COMMERCE DEPARTMENT
ENERGY RESOURCES

Welcome

Conservation Applied Research & Development (CARD) Webinar

September 22, 2020

Capture Energy Savings in New Commercial Construction in Minnesota

Capture Energy Savings in New Commercial Construction in Minnesota

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Webinar Basics

Open or close your control panel

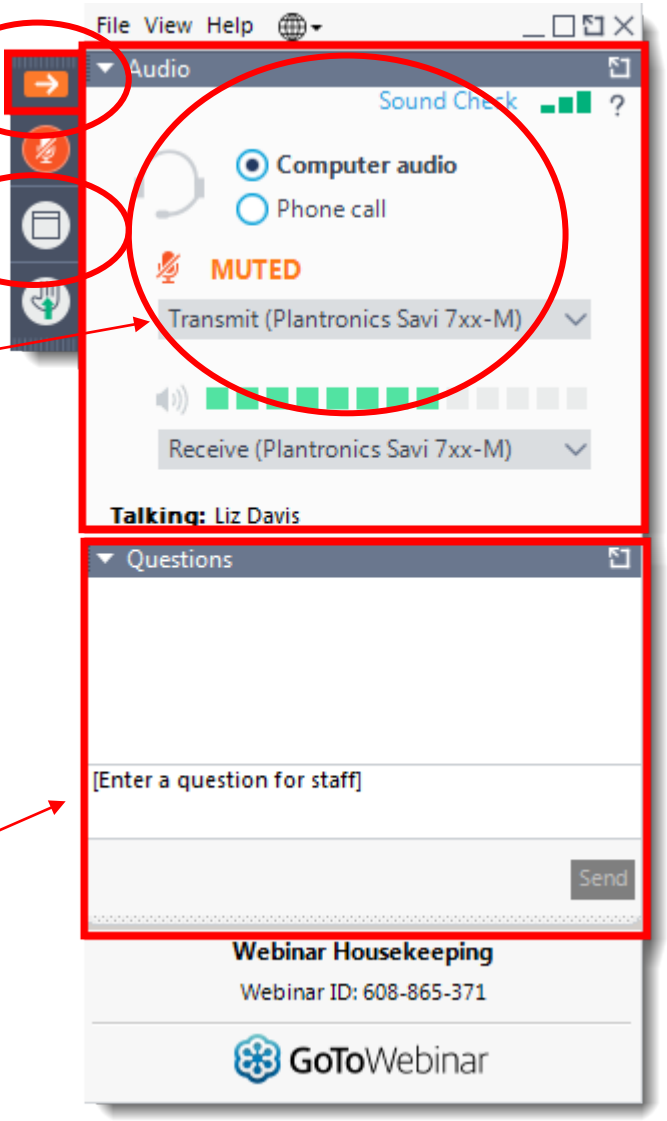
Screen
Maximize screen for better view.

Audio options
Select either the Computer audio or a Phone call.

- If you are using your telephone:
  - Select the “Phone call” button
  - Dial in and enter your access code
  - Enter your audio pin and press #

You will be joined into the webinar on mute.

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



Minnesota Applied Research & Development Fund

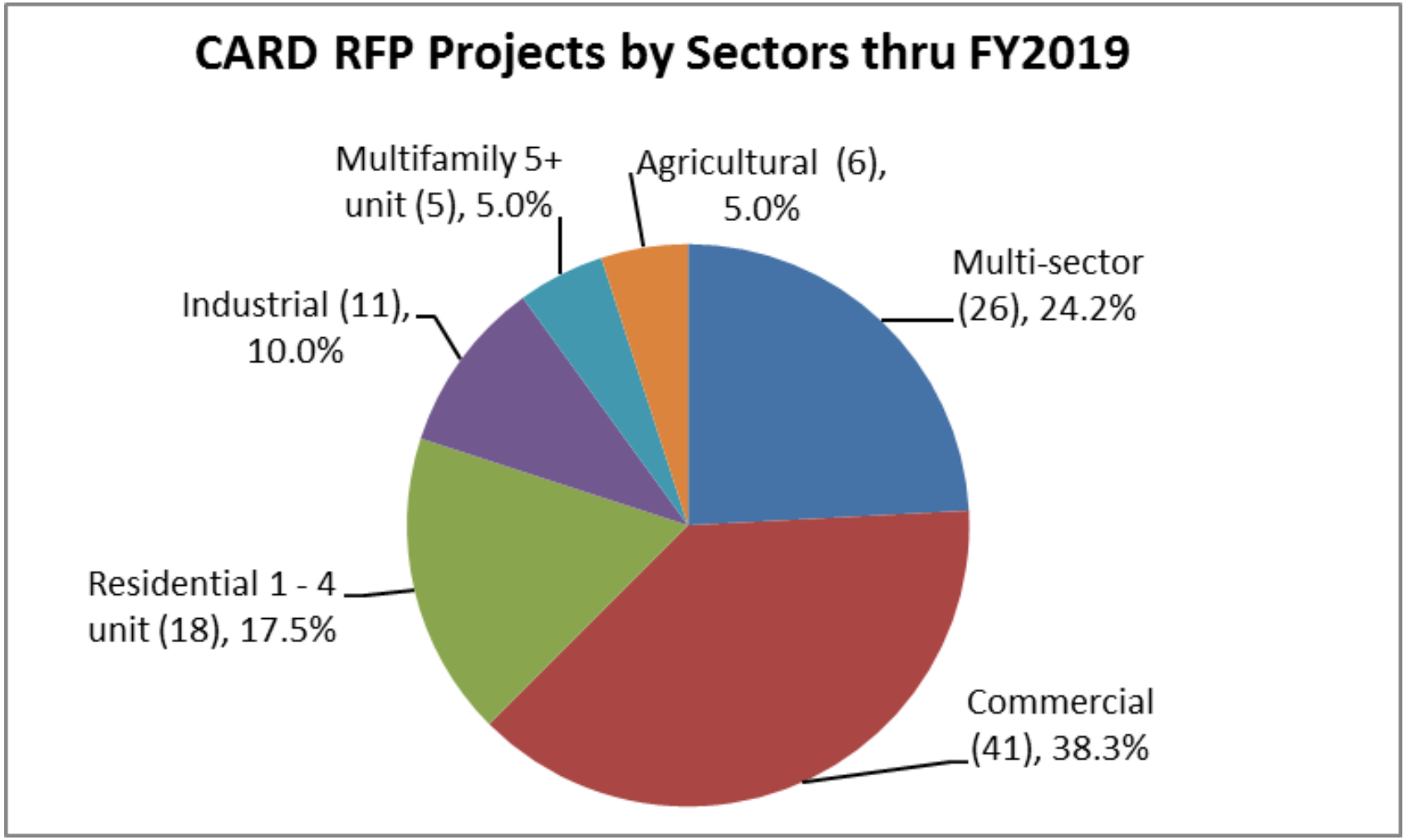
- **Purpose to help Minnesota utilities achieve 1.5% energy savings goal by:**
  - ***Identifying new technologies or strategies to maximize energy savings;***
  - ***Improving effectiveness of energy conservation programs;***
  - ***Documenting CO_2 reductions from energy conservation programs.***

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

Acknowledgments

Thank you to our research partners!

Agenda

- Study Goals and Approach
- Results
- Recommendations and Opportunities
- Questions

Study goals and approach

Compliance Paths for 2015 Minnesota Energy Code

IECC 2012
- Prescriptive path
- Performance path

ASHRAE Standard 90.1-2010
- Prescriptive path
- Energy Cost Budget performance path

Why study building energy codes?

Building energy codes can be an effective tool to improve building energy performance.

But…only as effective as the rate of compliance

Study Goals

1) **Characterize energy efficiency** in Minnesota for new and renovated buildings;

2) Identify specific opportunities for increased energy savings through **existing** commercial energy codes; and

3) Identify specific opportunities for increased energy saving measures that **go beyond existing** commercial energy code requirements

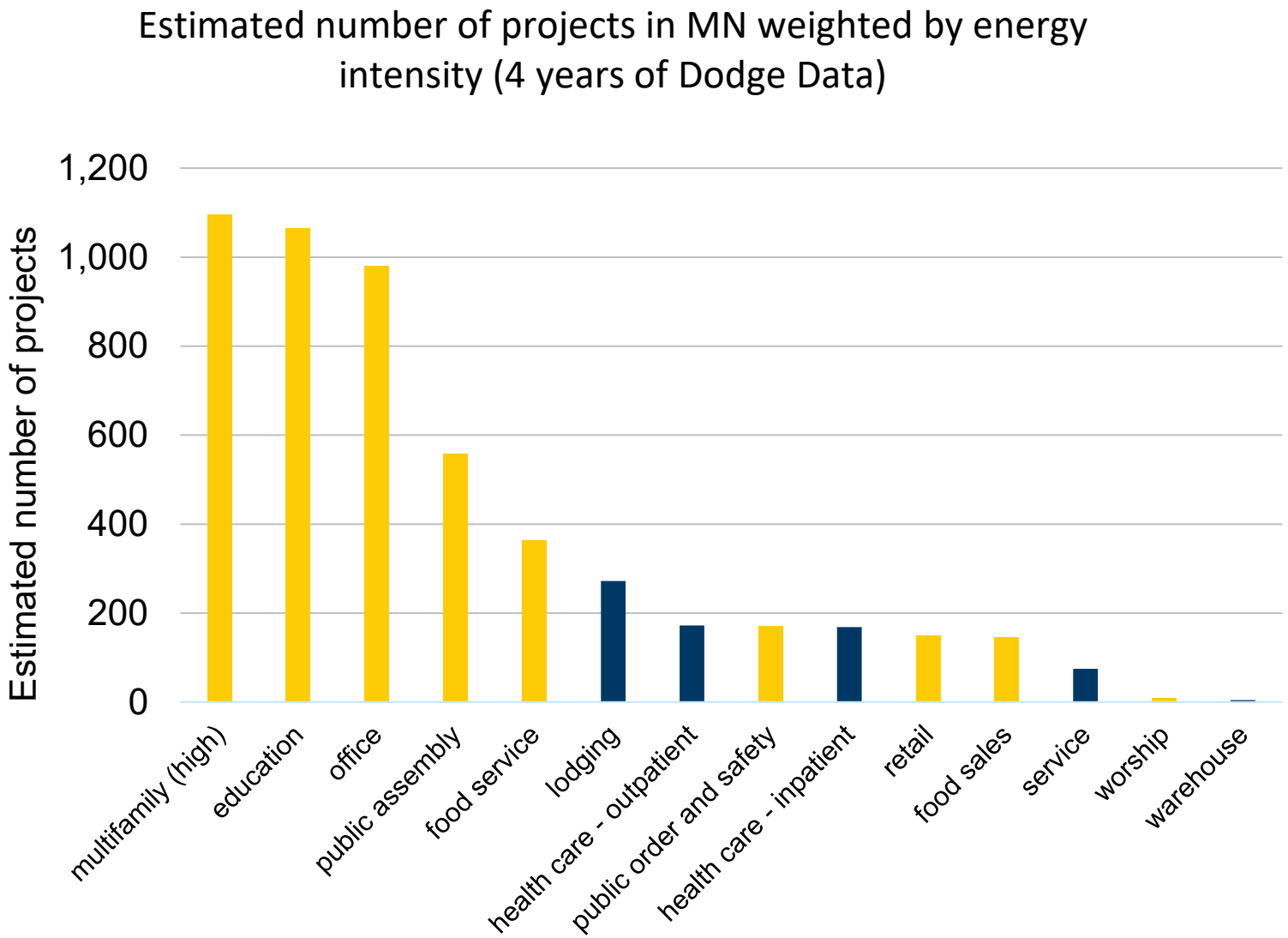
NOT a Formal Code Compliance Study

We are **not** code officials deciding whether a commercial building complied with building code or not ….

