Convenience Store Energy Efficiency

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Department of Commerce
Division of Energy Resources

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Michaels Energy
Introduction and Acknowledgements

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Speakers

Nancy M. Kelly, P.E., C.E.M.
Managing Engineer – Energy Programs

- 29 years of engineering experience, including 17 years in energy efficiency
- Registered engineer in Minnesota, Wisconsin, and California
- Leads energy audits and energy analysis to determine potential energy savings for small businesses in MN
Michaels Energy has extensive experience supporting utility energy efficiency programs.

Our engineers provide technical, program management, and administrative support for demand-side management (DSM) programs.

This experience includes commercial and industrial (C&I) retrocommissioning and custom efficiency programs, demand response, C&I new construction, C&I program evaluation, and more.

Locations:
• La Crosse
• Cedar Rapids
• Madison
• Green Bay
• St. Paul
Why C-Stores?

- Highest Electrical Energy Intensity
  - 49.4 kWh/ft² (CBECS)
  - Over 80% Electrical Energy

- Opportunities for Existing and New Stores
  - Outdoor Lighting – 24 hours per day
  - Refrigeration Equipment for Reach-in Coolers

- Great Opportunity for Small Business Program
  - Common Business - 2,000 in MN
  - Audits, Education, Project Management
  - Incentives
50 Stores Participated in Study

- 50 Stores
  - 5 in depth
  - 45 short audits

12 Utilities

Ownership:
- 29 Corporate
- 21 Independent

Car wash?

Hours – 18 or 24?
Kelly Lady – Austin Utilities
Store Profile

- 4,400 ft²
- 18/7
- 24/7

Size / Hours

- 20 fuel canopy lights
- 4 parking lot pole lights
- 4 wall packs
- 136 4 Ft T8 interior lights

Lighting

- 8 door walk-in cooler
- 3 door walk-in freezer
- Motors
- Door Heaters
- Compressors

Refrigeration
Scope of Work

1. Review Energy Use and Understand Technologies
2. Review of Codes and Market
3. Development of Standardized Calcs and Audit Materials
4. Test audit delivery with 45 businesses
5. Data Analysis and Program Design
Results – First Five Stores

- Water –
  - Electric domestic water heaters (2%)
  - Gas water heating for car washes
- Lighting
- Refrigeration
- Plug loads - variable
- HVAC - mostly A/C

Average C-Store End Use

- Lighting 28%
- Refrigeration 27%
- Car Wash 11%
- HVAC 11%
- Plug Loads 23%

CBECS Energy Use Intensity = 49.4 kWh/ft²
New performance standards for self-contained equipment (reach-in refrigerators and freezers and open refrigeration equipment) went into effect in 2009 and standards for walk-in coolers and freezers were effective in 2011.
Ownership Structure

Chain
- Knowledgeable Corporate Energy Manager
- Use more energy due to higher plug loads
- May only focus their efforts on new stores

Independent
- Need more information and education
- Has higher potential for savings
- Can’t leverage bulk buying opportunities
EUI - Study Results for 50 Minnesota C Stores

Chain 109: 109
Overall 94: 94
CBEC 49.4
Indep 72: 72

Energy Use Index, KWh/ft²
Annual Energy Use, kWh

- Carwash: 509,000 kWh
- Chains: 417,000 kWh
- Average: 364,000 kWh
- Independent: 290,000 kWh
Overall Opportunities

- Annual Usage: 360,000 kWh
  - Annual Costs: $32,400

- Energy Savings: 20%
  - Savings: $7,000

- Investment: $23,000
  - Simple PB = 3.3
  - ROI = 30%

- Rebate?

- Other Issues?
Current Rebate Levels

- LED Wall Packs (4)
  - $300 High
  - $40 Low
- LED Fuel Canopy (20)
  - $3,500 High
  - $200 Low
  - $1,300 High
  - $130 Low
  - $660 High
  - $0 Low
<table>
<thead>
<tr>
<th>Opportunities – 24 Hrs with “Good” Rebate</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>20 Fuel Canopy LED Lights</strong></td>
</tr>
<tr>
<td>Cost</td>
</tr>
<tr>
<td>$7,800</td>
</tr>
<tr>
<td>$2,300</td>
</tr>
<tr>
<td>$2,200</td>
</tr>
<tr>
<td>$460</td>
</tr>
</tbody>
</table>
Fuel Canopy Lights

