Regional Emerging Technology Advisory Committee (RETAC)

Northwest Energy Efficiency Alliance

Q1 2026 Meeting

March 11, 2026

8:30 a.m. – 12:00 p.m.

Name, Title, Organization and…

If you could instantly become an expert in something, what would it be?

Agenda

8:30 am	Welcome and Announcements
9:00 am	Bonneville Power Administration
9:45 am	Round Robin
10:30 am	*Break*
10:45 am	Pacific Northwest National Laboratory
11:45 am	Wrap-Up

Could others in your organization benefit from a NEEA / MT 101?

- Offering 2x/year 90 min webinar for alliance members
- Target audience:
  - Committee members wanting a refresher
  - Team members not on NEEA committees, but interact with NEEA's work or would benefit from a basic overview
- **Next session: Tues Mar 31, 9-10:30**
- Proposed special topic feature: Emerging Tech
  - Future special topics include: Codes & Standards, Regional Studies & Infrastructure, Market Research/Evaluation, Data Acquisition, MT Barrier Removal, Special Projects
- Contact: Alisyn Maggiora

Efficiency Exchange 2026 (EFX26)

Early Bird Registration

February 9 – April 3

neea.org/EFX

EFX26 In-person Conference

May 5-6 in Boise, ID

Preconference tours and networking on May 4

Energy Upgrades at Dairies

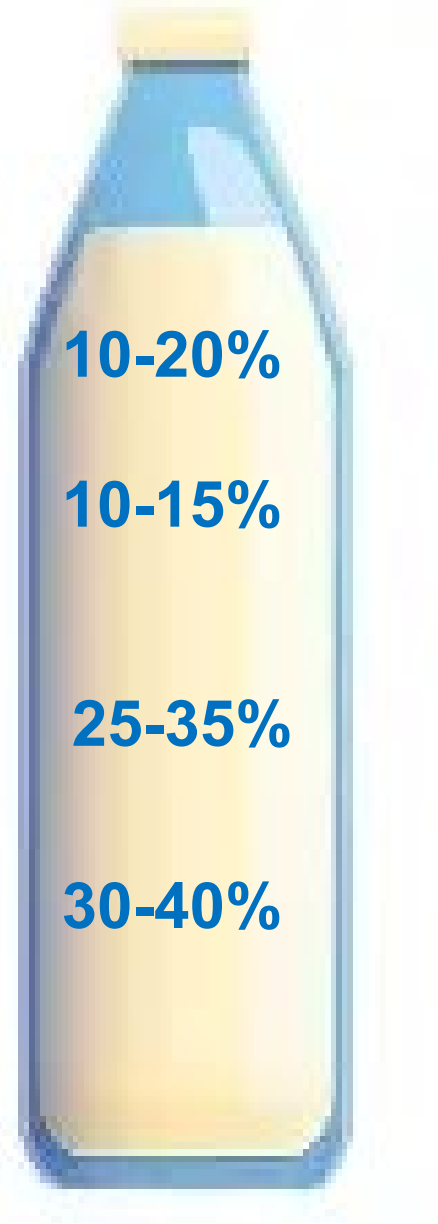
Recovering waste heat and improving operations

Why Dairies?

- Savings are difficult to achieve
- New technologies offer additional energy savings
- Demonstrations and case studies may lead to prescriptive measures based on sizing

Energy is a *significant* and *controllable* operating cost

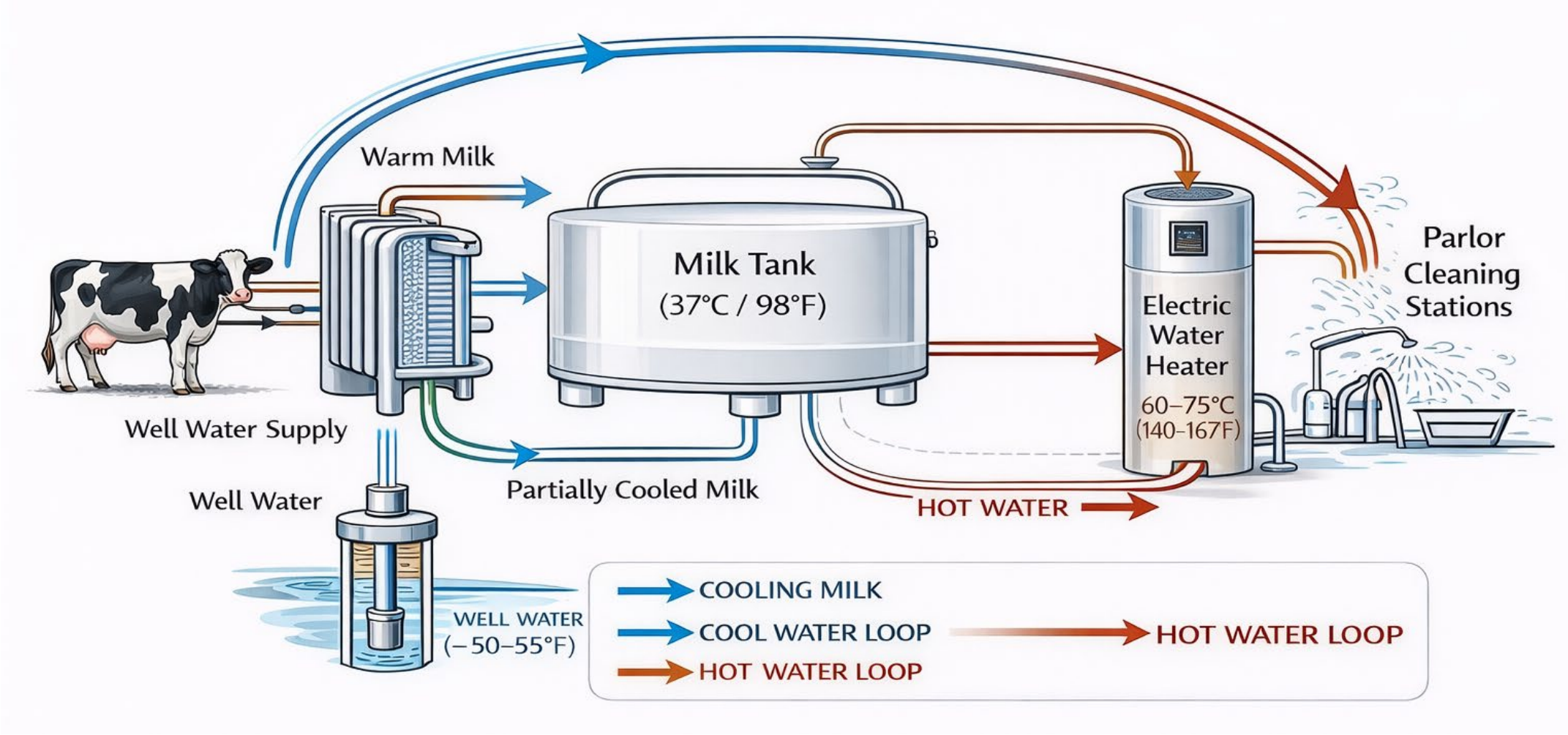
Vacuum Pumps	10-20%
Lighting & Ventilation	10-15%
Milk Cooling	25-35%
Water Heating	30-40%



Waste Heat Recovery

- Cooling milk generates recoverable heat
- Transfer heat to other dairy processes

