

## Executive Summary

### **Next Generation Standards: How the National Energy Efficiency Standards Program Can Continue to Drive Energy, Economic, and Environmental Benefits**

Appliance, equipment, and lighting efficiency standards have ranked among the top policies for saving energy and water since first adopted by California in the 1970s. Congress spread standards nationwide with enactment of the National Appliance Energy Conservation Act of 1987 (NAECA) and major expansions under laws passed in 1992, 2005, and 2007. NAECA and each subsequent legislative expansion and revision were enacted with broad bipartisan support. In general, the laws established initial standards for specific products and created a schedule, process, and criteria for the US Department of Energy (DOE) to review and, if warranted, update standards.

DOE's updates to standards completed through the public rulemaking process have added substantially to the savings achieved by congressionally set standards. Under the Obama administration, the pace of regulatory activity, which had lagged behind legal deadlines under prior administrations, picked up. The agency caught up on all previously missed deadlines and managed not only to largely stay abreast of its legal requirements to review and update standards but also to exercise its authority to develop standards for new, previously unregulated product categories.

DOE estimates that existing efficiency standards completed through February 2016 will, on a cumulative basis between NAECA's 1987 enactment and 2030, save 132 quadrillion Btus (quads) of energy, save consumers nearly \$2 trillion on their utility bills, and reduce CO<sub>2</sub> emissions by more than 7 billion metric tons. For comparison, the entire US economy uses about 100 quads per year.

Given this successful history, this paper addresses two research questions:

- With so much progress to date, especially over the past eight years, what is the potential for future savings with updates to existing standards?
- What strategies could be employed to further increase savings available from standards?

To address the first question, we developed product-by-product estimates of the potential future savings resulting from the next update due after January 2017 (i.e., after the inauguration of the next president). We assessed savings potential based on currently available technology, using existing metrics, test procedures, and product scopes. The national appliance standards law requires DOE to review each standard at least once every six years to determine if an update is warranted and, if so, to complete that update within an additional two years. The analysis assumed future standards will be completed and take effect on the latest date allowable under the law. We were able to develop estimates for 45 of the roughly 55 products currently included in the national standards program.

We found that the potential savings from updated standards are enormous. As shown in figure ES1, potential primary energy savings grow to an annual rate of 2.6 quads of energy in 2035 and increase to 4.0 quads per annum in 2050. Annual savings rates grow over time as more updated standards come into force and those already in place affect a greater portion of products in use. Potential annual energy savings in 2035 equal the current annual energy consumption of all the homes in Texas and Ohio combined. Potential savings in 2050 grow to cover current consumption of homes in those states plus New York and South Carolina.

As figure ES1 shows, electricity accounts for most of the energy savings. These increase to an annual rate of 215 billion kilowatt hours (kWh) by 2035 and 335 billion kWh by 2050 (table ES1). For comparison, 60,000 new wind turbines generate about 335 billion kWh per year. The potential annual rate of CO<sub>2</sub> reductions from all fuels rises to more than 130 million metric tons in 2035, further increasing to an annual rate of more than 200 million metric tons in 2050, an amount about equal to the emissions of 60 coal-fired power plants.

