

# ADVANCED LIGHTING CONTROLS SYSTEMS

## PERFORMANCE AND POTENTIAL

November 19, 2019

Presented by Jeremy Kraft, EMI Consulting

## OBJECTIVE

- ALCS technologies are becoming an increasingly large part of non-residential program portfolios
- Share lessons learned on advanced lighting controls systems (ALCS) from both national and local research



# AGENDA

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Overview of Technology

Industry Findings

Consumers Energy's ALCS Offerings

Key Takeaways



A pair of hands is shown from the wrists up, palms facing each other and slightly cupped, holding a tangled string of warm white LED lights. The lights are glowing, and the background is a clear, light blue sky. The hands are positioned on the left side of the frame, with the fingers spread and the thumbs pointing towards the center.

WHAT IS IT?

# OVERVIEW OF ALCS TECHNOLOGY



# OVERVIEW OF ALCS TECHNOLOGY

Provide **networked control and monitoring** capabilities of connected lighting using built-in metering and analytics

- Provides greater control for users
- Uses various control strategies to optimize daylight harvesting, occupancy, and task lighting (“high end trim”) to achieve energy savings

# OVERVIEW OF ALCS TECHNOLOGY



Source: BPA.gov

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## Characteristics of an ALC System



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## Characteristics of an ALC System



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**Accessible by GUI:** Includes a user interface



**Addressable:** Identified uniquely and controlled individually



**Zoned:** Organized into groups of fixtures



**Layered:** Control is determined by multiple input

# OVERVIEW OF ALCS TECHNOLOGY

ALC systems are **commercially available with 30 vendors** vetted by the Design Lights Consortium.





# OVERVIEW OF ALCS TECHNOLOGY

## High Opportunity Sectors:



Offices



Retail spaces



Educational facilities



Health Care facilities



Institutional facilities



Assembly plants



Hospitality



Warehouses



# WHAT WE KNOW: INDUSTRY RESEARCH

# INDUSTRY RESEARCH



*Advanced Lighting Control Systems: Bench Testing (2015)*

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*Evaluation Of Advanced Lighting Control Systems In A Working Office Environment (2018)*

*Advanced Lighting Control System Performance: A Field Evaluation Of Five Systems (2018)*

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*Advanced Lighting Controls System Tool Trial Evaluation (2019)*



# INDUSTRY RESEARCH: CA LIGHTING TECHNOLOGY CENTER

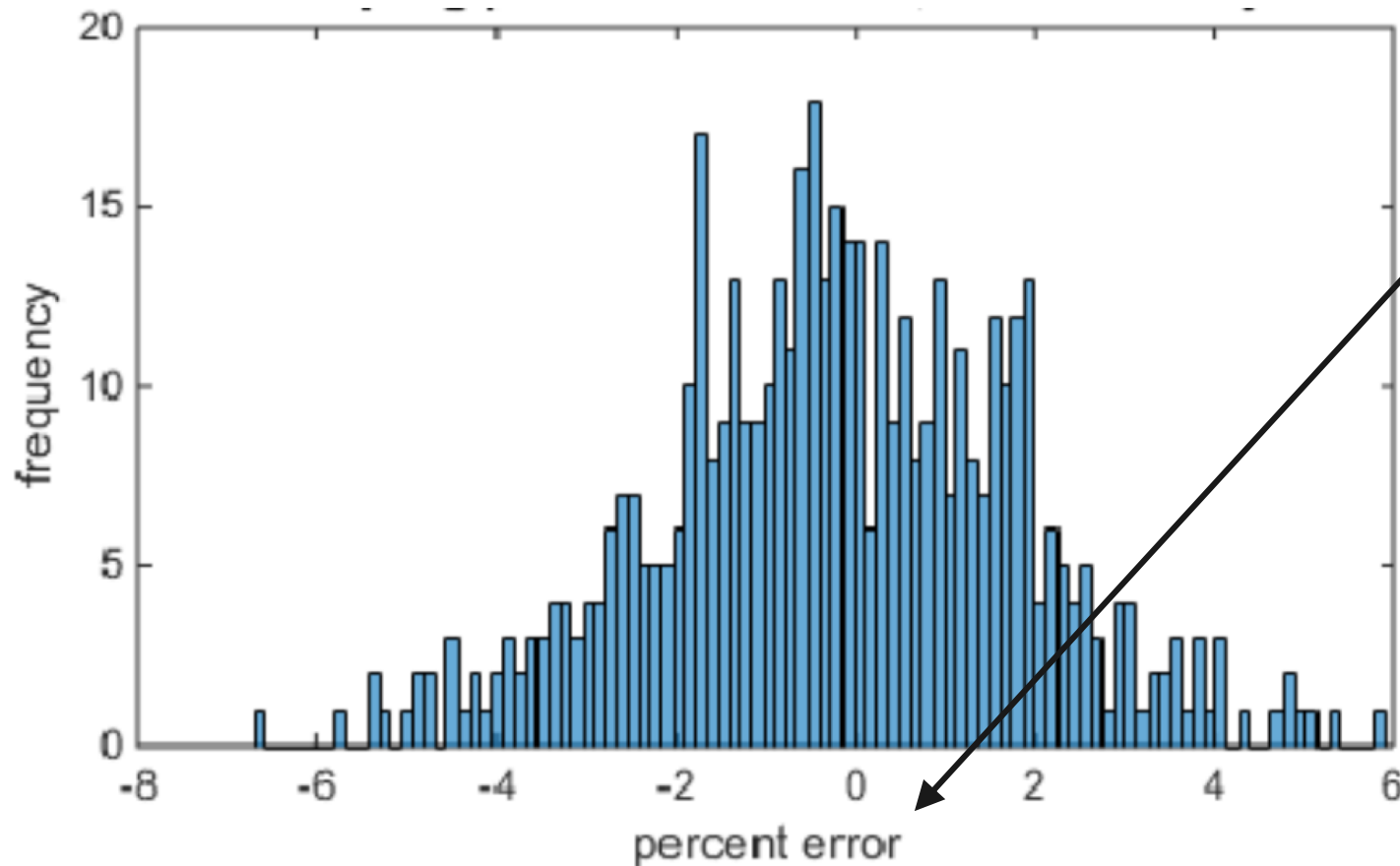
**Key Finding:** Each ALC system reports energy consumption slightly differently. Important for determining savings.



UC Davis

“ For utilities interested in using ALCS systems to provide lighting energy use data for measured incentives, *it is important to note the differences in power measurement and reporting capabilities of ALCS available today.* ”

# INDUSTRY RESEARCH: CA LIGHTING TECHNOLOGY CENTER



Graph shows differences in reported usage vs. actual usage observed in a lab setting.

