COMMERCE DEPARTMENT

Welcome

Conservation Applied Research & Development (CARD) Webinar

June 8, 2021

Energy Efficiency Opportunity Potential at Minnesota Water Utilities

Energy Efficiency Opportunity Potential at Minnesota Water Utilities



Mary Sue Lobenstein
Energy Conservation & Research Planner
MN Department of Commerce
marysue.Lobenstein@state.mn.us



Lindsay Anderson
State Program Administrator Principal
MN Department of Commerce
lindsay.anderson@state.mn.us



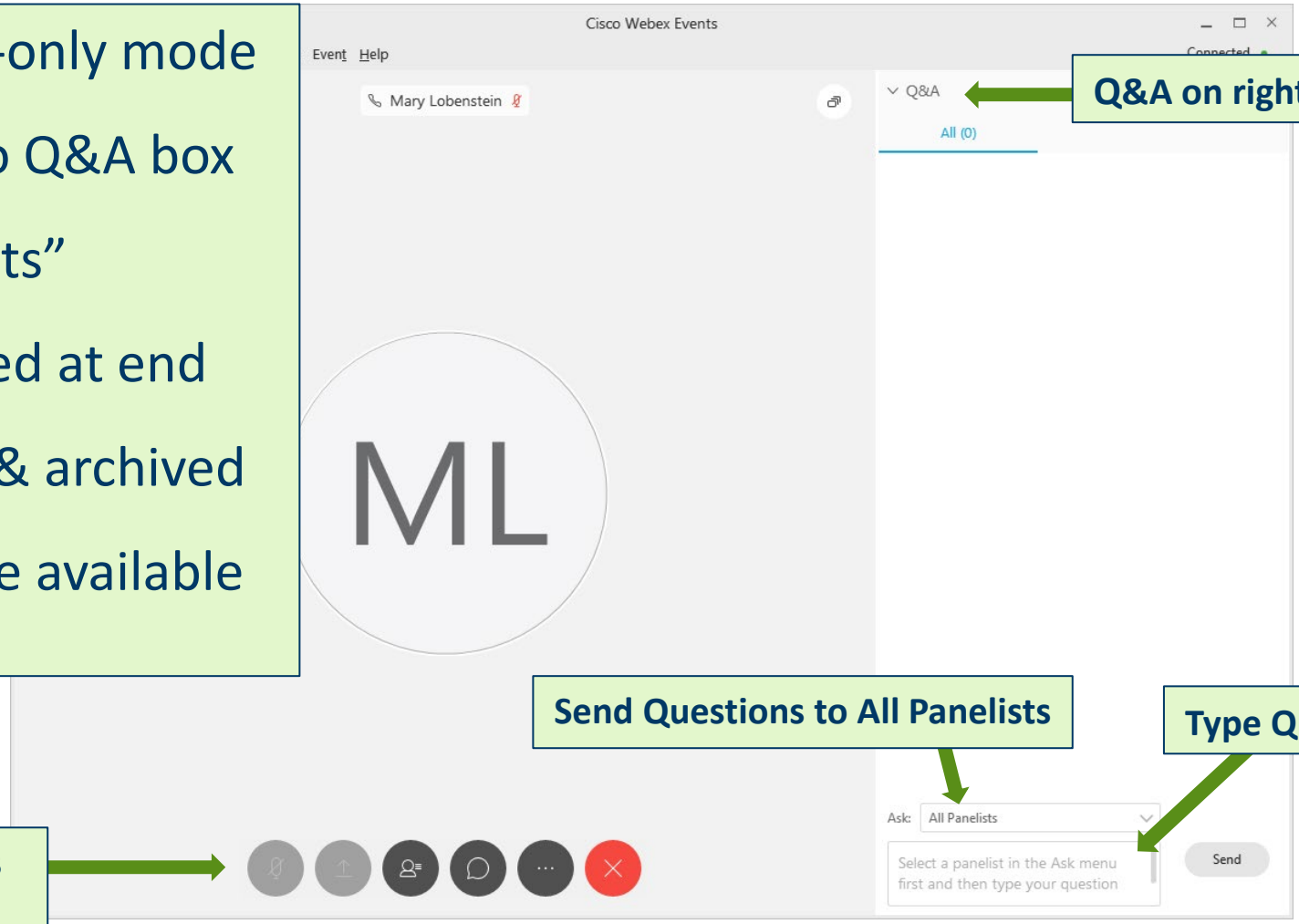
Brent Vizanko
Associate Engineer
MnTAP
bvizan@umn.edu



