for the following residential product categories: air cleaners, battery chargers, dedicated-purpose pool pumps,[4] external power supplies, furnace fans in constant circulation mode, pool heaters, uninterruptable power supplies, and portable electric spas. We excluded distribution transformers from the peak demand analysis due to uncertainty around the impact of higher efficiency levels on transformer efficiency during peak grid hours.

CO_2 emissions reductions calculation methodology

We calculated CO_2 emissions reductions from electricity savings by multiplying annual electricity savings by average annual CO_2 emissions factors based on the Annual Energy Outlook (AEO) 2023 reference case. Figure A1 shows the average carbon intensity of electricity over our analysis period.

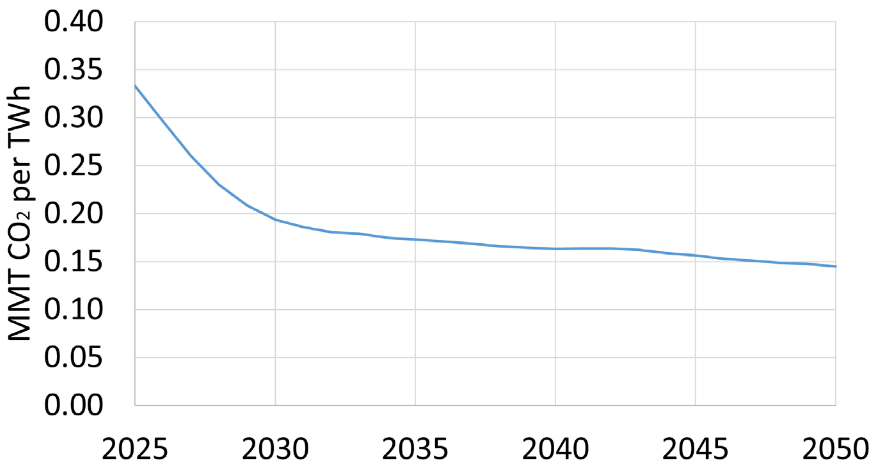


Figure A1. Annual carbon intensity of electricity

For natural gas and fuel oil, we assumed emissions factors of 53 and 74 MMT CO_2 per quadrillion Btus (quads), respectively, throughout the analysis period (EIA 2023a).

NO_X and SO_2 emissions reductions calculation methodology

As table A11 shows, we used NO_x emissions factors for electricity based on the AEO 2023 reference case. For natural gas, we assumed 94 lb./million standard cubic foot (scf) (EPA 1998), while for fuel oil we assumed 20 lb./thous. gallons (EPA 2010). We used SO_2 emissions factors for electricity based on the AEO 2023 reference case, as table A12 shows (EIA 2023a). For natural gas, we assumed 0.6 lb./million scf (EPA 1998). For fuel oil combustion, we used 220 grams per barrel (DOE 2023).

Table A11. Assumptions for NO_X emissions factors for select years

NO_X emission factors (thous. tons/TWh)				
2030	2035	2040	2045	2050

[4] California has flexible demand appliance standards for pool controls, which include pool pumps and pool heaters. CEC determined that the load curve for pool controls peaks during mid-day (CEC 2023). The regulation does not permit the default operation of the pool filter pump, pressure cleaner booster pump, or electric pool heater between 4 p.m. and 9 p.m. local time. The impact would be to reduce to the peak demand savings we have calculated here.

0.086	0.076	0.063	0.060	0.057

Table A12. Assumptions for SO_2 emissions factors for select years

SO_2 emission factors (thous. tons/TWh)				
2030	2035	2040	2045	2050
0.057	0.055	0.049	0.045	0.040

To determine the diesel school bus equivalency, we assumed 4.374 grams of NO_x per mile driven for diesel buses (BTS 2024), and assumed the average annual miles driven for school buses as 14,084 (DOE 2024c).

Appendix B: Utility bill savings by residential product category

Table B1 shows the potential cumulative utility bill savings through 2050 for residential product categories in billions of dollars. Note that for products that are also used in commercial applications (e.g., air cleaners), the bill savings include the commercial bill savings.

Table B1. Potential cumulative utility bill savings for residential product categories

Product category	Bill savings (billion 2024$)
Air cleaners	8.9
Battery chargers	28.6
Boilers	3.5
Ceiling fans	10.6
Central ACs and heat pumps	67.6
Circulator pumps	4.2
Clothes dryers	34.4
Clothes washers	14.5
Cooking products	6.0
Dedicated-purpose pool pumps	5.2
Dehumidifiers	4.3
Direct heating equipment	1.3
Dishwashers	9.6
External power supplies	3.5
Faucets	56.4
Furnaces	5.8
Furnace fans	6.2
Microwave ovens	0.5
Miscellaneous refrigeration equipment	1.2
Pool heaters	8.2
Portable ACs	6.7
Portable electric spas	16.8
Refrigerators and freezers	11.6
Room ACs	20.6
Showerheads	30.2

Product category	Bill savings (billion 2024$)
Toilets	14.0
Uninterruptible power supplies	10.5
Water heaters	46.1

Appendix C: Utility bill savings by commercial and industrial product category

Table C1 shows the potential cumulative utility bill savings through 2050 for commercial and industrial product categories in billions of dollars. Note that for products that are also used in residential applications (e.g., expanded scope electric motors), the bill savings include the residential bill savings.

Table C1. Potential cumulative utility bill savings for commercial and industrial product categories

Product category	Bill savings (billion 2024$)
Air compressors	4.5
Automatic commercial ice makers	1.3
Beverage vending machines	0.6
Commercial packaged boilers	6.1
Commercial clothes washers	4.5
Commercial warm air furnaces	6.9
Commercial package ACs and heat pumps	17.3
Commercial refrigeration equipment	3.9
Commercial three-phase ACs and heat pumps	2.6
Commercial water heaters	0.9
Distribution transformers	15.5
Electric motors	38.6
Expanded scope electric motors	77.2
Fans and blowers	67.6
Packaged terminal ACs and heat pumps	1.0
Pumps	5.4
Single-package vertical ACs and heat pumps	1.8
Small electric motors	8.2
Urinals	5.5
Walk-in coolers and freezers	13.6
Water-source heat pumps	6.4

Appendix D: Electricity and peak demand savings by product category

Tables D1 and D2 show the potential electricity and peak demand savings in 2040 and 2050 for residential and commercial and industrial product categories, respectively.

Table D1. Potential electricity and peak demand savings for residential product categories

Product category	Annual electricity savings in 2040 (TWh)	Annual electricity savings in 2050 (TWh)	Peak electricity demand savings in 2040 (MW)	Peak electricity demand savings in 2050 (MW)
Air cleaners	4.0	4.3	460	487
Battery chargers	8.3	8.3	952	952
Boilers	0	–0.1	–0.1	–0.1
Ceiling fans	3.5	4.1	1,452	1,696
Central ACs and heat pumps	19.3	41.8	1,041	2,297
Circulator pumps	1.4	2.3	35	57
Clothes dryers	9.6	20.7	1,167	2,514
Clothes washers	2.0	4.1	306	631
Cooking products	1.4	3.6	577	1,465
Dedicated-purpose pool pumps	1.7	1.7	193	193
Dehumidifiers	1.4	1.4	165	165
Direct heating equipment	0	–0.1	0	–0.1
Dishwashers	0.9	1.8	111	224
External power supplies	1.0	1.0	35	35
Faucets	2.8	2.3	287	266
Furnaces	–0.6	–1.7	–1	–2
Furnace fans	2.3	5.1	750	1,633
Microwave ovens	0.2	0.2	69	87
Miscellaneous refrigeration equipment	0.4	0.7	50	100
Pool heaters	0.1	0.2	15	25
Portable ACs	2.4	3.4	1,899	2,659
Portable electric spas	6.5	6.5	746	746
Refrigerators and freezers	2.9	9.1	525	1,618

Product category	Annual electricity savings in 2040 (TWh)	Annual electricity savings in 2050 (TWh)	Peak electricity demand savings in 2040 (MW)	Peak electricity demand savings in 2050 (MW)
Room ACs	8.3	9.1	5,031	5,504
Showerheads	2.0	1.7	204	189
Toilets	--	--	--	--
Uninterruptible power supplies	4.4	4.4	501	501
Water heaters	4.0	11.2	400	1,112

Table D2. Potential electricity and peak demand savings for commercial and industrial product categories

Product category	Annual electricity savings in 2040 (TWh)	Annual electricity savings in 2050 (TWh)	Peak electricity demand savings in 2040 (MW)	Peak electricity demand savings in 2050 (MW)
Air compressors	2.7	4.8	36.5	63.3
Automatic commercial ice makers	0.5	0.5	7.1	7.1
Beverage vending machines	0.3	0.3	3.9	4.2
Commercial packaged boilers	0	0	0	0
Commercial clothes washers	0.1	0.1	2.1	2.1
Commercial warm air furnaces	–0.6	–1.1	–0.1	–0.1
Commercial package ACs and heat pumps	5.7	16.2	86.2	242.8
Commercial refrigeration equipment	1.4	2.9	19.2	39.5
Commercial three-phase ACs and heat pumps	1.0	1.9	15.5	30.2
Commercial water heaters	0	0	0.1	0.1
Distribution transformers	5.1	14.5	0	0
Electric motors	19.2	34.4	256.1	458.6
Expanded scope electric motors	29.6	49.9	394.2	665.1
Fans and blowers	30.4	43.5	346.5	495.1
Packaged terminal ACs and heat pumps	0.5	0.5	20.8	20.8
Pumps	2.9	3.6	38.3	48

Product category	Annual electricity savings in 2040 (TWh)	Annual electricity savings in 2050 (TWh)	Peak electricity demand savings in 2040 (MW)	Peak electricity demand savings in 2050 (MW)
Single-package vertical ACs and heat pumps	0.7	1.0	28.6	41.1
Small electric motors	5.1	5.1	68.1	68.4
Urinals	--	--	--	--
Walk-in coolers and freezers	6.2	8.4	84.3	114.4
Water-source heat pumps	2.4	4.3	96.9	175.4

Appendix E: CO_2 emissions reductions by product category

Tables E1 and E2 show the potential cumulative CO_2 emissions reductions through 2050 for residential and commercial and industrial product categories, respectively.

Table E1. Potential cumulative CO_2 emissions reductions for residential product categories

Product category	Cumulative CO_2 emissions reductions (MMT)
Air cleaners	9.8
Battery chargers	30.3
Boilers	13.3
Ceiling fans	10.4
Central ACs and heat pumps	64.3
Circulator pumps	4.2
Clothes dryers	33.7
Clothes washers	14.4
Cooking products	8.2
Dedicated-purpose pool pumps	5.2
Dehumidifiers	4.2
Direct heating equipment	5.1
Dishwashers	8.0
External power supplies	3.7
Faucets	26.3
Furnaces	28.1
Furnace fans	0.7
Microwave ovens	0.5
Miscellaneous refrigeration equipment	1.2
Pool heaters	40.2
Portable air conditioners	6.9
Portable electric spas	16.3
Refrigerators and freezers	11.1
Room air conditioners	20.7
Showerheads	18.7
Toilets	--

Product category	Cumulative CO_2 emissions reductions (MMT)
Uninterruptible power supplies	12.8
Water heaters	132.4

Table E2. Potential cumulative CO_2 emissions reductions for commercial and industrial product categories

Product category	Cumulative CO_2 emissions reductions (MMT)
Air compressors	8.6
Automatic commercial ice makers	1.6
Beverage vending machines	0.8
Commercial packaged boilers	30.1
Commercial clothes washers	0.3
Commercial warm air furnaces	44.2
Commercial package ACs and heat pumps	20.7
Commercial refrigeration equipment	4.7
Commercial three-phase air ACs and heat pumps	3.1
Commercial water heaters	4.8
Distribution transformers	18.5
Electric motors	59.7
Expanded scope electric motors	88.6
Fans and blowers	94.3
Packaged terminal ACs and heat pumps	1.3
Pumps	8.3
Single-package vertical ACs and heat pumps	2.2
Small electric motors	12.6
Urinals	--
Walk-in coolers and freezers	16.6
Water-source heat pumps	7.8

Appendix F: NO_X and SO_2 emissions reductions by product

Tables F1 and F2 show the potential NO_X and SO_2 emissions reductions in 2040 and 2050 for residential and commercial and industrial product categories, respectively.

Table F1. Potential annual NO_X and SO_2 emissions reductions for residential product categories

Product category	Annual NO_X emissions reductions in 2040 (thous. tons)	Annual NO_X emissions reductions in 2050 (thous. tons)	Annual SO_2 emissions reductions in 2040 (thous. tons)	Annual SO_2 emissions reductions in 2050 (thous. tons)
Air cleaners	0.3	0.2	0.2	0.2
Battery chargers	0.2	0.2	0.4	0.3
Boilers	0.0	0.1	0.0	0.1
Ceiling fans	0.3	0.6	0.2	0.2
Central ACs and heat pumps	1.2	2.4	0.9	1.7
Circulator pumps	0.1	0.1	0.1	0.1
Clothes dryers	0.7	1.3	0.5	0.8
Clothes washers	0.4	0.9	0.1	0.2
Cooking products	0.2	0.5	0.1	0.1
Dedicated-purpose pool pumps	0.1	0.1	0.1	0.1
Dehumidifiers	0.1	0.1	0.1	0.1
Direct heating equipment	0.2	0.4	0.0	0.0
Dishwashers	0.3	0.5	0.0	0.1
External power supplies	0.2	0.2	0.0	0.0
Faucets	1.2	1.2	0.1	0.1
Furnaces	1.1	3.1	0.0	0.0
Furnace fans	–0.2	–0.4	0.1	0.2
Microwave ovens	0.0	0.0	0.0	0.0
Miscellaneous refrigeration equipment	0.0	0.0	0.0	0.0
Pool heaters	1.8	3.0	0.0	0.0
Portable ACs	0.2	0.2	0.1	0.1
Portable electric spas	0.7	0.6	0.3	0.3
Refrigerators and freezers	0.2	0.5	0.1	0.4

Product category	Annual NO_X emissions reductions in 2040 (thous. tons)	Annual NO_X emissions reductions in 2050 (thous. tons)	Annual SO_2 emissions reductions in 2040 (thous. tons)	Annual SO_2 emissions reductions in 2050 (thous. tons)
Room ACs	0.7	0.7	0.4	0.4
Showerheads	0.9	0.9	0.1	0.1
Toilets	0.0	0.0	0.0	0.0
Uninterruptible power supplies	0.3	0.3	0.2	0.2
Water heaters	4.7	12.2	0.2	0.5

Table F2. Potential NO_X and SO_2 emissions reductions for commercial and industrial product categories

Product category	Annual NO_X emissions reductions in 2040 (thous. tons)	Annual NO_X emissions reductions in 2050 (thous. tons)	Annual SO_2 emissions reductions in 2040 (thous. tons)	Annual SO_2 emissions reductions in 2050 (thous. tons)
Air compressors	0.3	0.4	0.1	0.2
Automatic commercial ice makers	0.1	0.1	0.0	0.0
Beverage vending machines	0.0	0.0	0.0	0.0
Commercial packaged boilers	1.3	2.5	0.1	0.2
Commercial clothes washers	0.0	0.0	0.0	0.0
Commercial warm air furnaces	1.9	3.7	0.0	0.0
Commercial package ACs and heat pumps	0.4	0.9	0.3	0.6
Commercial refrigeration equipment	0.0	0.1	0.1	0.1
Commercial three-phase ACs and heat pumps	0.1	0.1	0.1	0.1
Commercial water heaters	0.2	0.4	0.0	0.0
Distribution transformers	0.3	0.8	0.3	0.6
Electric motors	1.3	2.1	0.9	1.4
Expanded scope electric motors	2.7	3.2	1.4	2.0
Fans and blowers	0.7	1.7	1.5	1.7
Packaged terminal ACs and heat pumps	0.0	0.0	0.0	0.0
Pumps	0.2	0.2	0.1	0.1
Single-package vertical ACs and heat pumps	0.0	0.1	0.0	0.0

Product category	Annual NO_X emissions reductions in 2040 (thous. tons)	Annual NO_X emissions reductions in 2050 (thous. tons)	Annual SO_2 emissions reductions in 2040 (thous. tons)	Annual SO_2 emissions reductions in 2050 (thous. tons)
Small electric motors	0.3	0.3	0.2	0.2
Urinals	0.0	0.0	0.0	0.0
Walk-in coolers and freezers	0.2	0.3	0.3	0.3
Water-source heat pumps	0.2	0.2	0.1	0.2

Appendix G: Water savings by product category

Table G1 shows the cumulative water savings for water-using products.

Table G1. Water savings for water-using products

Product	Cumulative water savings through 2050 (billion gallons)
Commercial clothes washers	200
Residential clothes washers	359
Dishwashers	244
Faucets	
Residential lavatory	476
Residential kitchen	1,630
Showerheads	1,024
Toilets	663
Urinals	265

Appendix H: Sources for assumptions

Table H1. Sources for product assumptions for residential products

Product	Sources
Air cleaners	DOE, "Technical Support Document: Energy Efficiency Program for Consumer Products and Commercial and Industrial Equipment: Air Cleaners, March 2023" (Washington, DC: DOE, 2023). www.regulations.gov/document/EERE-2021-BT-STD-0035-0024. DOE, "Air Cleaners Direct Final Rule National Impact Analysis (NIA) Spreadsheet" (Washington, DC: DOE, 2023). www.regulations.gov/document/EERE-2021-BT-STD-0035-0022.
Battery chargers	DOE, "2023-03 Technical Support Document: Energy Efficiency Program for Consumer Products and Commercial and Industrial Equipment: Battery Chargers" (Washington, DC: DOE, 2023). www.regulations.gov/document/EERE-2020-BT-STD-0013-0025. DOE, "National Impact Analysis (NIA) Notice of Proposed Rulemaking (NOPR) Spreadsheet" (Washington, DC: DOE, 2023). www.regulations.gov/document/EERE-2020-BT-STD-0013-0023.
Boilers	DOE, "2023-07 Technical Support Document: Energy Efficiency Program for Consumer Products and Commercial and Industrial Equipment: Consumer Boilers (NOPR)" (Washington, DC: DOE, 2023). www.regulations.gov/document/EERE-2019-BT-STD-0036-0043. DOE, "Consumer Boilers National Impact Analysis (NIA) (NOPR) Spreadsheet" (Washington, DC: DOE, 2023). www.regulations.gov/document/EERE-2019-BT-STD-0036-0048.
Ceiling fans	DOE, "2023-06 Technical Support Document: Energy Efficiency Program for Consumer Products and Commercial and Industrial Equipment: Ceiling Fans (NOPR)" (Washington, DC: DOE, 2023). www.regulations.gov/document/EERE-2021-BT-STD-0011-0028. DOE, "National Impact Analysis (NIA) Spreadsheet (NOPR)" (Washington, DC: DOE, 2023). www.regulations.gov/document/EERE-2021-BT-STD-0011-0029.
Central ACs and heat pumps	DOE, "2016-12 Technical Support Document: Energy Efficiency Program for Consumer Products: Residential Central Air Conditioners and Heat Pumps" (Washington, DC: DOE, 2016). www.regulations.gov/document?D=EERE-2014-BT-STD-0048-0098. DOE, "Final Rule Analytical Spreadsheets: National Impact Analysis (NIA)." www.regulations.gov/document?D=EERE-2014-BT-STD-0048-0099.
Circulator pumps	DOE, "Technical Support Document: Energy Efficiency Program for Consumer Products and Commercial and Industrial Equipment: Circulator Pumps April 2024" (Washington, DC: DOE, 2024). www.regulations.gov/document/EERE-2016-BT-STD-0004-0137. DOE, "National Impact Analysis (NIA) Spreadsheet for Circulator Pumps Final Rule" (Washington, DC: DOE, 2024). www.regulations.gov/document/EERE-2016-BT-STD-0004-0139.
Clothes dryers	DOE, "2024-02 Technical Support Document: Energy Efficiency Program for Consumer Products and Commercial and Industrial Equipment: Residential Clothes Dryers" (Washington, DC: DOE, 2024). www.regulations.gov/document/EERE-2014-BT-STD-0058-0059. DOE, "National Impact Analysis (NIA) Consumer Clothes Dryers ECS Direct Final Rule Spreadsheet" (Washington, DC: DOE, 2024). www.regulations.gov/document/EERE-2014-BT-STD-0058-0061.
Clothes washers	DOE, "2024-02 Technical Support Document: Energy Efficiency Program for Consumer Products and Commercial and Industrial Equipment: Residential Clothes Washers" (Washington, DC: DOE, 2024). www.regulations.gov/document/EERE-2017-BT-STD-0014-0510. DOE, "National Impact Analysis (NIA) RCW ECS Direct Final Rule Spreadsheet" (Washington, DC: DOE, 2024). www.regulations.gov/document/EERE-2017-BT-STD-0014-0512.

Product	Sources
Cooking products	DOE, "2024-01 Technical Support Document: Energy Efficiency Program for Consumer Products and Commercial and Industrial Equipment: Consumer Conventional Cooking Products, January 2024" (Washington, DC: DOE, 2024). www.regulations.gov/document/EERE-2014-BT-STD-0005-12819. DOE, "National Impact Analysis (NIA) Spreadsheet (DFR)" (Washington, DC: DOE, 2024). www.regulations.gov/document/EERE-2014-BT-STD-0005-12821.
Dedicated-purpose pool pumps	DOE, "2016-12 Final Rule Technical Support Document: Energy Efficiency Program for Consumer Products and Commercial and Industrial Equipment: Dedicated-Purpose Pool Pumps" (Washington, DC: DOE, 2016). www.regulations.gov/document?D=EERE-2015-BT-STD-0008-0105. DOE, "2016 Final Rule Spreadsheet: National Impact Analysis (NIA)." www.regulations.gov/document?D=EERE-2015-BT-STD-0008-0107.
Dehumidifiers	DOE, "2023-10 Technical Support Document: Energy Efficiency Program for Consumer Products and Commercial and Industrial Equipment: Dehumidifiers, October 2023" (Washington, DC: DOE, 2023). www.regulations.gov/document/EERE-2019-BT-STD-0043-0023. DOE, "National Impact (NIA) Analysis Spreadsheet (NOPR)" (Washington, DC: DOE, 2023). www.regulations.gov/document/EERE-2019-BT-STD-0043-0025.
Direct heating equipment	DOE, "2021-11-23 Energy Conservation Program: Energy Conservation Standards for Direct Heating Equipment; Final Determination" (Washington, DC: DOE, 2021). www.regulations.gov/document/EERE-2019-BT-STD-0002-0022. DOE, "2010-03-23 National Impact Analysis DHE" (Washington, DC: DOE, 2010). www.regulations.gov/document?D=EERE-2006-STD-0129-0148.
Dishwashers	DOE, "2024-04 Technical Support Document: Energy Efficiency Program for Consumer Products and Commercial and Industrial Equipment: Dishwashers April 2024" (Washington, DC: DOE, 2024). www.regulations.gov/document/EERE-2019-BT-STD-0039-0061. DOE, "National Impact Analysis (NIA) Dishwashers Direct Final Rule Spreadsheets" (Washington, DC: DOE, 2024). www.regulations.gov/document/EERE-2019-BT-STD-0039-0064.
External power supplies	DOE, "2023-01 Technical Support Document: Energy Efficiency Program for Consumer Products and Commercial and Industrial Equipment: External Power Supplies" (Washington, DC: DOE, 2023). www.regulations.gov/document/EERE-2020-BT-STD-0006-0026. DOE, "National Impact Analysis (NIA) Spreadsheet (NOPR)" (Washington, DC: DOE, 2023). www.regulations.gov/document/EERE-2020-BT-STD-0006-0027.
Faucets	California Investor-Owned Utilities. "Faucets: Codes and Standards Enhancement (CASE) Initiative for PY 2013: Title 20 Standards Development: Analysis of Standards Proposal for Residential Faucets and Faucet Accessories, 2013." efiling.energy.ca.gov/GetDocument.aspx?tn=71768&DocumentContentId=8103. CEC, "Staff Analysis of Water Efficiency Standards for Toilets, Urinals, and Faucets" (Sacramento, CA: CEC, 2015). efiling.energy.ca.gov/GetDocument.aspx?tn=203718&DocumentContentId=11538. EIA, "Residential Energy Consumption Survey (RECS): 2020 RECS Survey Data" (Washington, DC: EIA, 2023).www.eia.gov/consumption/residential/data/2020/index.php?view=characteristics#waterheating. DOE, "2024-04 Technical Support Document: Energy Efficiency Program for Consumer Products and Commercial and Industrial Equipment: Dishwashers April 2024" (Washington, DC: DOE, 2024). www.regulations.gov/document/EERE-2019-BT-STD-0039-0061. DOE, "2010-04-08 Final Rule Technical Support Document Chapters 1 through 16" (Washington, DC: DOE, 2011). www.regulations.gov/#!documentDetail;D=EERE-2006-STD-0129-0149. DOE, Compliance Certification Database, "Faucets" (Washington, DC: DOE, 2024).

