

# The Efficiency Boom: Cashing In on the Savings from Appliance Standards

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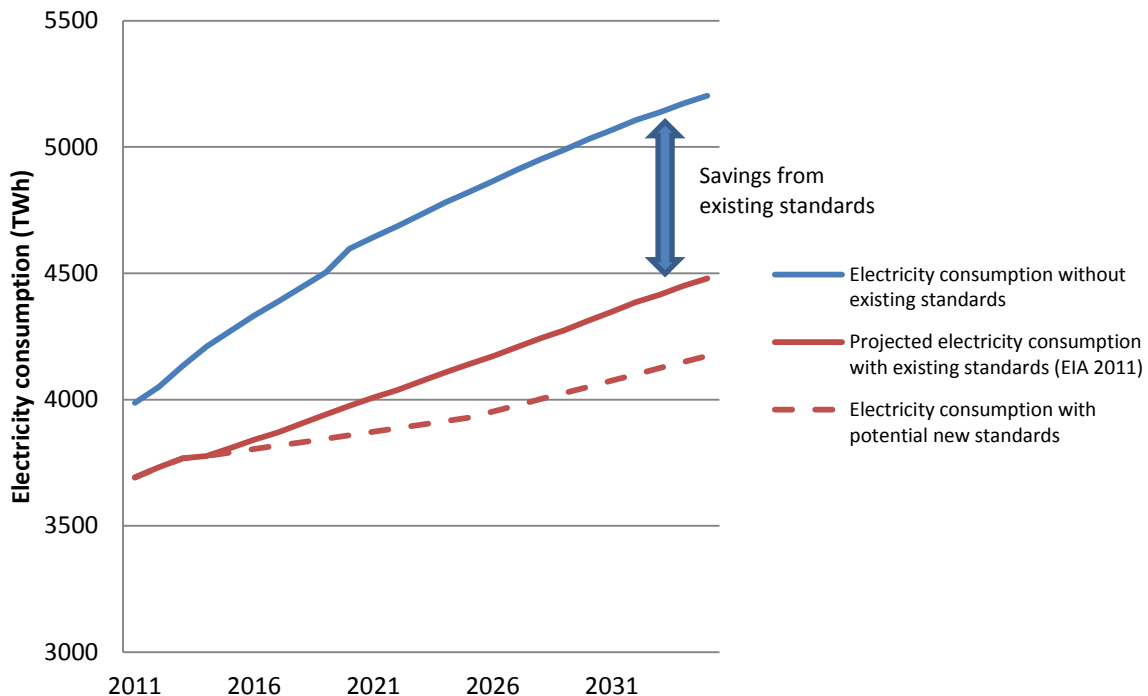
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## EXECUTIVE SUMMARY

Appliance, equipment, and lighting standards have been a cornerstone of U.S. energy policy since Congress enacted the first standards in the 1980s. They have significantly reduced U.S. energy consumption, providing large economic benefits for consumers and businesses. Taking into account products sold from the inception of each national standard through 2035, existing standards will net consumers and businesses more than \$1.1 trillion in savings cumulatively. By 2035, cumulative energy savings will reach more than 200 quads, an amount equal to about two years of total U.S. energy consumption.

Standards have had a particularly large effect on electricity use. The top line in Figure ES-1 shows how much higher U.S. electricity consumption would be if existing product efficiency standards had never taken effect. On an annual basis, products meeting existing standards reduced U.S. electricity use in 2010 by about 280 terawatt-hours (TWh), a 7% reduction. The electricity savings will grow to about 680 TWh in 2025 and 720 TWh in 2035, reducing U.S. electricity consumption by about 14% in each of those years.

Figure ES-1. The Effect of Standards on Total U.S. Annual Electricity Consumption



Lower energy use has resulted in reduced emissions of greenhouse gases and other pollutants. Standards have also lowered peak electric demand levels, reducing strain on the electric grid and the need to build costly new power plants. Reduced energy consumption also puts downward pressure on overall energy prices, saving money for all energy consumers.

This report's key findings regarding the savings from products meeting existing standards are as follows:

- Annual electricity savings in 2035 of around 720 TWh, saving about 14% of what the projected electricity consumption in that year would have been without standards.
- Annual natural gas savings in 2035 of about 950 trillion British thermal units (TBtu), or enough to heat 32% of all natural-gas-heated U.S. homes.
- Peak demand savings in 2035 of about 240 gigawatt (GW), saving about 18% of what the total generating capacity projected for 2035 would have been without standards.
- Annual emissions reductions in 2035 of around 470 million metric tons of carbon dioxide (CO<sub>2</sub>), an amount equal to the emissions of 118 coal-fired power plants.