Karl DeWahl
Senior Engineer
MnTAP
dewah001@umn.edu

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

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Type Questions in Q&A box

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Minnesota Applied Research & Development Fund

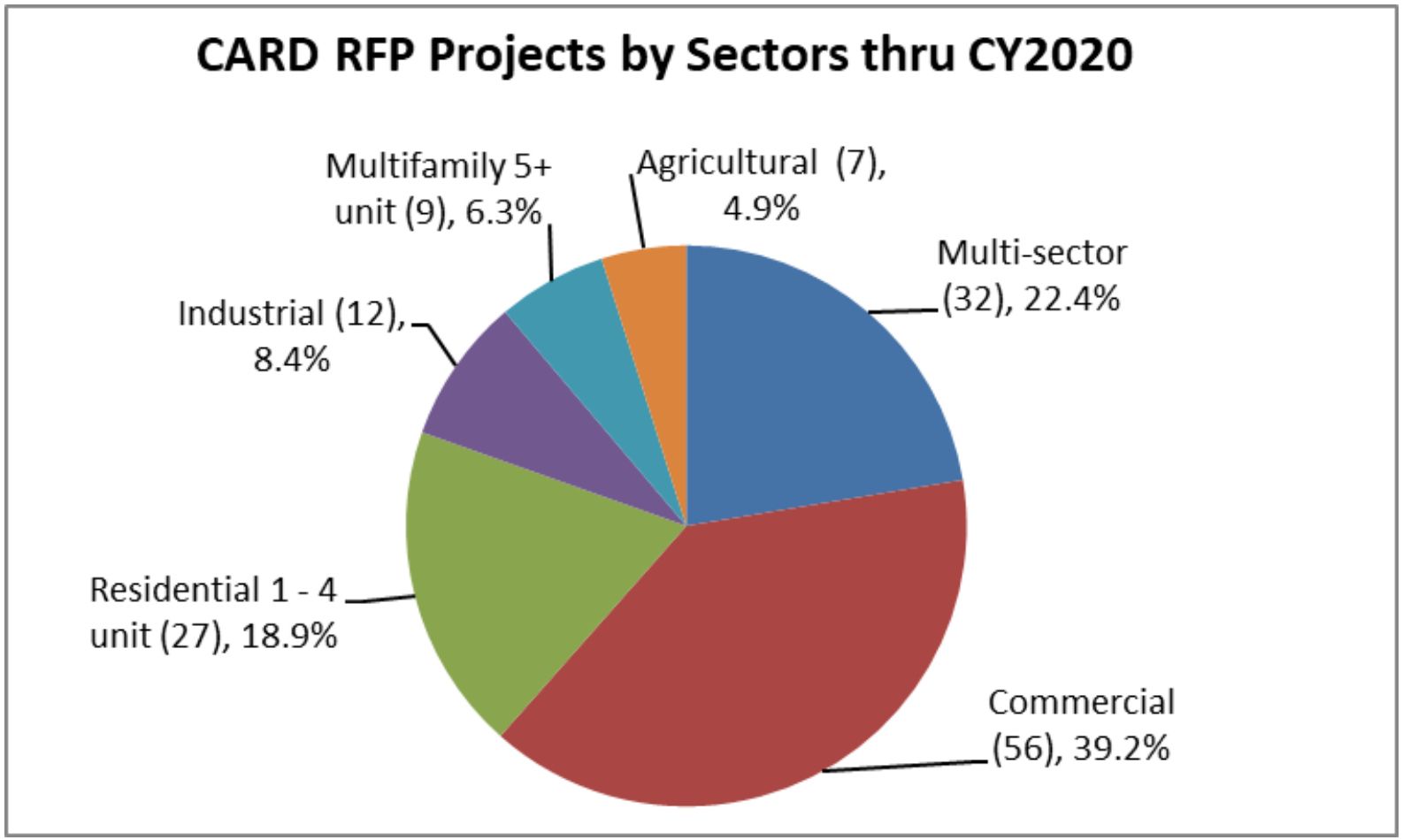
- **Purpose to help Minnesota utilities achieve 1.5% energy savings goal by:**
  - ***Identifying new technologies or strategies to maximize energy savings;***
  - ***Improving effectiveness of energy conservation programs;***
  - ***Documenting CO_2 reductions from energy conservation programs.***

