



Integrated Lighting Campaign (ILC)

Recognition Opportunities for Participants
February 11, 2021



Introductions



Tracy Beeson
Outreach and Data Management
Pacific Northwest National Laboratory



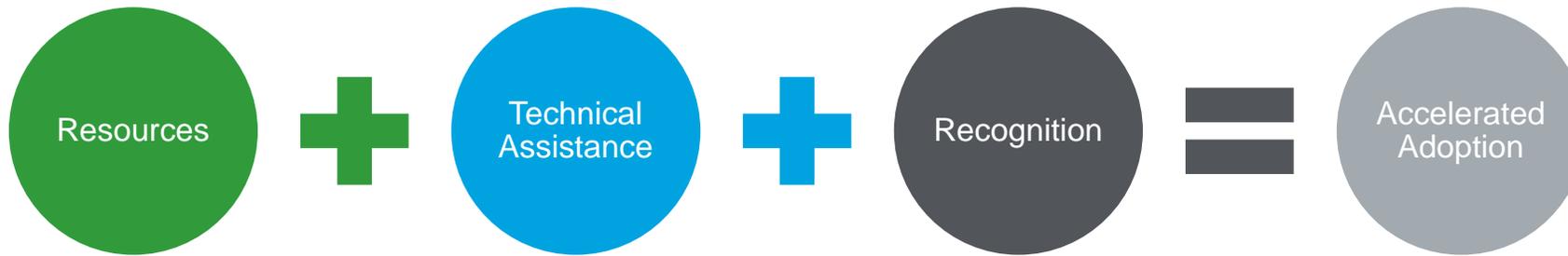
Dr. Kim Trenbath
Technical Team Lead
National Renewable Energy Laboratory



Michael Myer
Technical Team Lead
Pacific Northwest National Laboratory

What Exactly is a Technology Campaign?

A collaborative platform to speed technology adoption



In 2019, participants reported energy savings of more than \$250 million from interior lighting improvements, HVAC rooftop unit replacements and retrofits, and the use of energy management systems. – *Better Buildings Solution Center*

Completed campaigns: Smart Energy Analytics, Advanced Rooftop Unit, Interior Lighting Campaign, and Lighting Energy Efficiency in Parking
More info about campaigns available at <https://betterbuildingsolutioncenter.energy.gov/alliance/tech-campaigns>

Better Buildings Campaigns



Building Envelope Campaign

Website: EC.ORNL.GOV

Email: envelopecampaign@ornl.gov



Integrated Lighting Campaign

Poll Time!

Which of the following categories most accurately describe your organization?

- Commercial Real Estate and Hospitality
- Government
- Healthcare
- Higher Education
- Retail, Food Service, or Grocery

ILC Organizers





Tyler Cooper

General Services Administration (GSA)
Mechanical Engineer, EIT, Office of Facilities
Management



PROUD
ORGANIZER

GSA: Largest US Portfolio of Commercial Office Space

8,721

PROPERTIES MANAGED, 377M ft²

1,574

OWNED, 188M ft²

\$325M

ANNUAL ENERGY COSTS FOR OWNED REAL-ESTATE



"Sensor-based wireless architecture at every light fixture optimizes building systems & operations—lighting, HVAC, asset tracking, space management..."

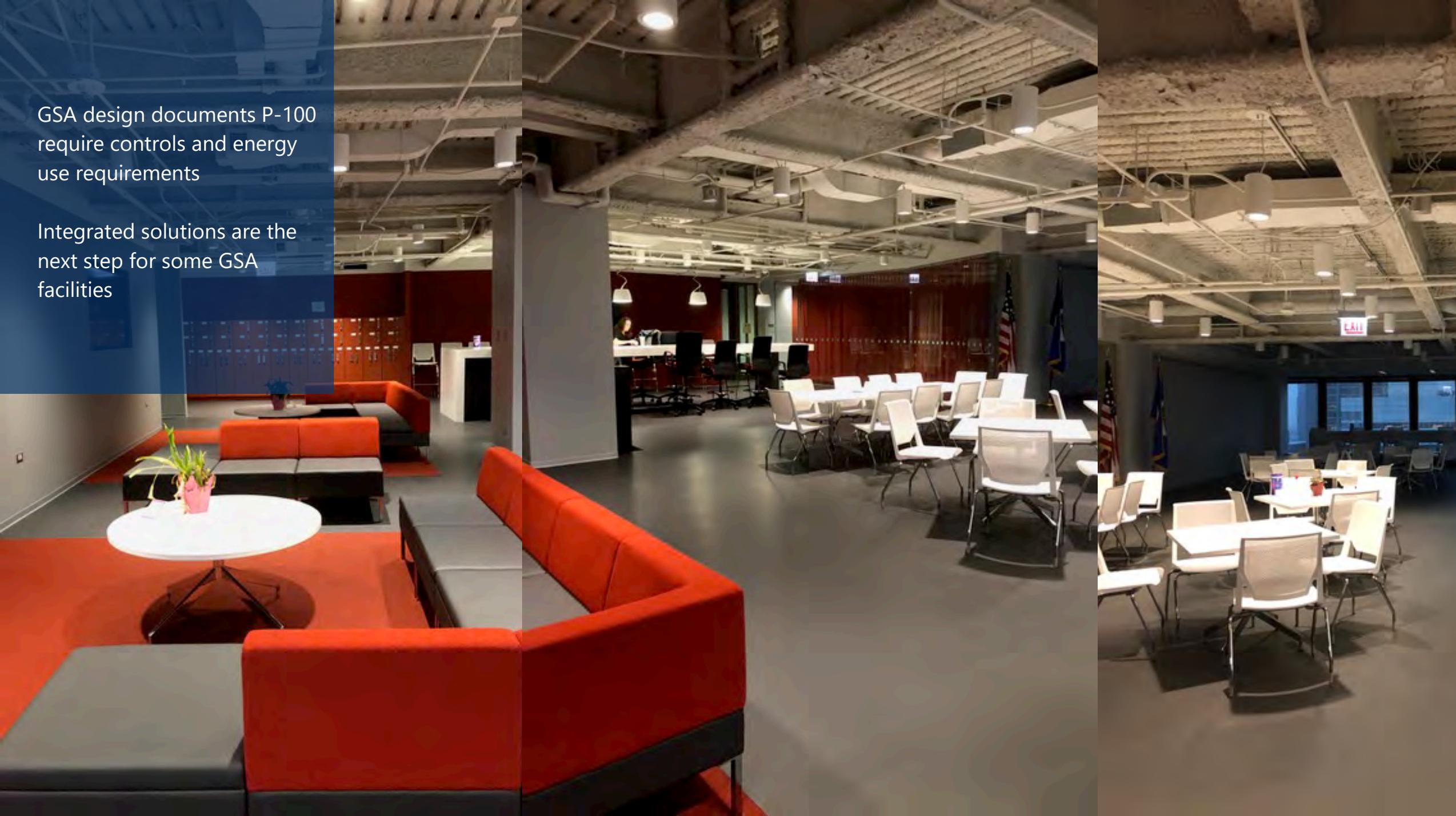
*GPG testbed site:
John C Kluczynski FB, Chicago,
IL*

At a Glance...