… But rather, this is a study of **lost energy savings** relative to prescriptive energy code

… which builds upon a legacy of work on energy code compliance

Study Approach

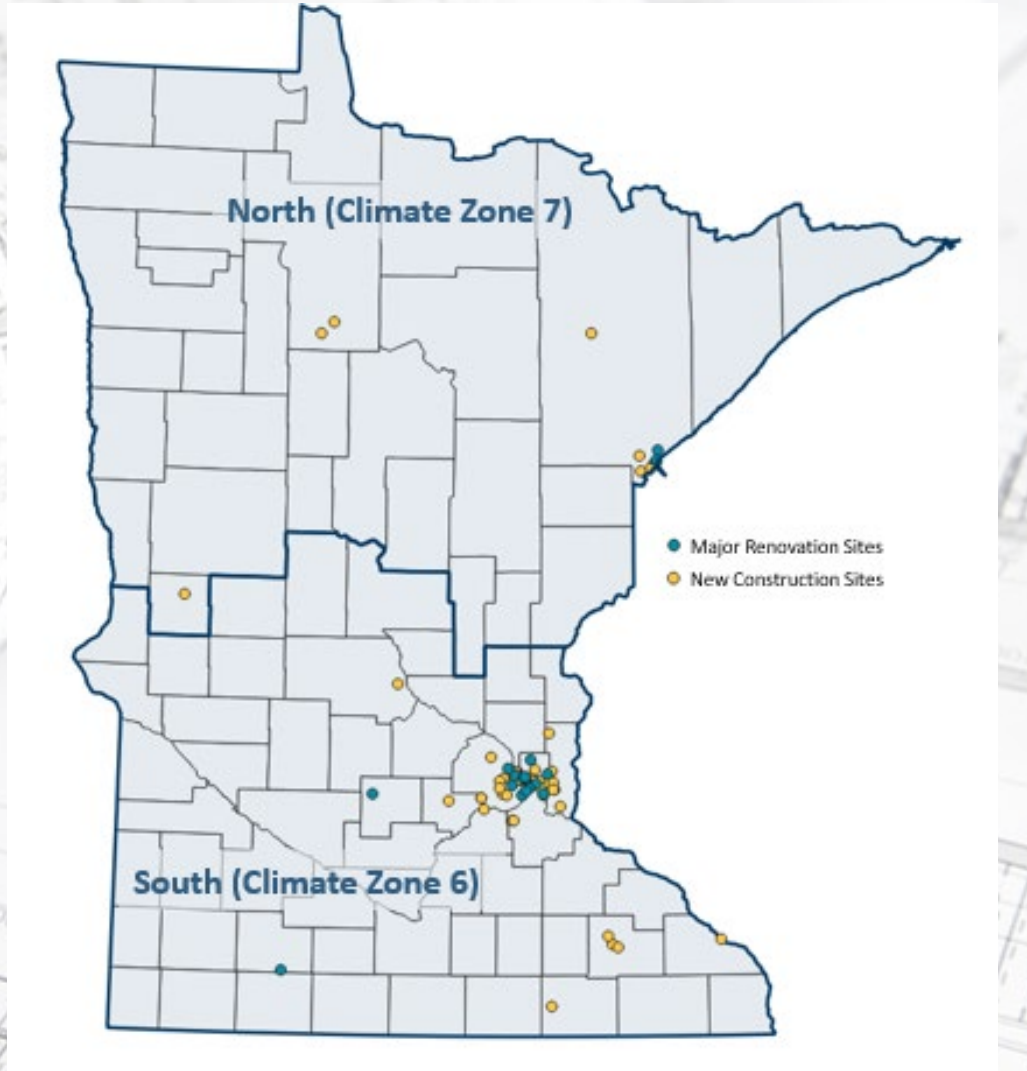


- Four major building segment groups:
  1) High-rise multifamily
  2) Office
  3) Food service and retail
  4) Education and other (which encompasses public assembly, public order and religious facilities)
- All segments split between small (<100,000 SF) and large (>=100,000SF) *except* for FS/Retail
- 78 projects

Study Approach

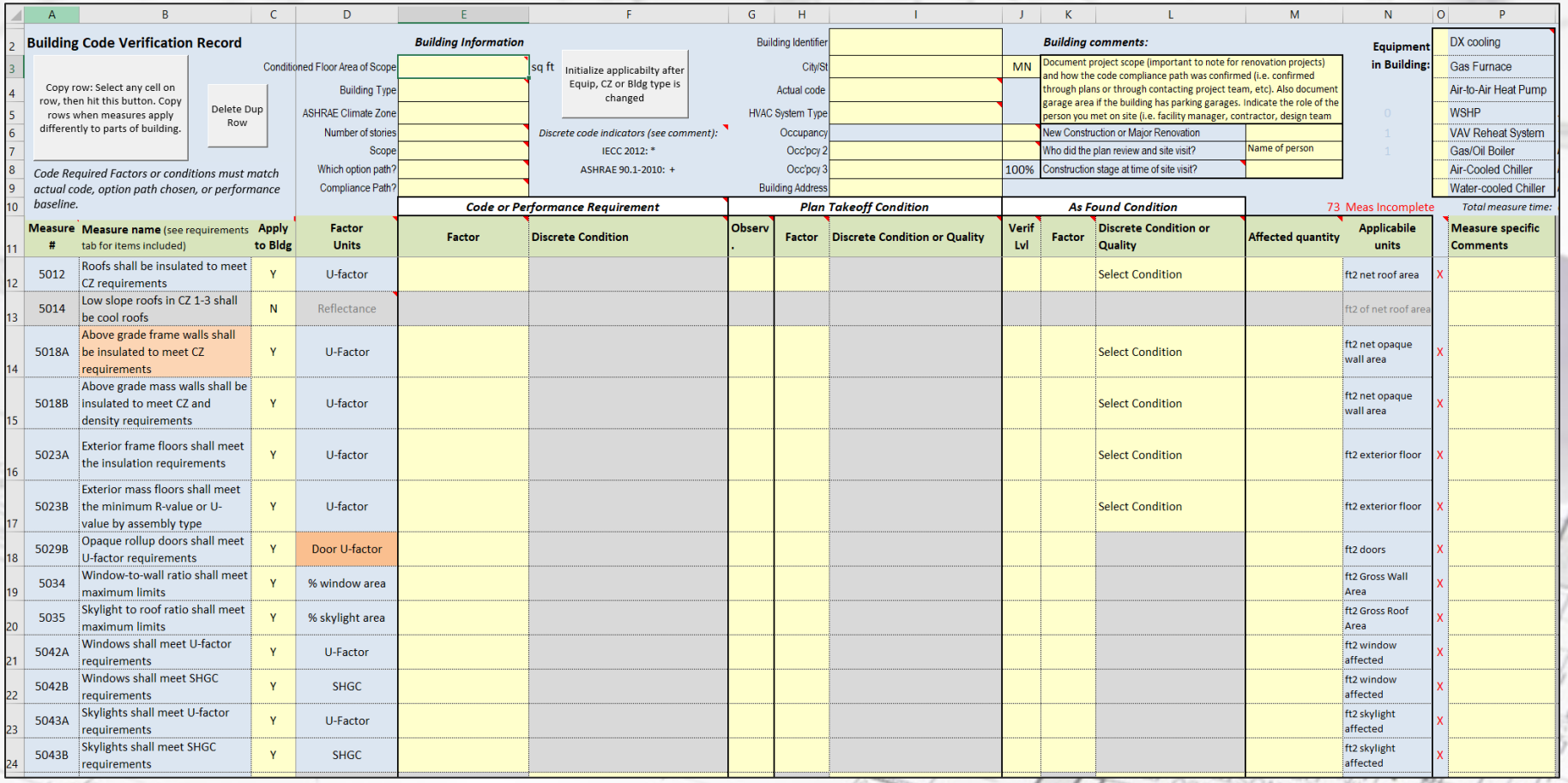
Data collection methods

- Recruit
- Review detailed plans
- On-site verification
- Lost savings calculations



Analytic tool

Data collection tool



Building Code Verification Record

Copy row: Select any cell on row, then hit this button. Copy rows when measures apply differently to parts of building.

Delete Dup Row

Code Required Factors or conditions must match actual code, option path chosen, or performance baseline.

Building Information

Conditioned Floor Area of Scope	sq ft
Building Type	
ASHRAE Climate Zone	
Number of stories	
Scope	
Which option path?	
Compliance Path?	

Initialize applicabilty after Equip, CZ or Bldg type is changed

Discrete code indicators (see comment):

IECC 2012: *

ASHRAE 90.1-2010: +

Building Identifier	
City/St	
Actual code	
HVAC System Type	
Occupancy	
Occ'pcy 2	
Occ'pcy 3	
Building Address	

Building comments:

MN	Document project scope (important to note for renovation projects) and how the code compliance path was confirmed (i.e. confirmed through plans or through contacting project team, etc). Also document garage area if the building has parking garages. Indicate the role of the person you met on site (i.e. facility manager, contractor, design team	
	New Construction or Major Renovation	
	Who did the plan review and site visit?	Name of person
100%	Construction stage at time of site visit?	

Equipment in Building:

	DX cooling
	Gas Furnace
	Air-to-Air Heat Pump
0	WSHP
1	VAV Reheat System
1	Gas/Oil Boiler
	Air-Cooled Chiller
	Water-cooled Chiller

73 Meas Incomplete

Total measure time:

					Code or Performance Requirement			*Plan Takeoff Condition*				*As Found Condition*				
Measure #	**Measure name** (see requirements tab for items included)	**Apply to Bldg**	**Factor Units**	**Factor**	**Discrete Condition**	**Observ.**	**Factor**	**Discrete Condition or Quality**	**Verif Lvl**	**Factor**	**Discrete Condition or Quality**	**Affected quantity**	**Applicabile units**		**Measure specific Comments**
5012	Roofs shall be insulated to meet CZ requirements	Y	U-factor								Select Condition		ft2 net roof area	X	
5014	Low slope roofs in CZ 1-3 shall be cool roofs	N	Reflectance										ft2 of net roof area		
5018A	Above grade frame walls shall be insulated to meet CZ requirements	Y	U-Factor								Select Condition		ft2 net opaque wall area	X	
5018B	Above grade mass walls shall be insulated to meet CZ and density requirements	Y	U-factor								Select Condition		ft2 net opaque wall area	X	
5023A	Exterior frame floors shall meet the insulation requirements	Y	U-factor								Select Condition		ft2 exterior floor	X	
5023B	Exterior mass floors shall meet the minimum R-value or U-value by assembly type	Y	U-factor								Select Condition		ft2 exterior floor	X	
5029B	Opaque rollup doors shall meet U-factor requirements	Y	Door U-factor										ft2 doors	X	
5034	Window-to-wall ratio shall meet maximum limits	Y	% window area										ft2 Gross Wall Area	X	
5035	Skylight to roof ratio shall meet maximum limits	Y	% skylight area										ft2 Gross Roof Area	X	
5042A	Windows shall meet U-factor requirements	Y	U-Factor										ft2 window affected	X	
5042B	Windows shall meet SHGC requirements	Y	SHGC										ft2 window affected	X	
5043A	Skylights shall meet U-factor requirements	Y	U-Factor										ft2 skylight affected	X	
5043B	Skylights shall meet SHGC requirements	Y	SHGC										ft2 skylight affected	X	