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 FY2020



RFP Summary

- 12 Funding Cycles
- 513 proposals
- 143 projects funded
- $31.2 million in research

Drinking Water Utility Energy Efficiency Market Study

Brent Vizanko

UNIVERSITY OF MINNESOTA
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Overview

- Background information
- Literature review
- Informational Interviews
- Technical Assessments
- Sector Opportunity Potential
- Conclusions for Electric Utilities

Basic Water Utility Configuration

- **Acquisition**
  - Pumping water from source (i.e. wells or a surface water source)
- **Treatment**
  - Disinfecting and/or filtering incoming water for safe consumption
- **Distribution**
  - Pumping finished water to the customer



Discussion on Units

- **MG = million gallons**
- **MGY = million gallons per year**

Average yearly flow: 280 MGY

- **Important concept: specific energy**
  - Definition: energy required to pump a certain amount of water
  - Units: kWh/MG
  - Basis for most calculations

Snapshot of Minnesota Water Utilities

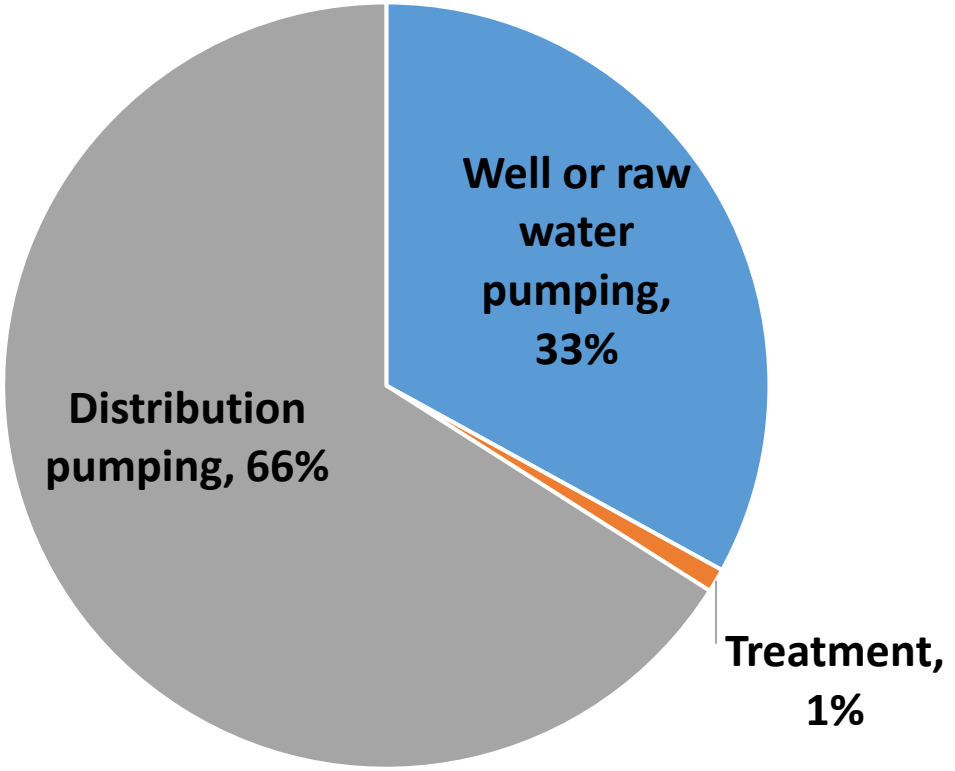
- **Most utilities use ground water**
  - 537 groundwater
  - 17 surface water
  - 4 that use both
- **53% of utilities in state produce 92% of the water**
  - 47% of utilities produce less than 50 MGY

