

Welcome

Conservation Applied Research & Development (CARD) Webinar

December 10, 2020

CIP Opportunities in the C&I Refrigeration Market

CIP Opportunities in the C&I Refrigeration Market



Mary Sue Lobenstein
R&D Program Adm.
MN Depart ’t of Commerce
marysue.Lobenstein@state.mn.us



Laura Silver
Senior State Program Adm.
MN Depart ’t of Commerce
laura.silver@state.mn.us



Russ Landry
Senior Mechanical Engineer
Center for Energy and Environment
rlandry@mncee.org



Steve Mulqueen
Energy Engineer
Cascade Energy
steve.mulqueen@cascadeenergy.com



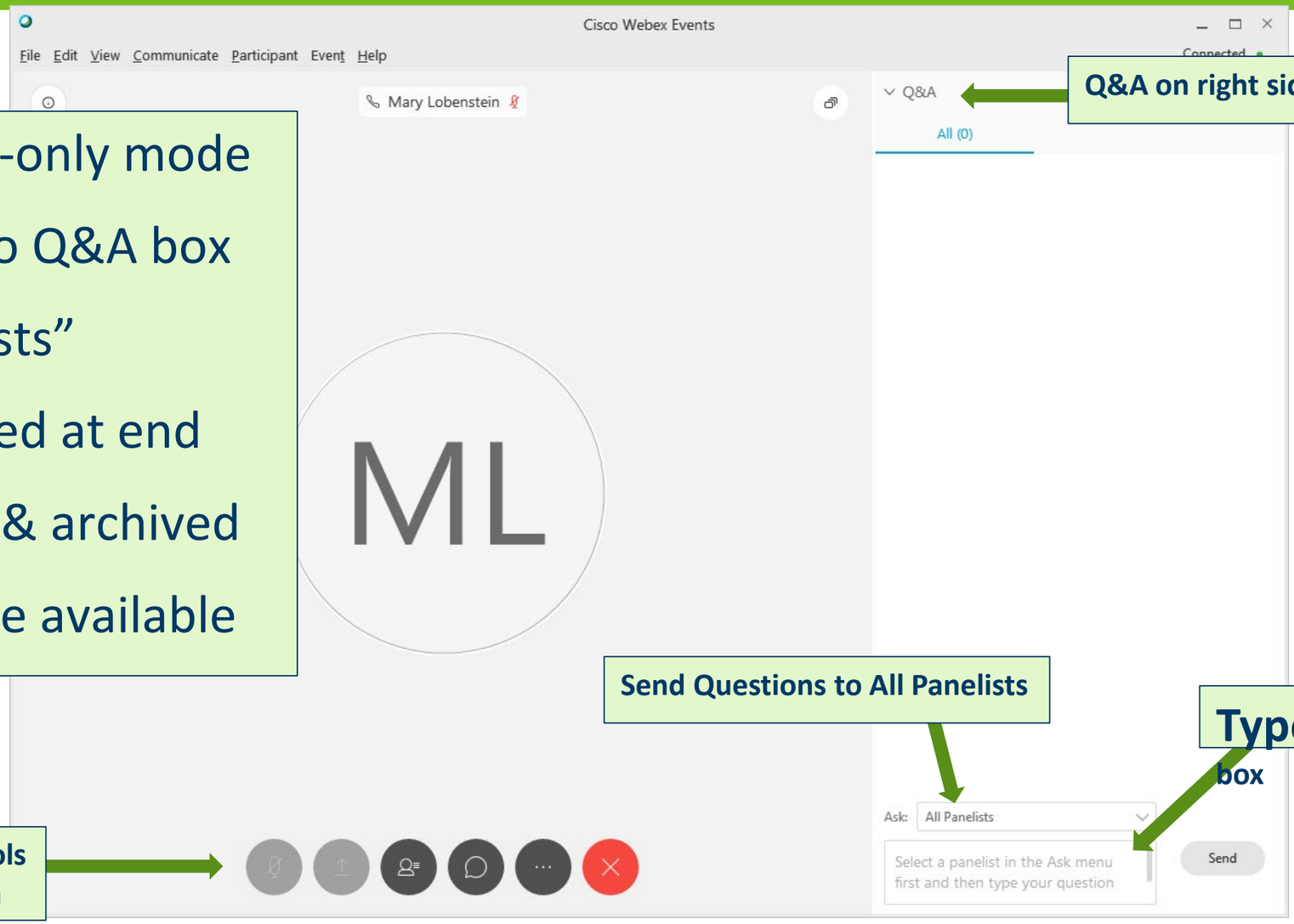
Melanie Lord
Sr. Project Manager
Slipstream
mlord@slipstreaminc.org



Jim Kelsey
President
KW Engineering
kelsey@kw-engineering.com

Webinar Basics

- Attendees in listen-only mode
- Type questions into Q&A box
- Send to “All Panelists”
- Questions addressed at end
- Webinar recorded & archived
- Slide set will also be available



Q&A on right side of WebEx panel

Send Questions to All Panelists

Type Questions in Q&A box

Additional WebEx Controls at Bottom of Your Screen

Minnesota Applied Research & Development Fund

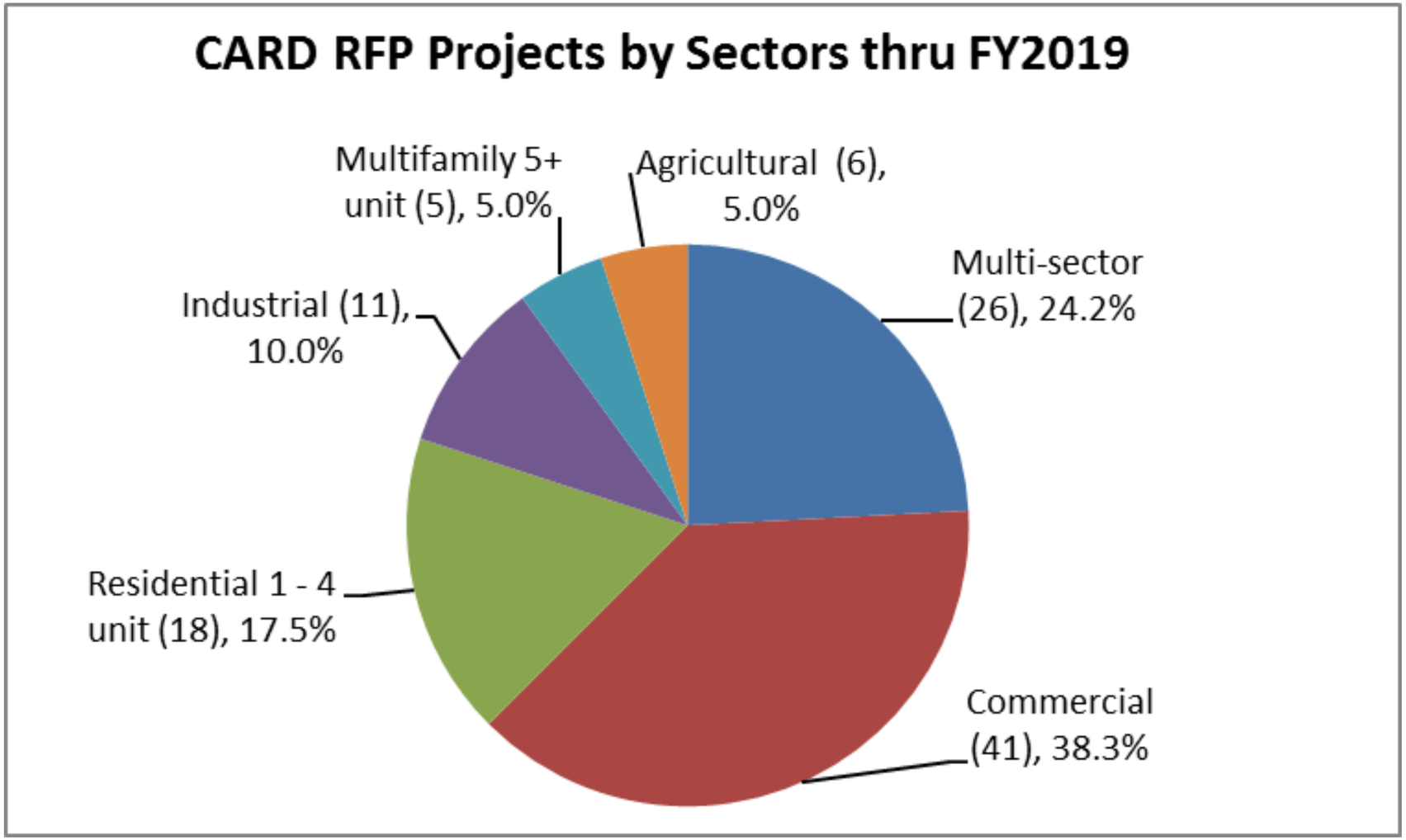
- **Purpose to help Minnesota utilities achieve 1.5% energy savings goal by:**
  - ***Identifying new technologies or strategies to maximize energy savings;***
  - ***Improving effectiveness of energy conservation programs;***
  - ***Documenting CO_2 reductions from energy conservation programs.***

