The Impact of Federal Energy Efficiency Programs

Federal energy efficiency programs have played a key role in reducing energy use and saving consumers hundreds of billions of dollars a year in energy bills. But, like many other federal efforts, these programs have come under budgetary attack. This series of fact sheets estimates some of the impacts of selected programs, both what they are saving now and what would be lost if the attacks succeed.

These fact sheets estimate the impacts of seven programs:

1. The Department of Energy (DOE) **appliance standards program** sets minimum efficiency levels for about 60 consumer and commercial products. It already **saves the average family almost $500 each year** in energy and water bills.
2. The Environmental Protection Agency (EPA) **vehicle emissions program** sets emissions requirements and fuel economy labels for cars and trucks. If allowed to take effect, the 2017–25 standards will **help Americans save $370 billion** through 2030.
3. The DOE **Building Energy Codes Program** helps states and local governments develop and implement energy codes for homes and commercial buildings. It **saves the average family with a new home $260** in energy bills each year.
4. The **ENERGY STAR®** program labels efficient products and runs efficiency programs for homes, commercial buildings, and industry. It **saves as much electricity as 30 million homes use in a year.**
5. DOE **Industrial Assessment Centers** train college students to help small and medium-sized manufacturing plants save energy. They have **assisted more than 18,000 plants**.
6. The DOE **State Energy Program** helps state governments advance energy efficiency, renewable energy, and energy security. Additional investments **could save as much as $7 billion through 2040**.
7. The **DOE Weatherization Assistance Program** (with added funding from the Low Income Home Energy Assistance Program) makes energy efficiency improvements to the homes of low-income families. The **families save an average of $4,200** in lifetime utility bills.

Better energy efficiency saves consumers money, makes businesses more competitive, reduces energy imports and strain on energy supplies, cuts air pollution, and helps grow the economy. Federal programs have been an important contributor to these benefits in several ways. Federally funded research and development at national labs and universities have enabled today's light bulbs, refrigerators, and building controls. The ENERGY STAR label and other voluntary programs like Industrial Assessment Centers help consumers and businesses learn how they can save energy and money. Assistance programs like the State Energy Program help others make the needed investments. Fuel economy and appliance efficiency standards protect consumers and the environment by setting minimum efficiency levels for new vehicles and products.

These programs succeed by addressing market barriers that prevent consumers and businesses from adopting beneficial energy efficiency measures. They use national labs to do pre-commercial research that the varied industries could not do on their own. They provide credible information on measures that cannot be seen. And they ensure that consumers, including renters and home buyers who often cannot choose the energy efficiency features in their homes, are not saddled with excessive energy bills. These programs also are highly cost effective. From a small federal investment they leverage billions of dollars of market investment, which in turn yields trillions of dollars in savings on energy bills.

Despite the savings they create, the current administration has proposed slashing these programs. The administration proposed ending programs including the Advanced Research Projects Agency-Energy, ENERGY STAR, Weatherization Assistance Program, State Energy Program, TIGER transportation grants, and the Rural Energy Savings Program. It would also cut the Buildings Technologies, Advanced Manufacturing, and Vehicles Technologies efficiency programs at DOE.

Detailed evaluations of several of these programs (sometimes running to many volumes and taking several years) have estimated the impacts from a single year of program activities. Databases or regulatory impact analyses on other programs present voluminous data but limited overviews. The following fact sheets aim to be more comprehensive if less rigorous than those evaluations and analyses. For selected programs, we used available data and analyses to estimate 1) the current impacts of program activities to date, and 2) the expected future program savings that would be lost if the programs were terminated today.

Note that the data sources differ for each program, and often the specific impacts we were able to estimate vary as well. Thus these impact numbers should not be compared between programs. However we believe they demonstrate the significant energy savings and related impacts each program provides.

We did not include the impacts of research programs, which are more difficult to estimate. Research is, however, just as essential to current and future energy savings. Recent evaluations have estimated large savings from DOE research programs, including at least $6 billion in energy savings from just three projects on heating and cooling efficiency—20 times the total cost of research programs in this area and possibly much greater.

We briefly describe the sources and methodologies we used for each of the programs in a Methodology and Sources document that accompanies the fact sheets.

This document introduces a set of fact sheets on federal efficiency programs issued February 2018. For more information, sources, and analysis methodology, please see aceee.org/portal/national-policy or contact Pasha Majdi at (202) 507-4037 or pmajdi@aceee.org.

Savings from

APPLIANCE STANDARDS

- **Nearly $500/year** average family savings on utility bills
- **$80 billion/year** energy and water bill savings
- **490 billion kWh/year** electricity savings (≈ electricity use of 40 million households)
- **300 MMT CO_2/year** emissions reduction (≈ emissions of 60 million cars)
- **$2.4 trillion** savings from existing standards through 2035 (after added costs)

The Department of Energy (DOE) sets minimum performance requirements for the energy and water use of new appliances and equipment. These products range from refrigerators to furnaces to light bulbs to electric transformers. States usually may not set standards for the same products.