- GSA annual cost for lighting: \$36M
- GSA annual cost for HVAC: \$105M
- Technology claim:
 - 78% lighting energy savings
 - 25% HVAC savings
 - <8 year payback

GSA design documents P-100
require controls and energy
use requirements

Integrated solutions are the
next step for some GSA
facilities





Bill Conley

International Facility Management Association
(IFMA), National Manager- Facility Services



**PROUD
ORGANIZER**

What IFMA Offers



01 **Membership**
offering global standards, international reach, recognized worldwide



03 **Professional Advancement**
through credentialing programs and a range of educational courses



02 **Events + Conferences**
access to powerful networking and development



04 **Knowledge/Information**
cutting edge, specific to FM and built environment professionals

IFMA is the world's largest and most widely recognized international association for facility management professionals

23,368 Members
in 112 Countries

IFMA Impact on Built Environment

**01**

IFMA Members

Manage more than 78 billion square feet of property

**02**

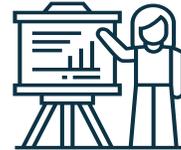
Purchasing Power

Purchase more than US\$526 billion in products and services annually

**04**

ILC Influence

Provides Resources, Guidance & Technical Advice to IFMA members to achieve their goals through lighting upgrades

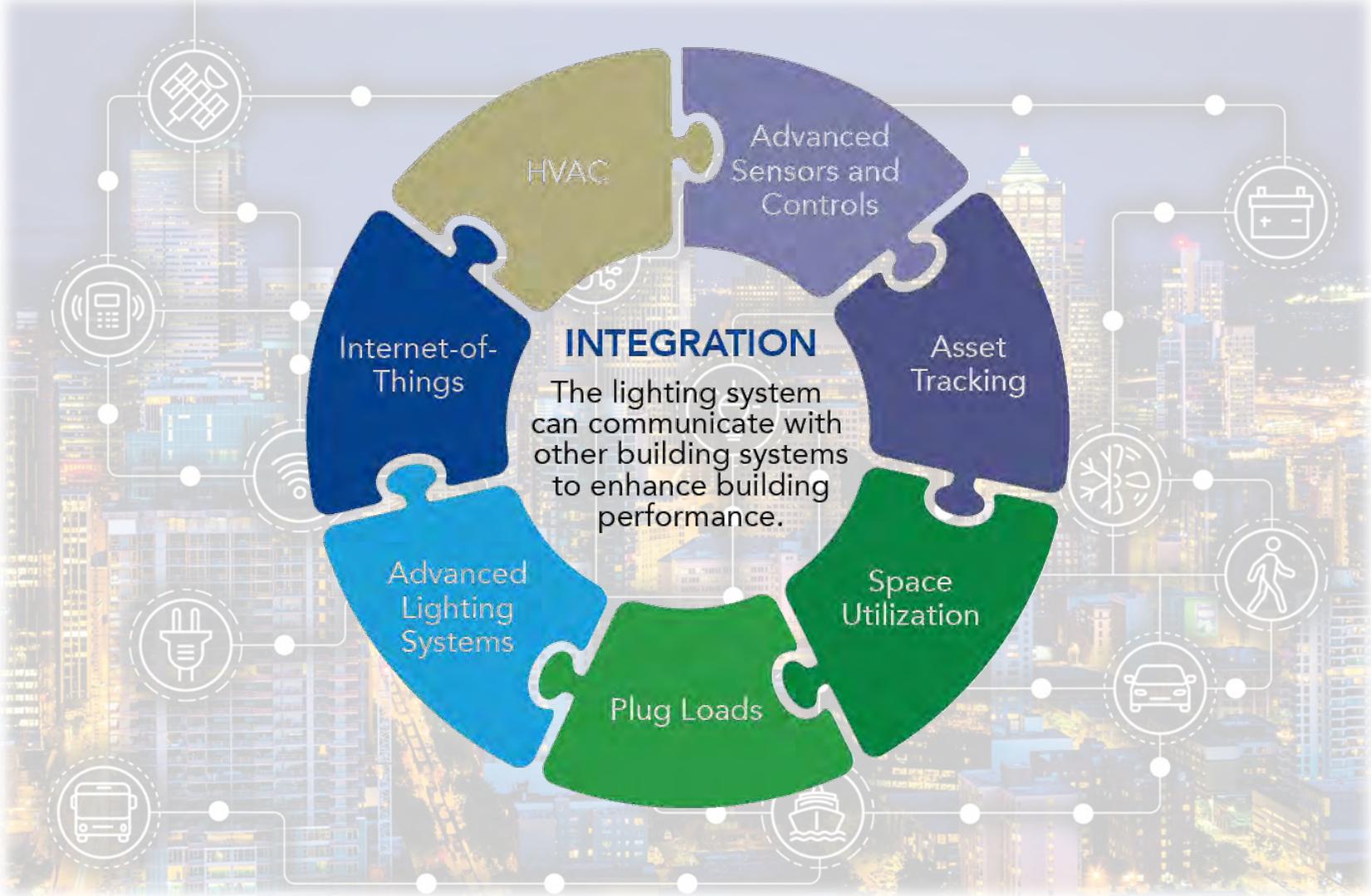
03

Triple Bottom Line Focus

Energy Efficiency
Cost Savings
Indoor Environmental Quality



Integrated Lighting Campaign - The Focus



How to Join as a Participant

- Provide contact Information
- Information about your organization



Municipal/State Government



Retail, Food Service, or Grocery



Commercial Real Estate and Hospitality



Health Care



Higher Education



Federal Government

- Tell us about your interests



Advanced Sensors/Devices/Capabilities Through Lighting*

From the list below, please indicate your organization's use of, or interest in, advanced sensors or devices/functionality that extend lighting system capability beyond the luminaire.

Which of the following best describes the use of advanced sensors or devices/functionality that extend lighting system capability beyond the luminaire?*

- Select -

Please share information about your facilities and any use of, or interest in, advanced sensors/devices/capabilities via lighting.

Total number of facilities for your organization

Number of facilities currently using advanced capabilities in lighting

Number of facilities where we might consider using advanced capabilities

Lighting Integration Use Cases

From the list below, please indicate your organization's use of, or interest in, integration of lighting with other building systems?	
<input type="checkbox"/>	Heating, Ventilation, and Air-Conditioning (HVAC)
<input type="checkbox"/>	Receptacles/Plug Loads
<input type="checkbox"/>	Demand Response
<input type="checkbox"/>	Interaction with other building systems (to save energy)
<input type="checkbox"/>	Interaction with other building or business systems (for non-energy benefits)

Please select all that apply and provide details for other systems benefitting from integrated lighting (e.g. heatmapping, asset tracking, security, etc.).

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The Benefits of Joining

Technical Assistance

Information Exchange

Recognition

Resources



- Access to **expertise** of lighting professionals at Pacific Northwest National Laboratory
 - What use cases might make sense for our project or building?
 - Are the products we are considering capable of meeting the project needs?
- Access to plug-load professionals from National Renewable Energy Laboratory
- We are also here to help you join or submit projects

The Benefits of Joining

Technical Assistance

Information Exchange

Recognition

Resources

- Your organization can be listed on our website with a link to your webpage
- Stay up-to-date with our newsletter
- Participate in learning opportunities such as webinars, forums, and other events
- Be on the list to learn of new case studies or research findings to support system integration
- Let us toot your horn!



The Benefits of Joining

Technical Assistance

Information Exchange

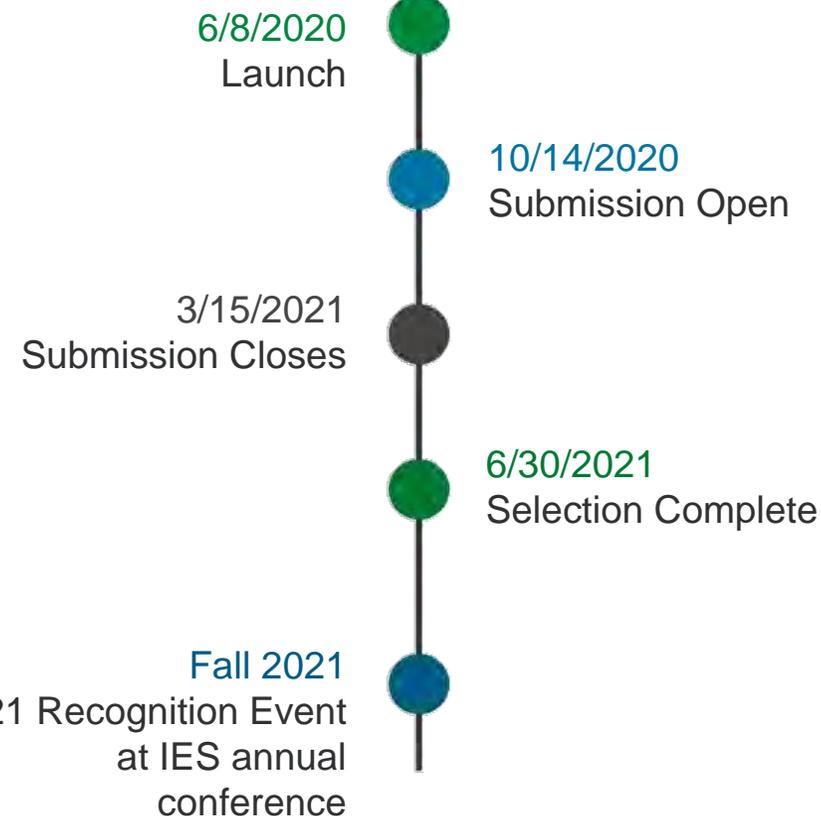
Recognition

Resources

- The ILC defines categories for recognition
- Submit your building or portfolio in the applicable category



Interior Lighting Campaign Recognition Event



The Benefits of Joining

Technical Assistance

Information Exchange

Recognition

Resources

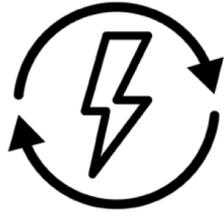
CATEGORY	
<input type="checkbox"/> Report Fact Sheet	(21)
<input type="checkbox"/> Videos	(8)
<input type="checkbox"/> Utility Incentive	(5)
<input type="checkbox"/> Webinars Training	(5)
<input type="checkbox"/> Other	(2)
<input type="checkbox"/> Product Search Tools	(1)

- Find national databases and lists for connecting to local utility incentive programs
- Discover research organizations publishing relevant materials
- Learn more about energy savings use cases that can help you maximize your efforts in building systems integration
- Find trainings and webinars that can be leveraged as staff training or continuing education for design professionals
- Watch videos to keep up-to-date on technologies and the work of ILC and our partners

Advanced Lighting Controls: The Possibilities



LIGHTING
CONTROL



ENERGY
CONSERVATION



SYSTEM
PERFORMANCE



REAL ESTATE
OPTIMIZATION



PROPERTY
SERVICES

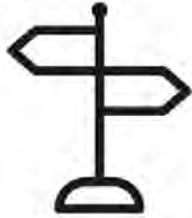


WELLBEING

Lighting System Integration: The Possibilities



ASSET
TRACKING



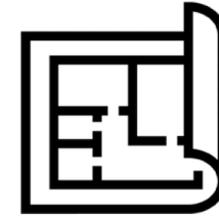
WAYFINDING



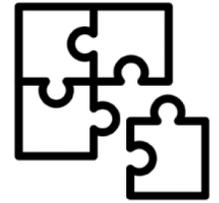
FACE-TO-FACE
INTERACTON



SAFETY AND
SECURITY



FLEXIBLE SPACE
UTILIZATION



VIEWER
ENGAGEMENT

Time for another Poll...

There are many ways to leverage the lighting system to attain additional benefits!
Select all that apply for your organization:

- System integrations that lead to building energy savings
- Data acquisition or smart analytics
- Health and well-being for building participants
- Location-based services
- Other



Dr. Kim Trenbath
Plug and Process Loads Overview

National Renewable Energy Laboratory
(NREL)



Plug and Process Loads (PPLs) Technology Research Team



Technical Team Lead:

Dr. Kim Trenbath

National Renewable Energy Laboratory
(NREL)

Kim.Trenbath@nrel.gov

Phone (office): (303) 275-3710



Amy LeBar
NREL



Robin Tuttle
NREL



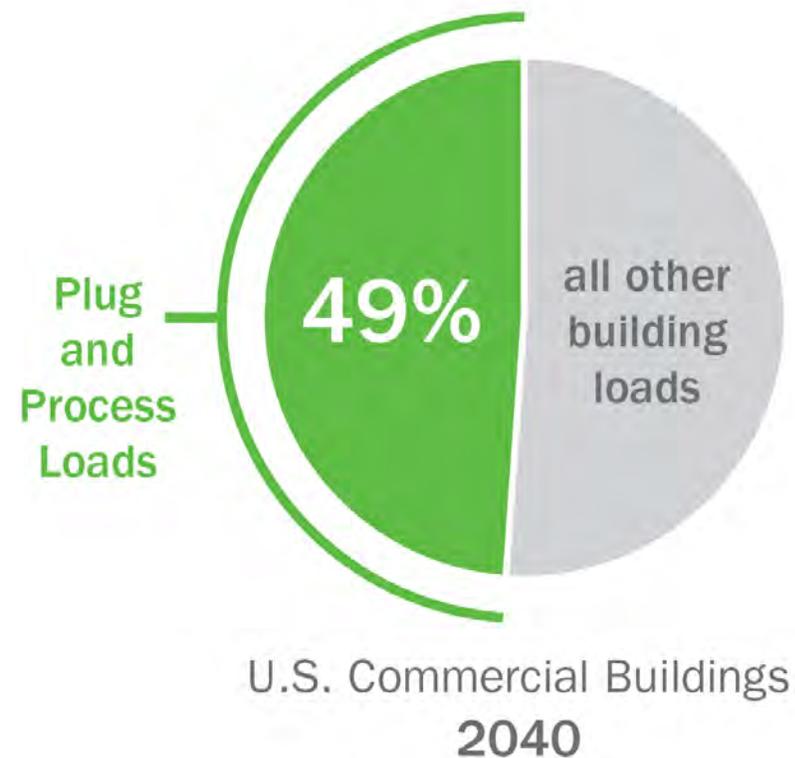
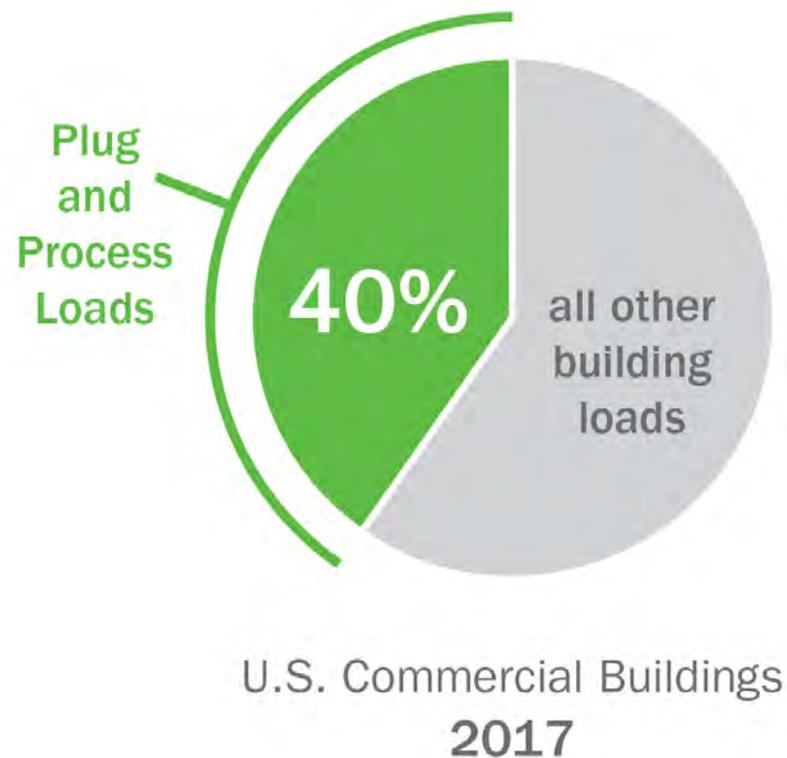
Kristi Maisha
NREL Intern

PPL@NREL.gov

Plug Loads Are....

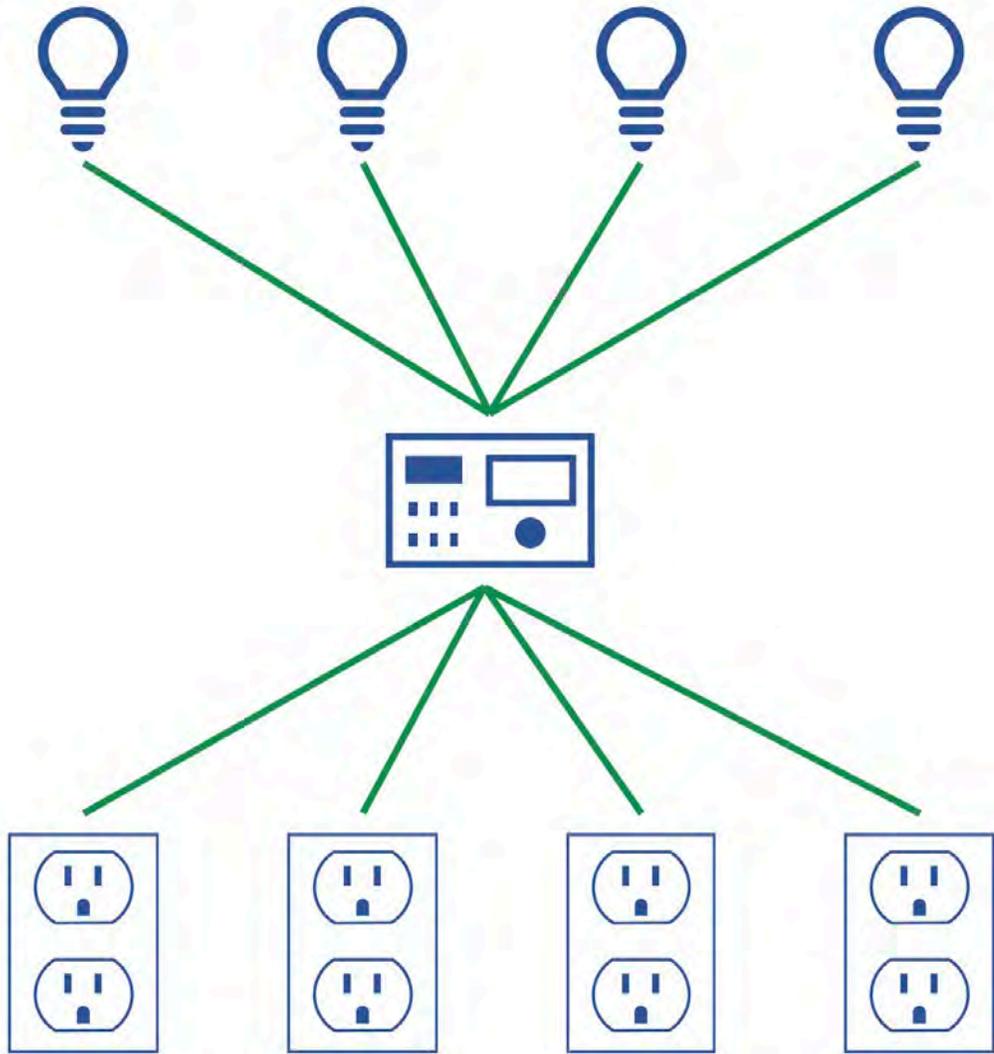


40% of whole-building energy



Data source: EIA's *Annual Energy Outlook 2018* (EIA 2018)

Integrating lighting and plug loads



Publication

[Integrating Smart PPL Controls into EMIS Platforms – A Landscaping Study](#)

- Technical Report
- Rois Langner & Kim Trenbath
- June 2019



Strategy: Education and Awareness



Designate a PPL champion

Choose someone who understands PPL systems and can work with all teams to implement system controls.



Institutionalize PPL reduction practices

Formalize and incorporate PPL energy-saving tactics into building policies (see guide for examples).



Establish the business case for PPL reduction

Utilize available resources to demonstrate the potential energy and financial savings from PPL reduction.



Educate employees on the benefits

Educate employees on the benefits of PPL reduction to realize improvements and prevent misuse.

Access at:

<https://www.nrel.gov/docs/fy20osti/76994.pdf>

Other Control Strategies



**Automatic
Receptacle
Controls**



Smart Outlets



**Advanced
Power Strips**

Visit Our Website for PPL Resources

<https://betterbuildingsolutioncenter.energy.gov/alliance/technology-solution/plug-process-loads>

- Recorded webinars
- Utility incentives
- Fact sheets (i.e. plug load disaggregation)
- Case studies
- *NEW* Guides for assessing and reducing plug loads

NREL
Transforming Buildings

Assessing and Reducing Plug and Process Loads in Retail Buildings

Introduction
Plug and process loads (PPLs) account for 47% of U.S. commercial building energy consumption (EIA 2020) (see Figure 1). Minimizing these loads is a significant challenge for energy-efficient building design and operation.

Langner and Trembath (2019) define PPLs as all plug-in and hardwired loads in a building that are not associated with heating, ventilating, and air conditioning (HVAC), lighting, water heating, or other major equipment needed for basic building operation. This includes all plug-in equipment and appliances, as well as processes for cooking, computing, and internal transportation. The percentage of total building energy use from PPLs is increasing; by 2025, the percentage of PPL energy consumption is anticipated to increase to 51% (EIA 2020). The commercial sector is making strides increasing energy efficiency in other end uses, such as HVAC and lighting, but to continue the trend of reducing whole-building energy consumption, PPLs must be targeted as well.

Retail PPLs present a unique challenge because they can directly generate revenue (e.g., vending machines) or be items for sale (e.g., televisions on display). Figure 2 shows the measured PPL energy use for a large retail building and the potential energy cost savings associated with a 30% PPL reduction (in this example, \$40,000 annually).

U.S. PRIMARY ENERGY BREAKDOWN

Category	Percentage
Industry	33%
Residential	21%
Commercial	16%
Transportation	14%
Water Heating	4%
Other	1%

COMMERCIAL BUILDINGS ENERGY CONSUMPTION BREAKDOWN

Category	Percentage
PPLs	47%
Lighting	14%
Other	10%
Water Heating	9%
Space Heating	9%
Refrigeration	6%
Process	6%
Electric Power	4%

Figure 2. A 30% saving in PPL energy use would save \$40,000 annually.

Category	Annual Energy Cost (\$/year)
Before	~1,400,000
After	~980,000

Automatic Receptacle Controls
Automatic receptacle controls are outlets installed in the building that can be controlled to shut off power to appliances based on schedule or occupancy. This may be done wirelessly, using sensors, or using buttons on the device. This strategy is effective for automatically controlling devices and for meeting the most recent ASHRAE standards (ASHRAE 2019) on PPL controls. To determine what method of control (schedule, occupancy) is most relevant for each device, see Table 2-2 in Lozano et al. (2012).

Integrated Controls
Integrated controls are an emerging area that offers potential for connecting lighting, HVAC, and PPL systems to monitor and control them together. They are not widely available yet but will soon be relevant in the market. This strategy is effective for automatically controlling devices and understanding full building and device-specific energy usage and behavior. Using various sensors (such as occupancy and photosensors), they can connect multiple systems for centralized control and monitoring and further interoperability. The sensor data is logged and can be analyzed to better understand energy savings and the building operation.

Figure 3. Automatic controlled receptacle. Photo from legend.

Figure 4. A woman plugging a power strip into a wall outlet.

Upcoming Webinar

- **Title:** Beyond Energy Efficiency: How Your Device Usage Patterns Affect Energy Consumption
- **Date/Time:** March 17, 2021; 1:00pm ET
- **Description:** How people use plug load devices can strongly affect their energy consumption. Learn what factors are most important for certain types of devices, and how to reduce inefficiencies.
- **Registration link:**
<https://attendee.gotowebinar.com/register/3183241606160939022>



Website and Contact

Kim Trenbath Email:

[Kim.trenbath @NREL.gov](mailto:Kim.trenbath@NREL.gov)

PPL Team Email:

PPL@NREL.gov

BBA website:

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

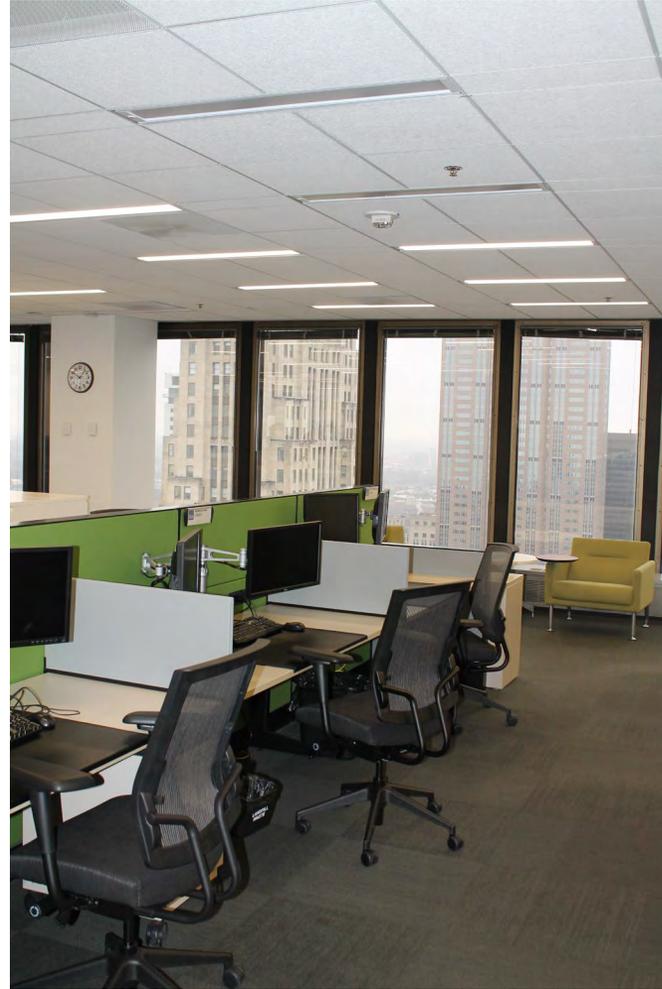


Michael Myer Case Studies on Lighting Integration

Pacific Northwest National Laboratory (PNNL)



GSA JCK Building – LED Lighting, Controls, HVAC Integration, IoT

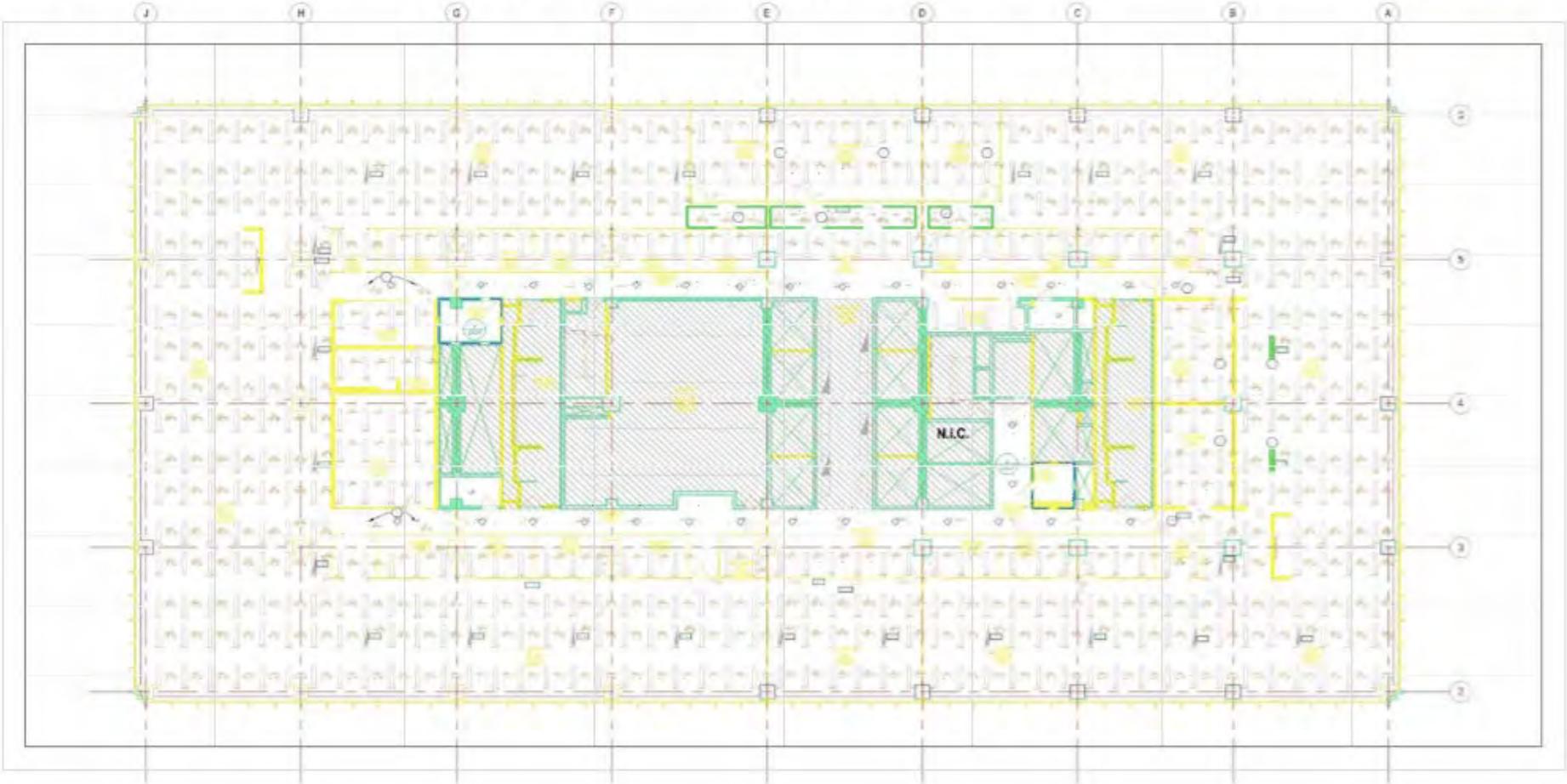


- 63% savings for LED lighting and controls
- HVAC integration attempted, but not successful – more of a building issue and less of a technology issue
- IoT system with workplace analytics
- GSA found the IoT system to be more valuable than the LED lighting and controls

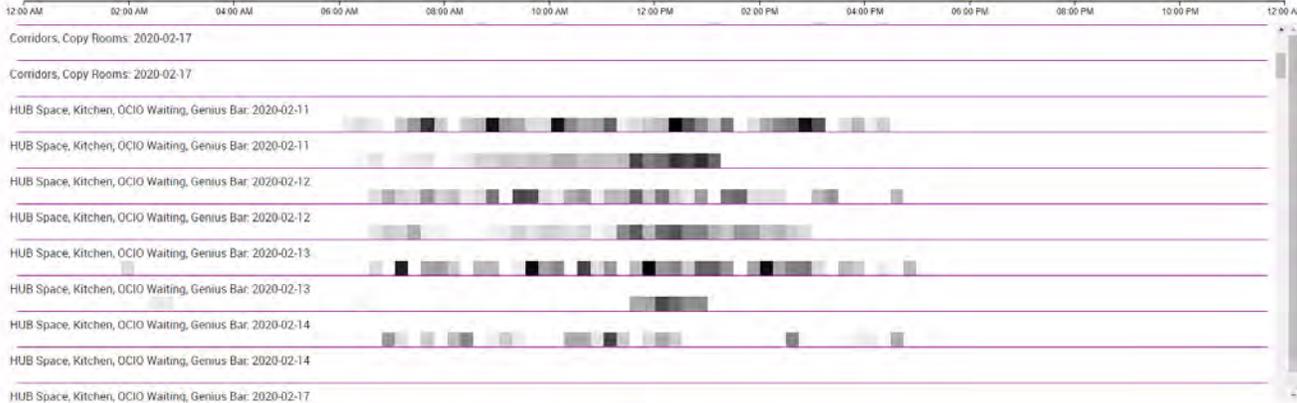
Lighting Control Data & IoT Applications

33rd Floor, average occupancy events per 5-minute interval, November-June

12:00:00 AM

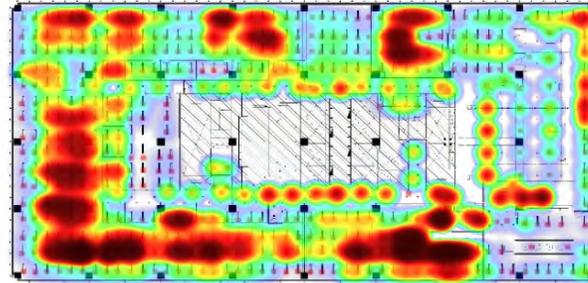
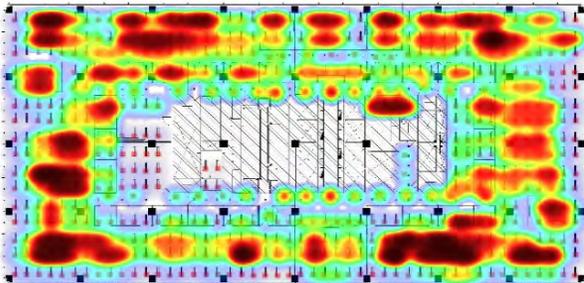


Sample IoT Applications Considered



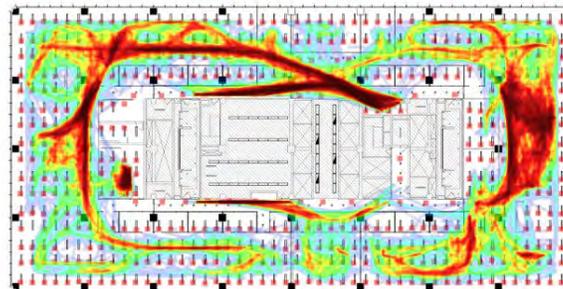
Space Utilization

- Time of day across the top
- Each row is a different room / zone
- Darker color indicates more usage



Space Optimization

- “Heat map” of data
- Dark red = high occupancy
- Green or purple = low occupancy



Real-Time Location System RTLS

- NOT actually tested, RF tag on badge
- Can tag assets, geofence an area
- Could be used for COVID contact tracing

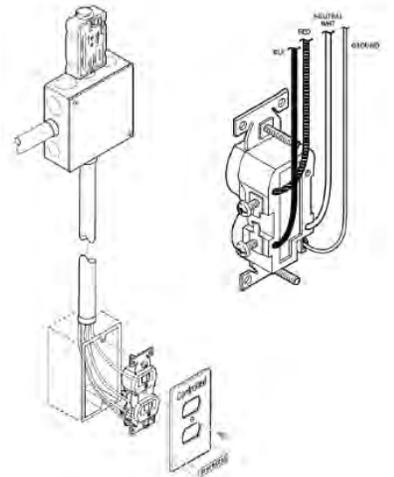
Tinker Air Force Base Lighting + Plug (Dept. of Defense / ESTCP project)



Project Details

- 5,000 ft² portion of office space
- 15 Initial / 14 actually working controlled receptacles
- ≈ \$160 material per receptacle

- \$550 labor per receptacle
- Labor involved rewiring of receptacle, mounting controller in outlet, and configuring



Tinker Air Force Base Lighting + Plug (Dept. of Defense / ESTCP project)

Cost Effective Criteria

This application not cost effective

- 14 controlled receptacles saved 25 kWh over a year
- At national electricity rate, saves \$2.58 / year
- Materials: 14 @ \$160 = \$2,240
 - Material simple payback greater than 100 years
- Labor: 14 @ \$550 = \$7,700
 - Labor simple payback greater than 100 years



Lessons Learned

- Saved 38% energy of controlled receptacles
- However, receptacles were controlling low power devices
 - 38% of low power loads (which translates to low energy) cannot easily be monetized
- More active load management necessary
 - Uncontrolled receptacle loads increased during study
- Firmware issues delayed the project
- Would a color reinforce the controlled receptacle better?



Tinker Air Force Base Lighting + HVAC (Dept. of Defense / ESTCP project)



Project Details

- Savings
 - 30% | 21,000 ft² high bay space
 - 13% | 5,000 ft² office space
 - 26% area-weighted average
- Site: Easy install – mounted the HVAC control hardware in the cabinet next to the MFR appliance & ran cables to the HVAC equipment.
- Delay 1 – Some non-project related equipment issues discovered
- Delay 2 – Over congested BACnet network, configuration, and overloaded server

HVAC Zones	Occupancy Control Days (Demo Project Control Setting)	Non-Control Days (Baseline Control Setting)
Occupied	Normal	Normal
Vacant	Occupancy Time Delay: 30 Min Vacant: Setback 2 degrees	Normal

Cost Effective Criteria

Application very cost effective

- Materials: \$3,278
- Labor: not separated from lighting, but estimated to be about \$8,000
- Saving \$7,400 / year
- Payback about 1.6 years

Tinker Air Force Base Lighting + HVAC (Dept. of Defense / ESTCP project)

Lighting



69% Savings

18.7-year simple payback

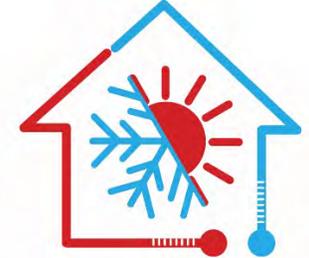
Plug Loads Controls



38% Savings

But costs outweighed savings and lighting + plugs **INCREASED** payback
20.7-year simple payback

HVAC Integration



26% Savings

HVAC was operational change and little equipment → high savings to initial cost
10.3-year simple payback

Recognition Opportunities for Participants

Advanced Use of Sensors and Controls for Lighting

- Beyond typical basic occupancy, daylighting, dimming, and scheduling approaches
- Particular interest in projects enabling deeper operational savings in lighting applications and/or that create enhanced user/occupant experience

Recognition Opportunities for Participants

Integrated Controls for Plug Loads and Lighting Systems

- Novel integration of lighting and plug load control systems with a focus on energy savings

Integrated Controls for HVAC and Lighting Systems

- Innovative approaches to save energy by managing lighting and HVAC loads together when spaces are not in use

Other Integrated Systems and Lighting

- Other ways in which lighting is integrating with other building and business systems
- Some examples: grid/storage, photovoltaics, automated shades, asset tracking, security, etc.

Final Poll:

Have you completed any projects that leverages advanced lighting controls or system integration to attain larger org. goals?

- Yes! We have a project to submit
- We are working on something now
- We are considering some work and we would like more info
- We find building controls integration to be prohibitive

California State University Dominguez Hills

About the school

- Established in 1960
- Over 17,000 students
- 346 acres in south bay region of Los Angeles

About the project

- In 2013, lighting retrofits began
- In 2015 tied upgraded space to the HVAC system
- In 2020, building upgrade completed
- Moving forward: new capabilities, more buildings, and deep savings!



PROUD
PARTICIPANT

EERE » ILC Home

Submit for Recognition Now!

Each year the Integrated Lighting Campaign will confer recognition for exemplary projects submitted by Participants, and for programs, incentives, and/or support to the ILC by

READ MORE



EERE » ILC Home » Submit for Recognition

ILC Exemplary Performance Recognition

2021 Recognition Cycle

The Integrated Lighting Campaign (ILC) is a recognition and guidance program designed to help facility owners, operators, and managers. The ILC focuses on high-efficiency lighting and control systems that are integrated with other building systems (e.g., HVAC and/or plug loads) for added efficiency and performance. The ILC also focuses on the integration of lighting with operational functions (e.g., asset tracking, wayfinding, security systems, etc.). This form is intended for the Recognition process for:

- ILC Participants (organizations including building owners, operators, and managers) to submit projects that they would like to have considered for recognition.
- ILC Supporters (utilities, manufacturers, energy efficiency organizations, lighting designers, and ESCOs) to submit for recognition for their efforts to support and implement the use of advanced technologies that facilitate integration in buildings.

Full Name: * Organization: *

Email: * Telephone: *

I would like to submit recognition for:

Exemplary Participant: I am submitting for my, or on behalf of another, organization for building(s) that have integrated their lighting system with other building systems or utilize advanced lighting sensors and controls.

Exemplary Supporter: My organization has been an active Supporter of the ILC through programs or incentives that accelerate the adoption of advanced sensors or the integration of lighting systems, or through Campaign recruitment and support.

Partners

Participants

Organizations—including building owners, operators, and managers—have access to resources and technical assistance.

[Learn More](#)

Supporters

Supporting partners include utilities, manufacturers, energy-efficiency organizations, lighting designers, and energy service companies (ESCOs).

[Learn More](#)

Submission Process

Full Name:*

Kenny Seeton

Organization:*

California State University Dominguez Hills (CSUDH)

Email:*

kseeton@csudh.edu

Telephone:*

3102432206

I would like to submit recognition for:*



Exemplary Participant: I am submitting for my, or on behalf of another, organization for building(s) that have integrated their lighting system with other building systems or utilize advanced lighting sensors and controls.



Exemplary Supporter: My organization has been an active Supporter of the ILC through programs or incentives that accelerate the adoption of advanced sensors or the integration of lighting systems, or through Campaign recruitment and support.

Building Information

Buildings being submitted: Single Building Building Portfolio

Building or Portfolio Name:*

James L. Welch Hall

Building Location(s):

Carson, CA

Approximate total building area being submitted for recognition (if known):

179222

ft²

Lighting Sensors/Controls Categories

Advanced Use of Sensors and Controls for Lighting:

The Campaign is interested in how sensors and controls are enabling deeper energy savings in lighting applications, improving building operations, and creating enhanced user/occupant experiences. This category seeks to recognize uses of sensors and controls that go beyond basic occupancy, daylighting, dimming, and scheduling approaches.

Integrated Categories

Integrated Controls for Plug Loads and Lighting Systems:

This category seeks to recognize integration of lighting and plug load meter and control systems, with a focus on energy savings. For example, lighting control signals can often be used to control plug load devices that are plugged into controlled outlets or panels. Similarly, energy signals from plug load devices could help inform lighting controls.

Integrated Controls for HVAC and Lighting Systems:

This category seeks to recognize innovative approaches the integration of HVAC and lighting systems. For example, lighting controls that are integrated with HVAC systems can indicate when a space is vacant to modify air flow or temperature set points during periods when spaces are un-occupied.

Other Integrated Systems:

This category recognizes new, novel uses of integrating the lighting to provide features other than simply lighting a space. Some examples include; grid services, external shading systems integrating with electric lighting, using sensors in the lighting to provide data about space utilization or asset tracking, or other unique features.

Lighting Sensors/Controls Categories

Advanced Use of Sensors and Controls for Lighting:

The Campaign is interested in how sensors and controls are enabling deeper energy savings in lighting applications, improving building operations, and creating enhanced user/occupant experiences. This category seeks to recognize uses of sensors and controls that go beyond basic occupancy, daylighting, dimming, and scheduling approaches.

Project Description (narrative):

Provide a written narrative about how your lighting system sensors and controls are going beyond the norm; the novel capabilities they provide, and the resulting outcomes (e.g., incremental savings, improved business operations, occupant satisfaction, etc.). Sites will be evaluated on the novelty of the approaches and the benefits/outcomes. Please note any building automation system or energy management information system platform used to integrate controls and include additional information deemed informative, including summary data quantifying energy benefits, business operation benefits, or occupant satisfaction (e.g., from formal or informal surveys).

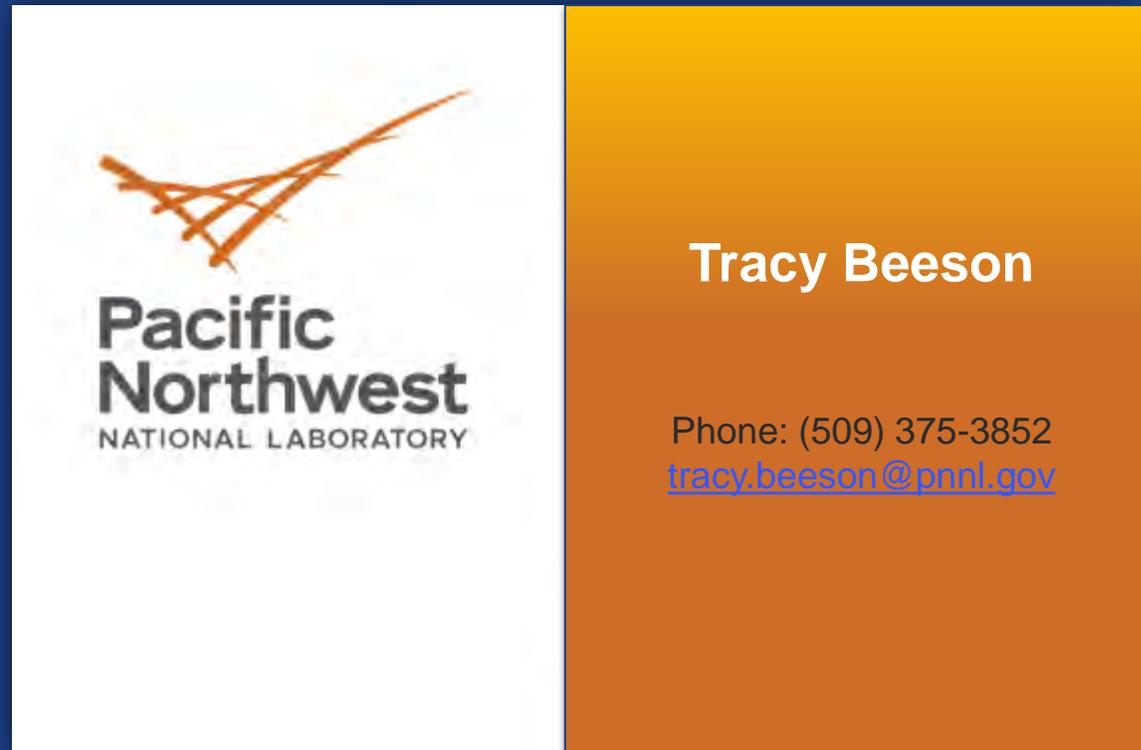
This project uses advanced sensors that with occupancy, photo-sensing, temperature sensor, kW logging, and Bluetooth. Every luminaire was hardwired to the retrofit kit from the previous lighting upgrade which reduced installation costs by not requiring access above the dropped ceiling. With the increased number of sensors the time-delay for turning luminaires off was decreased, which prevented false-offs while occupants are present. Luminaire-dedicated sensors also facilitate individual controllability of the luminaires, which allowed each user to select light levels comfortable for them. The average set-point based on occupant preference was 40% of full light output.

Measured/Perceived Benefits (narrative):

Our conservative estimated kWh savings were calculated at 556,000 kWh, or 34% of the baseline annual lighting and fan energy consumption. This approach also saved 2,985,918 kBtu, or 27% of the heating and cooling energy use.

An informal survey of building occupants showed that people love the light levels, because they have control of it.

More questions?



The image shows a business card for Tracy Beeson. The card is split into two vertical panels. The left panel is white and features the Pacific Northwest National Laboratory logo, which consists of several overlapping orange lines forming a stylized shape above the text "Pacific Northwest NATIONAL LABORATORY". The right panel is a solid orange color and contains the name "Tracy Beeson" in white, followed by the phone number "(509) 375-3852" and the email address "tracy.beeson@pnnl.gov".

... or IntegratedLighting@PNNL.GOV