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

What We'll Be Discussing Today

- Project Introduction
  - Russ Landry, CEE
- Utility Programs & Facility/Construction Activity Data
  - Melanie Lord, Slipstream
- Results by Sector
  - Grocery
    - Jim Kelsey, kW Engineering
  - Industrial
    - Steve Mulqueen, Cascade Energy
  - Ice Arenas
    - Russ Landry, CEE
- Summary & CIP Program Recommendations
  - Russ Landry, CEE

Market Study Context

- **Why Statewide Study?**
  - Low CIP program refrigeration savings compared to potential
  - Refrigerant and technology changes
  - Local factors (e.g. climate, market conditions, ice arenas)

- **Goal:** To generate information about the medium and large commercial and industrial refrigeration market in Minnesota that will help programs increase the savings realized in this sector.
  - New Measures
  - New Program Approaches

- **Sector:** Large, Refrigeration Dominated Facilities
  - Grocery
  - Industrial refrigeration (food processing and cold storage)
  - Ice arenas

Key Common Characteristics of Refrigeration Dominated Facilities Market

- Technology: Field Assembled Systems
  - Matching of components & system control often has bigger impact than the efficiency of any one component
  - Details of what contractors, designers & operators do is critical to maximizing efficiency

- Market: Very Few Key Trade Allies
  - Installation contractors
  - Service contractors
  - Designers

Market Study Investigation Approaches

- Utility Program Reviews
- Facility & Construction Data
- 20 national level Interviews
- 41 local market interviews
- 15 site reviews
- Estimated cost-effectiveness & potential increase to program impact for 25 “new” measures

Utility Programs & Facility/Construction Activity Data:

Melanie Lord, Slipstream

Minnesota Energy Efficiency Programs for Refrigeration

Program	Incentives	Utility	Common participants
HVAC+R (Refrigeration component)	Prescriptive and Custom	Xcel Energy	Grocery stores, large central cold storage facilities, food banks, hospitals
Custom Business Efficiency	Custom	Minnesota Power	Convenience stores and ice arenas
Refrigeration	Prescriptive	Otter Tail Power	Large customers with facility managers

Estimated Number of Grocery Stores, Indoor Ice Arenas and Food Manufacturing & Cold Storage