How do they help?

Standards save consumers money and protect them from spiking utility bills. They cut through multiple barriers to energy efficiency, including the fact that the people who pay energy and water bills often do not choose the appliances and equipment that use energy in their homes and businesses, and often do not have access to information on energy efficiency. Appliance standards also reduce stress on the electric grid and natural gas network, help states manage their energy systems, promote innovation, and reduce air pollution and global warming.
In addition, they protect manufacturers from a patchwork of state regulation and from wasteful imports.

How much do they cost?

In 2017 the DOE Equipment and Building Standards program was funded at $54 million. Consumers spent billions of dollars on better products, but will save tens of billions of dollars.

What is at stake?

If funding for the program is cut and standards are not advanced, the following benefits that we could gain from future standards would be lost (2013$):

	2035	2018–50
Utility bill savings	$43 billion	$1.1 trillion
Residential savings per family	$250	$5,600

Is the program cost effective?

The appliance standards program leverages billions of dollars in savings from a small federal investment. The benefit-cost ratio for utility bill savings compared to added consumer cost is at least 5:1.

Better Appliances

Dishwasher energy use has gone down 50% since 1987.

Appliance standards have not only saved consumers hundreds of billions of dollars but the quality of appliances also has improved under the standards. The following are a few examples:

Refrigerators. Since the first standard was set in 1987, energy use has gone down more than 50%, average capacity has gone up, temperature control is better, noise levels are down, and refrigerators offer more features. In addition, real prices are down about 35%.

Clothes washers. Energy use has decreased 75% since 1987. Front-loading machines in particular offer bigger tub capacities, are gentler on clothing, are often better at removing stains, and offer greater controls and new features. And real prices are down about 45%.

Dishwashers. Energy use has decreased 50% since 1987. New features have been added and many are quieter. Real prices are down about 30%.

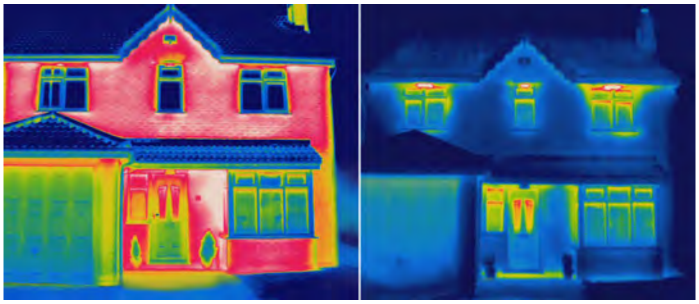
Light bulbs. CFLs and LEDs use about 75% less energy than traditional incandescent bulbs. The bulbs have to be changed much less often, and offer more choice in color range. Although prices are still somewhat higher for a single bulb, the payback period is a few months.

Savings from

BUILDING ENERGY CODES PROGRAM

- **$9 billion/year** energy bill savings
- **$260/year energy bill savings** for the average family with a new home
- **65 billion kWh/year** electricity savings (≈ electricity use of 5 million homes)
- **40 MMT CO_2/year** emissions reduction (≈ annual emissions of 9 million cars)

Building energy codes are minimum standards for the energy efficiency of new homes and commercial buildings as well as major alterations and additions—they set a cap on how wasteful a new building can be. Codes are mostly developed by national organizations, adopted by states, and enforced by local governments. The Building Energy Codes Program (BECP) at the Department of Energy (DOE) helps with each step—it does technical analysis (through the Pacific Northwest National Laboratory), provides technical assistance, and proposes code improvements.



Thermal images showing a home before and after improved insulation. (Source: www.heatseekers.co.uk)

How does it help?

Building energy codes protect consumers, reducing their energy bills over decades and improving home comfort. Without codes, homeowners face market barriers that can cost them hundreds of dollars each month. Builders do not pay the energy bills for homes they construct, and home buyers usually cannot choose the energy efficiency features of a home they purchase, or predict how energy efficient a home will be. Codes also are a key tool for state energy planning and air pollution reduction. DOE does not require codes, but provides technical assistance for states and local governments to develop energy codes and increase compliance with them.

How much does it cost?

In 2017 the BECP was funded at about $5 million. Better buildings can cost more up front, but owners save more on energy bills each month than they spend on the potential increase in mortgages.

What is at stake?

If funding continues, the current program is projected to save by 2040:

	2040	2018–40
Energy bill savings	$32 billion	$270 billion
Residential savings per family with new home	$170	$3,100

Is it cost effective?

The BECP leverages billions of dollars in savings from a small federal investment. The benefit-cost ratio for energy savings compared to added consumer cost for recent code improvements is at least 3:1.