For individual consumers, benefits have been very large and will grow as new and revised standards take effect. Based on a combination of existing and new standards, a typical household replacing its major appliances every 15 years will save over 180 megawatt-hour (MWh) of electricity and over 200,000 gallons of water between 1995 and 2040 simply by purchasing products that comply with minimum standards. Absent standards, this typical household's electricity use over this period would have been about 35% higher. The water savings, which do not include the savings from plumbing standards, would fill one-third of an Olympic-size swimming pool. Including the plumbing standards would increase these savings several-fold. Total bill savings over this 45-year period exceeds \$30,000, or about enough to cover nearly two years of mortgage payments for an average U.S. household.

Since 2006, the U.S. Department of Energy (DOE), facing a series of court-ordered and statutory deadlines, has been setting a record pace for completing new and updated national standards: 17 new standards have been completed since January 2009 and another 11 are scheduled for completion by January 2013. After January 2013, the rate of statutorily required new standards drops off to a more typical level. However, many important standards are due between 2013 and 2015. In addition, DOE has begun work to cover new products not previously subject to national standards. Concurrently, the California Energy Commission (CEC) has initiated work to develop a new round of state-level standards. Historically, once California establishes new standards, other states follow suit. Therefore, during the 2013 to 2015 timeframe, standards for previously unregulated products may be established at either the national or state level.

This report evaluates potential new or updated standards for 34 product categories that could be adopted within the next four years. Due to federal preemption, many of these standards may only be adopted at the national level, but others may be adopted at the state level first. This substantial set of new and updated standards has the potential to generate enormous additional energy and economic savings. These new standards would increase the annual national electricity and peak demand savings from all national standards by nearly 50% by 2035. In Figure ES-1, the bottom line shows how potential new standards would reduce future electricity consumption.

**Table ES-1. Potential Energy and Water Savings from New Standards**

Product	Annual Savings in 2025				Annual Savings in 2035				Cumulative Quads
	Electricity (TWh)	Peak demand (GW)	Natural gas (Tbtu)	Water (billion gallons)	Electricity (TWh)	Peak demand (GW)	Natural gas (Tbtu)	Water (billion gallons)	
<b>Residential:</b>									
Air handlers	13.7	5.6	-	-	29.1	11.9	-	-	2.9
Battery chargers	6.3	0.9	-	-	6.3	0.9	-	-	1.3
Boilers (nat. gas)	-	-	14.1	-	-	-	39.8	-	0.3
Clothes washers	5.3	0.8	25.3	160.3	7.0	1.0	33.8	213.7	1.5
Computer equipment and components	11.8	1.6	-	-	11.8	1.6	-	-	1.7
Dishwashers	2.6	0.8	3.2	15.8	2.6	0.8	3.2	15.8	0.5
External power supplies	5.0	0.7	-	-	5.0	0.7	-	-	1.0
Faucets (residential lavatory)	1.3	0.2	8.9	23.6	2.7	0.4	18.2	48.4	0.5
Game consoles	7.9	1.1	-	-	7.9	1.1	-	-	1.1
Microwave ovens	2.3	0.3	-	-	2.3	0.3	-	-	0.4
Set-top boxes & digital communication equipment	14.7	2.0	-	-	14.7	2.0	-	-	2.3
Televisions	9.4	0.2	-	-	9.9	0.2	-	-	1.5
Toilets	-	-	-	44.6	-	-	-	91.5	-
Water heaters	18.2	2.5	-	-	43.0	5.9	-	-	4.1
<i>Residential total</i>	<i>98.5</i>	<i>16.8</i>	<i>51.6</i>	<i>244.3</i>	<i>142.3</i>	<i>27.0</i>	<i>95.0</i>	<i>369.5</i>	<i>19.0</i>
<b>Commercial/Industrial:</b>									
Air conditioners, air-cooled	5.5	5.5	-	-	9.7	9.6	-	-	1.1
Automatic ice makers	3.1	0.7	-	5.3	3.1	0.7	-	5.3	0.5
Clothes washers	0.2	0.1	2.4	15.6	0.2	0.1	3.4	22.2	0.1
Distribution transformers	10.9	1.5	-	-	22.4	3.1	-	-	2.3
Electric motors	9.0	1.4	-	-	18.6	2.9	-	-	1.9
Fans, blowers & ventilation equipment	3.1	0.5	-	-	8.5	1.4	-	-	0.7
Furnaces, commercial warm-air	-	-	4.2	-	-	-	7.7	-	0.1
Pre-rinse spray valve	0.8	0.1	9.5	14.9	0.8	0.1	9.5	14.9	0.3
Pumps	8.8	1.4	-	-	13.9	2.2	-	-	1.7
Refrigeration equipment	6.3	0.9	-	-	6.6	0.9	-	-	1.0
Walk-in coolers and freezers	14.7	3.4	-	-	14.7	3.4	-	-	2.4
Unit heaters	-	-	58.1	-	-	-	119.3	-	1.2
Urinals	-	-	-	6.6	-	-	-	13.6	-
<i>Commercial total</i>	<i>62.4</i>	<i>15.5</i>	<i>74.2</i>	<i>42.4</i>	<i>98.5</i>	<i>24.5</i>	<i>139.9</i>	<i>55.9</i>	<i>13.4</i>
<b>Lighting:</b>									
Candelabra & intermediate base incandescent lamps	8.0	0.2	-	-	8.0	5.7	-	-	1.3
General service fluorescent lamps	6.9	1.7	-	-	6.9	1.7	-	-	1.1
HID lamps	2.9	1.0	-	-	-	-	-	-	0.4
Incandescent reflector lamps	20.2	5.0	-	-	20.2	5.0	-	-	3.9
Luminaires (portable light fixtures)	0.2	0.0	-	-	-	-	-	-	0.0
Metal halide lamp fixtures	2.2	0.7	-	-	4.3	1.4	-	-	0.5
Outdoor lighting fixtures	10.3	0.7	-	-	26.1	1.8	-	-	2.3
<i>Lighting total</i>	<i>50.8</i>	<i>9.3</i>	<i>-</i>	<i>-</i>	<i>65.6</i>	<i>15.6</i>	<i>-</i>	<i>-</i>	<i>9.5</i>
<b>TOTAL:</b>	<b>212</b>	<b>42</b>	<b>126</b>	<b>287</b>	<b>306</b>	<b>67</b>	<b>235</b>	<b>425</b>	<b>41.9</b>