Standard Dairy Design

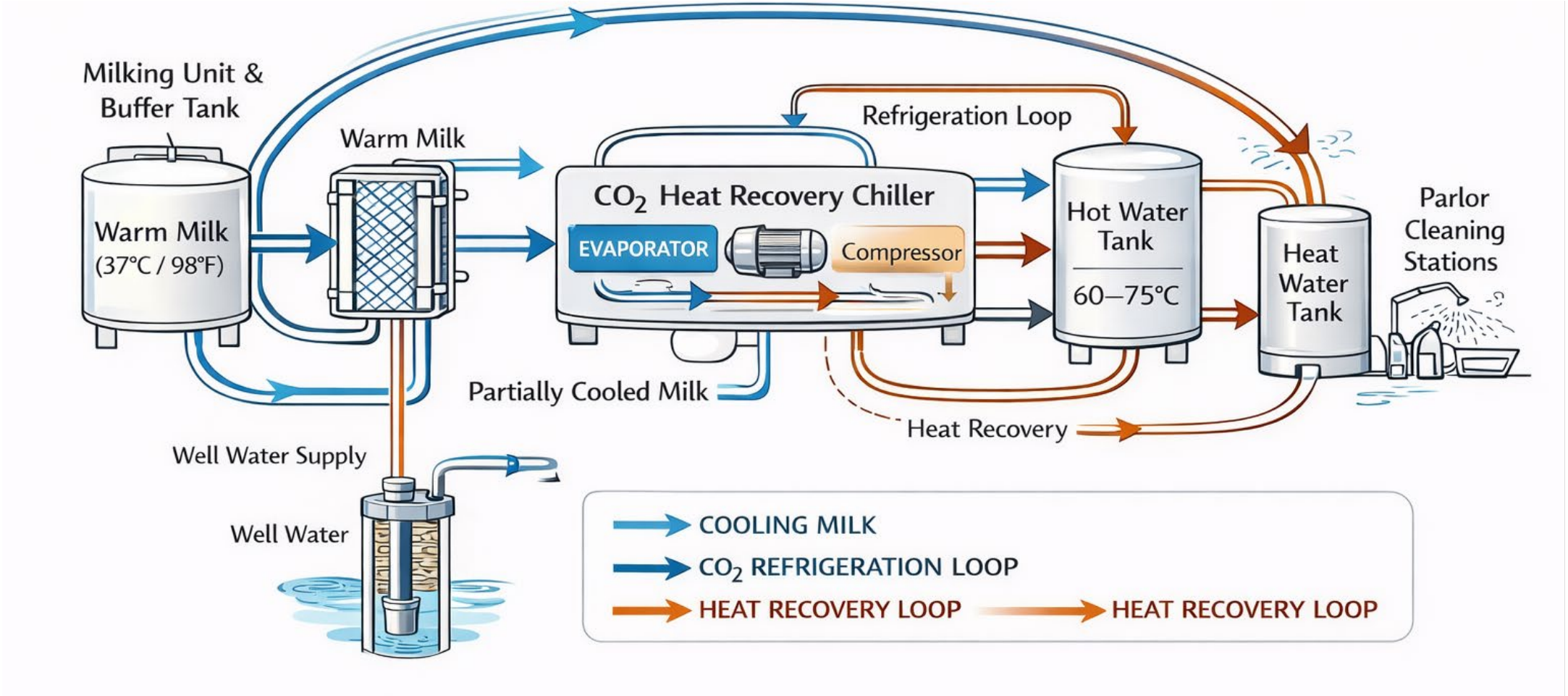


Operational Costs Estimates

Energy Use	Annual Energy
Milk Cooling	55,000 kWh
Water Heating	45,000 kWh
Vacuum Pumps	35,000 kWh
Fans & Ventilation	25,000 kWh
Lighting & Misc	20,000 kWh

180 kWh Cow per year

Integrated Dairy Energy System



Operational Costs Estimates

Annual Energy Use	Baseline		Post
Milk Cooling	55,000 kWh	↓	45,000 kWh
Water Heating	45,000 kWh	↓	15,000 kWh
Vacuum Pumps	35,000 kWh		unchanged
Fans & Ventilation	25,000 kWh		unchanged
Lighting & Misc	20,000 kWh		unchanged

40 kWh Savings / Cow / Year

BPA Seeking Studies

- $150 Dairy Facility Audit
- $15,000 of audit cost
- Seeking 3-4 demonstrations
- M&V Energy Savings
- Potential new prescriptive measures

Site Attributes

- Aging systems (chiller, water heating)
- Place for hot water storage
- Large water draw profile ~ 3000 gal/day
- Have an air or water source chiller to cool the milk
- Currently not using heat recovery

Round Robin

Break

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Pacific Northwest NATIONAL LABORATORY

U.S. DEPARTMENT of ENERGY

PNNL Overview

U.S. DEPARTMENT of ENERGY BATTELLE

PNNL is operated by Battelle for the U.S. Department of Energy

Pacific Northwest NATIONAL LABORATORY

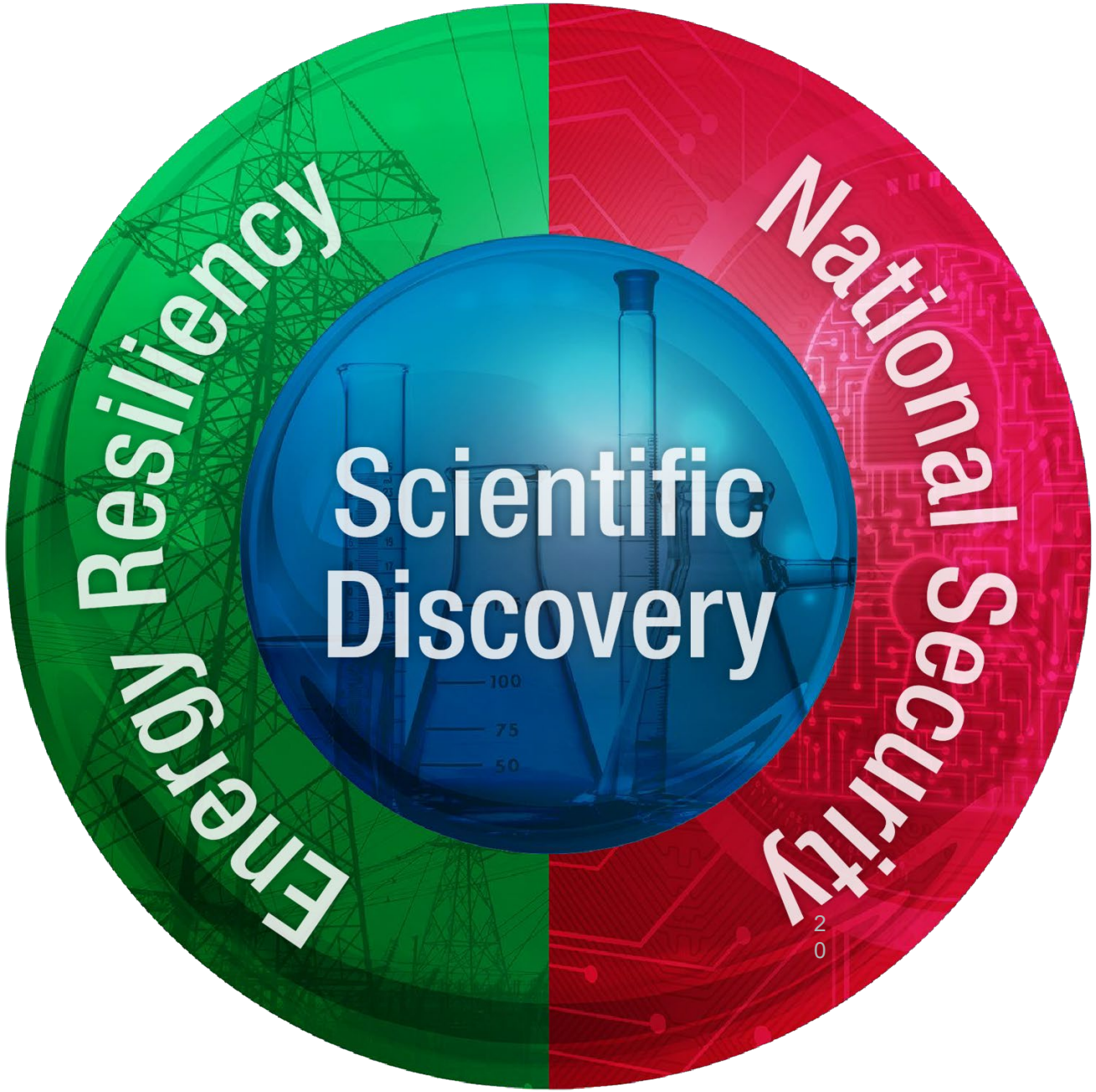
U.S. DEPARTMENT of ENERGY

We are one of DOE's 17 **national laboratories** addressing critical scientific challenges

Pacific Northwest
NATIONAL LABORATORY

U.S. DEPARTMENT of ENERGY

We **advance scientific frontiers** and **provide solutions** to critical national needs



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PNNL By The Numbers

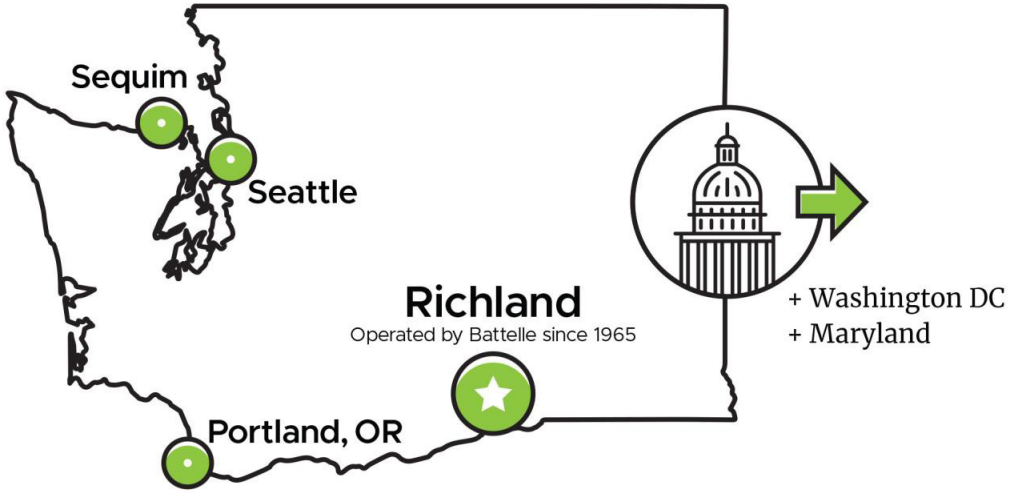
$1.64B
Annual budget

6,437
Scientists, engineers, and professional staff

229
FLC and R&D 100 awards (since 1965)

3,213
U.S. and foreign patents granted (since 1965)

319
Invention disclosures



11
Licenses granted

1,672
Peer-reviewed, published articles

2,297
Active S&T projects*

125+
Countries where staff at PNNL are actively engaged

2,779
Staff with advanced academic degrees

211
Companies with PNNL roots — IP or expertise (since 1965)

2,208
Cleared staff

* FY 2024 data

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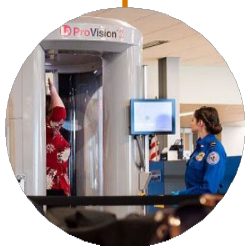
Our innovations have **improved millions of lives**

Optical Digital Recording:
Basis for music, video, and data storage

1960s

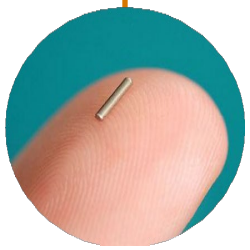
Airport Security Technology:
Scanned 100+ million airport passengers worldwide for concealed threats



1970s

1980s

Cancer Treatment:
13,000 patients treated with targeted medical isotope "seeds"



1990s

U.S. Border Protection:
1,300 systems installed to detect illicit nuclear materials entering the United States

2000s ➔

Reducing Harmful Vehicle Emissions:
Technology used in millions of diesel-engine vehicles

Grid Cybersecurity:
U.S. utilities receiving threat awareness updates for 75% of U.S. electricity transmission infrastructure

Nanotechnology:
Worldwide waste cleanup and air purification in Navy submarines

Recycled Waste Jet Fuel:
Catalytic process leads to first commercial flight flown on recycled jet fuel

Safe Fish Passage through Hydropower Dams:
Tiny acoustic transmitters used to study fish traveling through dams located around the world

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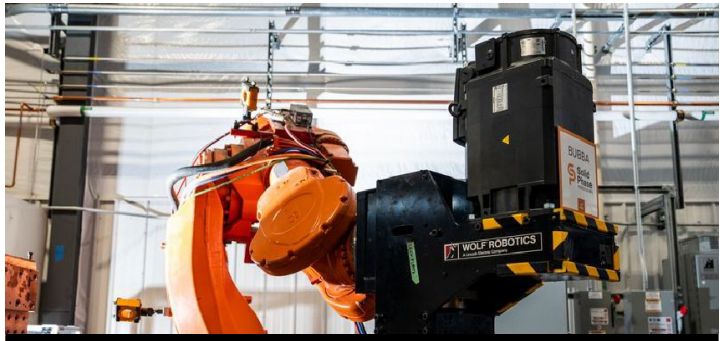
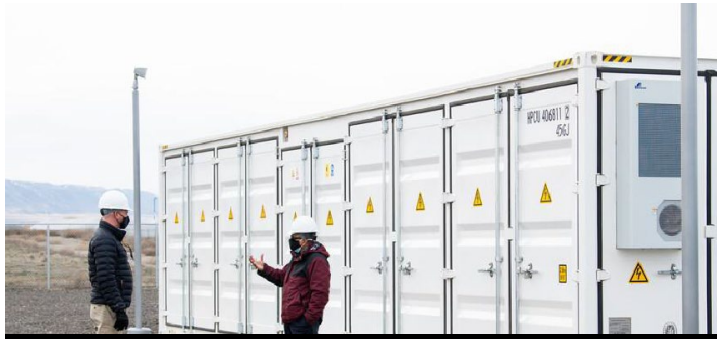
PNNL's **energy and environment mission** delivers innovations for our energy future

Grid Resilience, Analytics & Controls

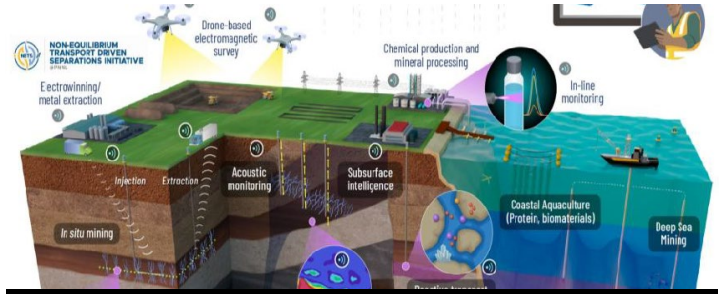


Transportation & Manufacturing

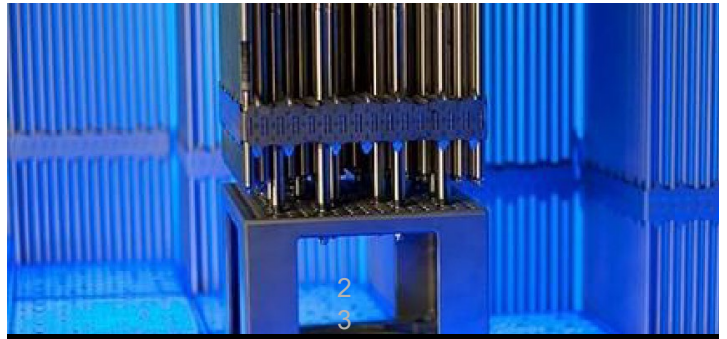
Advanced Buildings Solutions



Energy Storage Solutions for Grid & Transportation



Critical Minerals & Subsurface Science



Nuclear Energy, Waste Processing & Environmental Management

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PNNL's Buildings Portfolio

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PNNL Buildings Facilities

Environmental Chambers

Lab Homes

Energy Storage System

Lighting and Acoustics Technology Lab in Portland, OR

Advanced Building Controls Lab

New Chambers Coming 2026!