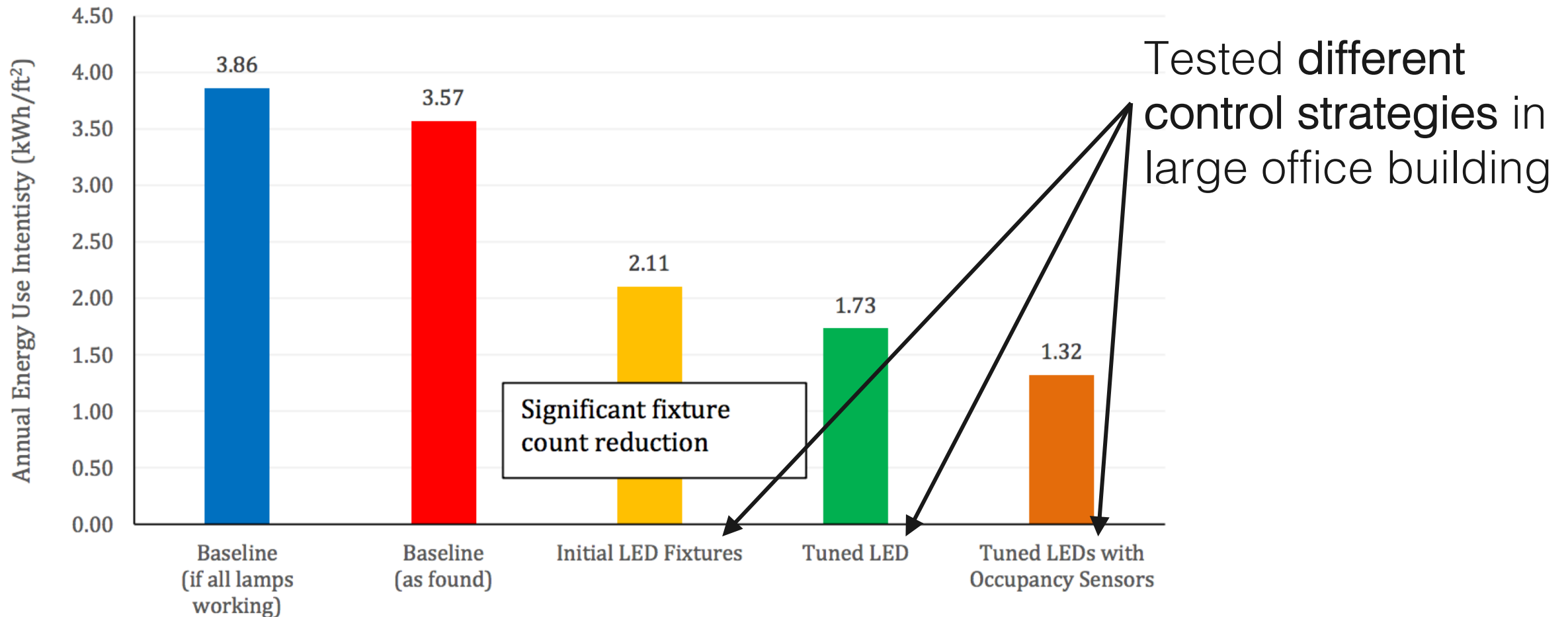
# INDUSTRY RESEARCH: PACIFIC NORTHWEST NATIONAL LAB

**Key Findings:** At one case study facility, significant reduction in energy use due to control systems – 63%

## Other benefits:

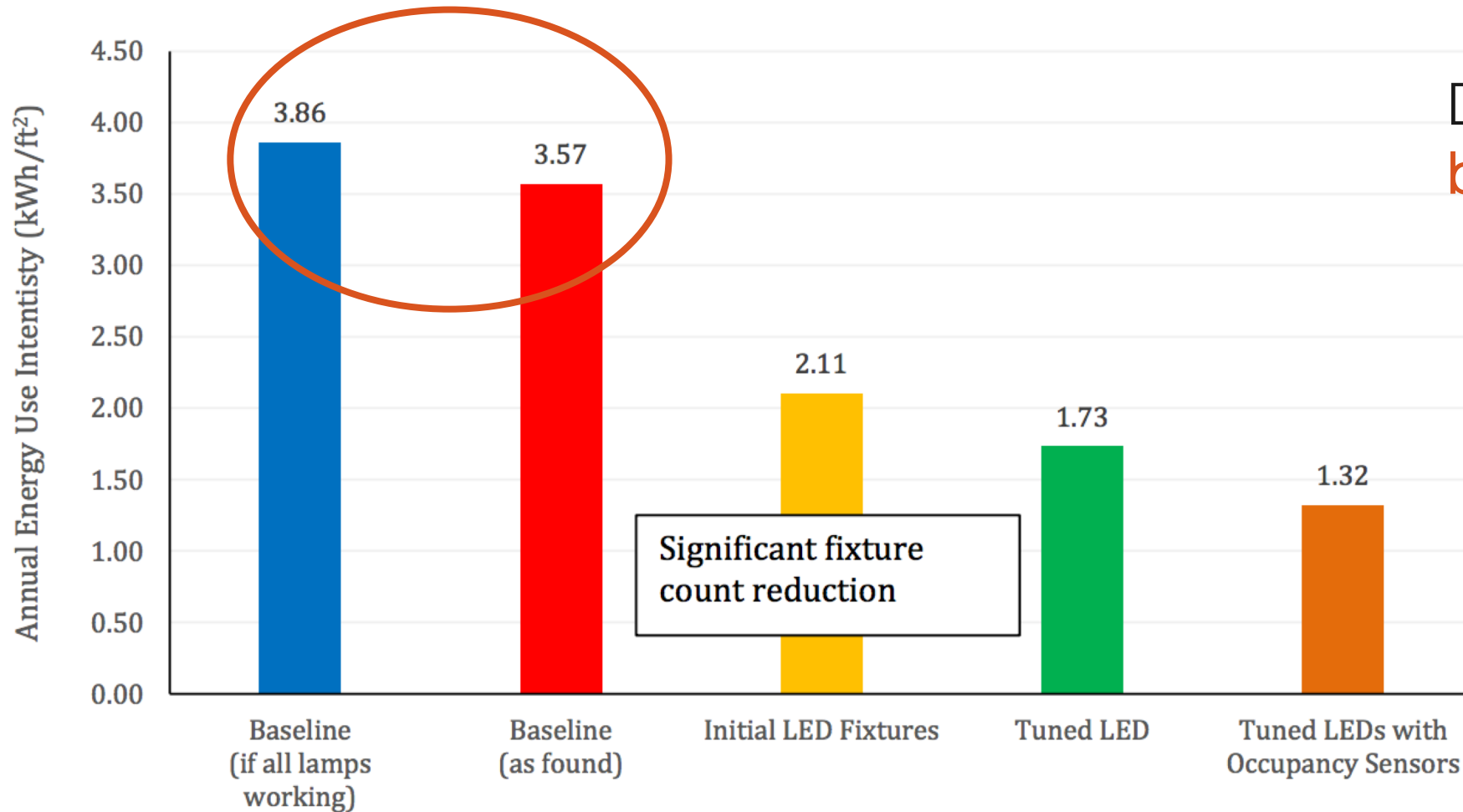
- Easy installation
- Reduced maintenance
- Occupant satisfaction

# INDUSTRY RESEARCH: PNNL – OFFICE CASE STUDY



Source: Pacific Northwest National Lab. *Evaluation of Advanced Lighting Control Systems in a Working Office Environment* (2018)