Product	Sources
	www.regulations.doe.gov/certification-data/CCMS-4-Faucets.html#q=Product_Group_s%3A%22Faucets%22. Accessed July 5, 2024. U.S. Census Bureau, "QuickFacts. California; United States." www.census.gov/quickfacts/fact/table/CA,US/HSD410223. Accessed January 2025.
Furnaces	DOE, "2023-09 Technical Support Document: Energy Efficiency Program for Consumer Products and Commercial and Industrial Equipment: Consumer Furnaces, September 2023" (Washington, DC: DOE, 2023). www.regulations.gov/document/EERE-2014-BT-STD-0031-4100. DOE, "Residential Furnace National Impact Analysis (NIA) Spreadsheet (Final Rule)" (Washington, DC: DOE, 2023). www.regulations.gov/document/EERE-2014-BT-STD-0031-4101.
Furnace fans	DOE, "2024-10-18 Energy Conservation Program: Energy Conservation Standards for Consumer Furnace Fans; Final Determination" (Washington, DC: DOE, 2024). www.regulations.gov/document/EERE-2021-BT-STD-0029-0033. DOE, "2023-10-06 Energy Conservation Program: Energy Conservation Standards for Consumer Furnace Fans; Notification of Proposed Determination and Request for Comment" (Washington, DC: DOE, 2024). www.regulations.gov/document/EERE-2021-BT-STD-0029-0028. DOE, "2022-09-30 Preliminary Consumer Furnace Fan National Impact Analysis (NIA) Spreadsheet" (Washington, DC: DOE, 2010). www.regulations.gov/document/EERE-2021-BT-STD-0029-0013.
Microwave ovens	DOE, "2023-04 Technical Support Document: Energy Efficiency Program for Consumer Products and Commercial and Industrial Equipment: Microwave Ovens, April 2023" (Washington, DC: DOE, 2023). www.regulations.gov/document/EERE-2017-BT-STD-0023-0032. DOE, "Microwave Oven National Impact Analysis (NIA) Spreadsheet (Final Rule)" (Washington, DC: DOE, 2023). www.regulations.gov/document/EERE-2017-BT-STD-0023-0033.
Miscellaneous refrigeration equipment	DOE, "2024-04 Technical Support Document: Energy Efficiency Program for Consumer Products and Commercial and Industrial Equipment: Miscellaneous Refrigeration Products April 2024" (Washington, DC: DOE, 2024). www.regulations.gov/document/EERE-2020-BT-STD-0039-0037. DOE, "National Impact Analysis (NIA) Miscellaneous Refrigeration Products ECS Direct Final Rule Spreadsheet" (Washington, DC: DOE, 2024). www.regulations.gov/document/EERE-2020-BT-STD-0039-0040. DOE, "2024-04 Government Regulatory Impact Model (GRIM) Miscellaneous Refrigeration Products ECS Direct Final Rule Spreadsheet" (April 2024) (Washington, DC: DOE, 2024). www.regulations.gov/document/EERE-2020-BT-STD-0039-0038.
Pool heaters	DOE, "2023-03 Technical Support Document: Energy Efficiency Program for Consumer Products and Commercial and Industrial Equipment: Consumer Pool Heaters" (Washington, DC: DOE, 2023). www.regulations.gov/document/EERE-2021-BT-STD-0020-0025. DOE, "Consumer Pool Heaters National Impact Analysis (NIA) Spreadsheet (Final Rule)" (Washington, DC: DOE, 2023). www.regulations.gov/document/EERE-2021-BT-STD-0020-0021.
Portable ACs	DOE, "2016-12 Final Rule Technical Support Document: Energy Efficiency Program for Consumer Products and Commercial and Industrial Equipment: Portable Air Conditioners" (Washington, DC: DOE, 2016). www.regulations.gov/document/EERE-2013-BT-STD-0033-0047. DOE, "Final Rule Spreadsheet: National Impact Analysis (NIA)" (Washington, DC: DOE, 2016). www.regulations.gov/document/EERE-2013-BT-STD-0033-0048.
Portable electric spas	DOE, "2025-01 Support Document: Energy Efficiency Program for Consumer Products and Commercial and Industrial Equipment: Portable Electric Spas, January 2025" (Washington, DC: DOE, 2025). www.regulations.gov/document/EERE-2022-BT-STD-0025-0016. DOE, "2025 Government Regulatory Impact Model (GRIM) Portable Electric Spas NODA Spreadsheet" (Washington, DC: DOE, 2025). www.regulations.gov/document/EERE-2022-BT-STD-0025-0013.