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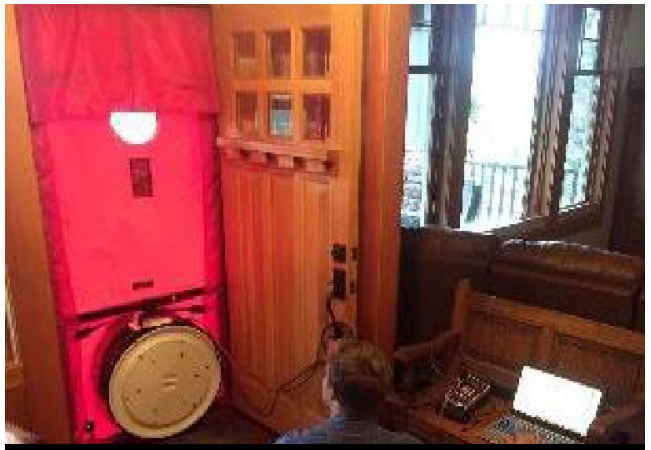
Real-World Validation of Innovative Tech

For real-world performance data on innovative tech under controlled, representative, and regionally relevant conditions.

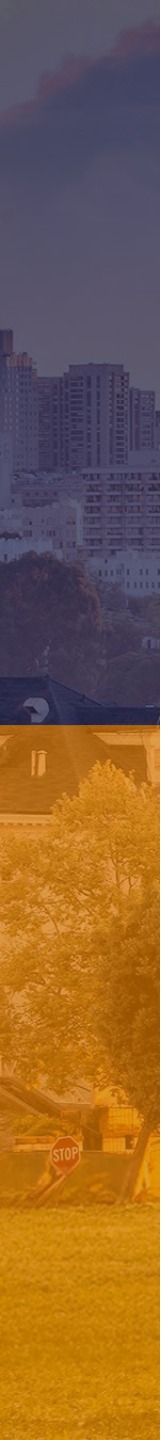


Air Tightness

Dual-Fuel HVAC

Windows

Indoor Air Quality



Emerging Technologies

Emerging Technologies

Residential and Commercial Buildings Integration (RBI, CBI)

PNNL Refrigerant Leak Detection Project

Problem: High performance HVAC equipment that uses flammable refrigerants requires low-cost, fast leak sensors for safe operation.

Challenge: Develop fast, low-cost, and selective sensing technology for propane leaks.

Pre-Commercial R&D by BTO: This builds off a TCF-funded project to develop a proof-of-concept sensor for A2L refrigerants.

Technical Advisory Group: The project receives feedback and guidance from a technical advisory group consisting of experts from AHRI, DOD, NIST, ORNL, Guidehouse, and NLR.

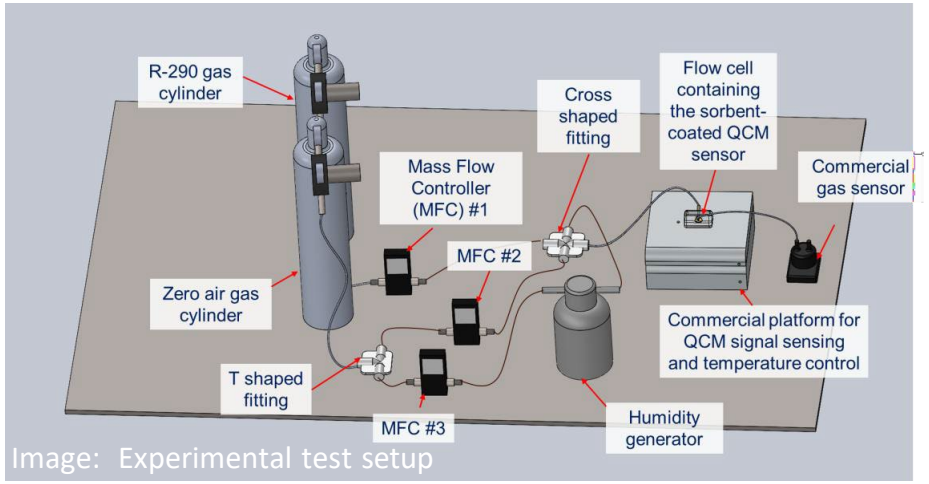


Image: Experimental test setup

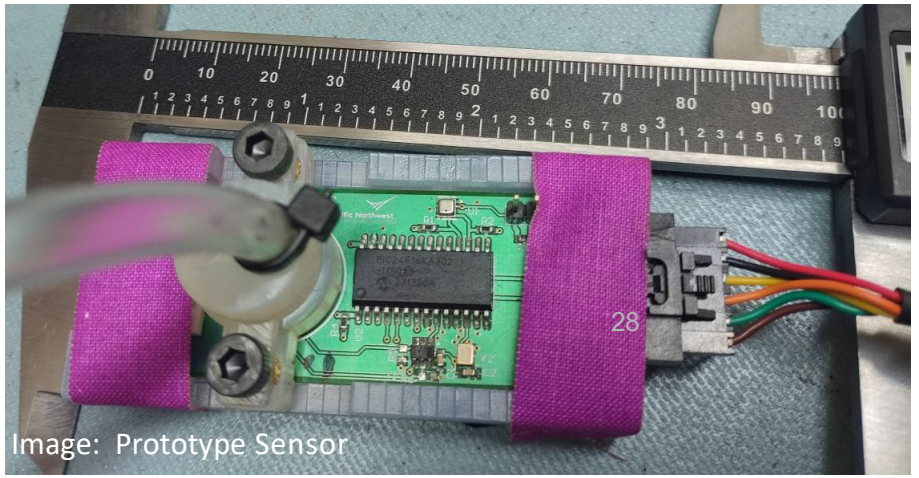


Image: Prototype Sensor

Advancing Multifunctional HVAC Systems through Hardware and Control Optimization

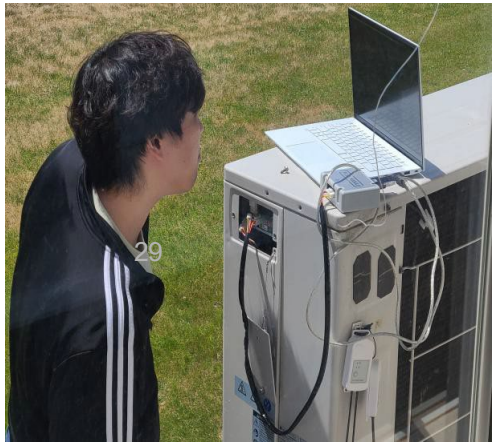
Problem: High costs, reliability issues, and poor efficiency in low temperature operation and defrost mode.

Challenge: Co-optimize the design of a multifunctional HP (MHP) solution. Develop advanced control to boost operational efficiency, enhance heat recovery, and enable grid-responsive operation.

Pre-Commercial R&D by BTO: BTO partnered with PNNL and LG to improve control firmware, develop predictive controls for load shifting and shedding, and design a new MHP system with 40% reduced system components, simplifying installation and lowering costs.

Industry Engagement and Tech Transfer: Simulation and lab testing informed LG's development of the new MHP system. The prototype system was tested in PNNL's Lab Home.

Industry: LG is developing a roadmap to bring the new MHP system to market, targeting improved affordability, performance, and demand flexibility.