979 Grocery Stores

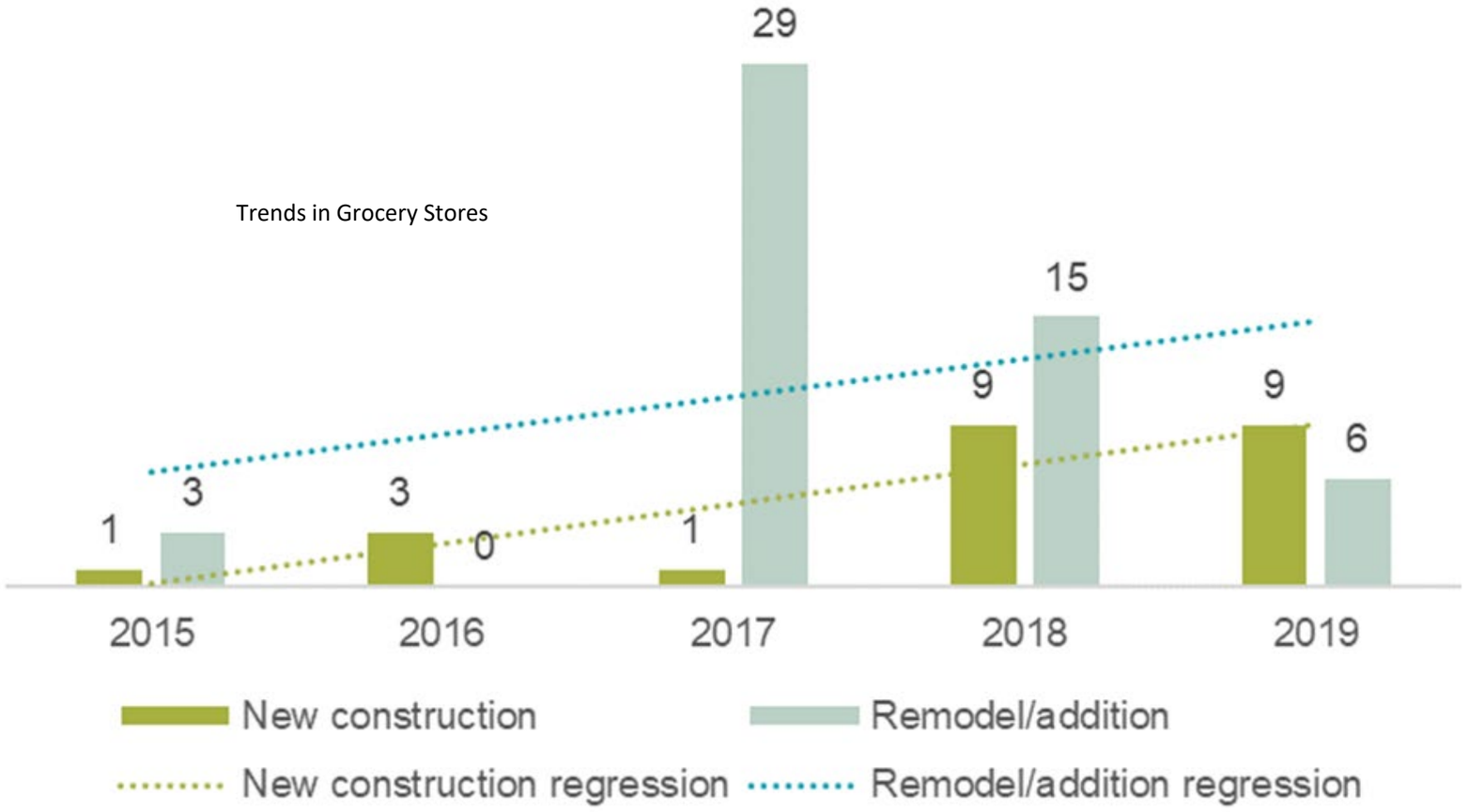


208 Indoor Ice Arenas

223 Refrigeration-dominated Food Manufacturing And Cold Storage Facilities

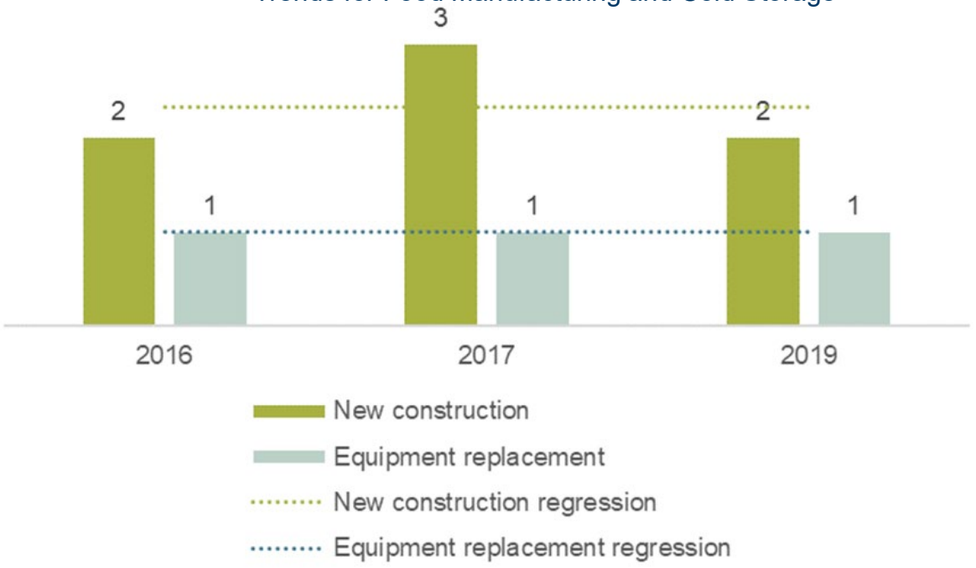


New Construction and System Replacement Rates

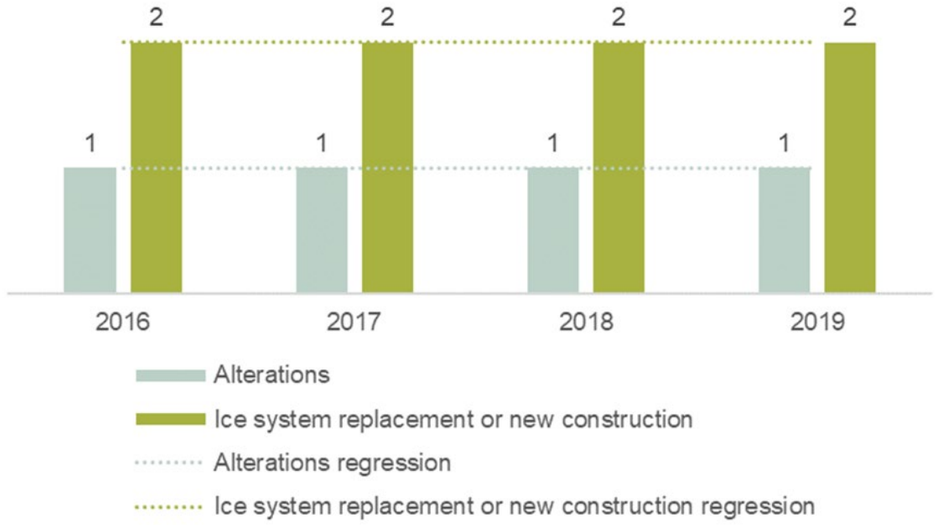


New Construction and System Replacement Rates (cont.)

Trends for Food Manufacturing and Cold Storage



Trends for Indoor Ice Arenas



Programs Outside of Minnesota

Program	Incentives	Utility	Common participants
Energy Smart Industrial	Prescriptive/ Custom	Bonneville Power Administration	Food processors and pulp & paper
Industrial System Optimization Program	Custom	Puget Sound Energy	Cold storage
Industrial Refrigeration Study	Custom	ComEd	Food processors and cold storage
Large Energy Users	Prescriptive and Custom	Various Wisconsin utilities	Food processors and cold storage
Municipal Ice Rink	Prescriptive and Custom	SaskPower	Indoor ice rinks
Pilot: Monitoring Based Commissioning	Custom	NYSERDA	Grocery stores
EnergySmart Grocer	Prescriptive	PG&E and National Grid	Grocery stores

Successful Program Approaches

Outreach recommendations

Subsector	Key Contact Type	Recommended Outreach
All	Service and Installation Contractors	Personal contact every other month to discuss potential projects
All	Service Contractors and ESPs[a]	Engage in the development and delivery of approaches targeting operational savings and retrofits to existing systems
All	Designers and Vendors	Personal contact semiannually to increase program awareness and as needed to address issues or conflicts with individual measures
Grocery	Retail Chain Decision Makers	Personal contact 2–6 times per year to ask about potential projects
Ice Arenas	Ice Arena Managers	Join trade association (MIAMA) and participate in trade shows
Industrial	Facility Operators	Work with trade association (RETA) local chapters to develop and promote approaches targeting operational savings measures
All	Other End Users	Regular project marketing and annual personal outreach

- Frequent outreach
- Promote operational improvements and cost-effective retrofits
- Minimize program barriers

Key Grocery Sector Findings:

