

# Realizing a Vision for Buildings and the Power Grid

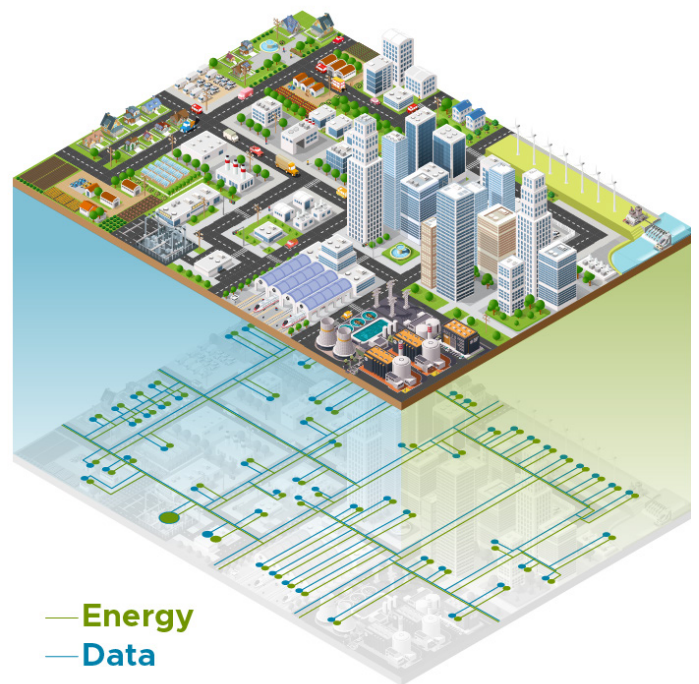
Pacific Northwest National Laboratory (PNNL) envisions a future integrated energy system that links commercial and residential buildings, emerging smart technologies, and the electrical power grid to deliver enhanced economic, energy, and environmental benefits.

## THE CHALLENGE

The current energy landscape continues to evolve in terms of needs and complexity. In homes and buildings, new consumer requirements, such as electric vehicle charging capabilities, join the list of traditional electricity-consuming appliances and devices. There's also the matter of broader electrification, which includes the transition from natural gas appliances to electric.

Concurrently, energy sources are evolving and extending beyond traditional generation to include solar, wind, geothermal, and more, which require improved grid coordination strategies and energy storage technologies. Some of these sources, particularly solar power, are increasingly incorporated as on-site generation for homes and buildings and, along with other technologies, could improve the viability of net-zero-energy buildings that achieve a balance between energy generation and consumption.

Today's more complex energy environment demands an integrated control strategy, which PNNL is developing to manage all of the diverse components and achieve maximum efficiency, functionality, and comfort in homes and buildings. The strategy also will enable coordination with the larger energy system and increased flexibility, setting the stage to dramatically reduce carbon emissions and improve power grid reliability and resiliency.



The challenges of the evolving energy landscape will require creative solutions. New consumer requirements, energy sources, and technologies, combined with growing data resources, will influence the coordination of energy between homes, buildings, power markets, and the grid.

## CONCEPTS BEHIND PNNL RESEARCH

Over the past two decades, PNNL has established a unique “whole building” understanding of energy consumption, management, and control. As part of this work, researchers have developed methods that leverage data and provide insights into how buildings use, generate, and store energy at any given time.

This knowledge enables PNNL’s integrated, real-time control and coordination solutions for a building’s “behind-the-meter” aspects of energy consumption and production (e.g., on-site solar panels and batteries) with the power grid.

## PUTTING KNOWLEDGE TO WORK IN NEW INNOVATIONS

PNNL’s capabilities have led to new technologies that are increasingly deployed across the nation and helping to fulfill the vision for the future energy system. The technologies include:

- **Intelligent Load Control (ILC)**, which coordinates the operation of building heating, cooling, and other systems with the power grid to help address spikes in electricity demand. ILC has been successfully deployed on the PNNL campus, at the University of Toledo, and in Washington, D.C., and is set for additional deployments in two states.
- **Transactive Coordination and Control (TCC)**, an innovation that represents a complete solution for a future energy system is enabling coordination and negotiation between energy producers and consumers. TCC has been successfully tested on the PNNL campus.

## ABOUT PNNL

PNNL is a Department of Energy Office of Science laboratory located in Richland, Washington, with an enduring mission to transform the world through courageous discovery and innovation. Our science and technology inspires and enables the world to live prosperously, safely, and securely.



## A NEW, REAL-WORLD TEST

In 2022, PNNL methodologies are being deployed and tested for the first time in a net-zero-energy commercial development in Spokane, WA. The development site, which offers control over on-site energy generation, electrical energy storage, thermal storage, vehicle charging, and building energy use, provides PNNL with its most comprehensive test environment to date.

## SYSTEMS ENGINEERING BUILDING: PNNL’S UNIQUE RESOURCE

The Systems Engineering Building (SEB) is a research and office building on the PNNL-Richland campus that enables actual testing and evaluation of technologies in an occupied setting. Many PNNL advances in coordination and control of building operations are tied to this facility, which serves as a unique resource in the Department of Energy national laboratory system.

The building’s ducting and operational infrastructure are fitted with sensors that allow for the testing of building control ideas and technologies. Recent upgrades have improved the ability to control SEB’s electrical loads, including lighting.

While the SEB is a Department of Energy facility, PNNL’s partnership with the state of Washington’s Clean Energy Fund has resulted in research assets being sited at SEB. These include a thermal energy storage system and a battery for electrical energy storage. Along with PNNL’s nearby solar array, the capabilities help researchers identify energy consumption and storage strategies that benefit grid operations, clean energy integration, and costs.

### For more information, contact

#### Dennis Stiles

Pacific Northwest National Laboratory  
P.O. Box 999 | Richland, WA 99352  
(509) 375-6374 | [dennis.stiles@pnnl.gov](mailto:dennis.stiles@pnnl.gov)