Overall Sector Energy Use

	Total Number of Plants	Total Million Gallons Pumped (MG/yr)	Specific Energy (kWh/MG)	Total Energy (kWh/yr)
Small (5 – 50 MGY)	299	5,900	2,300	13,400,000
Medium (50 – 500 MGY)	189	32,000	1,600	52,500,000
Large (>500 MGY)	70	100,000	2,300	227,200,000
Total	558	138,000	N/A	293,000,000

Literature Review – Key Findings

- **Distribution is largest energy use followed by acquisition**
- **Treatment is extremely small.**
  - Treatment was not a major focus



R. Brown, J. R. (2005, May). *Overview of Energy Use in the Drinking Water and Wastewater Industries.* Retrieved from Lawrence Berkeley National Laboratory.

Literature Review – Key Findings

Best Practice	Capital Investment	Potential Savings	Payback Period
Minimize Water Losses	Variable	Proportional to water loss rate	Variable, depends on severity
Install Premium-Efficiency Motors	$3,100-175,000	5-10% of pumping energy, $2,800-44,300	0.5+ years
Rehabilitate Old Pumps	Variable depending on size	Variable	2-3 years
Apply Internal Coatings to Pumps	Low	5-10% of pumping energy	Short, < 1 year
Use Smaller Pumps in Parallel	Variable	10-50% of pumping energy	Variable
Install VFDs	$3-126.5k	$1,620-51,600	Several months to years
Replace or Trim Impellers	Low	Depends on extent of throttling	Short or immediate
Prioritize Most Efficient Well and Distribution Pumps	None	10-20% of pumping energy	Immediate
Manage Peak Energy Demand	None	Variable	Immediate
Minimize Pipe Head Losses	Variable	5-20% of pumping energy	Variable
Rapid-Gravity Filtration versus Pressure Filtration		50%	
Install High-Efficiency Lighting and HVAC Systems	$7-154k	20-40% of associated energy	Variable

