Measure Categories

• 9:00-10:00 Gas Non-HVAC and Envelope
• 10:00-10:30 Codes and Standards Changes
• 10:30-12:00 Electric and Gas HVAC
• 12:00-1:00 Lunch Break
• 1:00-1:30 Lighting
• 1:30-2:30 Other Electric Measures
Gas Non-HVAC and Envelope

- Draft Workpapers
  - Commercial Water Heater
  - Commercial Dishwasher
  - Thermostatic Shower Valve
  - Loading Dock Seals

- General Items
  - Confirming water temperatures
Gas Non-HVAC and Envelope

– Commercial Water Heater
  • New standard
  • Savings vary by size, under and over 55 gal

– Commercial Dishwasher
  • ENERGY STAR calculator and assumptions
  • Many types and options, but savings vary considerably
Gas Non-HVAC and Envelope

– Thermostatic Shower Valve

• Algorithm similar to showerheads, main new variable is time of savings, obtained from a recent study
Gas Non-HVAC and Envelope

– Loading Dock Seals
  • Algorithm and approach developed, simplified inputs are next step

• General Items
  – Confirming water temperatures, Aerators, showerheads, spray valves
  • Sources welcome
Agenda

• 2017-2019 evaluation and update
• Review measure findings and draft workpapers
• Next meeting / next steps
• Q/A
TRMAC Mission

• In a nutshell...
  – Advisory body to Commerce
  – Recommend new measures or changes to existing measures
  – Recommend field studies, evaluations, research
  – Recommend policies, protocols, and guidelines related to evaluation and TRM

• Stay out of weeds
Update on Recent Work

• TRM 2.0 (2016) in progress
• RFP for 2017-2019 TRM
  – Quick Review
TRM Evaluation & Update

• Three major tasks:
  – Evaluation and update for 2017-2019
  – Generate load profiles
  – Build Smart Measures
TRM Evaluation & Update

• Major deliverables

<table>
<thead>
<tr>
<th>Date</th>
<th>Deliverable</th>
</tr>
</thead>
<tbody>
<tr>
<td>January 30, 2015</td>
<td>Kick-off meeting with the Department and TRMAC</td>
</tr>
<tr>
<td>June 1, 2015</td>
<td>List of codes and standards changes</td>
</tr>
<tr>
<td>November 13, 2015</td>
<td>Draft TRM delivered</td>
</tr>
<tr>
<td>December 11, 2015</td>
<td>Final TRM delivered</td>
</tr>
<tr>
<td>December 11, 2015</td>
<td>Smart Measure library complete</td>
</tr>
<tr>
<td>December 11, 2015</td>
<td>Electric and gas load profiles delivered</td>
</tr>
</tbody>
</table>
Timeline

- 3/1/15: Existing measure updates
- 5/1/15: Member feedback - existing measures
- 7/1/15: Research coincident peak demand savings
- 8/31/15: Research new measures
- 10/31/15: Member feedback - new measure selection
- 12/31/15: Technical working meetings
- Existing measure updates
- Member feedback - existing measures
- Research coincident peak demand savings
- Research new measures
- Member feedback - new measure selection
- Technical working meetings
- Documentation of updated and new measures
- Load profile research
- Generate load profiles
- Smart measure library
Measure Categories

• 9:00-10:00 Gas Non-HVAC and Envelope
• 10:00-10:30 Codes and Standards Changes
• 10:30-12:00 Electric and Gas HVAC
• 12:00-1:00 Lunch Break
• 1:00-1:30 Lighting
• 1:30-2:30 Other Electric Measures
Code and Standard Changes

- Summary Spreadsheet
- Main updates 2015/2016
- Main updates 2017/2019
Main updates 2015/2016

- ASHRAE 90.1-2010 C/I
  - January 25, 2015
  - Lighting and Lighting Controls
  - HVAC VSD
  - Chillers
  - Economizer and Energy Recovery
  - Unitary and Split Systems
Main updates 2015/2016

• New Federal Standards
  – Water Heaters
    • Higher Minimum Efficiencies
    • >55 gal Electric Resistance Phased Out
HVAC Gas and Electric

• Draft Workpapers
  – Boilers – algorithm changes
  – