Better Buildings Webinar Series

We'll be starting in just a few minutes….

Tell us…

What topics are you interested in for future webinars?

Please send your response to the webinar organizers via the question box.

Better Buildings®
U.S. DEPARTMENT OF ENERGY

Latest News From The Technology Research Teams

December 4, 2018
3:00 – 4:00 PM EST

U.S. DEPARTMENT OF ENERGY

Today's Presenters

Name	Organization	Technology Research Team
Jessica Granderson	Lawrence Berkeley National Laboratory	EMIS
Kim Trenbath	National Renewable Energy Laboratory	Plug and Process Loads
Michael Deru	National Renewable Energy Laboratory	Space Conditioning
Melissa Voss Lapsa	Oak Ridge National Laboratory	Building Envelopes
Michael Myer	Pacific Northwest National Laboratory	Lighting and Electrical

Jessica Granderson

EMIS Technology Research Team

Lawrence Berkeley National Laboratory

U.S. DEPARTMENT OF ENERGY

EMIS Defined

- Energy Management and Information Systems (EMIS)
  - Energy Management and Information Systems comprise a broad family of tools and services to manage commercial building energy use. EMIS technologies offer a mix of capabilities to store, analyze, and display energy use and system data, and in some cases, provide control

EMIS Project Team Overview

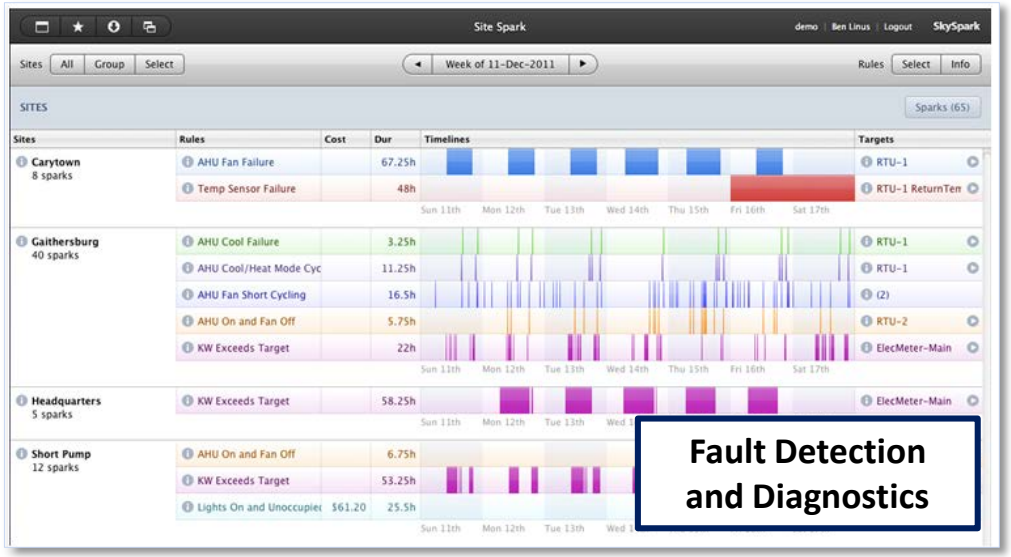
- Support members in adopting, expanding use of EMIS
  - Laboratory technical expertise and market intelligence connects utilities, owner/operator community, vendors of commercial tools
  - Development of new analytical approaches, identification of best-practice uses
  - Knowledge and technology transfer to facilitate market push and market pull

LBNL w/vendor community

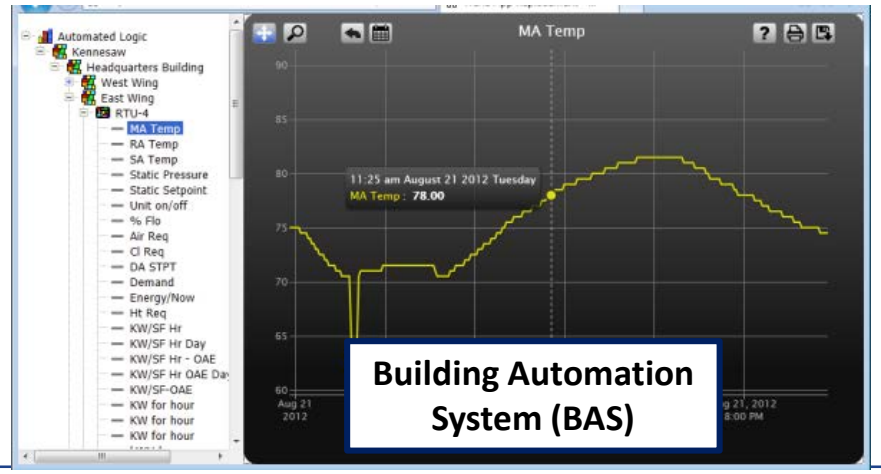
LBNL w/private and public sector, vendor community, utilities

EMIS Examples

Benchmarking and Monthly Utility Bill Analysis

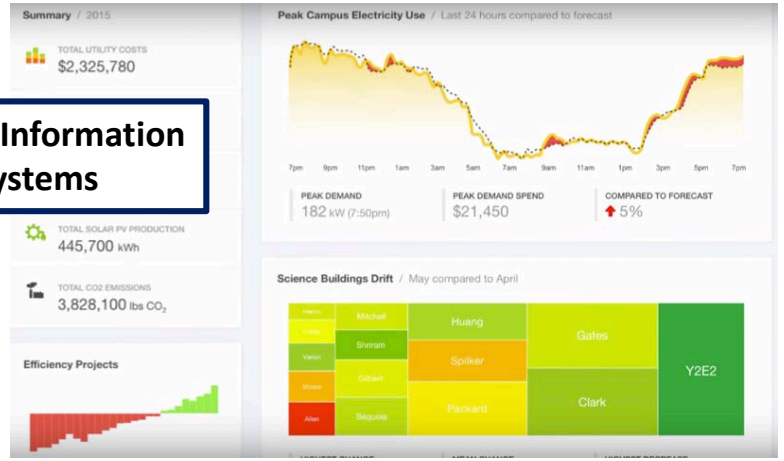


Fault Detection and Diagnostics



Building Automation System (BAS)

Energy Information Systems



Benchmarking: Performance Systems Development
BAS: Automated Logic
EIS: Lucid
FDD: SkyFoundry

Resource Examples

- Resources
  - Characterization and Survey of Automated FDD Tools
  - Using EMIS to Identify Top Opportunities for Commercial Building Efficiency
  - Corporate Delivery of a Global Smart Buildings Program

- Webinars
  - Building Data Management – Best Practices and Lessons Learned from EMIS Installations
  - Dashboards and Beyond: Designing EIS for Success
  - Success Stories for exemplary EMIS implementations

Commissioning (Cx) Study Update

- The *Cost-effectiveness of Commercial Buildings Commissioning* (2004/2009): routinely cited by to make business case for Cx implementation and programs

- Now updated with new information for Cx projects completed between 2010-2017

- Largest database of results 1482 buildings 373 million sf

Smart Energy Analytics Campaign

- Goal: Facilitate adoption of EMIS and monitoring-based commissioning
- Benefits to participants: technical assistance, recognition, peer learning groups
- 77 participating organizations; 400+ million sq ft
- Largest data set on EMIS use
- **Still accepting participants! https://smart-energy-analytics.org**

BCxA Building Commissioning Association
ComEd An Exelon Company
BOMA International
IFMA International Facility Management Association
Better Buildings U.S. Department of Energy

Fall 2018 Recognition

- **New Installation Recognition**
  - **Clise Properties**
    EIS in a Single Site (500,000 sq ft)
  - **Kerry Inc.**
    FDD in a Single Site (320,000 sq ft)
  - **Stanford University Dining and Residence**:
    EIS in a Portfolio (4.9 million sq ft)

Additional Areas of Team Research

- Highlights
  - Integrating autonomous commissioning via automated fault correction, with fault detection providers
  - Machine learning and unstructured data to enhance energy analytics

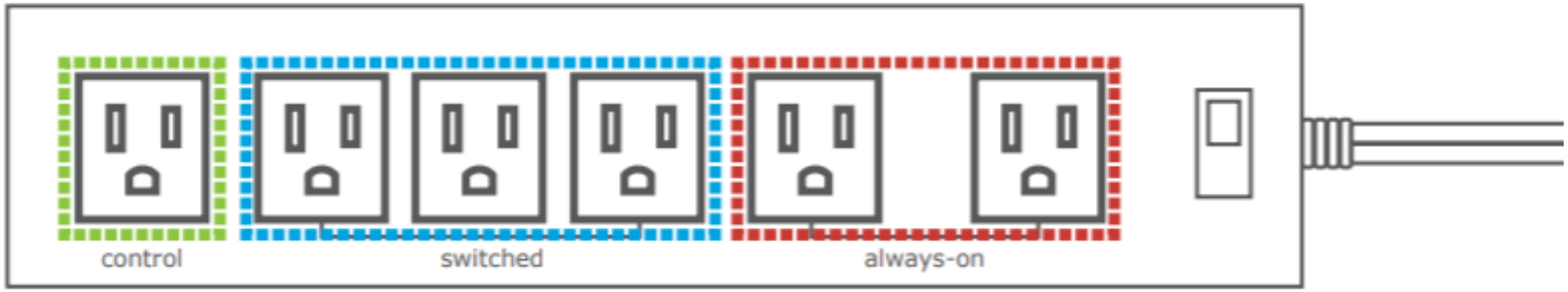
- Team members expertise
  - Monitoring-based commissioning
  - Meter-based savings measurement and verifications
  - Commercial building operational efficiency
  - Organizational processes
  - Machine learning and statistics

Kim Trenbath

Plug and Process Loads Technology Research Team
National Renewable Energy Laboratory

U.S. DEPARTMENT OF ENERGY

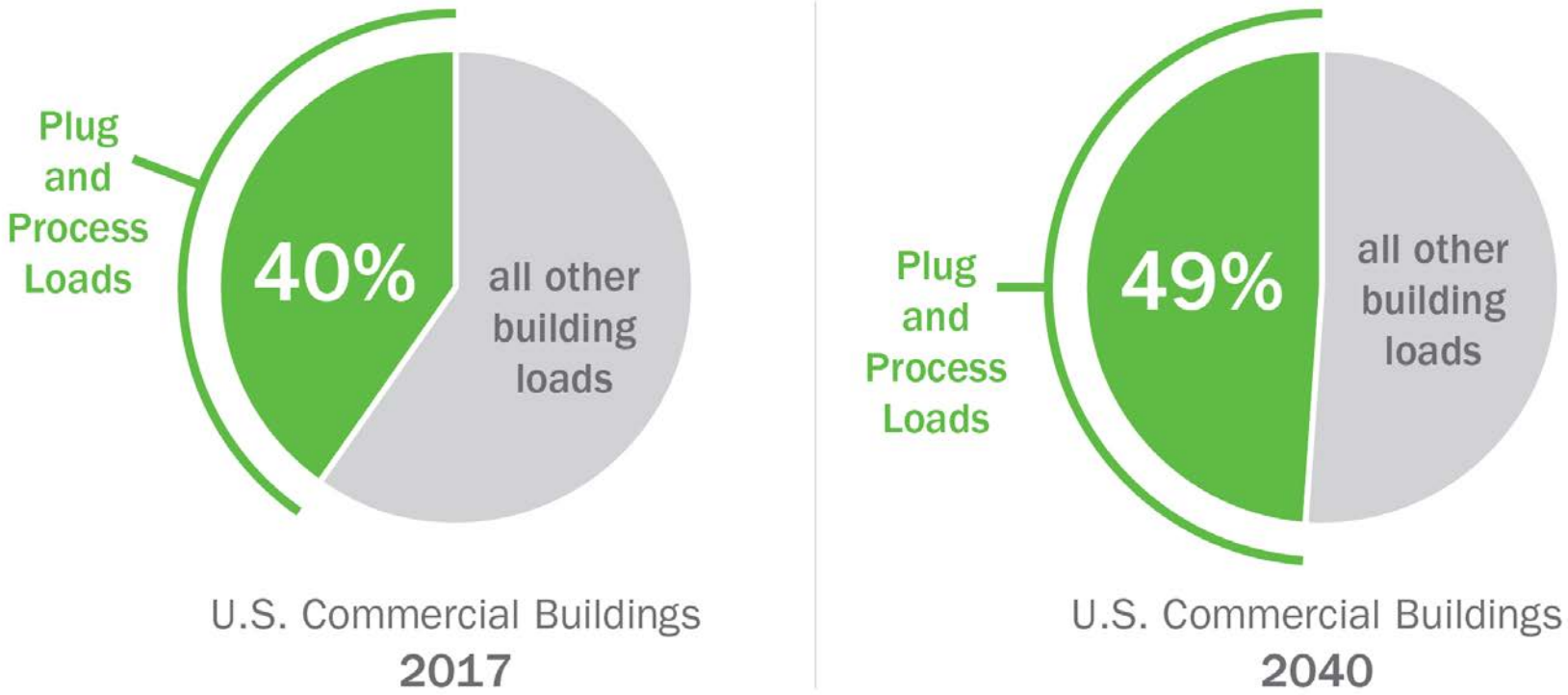
Plug and Process Loads Technical Team



Learn more at:

https://betterbuildingsinitiative.energy.gov/alliance/technology-solution/plug-process-loads

Plug and Process Loads Technical Team



Data from EIA Annual Energy Outlook 2018.

What Are Plug and Process Loads?

Who We Are

Team Leads

Rois Langner

Kim Trenbath

NREL

Technical Research Team

Icons from Flaticon.com

Strategic Working Group

Icons from Flaticon.com

Join Us!

Please contact Katie Vrabel: ppl@waypoint-energy.com

What We Do

Collaborate

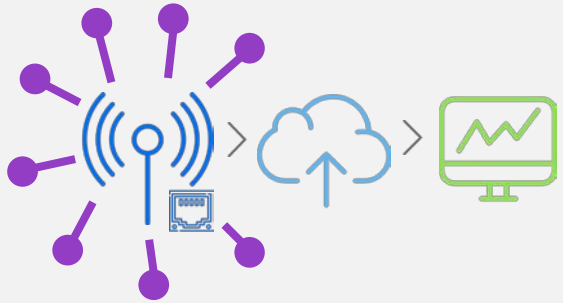
Technical Research Team Webinars

One-to-one calls

Conference meet ups

Investigate

Wireless meter & controls for plug loads (“smart outlets”)



Icon from Flaticon.com

Integrated Controls

Communicate

Conferences and Presentations

Resources on the BBA PPL website

18

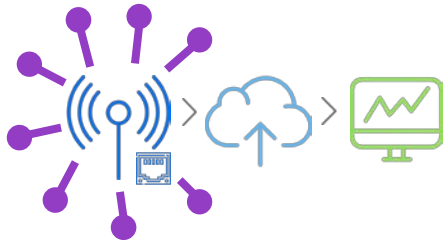
Collaborate

- BBA PPL Technical Team Bi-Annual Webinars
  - Next webinar in March 2019: Outcomes of GPG field study with wireless meter and control technology from Ibis Networks
- Conference Get-Togethers
- One-to-one calls
- Field Study Test Sites

Investigate

Wireless meter & controls for plug loads ("smart outlets")

Navigating Cybersecurity Implications of Smart Outlets



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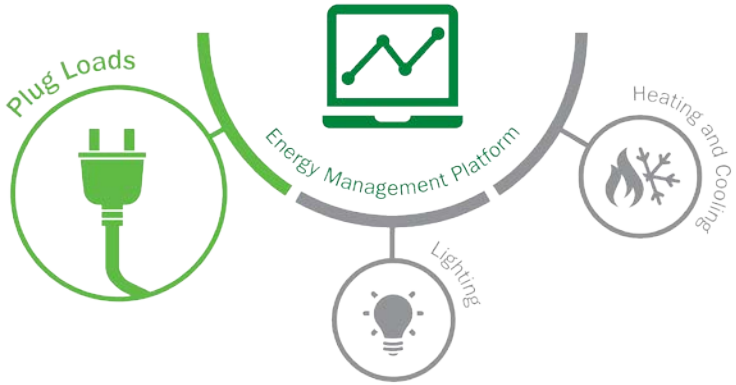
Outcomes of GPG field study with wireless meter and control technology from Ibis Networks

Integrated controls

Landscaping Study: Integrating Smart PPL Controls into Energy Management Information System (EMIS) Platforms

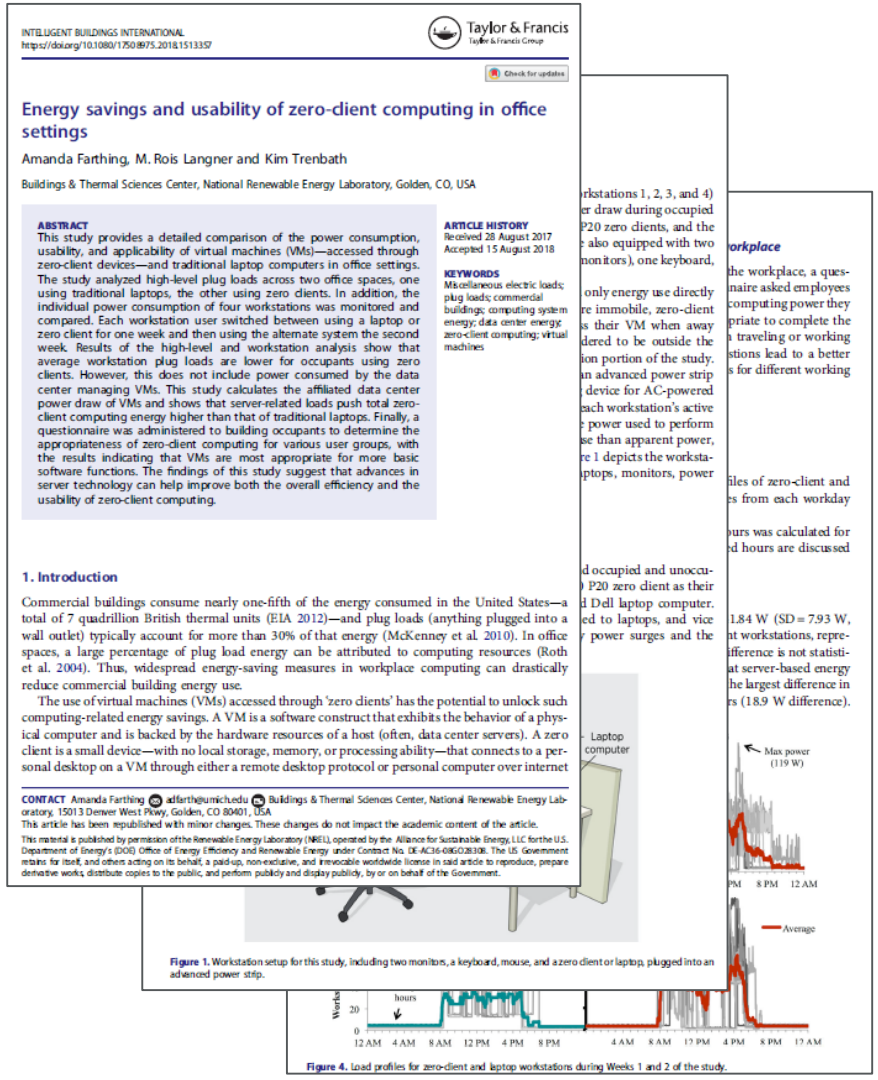


Investigate

Other

Energy Savings and Usability of Zero-Client Computing in Office Settings

Available from *Intelligent Buildings International*



INTELLIGENT BUILDINGS INTERNATIONAL
https://doi.org/10.1080/17508975.2018.1513357

Taylor & Francis
Taylor & Francis Group

Check for updates

Energy savings and usability of zero-dient computing in office settings

Amanda Farthing, M. Rois Langner and Kim Trenbath

Buildings & Thermal Sciences Center, National Renewable Energy Laboratory, Golden, CO, USA

ABSTRACT

This study provides a detailed comparison of the power consumption, usability, and applicability of virtual machines (VMs)—accessed through zero-client devices—and traditional laptop computers in office settings. The study analyzed high-level plug loads across two office spaces, one using traditional laptops, the other using zero clients. In addition, the individual power consumption of four workstations was monitored and compared. Each workstation user switched between using a laptop or zero client for one week and then using the alternate system the second week. Results of the high-level and workstation analysis show that average workstation plug loads are lower for occupants using zero clients. However, this does not include power consumed by the data center managing VMs. This study calculates the affiliated data center power draw of VMs and shows that server-related loads push total zero-client computing energy higher than that of traditional laptops. Finally, a questionnaire was administered to building occupants to determine the appropriateness of zero-client computing for various user groups, with the results indicating that VMs are most appropriate for more basic software functions. The findings of this study suggest that advances in server technology can help improve both the overall efficiency and the usability of zero-client computing.

ARTICLE HISTORY
Received 28 August 2017
Accepted 15 August 2018

KEYWORDS
Miscellaneous electric loads; plug loads; commercial buildings; computing system energy; data center energy; zero-client computing; virtual machines

1. Introduction

Commercial buildings consume nearly one-fifth of the energy consumed in the United States—a total of 7 quadrillion British thermal units (EIA 2012)—and plug loads (anything plugged into a wall outlet) typically account for more than 30% of that energy (McKenney et al. 2010). In office spaces, a large percentage of plug load energy can be attributed to computing resources (Roth et al. 2004). Thus, widespread energy-saving measures in workplace computing can drastically reduce commercial building energy use.

The use of virtual machines (VMs) accessed through 'zero clients' has the potential to unlock such computing-related energy savings. A VM is a software construct that exhibits the behavior of a physical computer and is backed by the hardware resources of a host (often, data center servers). A zero client is a small device—with no local storage, memory, or processing ability—that connects to a personal desktop on a VM through either a remote desktop protocol or personal computer over internet

CONTACT Amanda Farthing adfarth@umich.edu Buildings & Thermal Sciences Center, National Renewable Energy Laboratory, 15013 Denver West Pkwy, Golden, CO 80401, USA
This article has been republished with minor changes. These changes do not impact the academic content of the article.

Figure 1. Workstation setup for this study, including two monitors, a keyboard, mouse, and a zero client or laptop, plugged into an advanced power strip.

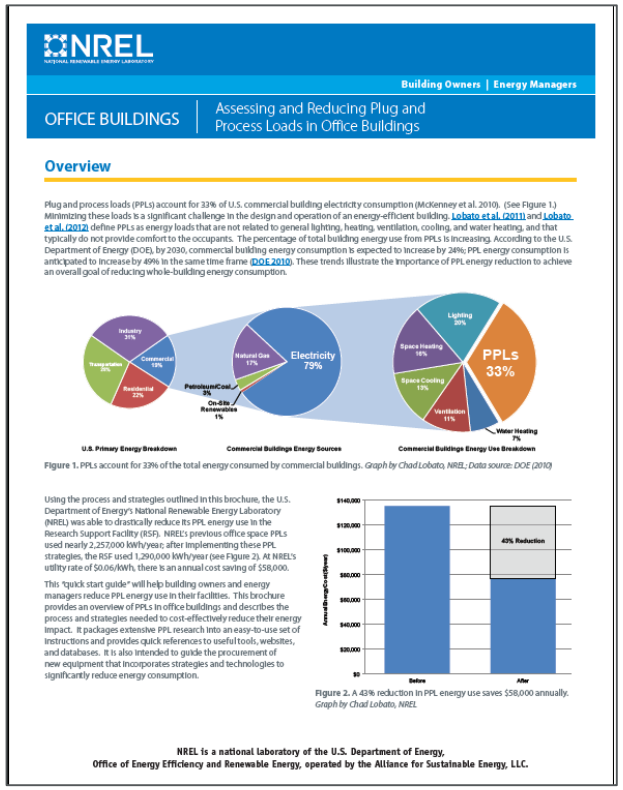
Figure 4. Load profiles for zero-client and laptop workstations during Weeks 1 and 2 of the study.

Communicate

Presentations

- Better Buildings Summit
- ACEEE Summer Study on Efficiency in Buildings
- Better Plants Day

Resources


NREL

Building Owners | Energy Managers

OFFICE BUILDINGS | Assessing and Reducing Plug and Process Loads in Office Buildings

Overview

Plug and process loads (PPLs) account for 33% of U.S. commercial building electricity consumption (McKenney et al. 2010). (See Figure 1.) Minimizing these loads is a significant challenge in the design and operation of an energy-efficient building. Lobato et al. (2011) and Lobato et al. (2012) define PPLs as energy loads that are not related to general lighting, heating, ventilation, cooling, and water heating, and that typically do not provide comfort to the occupants. The percentage of total building energy use from PPLs is increasing. According to the U.S. Department of Energy (DOE), by 2030, commercial building energy consumption is expected to increase by 24%; PPL energy consumption is anticipated to increase by 49% in the same time frame (DOE 2010). These trends illustrate the importance of PPL energy reduction to achieve an overall goal of reducing whole-building energy consumption.

Figure 1. PPLs account for 33% of the total energy consumed by commercial buildings. *Graph by Chad Lobato, NREL; Data source: DOE (2010)*

Using the process and strategies outlined in this brochure, the U.S. Department of Energy's National Renewable Energy Laboratory (NREL) was able to drastically reduce its PPL energy use in the Research Support Facility (RSF). NREL's previous office space PPLs used nearly 2,252,000 kWh/year; after implementing these PPL strategies, the RSF used 1,290,000 kWh/year (see Figure 2). At NREL's utility rate of $0.06/kWh, there is an annual cost saving of $58,000.

This "quick start guide" will help building owners and energy managers reduce PPL energy use in their facilities. This brochure provides an overview of PPLs in office buildings and describes the process and strategies needed to cost-effectively reduce their energy impact. It packages extensive PPL research into an easy-to-use set of instructions and provides quick references to useful tools, websites, and databases. It is also intended to guide the procurement of new equipment that incorporates strategies and technologies to significantly reduce energy consumption.

Figure 2. A 43% reduction in PPL energy use saves $58,000 annually. *Graph by Chad Lobato, NREL*

NREL is a national laboratory of the U.S. Department of Energy, Office of Energy Efficiency and Renewable Energy, operated by the Alliance for Sustainable Energy, LLC.

For more information: https://betterbuildingsinitiative.energy.gov/alliance/technology-solution/plug-process-loads

Get Involved

- Join the PPL Technical Research Team: ppl@waypoint-energy.com
- Attend the next webinar: March 2019
- Check out the resources on our webpage. Blog example below.
- Meet us at conference get-togethers
- Host a field study!
- Participate in the Interior Lighting Campaign innovation category (lighting and plug load controls)
- Research-oriented? Contact us about the PPL Strategic Working Group

UTILITY INCENTIVES FOR COMMERCIAL BUILDING PLUG LOAD EFFICIENCY

Plug and Process Loads (PPLs) are relatively easy to manage with the right equipment, as DOE's Better Buildings Alliance Plug and Process Load (PPL) Technical Research Team can tell you. Obtaining that equipment can be even easier, thanks to utility incentives and rebates!

The PPL Tech Team has released the annual update of its database of utility incentives and rebates for plug load efficiency. This database includes a list of financial and other incentives offered by state and sponsor, which is often the electric utility or energy efficiency program administrator. The database groups the types of PPL incentives into five categories, shown in Figure 1 and explained below.

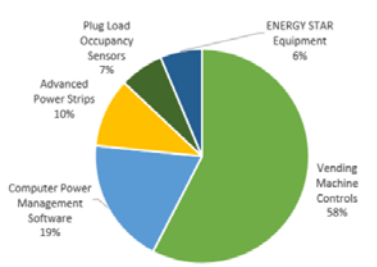


Figure 1. Proportion of plug and process load incentives by category

Michael Deru

Space Conditioning TRT
National Renewable Energy Laboratory

U.S. DEPARTMENT OF ENERGY

Space Conditioning Team

Michael Deru, michael.deru@nrel.gov

Advanced RTU Campaign

- Technology and Business resources at **www.advancedRTU.org**
- 2019 Recognition Awards
  - Categories announced in January
  - Winners announced at PRSM National Conference, April 30

RTU AFDD Field Study

- Landscaping report coming in early 2019 – looking for participants
- Collecting real time data in 2019 – looking for participants

Multiple RTU Coordination New project

- Determine energy, demand, and cost savings with optimized control of multiple RTUs
- Lab testing in 2019 and field testing 2019-2020

Space Conditioning Team

Michael Deru, michael.deru@nrel.gov

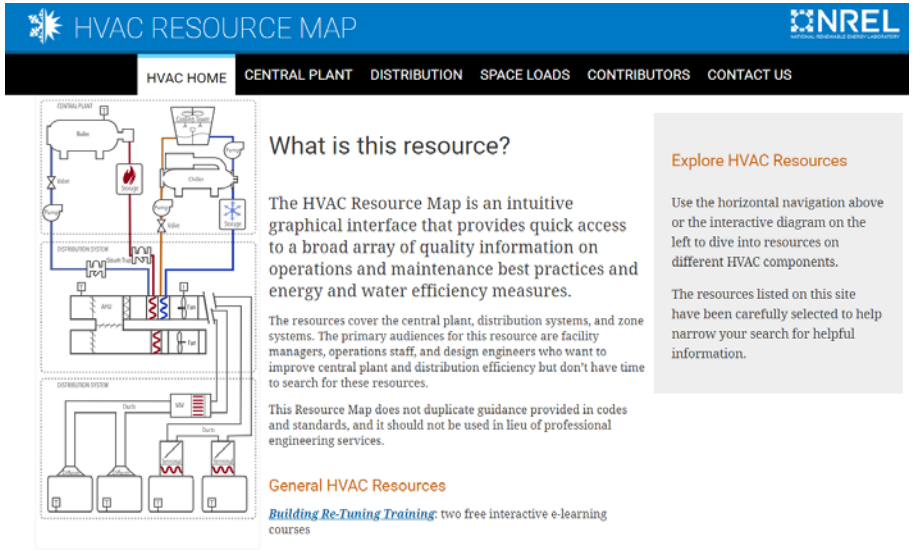
Technology Demonstrations

Reports coming in 2019

- HVAC air cleaning technology
- High-efficiency smart motor
- Cooling tower water treatment systems

Resources

- www.HVACResourceMap.net
- Water resources tool kit New
  - Looking for input



Tech Team Calls

- February and August
- Looking for topics of interest

Melissa Voss Lapsa

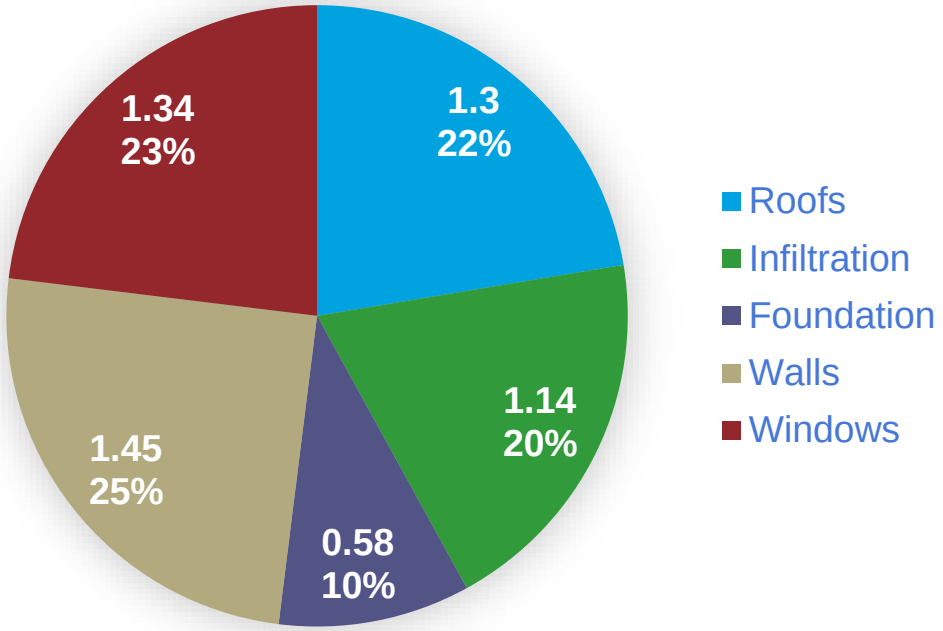
Building Envelopes TRT

Oak Ridge National Laboratory

U.S. DEPARTMENT OF ENERGY

Building Envelope Market Potential

The Commercial Building Envelope:
5.81 Quads of primary energy use



Envelope Technology Research Team (ETRT)

Melissa Lapsa, MBA

ETRT Lead

Simon Pallin, PhD.

ETRT Technical Lead

Mahabir Bhandari, Ph.D.

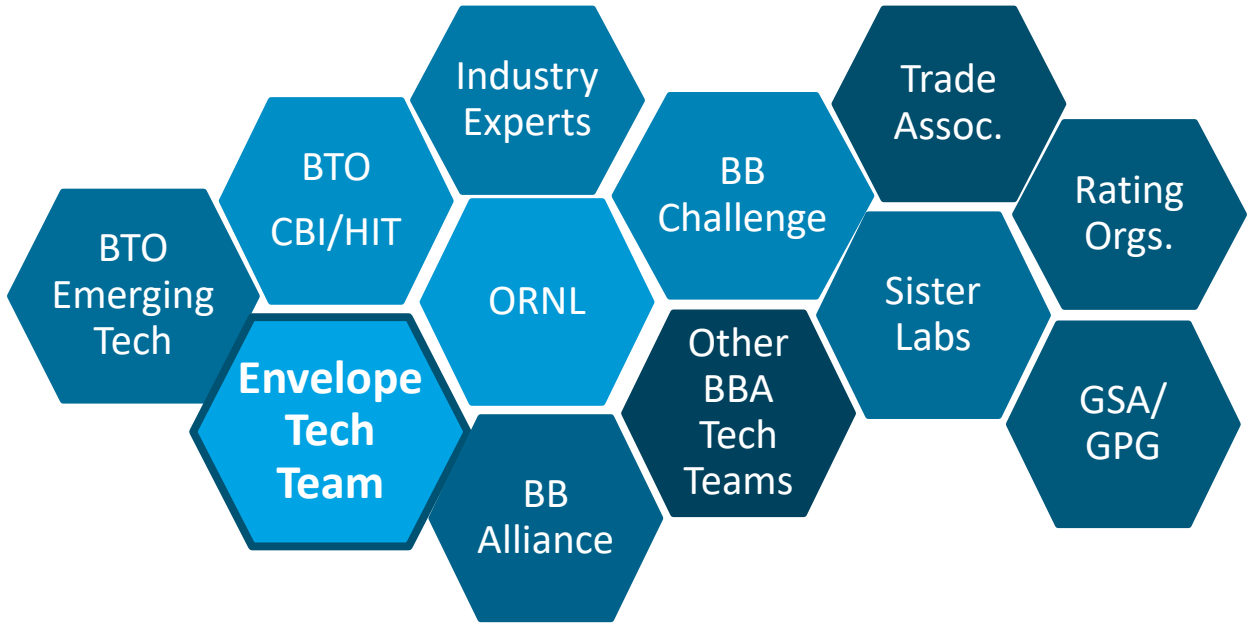
ETRT Tech Support

Caroline Hazard, M.S.

ETRT Support

- Toolkit solutions for advanced technologies for windows, walls, and roofs
- Building envelope project best practice guidance and tools
- Technical expertise from Oak Ridge National Laboratory

A Unique and Diverse Team



- Demonstration of high performance envelope technologies and solutions
- Comprised of Better Buildings Partners and representatives from the design community, including A&E firms

29 Members

Adams 12; Community College of Allegheny County, Arlington County; Brevard County Schools; Clark Atlanta Univ.; Cook County; Emory; exp US Services; Green Dinosaur;Hersha Hospitality Mgmt; HOK; Instit. Engenharia do Porto; Legacy Health; MA DOER; More; Newmark Grubb Knight Frank; Parkway Schools; SABEY; Schmidt; SIM2; Smart Bldg Strategies, TN Energy Office; Tishman Speyer; Turner Construction; US ACE; z2zero

Current Building Envelope R&D Efforts

Building Enclosure Commissioning (BECx)

- Best Practices, Case Studies
- Benefits and Costs Study

Building Enclosure Performance Metric

- Investigating market need
- Identifying variables
- Validation with lab testing & simulations

Current Wall Systems

- Performance data and gap analysis
- Investigate opportunities for “active/controllable wall systems”