Jim Kelsey, kW Engineering

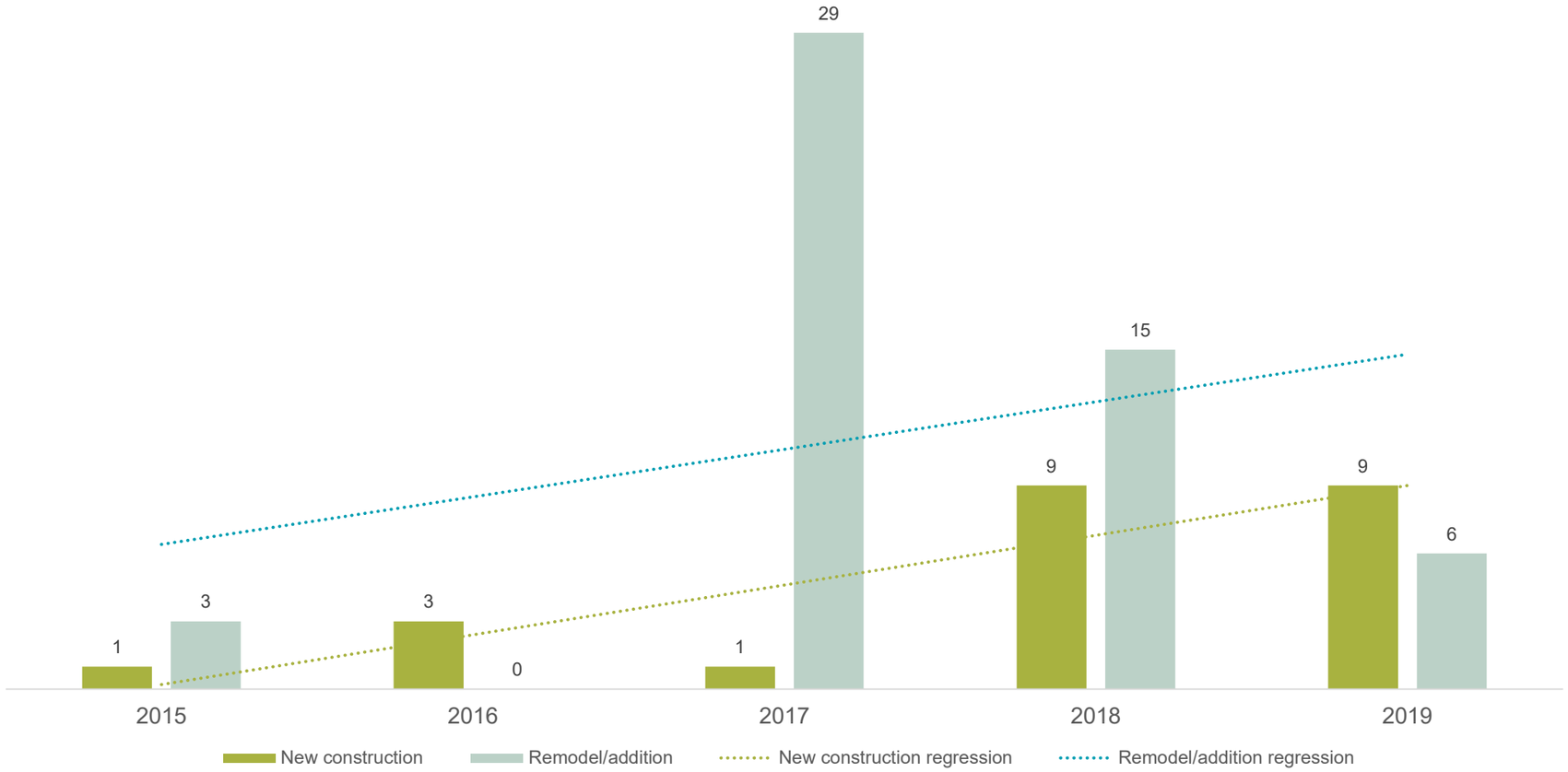


Topics to cover

- Basic system characterization
- Decision makers
- Refrigerant phase-out impacts

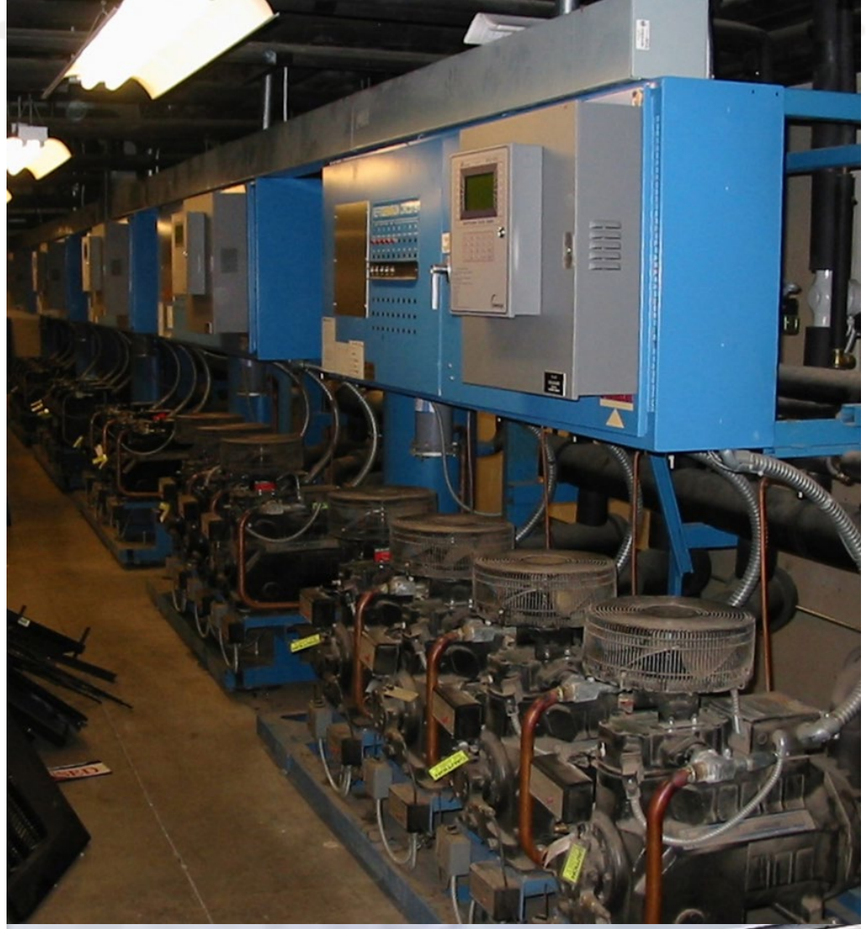


Turnover is slow



Existing systems

- Custom design/build
- Centralized controls
- Semi-hermetic compressors
- Air-cooled condensers
- Fixed head pressure
- HCFC / HFC Refrigerants
- Long piping runs → leaks







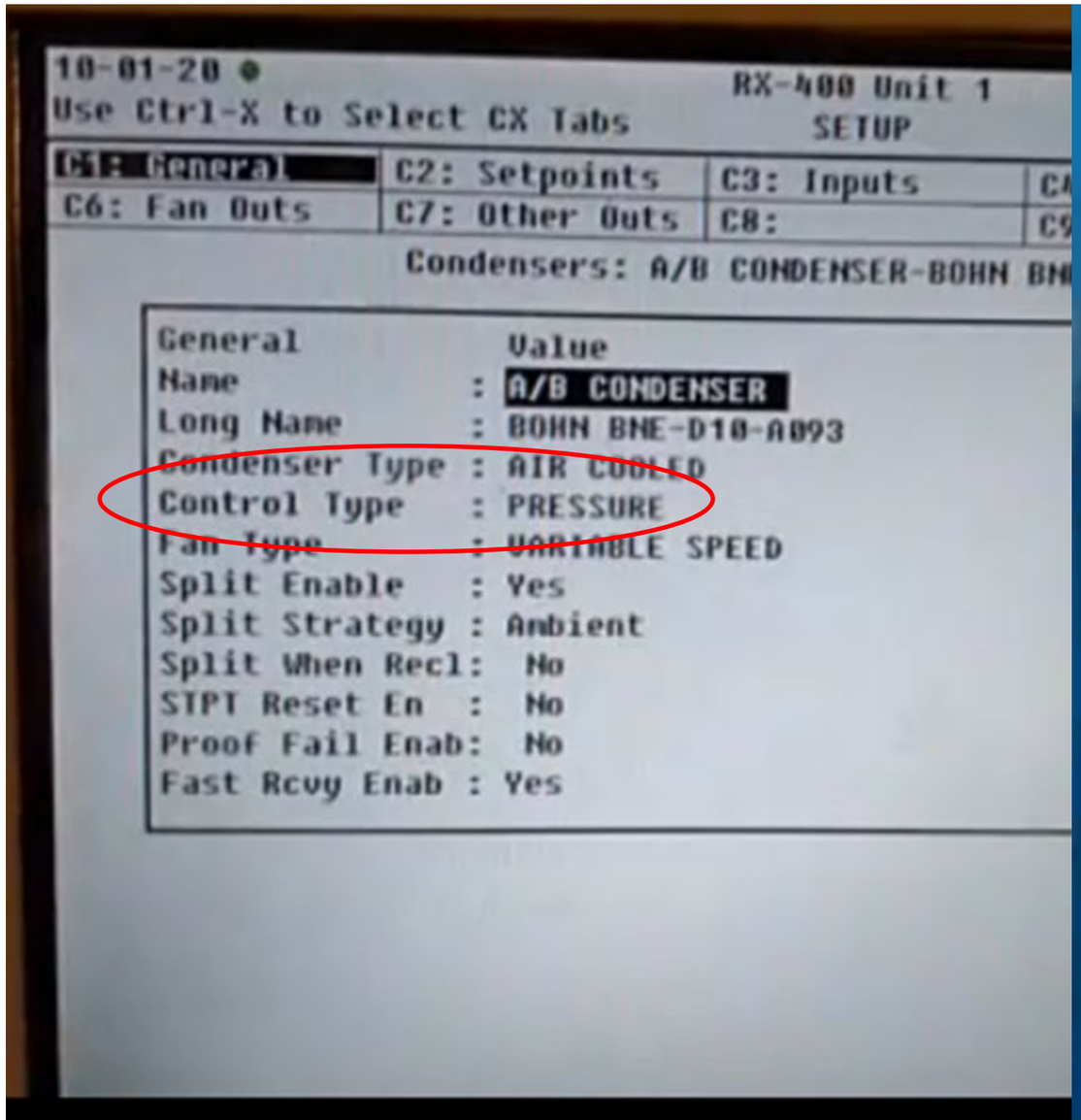


Prevalent Heat Recovery





15-year-old controls, underutilized





Driving greater program results

- Small number of decision makers influence market
- Their trust is hard won / they are risk averse
- Experience with custom incentives