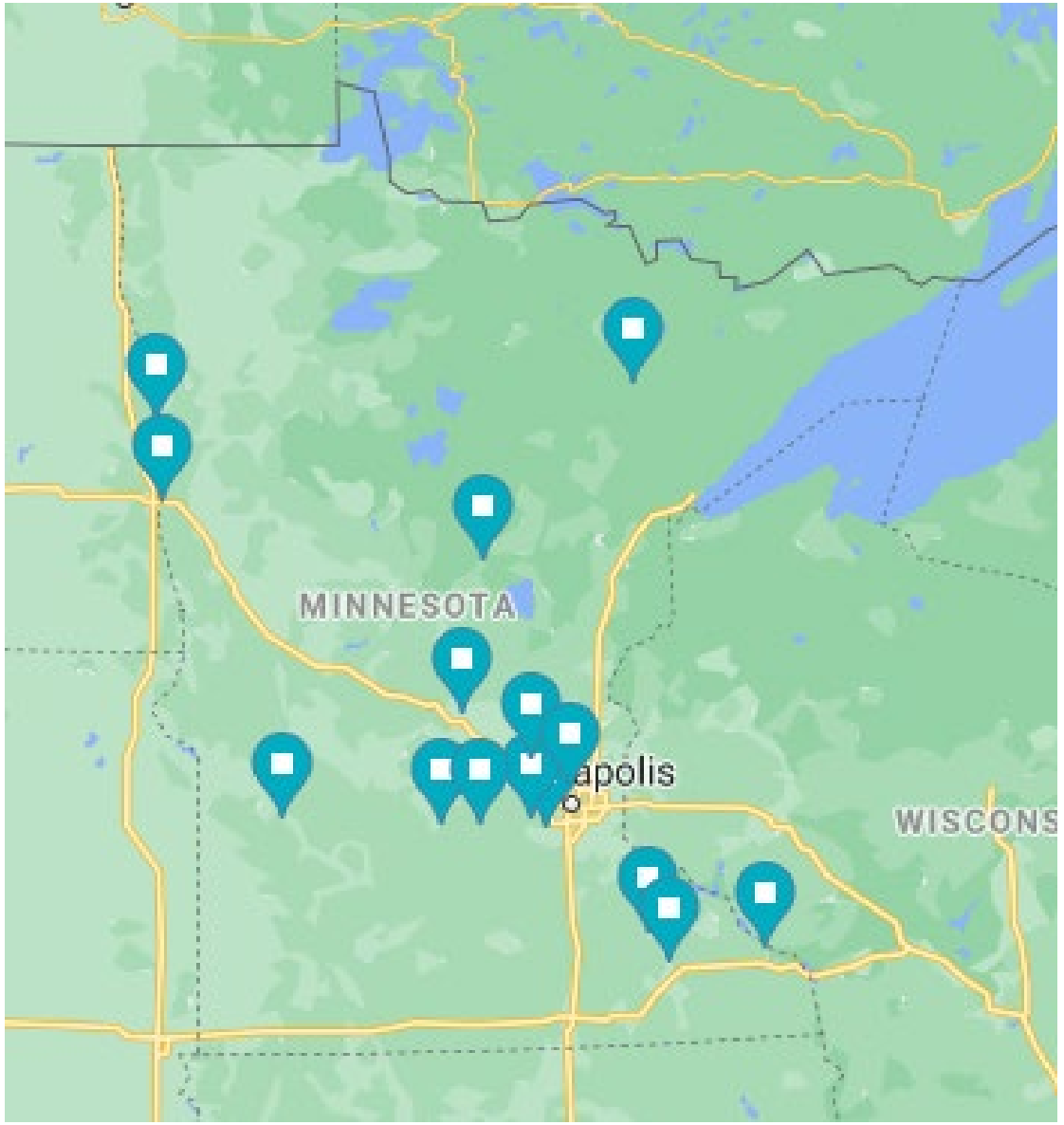
Informational Interviews

- **Goals:**
  - Confirm energy saving opportunities within the drinking water treatment sector in Minnesota.
  - Gain general awareness of sector operation.



Interview Process

- **Interviewed 22 organizations**
  - 15 water utilities
  - 3 energy utility
  - 2 well drillers
  - 2 partners
- **Water Utilities selected on four criteria**
  - Groundwater vs. surface water
  - Yearly production
  - Location
  - Universal well metric (UWM)



Interview Selection

- Difficult to recruit small sites
- Evenly dispersed throughout the state
- 13 ground water, 1 surface water and 1 combination

	Metro	NE	NW	SE	SW	Total
GW Small (5-50 MGY)	1	0	1	0	1	3
GW Medium (50-500 MGY)	0	1	1	1	1	4
GW Large (>500 MGY)	2	1	1	2	1	7
Total	3	2	3	3	3	14

Interview Findings - Overview

- **Many different plant configurations**
  - No treatment plant
  - Filtration
  - Lime softening
  - Reverse Osmosis
- **Wide variation in specific energy**
  - Size
  - Treatment style

Interview Findings – Size

- **Medium plants:**
  - Lowest specific energy
  - Lowest range of specific energy
- **Large plants:**
  - Larger sample size
  - Largest range

Size	Number in class	High (kWh/MG)	Low (kWh/MG)	Average (kWh/MG)
GW Small	3	2,950	1,250	2,300
GW Medium	4	2,150	950	1,600
GW Large	8	3,100	1,600	2,300

