Energy Savings Potential of Networked Lighting Control Systems in Small Business

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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

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\textsubscript{2} reductions from energy conservation programs.

- 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

Minnesota Statutes §216B.241, Subd. 1e
CARD RFP Spending by Sector thru FY2020

RFP Summary

- 12 Funding Cycles
- 513 proposals
- 143 projects funded
- $31.2 million in research
Networked Lighting Controls in Small Business

- Technology
- Research project
  - Educational seminars
  - Case studies
  - Discussion and recommendations
Networked Lighting Controls

Networked lighting controls (NLC) is an emerging Internet of Things technology that offers deep energy savings potential for commercial lighting.

Layered Control Strategies

- NLC systems enable energy saving strategies to be layered in the same space including occupancy sensing, daylight harvesting, scheduling, and task tuning.

- When combined with modern LED lighting, light output can be optimized through individual control and automated daylight sensing.
Watts

Daylighting

Time
Technology overview

What are Networked Lighting Controls? Digital networks of control devices – sensors, network interfaces, and controllers that affect changes in luminaires.

- Components are individually addressable.
- May be triggered automatically, (i.e. occupancy sensing) or manually, such as through a wall mounted switch.
- Digital communication network may be wireless, wired or a hybrid system.

• A NLC system must have the following capabilities at a minimum to qualify for DLC certification:

  **Must have:**
  • Networking of luminaries and devices
  • Occupancy sensing
  • Daylight Harvesting / Photocell control
  • High-End trim
  • Zoning
  • Individual Addressability
  • Continuous dimming
  • Cybersecurity
  • Energy Monitoring
Extended Capabilities

- **Demand response** – can be set up to automatically dim when signal is sent by the utility.
- **Asset Tracking** – RF sensor technology in luminaries can sense RFID tags and track objects in real time (use for inventory, forklifts, portable medical equipment etc.).
- **Indoor positioning** – Luminaries with Wi-Fi or Bluetooth capabilities used to track smartphones carried by people as they move throughout the building.
- **Heat maps** – Infrared sensors integrated in luminaries can track occupants over time, creating heat maps that indicate if building spaces are under- or over-utilized so organizations can reconfigure their spaces accordingly.
- **Security** – Outdoor security lighting can layer motion sensing on top of dimming schedule to switch luminaries to full brightness to deter vandalism/theft.
- **Fault detection** - capable of self-diagnostic testing and reporting of emergency lighting fixtures, enabling facility management to proactively address faulty equipment.
Educational seminars were held in Bemidji and Rochester, MN in December 2019.

Agendas:
- Technology overview by RAB Lighting
- Q&A
- Discussion of training needs and incentive structures
- Hands on learning opportunity

Attendees:
- Utilities
- End-use customers
- Distributors
- Consultants
- No contractors 😊
### Key Takeaways from Seminars

<table>
<thead>
<tr>
<th>Icon</th>
<th>Key Takeaway</th>
</tr>
</thead>
<tbody>
<tr>
<td>🔄</td>
<td>NLC technology is evolving to enable better integration with building control systems</td>
</tr>
<tr>
<td>🔒</td>
<td>Cybersecurity risks mitigated by compliance with latest DLC requirements</td>
</tr>
<tr>
<td>💡</td>
<td>Non-energy benefits are often most important to customers</td>
</tr>
<tr>
<td>📊</td>
<td>Energy monitoring capability can enable savings verification and performance-based incentives to encourage persistence</td>
</tr>
<tr>
<td>💰</td>
<td>Prescriptive incentives needed to help move projects</td>
</tr>
<tr>
<td>🏋️‍♂️</td>
<td>More training opportunities are needed*</td>
</tr>
</tbody>
</table>

*No contractors in attendance.
Case Studies

- Case studies of NLC deployment in small businesses

- Goals:
  - Measure energy savings
  - Gauge ease of commissioning
  - Survey customer satisfaction

- Methodology:
  - Submetering
  - Structured interviews
## Sites

<table>
<thead>
<tr>
<th>No.</th>
<th>Site</th>
<th>Location</th>
<th>Square Feet</th>
<th>Building Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Haley Comfort Systems</td>
<td>Rochester</td>
<td>73,000</td>
<td>Retail</td>
</tr>
<tr>
<td>2</td>
<td>Miller Ingenuity Winona</td>
<td>Winona</td>
<td>70,000</td>
<td>Manufacturing</td>
</tr>
<tr>
<td>3</td>
<td>Chisholm City Sports Arena</td>
<td>Chisholm</td>
<td>36,000</td>
<td>Sports Arena</td>
</tr>
<tr>
<td>4</td>
<td>McDonald's</td>
<td>Buffalo</td>
<td>6,500</td>
<td>Dining: Cafeteria/Fast Food</td>
</tr>
</tbody>
</table>
Site 1: Retail

- T8 & T12 fluorescent to LED
- NLC system-controlled circuits in front sales area along with “light clouds” showcasing lighting products.
- Cx performed by Lutron manufacturer’s representative.
- **Motivation:** reduce energy usage and costs.

