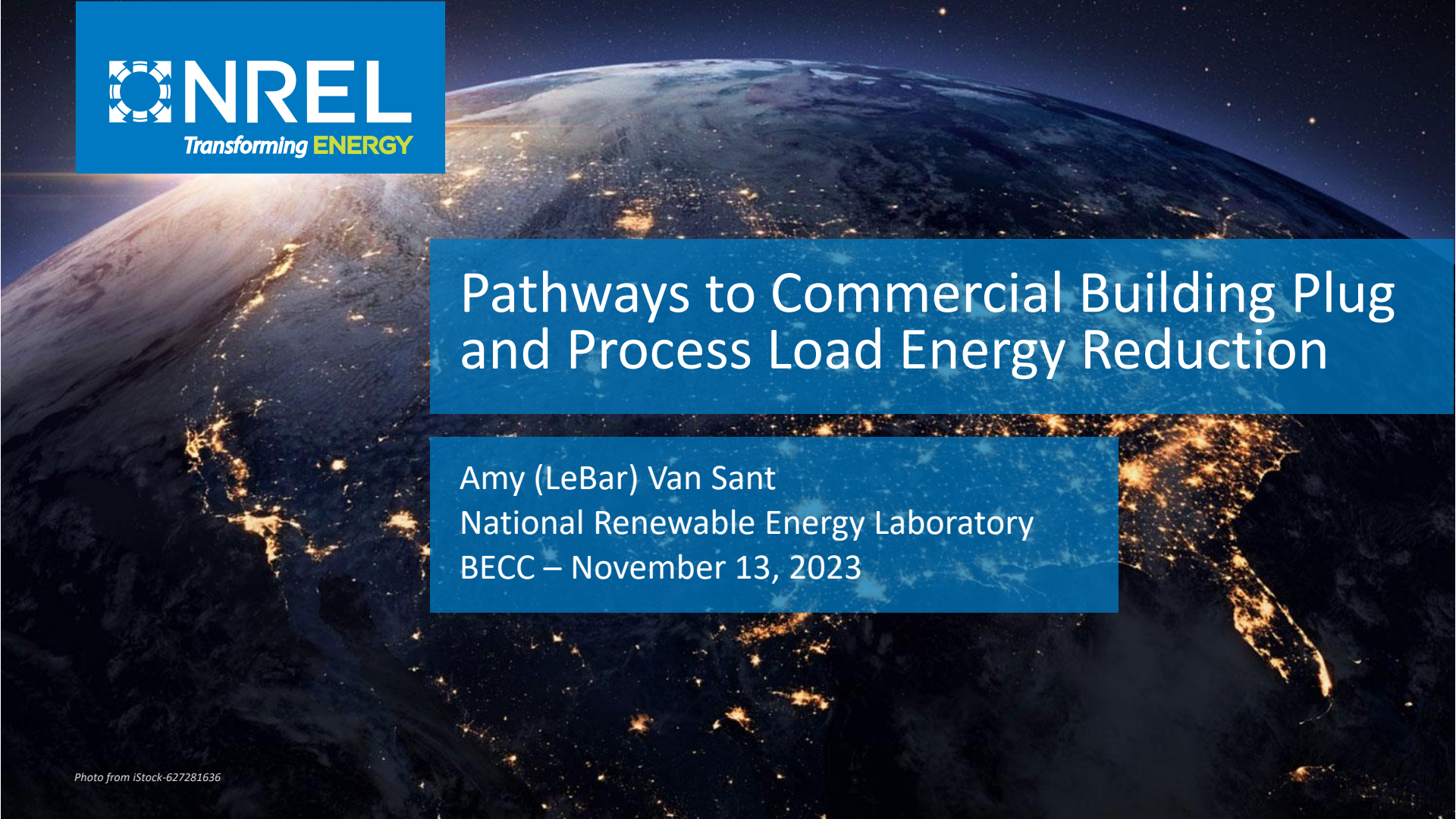

Pathways to Commercial Building Plug and Process Load Energy Reduction

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National Renewable Energy Laboratory
BECC – November 13, 2023

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Preliminary Results

PPLs are plug-in and hardwired loads not associated with other major building end uses

- Plug and process loads (PPLs) include a wide range of devices and appliances with varying levels of energy consumption.
- There can be thousands of individual PPLs in a commercial building – the energy adds up!

