

# Building Technologies Program Implementation

## Introduction

In partnership with the private sector, state and local governments, national laboratories, and universities, the Building Technologies Program (BTP) works to improve the efficiency of buildings and the equipment, components, and systems within them. The program supports research and development (R&D) activities and supplies tools, guidelines, training, and access to technical and financial resources.

## Systems Engineering

BTP's Building America research teams use a systems engineering approach to achieve higher quality and energy savings in **residential buildings** and homes. This type of approach unites segments of the industry that traditionally work independently. Teams of architects, engineers, builders, equipment manufacturers, material suppliers, community planners, mortgage lenders, and contractor trades collaborate to research and design optimal building solutions.

The systems engineering approach also allows builders to identify improvements to the design of a home that will ultimately save money. For example, the design might incorporate new techniques for tightening the building envelope and enable builders to install smaller, less expensive heating and cooling systems. Those savings can then be reinvested in high-performance windows that further reduce energy use and costs. Using these techniques, the energy consumption of new houses can be reduced by 40% or more with little or no impact on the cost of ownership.

For **commercial buildings**, BTP's teams of researchers, architects, engineers, building occupants and owners, and materials and systems specialists take an integrated, whole building design approach. The teams consider variables such as site location, energy resources, building materials, indoor air quality, acoustics, and natural resources from the initial design phase forward. Working together, these integrated project teams can make design decisions that reduce the financial impact of energy-saving technologies; for example, siting a building to maximize the use of daylighting and reduce the cost of lighting over the building's lifetime, or optimizing the building envelope's design to reduce heating and cooling costs. Savings from these design strategies can then be invested in higher quality windows or controls, reducing energy use even more.

Compared to conventional buildings, whole building design can reduce energy use by 50% or more, decrease maintenance and capital costs, increase occupant comfort and health, improve employee productivity, and reduce the building's environmental impact. Figure 1 is a photo of a building that embodies BTP's whole building design principles.



Credit: NREL PIX # 10856, RobbWilliamson.

**Figure 1. Oberlin College's Adam Joseph Lewis Center for Environmental Studies supports the college's mission of educating its students to make the world a better place. The building incorporates many features that lessen its impact on the environment. Designers were careful to use products and procedures to maintain a high indoor air quality, and materials are durable, recyclable, and low-maintenance.**

### **Technology Evaluations**

BTP activities are centered in public-private partnerships for the research, development, demonstration, standardization, and deployment of energy-efficient, cost-effective solutions for the buildings industry. These partnerships help the industry meet its technical and financial challenges by reducing the cost and risk of researching and demonstrating new technologies.

The steps involved in BTP's residential buildings performance analysis include defining a benchmark, measuring the actual performance of a house, and determining the energy savings. To track progress toward the program's aggressive multiyear, whole house energy savings goals of 40% to 100%, BTP developed a Building America research benchmark document in consultation with its Building America teams.<sup>1</sup> The document contains benchmark specifications for the building envelope, lighting, appliances, and

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<sup>1</sup> Hendron, R. *Building America Research Benchmark Definition*. NREL/TP-550-44816. Golden, CO: National Renewable Energy Laboratory, December 2008. [http://apps1.eere.energy.gov/buildings/publications/pdfs/building\\_america/44816.pdf](http://apps1.eere.energy.gov/buildings/publications/pdfs/building_america/44816.pdf), accessed August 2009.

other systems developed under a set of standard operating conditions for a single-family home.

In addition, the Building America teams have developed a series of Best Practices handbooks to help builders achieve whole house energy savings in five major climate zones (see Figure 2). Using the system recommendations and process improvements from the handbooks, all builders can re-engineer their designs to achieve improved energy performance and quality. Building America also produces case studies for all climate zones to further illustrate how these techniques and strategies are put into practice.