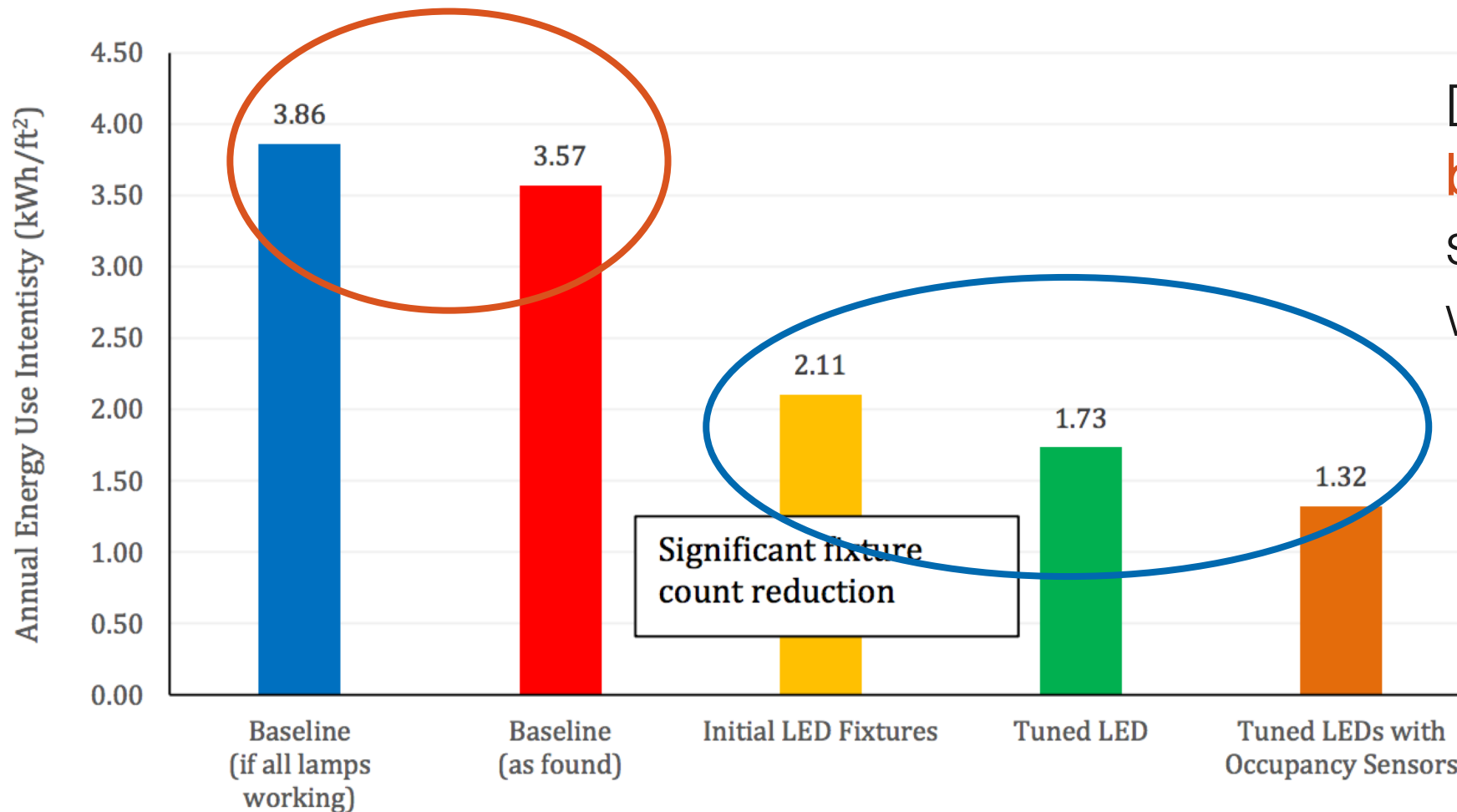
# INDUSTRY RESEARCH: PNNL – OFFICE CASE STUDY



Difference between  
baseline ...

Source: Pacific Northwest National Lab. *Evaluation of Advanced Lighting Control Systems in a Working Office Environment* (2018)

# INDUSTRY RESEARCH: PNNL – OFFICE CASE STUDY



Difference between **baseline** and **ALCS** shows large savings with ALCS

Source: Pacific Northwest National Lab. *Evaluation of Advanced Lighting Control Systems in a Working Office Environment* (2018)

# INDUSTRY RESEARCH: PNNL – ANALYSIS ACROSS FIVE SITES

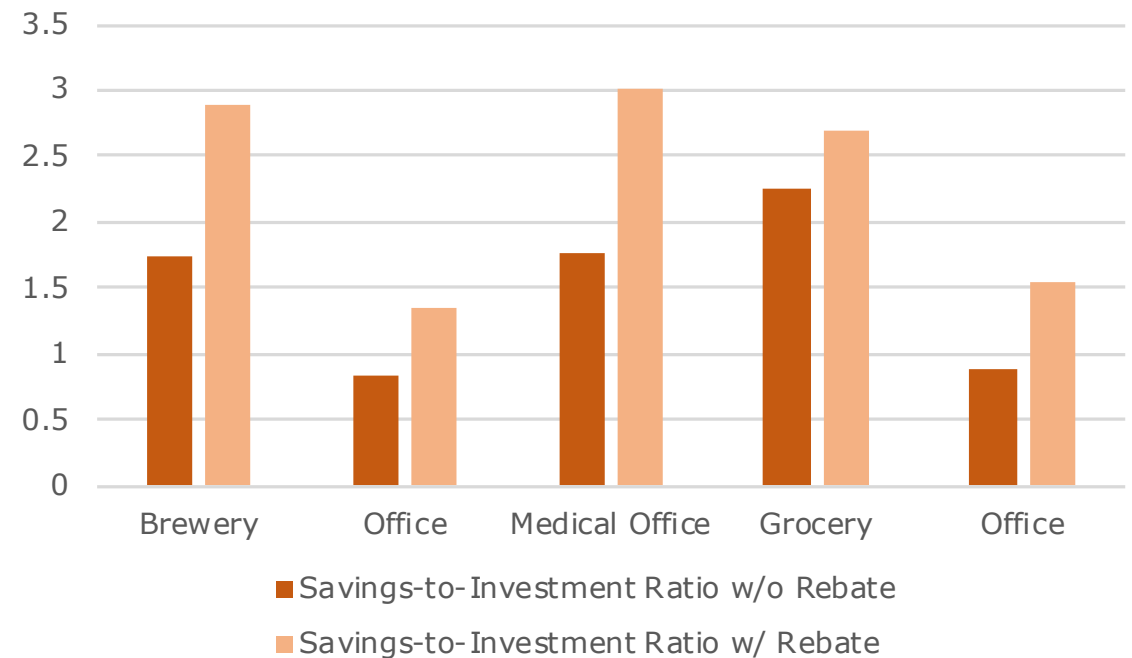
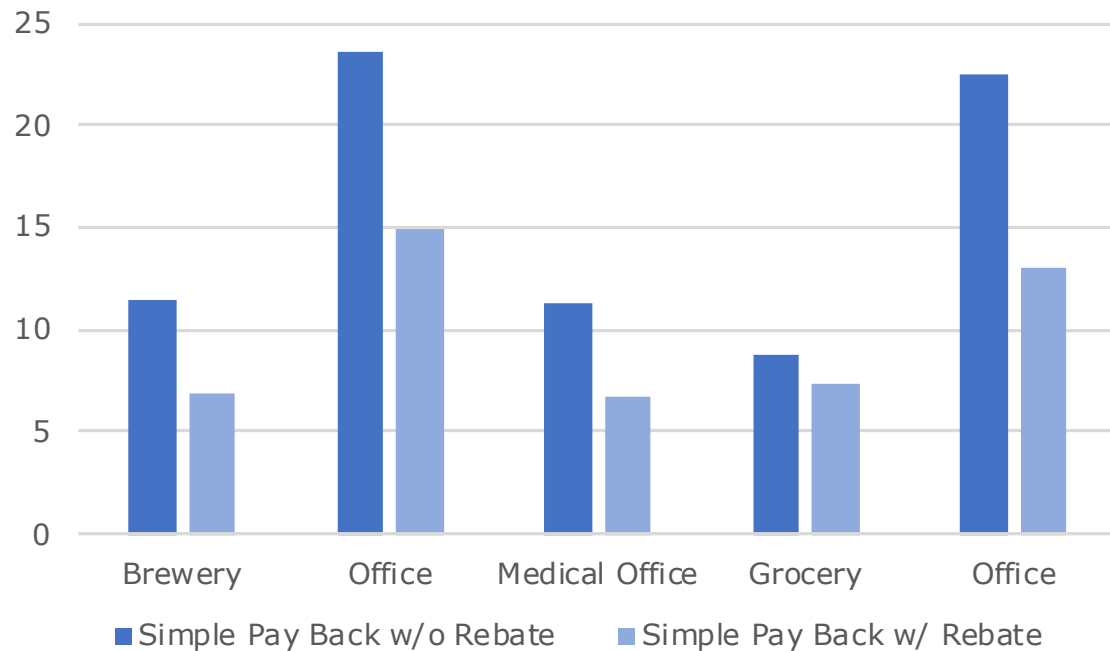
**Key Findings:** Significant reduction in energy use due to control systems – 66% with new lights, 40% on own