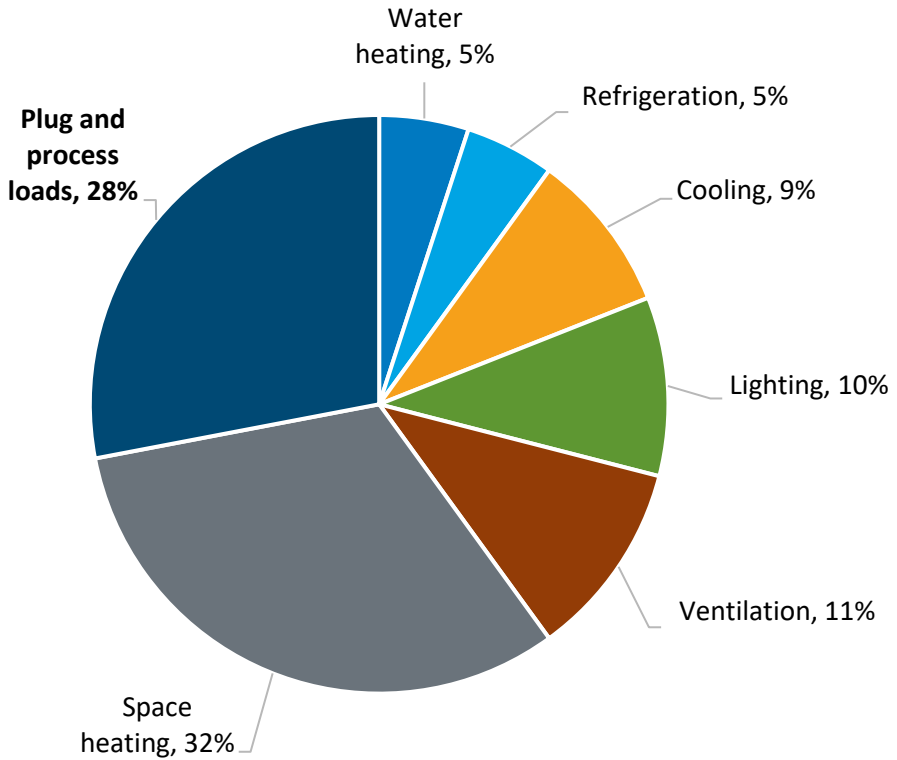
Motivation

PPLs constituted 28% of commercial building energy consumption in 2022.[1]

Challenging end use to manage:

- Volume of individual devices
- Breadth of types
- Highly occupant-dependent

Little information about the factors that influence PPL efficiency and control adoption in commercial buildings.



[1] U.S. Energy Information Administration (EIA), "Use of energy in commercial buildings." Accessed: Sep. 30, 2023. [Online]. Available: https://www.eia.gov/energyexplained/use-of-energy/commercial-buildings.php

Methods

- 22 one-on-one interviews with commercial building stakeholders
- Workshop with 22 members of the smart buildings industry
- Standardized questions

Category	Interview Participant Count	Workshop Participant Count	Total Participant Count
Building Occupant	3	0	3
Building Owner	4	4	8
Consultant	0	1	1
Design Engineer	4	2	6
Facility Manager	4	5	9
Lighting Industry	4	0	4
Sustainability Manager	2	0	2
Technology Company	1	10	11
Total	**22**	**22**	**44**

