Welcome

Conservation Applied Research & Development (CARD) Webinar

September 29, 2020

Improve your commercial light levels and save on cost

Light Level Analysis in Commercial Buildings: A Minnesota Market Study

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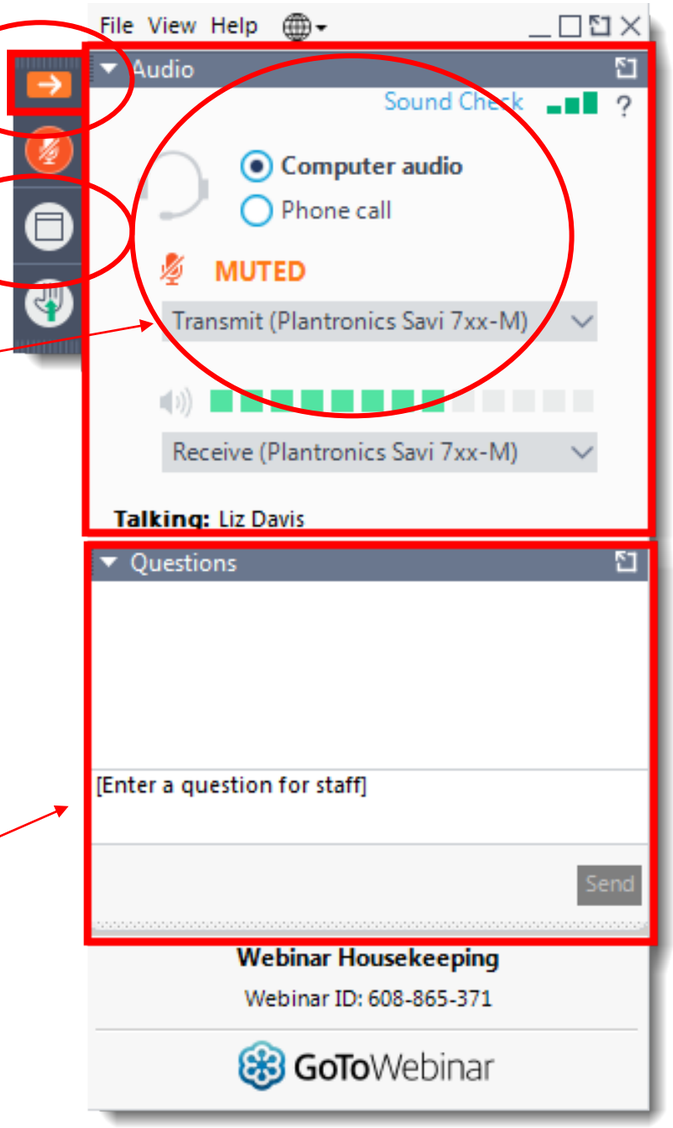
Type in a question and hit “send” to ask a question.



Minnesota Applied Research & Development Fund

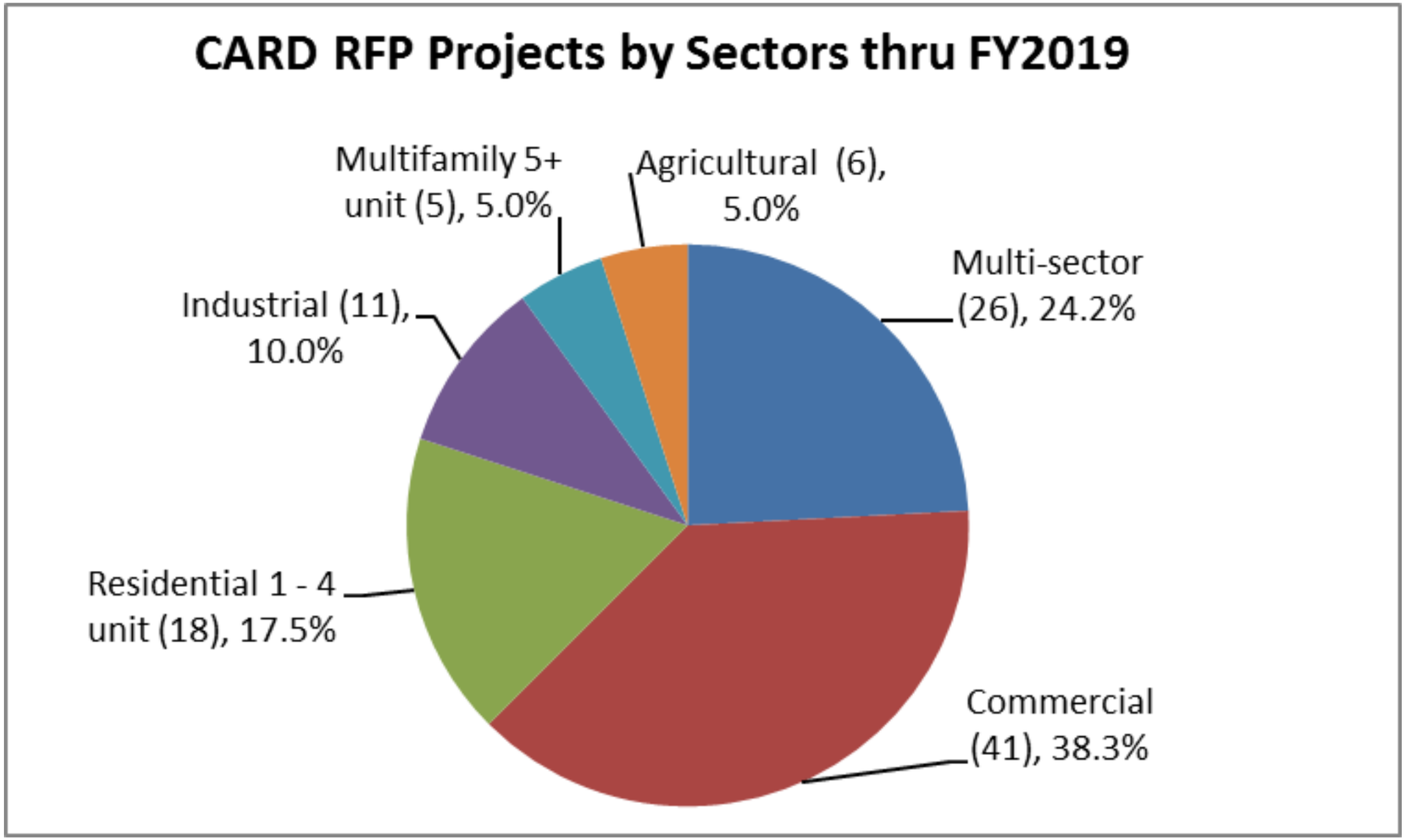
- **Purpose to help Minnesota utilities achieve 1.5% energy savings goal by:**
  - ***Identifying new technologies or strategies to maximize energy savings;***
  - ***Improving effectiveness of energy conservation programs;***
  - ***Documenting CO_2 reductions from energy conservation programs.***