Better Building in North Carolina

Harriet O'Rear (Source: Daniel M.N. Turner)

When Harriet O'Rear and her husband Steve moved to Snow Camp, NC, they wanted to build an energy-efficient home. Harriet researched building technologies and, rather than stick-frame construction, chose factory-built, airtight structural insulated panels. "The simplicity of it going up is incredible," said O'Rear. She said she wants to use as little energy as possible, because she's concerned about global warming: "Steve and I have spent our entire lives trying to make the place that we live as good or better as when we came.... We want to do the best we can for the world."

Codes in Idaho

Building energy codes save consumers money, improve comfort, cut pollution, and reduce strain on the electric grid. For example, let's look at a typical house in Idaho. The state adopts codes based on the national model, the International Energy Conservation Code (IECC). This works because the IECC has different requirements for different climate zones—parts of Idaho are in zones 5 and 6. The current Idaho energy code for homes is similar to the 2009 IECC.

If Idaho adopted the 2015 IECC for homes, new homes would have more insulation in the attic and basement, better windows, and better construction, making them less leaky. The Pacific Northwest National Lab estimates that the changes for a typical home would cost $1,100, which over a 30-year mortgage works out to about $5 per month. Homeowners would save $21 each month on electricity and natural gas. After recouping a 10% down payment, they would be ahead in about six months, and would save $3,600 (net present value) over 30 years.

Savings from

ENERGY STAR®

- **$34 billion/year** energy bill savings (net)
- **$575 in energy bill savings/ year** for typical family with all new ENERGY STAR products and insulation
- **370 billion kWh/year** electricity savings (≈ electricity use of 30 million homes)
- **300 MMT CO_2/year** emissions reduction (≈ emissions of 60 million cars)

The ENERGY STAR program helps consumers save energy. Created in 1992, the ENERGY STAR label is the mark of efficient appliances, electronics, lights, new homes, and more. ENERGY STAR also helps owners track the efficiency of their commercial buildings and runs home energy upgrades, industrial efficiency, and other programs.

How does it help?

Energy efficiency is often invisible, and ENERGY STAR helps consumers see which products save energy. More than 90% of Americans recognize the ENERGY STAR label and can use it to save money on their utility bills and to help the environment. Utilities and states use the program to achieve their energy savings goals and manage electricity loads. Manufacturers and retailers use it to market efficient products.

An advertisement for an ENERGY STAR campaign (Source: energystar.gov)

How much does it cost?

In 2017, ENERGY STAR was funded at about $41 million by the Environmental Protection Agency (EPA), with much less spending at the Department of Energy (DOE). (The EPA runs most of the ENERGY STAR program, but DOE performs testing and runs the home energy upgrade program.) Consumers buy 300 million ENERGY STAR products and almost 100,000 ENERGY STAR homes each year.

What is at stake?

If funding for the program is cut, some or all of the following benefits we estimate for future ENERGY STAR work would be lost:

	2018–30	2018–40
Energy bill savings (net present value)	$170 billion	$320 billion
Number of ENERGY STAR products sold	4 billion	7 billion

Is it cost effective?

ENERGY STAR leverages billions of dollars in savings from a small federal investment. For every dollar consumers invest in efficiency using ENERGY STAR, they save $4.50.

A Home Performance Star in Arizona

Elena Chrimat working in an attic (left) and next to bales of insulation in her workshop (right). (Source: Elena Chrimat)

When Elena Chrimat could not get a buildings job in Arizona during the recession of 2008, she cofounded a small business (working out of her 1989 Land Cruiser) to save energy in homes. Ideal Energy LLC now employs 10 people in Tempe. They completed 1,179 jobs in 2016, many as part of Home Performance with ENERGY STAR programs through their local utilities. These included energy audits, installing efficient air conditioners and insulation, and sealing air leaks. With efficiency, Chrimat said, she "didn't just want a job to make a buck, [but] to do something more impactful."

Saving Energy in Florida

The Almonte family made energy efficiency upgrades to their home in Miami, FL, not only to reduce their monthly energy bill, but also to minimize their impact on the environment. They replaced all of their kitchen appliances with ENERGY STAR models, replaced their water heater, put in ENERGY STAR lighting, added weather stripping, and even bought an ENERGY STAR computer. With these upgrades they saved $63 a month in utility bills.

This is one of a set of fact sheets on federal efficiency programs issued February 2018. For more information, sources, and analysis methodology, please see **aceee.org/portal/national-policy** or contact Pasha Majdi at (202) 507-4037 or pmajdi@aceee.org.

