

Energy-Saving HOMES, BUILDINGS, & MANUFACTURING

Office of Energy Efficiency and Renewable Energy
U.S. Department of Energy

Energy efficiency offers consumers and businesses the opportunity to save billions of dollars on energy bills, avoid unnecessary pollution, create jobs, improve U.S. competitiveness, and reinvigorate domestic manufacturing. In the Office of Energy Efficiency and Renewable Energy (EERE), part of the U.S. Department of Energy (DOE), we design and manage our portfolio to deliver these many benefits to the nation.

Our **homes and buildings**—offices, schools, hospitals, restaurants, and more—are responsible for about 40% of the energy used in the United States, 40% of the country's carbon dioxide emissions, and an annual energy bill of more than \$400 billion. Our **factories and industrial plants** account for another third of U.S. energy use, 25% of our carbon dioxide emissions, and an annual energy bill near \$200 billion^[1]. Making our industrial sector more energy-efficient will also make these companies more competitive.

We can save more than 20% of that energy—and the money we spend to pay for it—by reducing waste with cost-effective, off-the-shelf solutions. And we expect to save even more with the next generation of technologies and approaches EERE is helping to accelerate to market now. Developing and applying these solutions also sharpens the competitive edge of U.S. manufacturers, which provide millions of high-paying jobs^[2] and produce about 60% of our nation's exports each year^[3].

EERE leads a robust network of researchers and other partners to continually develop innovative, cost-effective

energy-saving solutions, which helps make our country run better through increased efficiency—better plants, manufacturing processes, products, new homes, ways to improve older homes, and buildings in which to work, shop, and lead our everyday lives. Highlights of the EERE portfolio include:

Better Buildings Challenge

EERE is spearheading this new public-private leadership program to reduce commercial building energy use by 20% by 2020, to help save \$40 billion on energy bills annually, and to grow American jobs. More than 100 diverse organizations have already committed to this goal, including companies such as Best Buy, Staples, 3M, and Alcoa, and state and local governments in Los Angeles, California; Will County, Illinois; and the state of North Carolina. They have agreed to publicly showcase the 'how' and 'why' of their solutions so others can follow. EERE continues to sign up new partners to help create a robust energy efficiency solution center for organizations of all types and sizes.

Better Products and Equipment

EERE's innovative approaches bring real value to a variety of markets by helping deliver products that raise the bar for performance and efficiency, saving consumers money, and making American businesses more competitive:

- **Refrigerators** today use a quarter of the energy as they did in 1972, cost half as much to purchase, and have more features. Much of this progress stems from EERE investments in better refrigerator/freezer compressor technology since the early 1980s^[4].
- **Efficient windows** pioneered with EERE funding have played a critical role in the market shift toward double-pane windows with low-e coatings, which insulate three times better than typical single-pane windows. More



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recently, EERE has developed and commercialized technology to create smarter windows for cold climates that will allow in more energy than they lose.

- **New heat pump water heaters** offer households large savings on water heating, more than 50% in many cases. As a nation, we spend \$34 billion^[5] each year on energy for water heating^[6], and heat pump water heaters could free a large percentage of that money to meet other household expenses. The first of these innovative water heaters are rolling off the line at the General Electric plant in Louisville, Kentucky, employing hundreds of workers.
- **High efficiency LED lighting** has the potential to save consumers 90% of the \$23 billion^[5] we spend as a nation each year on energy to light our homes. New technology developed with EERE support has led to a bulb that lasts roughly 25 times longer than traditional incandescent bulbs^[7]. Even with a higher initial price, this new technology saves consumers money. As with other electronics, LED bulb prices should drop substantially as the market develops.
- **Combined heat and power (CHP) systems** offer some manufacturers a way to cut energy consumption by as much as 50%. Also known as cogeneration, CHP uses a single source of energy to simultaneously deliver both power and thermal energy for industrial processes that require heating or cooling. EERE-supported research led to the development of key CHP components that U.S. manufacturers make in America for a growing global market—more than 3,700 CHP sites represent a total generating capacity of more than 80 gigawatts^[8].

Buildings Innovation Hub Optimizes Energy Efficient Upgrades

DOE's Energy Efficient Buildings (EEB) Hub at Philadelphia's Navy Yard hosts a consortium of universities, national labs, and private companies that are jointly

committed to pioneering solutions to cut energy use in existing buildings by 50% by 2015. The EEB Hub includes 270 buildings that consortium members can use to conduct energy efficiency experiments. The Hub is working with software partners to develop building design and upgrade tools to view all

American-made components for combined heat and power systems have become high-revenue exports. One generator developed with EERE support accounts for about \$3 billion of Caterpillar's global sales.



the building's systems—air conditioning, heating, and water—as a single system that can be optimized for best performance according to its users' needs.