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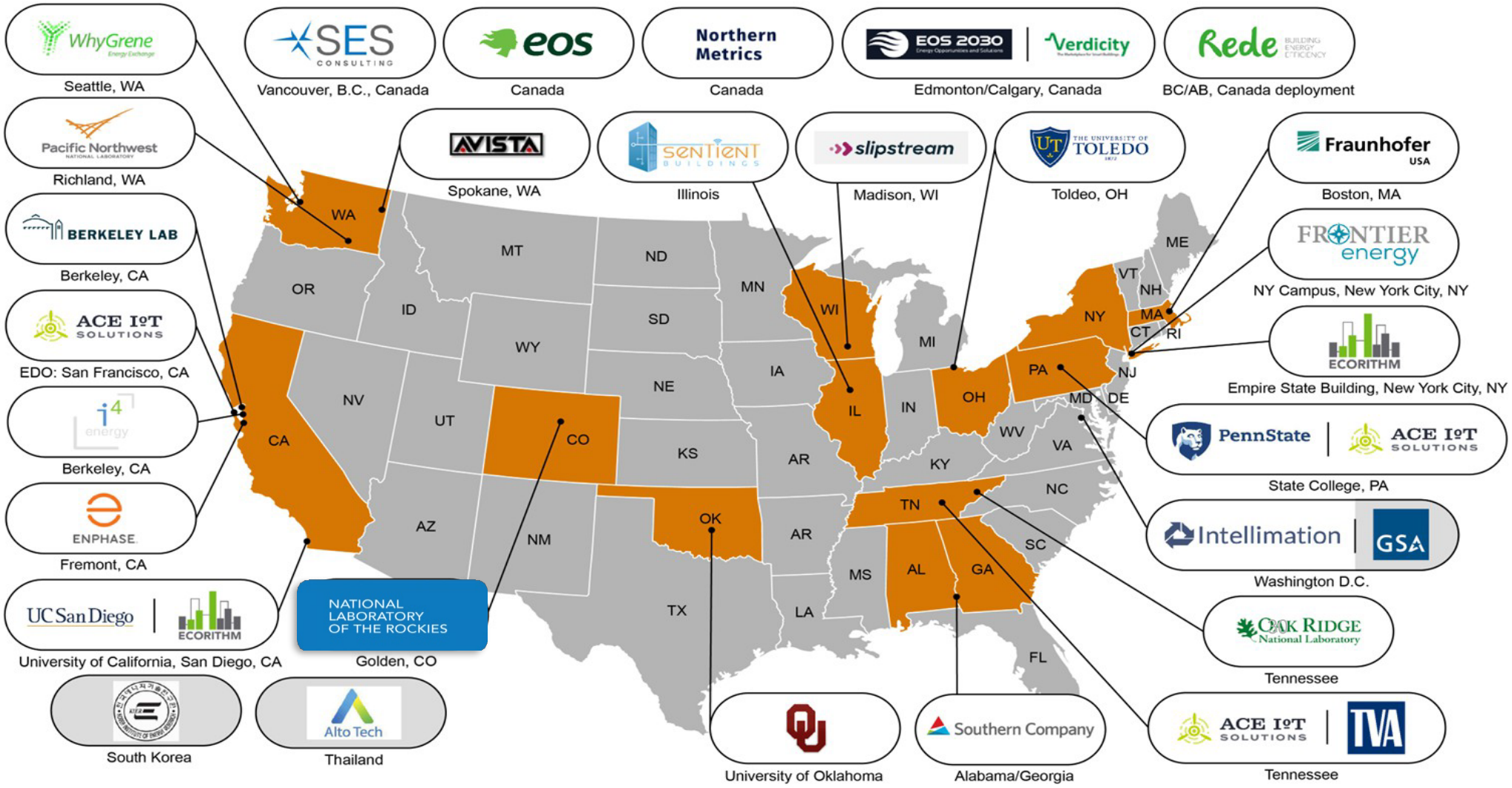
Scaling Open-Source Controls to Boost Grid Reliability

Volttron.org



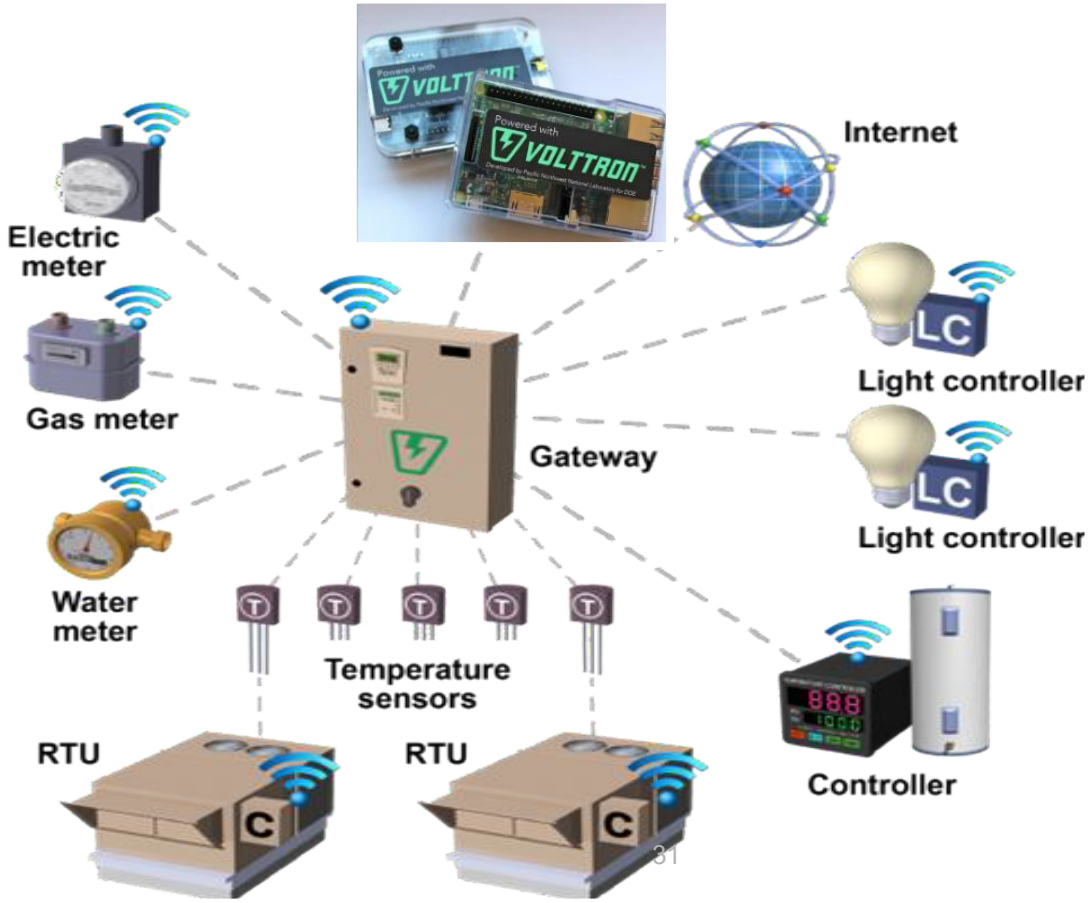
Delivering Affordable Control Solutions for Small Businesses

Problem: Small-to-medium commercial buildings need low-cost control solutions to lower their energy bills.

R&D: PNNL developed autonomous energy management software system for buildings without costly central control systems.

Technologies yield:

- 15–25% energy cost savings
- Up to 20% peak demand reduction
- Payback < 3 years