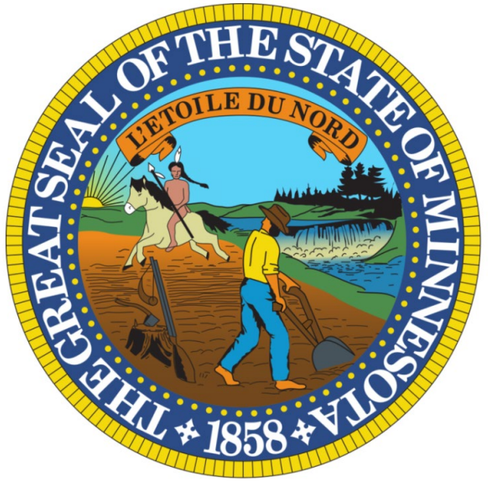
Options

- Eliminate or reduce hassles of custom incentives
- Apply deemed or “quick calc” scaled incentives

Refrigerant Phase Outs

- “There is still a lot of R-22 out there”
- Minnesota is U.S. Climate Alliance member
- Participants are regulatory driven
- New stores – gaining experience with CO2
  - MN climate makes this option a likely market leader
  - Some chains using micro-distributed propane

UNITED STATES
CLIMATE ALLIANCE



Lower GWP Refrigerant Pathways

Mid GWP

- R-448 / R-449 HFO Blends
- GWP ~ 1400
- Minor system mods needed
- Utilize existing systems
- Little performance impact

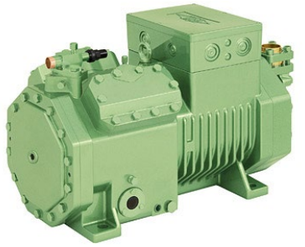


Low GWP

- Entire system replacements
- New
- Very costly
- Primarily new construction



www.hussmann.com



www.bitzerus.com

Opportunities: Grocery

- Adding doors to open cases
- Replacing island cases
- Commissioning existing controls
- LED lighting (area and case)

- Consider: incentives for high efficiency TC CO_2 options (new only)



Take home points

- Opportunities in existing stores:
  - Case retrofits
  - Commissioning
  - Controls

- Regulatory trends (HFC phase outs) will drive investments
  - Already occurring
  - MN is good opportunity for CO2 systems
  - Make sure we make them as efficient as possible

Key Industrial Sector Findings:

Steve Mulqueen, Cascade Energy

Industrial Refrigeration



Industrial Refrigeration System Types

	Large Systems	Small Systems
Characteristics		
Type	Central System	Packaged Units
Assembly	Field	Factory
Compressors	Screw	Reciprocating
Condensers	Evaporative	Air Cooled
Refrigerant	Ammonia, R-22	R-22, Synthetic
Uses		
Space Cooling/Freezing	✓	✓
Product Cooling/Freezing	✓	✓

Refrigerants

- Ammonia more efficient than R-22.
- Difficult to retrofit ammonia with R-22.
- Phaseout of R-22 may increase major retrofits (non Ammonia)

Industrial Refrigeration
National & Local Market

	National	Local
Interviews		
Number	7	16
Experience with EE programs	High	Moderate
Efficiency Projects		
VFDs	✓	✓
Controls	✓	✓
Condensing pressure	✓	✓
Suction pressure	✓	✓
Oil cooling retrofits	✓	✗
Envelope improvements	✓	✓
Tuneups	✓	✓
Project Economics		
Payback requirement	2-3 years	2-3 years
Trend	Higher ROIs	Higher ROIs
Utility Support		
Technical	✓	✓
Rebates	✓	✓

Industrial Refrigeration
National & Local Market (continued)

	National	Local
New Technologies of Interest		
Thermal energy storage	✓	✓
Low refrigerant charge packaged sys.	✓	✓
Smart controls	✓	✓
R-22 Phaseout		
Urgency	✗	✗
Low charge ammonia as replacement	✗	✓
Opportunities for Minnesota		
Lower condensing pressure	✓	✓
Tuneups	✓	✓

Improvements

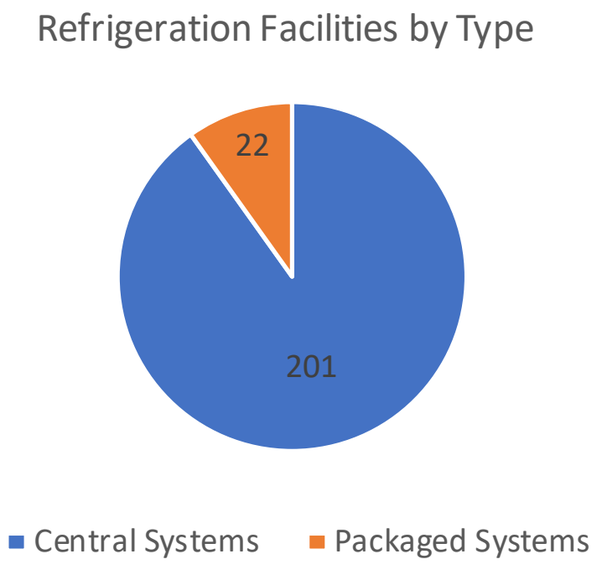
National	Local
• More awareness of utility offerings.	• Lower burden of rebate & M&V process on contractors and customers
• Utility involvement from beginning of project.	• Improve contractor involvement

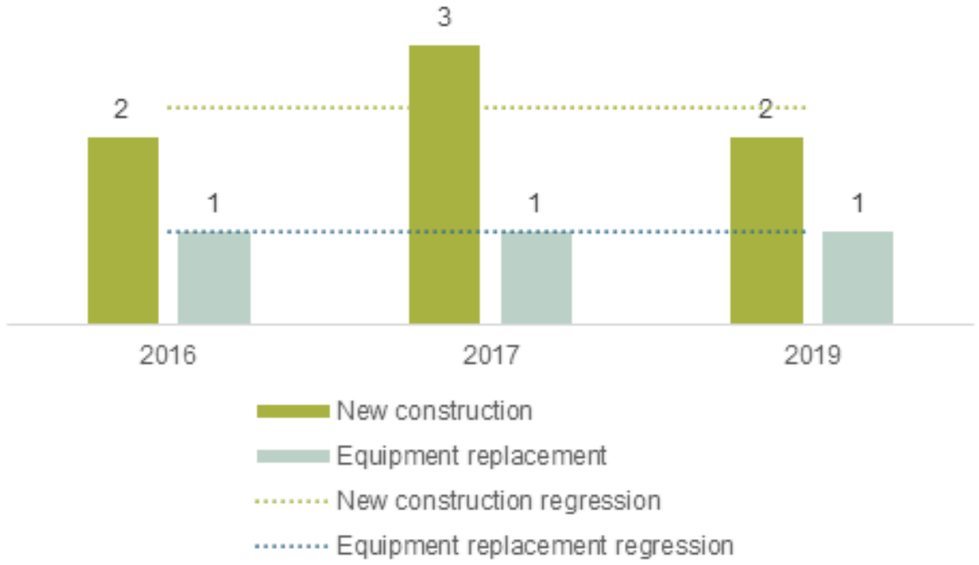
Industrial Refrigeration Facility Plan/Site Reviews

