

EI&BD CORE COMPETENCY:

Data Analytics, Controls, and Cybersecurity

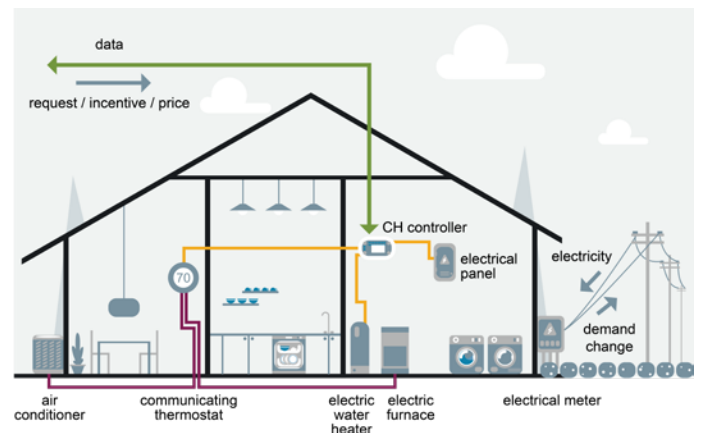
The Electricity Infrastructure and Buildings Division (EI&BD) at Pacific Northwest National Laboratory (PNNL) accelerates the transition to a sustainable, efficient, resilient, and secure energy system through innovation and actionable solutions. To achieve success, the division applies a distinctive set of core competencies to its work.

EI&BD's **Data Analytics, Controls, and Cybersecurity core competency** focuses on data-driven analytics and machine learning to support decision-making, advanced control and optimization approaches, and cybersecurity research and development. EI&BD readily moves research from theory to practice, with applications spanning from individual devices to large-scale, complex systems. Cross-disciplinary research teams identify, enhance, and apply appropriate data-driven models and optimization techniques combined with high-performance computing (HPC) to solve complex problems. This competency enables a decarbonized energy system that is secure, reliable, and resilient.

Data Analytics, Controls, and Cybersecurity capability areas include:

Data Management and Predictive Analytics: EI&BD's signature capabilities in data management, including data collection, curation, storage, and dissemination, support multiple use cases throughout the energy system. The division's access to real-world data and HPC positions EI&BD's technical leadership in the

use of artificial intelligence and machine learning for energy system applications. Researchers possess demonstrated expertise and experience in applied statistics and physics-informed machine learning for grid sensor analytics, energy demand forecasting, fault detection and diagnosis, and real-time control.



Researchers in EI&BD enhance and streamline predictive optimization-based control approaches to enable existing residential homes and legacy equipment to participate in advanced demand response at low upfront costs.

Distributed Control and Coordination: EI&BD has developed and demonstrated hierarchical control and coordination strategies for engaging heterogeneous distributed energy resources to provide multi-scale ancillary grid services. Researchers at PNNL pioneered transactive control and coordination, which remains a dominant approach for coordinating distributed energy resources and flexible loads. EI&BD expertise in the theoretical design and practical implementation of distributed control strategies is reflected in the division's publications and patents.

System-level Optimization Coupled with HPC: As electric power systems evolve to include distributed stochastic energy generation and responsive demands, advanced methods are needed to solve the underlying optimization problems for energy system planning and operation. This capability includes techniques for mathematical problem formulation and computational solutions. Specific capabilities include robust optimization, distributed/parallel approaches, and stochastic and large-scale optimization.



PowerNET, a world-class testbed for energy delivery systems, enables cybersecurity testing and evaluations and exemplifies PNNL's leadership in the grid cybersecurity domain.

Domain Knowledge and Risk Management Perspective to Cybersecurity Research: Power system domain knowledge combined with cyber knowledge, from unclassified to classified, provides EI&BD's competitive edge. This allows division staff to pursue best practices, effective research and development, and operational tools and systems. EI&BD seeks to develop new secure methods to be included in product lifecycle management and architecture.

EI&BD STAFF AND PARTNERSHIPS

EI&BD's staff members offer expertise in electrical, mechanical, and systems engineering, data and computer sciences, cybersecurity, policy, economics, and other energy- and water-related areas. Staff represent the division's greatest resource and strength and are widely recognized internally and externally for their expertise and commitment to excellence. EI&BD also values its partnership with the Department of Energy and other federal agencies and collaborative relationships with a wide range of major companies, vendors, institutes, academia, and technical societies.

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.

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