Results

Key Takeaways

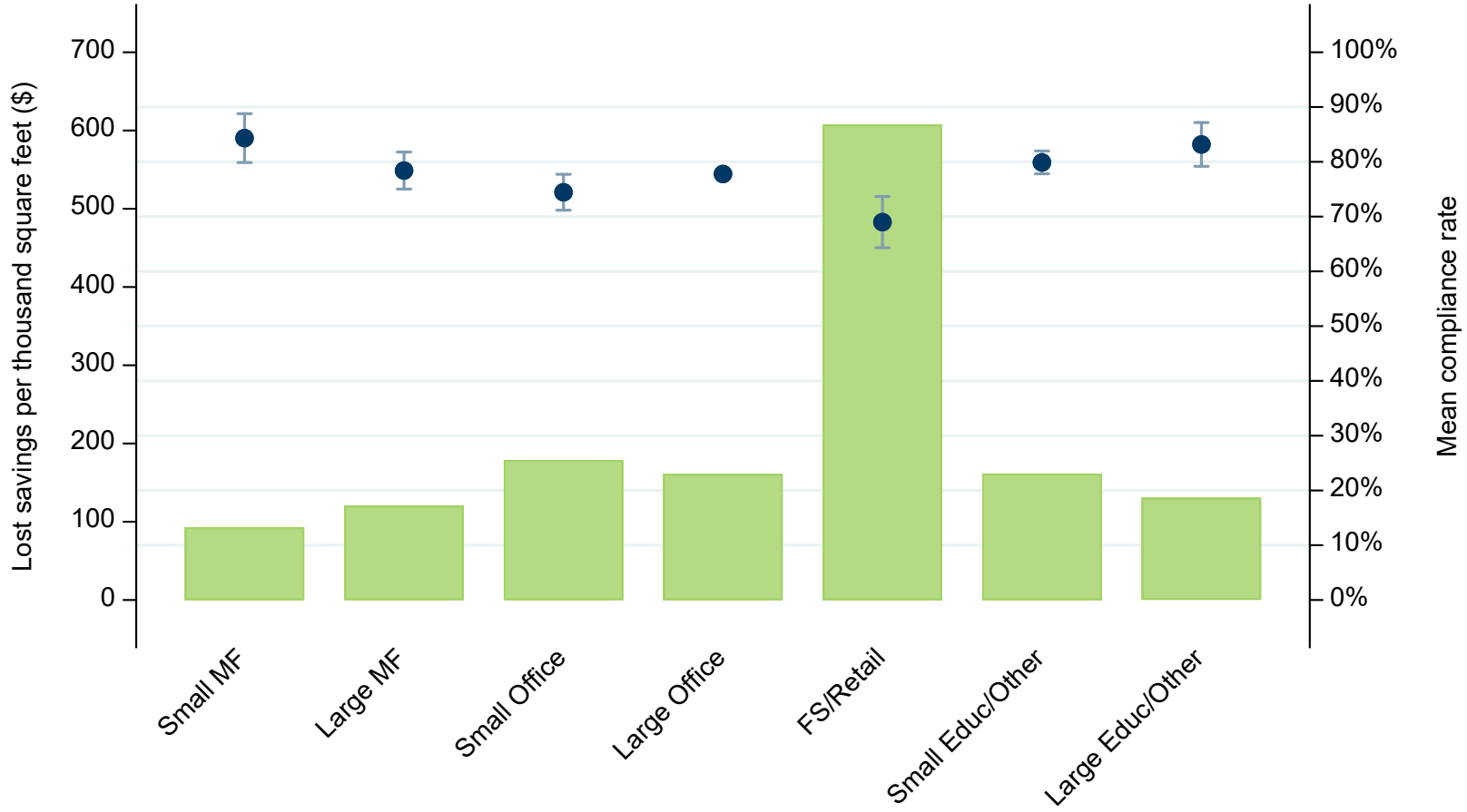
- **Substantial lost savings** for meeting code
- **Envelope measures** were more likely to be complied with
- Non-compliance in mechanical code elements driven by **control and configuration elements**
- Several code elements commonly **go beyond prescriptive code**

Results: Overview

Average compliance rates generally range between **70%–85%**

This translates to **over $10 million** in annual lost savings

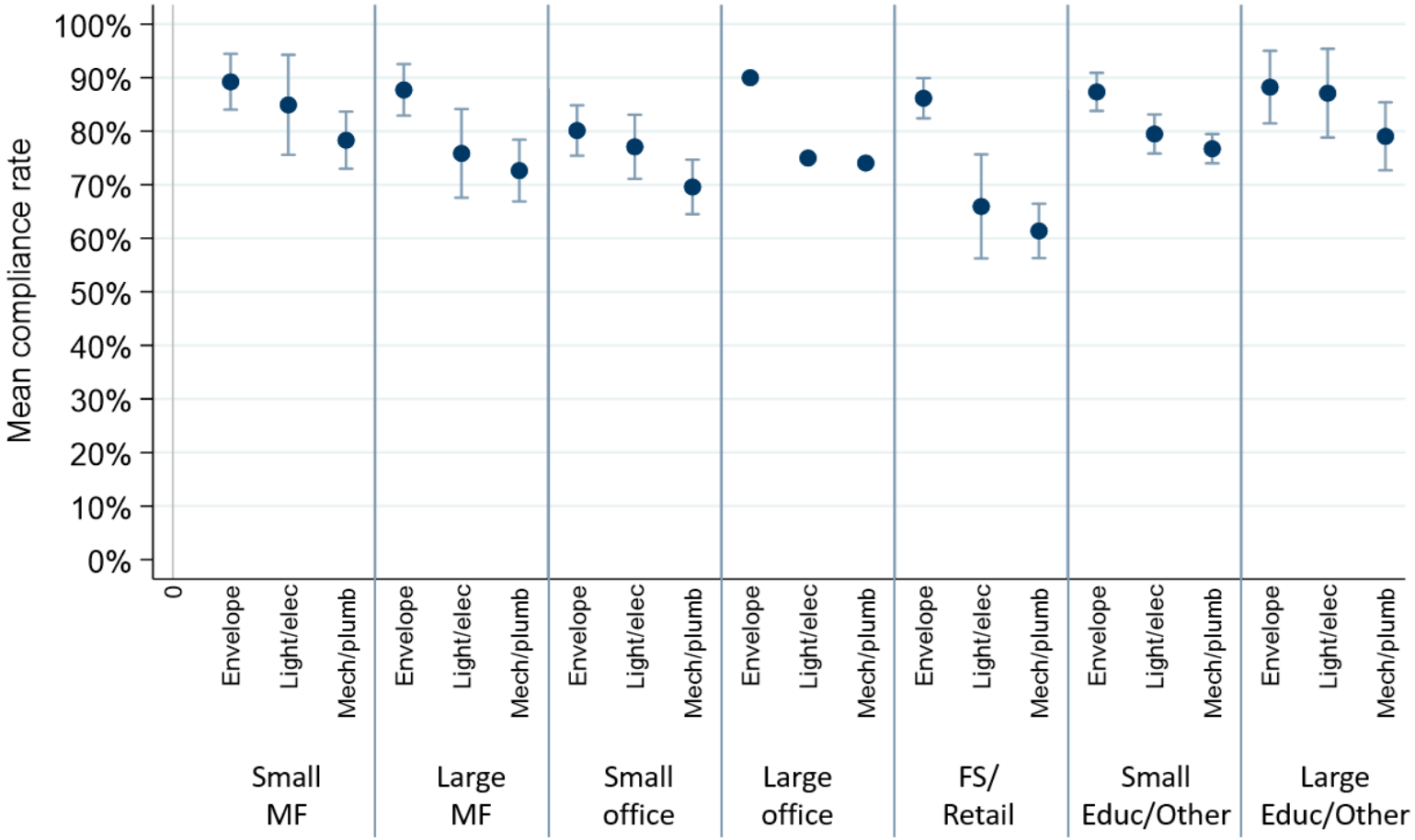
Mean compliance rate and average normalized lost savings



Vertical lines are 90% sampling error margins
Large office does not have error bars because it is a sample of one

Results: Code Compliance by End Use

When focusing on end-use, some differences emerge…



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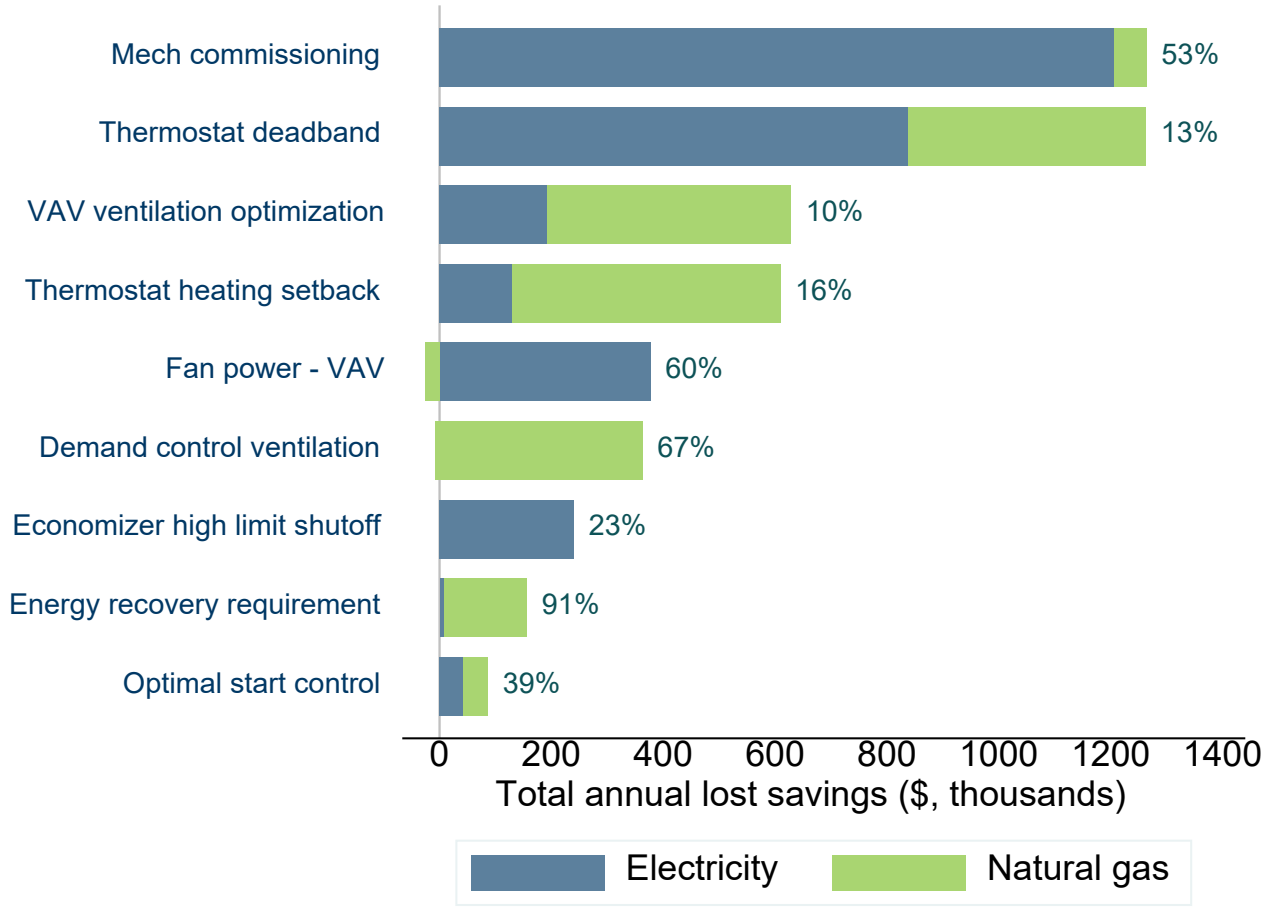
Results: Worst-Performing Mechanical and Plumbing Code Elements

Worst-performing mechanical / plumbing code elements: lost savings and compliance rate



Percentages indicate overall compliance rate for all building segments

Note: this slide has been updated from the original webinar aired on September 22