Billions in Savings through Minimum Standards

Standards make it easy for consumers to save energy and money by ensuring that appliances and products sold in the United States are efficient. EERE implements minimum product standards based on congressional authorization to avoid a patchwork of state-by-state standards. Moreover, a national standard provides consistency for manufacturers.

Since 2009, EERE has issued or codified efficiency standards for more than 30 products, which will result in more than \$45 billion in collective savings by 2015 and \$390 billion by 2030^[9]. EERE is also on course to finalize an additional nine standards by the end of 2013. EERE is also on course to finalize an additional nine standards by the end of 2013. Standards are negotiated with U.S. industries to ensure that they are set at the highest level that is practically and economically achievable to avoid wasting energy. High efficiency standards generally favor the high-tech companies found in the United States, making them more competitive

Better Practices via the Commercial Building Energy Alliances

In partnership with EERE, commercial building owners and operators can join dozens of peer organizations in the Commercial Building Energy Alliance (CBEA) to learn new strategies to save energy and money. Members of CBEA—representing a diverse set of building types and about 20% of the total U.S. floor space in their respective sectors^[10]—are developing energy-saving solutions to common problems, adopting these solutions, and saving millions of dollars^[11]. Here are some examples:

- **Energy-efficient commercial lighting specifications** applied at more than 800 U.S. sites since 2010 are saving more than 60 million kilowatt hours per year, enough to power 4,000-5,000 homes. Alliance members as diverse as Safeway, the Cleveland Clinic, USAA Real Estate, Walmart, and BJ's Wholesale are already saving millions of dollars annually through lighting improvements alone^[12].
- **High efficiency roof-top air conditioners units (RTUs)** that meet a 2011 CBEA specification will reduce energy use by as much as 50% compared to standard equipment,



allowing U.S. businesses to save up to \$1 billion each year in energy costs. As part of a cooperative DOE program, Target, Walmart, and other Alliance members jointly expressed an interest in equipment that meets the new energy efficiency specification at an affordable price. Five manufacturers responded to this "RTU Challenge" by agreeing to submit a product to EERE for independent testing. The market for a cost-effective product is huge: RTUs cool more than half of the air-conditioned commercial floor space in the United States^[13].

- **Five new high efficiency product specifications** are planned for introduction in 2012 in the areas of refrigeration, HVAC, and lighting. These specifications will set the stage for innovation among competitors to develop products that perform up to 75% better than existing options and offer Americans billions of dollars in additional savings.

Efficient New Buildings

New home and commercial building construction offers an important opportunity to incorporate energy efficiency at the start, when these improvements offer the most value per dollar, delivering more savings. EERE advances technically sound and cost-effective model building energy codes, which are the first steps to code adoption and implementation by states and local jurisdictions, with which EERE works closely. The most recent improvements to residential and commercial building energy codes could save home and business owners 30% more energy than previous versions of the code—and billions of dollars in reduced energy bills^[14]. We continue to work with industry partners on model codes that would make new homes and buildings even more efficient.

Low-Income Weatherization

Many households could save \$400 or more on their annual energy bills through upgrades that improve insulation and warm or cool air delivery throughout the home. The millions of homes constructed before modern building codes are all candidates for these upgrades, and the savings they deliver are especially important for low income families. Between 2009 and late September 2012, EERE has weatherized more than 1 million homes across the country. These efforts have been saving eligible families hundreds on their heating and cooling bills in the first year alone, reducing the nation's energy bills by more than

\$2 billion annually, and supporting about 20,000 jobs at any one time. To date, these programs have trained 200,000 workers^[23], boosting their eligibility for American jobs and helping to grow the clean energy workforce.

Better Manufacturing Technology and Materials

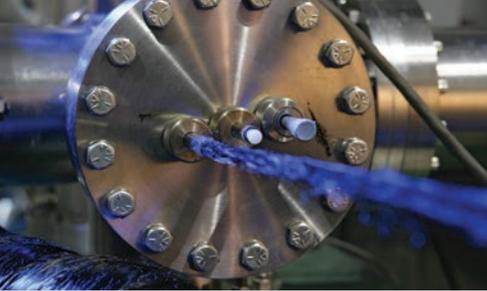
EERE has supported the development of more than 250 energy-saving industrial technologies that have been commercialized since 1976^[16]. Recent examples include:

- Minnesota steelmaker Mesabi Nugget LLC partnered with EERE to reduce four energy-intensive iron plant process steps—coke making, sintering, power plants, and blast furnaces—into a one-step breakthrough iron manufacturing process that saves time, eliminates the need for carbon-intensive coke, and consumes 30% less energy than a conventional blast furnace^[17].
- Aspen Aerogels used EERE support to take previously fragile and expensive insulation and pioneer the commercial-scale production of flexible industrial insulation for piping, tanks, and other equipment that is twice as thin and up to five times more thermally efficient than the current standard. Aspen Aerogels sold millions of square feet of this insulation, saving U.S. manufacturers money on energy costs while improving competitiveness^[18].
- The National Energy Technology Laboratory; MDS Coating Technologies, Eaton, and Greenleaf Corporations; and Ames Laboratory are working with EERE to engineer innovative nanostructure coatings that significantly reduce the erosion and corrosion on turbine blades, the wear-and-tear on hydraulic components and tooling systems, and, overall, reduce fuel use, energy costs and improve the performance and efficiency of electric power generation, including for aircraft^[18].