Product	Sources
Refrigerators and freezers	DOE, "2023-12 Technical Support Document: Energy Efficiency Program for Consumer Products and Commercial and Industrial Equipment: Refrigerators, Refrigerator-Freezers, and Freezers, December 2023" (Washington, DC: DOE, 2023). www.regulations.gov/document/EERE-2017-BT-STD-0003-0108. DOE, "Consumer Standard-size Refrigerators and Refrigerator-Freezers National Impact Analysis (NIA) Spreadsheet (Direct Final Rule)" (Washington, DC: DOE, 2023). www.regulations.gov/document/EERE-2017-BT-STD-0003-0113. DOE, "Consumer Compact Refrigerators National Impact Analysis (NIA) Spreadsheet (Direct Final Rule)" (Washington, DC: DOE, 2023). www.regulations.gov/document/EERE-2017-BT-STD-0003-0110. DOE, "Consumer Standard-size Freezers National Impact Analysis (NIA) Spreadsheet (Direct Final Rule)" (Washington, DC: DOE, 2023). www.regulations.gov/document/EERE-2017-BT-STD-0003-0112. DOE, "Consumer Compact Freezers National Impact Analysis (NIA) Spreadsheet (Direct Final Rule)" (Washington, DC: DOE, 2023). www.regulations.gov/document/EERE-2017-BT-STD-0003-0111.
Room ACs	DOE, "2023-03 Technical Support Document: Energy Efficiency Program for Consumer Products and Commercial and Industrial Equipment: Room Air Conditioners, March 2023" (Washington, DC: DOE, 2023). www.regulations.gov/document/EERE-2014-BT-STD-0059-0053. DOE, "National Impact Analysis (NIA) Final Rule Spreadsheet" (Washington, DC: DOE, 2023). www.regulations.gov/document/EERE-2014-BT-STD-0059-0054.
Showerheads	California Investor-Owned Utilities, "Showerheads: Codes and Standards Enhancement (CASE) Initiative for PY 2015: Title 20 Standards Development: Analysis of Standards Proposal for Showerheads, 2015." efiling.energy.ca.gov/GetDocument.aspx?tn=205606&DocumentContentId=11922. CEC, "Staff Analysis of Water Efficiency Standards for Showerheads" (Sacramento, CA: CEC, 2015). efiling.energy.ca.gov/GetDocument.aspx?tn=205654&DocumentContentId=11944. EIA, "Residential Energy Consumption Survey (RECS): 2020 RECS Survey Data" (Washington, DC: EIA, 2023). www.eia.gov/consumption/residential/data/2020/index.php?view=characteristics#waterheating. DOE, "2024-04 Technical Support Document: Energy Efficiency Program for Consumer Products and Commercial and Industrial Equipment: Dishwashers April 2024" (Washington, DC: DOE, 2024). www.regulations.gov/document/EERE-2019-BT-STD-0039-0061. DOE, Compliance Certification Database, "Showerheads" (Washington, DC: DOE, 2024). www.regulations.doe.gov/certification-data/CCMS-4-Showerheads.html#q=Product_Group_s%3A%22Showerheads%22. Accessed July 9, 2024. U.S. Census Bureau, "QuickFacts. California; United States." www.census.gov/quickfacts/fact/table/CA,US/HSD410223. Accessed January 2025.
Toilets	California Investor-Owned Utilities, "Toilets and Urinals Water Efficiency: Codes and Standards Enhancement (CASE) Initiative for PY 2013: Title 20 Standards Development: Analysis of Standards Proposal for Toilets and Urinals Water Efficiency, 2013." efiling.energy.ca.gov/GetDocument.aspx?tn=71765&DocumentContentId=8087efiling.energy.ca.gov/GetDocument.aspx?tn=71765&DocumentContentId=8087. CEC. "Staff Analysis of Water Efficiency Standards for Toilets, Urinals, and Faucets" (Sacramento, CA: CEC, 2015). efiling.energy.ca.gov/GetDocument.aspx?tn=203718&DocumentContentId=11538.efiling.energy.ca.gov/GetDocument.aspx?tn=203718&DocumentContentId=11538. CEC, "Analysis of Proposed Efficiency Standards for Water Closets (Toilets)" (Sacramento, CA: CEC, 2024). efiling.energy.ca.gov/GetDocument.aspx?tn=259915&DocumentContentId=96120. U.S. Census Bureau, "QuickFacts. California; United States." www.census.gov/quickfacts/fact/table/CA,US/HSD410223. Accessed January 2025. DOE, Compliance Certification Database, "Water Closets" (Washington, DC: DOE, 2024). www.regulations.doe.gov/certification-data/CCMS-4-

Product	Sources
	Water_Closets.html#q=Product_Group_s%3A%22Water%20Closets%22. Accessed July 9, 2024.
Uninterruptible power supplies	DOE, "UPS Final Rule Technical Support Document" (Washington, DC: DOE, 2016). www.regulations.gov/document/EERE-2016-BT-STD-0022-0023. DOE, "UPS Final Rule National Impact Analysis" (Washington, DC: DOE, 2016). www.regulations.gov/document/EERE-2016-BT-STD-0022-0025.
Water heaters	DOE, "2024-04 Technical Support Document: Energy Efficiency Program for Consumer Products and Commercial and Industrial Equipment: Consumer Water Heaters, April 2024" (Washington, DC: DOE, 2024). www.regulations.gov/document/EERE-2017-BT-STD-0019-1416. DOE, "Consumer Water Heaters National Impact Analysis (NIA) Final Rule Spreadsheet" (Washington, DC: DOE, 2024). www.regulations.gov/document/EERE-2017-BT-STD-0019-1425.

Table H2. Sources for product assumptions for commercial and industrial products

Product	Sources
Air compressors	DOE, "2016-12 Final Rule Technical Support Document: Energy Efficiency Program for Consumer Products and Commercial and Industrial Equipment: Air Compressors" (Washington, DC: DOE, 2016). www.regulations.gov/document/EERE-2013-BT-STD-0040-0082. DOE, "Final Rule Analytical Spreadsheets: National Impact Analysis (NIA)" (Washington, DC: DOE, 2016). www.regulations.gov/document/EERE-2013-BT-STD-0040-0084.
Automatic commercial ice makers	DOE, "2023-02 Technical Support Document: Energy Efficiency Program for Consumer Products and Commercial and Industrial Equipment: Automatic Commercial Ice Makers, February 2023" (Washington, DC: DOE, 2023). www.regulations.gov/document/EERE-2017-BT-STD-0022-0032. DOE, "Automatic Commercial Ice Makers National Impact Analysis (NIA) Model (NOPR)" (Washington, DC: DOE, 2023). www.regulations.gov/document/EERE-2017-BT-STD-0022-0033.
Beverage vending machines	DOE, "2023-04 Technical Support Document: Energy Efficiency Program for Consumer Products and Commercial and Industrial Equipment: Refrigerated Bottled or Canned Beverage Vending Machines, April 2023 (NOPR)" (Washington, DC: DOE, 2023). www.regulations.gov/document/EERE-2020-BT-STD-0014-0019. DOE, "National Impact Analysis (NIA) Spreadsheet (NOPR)" (Washington, DC: DOE, 2023). www.regulations.gov/document/EERE-2020-BT-STD-0014-0017.
Commercial boilers	DOE, "2023-09-19 Energy Conservation Program: Energy Conservation Standards for Commercial Packaged Boilers; Final rule; Technical Amendment" (Washington, DC: DOE, 2023). www.regulations.gov/document/EERE-2013-BT-STD-0030-0103. DOE, "2020-01-10 Energy Conservation Program: Energy Conservation Standards for Commercial Packaged Boilers; Final rule" (Washington, DC: DOE, 2020). www.regulations.gov/document/EERE-2013-BT-STD-0030-0099. DOE, "2016-12-09 Final Rule Technical Support Document: Energy Efficiency Program for Consumer Products and Commercial and Industrial Equipment: Commercial Packaged Boilers" (Washington, DC: DOE, 2016). www.regulations.gov/document/EERE-2013-BT-STD-0030-0083. DOE, "Final Rule Spreadsheet: Commercial Packaged Boiler National Impact Analysis (NIA)" (Washington, DC: DOE, 2016). www.regulations.gov/document/EERE-2013-BT-STD-0030-0087.
Commercial clothes washers	DOE, "2022-02-08 Meeting Presentation: Commercial Clothes Washers Notice of Proposed Determination Webinar, February 8, 2022" (Washington, DC: DOE, 2022). www.regulations.gov/document/EERE-2019-BT-STD-0044-0010. DOE, "2021-12-20 Energy Conservation Program: Energy Conservation Standards for Commercial Clothes Washers; Notification of Proposed Determination and Request for Comment" (Washington, DC: DOE, 2021). www.regulations.gov/document/EERE-2019-BT-STD-0044-0009. DOE, "2014-12-15