- Task Tuning had greatest impact
- Overall improvement in satisfaction with lighting performance
- Installers found UI improved over past control systems



# INDUSTRY RESEARCH: PNNL – ANALYSIS ACROSS FIVE SITES

Testing different control strategies at five sites, shows positive payback periods and savings-to-investment ratios.



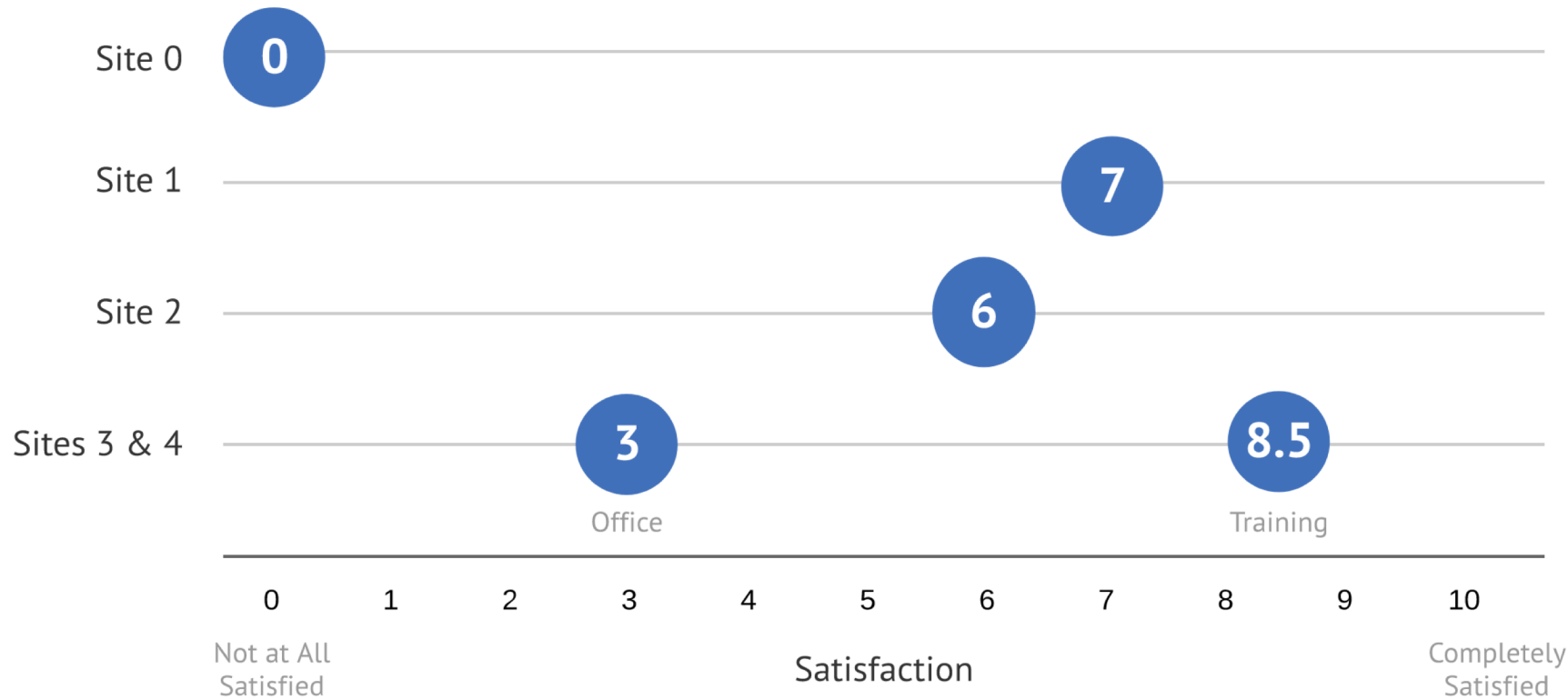
# INDUSTRY RESEARCH: PACIFIC GAS & ELECTRIC

## Key Findings:

- Customers are happy with equipment but commissioning can be labor intensive.
- When compared to the Tool, lots of variation between observed and measured savings.