Manufacturing Demonstration Facilities

EERE is working to create a network of Manufacturing Demonstration Facilities (MDFs). The MDFs will form collaborative communities, with each targeting a unique technology in advanced manufacturing. Each MDF will share a common infrastructure designed to provide innovative companies with timely, affordable access to physical and virtual tools and to enable demonstration of new materials and processes critical to advancing the industrial sector. With MDF infrastructure and resources, manufacturers can reduce technical risk and support the business case for further investment in advanced manufacturing capabilities, particularly important for the small- and medium-sized businesses that own more than 85% of U.S. plants and employ more than 40% of our manufacturing workforce^[15]. The first MDF, at DOE's Oak Ridge National Laboratory, is developing both low-cost carbon fiber technologies and additive manufacturing (also called 3D printing).





Dow is working with DOE's Oak Ridge National Laboratory to produce high-strength carbon fiber using polyolefin, a low-cost plastic.

Reducing Reliance on Critical Materials

Critical materials are key resources needed to manufacture many of today's clean energy technologies like wind turbines, solar panels, electric

vehicles, and energy-efficient lights. As these materials are essential to meeting our country's energy needs, EERE is working closely with other DOE program offices to bring together top researchers from academia, industry, and government laboratories to form a Critical Materials Energy Innovation Hub. The Hub will be devoted to finding substitute materials that can alleviate the impacts of supply chain disruptions and price fluctuations associated with sourcing these critical materials from abroad.

Federal Energy Leadership

The U.S. federal government, the nation's single largest user of energy, has both a tremendous opportunity and an acknowledged responsibility to lead by example in saving energy. Since 1975, the energy intensity of federal facilities has decreased by roughly 45%. Investing in federal energy efficiency remains an effective strategy for saving money by reducing waste. EERE's Federal Energy Management Program (FEMP) has played a critical role in this effort by providing technical assistance to federal agencies that helps drive demand and accelerate cost-effective adoption of energy-saving technologies and strategies.

Project funding mechanisms allow federal agencies to save energy without up-front capital costs or special congressional appropriations. Energy savings performance contracts (ESPC) and utility energy service contracts are important methods for agencies to implement energy projects and achieve challenging energy reduction goals while creating jobs in energy efficiency and renewable energy manufacturing, installation and services. From 2009 to 2011, FEMP arranged ESPCs that enabled federal agencies to save more than \$3.5 billion in energy costs associated with approximately \$1.2 billion in project

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investment[21]. The savings on utility bills and operations and maintenance created through the facility upgrades will be used to pay for the project over the term of the contract, and the agencies will continue to save money and energy after the contract term has ended. Building on this success, the U.S. Government has committed \$2 billion more by 2014 for performance-based contracts to improve the energy efficiency of federal buildings[22].

The Next Generation of Energy Managers

EERE supports a network of Industrial Assessment Centers at 24 universities across the country. Teams of engineering faculty and students serve small and medium manufacturers in their communities by identifying potential energy savings, pollution prevention measures, and productivity improvements. Since the program began in 1976, these assessments have helped manufacturers save more than \$5.6 billion in energy costs and 530 trillion Btu of energy—enough to meet the energy annual needs of 5.5 million American homes. More than 3,000 students have graduated from the Industrial Assessment Center program with more than 60% going on to careers in the energy industry[19].

Clean Energy Financing Programs

Many states used their Recovery Act grants to establish funding mechanisms such as revolving loan funds (RLF) that will provide lasting capacity to support clean energy projects. Currently, 39 states and territories have more than \$545 million in RLFs[20] and many are structuring them to leverage private sector capital to provide low-cost loans that will support independent energy efficiency and renewable energy project development. EERE will continue to monitor the use of this federal funding and connect these partners to share best-practice strategies for maximizing the impact of these funds.

The Office of Energy Efficiency and Renewable Energy is at the center of creating the clean energy economy today. We lead U.S. Energy Department efforts to develop and deliver market-driven solutions for energy-saving homes, buildings, and manufacturing; sustainable transportation; and renewable electricity generation.



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