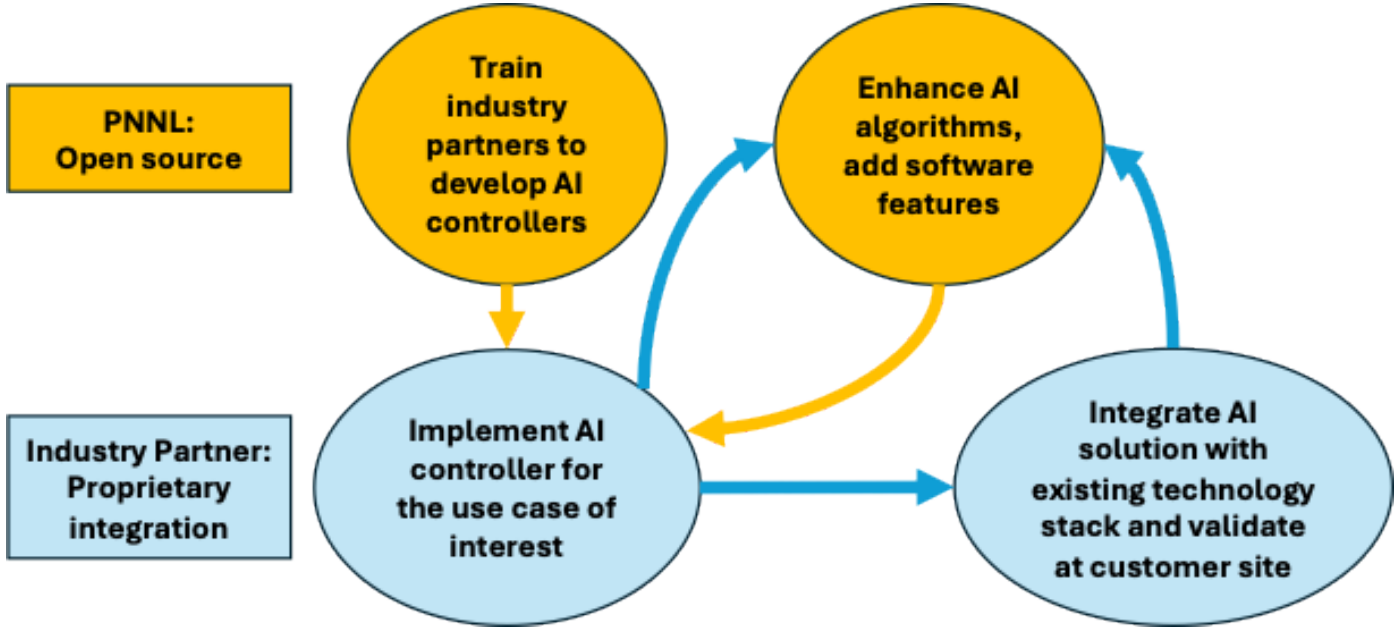
INDUSTRY PARTNERS ADOPTING CONTROL TECH

edo Intellimation GLOBAL MEDICAL REIT ACE IoT SOLUTIONS

Industry Adoption of AI-Based Controls Driving Cost Savings

Problem: AI-based control approaches offer superior performance, but aren't robust, cost effective, nor easily maintained.

R&D: Partner with industry to enable adoption of Differentiable Predictive Control.



Outcomes:

- **Carrier –** Demonstrated in a chiller plant; potential **15–20% bill savings**
- **Elexity** – Startup partner; released gold-standard product based on PNNL project
- **Delta** – Developed controller interface; tested at Carleton University

Understanding the Human Element to Accelerate Advanced Rooftop Unit Controls

Problem: Small commercial buildings lack affordable, deployable, efficient control solutions. Better controls, with simpler installation, will improve affordability (up to $1.6B annually), reduce installer call-backs, and provide improved high-quality installations and cybersecurity.

Goal: Identify human and human-technology interactions that hinder successful installation and use of advanced controls in small buildings.

Recent Highlights:

- Analyzed observation data from 29 RTU control retrofit projects at 5 sites across the U.S. Retrofits included smart thermostats, economizer controllers, and variable-frequency drives (VFDs).
- Identified opportunities for improved installation and operation practices, product features, and collaboration among key industry stakeholders.

Industry Partners

(Left) A smart thermostat retrofit in an 8,000-square foot office retail mall in Charlotte, NC. (Right) VDFs, economizer control, and smart thermostat retrofit in a 50,000-square foot retail space in Phoenix, AZ.

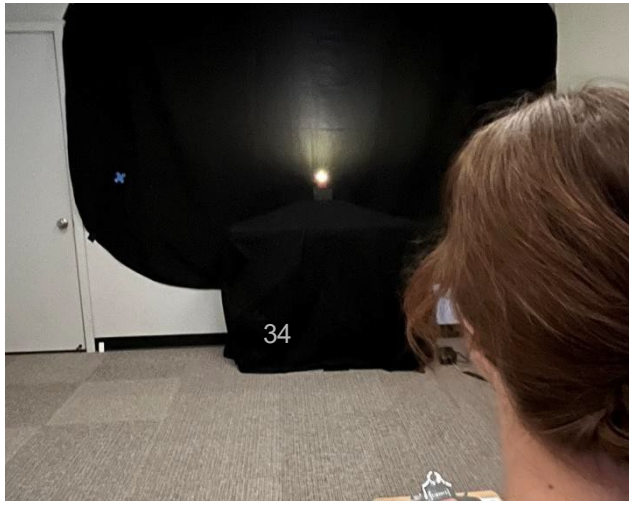
Innovation in Lighting for Better Quality LEDs

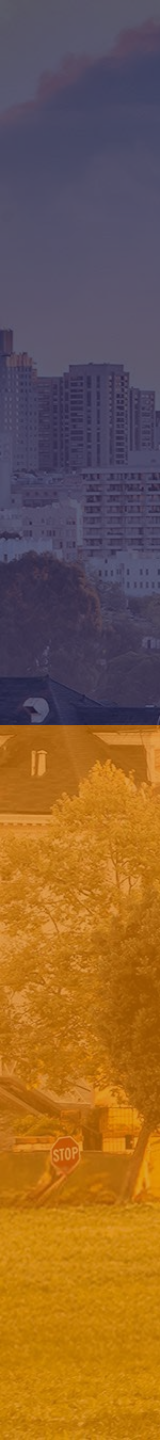
Problem: Low-cost LED products can often have poor quality, leading to health effects with reduced productivity and higher long-term costs.

Challenge: Poor performance is not inherent in LED products, but engineering solutions must minimize or overcome tradeoffs between size, performance, and cost. Increased information is needed to allow for informed decision-making.

Recent Highlights:

- PNNL developed a new metric and contributed to a new ANSI/IES industry consensus document that establishes performance tiers and other guidance to minimize flicker.
- PNNL published research that found people who get migraines saw flicker more often and were more likely to experience a headache within 4 hours after the experiment compared to non-migraineurs (41% vs. 8%).





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Residential and Commercial Buildings Integration

Emerging Technologies

Residential and Commercial Buildings Integration (RBI, CBI)

Connected Commissioning (CCX) with NEEA

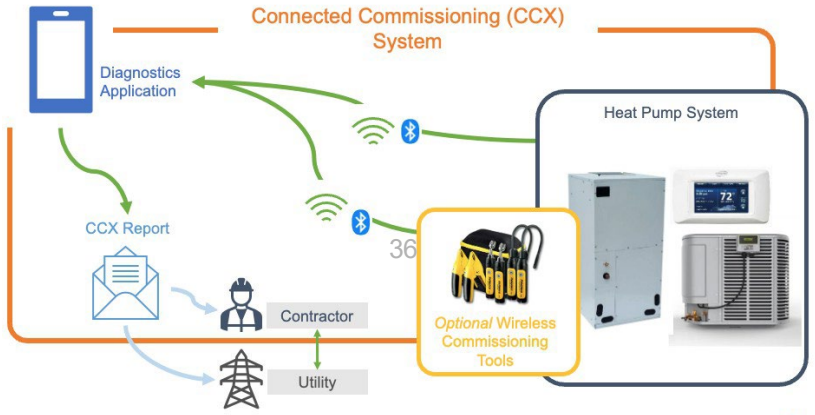
Problem: 70-90% of HVAC systems in U.S homes exhibit at least one performance-compromising issue resulting in 20.7 TWh of excess energy consumption annually.

Goal: Develop, lab certify, and field validate residential HVAC CCX technology to reduce common installation faults and in-field performance.

Outcomes:

- Residential HVAC commissioning as a business norm, not as an add-on service.
- Lesser installation faults, optimal system performance, improved system reliability.
- If deployed at scale, could save homeowners $2.5 billion in utility bills annually

Technical Working Group Participants



Adding Insulation when Re-Siding

Problem: More than 5 quads of energy are wasted on residential buildings per year through poorly insulated and air sealed envelopes.[1]

R&D: Partner with major manufacturers and local contractors to leverage re-siding projects in 9 states.