Technology Status: Residential Integration Performance Targets by Climate Zone					
Target (Energy Savings)	Marine	Hot-Humid	Hot-Dry/ Mixed-Dry	Mixed-Humid	Cold
30%	2006	2007	2005	2006	2005
40%	2008	2010	2007	2009	2009
50%	2012	2012	2011	2013	2014
70%	2017	2016	2015	2017	2018
ZEH	2020	2020	2019	2020	2020

Completed = ■ Current = ■

**Table 1. Building America works to integrate energy efficiency and on-site/renewable power solutions that will reduce whole house energy use in new homes by an average of 50% by 2015 and 70% or lower by 2020 (compared to the Building America Benchmark) at net-zero financial cost to the homeowner<sup>2</sup>.**

BTP’s **Commercial Building Energy Alliances** (CBEAs) are driven and managed by key industry partners working with the program and DOE’s national laboratories to help guide research and encourage industry to move toward energy-efficient design strategies. Alliance members who build, operate, manage, or sell hospital, retail, and other commercial real estate participate in face-to-face meetings, periodic conference calls, and online networking to set goals and strategies. Through these forums, they can discuss their unique energy challenges, engage experienced building owners to help them benchmark energy consumption and identify areas for improvement, and combine their purchases to reduce the cost of high-efficiency equipment.

CBEA members can also reply to solicitations to participate in **Commercial Building Partnerships** (CBP) under BTP’s **Net-Zero Energy Commercial Building Initiative**. CBP helps fulfill the program’s net-zero goals by committing to construct at least one new building and retrofit at least one existing building. DOE furnishes technical assistance. New buildings must achieve at least a 50% improvement in efficiency, and existing buildings should achieve at least a 30% improvement, relative to American

<sup>2</sup> Source: <http://www.akoyaonline.com/BTP/pages/RBA1.html>, accessed August 2009.

Society of Heating, Refrigerating, and Air-Conditioning Engineers (ASHRAE) Standard 90.1-2004.

### **Competitive Solicitations and Grant Processes**

BTP research, development, demonstration, and technology transfer is conducted in partnership with industry, government agencies, universities, and national laboratories that are often designed as cost-shared projects. In fact, most of the research conducted by the program is funded through competitive solicitations with partners. Program representatives select their research partners and projects based on factors such as energy savings potential, likelihood of success, and alignment with the recommendations of industry-developed technology roadmaps.

Information on current solicitations in the buildings technologies area as well as links to useful resources about financing and incentives for energy efficiency and renewable energy projects for homes, businesses, industries, utilities, and government entities can be found on the DOE Office of Energy Efficiency and Renewable Energy (EERE) Financial Opportunities Web site at [www.eere.energy.gov/financing](http://www.eere.energy.gov/financing).

Tax incentives for energy efficient technologies are also available for homeowners and businesses that purchase and install energy efficient equipment or make energy efficiency improvements to homes and buildings. See [www.buildings.energy.gov/tax\\_incentives.html](http://www.buildings.energy.gov/tax_incentives.html) for more information.

### **Peer Reviews, Public Workshops, and Hearings**

BTP offers opportunities for public input early in the rulemaking process for setting appliance and commercial equipment standards. Interested parties are invited to comment on the selection of design options and to assist the program in identifying analysis, data, and modeling needs for equipment standards and test procedures. Before final dissemination of any standards notices or rules, program team members also conduct a peer review, tapping qualified specialists to cover all the analyses performed in the course of a rulemaking: screening and engineering analysis; markups for appliance price determination; life-cycle cost and payback period analyses; consumer subgroup analysis; shipments analysis and national impact analysis; manufacturer impact analysis; utility impact analysis; environmental assessment; employment impact analysis; and regulatory impact analysis.

### **Partnership Programs and Education**

Nationwide acceptance and adoption of energy efficient buildings technologies is at the core of BTP's strategy. To accelerate the deployment of energy-saving buildings technologies into the marketplace, BTP engages industry, stakeholders, and end users in a variety of programs and educational activities and helps guide builders and manufacturers with a set of expertly certified codes and standards.