Table ES-1 shows the potential energy savings from the 34 new standards evaluated for this report. Key findings regarding energy savings and environmental benefits include:

- Annual electricity savings in 2035 would equal about 310 TWh, or about 7% of projected electricity consumption in that year.
- Annual natural gas savings would reach about 240 TBtu in 2035, or enough to heat 8% of all the natural-gas-heated U.S. homes.
- Annual water savings would reach about 430 billion gallons in 2035, or roughly enough to meet the needs of New York City.
- Peak electricity demand savings would reach about 67 GW in 2035, or about 6% of total U.S. generating capacity projected for 2035.
- Avoided CO<sub>2</sub> emissions in 2035 would equal around 200 million metric tons, an amount equal to the annual emissions of 49 coal-fired power plants. (The total estimated CO<sub>2</sub> savings in 2035 is more than the CO<sub>2</sub> reduction goal of New York.)

The potential savings from new standards are well-distributed between the residential, commercial and industrial sectors. The top ten products in terms of cumulative energy-saving potential are:

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<b>Product</b>	<b>Cumulative Quads (through 2035)</b>
1. Residential electric water heaters	4.1
2. Incandescent reflector lamps	3.9
3. Residential air handlers	2.9
4. Walk-in coolers and freezers	2.4
5. Distribution transformers	2.3
6. Outdoor light fixtures	2.3
7. Set-top boxes	2.3
8. Electric motors	1.9
9. Computers and monitors	1.7
10. Candelabra & intermediate base incandescent lamps	1.3

Other key findings about the relative savings of the evaluated standards include:

- Standards for seven products would deliver more than two quads of cumulative energy savings each. Together these seven categories comprise half of the total evaluated cumulative savings potential.
- Residential air handler standards would deliver the largest peak electric demand savings (about 12 GW in 2035), or roughly 18% of the total. Commercial air conditioners provide the second largest peak electric demand savings.
- Eight standards would achieve direct natural gas savings, with the largest potential gas savings deriving from commercial unit heaters.
- Residential clothes washer standards would provide the largest water savings, although another seven products also could contribute significant water savings.