Recent Success and Outcomes:

- Results show 25–40% whole-home savings.
- Initial air sealing reduced leakage by ~25%.
- **If deployed at scale, could save homeowners $44+ billion on utility bills annually.**

[1] https://www.energy.gov/sites/default/files/2025-01/bto-tech-innovation-011525.pdf

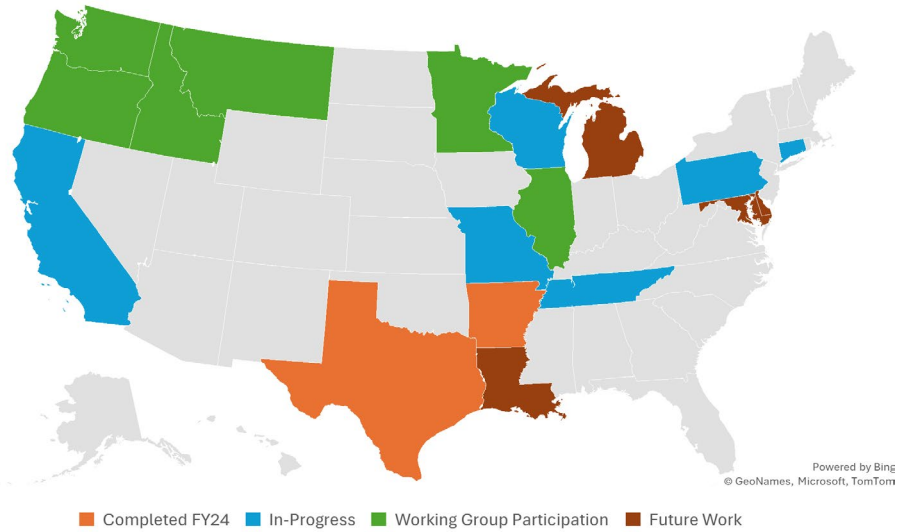
Utility Technical Assistance

Challenge: To minimize utility bills, utilities and TRMs must offer comprehensive rebate options, backed by transparent and consistent methods to assess energy and demand savings from envelope, window, and high-performance equipment measures.

Goal: Provide focused technical assistance to identify utility opportunity gaps for rebates, and ensure new and updated measures are comprehensive, accurate and meet best practices.

Recent Success:

- Reviewed and provided feedback on **53 measures across 5 programs (CA, CT, MO, TVA, WI) recently** reviewed with a focus on building envelope.
- Collaborated with Partnership for Advanced Window Solutions (PAWS) to support utilities and associated TRMs in adding advanced window measures.
- Several utility, regional, and industry partners expressed strong interest in developing a Quality Install and Verification measure for high-performance HVAC.



Support Provided in FY25

Supported Stakeholders

Energy Skilled: Consistency in Training

Problem: The buildings workforce faces negative perceptions, unclear career pathways, skill gaps, and limited access to training—which leads to qualified worker shortages, higher consumer energy costs, and reduced equipment reliability.

Goal: Competitive American talent with qualified technicians across the U.S. skilled in modern building technologies, reducing consumer costs.

Outcomes:

- 63 credentialed programs recognized, 24 added in FY25
- **60% of recognized HVAC programs have used our review process** to update and improve their using content on bsesc.energy.gov
- Arkansas HVACR Association standardized curriculum across 16 community colleges, setting a model for trade union and college collaborations.
- **Google launched the Energy Skilled label** in search results. Currently, more than 3,800 HVAC businesses are highlighted, representing tens of thousands of credentialed professionals, with the database expanding daily.

Arkansas HVACR Association

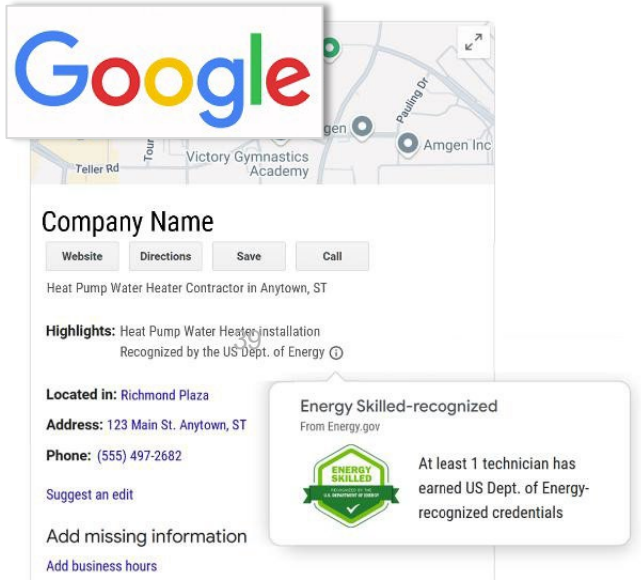
NCCER National Center for Construction Education and Research

DAIKIN

FUJITSU

Interplay Learning

Continuing to Add High Impact Recognizees!



Guiding 50,000+ Users Monthly: High-Performance Construction and Renovation Insights

Basc.pnnl.gov

Problem: Finding accurate, reliable and actionable construction guidance with proven performance is challenging.

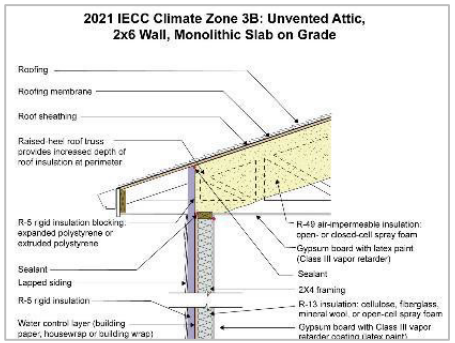
Goal: A one-stop shop for high-performance construction and renovation.

Recent Success:

- **New high-performance multifamily construction guides**, including 7 guide updates and 120+ guide revisions.
- **High-performance Envelope Assemblies Tool** that includes new, high-impact wall, roof, and foundation assembly drawings and notes for each of the 16 climate zones, done in collaboration with other national labs and Building America teams.
- **30+ practical DIY guides** on maintenance and upgrades to improve affordability, durability, comfort and efficiency, with extensive illustrations, pro-tips, and cost and effort scales.

DIY Guidance

Factory Construction Job Process Sheet



High-Performance Assembly

Commercial Building HVAC Accelerator

Industry Input: Develop **dual-fuel systems** that can run on the energy source that is available and lower cost at a given time.

Goal: Partner with major manufacturers to field validate new products in large retailers.

Outcome: If deployed at scale, this equipment could save American businesses $6 billion on utility bills annually.

Installing a rooftop unit for field testing

Better Buildings™ Better Plants
U.S. DEPARTMENT OF ENERGY

MANUFACTURER PARTNERS

AAON · BOSCH · Carrier · DAIKIN · LENNOX · LG · Rheem · TRANE TECHNOLOGIES

CAMPAIGN PARTNERS

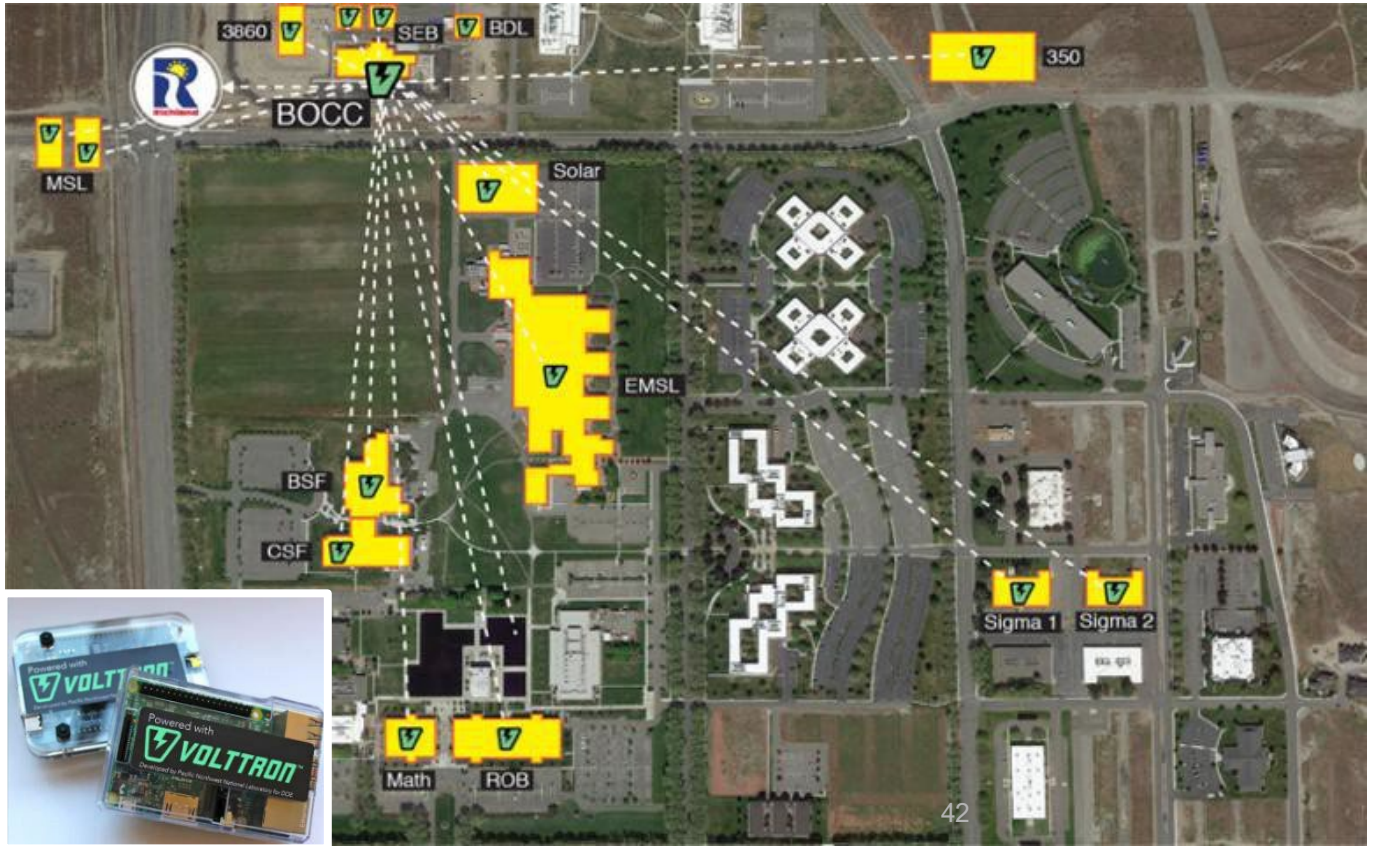
amazon · Columbia Association · target · LOWE'S · LIFE TIME · PROLOGIS