# INDUSTRY RESEARCH: PACIFIC GAS & ELECTRIC

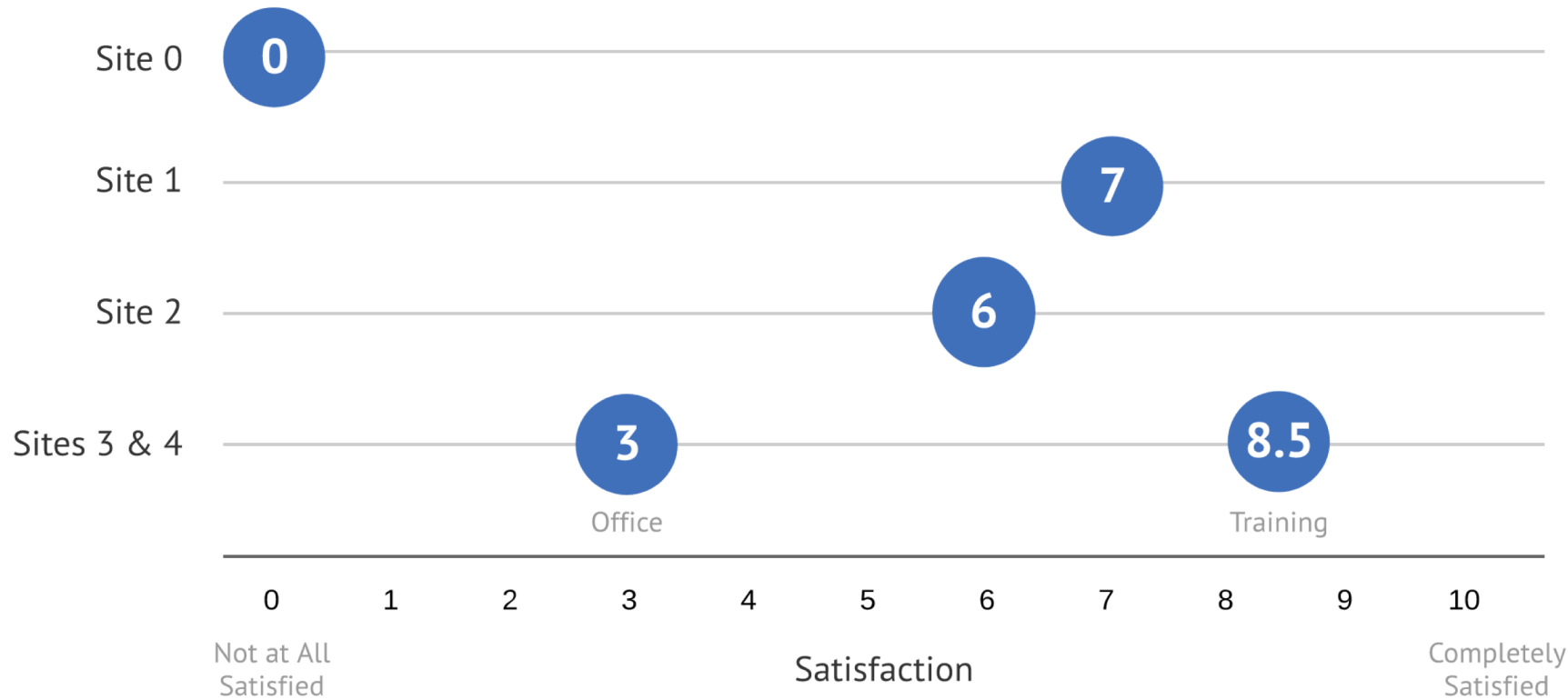
## Participant Satisfaction with Commissioning Process



Lower satisfaction with **commissioning process** than technology

# INDUSTRY RESEARCH: PACIFIC GAS & ELECTRIC

## Participant Satisfaction with Commissioning Process



All four said commissioning was “tedious” and “time consuming”



WHAT WE'RE DOING:  
CONSUMERS ENERGY  
ALCS OFFERINGS

# CONSUMERS ENERGY ALCS OFFERING

Currently, ALCS are offered as a C&I specialty program.

- Includes technical assistance, contractor listings, and financial incentives.
- Program was piloted in 2017 and moved to a full-scale program in 2018 for large customers.
- Currently piloting a version of ALCS for small businesses.

# CONSUMERS ENERGY ALCS OFFERING: EVALUATION EFFORTS

As an emerging technology that requires significant participant training, **Consumers Energy heavily invested in evaluation of ALCS.**

- Evaluation designed to ensure savings were reliable and the technology was market-ready.
- This investment continues as the program evolves in the future.



# CONSUMERS ENERGY ALCS OFFERING: EVALUATION EFFORTS



# CONSUMERS ENERGY ALCS OFFERING: PILOT EVALUATION

## Pilot Program Savings Analysis

### Key Findings:

- Reported savings followed best practice and aligned with industry results
- Recommended changes to kW savings to increase accuracy (was being under-reported)

# CONSUMERS ENERGY ALCS OFFERING: PILOT EVALUATION

## Pilot Program Savings Analysis:

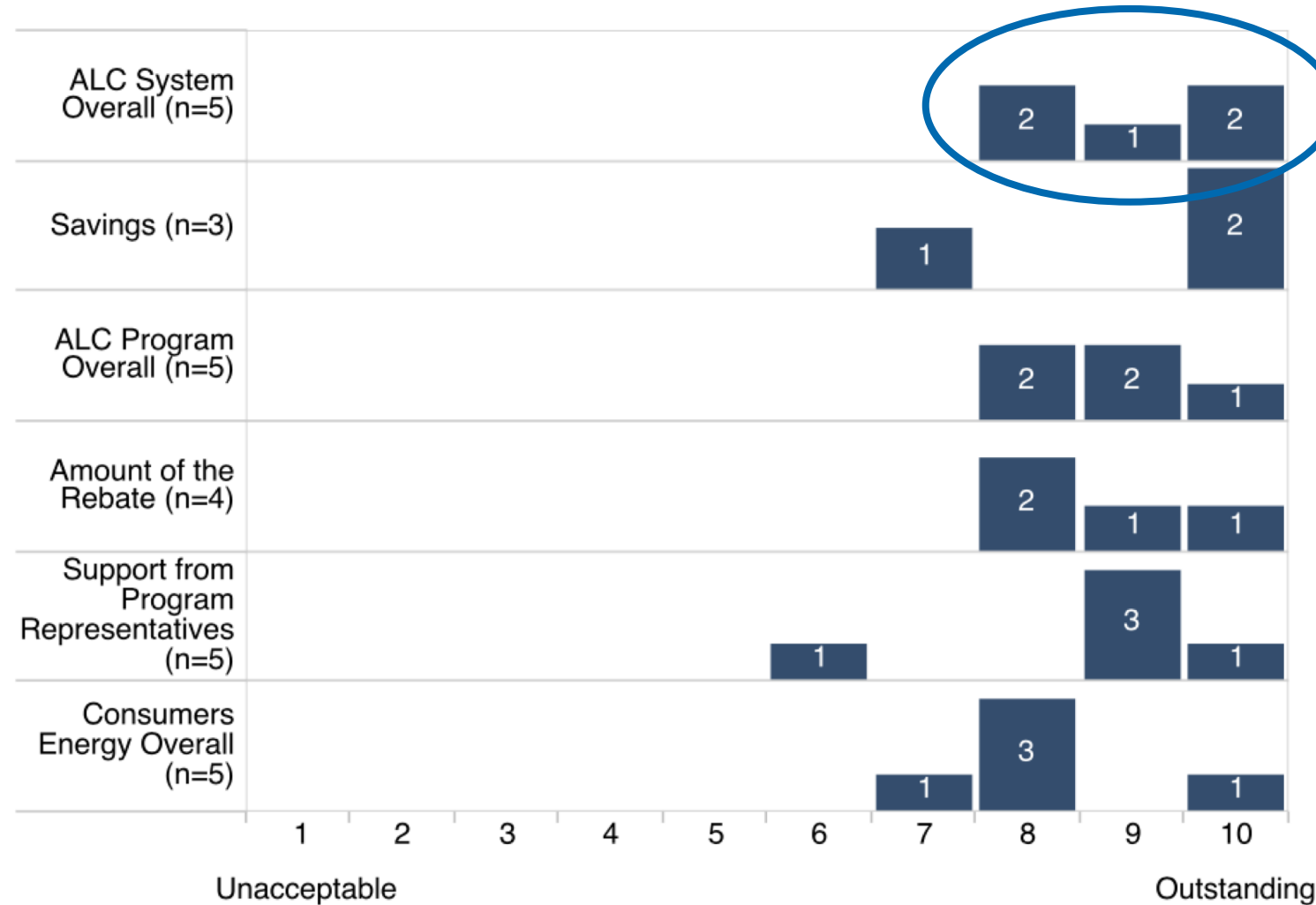
Project	Ex Ante Reported Savings (kWh)	Ex Post Evaluated Savings (kWh)	Realization Rate
1	206,734	206,734	100%
2	252,619	252,619	100%
3	2,638,760	2,612,568	99%
4	46,405	46,405	100%
5	3,598,774	3,598,774	100%
6	248,223	248,223	100%
7	262,332	262,332	100%
<b>Total</b>	<b>7,253,846</b>	<b>7,227,654</b>	<b>100%</b>