Minnesota Statutes §216B.241, Subd. 1e

- **Utility may reach its energy savings goal**
  - **Directly through its Conservation Improvement Program (CIP)**
  - **Indirectly through energy codes, appliance standards, behavior, and other market transformation programs**

State Capitol Image: Courtesy Minnesota Department of Administration

CARD RFP Spending by Sector thru FY2019



RFP Summary

- 10 Funding Cycles
- 472 proposals
- 121 projects funded
- $27.4 million in research

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COMMERCE DEPARTMENT
ENERGY RESOURCES

Conservation Applied Research and Development (CARD) Program

Agenda

Background and objective

Methodology

Results

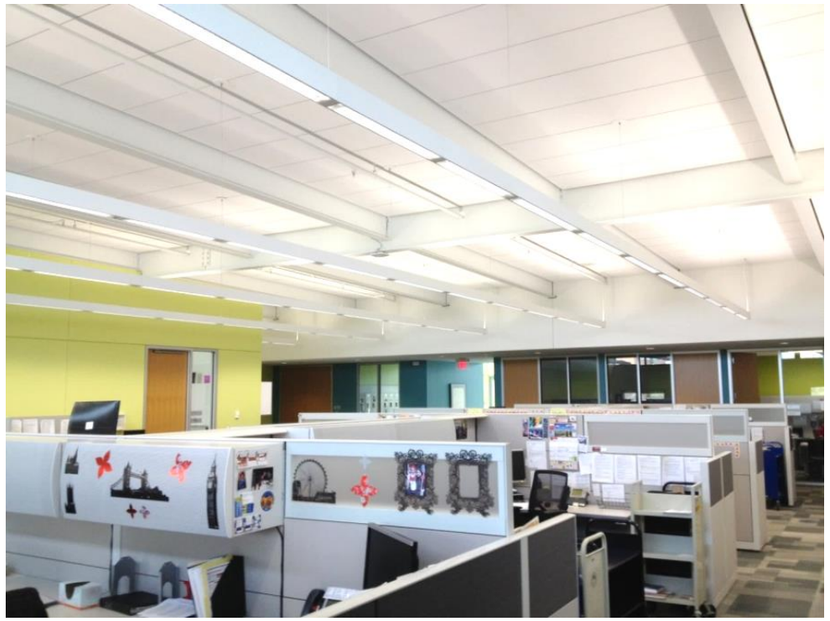
Conclusions and recommendations

Background and Objective

Background: The Opportunity

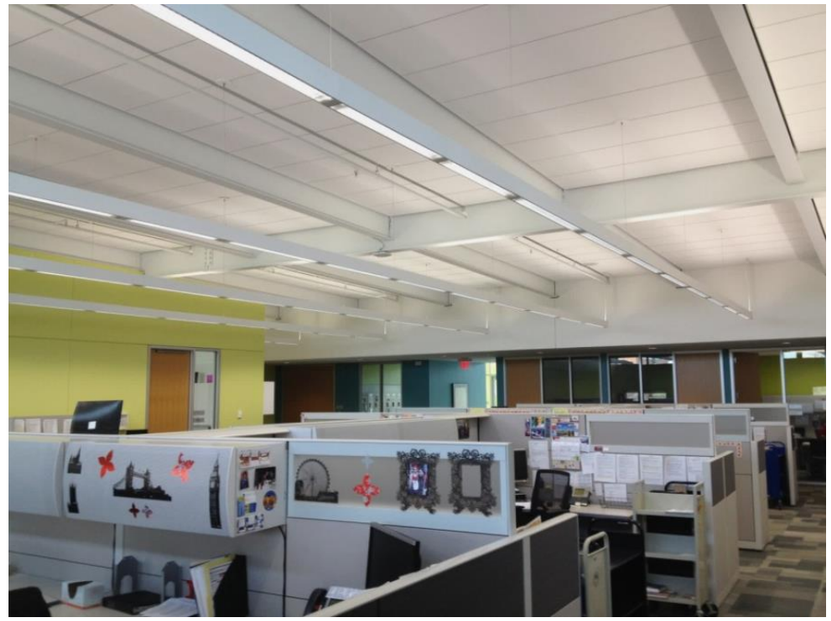
Dimming lights in commercial spaces so that the average light level is appropriate for the specific activities being performed