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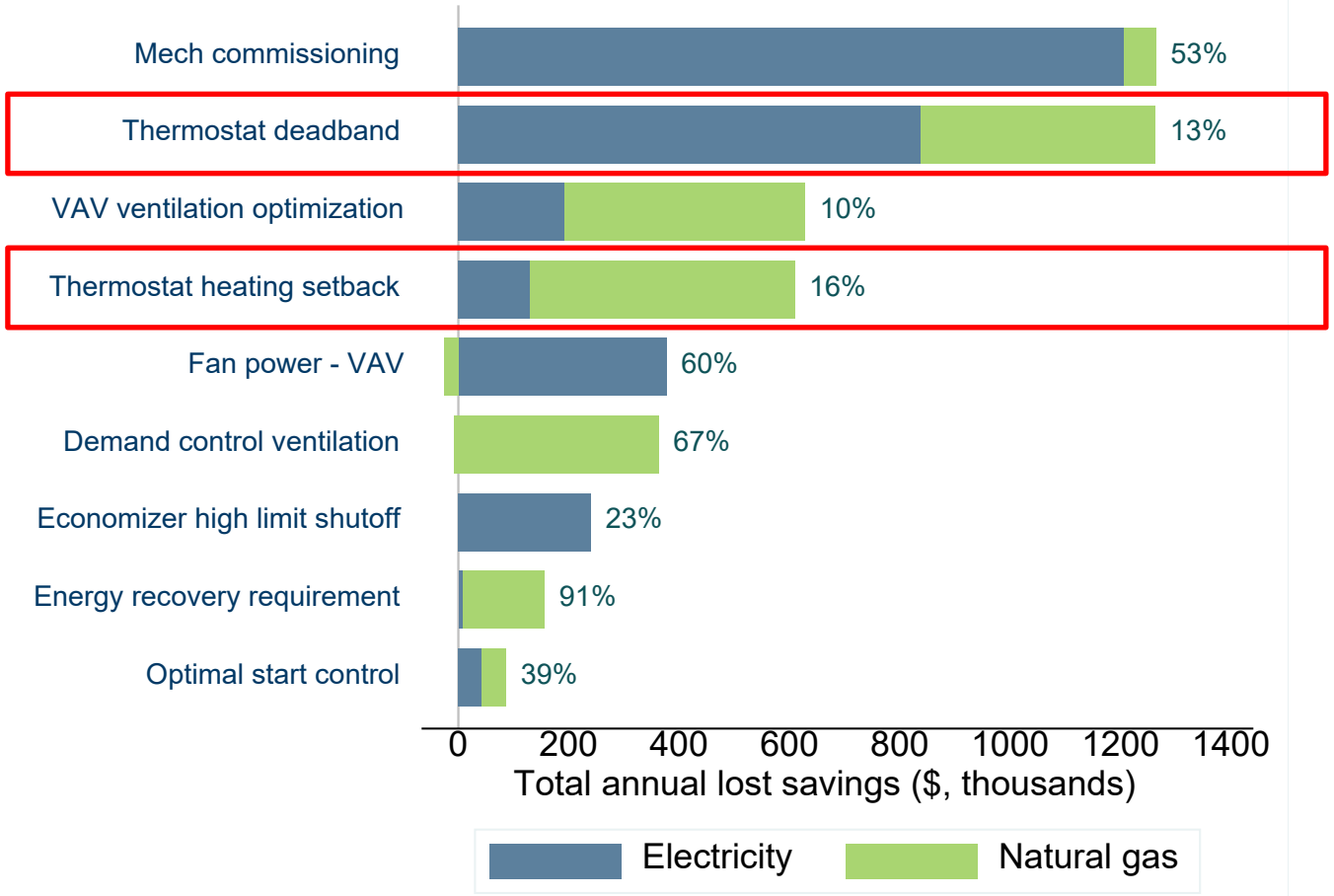

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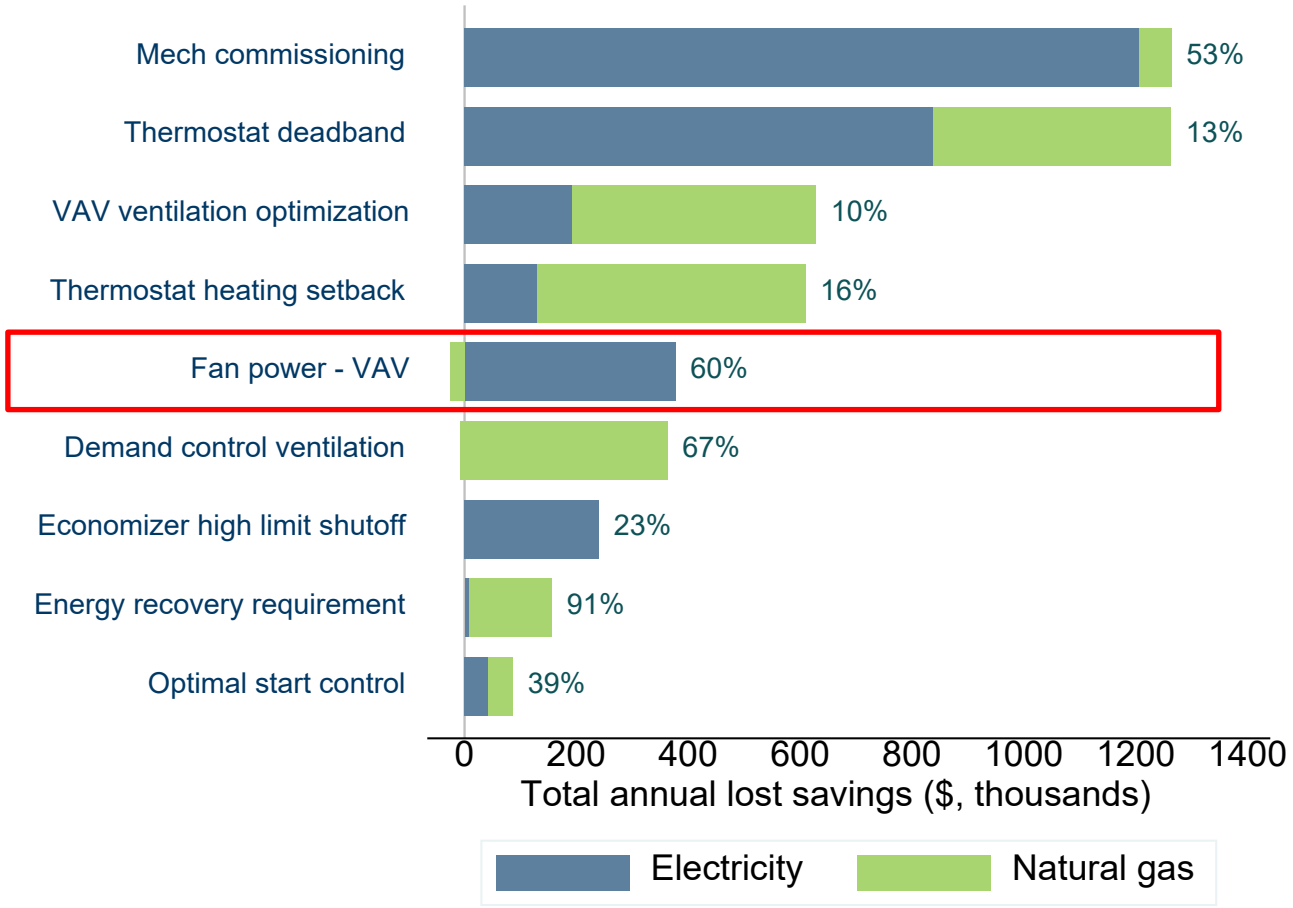

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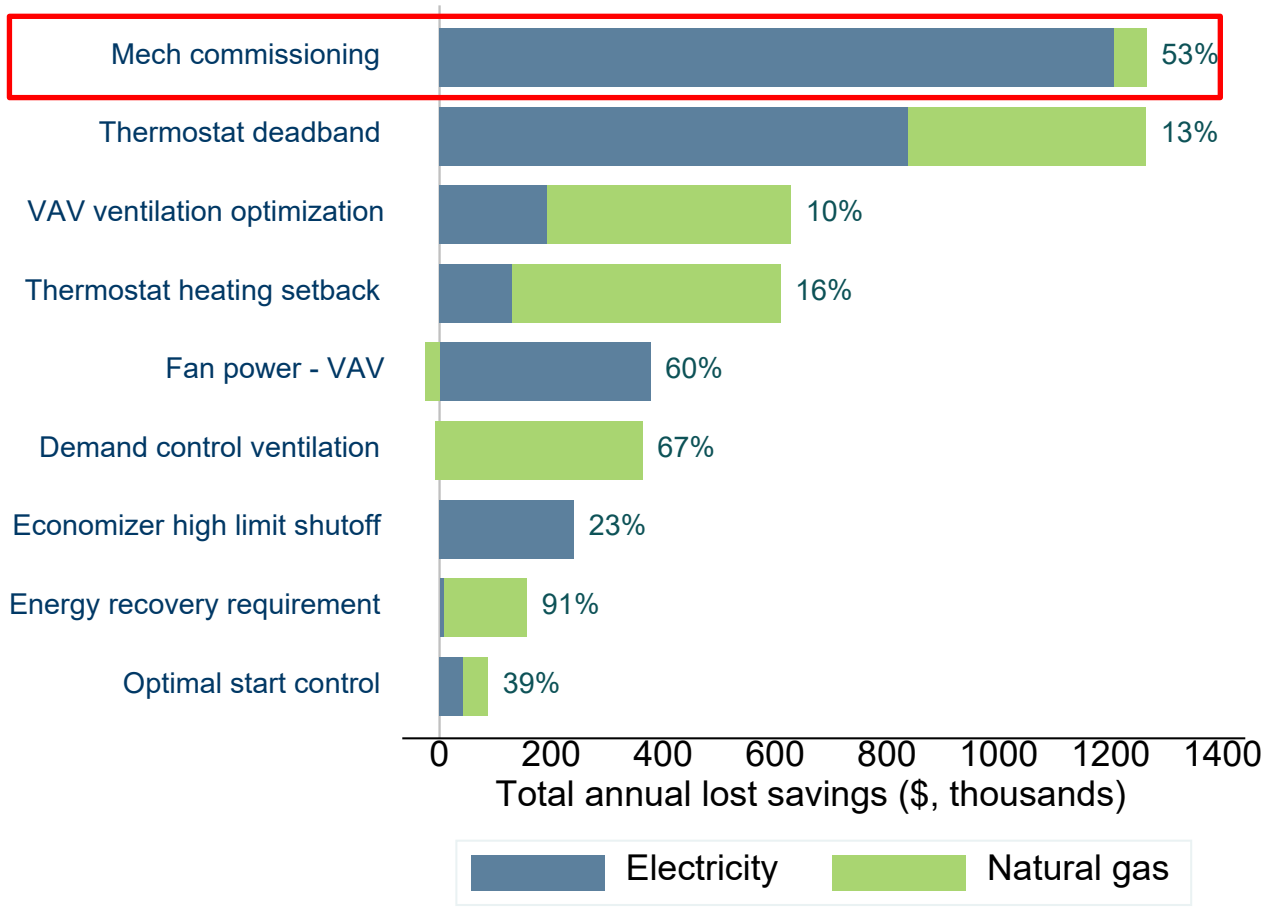