Found **extremely accurate** reported savings

# CONSUMERS ENERGY ALC'S OFFERING: PILOT EVALUATION

## Pilot Participant Interviews:

Highly satisfied with the  
ALC system

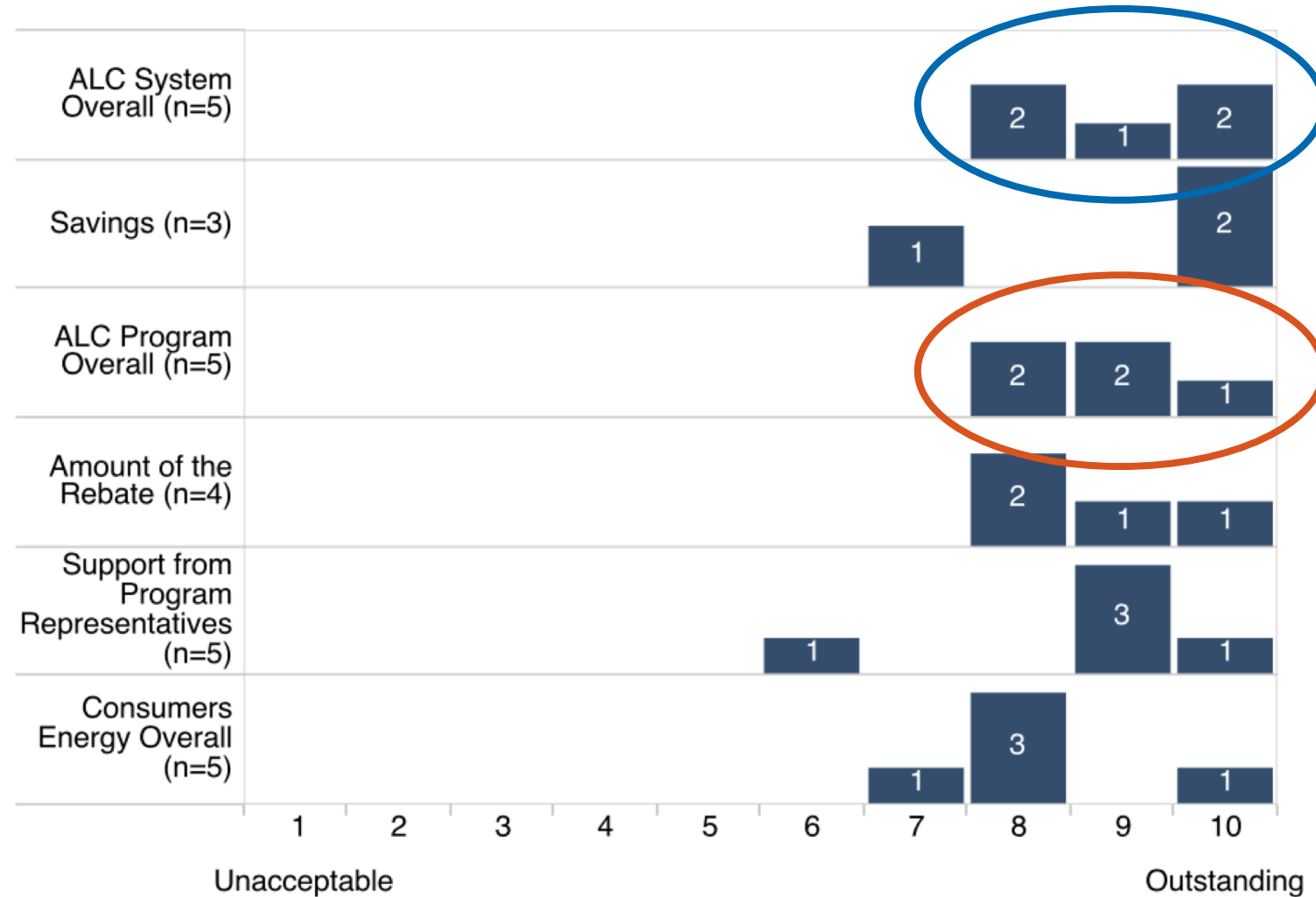


# CONSUMERS ENERGY ALCS OFFERING: PILOT EVALUATION

## Pilot Participant Interviews:

Highly satisfied with the  
ALC system

and the ALC program  
overall



# CONSUMERS ENERGY ALCS OFFERING: PILOT EVALUATION

## Pilot Participant Interviews – Key Findings:

- ALC pilot participants were satisfied with the overall pilot

# CONSUMERS ENERGY ALCS OFFERING: PILOT EVALUATION

## Pilot Participant Interviews – Key Findings:

- ALC pilot participants were satisfied with the overall pilot
- Participants reported significant non-energy benefits including:
  - Light quality is more aesthetically pleasing
  - Controls and UI was easier to use
  - ALC systems aligned with corporate sustainability goals