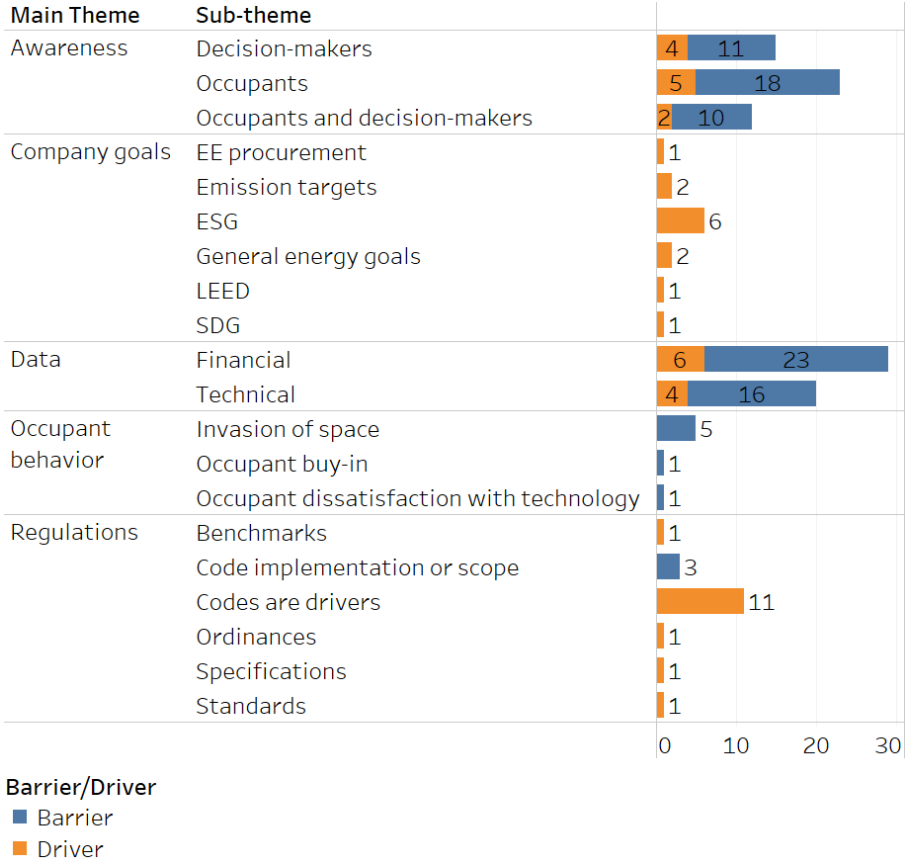
Sample questions

- How would you reduce the energy use of your PPLs?
- Are you implementing any of these strategies now? Why, or why not?
- What is encouraging, or what would encourage, you to reduce your building's PPL energy?
- What PPL reduction strategies or technologies have been implemented in the buildings you have designed?
- What is preventing design engineers from reducing a building's PPL energy?

Analysis

- Iterative process
- Categorized paraphrased quotes by theme, sub-theme and driver/barrier
- Analyzed data by grouping
  - Drivers and barriers by theme and sub-theme
  - Theme and sub-theme by participant category

Preliminary Results



Results

What or who is driving the implementation today?

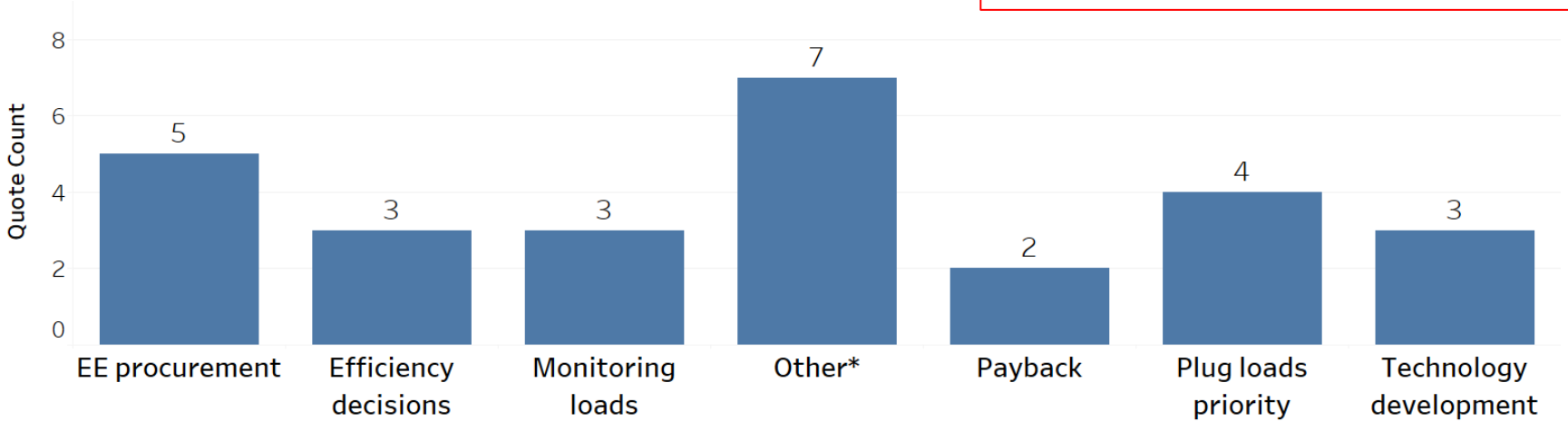
What?

- Energy-efficiency procurement policies
- PPLs are becoming higher priority
- Sub-metering

Who?

- Design engineers
- Building owners

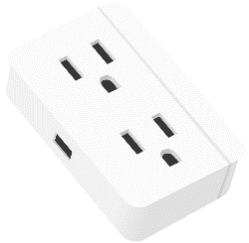
Preliminary Results



* Other includes quotes about building performance standards, decarbonization, environmental, social and governance (ESG), jurisdiction, load shedding, tenant/landlord relationships and utility rates.