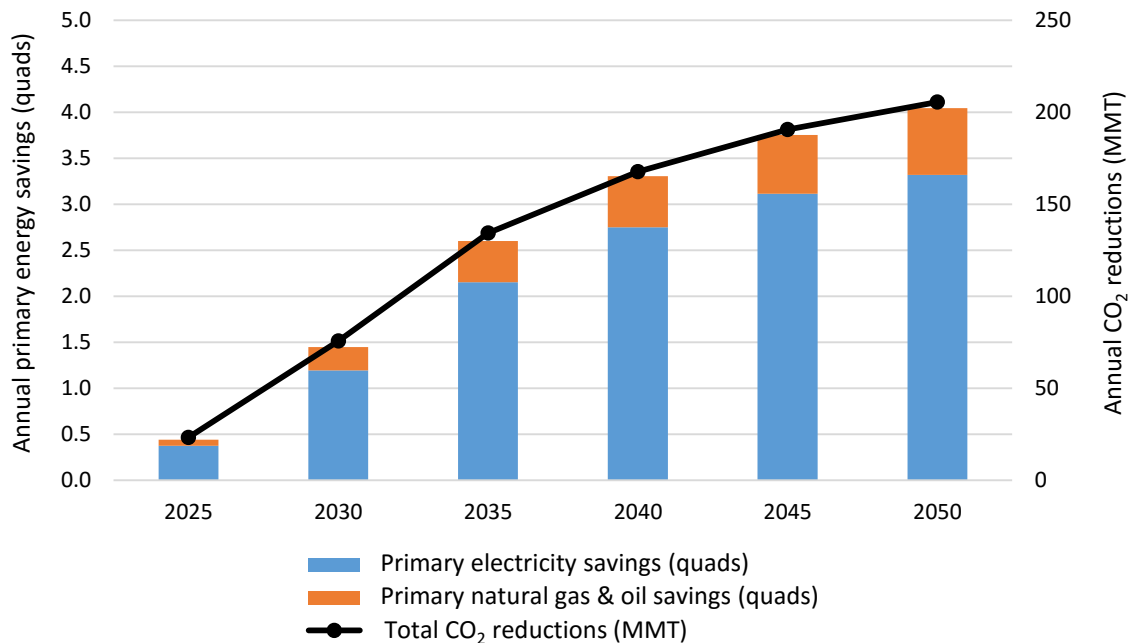


Figure ES1. Potential annual primary energy savings and CO<sub>2</sub> reductions from post-2016 standards for 2025-2050

Several standards address water-using products such as showerheads and faucets. Updates to these standards have the potential to save 770 billion gallons of water annually by 2035, increasing to an annual rate of 850 billion gallons by 2050, an amount greater than that used each year by all the nine million-plus households in Texas.

These energy and water savings translate into very large utility bill reductions for consumers and businesses. The potential annual bill savings for electricity, gas, oil, and water reach nearly \$43 billion by 2035, growing to \$65 billion in 2050, with electricity accounting for the majority of the bill savings. Table ES1 shows the potential annual electricity, natural gas, water, CO<sub>2</sub>, and utility bill savings in 2035 and 2050 for the residential and commercial/industrial products analyzed.

**Table ES1. Potential annual energy and water savings, CO<sub>2</sub> reductions, and utility bill savings from post-2016 standards**

Sector	Annual savings in 2035					Annual savings in 2050				
	Electricity (TWh)	Natural gas (TBtu)	Water (billion gallons)	CO <sub>2</sub> (MMT)	Utility bills (million 2013\$)	Electricity (TWh)	Natural gas (TBtu)	Water (billion gallons)	CO <sub>2</sub> (MMT)	Utility bills (million 2013\$)
Residential	138	388	737	92	33,732	182	554	816	121	45,888
Commercial & industrial	77	56	30	43	9,178	153	161	32	85	19,604
Total	215	444	768	134	42,910	335	715	848	206	65,493

Cumulatively, updates for the evaluated products have the potential to reduce US primary energy use by 70 quads by 2050 while cutting consumer and business utility bills by \$1.1 trillion (table ES2). Potential cumulative CO<sub>2</sub> emissions reductions are 3.5 billion metric tons. For comparison, total US CO<sub>2</sub> emissions in 2014 were about 5.6 billion metric tons.

**Table ES2. Potential cumulative primary energy and water savings, CO<sub>2</sub> reductions, and utility bill savings from post-2016 standards**

Product sector	Cumulative savings through 2050			
	Primary energy (quads)	Water (billion gallons)	CO <sub>2</sub> (MMT)	Utility bills (billion 2013\$)
Residential products	45	17,006	2,319	865
Commercial & industrial products	24	659	1,237	279
Total	70	17,665	3,556	1,144

A disproportionate share of the potential savings derives from the top 10 standards, which account for more than 70% of cumulative energy and utility bill savings potential. Figure ES2 shows the potential cumulative primary energy savings and utility bill savings through 2050 from these top 10 standards. For products that save both electricity and natural gas or oil, the share of energy savings for each energy source is shown.