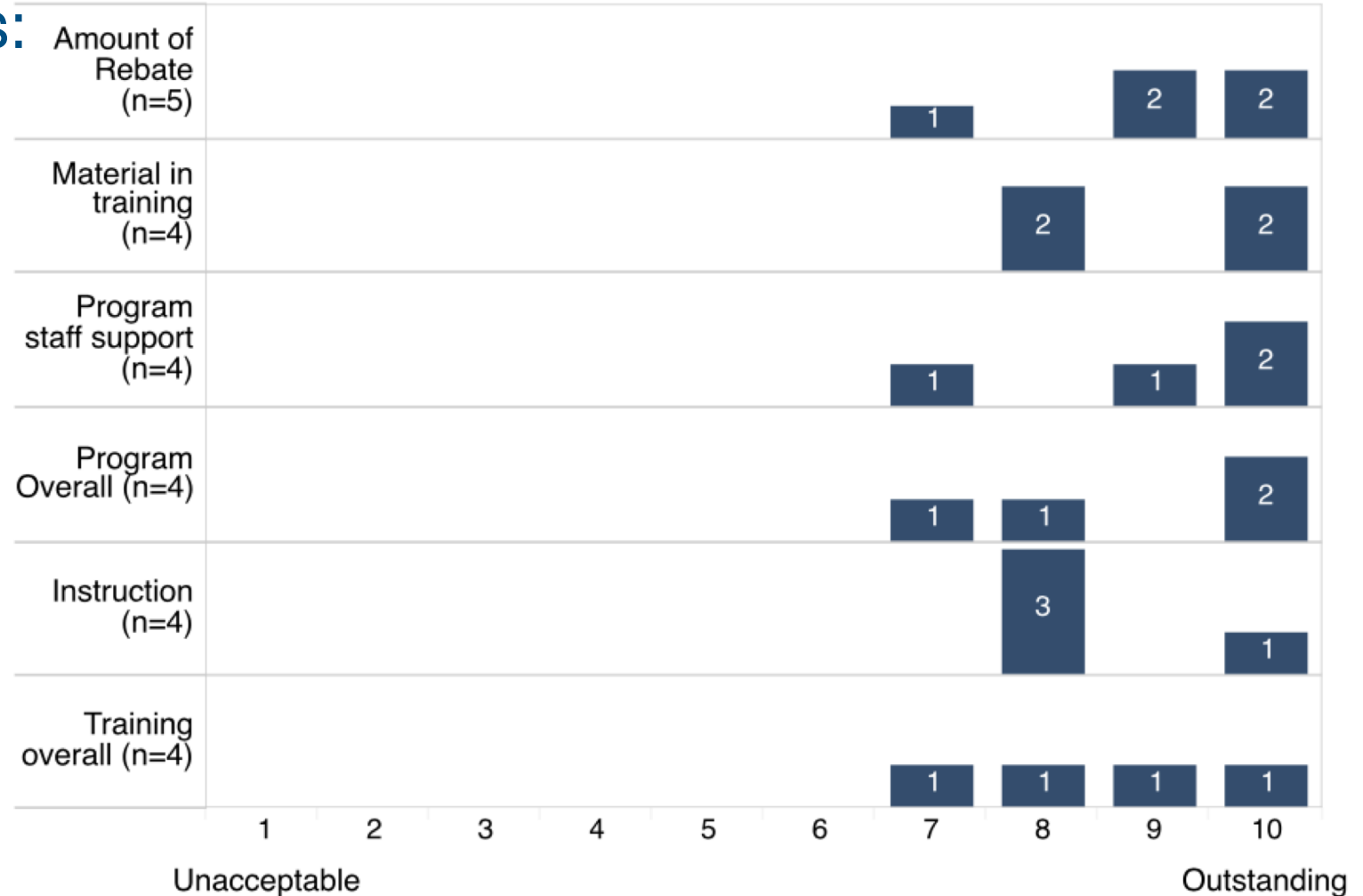
# CONSUMERS ENERGY ALCS OFFERING: PILOT EVALUATION

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- ALC pilot participants were satisfied with the overall pilot
- Participants reported significant non-energy benefits including:
  - Light quality is more aesthetically pleasing
  - Controls and UI was easier to use
  - ALC systems aligned with corporate sustainability goals
- Major barrier was commissioning systems post-installation

# CONSUMERS ENERGY ALCS OFFERING: PILOT EVALUATION

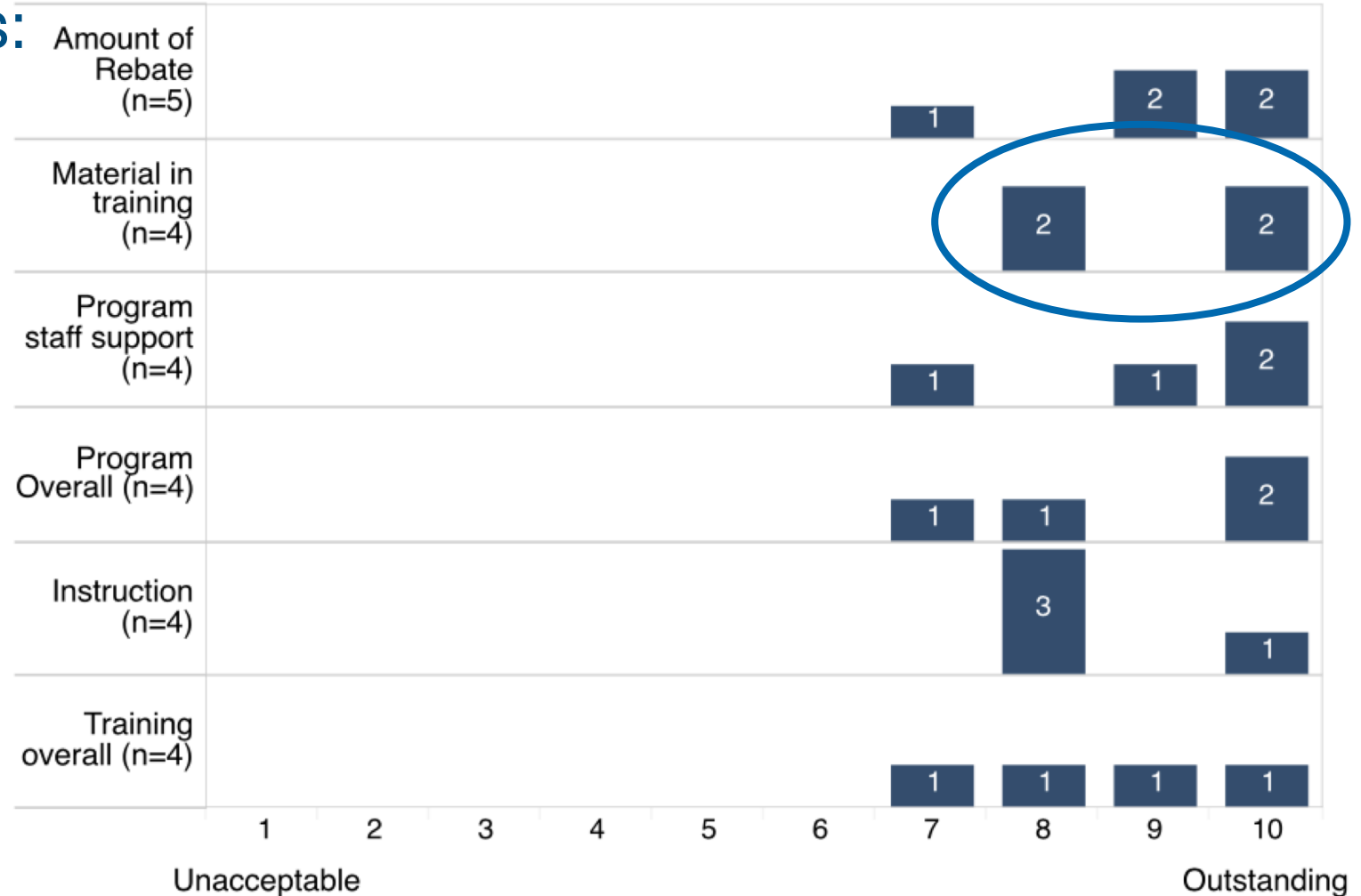
## Pilot Contractor Interviews:



