DOE ENERGY EFFICIENCY PROGRAMS: BENEFITS TO COLORADO

SOUTHWEST ENERGY EFFICIENCY PROJECT

The U.S. Department of Energy (DOE) manages energy efficiency programs involving both research and development (R&D) and programs to encourage adoption of energy efficiency technologies and best practices. These programs help Colorado businesses and consumers save energy and money, and they add jobs through businesses that sell, install, and maintain energy efficiency products and services. According to DOE's 2017 U.S. Energy and Employment Report, energy efficiency provides 29,800 jobs in Colorado.

ENERGY EFFICIENCY PROVIDES 29,800 JOBS IN COLORADO

The table below shows the main categories of DOE's energy efficiency programs, and the proposed levels of funding for FY 2018 under both the House and Senate Appropriations bills. How does the DOE directly benefit Colorado businesses and residents? Read on for some of the highlights.

DOE Energy Efficiency Programs	FY 2017 Budget (thou $)	2018 White House Request (thou $)	2018 House Approp. Bill (thou $)	House % Reduction vs. 2017	2018 Senate Approp. Bill (thou $)	Senate % Reduction vs. 2017
Advanced Manufacturing	306,959	82,000	125,000	59%	277,988	9%
Building Technologies	257,500	82,000	102,000	60%	252,000	2%
Vehicle Technologies	199,141	67,500	91,406	54%	195,000	2%
Weatherization Assistance	225,000	0	225,000	0%	212,000	6%
Total for EE programs above	**988,600**	**231,500**	**543,406**	**45%**	**936,988**	**5%**

BTO PROGRAMS

The Building Technologies Office (BTO) spearheads several programs including the Building America Program, the Building Energy Codes Program, and Appliance and Equipment Efficiency Standards, Emerging Technologies, and Residential and Commercial Building Integration.

Building America

The Building America Program conducts research on energy efficiency innovations to benefit the residential building industry and the public. The program helps push these innovations into the market through demonstrations, information dissemination, and voluntary residential energy efficiency programs. Through adopting energy efficiency improvements advanced by the Building America program:

- U.S. households save **$54 billion annually** on their utility bills, with **$170 of homeowner savings for each $1** of Building America revenue spent
- Highly efficient new homes generate millions of dollars per year in additional construction revenue and generate thousands of new jobs nationally

Building Energy Codes Program

The DOE Building Energy Codes Program contributes to energy savings in buildings by supporting the implementation of the model building energy codes. The program accomplishes this by: 1) Participating in industry processes to develop and update codes—analyzing energy and cost savings associated with code updates and improvements; 2) providing technical assistance to states and localities—helping them adopt and implement better codes; and 3) supporting energy code compliance through providing training and tools—ensuring that intended savings are realized by U.S. home and business owners. DOE estimates that adopting the latest model energy codes would result in these benefits by 2030:

- Save Colorado businesses and homes at least **$210 million per year**
- Reduce Colorado's energy consumption in residential and commercial buildings by **23 trillion Btu per year** or more (about 4% savings)

Appliance and Equipment Efficiency Standards

The federal government has adopted minimum energy standards for more than 60 products, representing about 90% of home energy use, 60% of commercial building energy use, and 30% of industrial energy use. DOE periodically reviews and updates the standards and test procedures. In Colorado, appliance and equipment standards adopted to date achieve these benefits:

- Colorado businesses save a total of **$280 million per year**
- A typical Colorado household saves about **$420 per year** (about 14% of its annual utility bill)

The national energy efficiency standards completed through 2016 will result in the following cumulative savings through 2020 for the U.S.:

- **71 quadrillion Btu** (quads) of energy savings
- **$1 trillion** of net economic benefits to consumers and businesses

R&D PROGRAMS - ADVANCED MANUFACTURING AND BUILDING TECHNOLOGIES

Both the Advanced Manufacturing Office (AMO) and Building Technologies Office (BTO) support R&D of new energy efficiency technologies, with the main goal of helping to introduce new technologies to the market that will improve energy efficiency in buildings and industry, savings businesses and consumers money on energy costs. In many cases the new technologies are manufactured by entrepreneurial start-up companies, creating new jobs in addition to contributing to energy and cost savings. Here are some examples of Colorado businesses that have benefited through collaborations with the DOE's R&D programs.