Too Bright

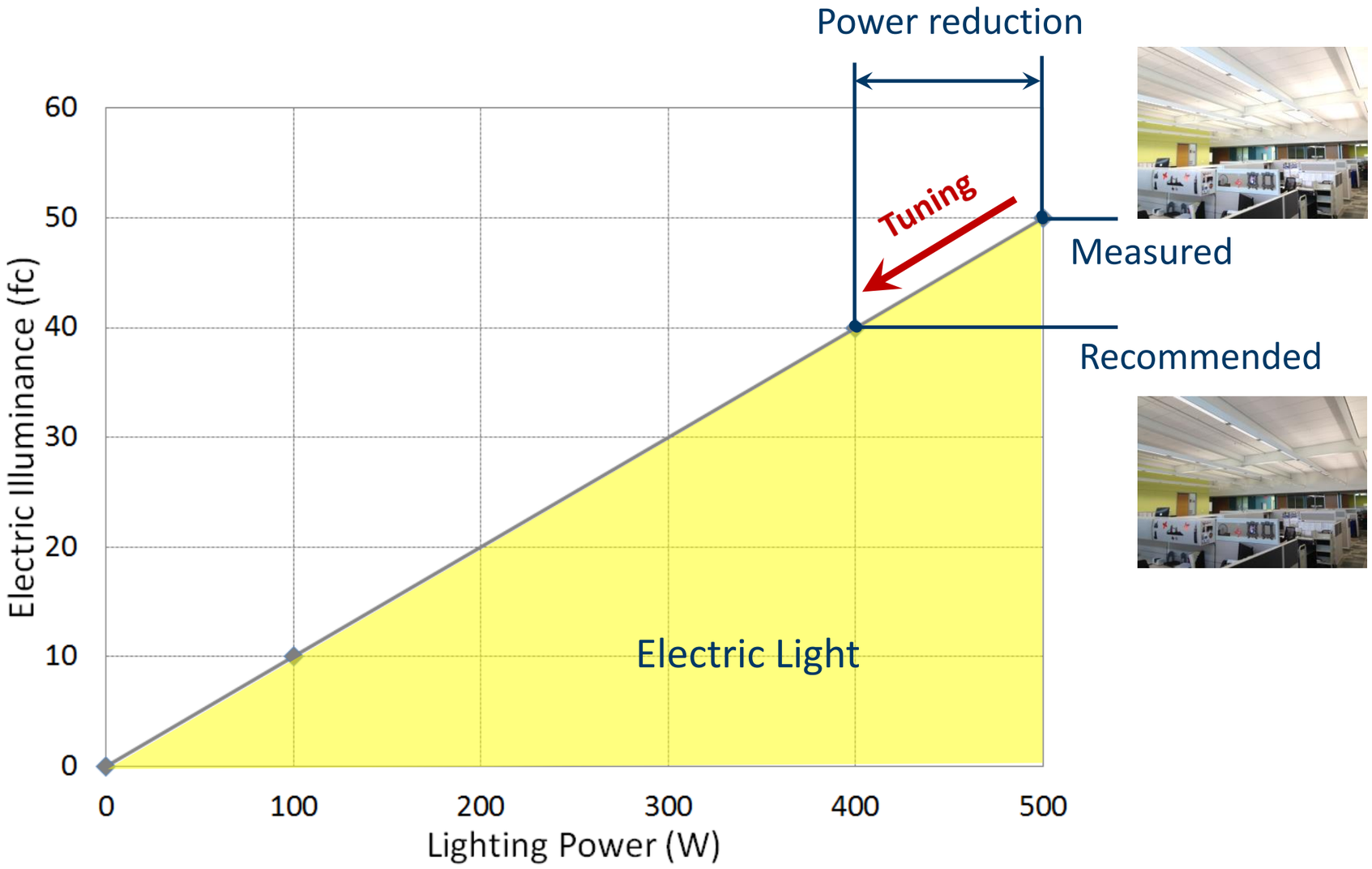


Tuning

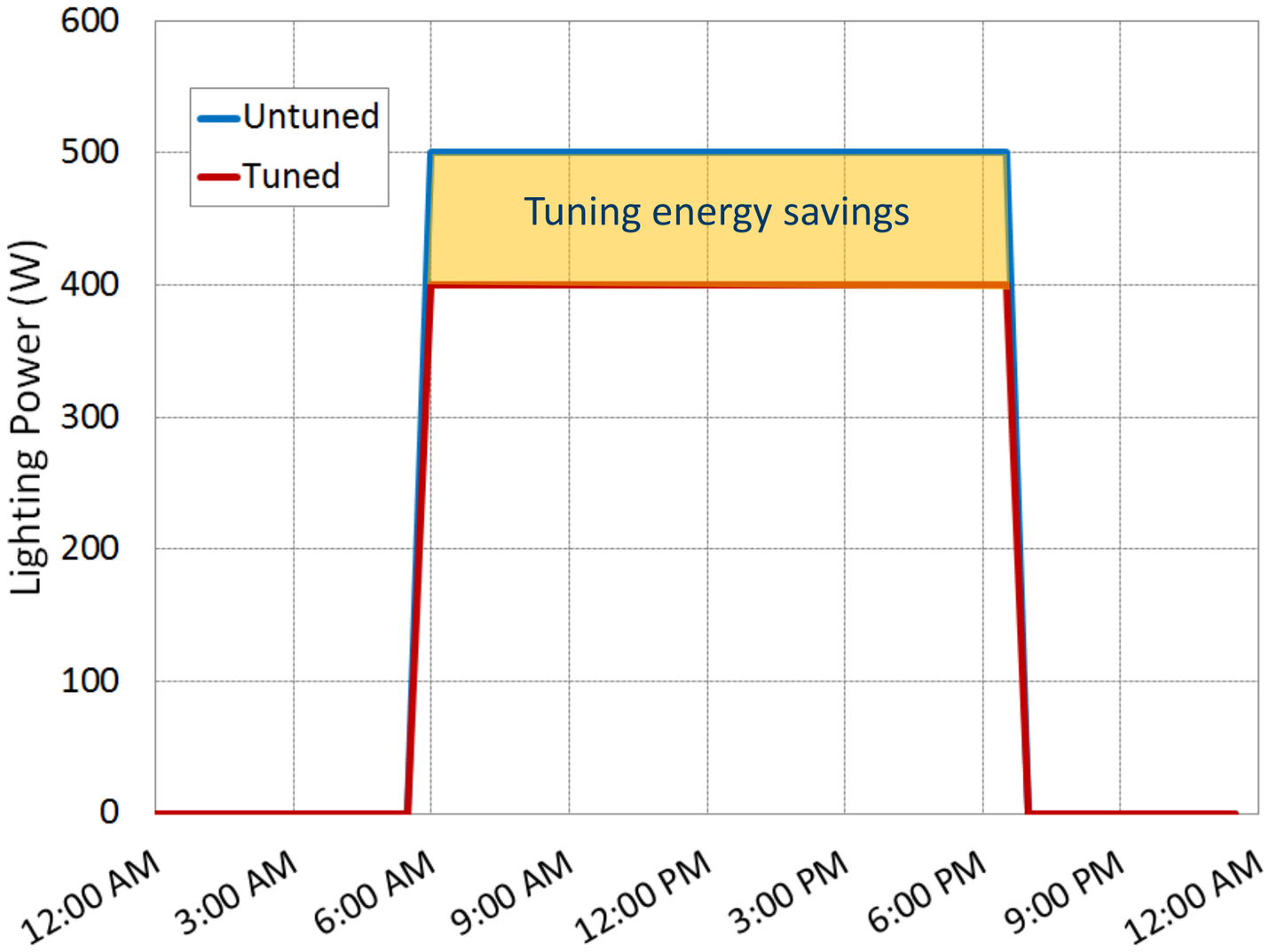
Just Right



Background: The Opportunity



Background: The Opportunity



Objective: Objectives

1) Characterize LED light levels in Minnesota commercial buildings.

2) Develop program recommendations for optimizing light levels.