Plan/Site Reviews	
Number	5
Overview	
Refrigerant	Ammonia
Controls	Central/Computerized
Evaporators	
Coil Design	Good practice
Variable speed	Mix
Hot-gas defrost	Reasonable
Compressors	
Type	Screw
Variable speed	Mix
Oil cooling	Mix
Condensers	
Variable speed fans	All
Pumps	Remote
Opportunity to reduce condensing pressure	4 of 5

Industrial Refrigeration Facility System Types

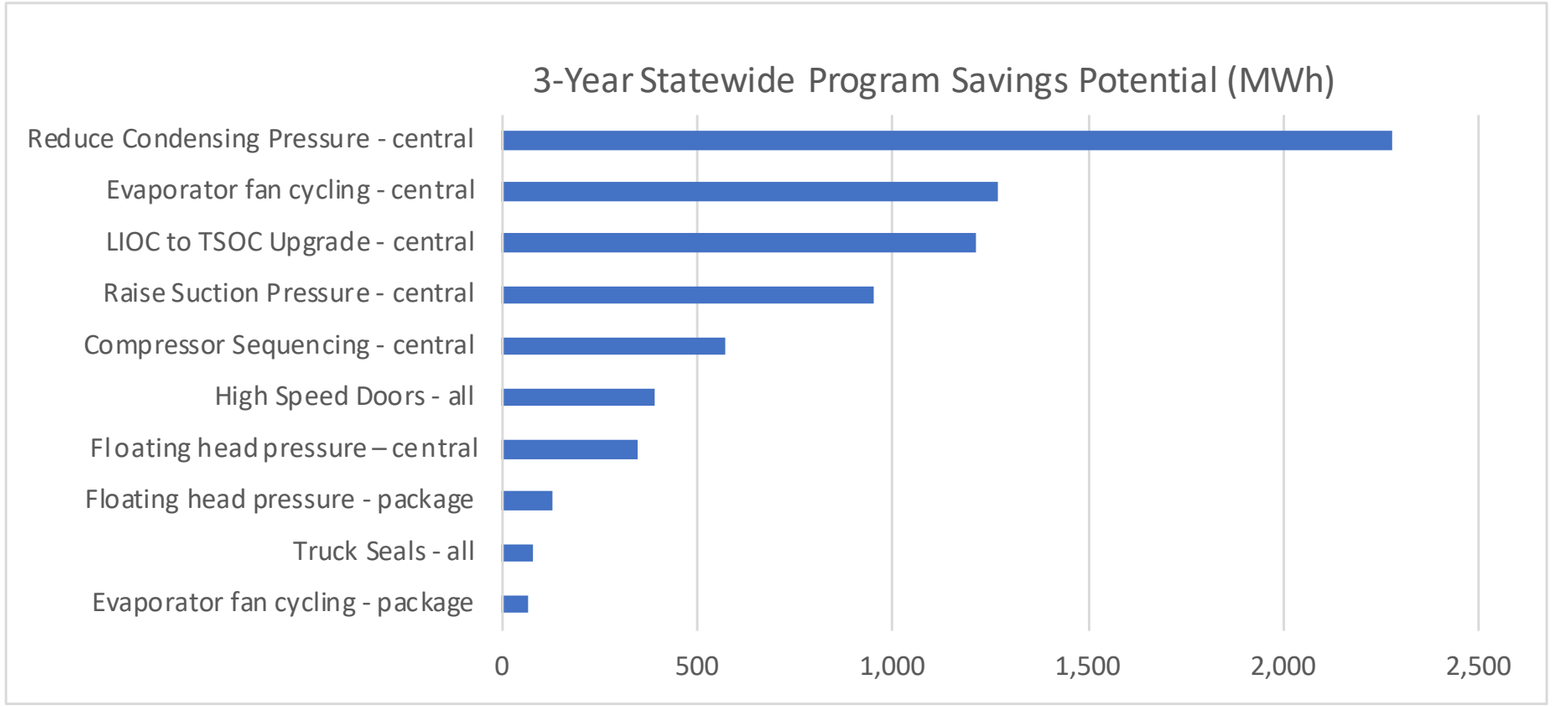
- ~90% of industrial refrigeration facilities are central (ammonia) systems
- Only a few new facilities are constructed each year.





Industrial Refrigeration Facility Savings Potential – Existing Facilities

- Estimated 3-year program savings potential for retrofits is 7.3 GWh
- Largest opportunity is to reduce condensing pressure



Industrial Refrigeration Recommendations

- Target capital, recommissioning and O&M savings in existing facilities through detailed onsite assessments (i.e. tuneups)
  - Leverage control system and utility data to make informed recommendations
- Reduce effort required by customers and contractors for program participation.
- Use approved tools to expedite rebates for common measures (e.g. doors)

Key Ice Arena Sector Findings & Summary:

Russ Landry, Center for Energy and Environment

Ice Arena Summary

- Unique Sector Characteristic
  - Variety of commercial and industrial refrigeration equipment
  - Pump a secondary fluid under the ice sheet
  - Seasonality of ice rink schedule can have a big impact

- Trends/Technologies
  - Little urgency around R-22 phaseout
  - Ammonia dominant in new systems
  - Controls upgrades
  - Aqueous ammonia secondary fluid
  - Reduced resurfacer flood water temperature

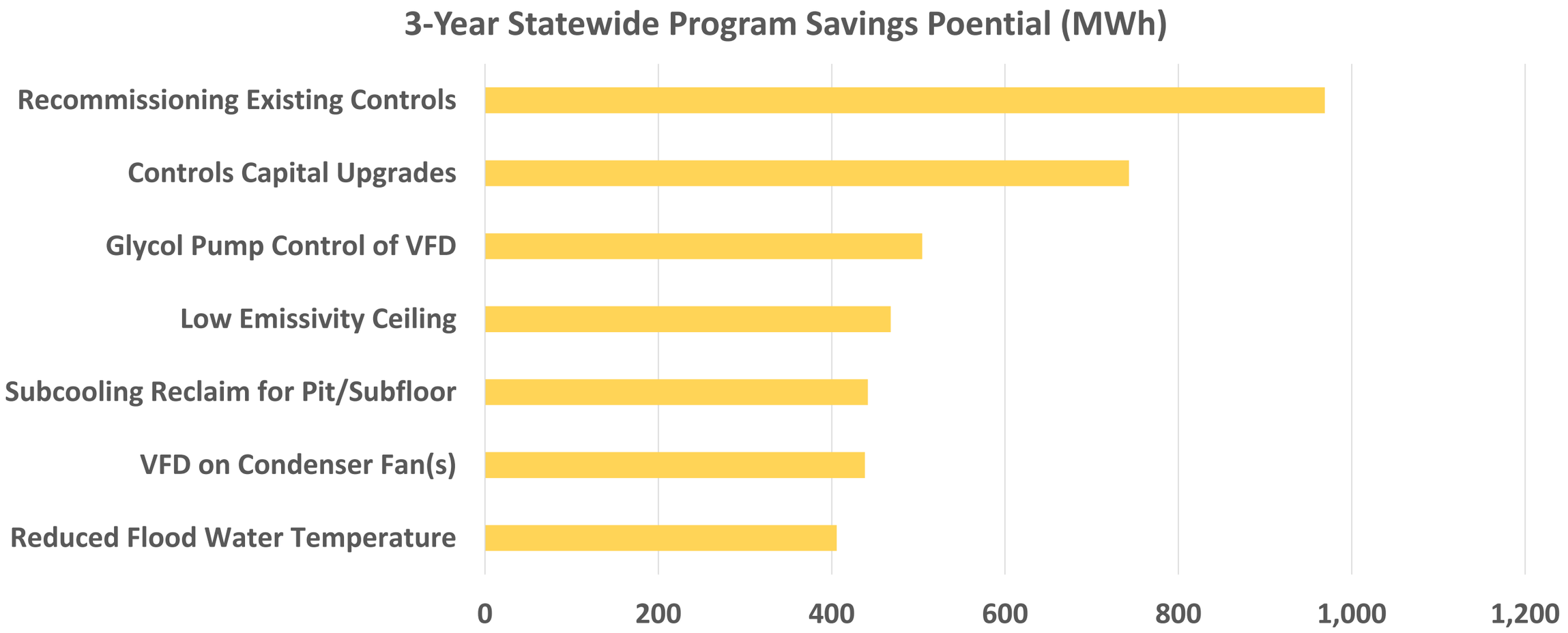


Arena Interview Comments: Utility Program Support

- Rebates Received
  - VFDs
    - Condenser fans
    - Glycol pumps
  - Limited Custom Participation
    - Low Emissivity Ceilings
    - Reduced Resurfacer Flood Water Temperature (and Higher Ice Temperature)