Colorado Business and location	Technology	Commercial -ization Date	No. of Employees	DOE Program Collaboration
Ravenwindow (Denver)	Smart window tinting	2007	10	BTO/NREL
Simuwatt (Boulder)	Building analysis software	2012	10	BTO/NREL
Coolerado (Denver)	High efficiency A/C equipment	2004	50	BTO/NREL
Sulfa-Trap (Wheat Ridge)	Biogas cleaning for fuel cells	2011	NA	AMO
Rio Tinto Minerals (Greenwood Village)	Borate auto-causticizing	2007	NA	AMO

Simuwatt provides software tools such as "Energy Auditor," which lowers the time and cost of providing high quality, commercial building energy assessments while preserving the data to facilitate reporting, portfolio-wide tracking, and reuse. Simuwatt's founders collaborated with the National Renewable Energy Laboratory (NREL) to apply for and receive federal grants to develop the software tools. "NREL's involvement, with its level of expertise, was crucial," noted Tom O'Connor, Simuwatt CEO. Simuwatt now has $2 million in private investment and 10 employees, and is selling licenses for its software and developing other business partnerships.

Ravenwindow produces high efficiency windows that feature the RavenWindow thermochromic filter, which is applied to the inside surface of the exterior glass pane of a double pane window. The filter activates when the exterior glass temperature rises above the "transition" temperature point. On warmer days, the window shifts to its tinted state, blocking solar heat from entering, minimizing glare, limiting UV degradation, and reducing the cooling load on air-conditioning systems. During cooler months when solar gain is desired to help heat the building, the filter remains clear to let in warming rays and light. Ravenwindow has been in business for 10 years and has 10 employees. NREL performed energy modeling of Ravenwindow's product to estimate energy savings and return on investment for an eight-story commercial building in Denver. NREL also helped Ravenwindow by showcasing its product in one of the NREL buildings in Golden. "NREL is a global platform, so third-party validation from such a reputable organization is the very thing a company like Ravenwindow needs," said Del Bankston, Ravenwindow CEO.

Coolerado produces air conditioning systems that use only 10-40 percent of the energy used by conventional air conditioners. The air conditioners use a three-step process to cool the air, using evaporative cooling rather than traditional refrigerant-based cooling. The three-step process allows

the system to use air it has already partially cooled to move to other stages of the conditioner as needed, reducing the amount of energy needed to cool the space. The air conditioner also filters the air as it cools, releasing clean air into the home, office, or other commercial space. Coolerado collaborated with the National Renewable Energy Laboratories (NREL) to analyze and test Coolerado's air conditioning systems to evaluate their potential energy savings. The data and third-party verification from NREL was very helpful in marketing Coolerado's products, according to Lee Gillan, Vice President of Coolerado.

Sulfa-Trap, Inc. Solid oxide fuel cells are an emerging low-emission power generation technology that can run on a variety of fuels, including by-products of other systems in a facility—for example, anaerobic digester gas, produced by microorganisms as they digest biomass. However, sulfur compounds in anaerobic digester gas must be removed before it can safely be used in the fuel cells. The Sulfa-Trap technology uses a strong sorbent to remove sulfur compounds from anaerobic digester gas, allowing safe use of biogas instead of natural gas in small-scale fuel cell systems. Sulfa-Trap received a grant from AMO to help develop this technology.

Rio Tinto Minerals. The kraft process, a standard process for converting wood into wood pulp for paper, requires sodium hydroxide. The conventional method is to use a lime kiln to accomplish this chemical reaction. The process developed by Rio Tinto Minerals is a boron-based auto-causticizing technology that reduces energy consumption and increases the causticizing and calcining capacities of the system. With this technology, the chemical reactions that produce the sodium hydroxide occur in the same mechanism, not in a separate lime kiln, which leads to the increases in efficiency. AMO provided funding to help Rio Tinto Minerals develop this new technology. Rio Tinto Minerals employs more than 50,000 people across the world, and has an office in Greenwood Village, CO.