Methodology

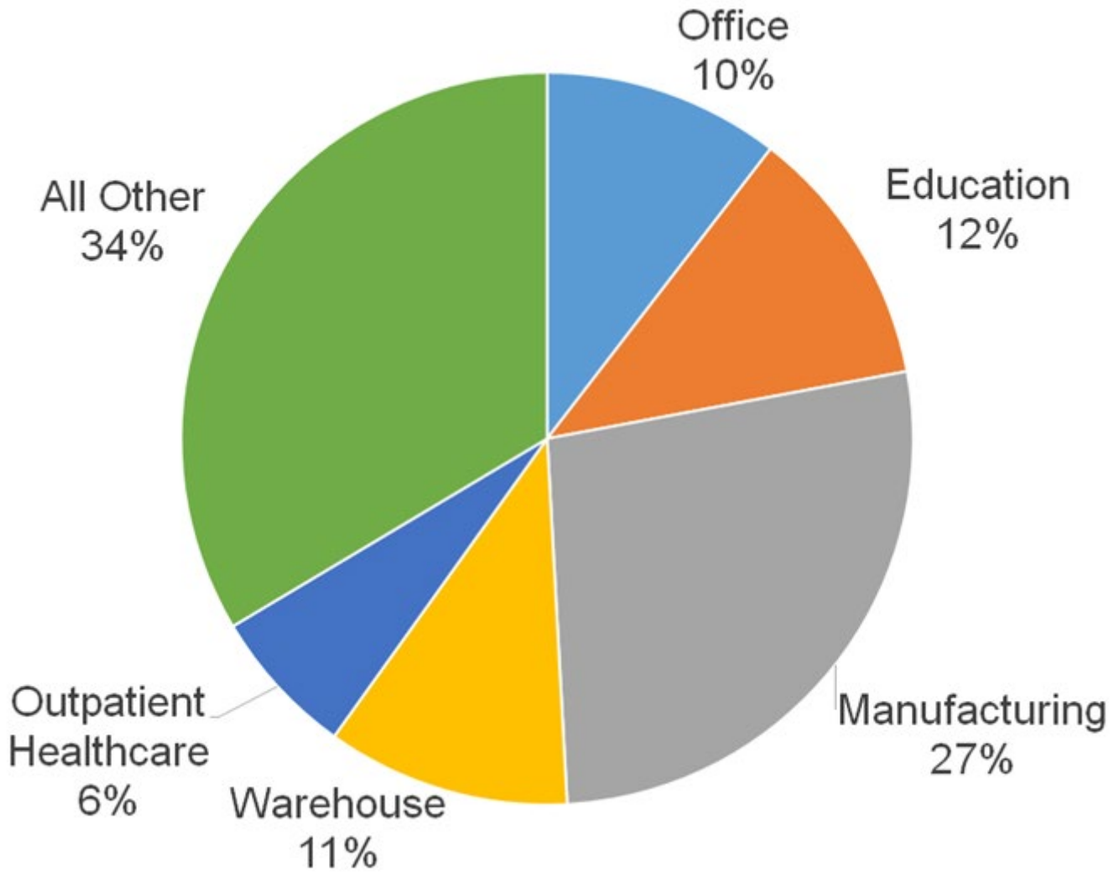
Methodology: Project Steps

1) Secondary research
2) Interviews
    - Utility program staff
    - Trade Allies, Manufacturers
3) Field work
4) Expedited assessment
5) Program recommendations