Savings from

THE EPA VEHICLE EMISSIONS PROGRAM

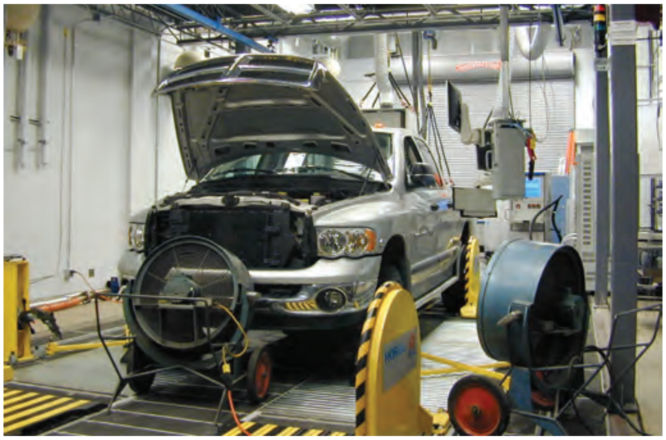
The Environmental Protection Agency (EPA) vehicle and fuel emissions testing program sets maximum average emissions levels for new cars, vans, trucks, and buses. The National Vehicle and Fuel Emissions Laboratory oversees fuel economy and emissions testing as they are closely related. The program also addresses fuel economy labels, fuel standards, and nonroad engines.

Vehicle fuel economy benefits:

- **$17 billion per year** savings at the pump
- **1/2 million barrels a day** oil savings (gasoline use of 14 million typical cars and light trucks)
- **83 MMT CO_2** emissions reduction
- **$1,650 (net)** savings on a typical 2016 car/light truck, over its life span

How does the Vehicle Emissions Program help?

Improving the fuel economy and reducing emissions of all kinds of vehicles saves consumers—and truckers—billions of dollars, cuts air pollution and associated health problems, and reduces our reliance on foreign oil. EPA fuel economy window stickers on new cars help buyers choose cars that will save them money.



A pickup truck being tested at the National Vehicle and Fuel Emissions Laboratory (source: EPA)

How much does it cost?

In 2016, lab and emissions standards work was funded at about $100 million. Consumers and businesses spent $20 billion on improved vehicle fuel economy in 2016, but will save more than $50 billion in reduced fuel costs over the lives of those vehicles.

What is at stake?

If average new-vehicle fuel economy were to stay at 2016 levels rather than meet the emissions and fuel economy standards that have been set for 2017–25, we estimate these vehicle fuel economy benefits would be lost:

	2025	2017–30
Consumer fuel savings	$43 billion	$370 billion
Oil savings	380 million barrels	4.4 billion barrels

Without these improvements, an American who owns a car made in 2025 would likely spend an extra $3,200 (net) over the life of the vehicle. A tractor-truck owner would spend an extra $31,000 (net).

Is it cost effective?

The EPA vehicle emissions program leverages billions of dollars in savings from a small federal investment. For 2025 vehicles, the benefit-cost ratio for fuel savings compared to added consumer cost will be about 3 to 1.

Logging Fuel Savings: From a North Carolina Plant to Michigan Roads

An Eaton worker assembling a transmission. (Source: Eaton)

Eaton produces advanced transmissions at its Kings Mountain, NC, facility. About 400 people work at the plant making truck transmissions that save fuel by using lighter materials, fewer parts, better integration with the powertrain, and smarter shifting. The facility's efficient operation also saves energy. It is one of Eaton's centers of excellence.

The efficient transmissions help people like Jim Hansen. Hansen's work week begins each Monday around 6 a.m. with a 200-mile ride up to northern Michigan from his home to collect some 100,000 pounds of logs. That same day Hansen typically travels another 200 miles to deliver the wood to mills in southeastern and central Michigan. The next day he does it again.

For businesses like Hansen's, fuel economy is crucial, as every gallon of diesel saved equates to revenue that can be reinvested in operations. Hansen now averages about 4.1 miles per gallon with his truck, which he says is very good for a heavy hauler, and his fuel savings have helped him get a larger truck that can carry more logs and will allow his business to grow. "My previous truck…gave me a million miles of reliable performance," Hansen said. "But this new UltraShift PLUS has just made my job so much easier."

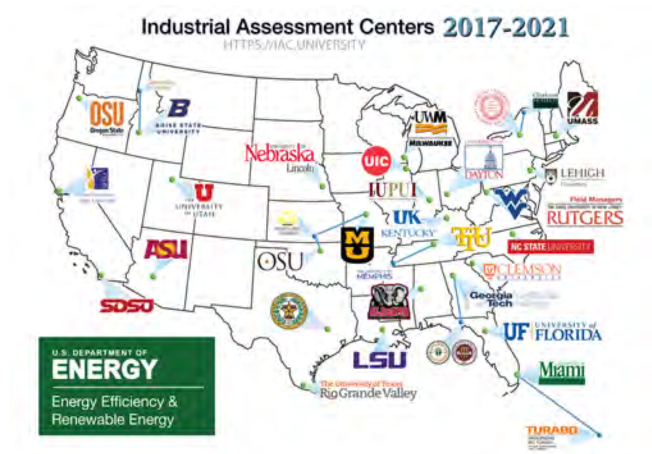
This is one of a set of fact sheets on federal efficiency programs issued January 2018. For more information, sources, and analysis methodology, please see **aceee.org/portal/national-policy** or contact Pasha Majdi at (202) 507-4037 or pmajdi@aceee.org.