Addressing Transmission Constraints on the Home Front

Problem: PNNL campus energy usage may be **capped at 5 MW in 2028**.

R&D: PNNL's new control tech can help immediately address these real-world energy challenges.

PNNL is partnering with Richland to expand testing of control technologies on campus and manage electricity use by up to 3 MW.



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Learn More!

- Visit www.pnnl.gov for news and info on our latest research
- Follow us on your favorite social media platforms

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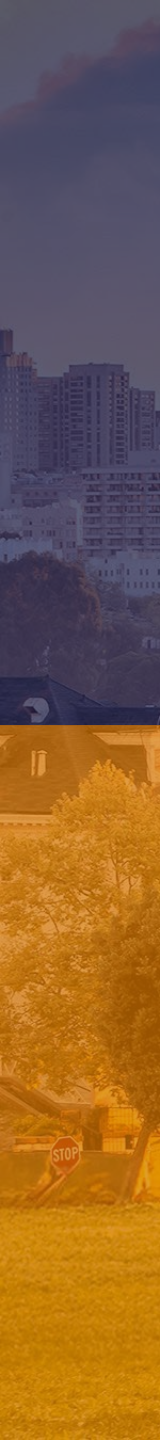
Thank you



Federal Buildings

Federal Buildings

Codes

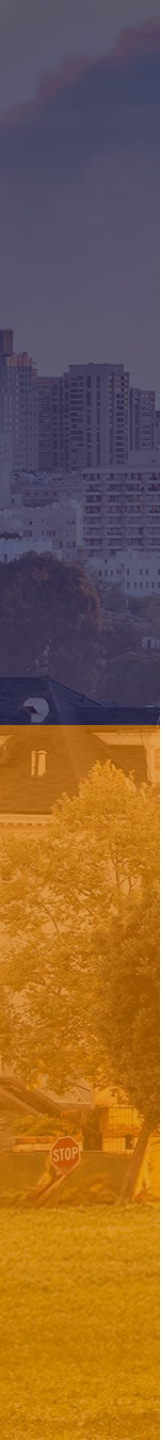
Resilience & Security

Problem: Traditionally non-connected operational technology can have cybersecurity vulnerabilities that bad actors can leverage to create mission operation disruptions at federal agencies through to the loss of utility-provided energy and water. However, many agencies lack familiarity with infrastructure resilience or cybersecurity solutions that prevent this.

facilitycyber.labworks.org

Recent Success:

- **New cybersecurity self-assessment tool**



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Codes Support

Federal Buildings

Codes

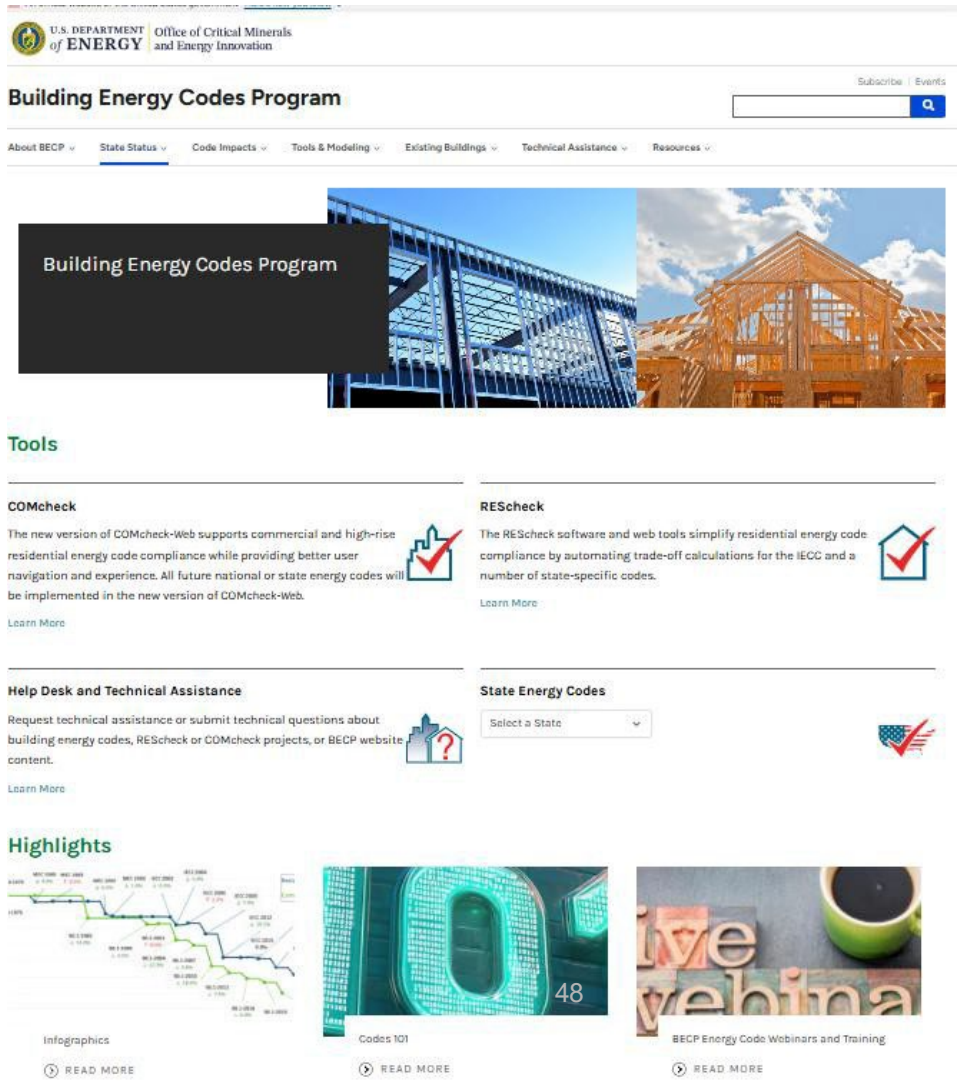
Pacific Northwest NATIONAL LABORATORY

Codes Support

- **Code specific analysis**
  - Cost effectiveness
  - Long term impacts
- **Large scale parametric simulation**
  - Ex. 23,000+ simulations in single commercial run
  - Utilizes PNNL's high performance research computing system

COMcheck•Web™

REScheck•Web™



Open Discussion/ Q&A

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Thank You!