Panasonic Partnership. In July 2017, the Department of Energy announced a new partnership between the DOE-funded NREL, Xcel Energy, and Panasonic to create a mixed-use, "smart-city" development site in Denver, CO. The site will run completely on clean energy sources and demonstrate numerous innovative technologies. For NREL, the project is an opportunity to demonstrate renewable power generation and energy storage technologies, while also testing NREL's micro-grid-modeling and management capabilities. NREL plans to use a software product called URBANopt, and its Energy Systems Integration Facility, to help design and analyze the development. For Panasonic, this large-scale project is an opportunity to test and continue to improve its solar panel and solar storage technologies.

AMO PROGRAMS

The Advanced Manufacturing Office (AMO) runs several programs including the Industrial Assessment Centers and the Combined Heat and Power (CHP) Technical Assistance Partnerships (TAPs). The CHP TAPs provide free assistance to industrial and commercial facilities in evaluating applications of combined heat and power, which can help businesses save money, improve reliability, and reduce their carbon footprint.

Industrial Assessment Centers

Industrial Assessment Centers (IACs) are operated by 28 universities throughout the U.S. The IACs provide free energy assessments to small and medium-size manufacturers, and provide training to

engineering students. From 1984 to 2016, the Colorado State University Industrial Assessment Center achieved the following results:

- **92 students** trained
- **720 assessments** completed (most of these for Colorado manufacturers)
- **3.5 trillion Btu** of energy savings from implemented recommendations
- **$30 million** in cost savings to the industrial facilities

VEHICLE TECHNOLOGIES

The Vehicle Technologies Office (VTO) supports research, development (R&D), and deployment of efficient transportation technologies that improve energy efficiency, improve fuel economy, and reduce petroleum consumption. These technologies include advanced batteries and electric drive systems, lightweight materials, advanced combustion engines, alternative fuels, and energy efficient mobility systems. VTO also supports implementation programs such as Clean Cities.

Clean Cities

The Clean Cities program supports state and regional actions to reduce petroleum consumption through the use of alternative fuels (mainly natural gas, ethanol, and electricity) and improved efficiency. In Colorado there are three Clean Cities coalitions, which have achieved the following results. In total, vehicle owners in Colorado have cut their gasoline consumption by over **12 million gallons** as a result of the efforts of the Clean Cities program. (See a list of Members of the Colorado Clean Cities coalitions on the next page.)

Clean Cities Coalition	Petroleum Savings (gallon equivalents)	Avoided CO_2 Emissions (tons)	Alternative Fuel Stations
Northern Colorado	2,651,000	10,400	315
Denver	7,182,000	29,600	828
Southern Colorado	2,327,000	12,300	267

WEATHERIZATION ASSISTANCE

The DOE's weatherization assistance program provides cost-effective energy savings and health benefits to low-income American families and supports jobs. In Colorado from 2010-2017, the program has achieved the following results:

- **10,800** Colorado homes received energy efficiency upgrades
- **$2.9 million per year** in energy cost savings to low-income Colorado homes
- **314 billion Btu per year** in energy savings

Here are some highlights of benefits at the national level:

- **$340 million per year** in energy cost savings
- **$280 per year** in average cost savings for a single-family home
- **8,500 jobs** supported
- **Benefit-to-cost ratio of 4.1** including energy savings and health and safety benefits

This fact sheet was produced by the Southwest Energy Efficiency Project (SWEEP), a non-profit, nonpartisan organization that promotes greater energy efficiency in AZ, CO, NM, NV, UT, and WY. (See www.swenergy.org.) Please send any questions or comments to Neil Kolwey at nkolwey@swenergy.org; ph: 303-499-0213.

MEMBERS OF COLORADO CLEAN CITIES COALITION

CPGA Colorado Propane Gas Association

American Power Group

AmeriGas America's Propane Company RELIABLE. SAFE. RESPONSIVE

Black Hills Energy Improving life with energy

colorado Corn

Boulder Nissan Boulder, CO

Boulder County Colorado

The Gas Connection

JW

Aqua-Hot

Lightning Hybrids

NREL National Renewable Energy Laboratory

CDOT Colorado Department of Transportation

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