Savings from

INDUSTRIAL ASSESSMENT CENTERS

- **$70 million/year** energy bill savings
- **$44,000/year savings** from implemented measures per plant
- **800 million kWh/year electricity savings** (≈ electricity use of over 60,000 homes)
- **3 million MMBtu/year** natural gas savings (≈ natural gas use of 70,000 homes)
- **0.5 MMT CO_2/year emissions reduction** (≈ emissions of over 100,000 cars)

Industrial Assessment Centers (IACs) provide energy assessments to small and medium-sized manufacturers while training students to conduct the assessments. There are now 28 IACs located at universities in 25 states. IACs have provided over 18,000 assessments since 1976.



Map of IACs (Source: https://iac.university/)

How do they help?

IACs help small and medium-sized industrial plants save money, addressing the barriers they face as small businesses that often lack dedicated energy managers. IACs make these businesses more competitive and help them create jobs. At the same time, the program trains the next generation of energy engineers, preparing students for jobs as energy efficiency professionals. IAC alumni find energy efficiency jobs faster than their peers and earn more.

How much do they cost?

The Department of Energy's IAC program spends about $9 million each year to fund most of the training and assessments. Companies invest $25–30 million each year in the efficiency improvements they choose to make.

What is at stake?

If funding for the IACs is cut, some or all of the following benefits we estimate for future assessments would be lost:

	2018–30	2018–40
Number of plants helped	6,000	11,000
Savings (net present value)	$280 million	$580 million

Is the program cost effective?

This small federal program yields much larger energy benefits and effective job training. The implemented measures pay back in less than a year on average, with energy and other savings each exceeding the investment over time.

Bricking in Savings: Boral Bricks in Oklahoma

Boral's cultured stone product (Source: boralamerica.com/Cultured-Stone/cultured-stone)

The Boral Bricks factory in Muskogee, OK, employs 40 people who make more than 100 million bricks each year, from clay mine to kiln. A team from the Industrial Assessment Center at Oklahoma State University examined the plant and made recommendations including variable frequency drives on air compressors and on the carts used to move the bricks, capacitor banks to improve the power factor, reducing air pressure and fixing compressed air leaks, a better HVAC system (and cleaning the condensers), and better lighting. The plant invested $79,000 in efficiency improvements, which were expected to yield $63,000 in savings each year. For the plant, "lower plant costs mean lower prices for the consumer."

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Savings from

STATE ENERGY PROGRAM

- **$0.36–1.8 billion/year*** energy bill savings
- **2.6–13 billion kWh/year** electricity savings (≈ electricity use of 0.2–1 million homes)
- **5–24 million MMBtu/year** natural gas savings (≈ natural gas use of 100,000–600,000 homes)
- **1.6–7.9 MMT CO_2/year** emissions reduction (≈ emissions of 0.3–1.7 million cars)

The State Energy Program (SEP) helps every state advance energy efficiency, renewable energy, and energy emergency preparedness. For over 30 years, states have used SEP funding and technical assistance to train building owners in energy efficiency, develop clean energy policies and programs, reduce state and local government energy waste, create state energy emergency plans, and create public-private partnerships to finance efficiency investments.

How does it help?

States use SEP funding to help institutions, consumers, and businesses reduce energy waste and lower utility bills, save taxpayer dollars, meet air quality requirements, and help keep the lights on and fuel flowing during natural disasters and other emergencies. Each state designs its own program, but most provide a combination of information and financing to overcome key barriers to energy savings. Since 2000, the SEP has helped upgrade 20,000 buildings and educate 2 million people.

How much does it cost?

In 2017 the SEP was funded at $50 million at the Department of Energy, primarily for formula grants. States must provide at least 20% matching funds, and most projects leverage much larger private investment—one study found the average match to SEP funds is over 10:1.

What is at stake?

If funding is cut, we estimate some or all of the following SEP benefits would be lost:

	2018–30	2018–40
Energy bill savings (present value)	$0.27–1.9 billion	$0.58–7.2 billion
Electricity savings	2.9–22 billion kWh	7.8–110 billion kWh

Just as important, the support for state energy emergency preparedness would be lost as well.

Is it cost effective?

The SEP leverages much larger state and private investment. The benefit-cost ratio of estimated savings generated by federal investment in SEP to the federal investment is between 2:1 and 31:1.