How is PPL energy consumption currently being reduced?

- Plug load control
  - Time clocks
  - Occupancy-based control
  - Smart outlets



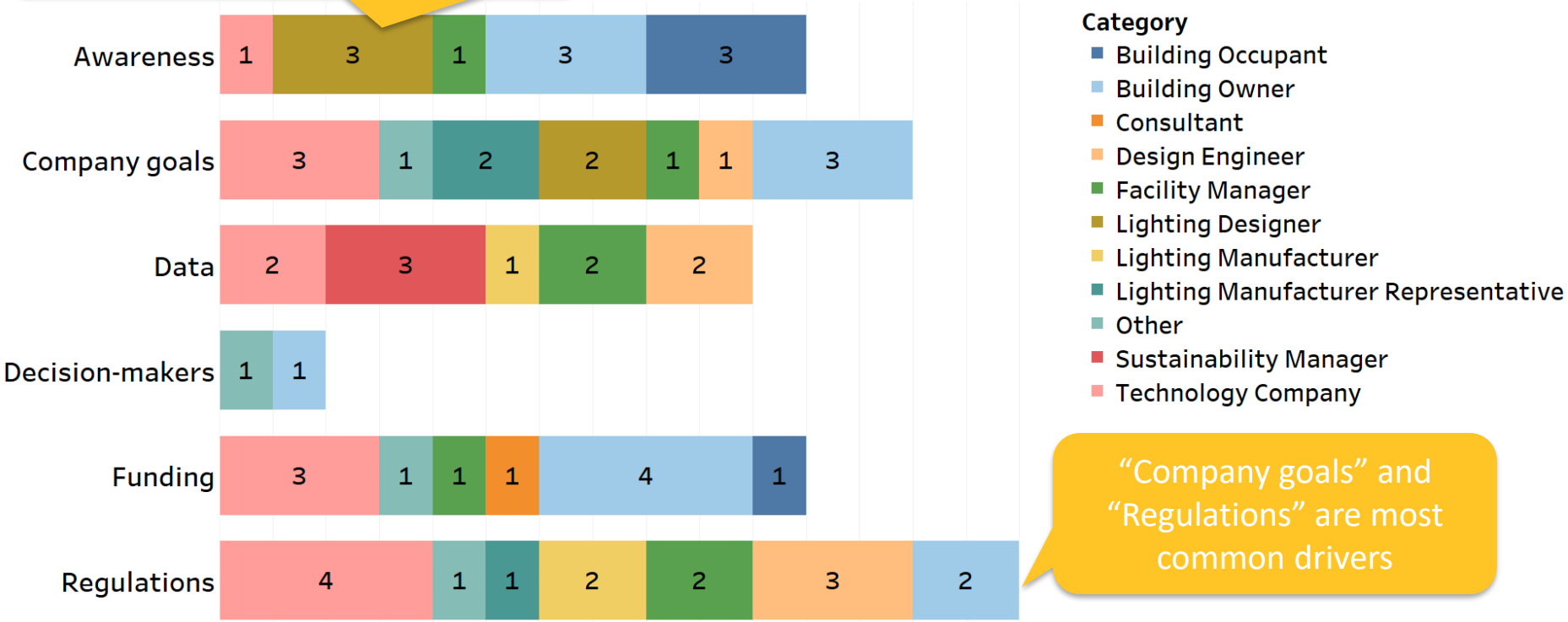
- Occupant engagement
  - Educational campaigns
  - Education about control technologies

Sticker used at NREL to promote awareness.

Preliminary Results

Drivers

Occupant and decision-maker "Awareness" was a common driver



"Company goals" and "Regulations" are most common drivers

Preliminary Results

Sample of driver quotes

Regulations: "Commercial real estate is still focused on 'meeting' not 'exceeding,' so **if PPL becomes a baseline requirement or if the incentives reduce cost sufficiently, it will become a higher priority.**"

Company goals:
"**Organizations that are environmentally conscious** tend to have better luck with these [plug load management] systems."