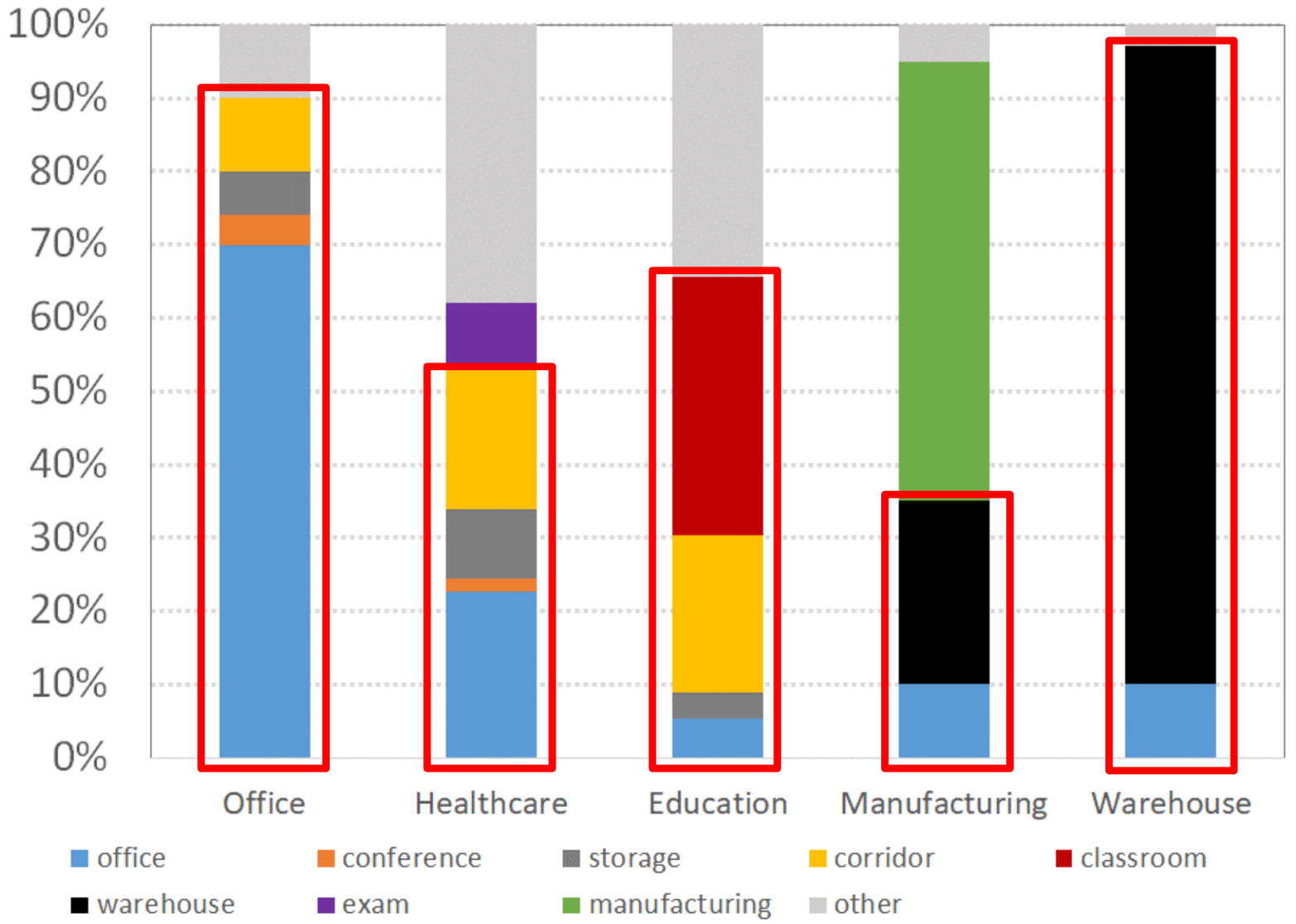
Results: Secondary Research

Segmentation: Commercial Lighting Energy by Building Type

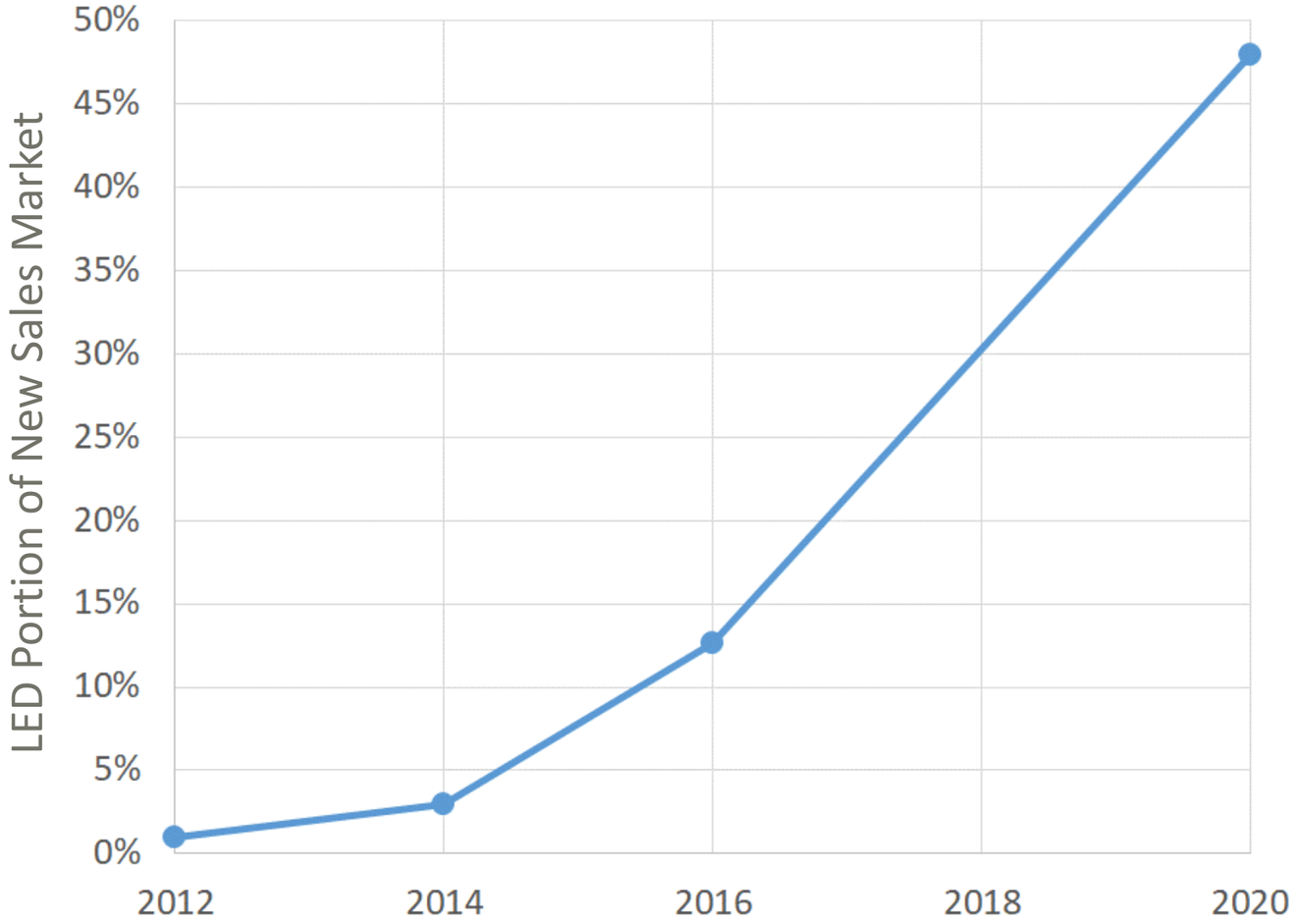
5.3 billion kWh annually



Segmentation: Space Types by Building Type



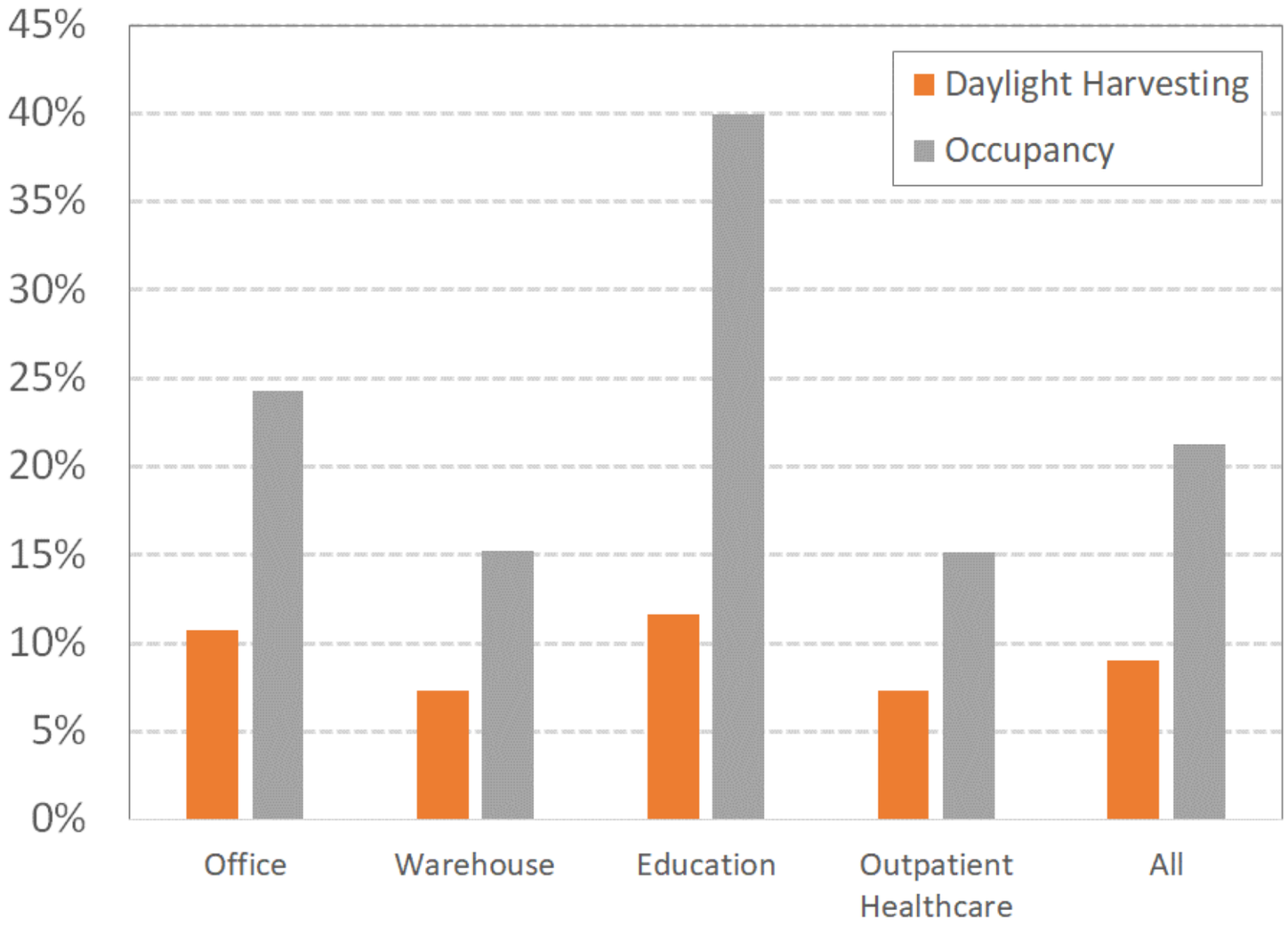
Segmentation: LED Penetration



LEDs currently installed in ~11% of commercial area in existing building stock in Minnesota

Navigant, "Adoption of Light-Emitting Diodes in Common Lighting Applications", July 2017

Segmentation: Lighting Controls



Results: Program Review

Program Review: Staff Interview Key Takeaways

- 60-90% of lighting program savings stem from one-for-one replacement projects.
- Concern about savings decline in future
  - More stringent codes
  - LED market saturation
- Most contractors do not measure light levels or do photometric calculations.