** Ranges in this fact sheet are due to different treatment of building energy codes savings. See Methodology and Sources in the collected fact sheets at aceee.org/portal/national-policy.*

Energy Education in Tennessee

K-12 teachers discuss plug loads at an energy camp for educators. (Source: Tennessee Department of Environment & Conservation)

The Tennessee Office of Energy Programs runs energy education camps to train K-12 educators how to teach the science of energy and energy conservation. These teaching methods help students learn the Tennessee science curriculum standards through real-world situations, including collection and analysis of data to evaluate and improve the schools' energy use. Participants also receive Electric Circuits KitBooks, a Tennessee-made educational tool that merges a hands-on science kit featuring a built-in circuit board with textbook materials. In 2016 and 2017, 160 educators participated. Their comments included, "Opened my mind to alternative sources of energy as well as how to use energy more efficiently," and "You've really created a workshop that can be applied in the classroom."

Energy Efficiency Loans in Nebraska

The Nebraska Dollar and Energy Saving Loan program helps families and businesses invest in energy efficiency. This revolving loan fund run by the Nebraska Energy Office has invested more than $300 million in over 28,000 projects since 1990. Over half of the funding is leveraged from private sources, combining market-rate private lending with zero-interest loans from the state, resulting in a low blended interest rate. It helps families buy ENERGY STAR appliances and HVAC equipment, businesses and schools improve lighting, and farms reduce waste in irrigation. Loan payments are returned to the fund to make more loans.

Savings from

WEATHERIZATION ASSISTANCE PROGRAM

- **$4,200** savings per weatherized home (lifetime)
- **$820 million/year** energy bill savings
- **2.6 billion kWh/year** electricity savings (≈ electricity use of 200,000 homes)
- **27 million MMBtu/year** natural gas savings: (≈ use of 700,000 homes)
- **3.5 MMT CO_2/year** emissions reduction (≈ emissions of 740,000 cars)

The Weatherization Assistance Program (WAP) helps low-income families by making energy efficiency improvements to their homes. Since 1976, WAP has funded and provided training to community assistance programs around the country to make more than 7 million homes of low-income families more energy efficient. Using energy assessments, the contractors seal air leaks, add insulation, and replace old heating and cooling equipment.

A Weatherization Assistance Program crew prepares to assist a West Virginia homeowner. (Source: Daniel M.N. Turner)

How does it help?

The WAP helps low-income families lower their energy bills with savings that last for decades. However evaluations find that other benefits are even greater: less asthma (and thus lower health costs), more money to pay for medications, and better comfort. WAP also trains and employs thousands of workers, often from the same low-income communities that benefit from the home improvements.

How much does it cost?

In 2017, WAP was funded at $228 million at DOE. In addition, almost all states transfer funds to WAP from the Department of Health and Human Services' Low Income Home Energy Assistance Program ($307 million in 2014), and in most states, utilities and others provide additional funding ($333 million in 2015).

What is at stake?

If funding is cut, some or all of the following benefits we estimate for future weatherization assistance would be lost:

	2018–30	2018–40
Number of low-income families helped	1.4 million	2.5 million
Energy bill savings (present value)	$1.8 billion	$4.2 billion

Is it cost effective?

Although WAP is not the cheapest program per unit of energy savings, the benefits to low-income families are great. Oak Ridge National Lab found a total benefit-cost ratio (including health and other benefits) of 4:1.

Healthier Home in West Virginia

(Source: Daniel M.N. Turner)

In the southernmost tip of West Virginia, where the state's poverty rates are highest, Brenda Kelsor struggles with chronic breathing problems. She has bronchitis and chronic obstructive pulmonary disease, and her home—an old trailer—was only making matters worse. It lacked central air conditioning and insulation so she found it difficult to breathe in both summer and winter. "It's hard to breathe...if it's too hot or too cold," said Kelsor. After her home was weatherized, its indoor temperature remained pleasant and her utility bills decreased. "Oh, my god, it feels good in here," she said about the difference. "This is going to help."

Enhanced Weatherization in Alaska

Alaska faces some of the highest energy costs in the United States, with residential costs that are 60% above the national average. These high costs are a problem especially for low-income households, but weatherization assistance programs help reduce this burden by keeping homes energy efficient. The federal program distributes about $1.5 million a year to Alaska; the State of Alaska has added hundreds of millions of dollars more. In the remote Kobuk River Valley, the program remodeled dozens of homes, employing several dozen local residents. The Enhanced Weatherization Program combined funds to help homeowners in Lake and Peninsula Borough. In the Village of Egegik, for example, one participant reduced energy consumption by 30% and saved $2,000 annually, while another reduced annual fuel oil use by 300 gallons.

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Methodology and Sources

For these fact sheets we used the results of program evaluations and other available impact estimates to derive estimates of the current impacts from program activities to date, and to project the savings that would be lost from future program activities if the programs were discontinued. Except where we state otherwise, we did not include the future impact of past program activities, although the savings often build up and last over many years.