Product	Sources
	Technical Support Document: Energy Efficiency Program for Consumer Products and Commercial and Industrial Equipment: Commercial Clothes Washers. (Final Rule)" (Washington, DC: DOE, 2014). www.regulations.gov/document/EERE-2012-BT-STD-0020-0036. DOE, "Final Rule National Impact Analysis Spreadsheet (FR_CCW_NIA_2014_09)" (Washington, DC: DOE, 2014). www.regulations.gov/document/EERE-2012-BT-STD-0020-0034.
Commercial furnaces	DOE, "2015-12-15 Direct Final Rule Technical Support Document: Energy Efficiency Program for Consumer Products and Commercial and Industrial Equipment: Commercial Warm Air Furnaces" (Washington, DC: DOE, 2015). www.regulations.gov/document/EERE-2013-BT-STD-0021-0050. DOE, "2015-12-14 Direct Final Rule National Impact Analysis (NIA) Spreadsheet" (Washington, DC: DOE, 2015). www.regulations.gov/document/EERE-2013-BT-STD-0021-0052.
Commercial packaged ACs and heat pumps	DOE, "2024-04 Technical Support Document: Energy Efficiency Program for Consumer Products and Commercial and Industrial Equipment: Air-Cooled Commercial Unitary Air Conditioners and Commercial Unitary Heat Pumps April 2024" (Washington, DC: DOE, 2024). www.regulations.gov/document/EERE-2022-BT-STD-0015-0096. DOE, "2024-04 Government Regulatory Impact Model (GRIM) Air-Cooled Unitary Air Conditioners and Heat Pumps Direct Final Rule Spreadsheet (April 2024)" (Washington, DC: DOE, 2024). www.regulations.gov/document/EERE-2022-BT-STD-0015-0097.
Commercial refrigeration equipment	DOE, "2024-12 Technical Support Document: Energy Efficiency Program for Consumer Products and Commercial and Industrial Equipment: Commercial Refrigeration Equipment, December 2024" (Washington, DC: DOE, 2024). www.regulations.gov/document/EERE-2017-BT-STD-0007-0118. DOE, "2024-2025 Government Regulatory Impact Model (GRIM) Commercial Refrigeration Equipment ECS Final Rule, Winter 2024-2025 Spreadsheet" (Washington, DC: DOE, 2024). www.regulations.gov/document/EERE-2017-BT-STD-0007-0119.
Commercial three-phase ACs and heat pumps	DOE, "2015-06 Final Rule: Technical Support Document: Energy Efficiency Program for Consumer Products and Commercial and Industrial Equipment: ASHRAE Equipment" (Washington, DC: DOE, 2015). www.regulations.gov/document/EERE-2014-BT-STD-0015-0043. DOE, "2023-06-02 Energy Conservation Program: Energy Conservation Standards for Air Cooled, Three-Phase, Small Commercial Air Conditioners and Heat Pumps with a Cooling Capacity of Less Than 65,000 Btu/h and Air-Cooled, Three-Phase, Variable Refrigerant Flow Air Conditioners and Heat Pumps with a Cooling Capacity of Less Than 65,000 Btu/h; Final Rule" (Washington, DC: DOE, 2023). www.regulations.gov/document/EERE-2022-BT-STD-0008-0011.
Commercial water heaters	DOE, "2023-07 Technical Support Document: Energy Efficiency Program for Consumer Products and Commercial and Industrial Equipment: Commercial Water Heating Equipment" (Washington, DC: DOE, 2023). www.regulations.gov/document/EERE-2021-BT-STD-0027-0038. DOE, "Commercial Water Heater National Impact Analysis (NIA) Spreadsheet (Final Rule)" (Washington, DC: DOE, 2023). www.regulations.gov/document/EERE-2021-BT-STD-0027-0041.
Distribution transformers	DOE, "2024-04 Technical Support Document: Energy Efficiency Program for Consumer Products and Commercial and Industrial Equipment: Distribution Transformers, April 2024" (Washington, DC: DOE, 2024). www.regulations.gov/document/EERE-2019-BT-STD-0018-0165. DOE, "2024-04 National Impact Analysis (NIA) Spreadsheet for Medium-Voltage Dry Type Distribution Transformers (MVDT) Final Rule" (Washington, DC: DOE, 2024). www.regulations.gov/document/EERE-2019-BT-STD-0018-0168. DOE, "2024-04 National Impact Analysis (NIA) Spreadsheet for Liquid-Immersed Distribution Transformers (LIDT) Final Rule" (Washington, DC: DOE, 2024). www.regulations.gov/document/EERE-2019-BT-STD-0018-0166. DOE, "2024-04 National Impact Analysis (NIA) Spreadsheet for Low-Voltage Dry Type Distribution Transformers (LVDT) Final Rule" (Washington, DC: DOE, 2024). www.regulations.gov/document/EERE-2019-BT-STD-0018-0167.