**Table ES-2. Potential Economic Savings from Future Standards**

Product	Annual bill savings (million 2010\$)		Purchases through 2035		
	in 2025	in 2035	Present value of costs (million 2010\$)	Present value of savings (million 2010\$)	Net present value (million 2010\$)
<b>Residential:</b>					
Air handlers	\$1,573	\$3,331	\$4,748	\$18,740	\$13,992
Battery chargers	\$721	\$721	\$6,091	\$7,061	\$969
Boilers (nat. gas)	\$158	\$446	\$1,245	\$2,679	\$1,434
Clothes washers	\$2,010	\$2,680	\$3,355	\$19,246	\$15,891
Computer equipment and components	\$1,348	\$1,348	\$0	\$8,608	\$8,608
Dishwashers	\$445	\$445	\$1,076	\$3,852	\$2,777
External power supplies	\$575	\$575	\$3,253	\$5,558	\$2,305
Faucets (residential lavatory)	\$413	\$847	\$332	\$5,692	\$5,360
Game consoles	\$910	\$910	\$0	\$5,263	\$5,263
Microwave ovens	\$267	\$267	\$392	\$2,145	\$1,753
Set-top boxes & digital communication equipment	\$1,679	\$1,679	\$0	\$11,586	\$11,586
Televisions	\$1,082	\$1,139	\$0	\$8,260	\$8,260
Toilets	\$312	\$640	\$0	\$4,303	\$4,303
Water heaters	\$2,087	\$4,933	\$18,886	\$23,807	\$4,921
<i>Residential total</i>	\$13,580	\$19,962	\$39,379	\$126,803	\$87,424
<b>Commercial/Industrial:</b>					
Air conditioners, air-cooled	\$563	\$993	\$3,526	\$5,953	\$2,426
Automatic ice makers	\$356	\$356	\$147	\$2,675	\$2,528
Clothes washers	\$148	\$210	\$488	\$1,277	\$788
Distribution transformers	\$1,112	\$2,283	\$6,366	\$16,708	\$10,342
Electric motors	\$609	\$1,251	\$2,284	\$8,405	\$6,121
Fans, blowers & ventilation equipment	\$211	\$575	\$592	\$2,659	\$2,067
Furnaces, commercial warm-air	\$38	\$70	\$215	\$434	\$219
Pre-rinse spray valve	\$274	\$274	\$0	\$2,225	\$2,225
Pumps	\$593	\$936	\$5,020	\$6,081	\$1,061
Refrigeration equipment	\$640	\$674	\$2,086	\$4,886	\$2,799
Walk-in coolers and freezers	\$1,495	\$1,495	\$2,600	\$11,727	\$9,127
Unit heaters	\$533	\$1,094	\$5,512	\$6,846	\$1,334
Urinals	\$46	\$95	\$0	\$637	\$637
<i>Commercial total</i>	\$6,618	\$10,306	\$28,838	\$70,514	\$41,676
<b>Lighting:</b>					
Candelabra & intermediate base incandescent lamps	\$917	\$917	\$629	\$5,888	\$5,259
General service fluorescent lamps	\$709	\$709	\$2,995	\$5,285	\$2,290
HID lamps	\$299	\$0	\$1,666	\$4,193	\$2,527
Incandescent reflector lamps	\$2,314	\$2,314	\$8,936	\$20,204	\$11,267
Luminaires (portable light fixtures)	\$27	\$0	\$21	\$134	\$114
Metal halide lamp fixtures	\$224	\$438	\$709	\$2,894	\$2,185
Outdoor lighting fixtures	\$1,179	\$2,993	\$2,005	\$16,283	\$14,278
<i>Lighting total</i>	\$5,669	\$7,371	\$16,960	\$54,881	\$37,920
<b>TOTAL:</b>	\$25,868	\$37,639	\$85,177	\$252,197	\$167,020

Table ES-2 shows the economic impacts of the evaluated standards. Key economic impact findings include:

- Consumers of the affected products would save around \$170 billion on a net present value basis.
- Twelve standards will each reduce consumer and business energy bills by at least a billion dollars a year by 2035.
- The largest net present value savings would come from clothes washers (\$16 billion), outdoor lighting (\$14 billion), air handlers (\$14 billion), set-top boxes (\$12 billion), and incandescent reflector lamps (\$11 billion). These five products would deliver 40% of the potential net present value benefits of new standards.

- The average simple payback of the evaluated standards is 3.3 years. Simple paybacks range from less than one year to around 10 years for some long-lived products.
- The average benefit-cost ratio for the evaluated standards is 4:1. That is, the present value of product lifetime savings is, on average, more than four times larger than the upfront incremental costs for efficiency improvements.

In sum, already existing appliance, equipment, and lighting standards have delivered enormous energy savings plus economic and environmental benefits. New and updated standards that can be completed within the next few years have the power to cost-effectively add even more energy savings while saving money for the consumers and businesses that buy and use the affected products. New standards can also make significant contributions toward environmental objectives by reducing energy-related emissions. Ultimately, standards can contribute towards bringing U.S. energy supply and demand into better balance, thereby improving the long-term reliability of our electric grid and helping to moderate long-term energy prices. These large potential benefits make a strong case for timely updates to existing national standards and development of standards for previously unregulated products at both the state and national levels.

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