Program Review: Staff Interview Key Takeaways

- Interest in light level optimization if:
  - Customer and program economics are viable
  - Occupant preferences are addressed
  - Programming process can be simplified
  - Messaging does not imply that LED retrofit under-delivered on expected savings

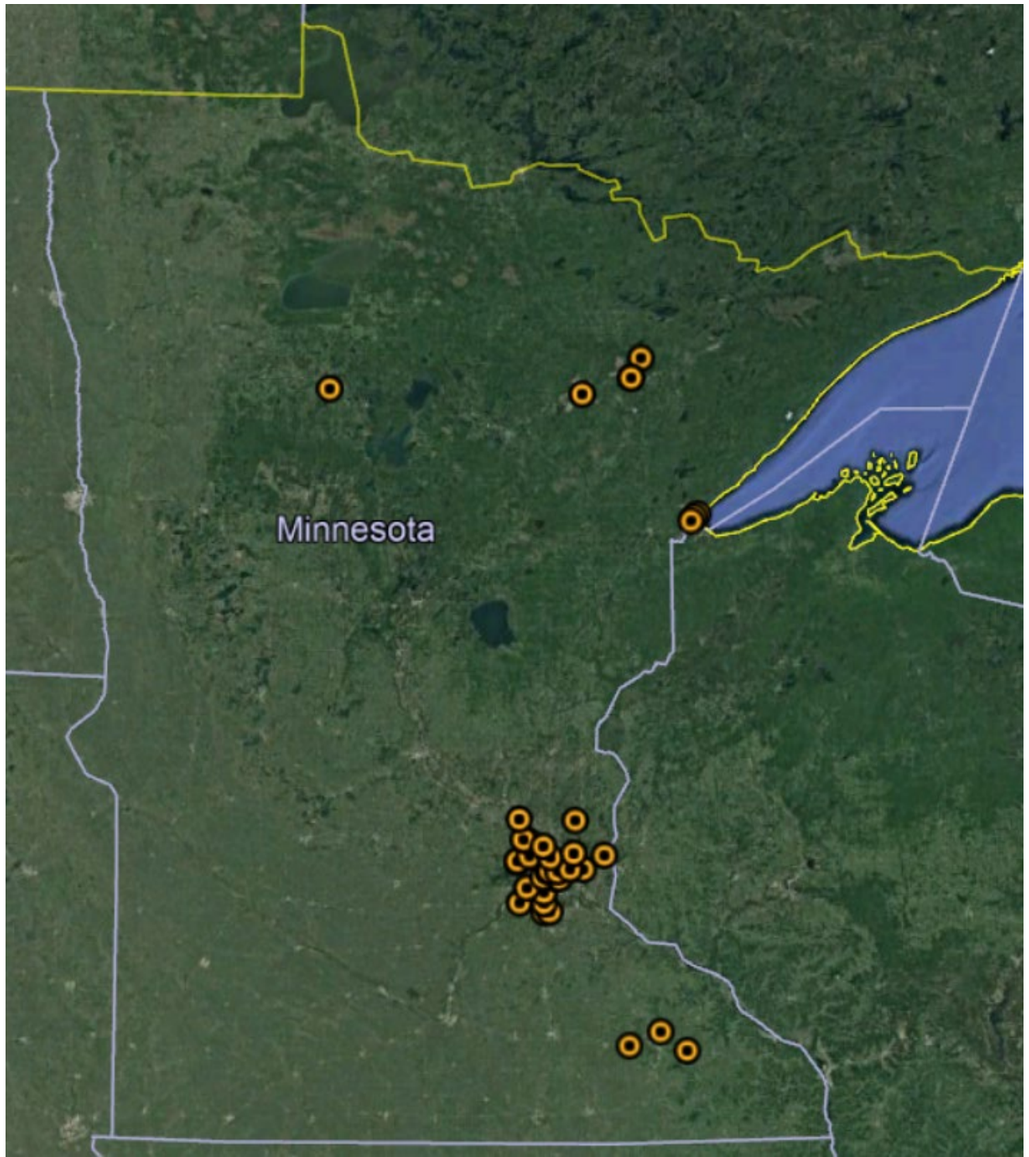
Results: Stakeholder Interviews

Program Review: Stakeholder Key Takeaways

- Incremental cost of dimmable fixtures is low.
- Agreement that spaces are often over-lit.
- Brightness preferences and perceptions drive importance of occupant feedback.
- Barriers to controls and task tuning include perceived complexity and low awareness of control benefits.