# CONSUMERS ENERGY ALCS OFFERING: PILOT EVALUATION

## Pilot Contractor Interviews:

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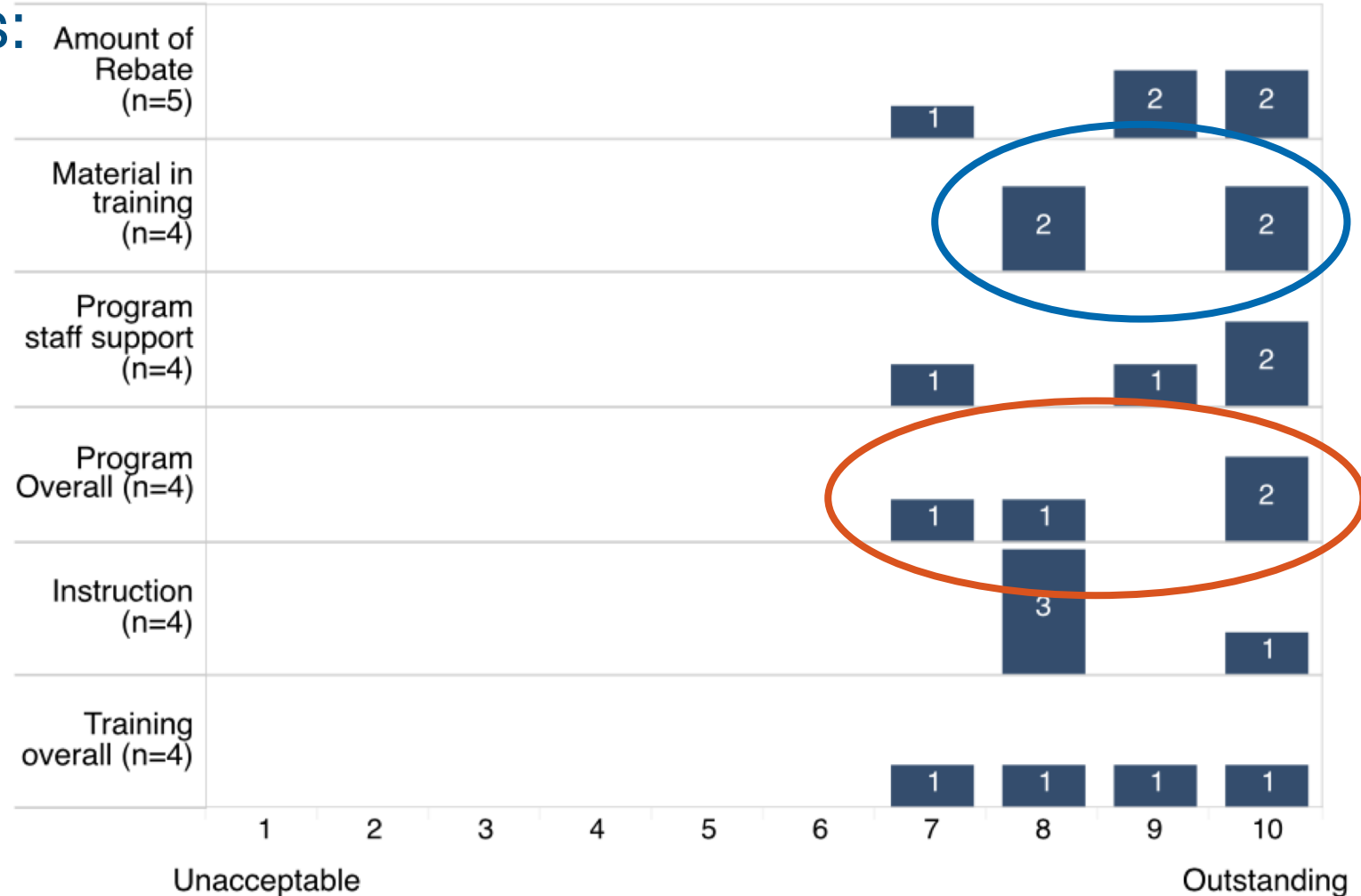


# CONSUMERS ENERGY ALCS OFFERING: PILOT EVALUATION

## Pilot Contractor Interviews:

Highly satisfied with the  
training materials ....

and the **ALC program**  
**overall**



# CONSUMERS ENERGY ALCS OFFERING: PILOT EVALUATION

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- Overall, contractors were highly satisfied with the ALC pilot.

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# CONSUMERS ENERGY ALCS OFFERING: PILOT EVALUATION

## Pilot Contractor Interviews – Key Findings:

- Overall, contractors were highly satisfied with the ALC pilot.
- Appreciated the Consumers Energy ALCS training workshop.
- Contractors reported more barriers to ALC system adoption:
  - High first cost
  - Uncertain energy savings
  - Difficult to quantify non-energy benefits (including new data streams)



# CONSUMERS ENERGY ALCS OFFERING: SPECIALTY EVALUATION

## Specialty Impact Evaluation

- After pilot, included in rigorous annual impact evaluations

# CONSUMERS ENERGY ALCS OFFERING: SPECIALTY EVALUATION

## Specialty Impact Evaluation

- After pilot, included in rigorous annual impact evaluations
- Impact evaluation shows high realization rates, with slight underestimation of demand savings:

**98.8%** kWh

Engineering Adjustment  
Factor

**145.9%** kW

Engineering Adjustment  
Factor

*Engineering Adjustment Factor* = adjustments to reported energy savings based equipment operation.

# CONSUMERS ENERGY ALCS OFFERING: SPECIALTY EVALUATION

## Specialty Trade Partner Interviews

- Non-Energy benefits extremely impactful in decision-making

# CONSUMERS ENERGY ALCS OFFERING: SPECIALTY EVALUATION

## Specialty Trade Partner Interviews

- Non-Energy benefits extremely impactful in decision-making



Productivity



Security

“You can **track the amount of traffic** ...[to] show which lights are getting turned on and off the most and how long they are on... we observed those benefits [in other projects] so I used [productivity] as a selling pitch.”

“They were driven not by the ALC **aspect at all** but inspired by something completely different from that...[**security via asset tracking**].”

# CONSUMERS ENERGY ALCS OFFERING: SPECIALTY EVALUATION

## Specialty Trade Partner Interviews

- Non-Energy benefits extremely impactful in decision-making
- Continued high satisfaction with ALCS program and equipment

# CONSUMERS ENERGY ALCS OFFERING: SPECIALTY EVALUATION

## Specialty Trade Partner Interviews

- Non-Energy benefits extremely impactful in decision-making
- Continued high satisfaction with ALCS program and equipment
- *However:*
  - Estimating energy savings is challenging
  - Some opportunities to streamline program participation



## WHAT IT MEANS: KEY TAKEAWAYS

# KEY FINDINGS

Advanced lighting controls systems have a high potential for energy savings even without lamp replacements.

- Industry research has shown significant savings based on case studies and lab testing.
- EMI Consulting's evaluation of ALCS projects during both the pilot and full scale program show strong energy savings.



# KEY FINDINGS

In addition to energy savings, advanced lighting control systems provide significant non-energy benefits to participants.

Customers cited several factors as non-energy benefits including:

- Improved lighting quality,
- Better aesthetics, and
- Greater appreciation of natural light.

# KEY FINDINGS

Customers found that the advanced lighting control systems were easy to operate.

When compared with traditional control systems, customers were able to easier adjust systems after installed and commissioned.

# KEY FINDINGS

Despite strong performance, there exist some challenges associated with the sales and installation of advanced lighting control systems.

Customers with ALC systems reported two major difficulties:

- The commissioning process is too complex and takes too long
- Contractors have reported some challenges associated with sales (unknown energy savings, high first cost)

# KEY FINDINGS

To ensure successful adoption of ALC systems in non-residential buildings, training of both contractors and customers is critical.

DSM programs can play a critical role in accelerating awareness among lighting contractors.

- Providing education on potential benefits, successful case studies, and the installation process.
- Help set expectations for customers on the installation requirements and process.



thank you

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