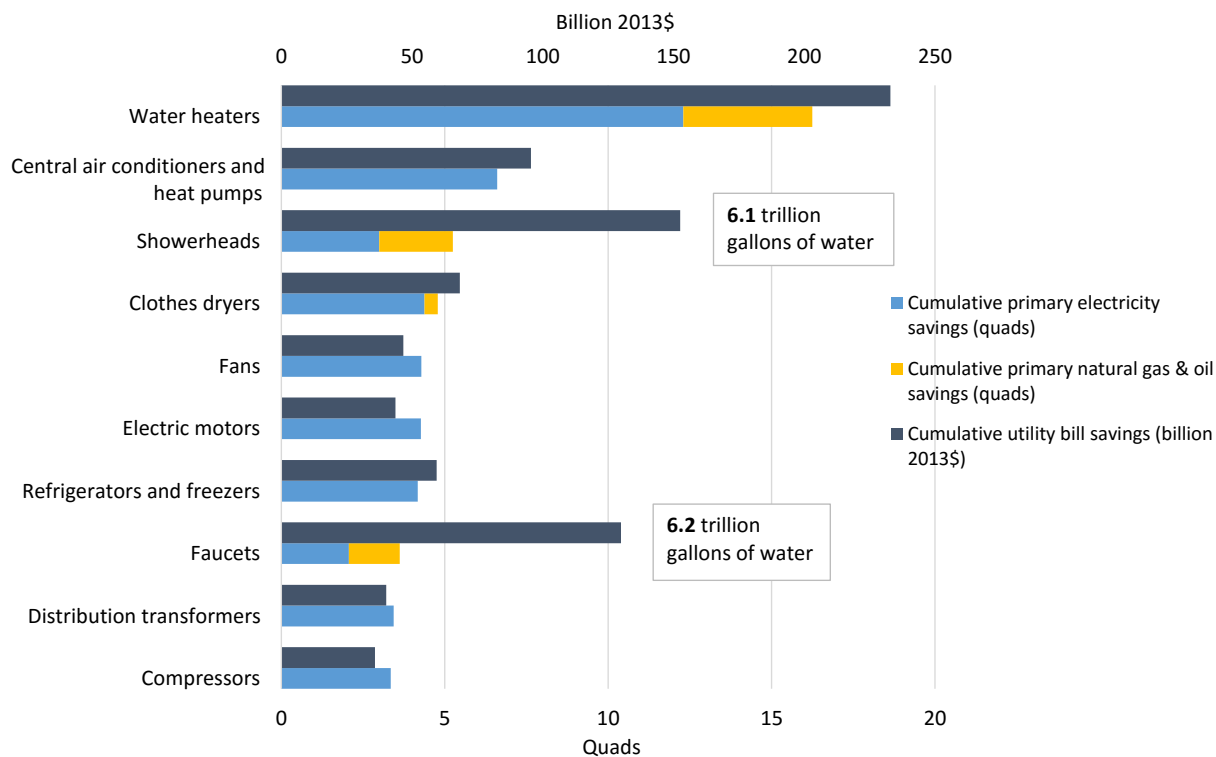


Figure ES2. Potential cumulative primary energy savings and utility bill savings through 2050 for top 10 standards updates

Six of the 10 products with the greatest savings potential have already had their standards updated, in some cases several times, demonstrating that innovation continues to open up new savings opportunities even for products that have already improved substantially. For the other top savings potential products – showerheads, commercial and industrial fans, faucets, and compressors – the next new national standard completed after January 2017 will be only the second.

To address the second research question, we convened two expert panels, conducted individual expert interviews, and drew on our own knowledge to consider a wide range of ideas for increasing savings from national standards. We applied two criteria: Actions had to be indisputably within DOE’s control (i.e., they could not require new legislation), and they had to offer potentially very large savings benefits. We distilled these ideas into five actionable recommendations.

- **Invest in improved test methods, including expedited updates for top priorities.**

DOE has been reviewing all test methods, as required by law, with some updates enabling larger savings than would have been possible with old test methods. By continuing to invest in better test methods and prioritizing test method updates for key products – including clothes dryers, commercial air conditioners, walk-in coolers, water heaters, televisions, computers, central air conditioners and heat pumps, and commercial boilers – DOE could enable significantly increased savings. As DOE undertakes test method reviews, the agency should take into account a number of crosscutting developments that may affect many products’ test methods, including new modes of operation such as network standby, expanded user-selectable

options or modes, controls that might help save energy, and the effect of software or firmware updates post-installation.