Results: Field Study

Field Study: Buildings Visited

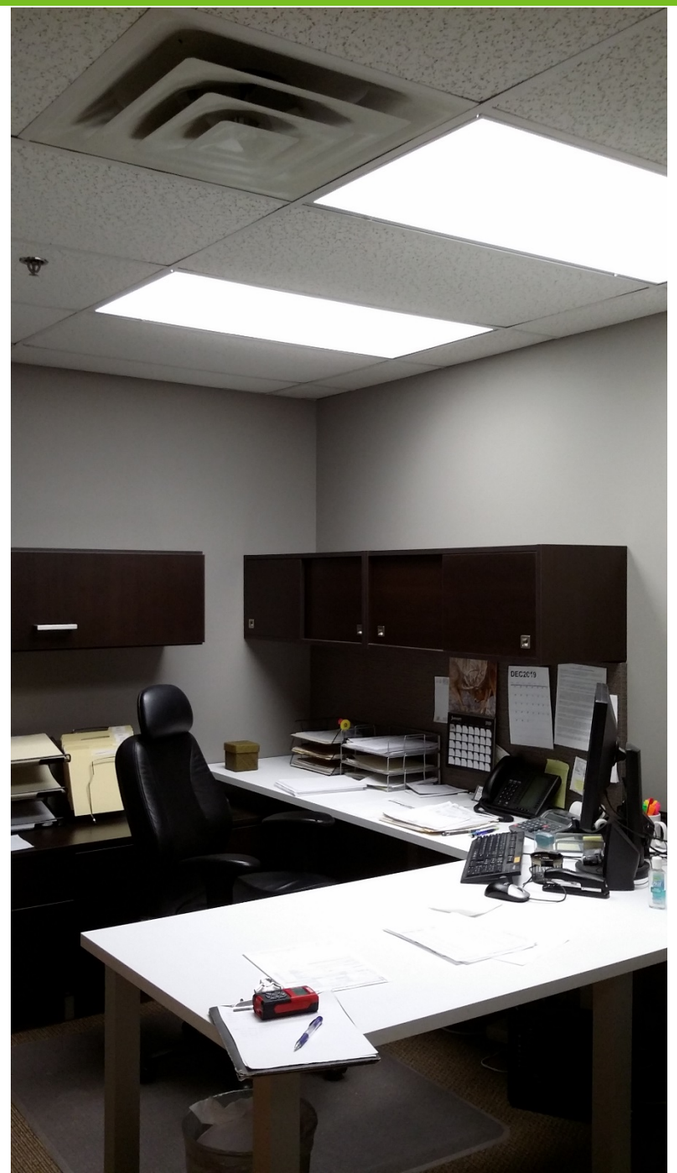


Building Type	Number Visited
Office	9
Education	9
Warehouse & Storage	10
Manufacturing	8

Field Study: Spaces Characterized

Space Type	Number Visited	Target Sample
Open Office	28	44
Private Office	50	44
Conference Room	36	44
Warehouse	27	44
Corridor	25	44
Classroom	19	44

Field Study: Spaces Characterized – Private & Open Office



Field Study: Spaces Characterized – Conference & Corridor

Field Study: Spaces Characterized – Warehouse & Classroom

Field Study: Mean Illuminance vs. IES Recommendation

Space Type	Mean	IES Recommendation	% Reduction
Open Office	49.6	30	40%
Private Office	47.7	30	37%
Conference Room	45.2	30	34%
Warehouse	31.2	30	4%
Corridor	34.5	5	86%
Classroom	48	40	17%

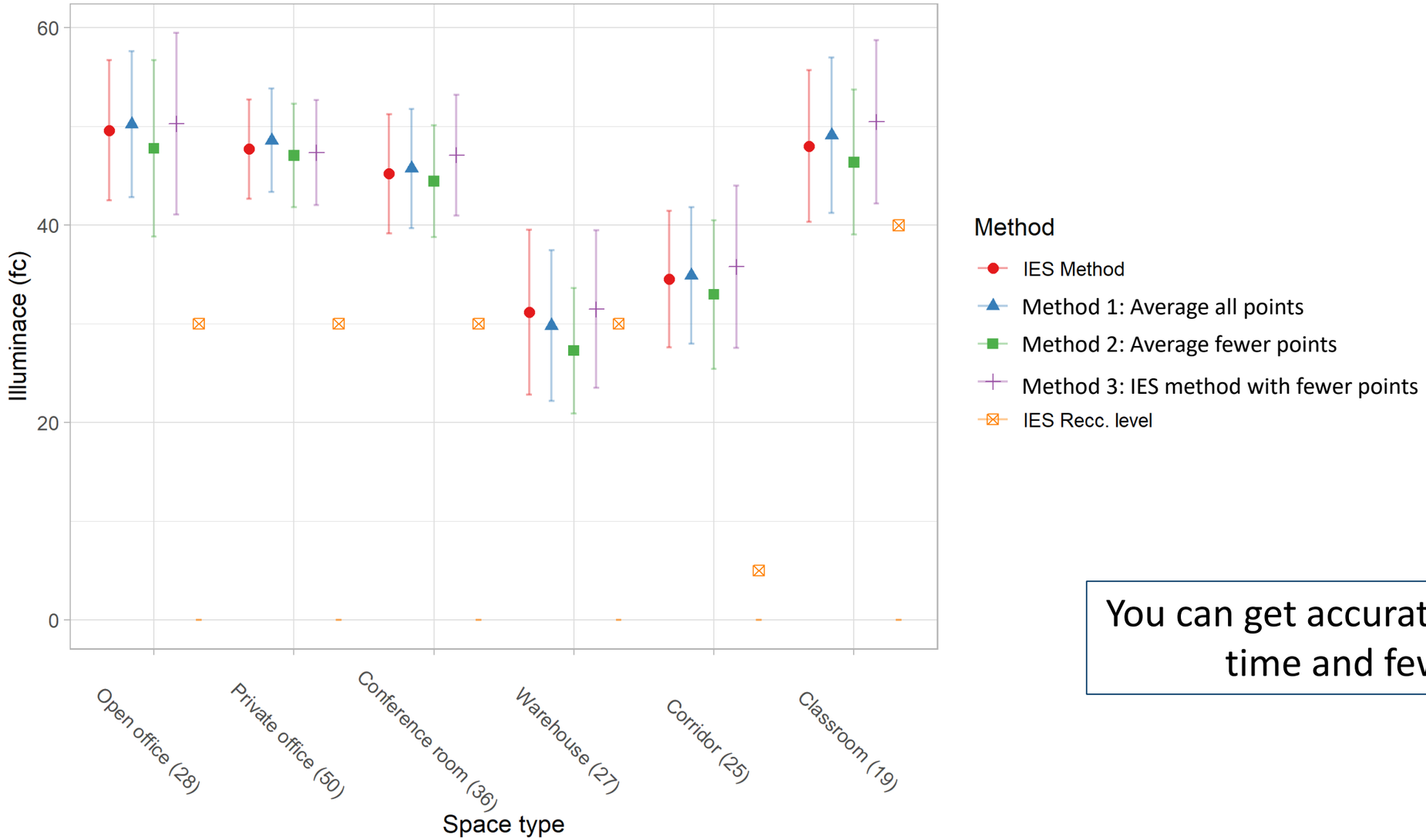
Field Study: Mean Illuminance vs. IES Recommendation

Field Study: Typical Savings

Building Type	Typical Electricity Savings (kWh/ft^2)	Typical Peak Demand Savings (W/ft^2)
Office	1.03	0.23
Education	0.46	0.13
Manufacturing	0.14	0.03
Warehouse	0.17	0.04

Expedited Assessment

Expedited Assessment: Reduced Sampling



Numbers in parentheses by x axis labels indicate sample size.

You can get accurate results with less time and fewer points!