Because methodologies of the sources we used vary widely, the impact estimates for different programs may not be comparable, even when covering the same years.

For current impacts we mostly report annual savings—the savings in a given year from program activities that occurred over multiple years. For projected impacts we mostly report cumulative savings—total savings over multiple years. To estimate future savings, we assumed program activities would continue at the same level as in recent years with similar incremental savings—savings due to each program year.

Where we did our own calculation of energy savings and carbon dioxide emissions reduction, we took the energy prices by sector and source and average emissions intensities from the No Clean Power Plan case in the Energy Information Administration's (EIA) *Annual Energy Outlook* (AEO) 2017. For the conversions based on electricity use by the average home, we used numbers for 2017 from AEO 2017. Our savings per family estimates used the total number of households in the appropriate year from the AEO. Our emissions per car figures are from the Environmental Protection Agency's (EPA) Greenhouse Gas Equivalencies Calculator for light-duty vehicles. We show monetary figures in 2017 dollars (adjusted using a GDP chained index price deflator), and we have discounted cumulative financial impacts at a real 5% rate; however, where we report figures from other reports, they may use other approaches.

We drew federal spending levels for each program primarily from congressional budget justification documents; however, in a few cases, we augmented those figures with information from private communications with agency officials.

The following explains detailed sources and methodologies for each program.

Introduction

We drew the statistics that appear in the introduction's numbered list from the fact sheets, so the sources and methodology for each number can be found in the section corresponding to its topic. Heating and cooling research savings information comes from a recent evaluation by RTI International. (Other evaluations of Department of Energy (DOE) Office of Energy Efficiency and Renewable Energy research programs are summarized in this analysis.)

Policy programs

Appliance standards

Appliance standards impact estimates are from two reports by the Appliance Standards Awareness Project (ASAP) and ACEEE. Current program impacts are for 2015 (in 2015 dollars) and are from *Energy-Saving States of America*. This paper estimated energy and water savings from all existing federal appliance standards based on product sales and per-unit costs and savings at the time each standard was set, typically (but not always) from DOE regulatory impact analyses. We calculated carbon impacts from the energy savings.

Savings at risk are potential savings from the next round of updates to current federal standards. DOE is required to review current standards and update them if warranted. These estimates are from *Next Generation Standards*, and mostly assume the maximum levels that were found to be technically feasible in the last round of rulemakings (but not necessarily economically justified yet).

The sidebar on Better Appliances is adapted from the ACEEE/ASAP *Better Appliances* report.

Vehicle emissions program

The savings numbers are for light-duty (car, SUV, and light truck) and heavy-duty (large trucks and buses) fuel economy and emissions standards that were set since 2010. Savings from earlier fuel economy standards are not included. ACEEE made the light-duty vehicle estimates using the VISION 2017 model from Argonne National Lab (which in turn is based on AEO 2017). The heavy-duty vehicle estimates are directly from or derived from EPA regulatory impact analyses for the standards.

The current light-duty vehicle savings are savings in 2016 from model year 2012–16 vehicles. The baseline was fixed at 2011 average fuel economy. The current heavy-duty vehicle savings are savings in 2016 for model year 2014–16 vehicles, with a baseline of 2010 average fuel economies.

The light-duty vehicle estimates of savings at risk are for model years 2017–30. The estimates compare the standards that have already been set for 2017–25 to fuel economy remaining at the 2016 average, assuming that the 2025 standards remain the same in subsequent model years. The heavy-duty vehicle estimates of savings at risk are for model years 2018–30. The estimates compare the standards that have already been set for 2018–27 to fuel economy standards remaining at 2017 levels.

Net savings for single light-duty and heavy-duty vehicles are the discounted fuel savings for average lifetime driving minus the average cost per vehicle taken from the EPA estimates in the regulatory impact analyses. The current estimate compares the 2016 standard to the 2011 standard; the projected estimates compare the 2025 standard to the 2016 standard for a car and to the 2017 standard for a tractor-truck.

The Logging Fuel Savings case study is adapted from ACEEE's Saving Energy Helps American Businesses and Creates Jobs fact sheet.

Building energy codes

Current savings are 2017 estimates from the 2014 *National Benefits Assessment* for the Building Energy Codes Program by the Pacific Northwest National Laboratory (PNNL). This paper used building energy simulations by state to estimate code-to-code savings for homes and commercial buildings starting in 1992, and expert opinion to estimate the impact of the program on code development, adoption, and compliance. Although DOE has published a subsequent national codes impact analysis, it estimated impacts from codes but did not attribute how much of the savings were due to the program. We calculated dollar savings and savings per home (using DOE's estimate of total home sales).