Composite Walls

Development of multifunctional composite panel:

- Envelope Retrofit
- Will combine heat, air and moisture barrier with the cladding system

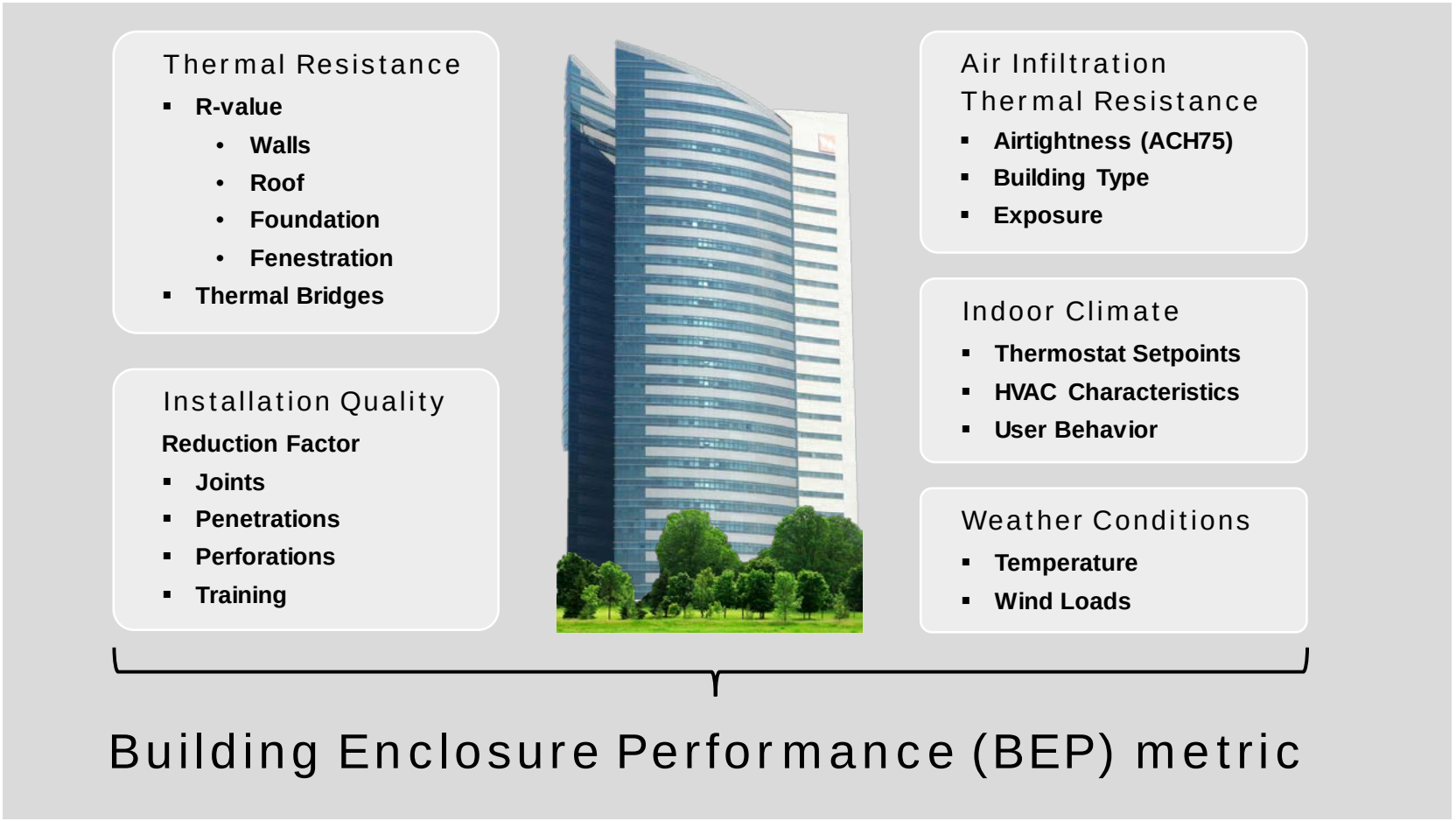
Window Attachments

Collaboration with Attachment Energy Rating Council (AERC)

- Field measurements
- Building Energy modeling

Quantifying Hidden Value with an Enclosure Performance Metric

- Conducting modeling simulations to verify variables for a quantitative metric
- Seeking real building data for field validations
  - Building type, location, size
  - Components and materials
  - Energy use, hours operation, etc.



Passive Walls: Investigating Performance & Gap Analysis

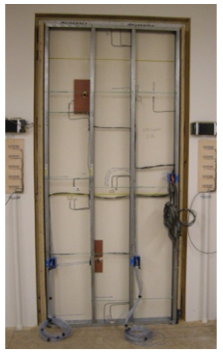
- Categorize common commercial wall assemblies
  - Research availability of measured envelope data
  - Identify performance indices for control and energy optimization
- Identify simulation model deficiencies
  - Do the models capture all the real wall assemblies accurately?
- Conduct sensitivity analysis
  - Light weight wall vs mass wall systems

Compare Performance in Natural Exposure Testing Facility

Wall panel data

- Air leakage
- Pressure distribution
- Temperature
- Relative humidity
- Moisture content
- Heat flux


Wood Framing


Light Gage Steel Framing


Pressurization Setup


Temperature
Fenwal 192-103LET-A01


Relative Humidity
Honeywell HIH-4000

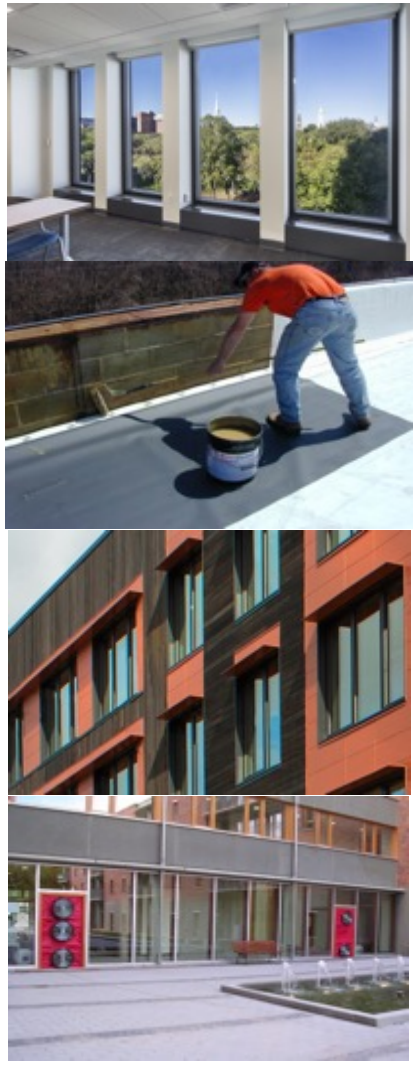

Mass Flowmeter
TSI 40211


Pressure
Energy Conservatory APT


Data Loggers
Campbell Scientific CR1000

Seeking ETRT Partner input: measured wall performance data

New ETRT Resources



Enclosure Technologies

- Tech Showcase: Windows and Air Barrier Technologies
- Tech Showcase: Enclosure Systems, Air Barrier Technologies, & Window Attachments

BECx

- Half-Day Workshop: Going Deep on Enclosure Commissioning
- BECx Resources Page *(coming soon)*

Airtightness

- **Airtighness of Commercial Buildings – Where are we and where could we go?** D. Hun et al, 2018 ACEEE Summer Study on Efficient Buildings
- ORNL/ABAA/NIST Airtightness Savings Calculator

Join the Envelope Tech Research Team!