Expedited Assessment: Photometric Analysis

Space Type	Fixture Type	Measured Illuminance (fc)	Modeled Illuminance (fc)	% Difference
Open Office	Whole Fixture	34.2	35.4	3.5%
Open Office	Tubular LED	32.0	31.1	2.8%
Private Office	Whole Fixture	63.7	66.2	3.9%
Private Office	Tubular LED	86.5	84.1	2.8%
Warehouse	Whole Fixture	64.2	59.0	8.1%
Warehouse	Tubular LED	35.6	35.3	0.85%
Warehouse	Tubular LED	18.1	17.9	1.1%
Warehouse	Tubular LED	26.9	25.8	4.1%
Classroom	Whole Fixture	57.5	53.0	7.8%
Classroom	Tubular LED	55.0	59.9	8.9%

Conclusions and Recommendations

Conclusions: Program Savings Estimates

Building Type	Estimated electricity savings (MWh)	Annual dollar savings ($)	Avoided GHG emissions (tCO2 eq.)
Office	95,520	$10,354,346	86,827
Education	45,433	$4,924,901	41,298
Manufacturing	9,183	$995,481	8,348
Warehouse	16,805	$1,821,677	15,276
Total	***166,941***	***$18,096,405***	***151,749***

Conclusions: Cost Effectiveness

Space Type	Cost Savings ($/ft^2)	Simple Payback (yr) New Construction	Simple Payback (yr) Existing
Office	$0.121	0.5	0.9
Conference	$0.090	0.6	1.3
Warehouse	$0.005	10.7	21.4
Corridor	$0.177	0.3	0.6
Classroom	$0.036	1.6	3.1

Conclusions: Occupant Comfort

Task tuning should be conducted with occupant feedback in order to balance energy savings with visual comfort

Conclusions: Program Approaches

Strategy	Description	Incentive Approaches
1 - Prescriptive lighting program enhancements		
2 - Task tuning of previously-installed dimmable LED lighting		
3 - Advanced lighting incentives		

Conclusions: Program Approaches

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1 - Prescriptive lighting program enhancements	Higher incentives for dimmable fixtures	$/unit
	De-lamping incentives	$/unit
	Incentive bonus for including task tuning in the lighting retrofit project scope	$/ft^2
2 - Task tuning of previously-installed dimmable LED lighting		
3 - Advanced lighting incentives		

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2 - Task tuning of previously-installed dimmable LED lighting	Incorporate measurement of light levels and task tuning into retrocommissioning (RCx) program scope	$/kWh
	Stand-alone initiative to revisit buildings that have installed dimmable LEDs + controls; measure light levels and tune to IES recommendations	$/ft^2
3 - Advanced lighting incentives		

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	Stand-alone initiative to revisit buildings that have installed dimmable LEDs + controls; measure light levels and tune to IES recommendations	$/ft^2
3 - Advanced lighting incentives	Incentives for installation of Networked Lighting Controls (NLC), luminaire-level lighting controls (LLLC), design assistance, commissioning	$/ft^2 $/unit $/kWh

Questions?

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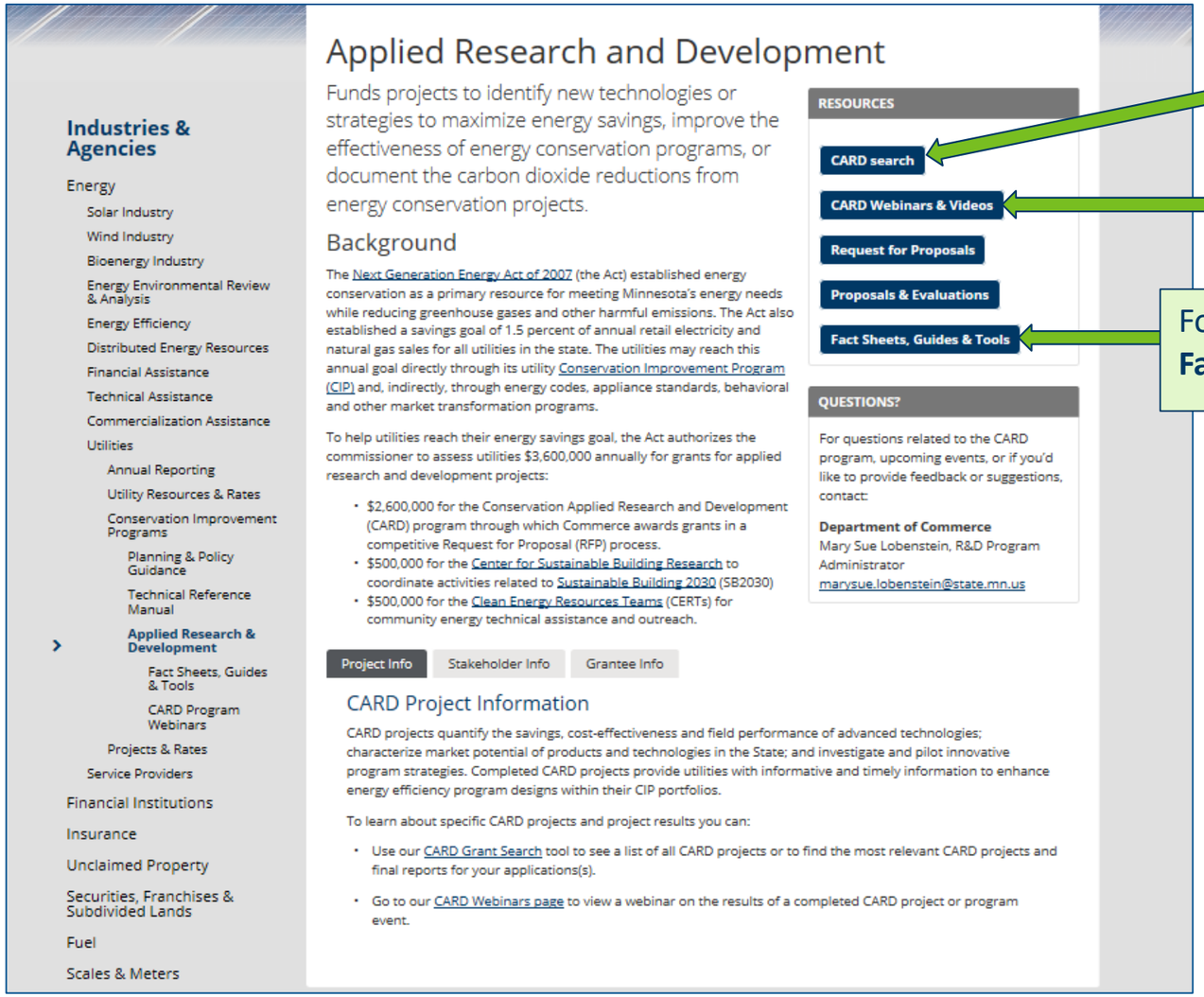
CARD Project Resources



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Webinar Recording & Final Report available in couple months

R&D Web Page (https://mn.gov/commerce/industries/energy/utilities/cip/applied-research-development/)

Thanks for Participating!

Upcoming CARD Webinars:

- **October 20** – Portable Dehumidification in MN Single-Family Homes (Center for Energy and Environment)
- **November 10** - Market Potential for Saving Energy and CO2 with Load Shifting Measures (Slipstream)
- **November 19** – Reconsidering Minnesota Cooling Loads (Center for Energy and Environment)

Commerce Division of Energy Resources e-mail list sign-up

If you have questions or feedback on the CARD program contact:
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