### Energy Savings Results:

<table>
<thead>
<tr>
<th>Space Type</th>
<th>Description</th>
<th>Existing controls</th>
<th>NLC Strategies</th>
<th>Fixtures Savings %</th>
<th>Controls Savings, % of New Fixtures</th>
</tr>
</thead>
<tbody>
<tr>
<td>Retail</td>
<td>Light Clouds</td>
<td>N/A</td>
<td>Schedule, Trim</td>
<td>N/A</td>
<td>49%</td>
</tr>
<tr>
<td>Retail, Front Sales</td>
<td>N/A</td>
<td>N/A</td>
<td>Schedule, Trim,</td>
<td>N/A</td>
<td>29%</td>
</tr>
<tr>
<td>Office Area</td>
<td>N/A</td>
<td>N/A</td>
<td>Occupancy</td>
<td>N/A</td>
<td>48%</td>
</tr>
</tbody>
</table>

Wtd-Ave
Site 2: Manufacturing

- T8 fluorescent high bay fixtures to LED.
- Cx performed by Lutron manufacturer’s representative.
- **Motivation**: grew out of lighting sales process. Drawn to scheduling and occupancy sensing benefits.

**Energy Savings Results:**

<table>
<thead>
<tr>
<th>Space Type</th>
<th>Description</th>
<th>Existing controls</th>
<th>NLC Strategies</th>
<th>Fixtures Savings %</th>
<th>Controls Savings, % of New Fixtures</th>
</tr>
</thead>
<tbody>
<tr>
<td>Manufacturing</td>
<td>Proprietary Process Room</td>
<td>Manual</td>
<td>Schedule, trim</td>
<td>54%</td>
<td>8%</td>
</tr>
<tr>
<td>Warehouse</td>
<td>Main Plant Aisle</td>
<td>Manual</td>
<td>Trim, occupancy</td>
<td>30%</td>
<td>29%</td>
</tr>
<tr>
<td>Warehouse</td>
<td>Shipping &amp; Receiving</td>
<td>Daylighting</td>
<td>Trim, occupancy, daylight</td>
<td>35%</td>
<td>33%</td>
</tr>
<tr>
<td>Manufacturing</td>
<td>Press Room</td>
<td>Manual</td>
<td>Trim, occupancy</td>
<td>48%</td>
<td>35%</td>
</tr>
<tr>
<td><strong>Wtd-Ave</strong></td>
<td></td>
<td></td>
<td></td>
<td>43%</td>
<td>24%</td>
</tr>
</tbody>
</table>
Site 3: Sports Arena

- T5 high bay lighting to LED.
- Wireless wall controller to enable manual dimming and preprogrammed scenes, 100% output for games, 50% for practice and general skating.
- Plagued by faulty and incompatible parts
- **Motivation:** Energy savings potential and incentive offers.

### Energy Savings Results:

<table>
<thead>
<tr>
<th>Space Type</th>
<th>Description</th>
<th>Existing controls</th>
<th>NLC Strategies</th>
<th>Fixtures Savings %</th>
<th>Controls Savings, % of New Fixtures</th>
</tr>
</thead>
<tbody>
<tr>
<td>Playing Area</td>
<td>Icesheet and spectator seating</td>
<td>Manual</td>
<td>Manual Scene Selection</td>
<td>65%</td>
<td>11%</td>
</tr>
</tbody>
</table>
Site 4: Fast Food

- Replacement of fluorescent downlight fixtures with LED fixtures.
- Renovation of play area to offices, conference room
- **Motivation:** desire to manage energy costs, “go digital” wherever possible

### Energy Savings Results:

<table>
<thead>
<tr>
<th>Space Type</th>
<th>Description</th>
<th>Existing controls</th>
<th>NLC Strategies</th>
<th>Fixtures Savings %</th>
<th>Controls Savings, % of New Fixtures</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dining</td>
<td>Dining Area</td>
<td>Manual</td>
<td>Schedule</td>
<td>76%</td>
<td>0%</td>
</tr>
<tr>
<td>Dining</td>
<td>Cash Registers</td>
<td>Manual</td>
<td>Schedule, trim</td>
<td>54%</td>
<td>19%</td>
</tr>
<tr>
<td>Closed Office</td>
<td>New Office Space</td>
<td>N/A</td>
<td>Schedule, occupancy, daylight</td>
<td>75%</td>
<td>43%</td>
</tr>
<tr>
<td>Wtd-Ave</td>
<td></td>
<td></td>
<td></td>
<td>73%</td>
<td>18%</td>
</tr>
</tbody>
</table>
## Findings-Energy Savings