Product	Sources
Electric motors	DOE, "2023-05 Technical Support Document: Energy Efficiency Program for Consumer Products and Commercial and Industrial Equipment: Electric Motors, May 2023" (Washington, DC: DOE, 2023). www.regulations.gov/document/EERE-2020-BT-STD-0007-0040. DOE, "National Impact Analysis (NIA) of Air-Over Electric Motors Spreadsheet (DFR)" (Washington, DC: DOE, 2023). www.regulations.gov/document/EERE-2020-BT-STD-0007-0043. DOE, "National Impact Analysis (NIA) of NEMA Design A and B Electric Motors Spreadsheet (DFR)" (Washington, DC: DOE, 2023). www.regulations.gov/document/EERE-2020-BT-STD-0007-0042.
Expanded scope motors	DOE, "2025-01 Technical Support Document: Energy Efficiency Program for Consumer Products and Commercial and Industrial Equipment: Electric Motors, January 2025" (Washington, DC: DOE, 2025). www.regulations.gov/document/EERE-2020-BT-STD-0007-0078. DOE, "2024 Government Regulatory Impact Model (GRIM) Expanded Scope Electric Motors (ESEMs) Final Rule Spreadsheet" (Washington, DC: DOE, 2025). www.regulations.gov/document/EERE-2020-BT-STD-0007-0079.
Fans and blowers	DOE, "2023-12 Technical Support Document: Energy Efficiency Program for Consumer Products and Commercial and Industrial Equipment: Fans and Blowers, December 2023" (Washington, DC: DOE, 2023). www.regulations.gov/document/EERE-2022-BT-STD-0002-0133. DOE, "2023-11-13 General Fans and Blowers National Impact Analysis (NIA) Spreadsheet (NOPR)" (Washington, DC: DOE, 2023). www.regulations.gov/document/EERE-2022-BT-STD-0002-0137.
Packaged terminal ACs and heat pumps	DOE, "2023-02-13 Energy Conservation Program: Energy Conservation Standards for Packaged Terminal Air Conditioners and Packaged Terminal Heat Pumps; Final Determination" (Washington, DC: DOE, 2023). www.regulations.gov/document/EERE-2019-BT-STD-0035-0023. DOE, "2022-06 Technical Support Document: Energy Efficiency Program for Consumer Products and Commercial and Industrial Equipment: Packaged Terminal Air Conditioners and Packaged Terminal Heat Pumps" (Washington, DC: DOE, 2022). www.regulations.gov/document/EERE-2019-BT-STD-0035-0013. DOE, "Notice of Proposed Determination National Impact Analysis (NIA) Spreadsheet" (Washington, DC: DOE, 2022). www.regulations.gov/document/EERE-2019-BT-STD-0035-0011.
Pumps	DOE, "2015-12 Final Rule Technical Support Document: Energy Efficiency Program for Consumer Products and Commercial and Industrial Equipment: Pumps" (Washington, DC: DOE, 2015). www.regulations.gov/document/EERE-2011-BT-STD-0031-0056. DOE, "2022-08 Technical Support Document: Energy Efficiency Program for Consumer Products and Commercial and Industrial Equipment: Pumps" (Washington, DC: DOE, 2022). www.regulations.gov/document/EERE-2021-BT-STD-0018-00132. DOE, "2022-08-11 Energy Conservation Program: Energy Conservation Standards for Commercial and Industrial Pumps; Notification of Data Availability ('NODA')" (Washington, DC: DOE, 2022). www.regulations.gov/document/EERE-2021-BT-STD-0018-0014.
Single-package vertical ACs and heat pumps	DOE, "2015-08 Final Rule Technical Support Document: Energy Efficiency Program for Commercial and Industrial Equipment: Single Package Vertical Units" (Washington, DC: DOE, 2015). www.regulations.gov/document/EERE-2012-BT-STD-0041-0027. DOE, "202211 Technical Support Document: Energy Efficiency Program for Consumer Products and Commercial and Industrial Equipment: Single Package Vertical Units, November 2022" (Washington, DC: DOE, 2022). www.regulations.gov/document/EERE-2019-BT-STD-0033-0013.
Small electric motors	DOE, "2010-03-09 Small Electric Motors Final Rule Analytical Spreadsheets: Life Cycle Cost Spreadsheet, National Impact Analysis, and Manufacturer Impact Analysis" (Washington, DC: DOE, 2011). www.regulations.gov/document/EERE-2007-BT-STD-0007-0055. DOE, "2021-01 Technical Support Document: Energy Efficiency Program for Consumer Products and Commercial and Industrial Equipment: Small Electric Motors" (cross reference: EERE-2019-BT-STD-0008-

Product	Sources
	0035) (Washington, DC: DOE, 2023). www.regulations.gov/document/EERE-2022-BT-STD-0014-0013. DOE, "2023-02-06 Energy Conservation Program: Energy Conservation Standards for Small Electric Motors; Notification of Proposed Determination and Request for Comment" (Washington, DC: DOE, 2023). www.regulations.gov/document/EERE-2022-BT-STD-0014-0014.
Urinals	California Investor-Owned Utilities, "Toilets and Urinals Water Efficiency: Codes and Standards Enhancement (CASE) Initiative for PY 2013: Title 20 Standards Development: Analysis of Standards Proposal for Toilets and Urinals Water Efficiency, 2013." efiling.energy.ca.gov/GetDocument.aspx?tn=71765&DocumentContentId=8087. CEC, "Staff Analysis of Water Efficiency Standards for Toilets, Urinals, and Faucets, 2015." efiling.energy.ca.gov/GetDocument.aspx?tn=203718&DocumentContentId=11538. DOE, Compliance Certification Database, "Urinals" (Washington, DC: DOE, 2024). www.regulations.doe.gov/certification-data/CCMS-4-Urinals.html#q=Product_Group_s%3A%22Urinals%22. Accessed August 8, 2024. U.S. Census Bureau, "QuickFacts. California; United States." www.census.gov/quickfacts/fact/table/CA,US/HSD410223. Accessed January 2025.
Walk-in coolers and freezers	DOE, "2024-11 Technical Support Document: Energy Efficiency Program for Consumer Products and Commercial and Industrial Equipment: Walk-In Coolers and Walk-In Freezers, November 2024 (Final Rule)" (Washington, DC: DOE, 2024). www.regulations.gov/document/EERE-2017-BT-STD-0009-0093. DOE, "Walk-In Coolers and Walk-In Freezers National Impacts Analysis (NIA): Final Rule for Envelope Components (Doors and Panels) and Refrigeration Systems Spreadsheets" (Washington, DC: DOE, 2024). www.regulations.gov/document/EERE-2017-BT-STD-0009-0096.
Water-source heat pumps	DOE, "Final Rule Spreadsheet: WSHP National Impact Analysis (NIA)" (Washington, DC: DOE, 2015). www.regulations.gov/document/EERE-2014-BT-STD-0015-0047. DOE, "2015-06 Final Rule: Technical Support Document: Energy Efficiency Program for Consumer Products and Commercial and Industrial Equipment: ASHRAE Equipment" (Washington, DC: DOE, 2015). www.regulations.gov/document/EERE-2014-BT-STD-0015-0043. DOE, "2020-05-12 Energy Conservation Program: Energy Conservation Standards for Water-Source Heat Pumps; Request for information" (Washington, DC: DOE, 2020). www.regulations.gov/document/EERE-2019-BT-STD-0031-0003.