Interview Findings – Stage

- **Treatment similar with respect to size**
- **Small plants had highest average for acquisition, treatment and distribution**

Size	Acquisition (kWh/MG)	Treatment (kWh/MG)	Distribution (kWh/MG)
GW Small	1,050	400	1,050
GW Medium	700	300	600
GW Large	900	350	1,000

Interview Findings - Treatment

Configuration	Number of Sites	Acquisition (kWh/MG)	Treatment (kWh/MG)	Distribution (kWh/MG)	Overall (kWh/MG)
Treat at well	3	700	0	600	1,300
Filtration	8	1,000	400	900	2,200
Lime softening	3	750	350	1,350	2,350
Reverse osmosis	1	1,100	830	1,150	3,100

Opportunities Identified

	Description
1. Pump Eff. Optimization	Prioritization of most efficient wells or distribution pumps based on specific metrics (kWh/MG).
2. Well/pump Rehabilitation	Periodic maintenance on wells including pump and casing components. 7-10 year rotation is typical.
3. Water Loss Reduction	Focused leak detection and repair.
4. Customer Conservation	Programs to incentivize water conservation within community (typically rebates for high efficiency appliances).
5. VFD Optimization	Optimizing already installed VFDs.

Assessment Procedure

- 5 sites selected for assessment
- Specific opportunities addressed at each site
- All analysis and data gathering completed without site visits



Opportunities for Energy Reduction

Opportunity	Estimated Sector Energy Saving (kWh/yr)
1. Pump Efficiency Optimization	25,000,000
2. Well/Pump Rehabilitation	9,300,000
3. Water Loss Reduction	3,500,000
4. Customer Conservation	2,700,000
5. VFD Optimization	1,900,000
Statewide Total	**42,000,000**

Opportunities Identified – Part 1

	Description
1. Pump Eff. Optimization	Prioritization of most efficient wells or distribution pumps based on specific metrics (kWh/MG).
2. Well/pump Rehabilitation	Periodic maintenance on wells including pump and casing components. 7-10 year rotation is typical.
3. Water Loss Reduction	Focused leak detection and repair.
4. Customer Conservation	Programs to incentivize water conservation within community (typically rebates for high efficiency appliances).
5. VFD Optimization	Optimizing already installed VFDs.

1. Pump Efficiency Optimization

Opportunity	Percent of State Water Utilities Available	Estimated Savings	Estimated Sector Energy Saving (kWh/yr)
Well Pump Selection	87%	5%	14,000,000
Distribution Pump Selection	87%	0.7%	2,200,000
Pump Redesign	10%	600 kWh/MG	8,300,000

Opportunities Identified – Part 2

	Description
1. Pump Eff. Optimization	Prioritization of most efficient wells or distribution pumps based on specific metrics (kWh/MG).
2. Well/pump Rehabilitation	Periodic maintenance on wells including pump and casing components. 7-10 year rotation is typical.
3. Water Loss Reduction	Focused leak detection and repair.
4. Customer Conservation	Programs to incentivize water conservation within community (typically rebates for high efficiency appliances).
5. VFD Optimization	Optimizing already installed VFDs.

Well/pump Rehabilitation

Opportunity	Percent of State Water Utilities Available	Estimated Savings	Estimated Sector Energy Saving (kWh/yr)
Well/Pump Rehabilitation	53%	6%	9,300,000

Opportunities Identified – Part 3

	Description
1. Pump Eff. Optimization	Prioritization of most efficient wells or distribution pumps based on specific metrics (kWh/MG).
2. Well/pump Rehabilitation	Periodic maintenance on wells including pump and casing components. 7-10 year rotation is typical.
3. Water Loss Reduction	Focused leak detection and repair.
4. Customer Conservation	Programs to incentivize water conservation within community (typically rebates for high efficiency appliances).
5. VFD Optimization	Optimizing already installed VFDs.