<table>
<thead>
<tr>
<th>Site No.</th>
<th>Building Type</th>
<th>Existing Controls</th>
<th>NLC Strategies</th>
<th>Fixture Savings %</th>
<th>Control Savings % of New Fixtures</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Retail</td>
<td>N/A</td>
<td>Schedule, Trim, Occupancy</td>
<td>N/A</td>
<td>48%</td>
</tr>
<tr>
<td>2</td>
<td>Manufacturing</td>
<td>Daylighting, Manual</td>
<td>Schedule, Trim, Occupancy, Daylight</td>
<td>43%</td>
<td>24%</td>
</tr>
<tr>
<td>3</td>
<td>Sports Arena</td>
<td>Manual</td>
<td>Manual Scene Selection</td>
<td>65%</td>
<td>11%</td>
</tr>
<tr>
<td>4</td>
<td>Dining: Fast Food</td>
<td>Manual</td>
<td>Schedule, Trim, Occupancy, Daylight</td>
<td>73%</td>
<td>18%</td>
</tr>
</tbody>
</table>

**Takeaways:**

- Control savings are small relative to fixture savings
- Occupancy sensing produced highest savings (with exception of light cloud)
- Savings are highly dependent on site conditions
Savings Compared to TRM

<table>
<thead>
<tr>
<th>Site No.</th>
<th>Building Type</th>
<th>TRM¹ Savings %</th>
<th>Case Study Control Savings %</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Retail</td>
<td>44%</td>
<td>48%</td>
</tr>
<tr>
<td>2</td>
<td>Manufacturing</td>
<td>30%</td>
<td>24%</td>
</tr>
<tr>
<td>3</td>
<td>Sports Arena</td>
<td>23%</td>
<td>11%</td>
</tr>
<tr>
<td>4</td>
<td>Dining: Fast Food</td>
<td>47%</td>
<td>18%</td>
</tr>
</tbody>
</table>

¹Minnesota TRM version 3.2

• TRM comparison reinforces the highly site-specific nature of control savings
Motivations for Choosing NLC

What factors were most important for choosing NLC?

<table>
<thead>
<tr>
<th>Site No.</th>
<th>Building Type</th>
<th>Energy Savings</th>
<th>Lighting Quality</th>
<th>Incentives</th>
<th>Remote Monitoring</th>
<th>Easily Re-configure Settings</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Retail</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Manufacturing</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Sports Arena</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Dining: Fast Food</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td>✓</td>
</tr>
</tbody>
</table>

- Participants valued energy savings from a “peace of mind” perspective
- Ancillary benefit: reconfigure fixture groups and relocate switches
## Commissioning Process

### It (Mostly) Went Well...

<table>
<thead>
<tr>
<th>Site No.</th>
<th>Approximate Commissioning Time</th>
<th>Commissioning Agent</th>
<th>Simple and Straightforward?</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2 visits/ 1 hour, 3 hours</td>
<td>Manufacturer’s Representative</td>
<td>Yes</td>
</tr>
<tr>
<td>2</td>
<td>2 visits/ 1 hour, 10 hours</td>
<td>Manufacturer’s Representative</td>
<td>Yes</td>
</tr>
<tr>
<td>3</td>
<td>&gt; 9 days</td>
<td>Manufacturer</td>
<td>No</td>
</tr>
<tr>
<td>4</td>
<td>1 visit/4 hours</td>
<td>Manufacturer’s Representative</td>
<td>Yes</td>
</tr>
</tbody>
</table>

- At all sites, commissioning was completed by an experienced technician working for the manufacturer or a manufacturer’s representative.
- Went smoothly, none indicated that the process was burdensome (*notable exception Site 3*).
- Installed using customers input, incorporated customer training in the process so customers could make future adjustments themselves.

*Problems at site 3 were result of communication and compatibility issues between the controller and luminaries. Serves as an example of challenges that can occasionally occur with connected technology.*
Discussion

• Control savings are small relative to fixture savings.
  • Majority of savings came from fixture upgrades.
  • Suggests NLC should be installed as part of an overall lighting upgrade whenever possible.
  • NLC on standalone basis may be harder to justify.

• Control savings are highly dependent on site conditions.
  • Occupancy sensing produced highest relative savings (with one exception)
  • Difference in findings from TRM and other sources reinforces site-specific nature of lighting control savings.
Recommendations

• Minnesota utilities are well-positioned to aid in the transition to advanced control technologies though their strong relationships with customers and trade allies.

• Promotion starts with education.
  • Many customers and contractors are not familiar with NLC.
  • Control companies offer their own training programs, but utilities can partner or offer parallel training and education efforts to reach more people.
  • NLC is increasingly part of advanced building controls that drive deeper savings

• Incentives help to seal the deal.

• We strongly recommend that utilities offer prescriptive incentives for NLC.
  • Properly designed prescriptive incentive allows trade allies to easily calculate and include the qualifying incentive amount in proposals.
  • Custom incentives require trade ally to complete and submit facility specific information to the utility, which then requires an engineering review.
Energy Savings Potential of Networked Lighting Control

Questions?

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CARD Project Resources

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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/)
mn.gov/commerce
Upcoming CARD Webinars:

• June 8, 2022: Slipstream - Opportunities for CIP to Support Tribal Food Sovereignty
• July 13, 2022: Citizens Utility Board of MN - Analysis of New or Modified Energy Efficiency Programs to Increase Energy Savings of Underserved Populations

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