- Comments
  - Make it easier to get rebates for control upgrades and low emissivity ceilings (savings calculations)
  - More outreach
  - Demonstration sites or technology evaluation
  - 3rd party rebate recipient

Top Measures for Existing Ice Arenas



Summary & CIP Program Recommendations:

Russ Landry, Center for Energy and Environment

Refrigeration Energy Saving Strategies

- Reduce Refrigeration Load
  - Display cases, ECM fans, pump VFDs or staging, fan cycling
- Increase Suction Pressure
  - Raise suction pressure when low loads (a.k.a. floating suction pressure)
- Reduce Head Pressure
  - Condenser control, different expansion valve
- Increase Component Efficiency
  - Condenser ECM motors, VFDs
- Provide Subcooling at Expansion Valve

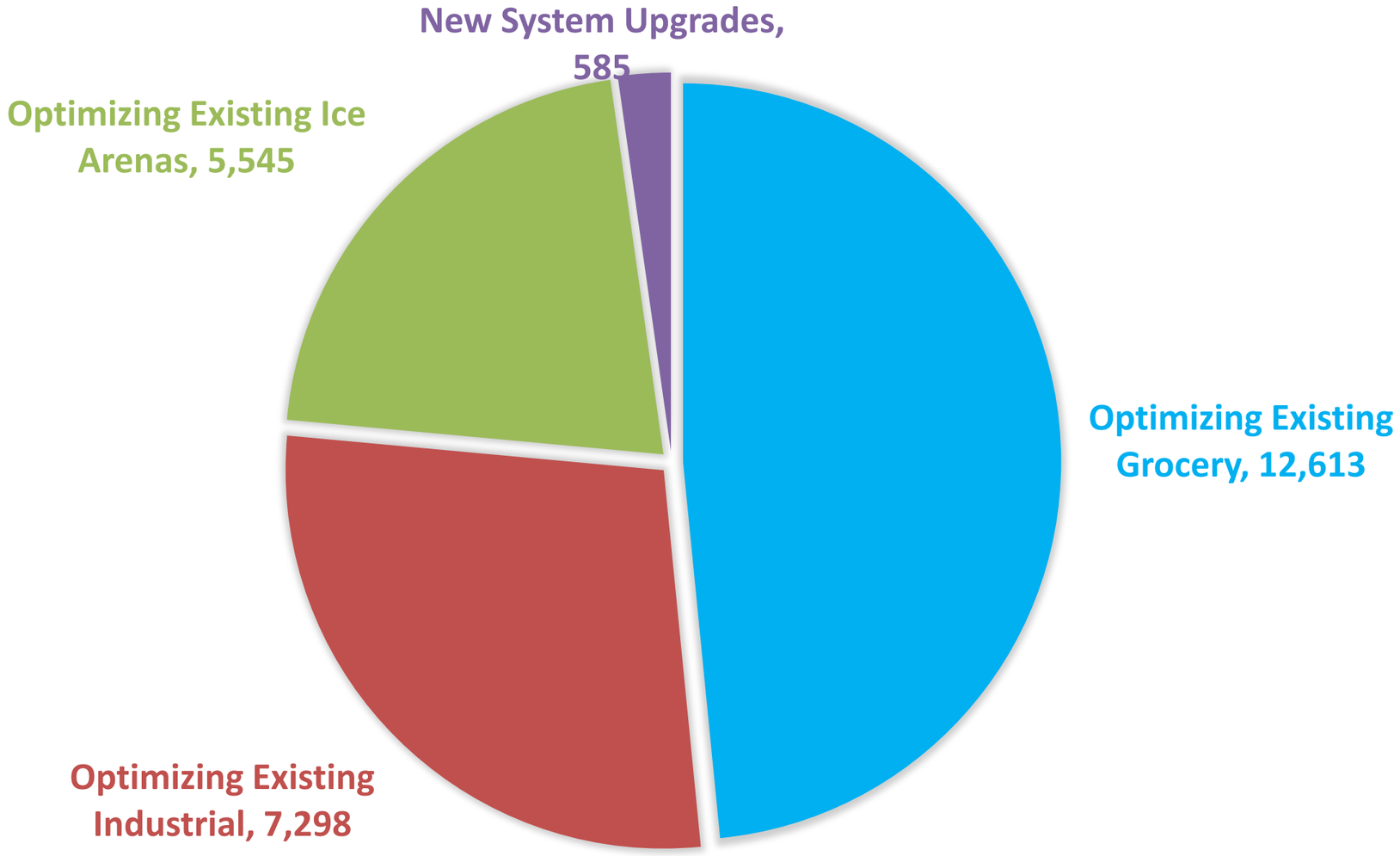
Overall Recommendations for New Measures

- Reduce Refrigeration Load
  - Display cases, ECM fans, pump VFDs or staging, fan cycling
  - evaporator fans, glycol pump VFDs or staging
- Increase Suction Pressure
  - Raise suction pressure when low loads (a.k.a. floating suction pressure)
- Reduce Head Pressure
  - Condenser control, different expansion valve
- Increase Component Efficiency
  - Condenser ECM motors, VFDs
- Provide Subcooling at Expansion Valve