- **Systematically assess opportunities to expand scope and conduct rulemakings for the biggest new opportunities.**

In certain cases, DOE can either develop standards for categories of products not previously subject to national standards or expand the types of products within a given category that are subject to standards. Potential opportunities for expanded scope include televisions and additional categories of motors, pumps, and lighting products. The growing but ill-defined category “other uses” may also reveal new opportunities for standards. Some existing lighting standards, such as the incandescent reflector lamp standard, should be superseded by technology-neutral standards, which would dramatically increase savings potential.

- **Continue to improve analysis methods and data sources.**

DOE’s analysis methods have improved significantly over the more than 30 years that the agency has conducted rulemakings. Nevertheless, its analyses can be made even better. DOE should undertake a major data gathering effort aimed at better characterizing the energy usage of products subject to standards. Further work building on DOE’s recent efforts to improve product price estimates would strengthen the agency’s analyses. And periodic retrospective analyses would help DOE continuously improve analysis approaches.

- **Consider how DOE test methods, ratings, and standards can realize or facilitate systems savings opportunities.**

Although most systems savings opportunities are outside the purview of standards, which apply to product manufacturers, some creative approaches have been used to capture systems benefits. Including the energy use of related products (e.g., dryer energy use reflected in washer ratings), developing ratings that reflect the better performance of efficient packaged systems (e.g., new pump standards), and using default values in test methods to encourage higher-efficiency systems (e.g., walk-in cooler standards) are systems strategies that should be considered in future rulemakings when relevant.

- **Develop a strategic approach to address connected products.**

As more and more products are connected to the Internet, these connected products will both draw power to maintain this connectivity and offer the potential for remote control, which may affect energy usage. DOE should develop a strategic approach to address the increased connectivity of products. This strategic approach should address the power used to maintain connectivity, the potential for connected appliances to reduce energy use, the potential for connected devices to circumvent standards, and the ability of these devices to provide usage data that can inform future standard-setting work.

In short, our analysis shows that efficiency standards updated within the next eight years have the potential to reap very large energy and consumer bill savings. The next administration could achieve cumulative nationwide savings of 70 quads of energy and 3.5 billion metric tons of CO<sub>2</sub> by 2050 while cutting consumer and business utility bills by \$1.1 trillion. Even greater

savings may be achieved by investing in improved test procedures, systematically assessing opportunities for expanding the scope of national standards, improving analysis techniques and data sources, assessing opportunities for standards to contribute to systems-level savings, and taking connectedness into account. With focused attention from the next administration, the national standards program will deliver significantly increased energy, economic, and environmental benefits for the nation.

## APPLIANCE STANDARDS

### THERE IS STILL ENORMOUS ROOM FOR IMPROVEMENT TO EXISTING STANDARDS

HERE'S WHAT THAT WOULD MEAN PER YEAR BY 2050:

#### ELECTRICITY SAVINGS

**335**  
BILLION KILOWATT HOURS (KWH)

EQUAL TO ELECTRICITY PRODUCED IN A YEAR BY  
**60,000 NEW WIND TURBINES**

#### LOWER UTILITY BILLS

**\$65** BILLION

ABOUT WHAT AMERICANS SPEND ON

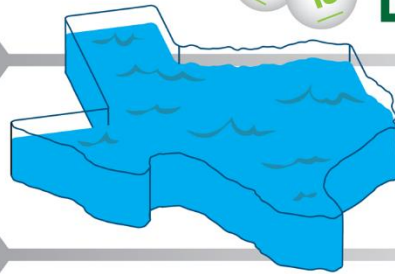
7 15

**LOTTERIES** EVERY YEAR

10 27 33

#### WATER SAVED

**850** BILLION GALLONS



EQUAL TO WHAT

**TEXAS**

HOUSEHOLDS USE IN A YEAR

#### CLIMATE EMISSION CUTS

**200** MILLION METRIC TONS OF CARBON DIOXIDE

EQUAL TO ANNUAL POLLUTION FROM

**60**

COAL-FIRED POWER PLANTS

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**ASAP** | APPLIANCE STANDARDS AWARENESS PROJECT

**ACEEE**  
American Council for an Energy-Efficient Economy