3. Water Loss Reduction

Opportunity	Percent of State Water Utilities Available	Estimated Savings	Estimated Sector Energy Saving (kWh/yr)
Distribution Leak Repair	95%	2.5-31% of losses	2,400,000
Hydrant Repair	96%	0.4-2.3% of losses	180,000
Treatment Losses	87%	2.3-43% of losses	890,000
Pressure Control	15%	1.4% of losses	31,000
Storage Mixing	15%	0.6% of losses	2,000

Opportunities Identified – Part 4

	Description
1. Pump Eff. Optimization	Prioritization of most efficient wells or distribution pumps based on specific metrics (kWh/MG).
2. Well/pump Rehabilitation	Periodic maintenance on wells including pump and casing components. 7-10 year rotation is typical.
3. Water Loss Reduction	Focused leak detection and repair.
4. Customer Conservation	Programs to incentivize water conservation within community (typically rebates for high efficiency appliances).
5. VFD Optimization	Optimizing already installed VFDs.

4. Customer Conservation

Opportunity	Percent of State Water Utilities Available	Estimated Savings	Estimated Sector Energy Saving (kWh/yr)
Irrigation	94%	N/A	1,200,000
Residential Appliances	94%	N/A	1,500,000
Other	94%	N/A	85,000

Opportunities Identified – Part 5

	Description
1. Pump Eff. Optimization	Prioritization of most efficient wells or distribution pumps based on specific metrics (kWh/MG).
2. Well/pump Rehabilitation	Periodic maintenance on wells including pump and casing components. 7-10 year rotation is typical.
3. Water Loss Reduction	Focused leak detection and repair.
4. Customer Conservation	Programs to incentivize water conservation within community (typically rebates for high efficiency appliances).
5. VFD Optimization	Optimizing already installed VFDs.

VFD Optimization

Opportunity	Percent of State Water Utilities Available	Estimated Savings	Estimated Sector Energy Saving (kWh/yr)
VFD Optimization	60%	1.5%	1,900,000

Barriers and Motivation

- **Major motivators for energy efficiency:**
  - Water quality
  - Well/pump reliability
  - System efficiency

- **Major barriers**
  - Cost
  - Time commitment
  - Uncertainty



Measurement Incentive

- **Similar to compressed air audit incentive structure**
  - Water utility buys measurement equipment
  - Implements efficiency opportunity
  - Electric utility rebates measurement equipment once savings are verified.

- **Applies to the following opportunities**
  - 1. Pump Efficiency Optimization
  - 2. Well/Pump Rehabilitation
  - 3. Water Loss Reduction

Electric Utility Summary Table

Opportunity	Identification	Implementation	Opportunity Potential (kWh/yr)
1. Pump Efficiency Optimization	Sites with measurement Large/medium sites	Measurement incentive	25,000,000
2. Well/pump rehabilitation	Sites with measurement Sites without rehab plans	Measurement incentive	9,300,000
3. Water Loss reduction	DNR database/report Aging systems	Measurement incentive	3,500,000
4. Customer Conservation	Most sites in state Large sites	Electric/water utility partnership	2,700,000
5. VFD Optimization	Most sites in state	Technical assistance	1,900,000

Conclusions

- **Biggest opportunities are pump efficiency optimization and pump/well rehabilitation.**
- **Overall savings potential is 42,000,000 kWh/yr**
- **All opportunities rely on specific energy (kWh/MG)**
  - Monitoring flow rate and energy draw is key
  - Need for specific metering at the well and distribution pump level
- **Demand charges on multiple wells can create an energy efficiency disincentive.**

Questions?