LED Lights 100 watts each

Metal Halide 458 watts each

Opportunity in 86% of Stores Audited
Visible and Straightforward
Lasts 100,000 hours
Lifetime savings of 350,000 kWh ($35,000)
Strip Curtains

Opportunity in 82% of Stores Audited
Employees don’t like them
Floating Head Pressure Controls

**Head Pressure Correlation**

\[ y = 1.8163x + 62.127 \]

**Power Correlation**

\[ y = 0.0118x + 2.244 \]
The Store of the Future

- LED Lighting
- Heat Recovery
- Controls for Refrigeration System
- Exhaust Hood Controls
Benefits of Targeted C Store Program

For Store Owners

- Potential for $7,000 Savings
- Payback Less than 2 years
- 22% Energy Cost Reduction

For Utilities

- Potential for 20% Energy Savings
- 86,000 kWh
- 14 kW per store
- Small Business Opportunity
Ideas for Program Design

Prescreen Businesses
- kWh per year
- Hours
- Size
- Car wash?

Offer Targeted Program
- Lighting and Refrigeration
- Rebates encourage deep retrofits

Conduct Site Visits
- Free Audit
- Report on site
- Trade Allies
- Savings Verifiable

Follow-up
- Qualified Contractors
- Measures Installed
- Paperwork Submitted
- Rebate Issued
Prescreen

24 Hr - 350,000

18 Hr - 225,000
Targeted Program - Design

Commitment
- Offer Free Audit and Education
- Package Rebate < 2 yr P.B.

Requirements
- 20% Savings
- Measures up to 5 year

Payback Rebate
- $0.01 per Lifetime kWh
- Up to 75% Project Cost
Engaging the Business Owner

Engage
- Produce report on site
- Include pictures
- Brief and easy to read

Instruct
- Benchmark
- List of actions

Financial Analysis
- Is this a good investment
- Relate to operating costs
- Provide rebate info
Follow-up

- Connect with Local Contractors
- Decision from Store Owner
- Installation of Measures
- Complete Paperwork and Issue Rebate
Targeted Program - Example

Store Profile

- Annual Usage: 415,000 kWh
- Annual Cost: $32,744
- 24 hr/day
- Target: 20% Savings or 83,000 kWh
# Targeted Program - Example

<table>
<thead>
<tr>
<th>Measure</th>
<th>Cost</th>
<th>Annual kWh Savings</th>
<th>Annual Savings</th>
<th>Lifetime kWh Savings</th>
<th>Rebate</th>
<th>PB</th>
<th>Cum. % Savings</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lighting</td>
<td>$15,000</td>
<td>66,000</td>
<td>$5,500</td>
<td>780,000</td>
<td>$7,800</td>
<td>1.3</td>
<td>16%</td>
</tr>
<tr>
<td>Anti-Sweat Heaters</td>
<td>$2,700</td>
<td>13,000</td>
<td>$900</td>
<td>160,000</td>
<td>$1,600</td>
<td>1.2</td>
<td>3%</td>
</tr>
<tr>
<td>ECM Motors</td>
<td>$2,200</td>
<td>6,000</td>
<td>$450</td>
<td>90,000</td>
<td>$900</td>
<td>2.9</td>
<td>1%</td>
</tr>
<tr>
<td>Floating Head</td>
<td>$2,100</td>
<td>5,500</td>
<td>$350</td>
<td>55,000</td>
<td>$550</td>
<td>4.6</td>
<td>1%</td>
</tr>
<tr>
<td><strong>Totals</strong></td>
<td><strong>$22,000</strong></td>
<td><strong>90,500</strong></td>
<td><strong>$7,200</strong></td>
<td><strong>1,085,000</strong></td>
<td><strong>$10,850</strong></td>
<td><strong>1.6</strong></td>
<td><strong>21%</strong></td>
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Conclusions

- C-Stores provide great opportunity for small business partnership
  - High Energy Use Index
  - Uniformity of Conservation Opportunities
  - Target lighting and refrigeration
  - Combine quicker payback with longer life projects for deep energy savings
State-wide Impact – 2,000 C-Stores

- **Lighting**
  - 18.2 MW
  - 77.4 GWh
  - $4.8 million

- **Refrigeration**
  - 3.1 MW
  - 41.0 GWh
  - $2.5 million

Almost 25 MW
Questions?

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