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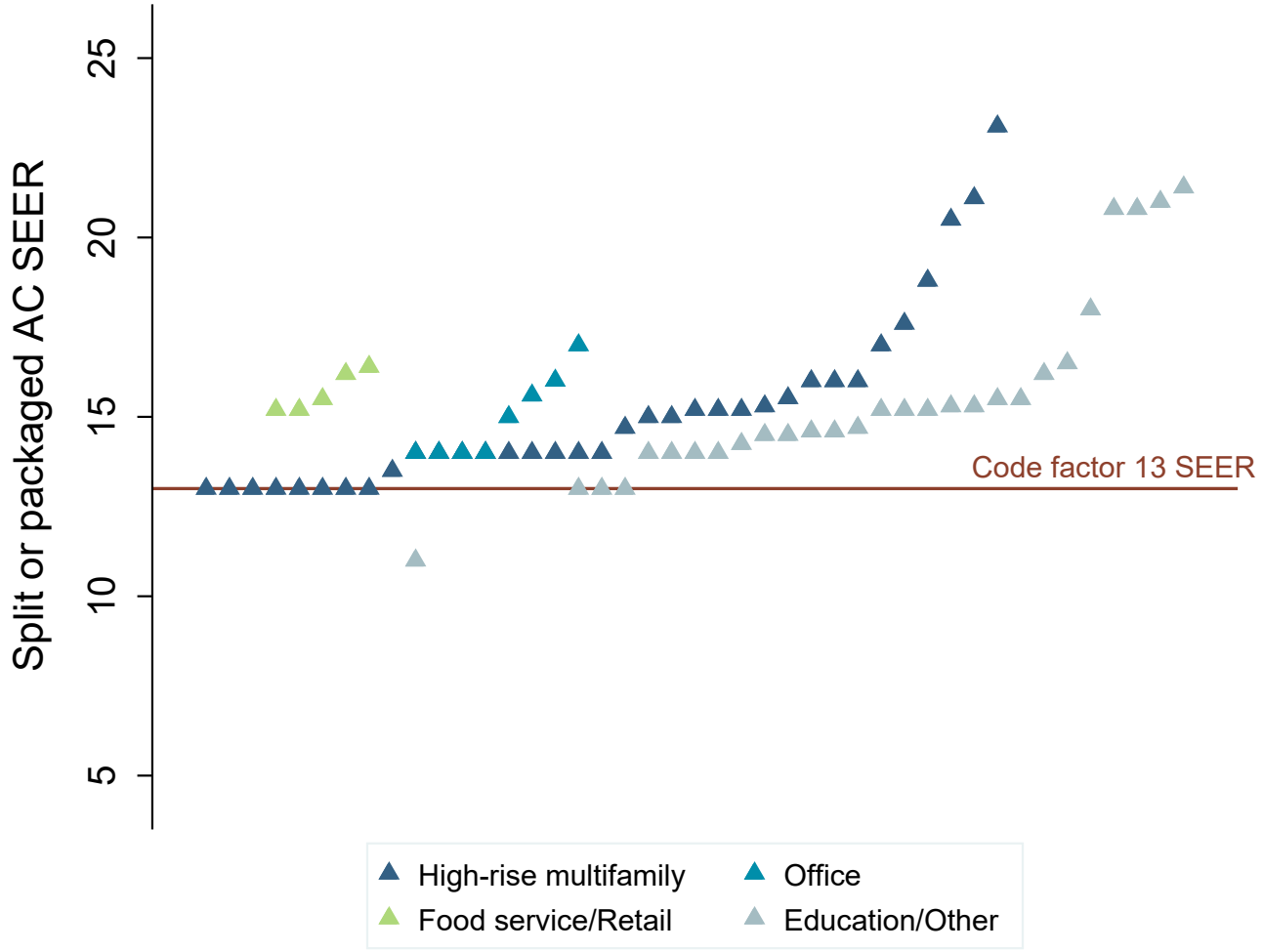
Examples of Compliant Mechanical Elements

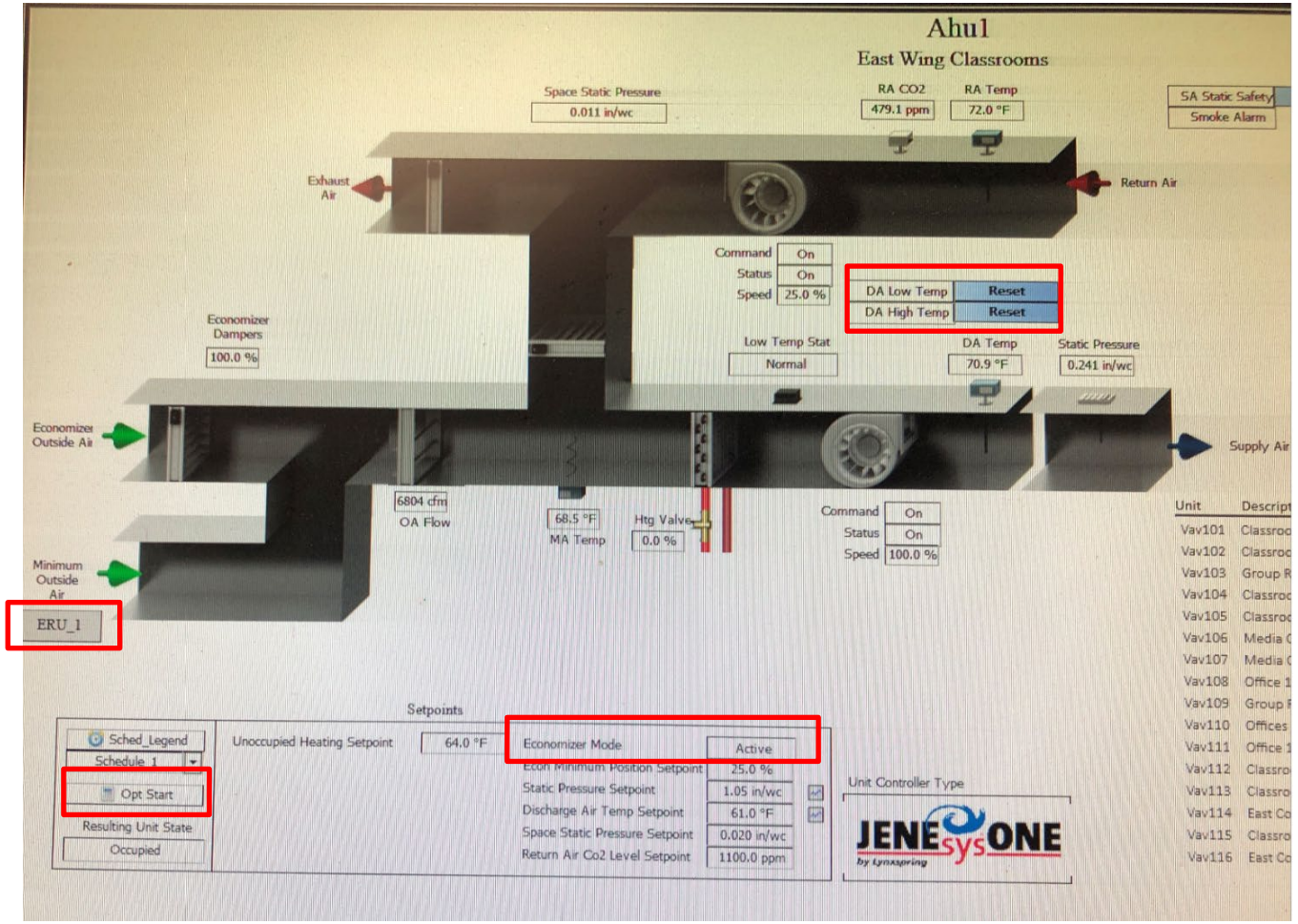
Most commonly complied with mechanical code elements include:

- Cooling and heating equipment efficiency
- Air economizer present
- Hot water pipe insulation (space heating and domestic hot water)
- Duct insulation



Reference lines indicate baseline code

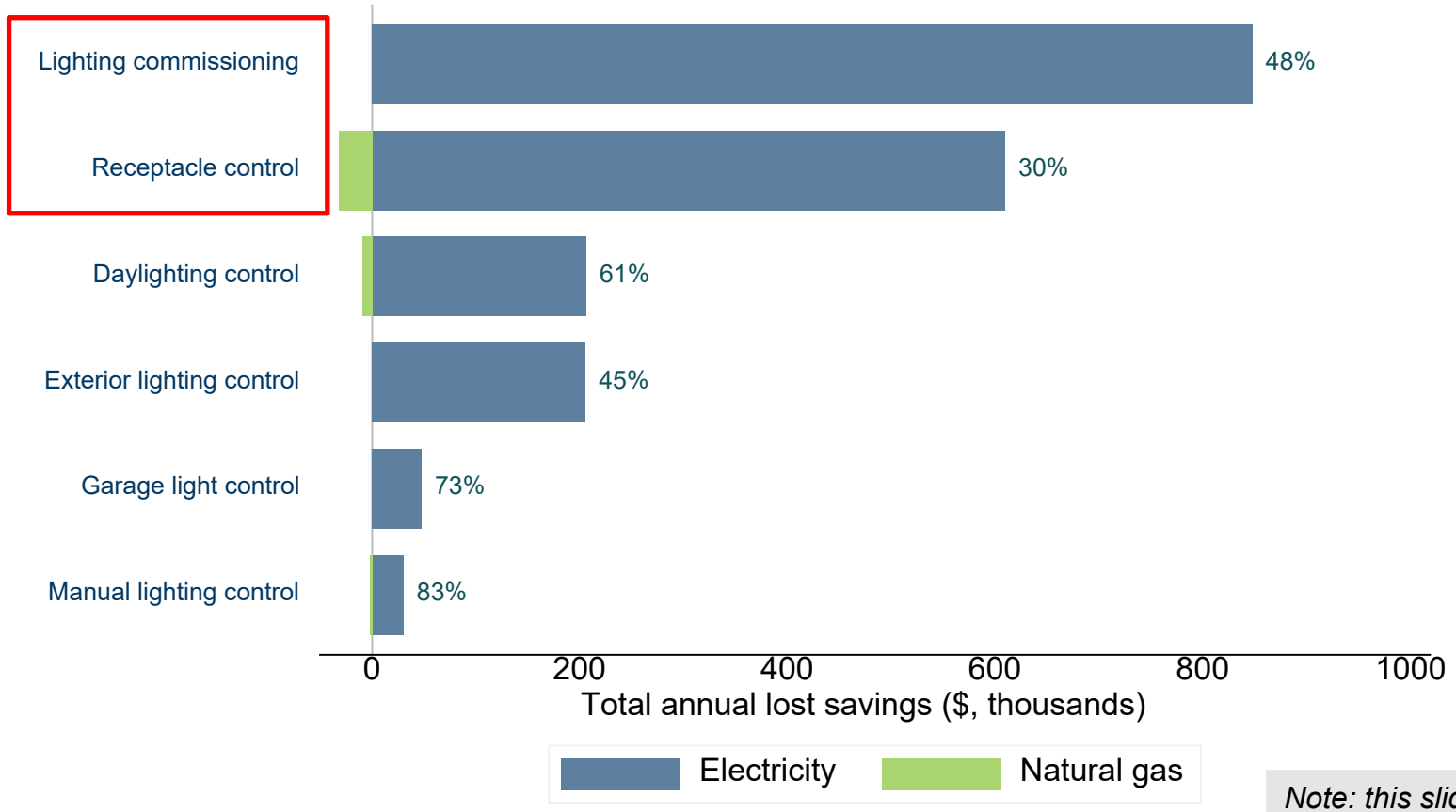
Examples of Compliant Mechanical Elements



Building Automation System (BAS) showing key operating inputs

Results: Worst-Performing Lighting and Electrical

Worst-performing lighting/electrical code elements: lost savings and compliance rate