Building Owners

Building Managers

Architects and Engineers

Subject Matter Experts

Trade Associations

Manufacturers

Installers/ Builders

Energy Service Providers

Researchers

Engage in R&D:

- **Addressing airtightness requirements**
- **Passive Walls Research**
- **Investigating Building Enclosure Performance Metric**

Thank you!

Melissa Lapsa

lapsamv@ornl.gov

Michael Myer

Lighting and Electrical TRT

Pacific Northwest National Laboratory

U.S. DEPARTMENT OF ENERGY

Lighting & Electrical Team

Webinars/Team Calls

- Portion of calls focuses on a topic
  - Lighting as a Service and Internet of Things (IoT) Research
  - Lessons Learned from IoT / Smart Lighting Installations
- Portion of calls allows for cross talk of members
- DOE-supported team
  - Pacific Northwest National Lab
- Individual requests
  - L&E member requested information for evaluating color
  - L&E member requested information about certain types of downlights

Meeting Dates

January 17, 2019
April 18, 2019
September 19, 2019

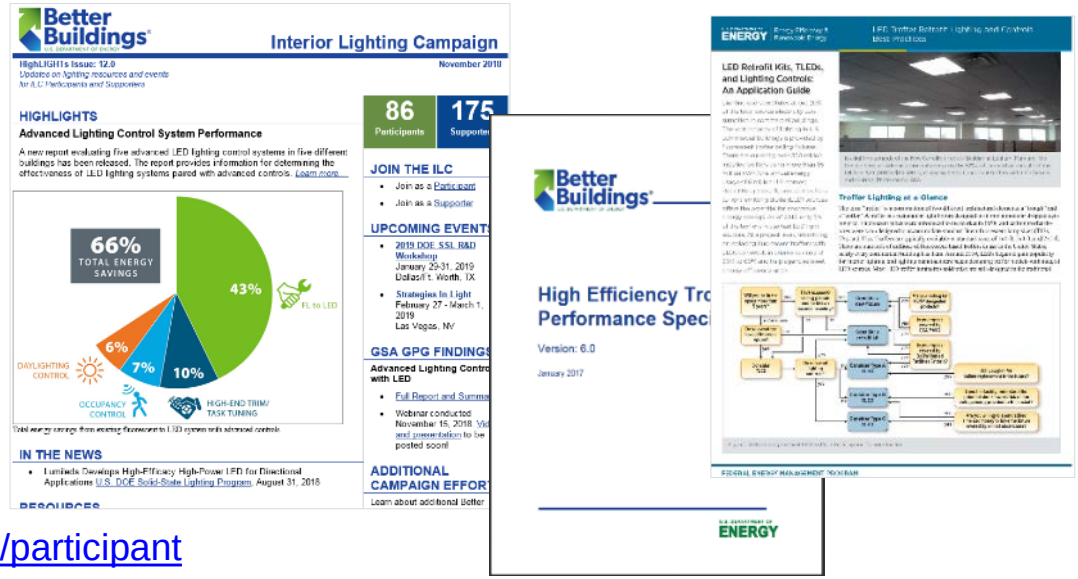
Interior Lighting Campaign (ILC)

2019 Recognition

- Recognized 15 organizations at the IES conference in Boston
- Similar event in the works for 2019
- Working to expand beyond just lighting to also include HVAC and plug load interactions

ILC Resources

- Specifications
- Utility incentives database
- Case studies
- HighLIGHTs Newsletter
- Application guides
- Technical assistance
- Join at https://interiorlightingcampaign.org/node/add/participant



Internet of Things (IoT) and Lighting

Recent work

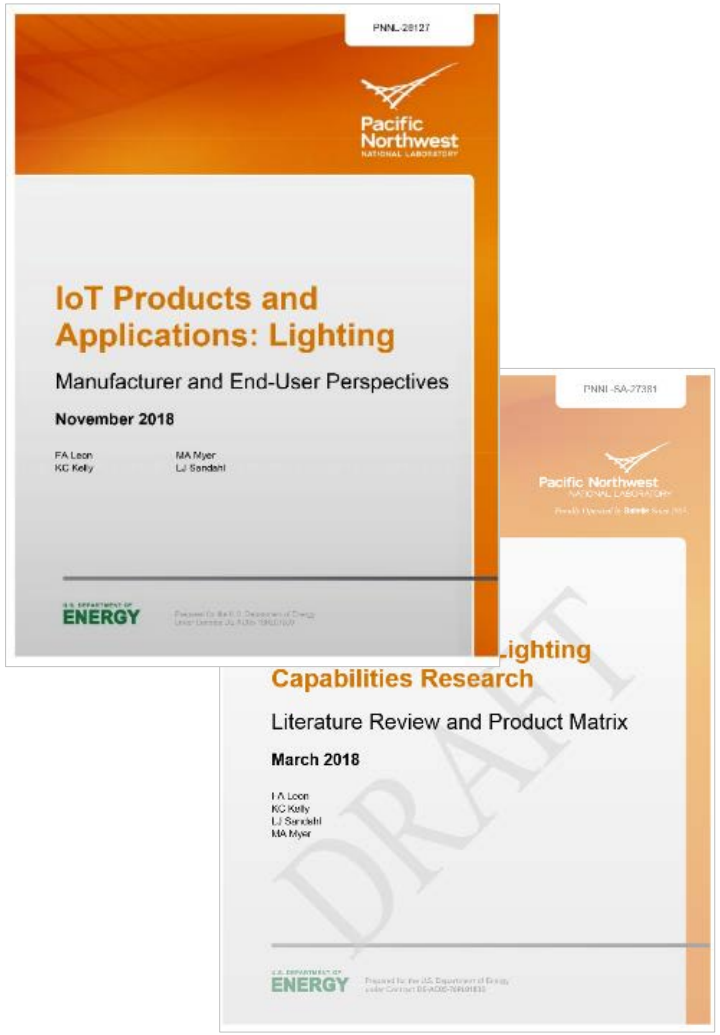
- Literature review and product matrix
- Manufacturer and end-user perspectives

Challenges related to IoT

1. Lack awareness of some of the benefits
2. Cyber security
3. Cost is a barrier
4. Interoperability, & End User Interviews

Next steps / work

- Challenge for fixtures with IoT port
- On going research related to the barriers

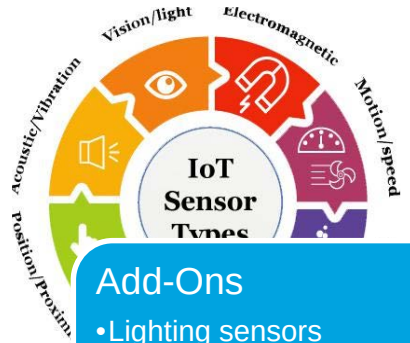


Internet of Things (IoT) and Lighting

Aspects of the Challenge

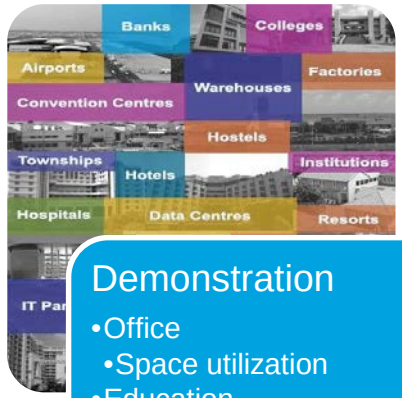
Product
- Luminaire
- Retrofit Kit
- Connectivity
- Upgradeability