### **Partnership Programs**

Through partnership programs like the **Zero Energy Commercial Buildings Consortium**, just one of BTP's Net-Zero Energy Commercial Building Initiative Alliances and Partnerships, building industry groups disseminate new technologies within

the commercial buildings community. BTP's **Builders Challenge** calls on homebuilders across the nation to use cost-effective net-zero energy approaches to build 220,000 high-performance homes by 2012. **EnergySmart Schools** and **EnergySmart Hospital** demonstrations are saving educational and medical administrators thousands of dollars in their strained budgets. Tornado-torn **Greensburg, Kansas**, became a model for how several of these programs can work in tandem to build an energy-efficient, sustainable community, literally from the ground up.

In 2006, **ENERGY STAR**<sup>®</sup> labeled products saved 170 billion kilowatt-hours—almost 5% of that year's electricity demand in the United States. These products helped avoid greenhouse gas emissions equal to that produced by 25 million automobiles, and saved consumers more than \$14 billion on their energy bills.<sup>3</sup>

### **Education**

Disseminating information and educational materials about energy efficient technologies and practices is a key strategy for BTP. Hundreds of BTP's **Commercial Buildings Energy Alliances** members and guests have attended Webcasts and meetings or accessed online fact sheets and other documents to help them make decisions about lighting, heating, ventilation, and air-conditioning, as well as other systems and equipment.

BTP offers online **EnergySmart Schools** training courses for school administrators, architects, and engineers. Online Webcasts have also proven to be a successful education tool for BTP's **Solid State Lighting** specialists, providing attendees with useful information about advances in super-efficient lighting systems.

The BTP **Building Energy Codes Program** offers training through several mechanisms, including recorded Webcasts, self-paced training courses, online presentations, and an annual energy codes conference. At the yearly conference, Energy Codes Program representatives deliver hands-on training and encourage face-to-face conversations among those in the energy codes community. The conference brings state energy office representatives and members of the building industry together to receive consistent technical training on building energy codes and standards.

### **Codes and Standards**

Strengthening energy codes increases the likelihood of energy and cost savings in new construction and renovations to existing buildings. BTP works closely with the International Code Council (ICC), ASHRAE, the Illuminating Engineering Society of North America (IESNA), and other code user groups to develop more stringent and easier-to-understand building energy codes.

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<sup>3</sup> *ENERGY STAR® and Other Climate Protection Partnerships: 2006 Annual Report.* United States Environmental Protection Agency Air and Radiation 6202J. EPA 430-R-07-010. Washington, DC: EPA, September 2007, p. 3.  
[http://www.energystar.gov/ia/news/downloads/annual\\_report\\_2006.pdf](http://www.energystar.gov/ia/news/downloads/annual_report_2006.pdf), accessed November 2009.

In addition to the training mentioned previously, the program makes direct financial and technical assistance available to states, with a goal of promoting the adoption, implementation, and enforcement of state and local building energy codes. Energy code experts help states modify national model energy codes to address state needs and develop state-specific code compliance software and training materials.

BTP also develops and distributes compliance tools and materials that make it easier for designers, builders, product manufacturers, and code officials to comply with energy codes based on the International Energy Conservation Code (IECC) or ASHRAE/IESNA Standard 90.1 requirements.

BTP's \$37.5-million investment in the Energy Codes Program has resulted in energy savings of nearly \$1 billion per year. The efforts have improved the energy efficiency of nearly 3 billion square feet of new commercial floor space and nearly four million new households. The cumulative energy cost savings from the effort is estimated to be more than \$4.2 billion as of 2001—enough to meet all the energy needs for more than three million homes for one year.<sup>4</sup>



**Figure 2. Tools available on the Building Energy Codes Program Web site include videos, presentations, graphics, and articles, among others<sup>5</sup>**

<sup>4</sup> U.S. Department of Energy, Energy Efficiency & Renewable Energy. Building Energy Code Programs Web page, About the Program. <http://www.energycodes.gov/whatwedo/>, accessed November 2009.

<sup>5</sup>Source: <http://www.akoyaonline.com/BTP/pages/Bcodes1.html>, accessed August 2009.