



ENERGY EFFICIENCY at PNNL

Energy efficiency research at Pacific Northwest National Laboratory (PNNL) transforms energy management in residential and commercial buildings, mitigates climate change, and helps drive a national clean energy economy.

It's estimated that buildings account for about 40 percent of the nation's energy use and consume three-fourths of America's electricity. Significant opportunities exist to improve building operations and substantially reduce

energy use while enhancing occupant comfort, productivity, well-being, and safety.

Research teams at PNNL achieve energy savings through acceleration of highly efficient solid-state lighting products to market, development and deployment of building controls, and advancement of improved appliance standards and building energy codes.

PNNL's energy efficiency research areas are highlighted below.

Advanced Lighting

PNNL has helped the U.S. Department of Energy's Building Technologies Office (BTO) make tremendous progress on a key goal—that of improving lighting while cutting U.S. lighting-related energy use by 75 percent by 2035. PNNL has shown that the benefits of improved, highly

efficient lighting in buildings extend beyond energy and cost savings to enhanced occupant comfort, health, and productivity.

PNNL's research addresses a range of needs. For instance, PNNL-derived scientific measurements and data have been central in driving new lighting measurement methods adopted by industry standards organizations. These methods are subsequently employed by manufacturers to significantly improve product performance.

Other PNNL research leverages the exquisite control that can be achieved in solid-state lighting products to deliver precisely the kind and quality of light that's required for particular lighting applications, whether in retail, clinical, classroom, or other settings. With lighting products increasingly connected, researchers at PNNL also are exploring methods to capitalize on this connectivity to deliver new features and value.

PNNL's advanced lighting research activities are supported by a team of recognized experts, specialized facilities, and field work with partners that deploys new technology in indoor and outdoor settings.



PNNL's lighting research emphasizes improved energy efficiency, functionality, and quality.

Building Controls

Researchers at PNNL have developed techniques that illuminate all aspects of energy consumption and production (e.g., on-site generation and energy storage) in buildings.

This “whole building” understanding is foundational. It leads to new, more effective approaches for controlling energy use, optimizing efficiencies, coordinating energy needs with the electric grid, and simultaneously maximizing the performance of buildings to deliver occupant comfort and continuity of operation.

PNNL expertise and facilities underpin the development of buildings-related advances. One resource, the Integrated Building Assets, a living laboratory, supports a range of research and testing and includes a network of more than 20 PNNL buildings, a thermal energy storage system, battery energy storage, a laboratory, and electric vehicle chargers.

PNNL-developed methods and technologies are deployed and adopted in projects and buildings across the United States, affecting the efficiency of millions of square feet of floor space nationwide. These advances help BTO achieve objectives of enhanced building performance that leads to energy savings, economic benefits, and reduced carbon emissions.



Researchers at PNNL advance the science and engineering of energy efficiency by transforming the way building systems are evaluated, operated, and integrated into surrounding communities.



PNNL’s Thermal Energy Storage System helps researchers better understand how building cooling methods can become contributors to energy efficiency and improved grid operations.

Appliance and Equipment Standards

PNNL supports BTO in meeting statutory commitments to set minimum energy conservation standards for residential and commercial appliances and equipment, as well as to develop test procedures that can be used to validate product conformity with standards.

PNNL’s expertise in economics, engineering, and energy markets is key to developing standards and

understanding a variety of factors, including the cost-effectiveness of more efficient technologies and associated economic and environmental impacts.

PNNL operates specialized research facilities that evaluate commercial heating and cooling equipment and help establish test procedures for those products.

Building Energy Codes

PNNL is the lead support organization for BTO's Building Energy Codes Program (BECP). PNNL's efforts focus on the model codes developed and adopted by the American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE) and the International Energy Conservation Code (IECC). As codes are formulated, PNNL contributes technical analysis and modeling capabilities to the process and delivers recommendations to ASHRAE and IECC. PNNL also assists BTO in the next stage—that of helping state and municipal governments incorporate and implement new codes.

PNNL creates and supports software tools used to demonstrate energy code compliance and provides education and training programs that help the workforce adapt to new technologies and practices.

Building energy codes vastly improve the efficiency of residential and commercial structures nationwide. Buildings constructed under the current code use about half the energy per square foot as a structure built at the BECP's inception in the late 1970s. Further, improved energy efficiency has reduced carbon dioxide emissions by hundreds of millions of tons.

For more information, contact:

Bing Liu

Building Subsector Lead

Pacific Northwest National Laboratory
902 Battelle Boulevard, Richland, WA, 99352

(509) 375-2263 | bing.liu@pnnl.gov

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Keys to Success: PNNL's Energy Efficiency Expertise and Capabilities

PNNL's leadership in energy efficiency research is anchored by scientists and engineers known for their subject matter expertise and innovative solutions. These researchers represent disciplines ranging from electrical and mechanical engineering to economics and cybersecurity. Staff at PNNL lead key national projects, expand the body of knowledge through publications, and create and deploy new technologies. Additionally, PNNL offers numerous facilities and equipment that help move concepts to real-world application.

Market Transformation

PNNL's Market Transformation team is key to advancing energy efficiency objectives. The team helps clients understand and address the challenges and issues associated with the performance, adoption, and deployment of new technologies, resulting in faster and stronger market acceptance.

As part of the effort, PNNL supports DOE's technology competitions, including campaigns, prizes, technology procurements, and challenges. These activities foster synergies between developers, government, industry, and others to rapidly move high-performing products to the marketplace.

About PNNL

Pacific Northwest National Laboratory advances the frontiers of knowledge, taking on some of the world's greatest science and technology challenges. Distinctive strengths in chemistry, Earth sciences, biology, and data science are central to our scientific discovery mission. PNNL's research lays a foundation for innovations that advance sustainable energy through decarbonization and energy storage and enhance national security through nuclear materials and threat analyses.