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Brent Vizanko
bvizan@umn.edu



Karl DeWahl
dewah001@umn.edu



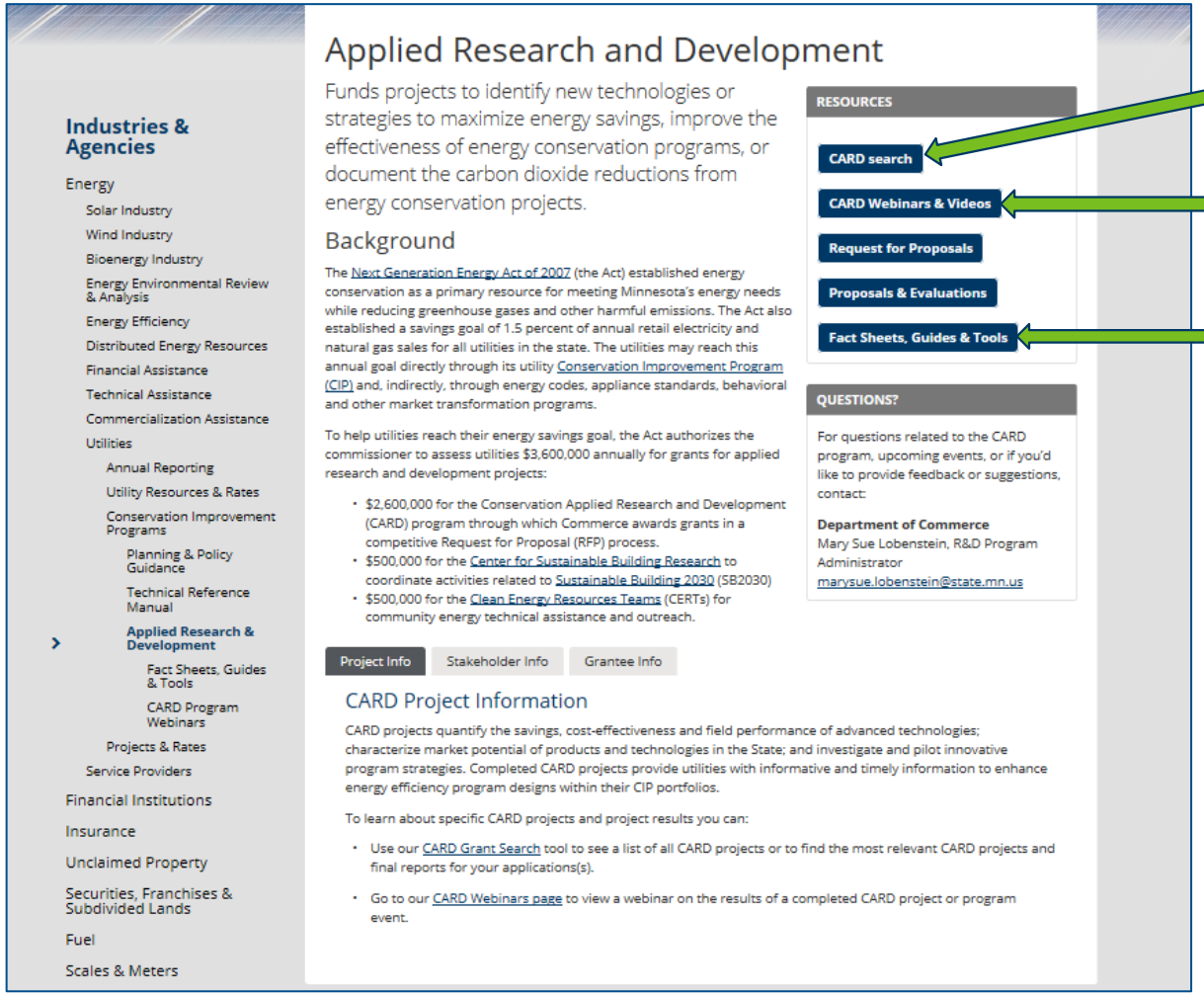
Lindsay Anderson
lindsay.anderson@state.mn.us



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

Send us your questions using the Q&A panel

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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:

- **July 21: Center for Energy and Environment – Expanded Scope of Boiler Tune-ups**

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Mary Sue Lobenstein | Energy Conservation & Research Planner
marysue.Lobenstein@state.mn.us | 651-539-1872

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