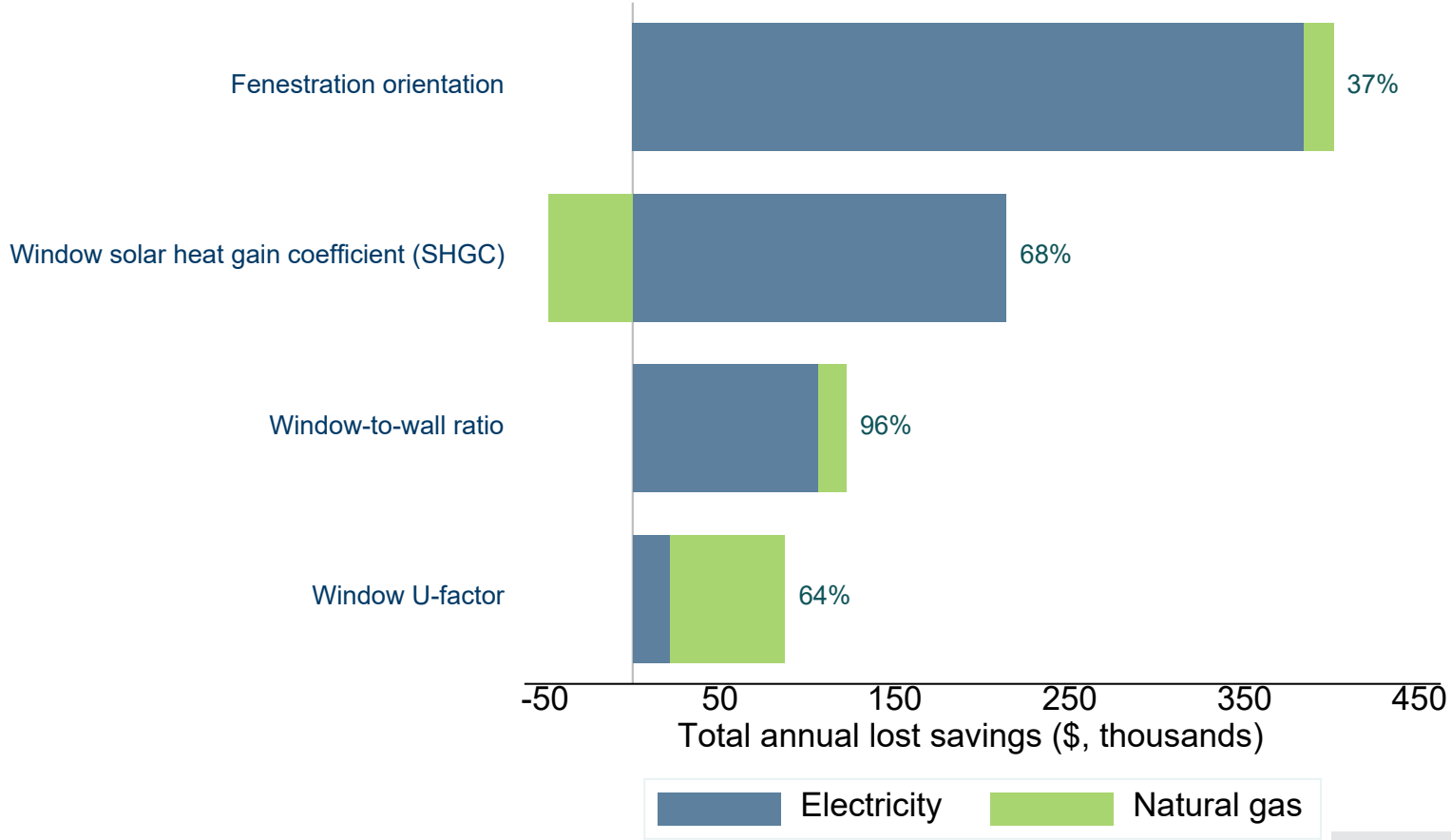


Percentages indicate overall compliance rate for all building segments

Note: this slide has been updated from the original webinar aired on September 22

Results: Worst-Performing Envelope Elements

Worst-performing envelope code elements: lost savings and compliance rate



Percentages indicate overall compliance rate for all building segments

Note: this slide has been updated from the original webinar aired on September 22

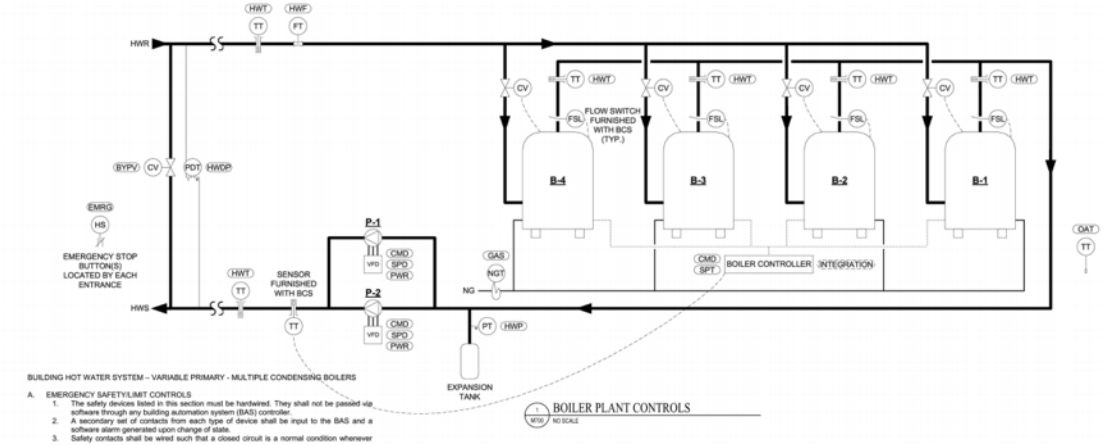
Plan Documentation

Plan documentation is **critical** in ensuring compliance of code elements

If elements are poorly documented…

… increased risk for **confusion**

… any compliance is either **accidental** or due to a **contractor's prior knowledge** of the code.



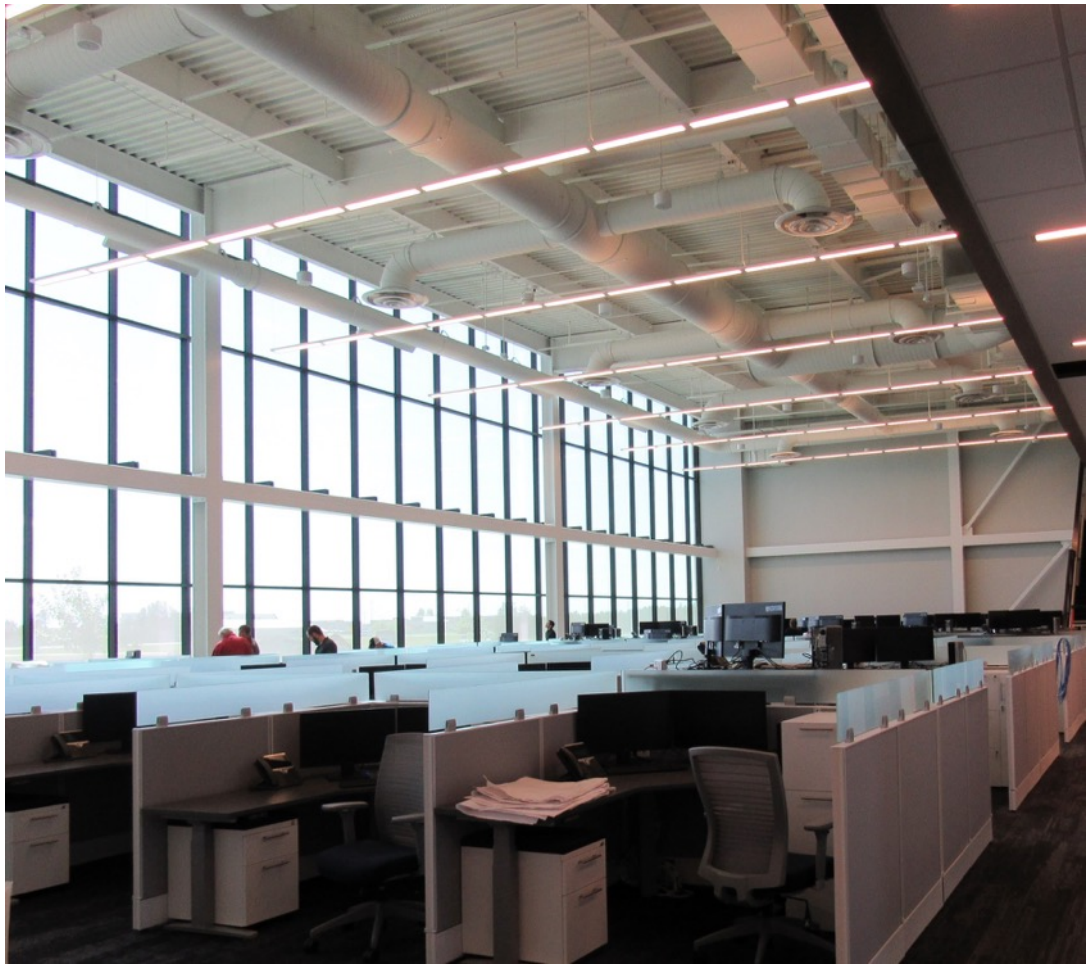
C. ZONE TEMPERATURE
1. Occupied heating and cooling zone temperature setpoints shall be 68°F (adj.) and 75°F (adj.) respectively.
2. Unoccupied heating and cooling zone temperature sepoints shall be 60°F (adj.) and 80°F (adj.) respectively.

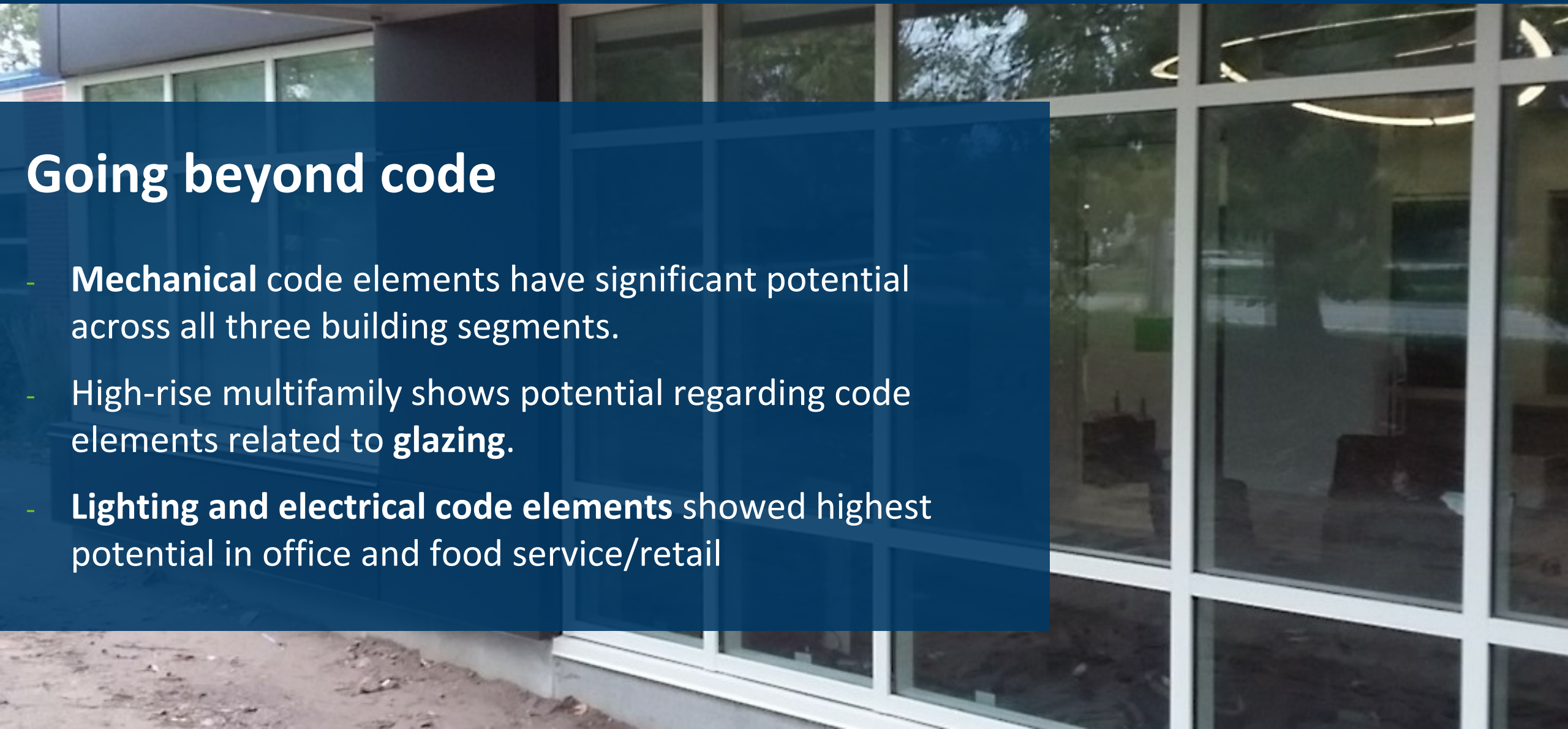
D. SUPPLY FAN CONTROL
1. Fan shall run continuously during occupied mode.
2. Fan shall run intermittently only to provide heating and cooling as required during unoccupied mode.
3. VFD command, power, and speed signals shall be hardwired to/from BAS controller. VFD status shall be determined in software. VFD status shall read as on when power is above normal minimum operating range, to be field determined. For example, status may be on