Future impact estimates are from the same paper and include impacts from program activities in past years, as well as program activities anticipated in future years.

The Codes in Idaho sidebar is based on a PNNL analysis for Idaho and associated spreadsheet. The story of Harriet O'Rear is from an ACEEE video.

Deployment programs

ENERGY STAR

We took current savings numbers from the ENERGY STAR program's own impact estimates, which used different methods for different programs. Net dollar and total energy savings are reported for 2015 in ENERGY STAR by the Numbers, and electric savings and carbon reductions are from graphs in the Overview of 2015 Achievements (see also their methodological description). We assumed natural gas savings to be the difference between energy and electricity savings. The benefit-cost ratio is from the 2014 Annual Report.

We based future savings estimates on the 2015 annual savings mentioned above, assuming a savings lifetime of seven years to estimate incremental savings. We assumed that ENERGY STAR to date would continue to influence future purchases and investments after the program ends and therefore phased in the incremental impacts over five years. We estimated the cost of 2015 savings by subtracting the net savings from the savings (using energy prices from the Energy Information Administration). We converted from a cost allocated to the specific year savings to an initial cost using the seven-year lifetime and 5% real discount rate, and assumed the cost also would remain constant (in real terms).

The story of Elena Chrimat is adapted from an ACEEE fact sheet on energy efficiency jobs. The story of the Almonte family is based on an ENERGY STAR web page.

Industrial Assessment Centers

We drew impacts for Industrial Assessment Centers (IACs) from the IAC Database, which is maintained by Rutgers University. We extracted annual savings by fuel, total annual dollar savings, and costs of implemented measures by year. We only counted 62% of costs and savings, assuming the other measures would have been done anyway based on a survey in a 2015 SRI evaluation. We assumed linear decay of savings with an average seven-year measure life. The future savings estimates assumed new savings and costs would be an average of those from 2014–16.

The SRI evaluation also is the source for the workforce impact statements.

The Boral Bricks story is from an IAC case study supplemented by a *Muskogee Phoenix* article.

State Energy Program

State Energy Program (SEP) impacts are based on Oak Ridge National Laboratory's evaluation of the 2008 program year and of the Recovery Act (ARRA) program. They estimated savings attributable to SEP (i.e., savings that would not have occurred in the absence of the program) for selected Broad Program Area Categories (BPACs), including a little more than half of 2008 funding and ARRA funding. We assumed the savings per program dollar for 2008 also applied to other program years, starting in 1997.

The BPACs evaluated for 2008 did not include building energy codes work, which was found to be the most cost effective by far for ARRA and in previous evaluations. To better include codes impacts, we took estimated savings per program dollar from the ARRA evaluation, and applied that ratio to each program year, assuming codes funding was a similar proportion of total funding as in 2008. We did not include impacts from other BPACs that were not evaluated. For example, we assumed $50 million funding in future years (almost the same as the 2008 level), and from that assumed each program year would yield roughly the evaluated impacts for 2008 (from $29 million in programs) plus roughly half of the evaluated codes impacts from ARRA (from $7 million in programs). Because the codes impacts are much larger and more uncertain, in the fact sheet we show a range from no codes impacts to full estimated codes impacts.

We used data for total savings by fuel from Tables 4-2, 5-2, and 5-15 and associated graphs of the evaluation, and from those, estimated total savings by year (for program year impacts, we roughly fit the shape of the savings growth and decay). To estimate energy costs, we allocated the savings to economic sectors using Tables 4-4, 5-4, and 5-16. Codes spending was taken from Tables 7 and 14 in Appendix C.

Additional statistics are from a DOE fact sheet.

Information on the Tennessee camps is available on the Tennessee Department of Environment & Conservation website, and information on the Nebraska loans is from a fact sheet, web site, and ACEEE paper.

Weatherization Assistance Program

Weatherization Assistance Program (WAP) impacts are based on the Oak Ridge National Laboratory evaluations of the 2008 program year and of the Recovery Act (ARRA) program. We extracted data for annual savings per weatherized home by fuel and aggregated over the housing types. We assumed savings per home remains the same over other program years, starting in 1997.

We counted retrofits using DOE funds and Low Income Home Energy Assistance Program (LIHEAP) funds based on the 2008 evaluation, and retrofits using ARRA funds based on the ARRA evaluation, but did not include state or utility funding. We used the number of homes that programs expected to weatherize from the National Association of State Community Services Programs annual survey for years such data was available (2004–15), and estimated the number of homes from annual funding levels in other years. Future program estimates are based on the most recent funding data available, and hence are based only on the 2008 evaluation. We assumed a 20-year lifetime for savings based on previous evaluations.

The Enhanced Weatherization in Alaska sidebar is adapted from the ACEEE Alaska score sheet, with additional information from *The Arctic Sounder*. The story of Brenda Kelsor is adapted from an ACEEE video.

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