Challenge



Add-Ons
- Lighting sensors
  - Connected
- IoT devices
  - Equip. tracking
  - Space utilization
  - Gunshot detect/locate

Prove it



Demonstration
- Office
  - Space utilization
- Education
  - Security system integration
- Healthcare
  - Equipment locate
  - Fall detection

Pilot it

Field Evaluations

In progress

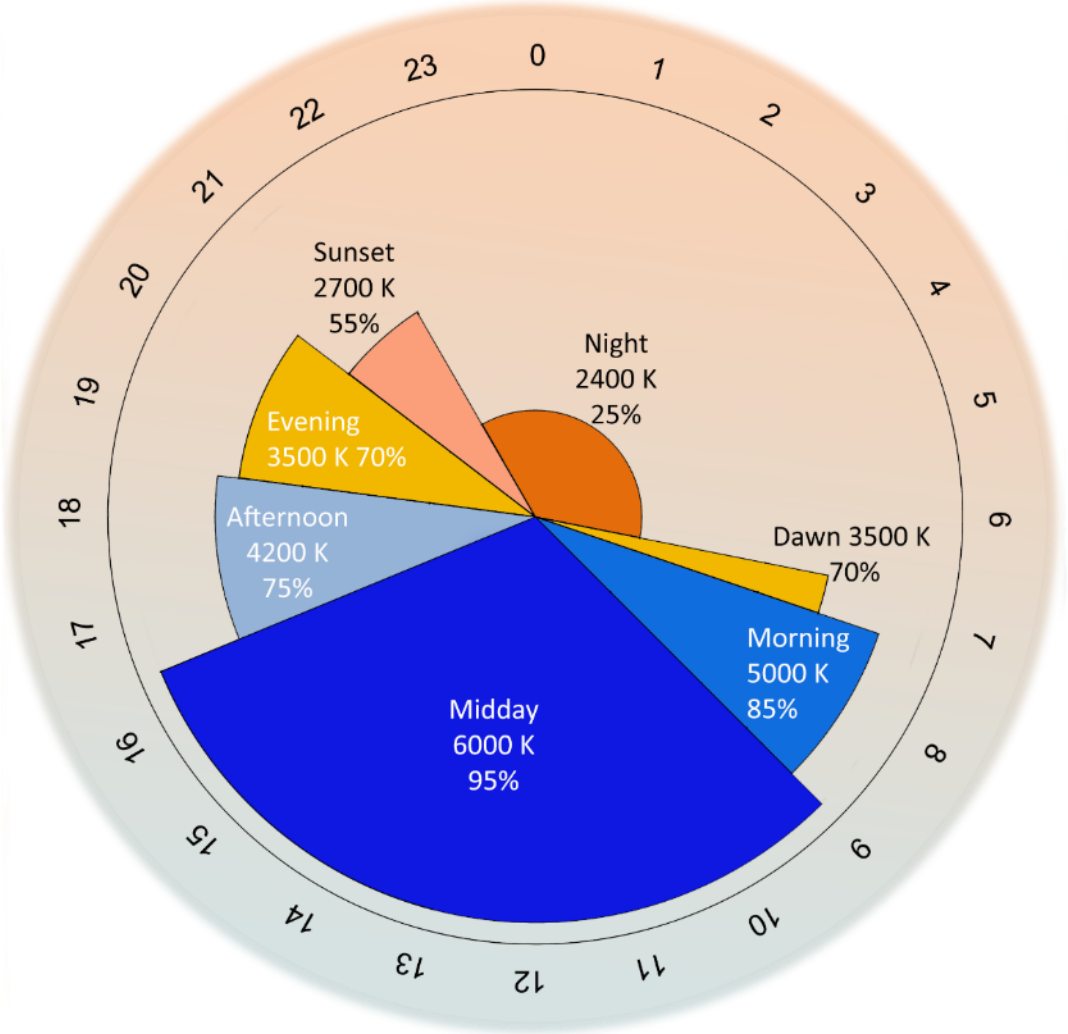
- Lighting + HVAC
  - Federal building using smart sensors to interface with the HVAC and lighting
- Lighting + HVAC + Plugs
  - 4+ sites in Minnesota LED retrofits interfacing with HVAC and occupancy sensors

Field Evaluations / Demonstrations

- ***Seeking Partners:*** Tuning LED systems
- ***Seeking Partners:*** PV + Direct Current + LED + Battery

Field Evaluations: Tuning LED systems

Field Evaluations: Tuning LED systems



Field Evaluations: Tuning LED systems

Field Evaluations: Tuning LED systems

Overview:

- Color tuning LED fixture *might* have benefits

Seeking Partners:

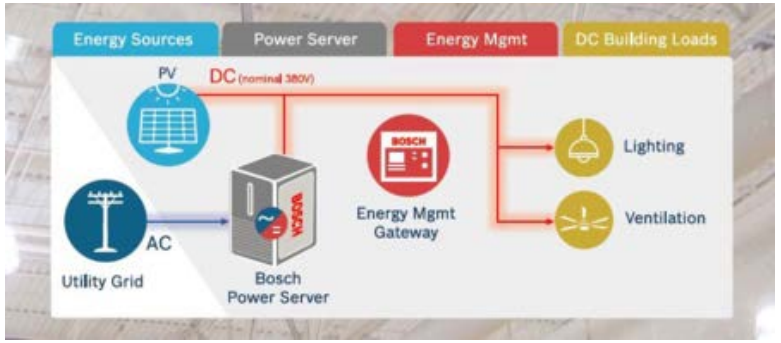
- *Office Setting*
- Requires consent of those participating in field evaluation
- Ideal building has duplicate floors / floor plans that can be segregated
- Workers work a standardized day shift with limited travel
- Ideally would involve some type of task that could evaluated or included into the tracking metrics

Research Questions:

- Energy savings of different systems
- User perspective
- Any benefits that could be monetized

Field Evaluations: PV + DC + LED + Battery

Photovoltaics



Direct Current

DC LED Ltg

Battery Storage

Field Evaluations: Tuning LED systems

Overview:

- PV + DC + LED + Battery Storage

Seeking Partners:

- Building type TBD
- Small commercial building
- Interested in DC power
- Most likely a new construction project
- Limited effects on staff

Research Questions:

- Energy savings of different systems
- How hard / challenges of design

Additional Resources

- EMIS
  - Characterization and Survey of Automated FDD Tools
  - Using EMIS to Identify Top Opportunities for Commercial Building Efficiency
  - Corporate Delivery of a Global Smart Buildings Program
  - Building Data Management – Best Practices and Lessons Learned from EMIS Installations
  - Dashboards and Beyond: Designing EIS for Success
  - Success Stories for exemplary EMIS implementations
- Lighting and Electric
  - https://interiorlightingcampaign.org/node/add/participant
- ETRT
  - Windows and Air Barrier Technologies
  - Enclosure Systems, Air Barrier Technologies, & Window Attachments
  - Going Deep on Enclosure Commissioning
  - Airtightness of Commercial Buildings – Where are we and where could we go?
  - Airtightness Savings Calculator
- PPL
  - https://betterbuildingsinitiative.energy.gov/alliance/technology-solution/plug-process-loads
- Space Conditioning
  - www.advancedRTU.org
  - www.HVACResourceMap.net

Q&A

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Additional Questions? Please Contact Us

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