Poorly Documented Elements Not Built to Code

Most common non-compliant elements that were poorly documented:

- Mechanical and lighting commissioning
- Thermostat deadband and setbacks
- Economizer high-limit shutoff control
- Receptacle controls
- Window properties
- Optimal start controls



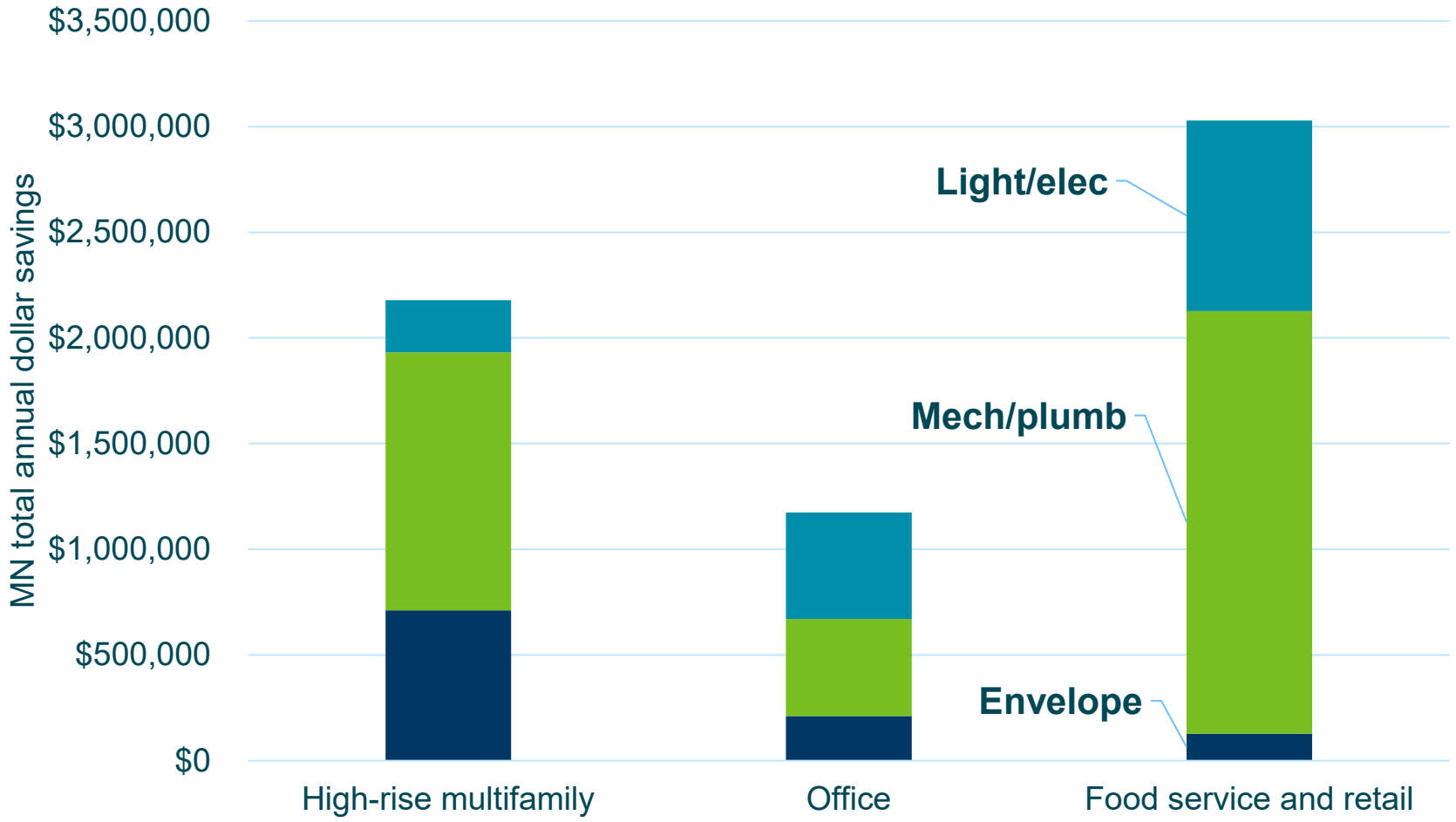


Going beyond code

- **Mechanical** code elements have significant potential across all three building segments.
- High-rise multifamily shows potential regarding code elements related to **glazing**.
- **Lighting and electrical code elements** showed highest potential in office and food service/retail

Beyond Code Savings

Potential savings beyond ASHRAE 90.1-2010 prescriptive code, by end use

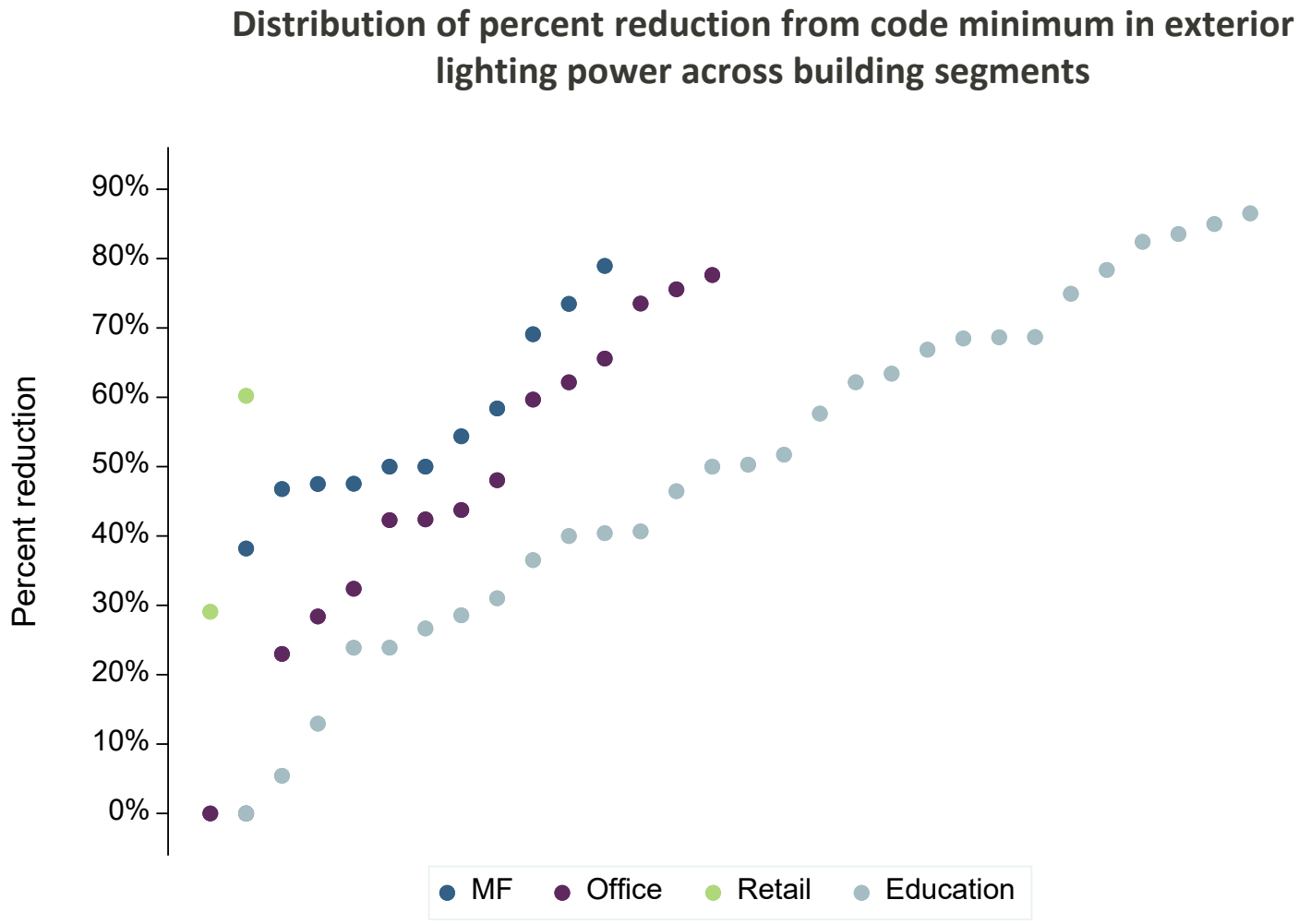


This totals **over $6 million** in additional potential energy savings for MN commercial customers

Elements Already Exceeding Code

A number of elements already were going beyond code:

- Mass wall insulation
- **Interior and exterior lighting power**
- Equipment cooling and heating efficiency