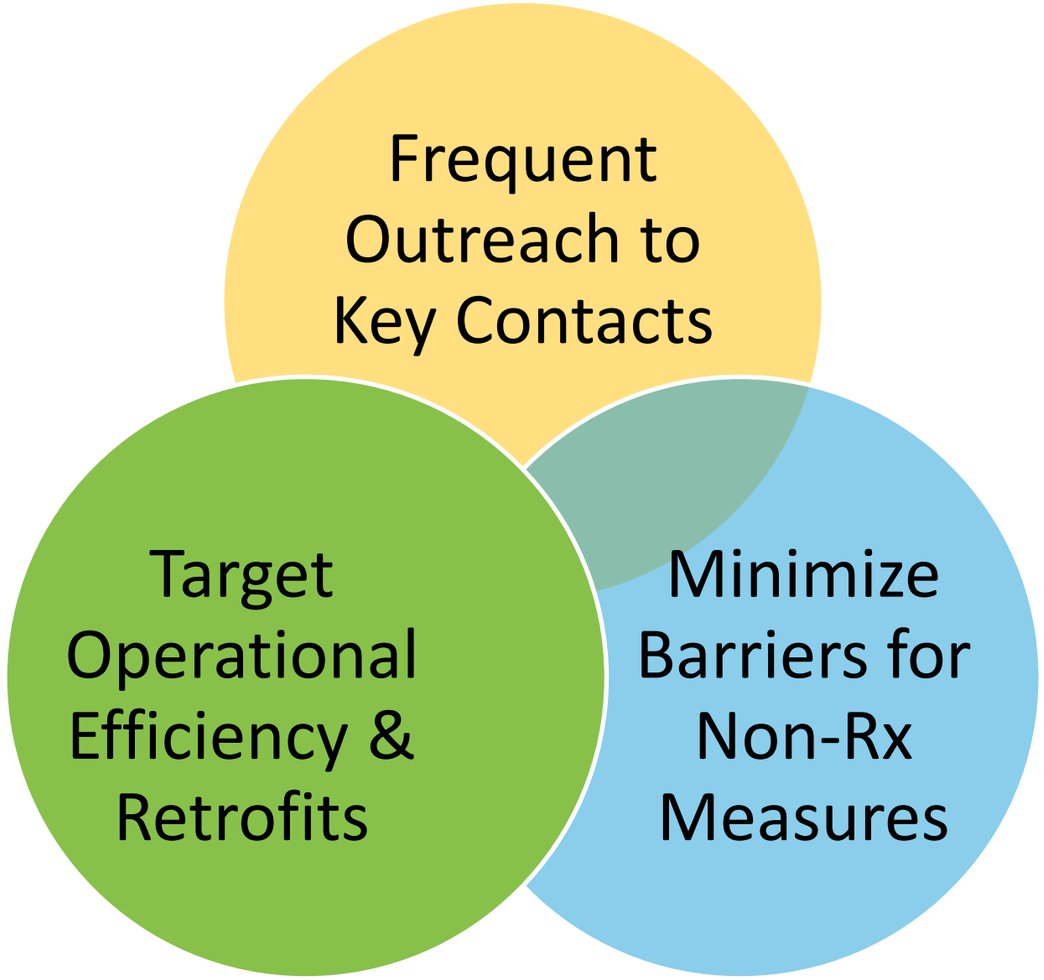
Overall Recommendations for Measures

- Identified 14 Top Priority Measures to Better Address
- Recommend Additional Technology Evaluation for 9 Measures
- Identified 4 Lower Priority Measures
- Noted 16 MN Energy Code & Federal Standard Requirements that may Limit Rebate Applicability for New Systems

3-Year Increased Program Savings Potential (MWh)



Recommendations: CIP Approaches



Frequent Outreach to Key Industry Contacts

- Installation & service contractors—6 times/year
- Designers, vendors & energy service providers—consult on program development & 2 times/year
- Retail chain decision makers—2-6 times/year
- Industry Associations
  - MIAMA
  - Minnesota Grocers Association
  - RETA Northern Plains Chapter

Target Operational Efficiency & Retrofits

- Refrigeration Expert Work On-Site with Technicians
- Provide Reduced Cost Assessment
- Use Sector-Specific Expert
- Leverage Remote Monitoring
- Provide Operator Workshops

Minimize Barriers for Measures Without Prescriptive Rebates

- Develop More Prescriptive Rebates
- Shift Custom Analysis Burden to Utility/Implementer
- Develop TRMs and Other Approaches to Expedite Custom Measure Analysis
- Provide One Week Turnaround for Smaller Scale Retrofits and Equipment Replacement Projects

Summary of Study Findings

- Field assembly of systems and market dominance of a few key trade allies make this market unique
- >25 Refrigeration System Efficiency Measures Have Not Been Well Addressed in MN
- The 3-Year Potential for Increased Program Savings for These Items is ~26,000 MWh
- The Vast Majority of This Potential is for Optimizing Existing Systems

Questions?

CIP Opportunities in the C&I Refrigeration Market



Russ Landry
rlandry@mncee.org



Steve Mulqueen
steve.mulqueen@cascadeenergy.com



Melanie Lord
mlord@slipstreaminc.org



Jim Kelsey
kelsey@kw-engineering.com



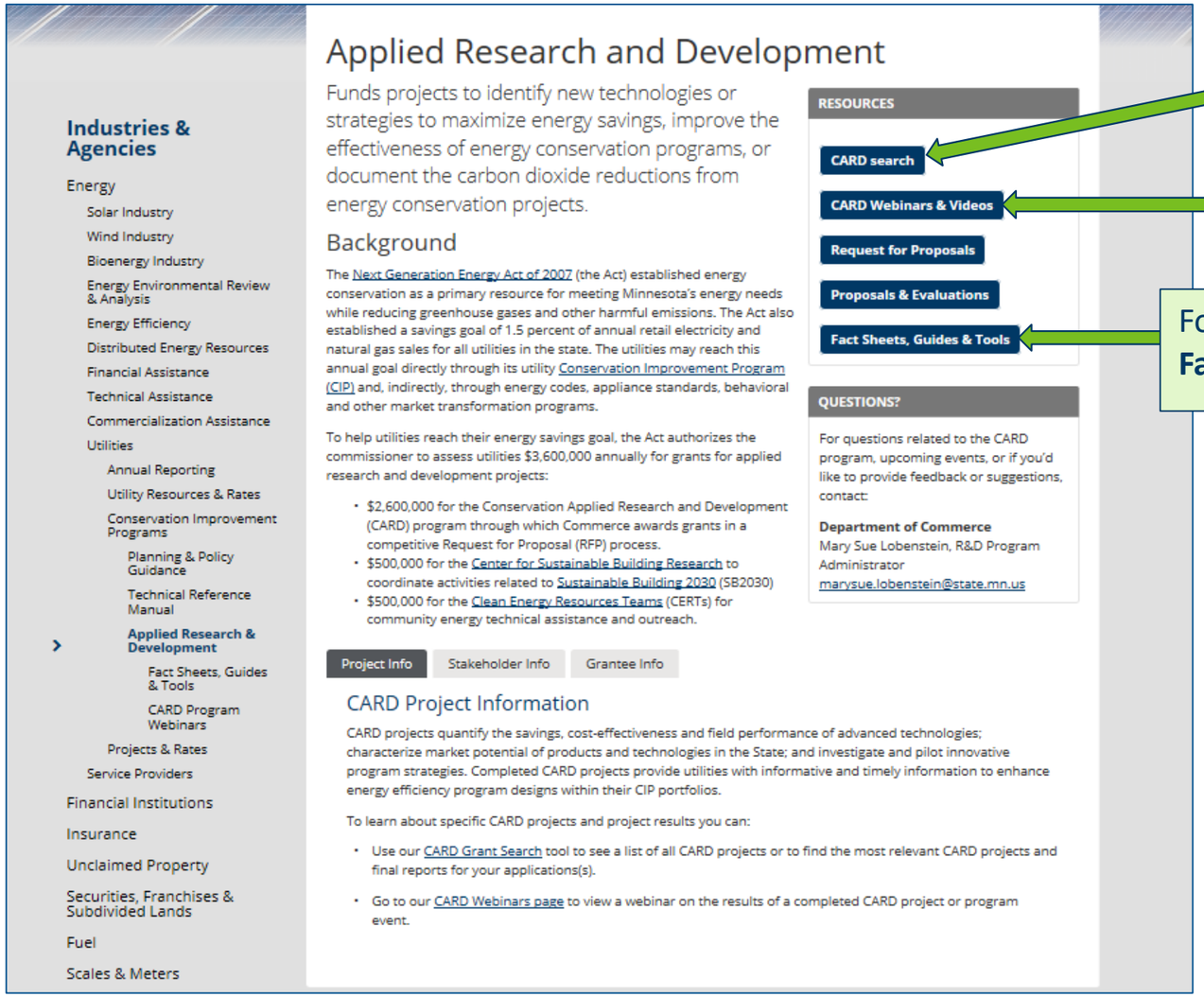
Mary Sue Lobenstein
marysue.Lobenstein@state.mn.us



Laura Silver
laura.silver@state.mn.us

Send us your questions using the Webex Q&A box

CARD Project Resources



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/)

Thanks for Participating!

Upcoming CARD Webinars:

- **January 21, 2021** – Codes and Standards Roadmap (2050 Partners)

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

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

Mary Sue Lobenstein
R&D Program Administrator
marysue.Lobenstein@state.mn.us
651-539-1872

COMMERCE DEPARTMENT
ENERGY RESOURCES

Let us know how we did today!