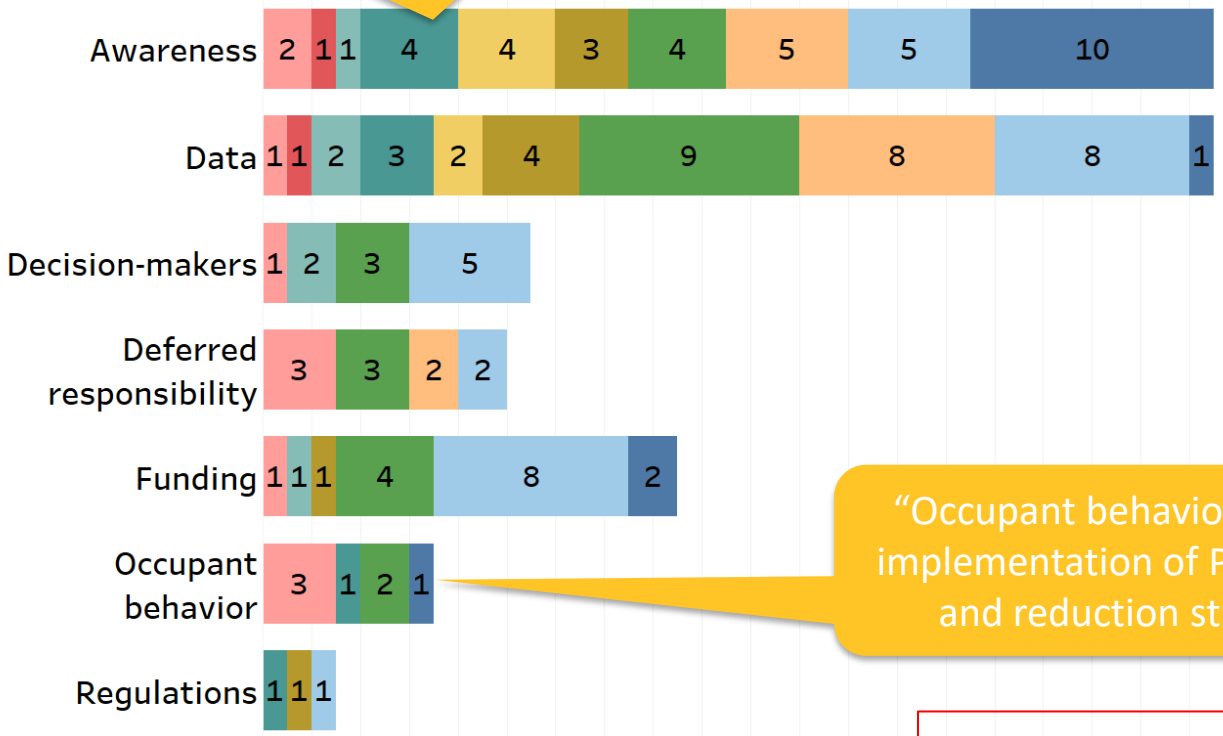
"[They are] heartened by the fact that **environmental, social and governance (ESG) is becoming a big thing**. [There are] cities like New York and Washington D.C. that are focused on the performance of the building."

Awareness: "Game of telephone to get to occupants. **Education of facility mangers is incredibly useful.**"

Preliminary Results

Barriers

Lack of “Awareness” and “Data” are most common barriers



“Occupant behavior” impacts implementation of PPL controls and reduction strategies

Preliminary Results

Sample of barrier quotes

Awareness:
"They are concerned their loads will be turned off when they are expecting them to continue to function. Example: if you are charging something and you leave, occ sensor will turn off receptacles. **They are not used to the idea that power would not be available.**"

"**No information was provided when plug load control was installed.** It was fairly easy to use but some occupants were annoyed and did not use PL control."

Occupant behavior:
"**Individual workers like to have things on all the time**. Don't want to wait for them to turn on."

"Frustration from occupants, especially private offices, **feel like their space is being taken over from their control.**"

Preliminary Results

Actionable pathways towards greater PPL efficiency and control

- **Awareness**
  - Occupant education; decision-makers
- **Company goals**
  - Company and building owners setting climate-related goals
- **Codes and incentives**
  - Code bodies including PPL code requirements for commercial buildings

Preliminary Results

Thank you!

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This work was authored by the National Renewable Energy Laboratory, operated by Alliance for Sustainable Energy, LLC, for the U.S. Department of Energy (DOE) under Contract No. DE-AC36-08GO28308. Funding provided by the U.S. Department of Energy Office of Energy Efficiency and Renewable Energy Building Technologies Office. The views expressed in the article do not necessarily represent the views of the DOE or the U.S. Government. The U.S. Government retains and the publisher, by accepting the article for publication, acknowledges that the U.S. Government retains a nonexclusive, paid-up, irrevocable, worldwide license to publish or reproduce the published form of this work, or allow others to do so, for U.S. Government purposes.