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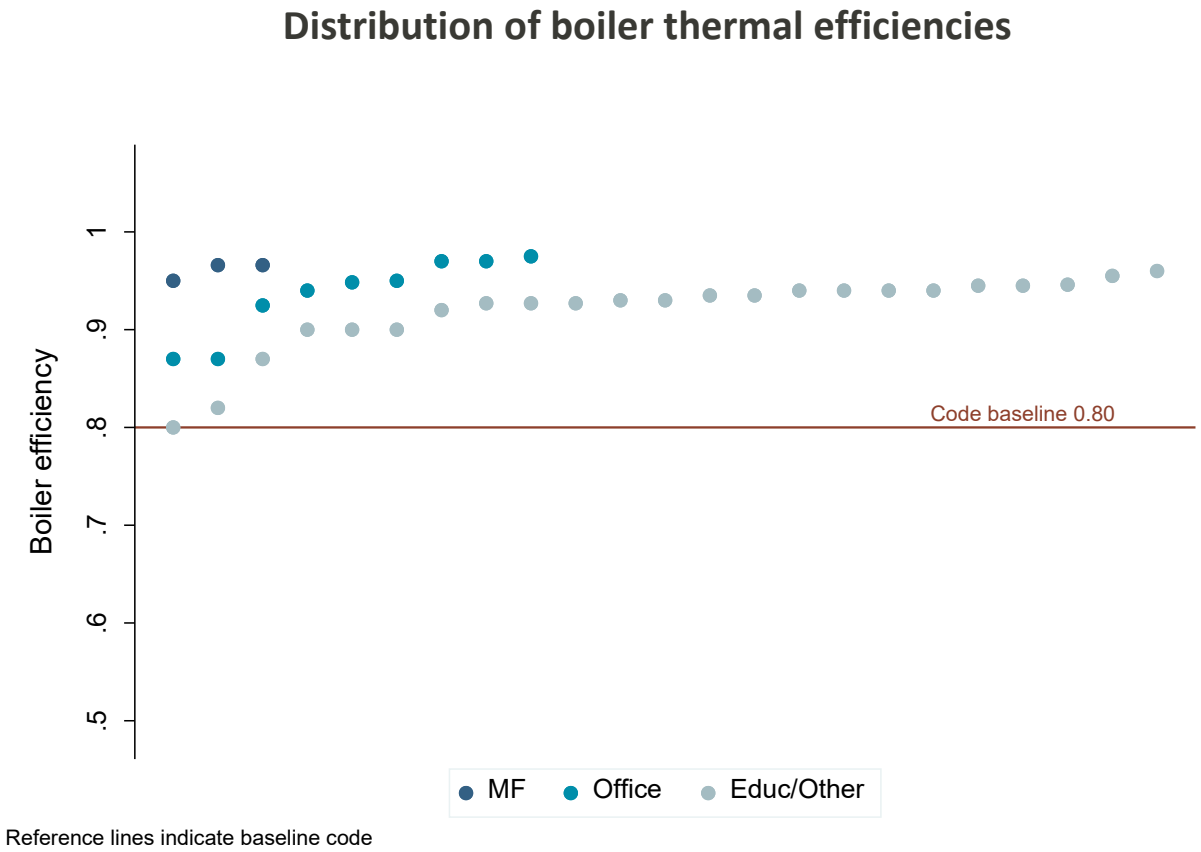

Opportunities and Recommendations

Opportunities for Reaching Full Potential of the Energy Code

Code officials in the plan review and inspection process

Design teams to improve understanding of code elements and documentation practices.

Controls documentation and commissioning

Reaching Full Potential: Support for Code Officials

Support for Code Officials

Opportunities

- Educate design teams
- Catch non-compliant code elements during plan review
- Verify commonly non-compliant elements through on-site inspections

Recommendation

Provide a menu of support options for code officials:

- Circuit rider
- Third-party reviewers

Examples: Minnesota's 2018 Commercial Energy Code Compliance Enhancement Pilot, Florida, Massachusetts, Dallas, District of Columbia

Support for Design Teams

Opportunities

Minimize code elements that are either:

- Not specified in the design documents
- Specified, but not meeting energy code requirements

Recommendation

Provide a shared set of resources, including:

- A sample agenda an early design kick-off meeting
- Phase-specific checklists
  - Design phase
  - Construction phase
  - Testing and commissioning phase

Support for Controls Documentation and Commissioning

Opportunities

- Improve documentation of controls and commissioning requirements
- Increase number of projects that are commissioned

Recommendations

- Educate owners on value of commissioning
- Provide commissioning guidance and resources
- Improve enforcement of controls and commissioning

Examples: Washington State, California, and Austin, Texas

Achieve Beyond Code Savings

Promote high-impact prescriptive strategies

Promote energy modeling

Address operational performance

Achieve Beyond Code Savings: Promote Prescriptive Strategies

Promote Prescriptive Strategies

Opportunities

- Expand use of market-ready efficiency strategies
- Preview future code requirements

Recommendation

- Incorporate into new construction CIPs
  - A la carte
  - Strategy bundles

Achieve Beyond Code Savings: Promote Energy Modeling

Promote Energy Modeling

Opportunities

- Expand use of performance code pathways
- Expand energy modeling analysis of non-regulated elements

Recommendations

- Conduct a market analysis of energy modeling in Minnesota
- Expand energy modeling through CIPs

Achieve Beyond Code Savings Address Operational Performance

Address Operational Performance

Opportunities

- Verify operations-dependent savings are maintained
- Ensure hard-to-verify code elements achieve savings

Recommendation

- Offer a pay-for-performance program

Options for future code pathways

1. More **aggressive pathways** within building energy code
2. **Step energy code** option for local jurisdictions
3. Pilot **outcome-based energy** code pathway

Examples: New York State, Boulder, California, Seattle, Minnesota's SB 2030 Program

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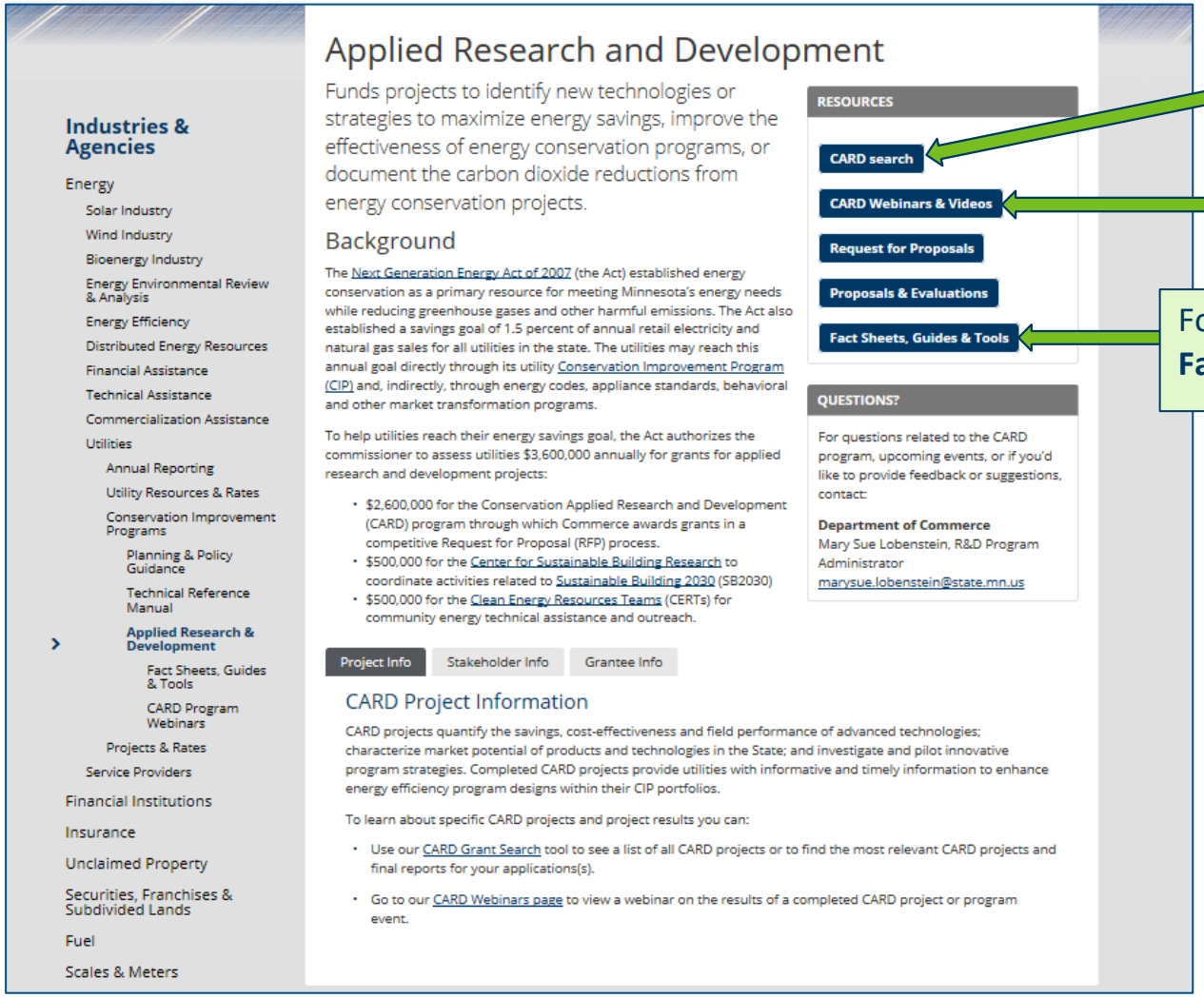
Type questions into the Q&A box on the bottom right side of the WebEx panel and send them to "**All Panelists**."

CARD Project Resources



Industries & Agencies

- Energy
  - Solar Industry
  - Wind Industry
  - Bioenergy Industry
  - Energy Environmental Review & Analysis
  - Energy Efficiency
  - Distributed Energy Resources
  - Financial Assistance
  - Technical Assistance
  - Commercialization Assistance
  - Utilities
    - Annual Reporting
    - Utility Resources & Rates
    - Conservation Improvement Programs
      - Planning & Policy Guidance
      - Technical Reference Manual
      - **Applied Research & Development**
        - Fact Sheets, Guides & Tools
        - CARD Program Webinars
      - Projects & Rates
  - Service Providers
- Financial Institutions
- Insurance
- Unclaimed Property
- Securities, Franchises & Subdivided Lands
- Fuel
- Scales & Meters

Applied Research and Development

Funds projects to identify new technologies or strategies to maximize energy savings, improve the effectiveness of energy conservation programs, or document the carbon dioxide reductions from energy conservation projects.

Background

The Next Generation Energy Act of 2007 (the Act) established energy conservation as a primary resource for meeting Minnesota's energy needs while reducing greenhouse gases and other harmful emissions. The Act also established a savings goal of 1.5 percent of annual retail electricity and natural gas sales for all utilities in the state. The utilities may reach this annual goal directly through its utility Conservation Improvement Program (CIP) and, indirectly, through energy codes, appliance standards, behavioral and other market transformation programs.

To help utilities reach their energy savings goal, the Act authorizes the commissioner to assess utilities $3,600,000 annually for grants for applied research and development projects:

- $2,600,000 for the Conservation Applied Research and Development (CARD) program through which Commerce awards grants in a competitive Request for Proposal (RFP) process.
- $500,000 for the Center for Sustainable Building Research to coordinate activities related to Sustainable Building 2030 (SB2030)
- $500,000 for the Clean Energy Resources Teams (CERTs) for community energy technical assistance and outreach.

RESOURCES

CARD search

CARD Webinars & Videos

Request for Proposals

Proposals & Evaluations

Fact Sheets, Guides & Tools

QUESTIONS?

For questions related to the CARD program, upcoming events, or if you'd like to provide feedback or suggestions, contact:

Department of Commerce
Mary Sue Lobenstein, R&D Program Administrator
marysue.lobenstein@state.mn.us

Project Info | Stakeholder Info | Grantee Info

CARD Project Information

CARD projects quantify the savings, cost-effectiveness and field performance of advanced technologies; characterize market potential of products and technologies in the State; and investigate and pilot innovative program strategies. Completed CARD projects provide utilities with informative and timely information to enhance energy efficiency program designs within their CIP portfolios.

To learn about specific CARD projects and project results you can:

- Use our CARD Grant Search tool to see a list of all CARD projects or to find the most relevant CARD projects and final reports for your applications(s).
- Go to our CARD Webinars page to view a webinar on the results of a completed CARD project or program event.

For **Reports** use **CARD Search** Quick Link

For **Webinars** use **CARD Webinars & Videos** Quick Link

For **Other** research documents use **CARD Fact Sheets, Guidelines & Tools** Quick Link

Webinar Recording & Final Report
available in couple months

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

How Did We Do?

Location:

https://app.keysurvey.com/f/41507551/3ead/

Thanks for Participating!

Upcoming CARD Webinars:

- **September 29** – Improve Your Commercial Light Levels and Save on Cost (Slipstream)
- **October 20** – Portable Dehumidification in MN Single-Family Homes (Center for Energy and Environment)
- **November 10** – Market Potential for Saving Energy and Carbon Emissions with Load Shifting Measures (Slipstream)

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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651-539-1872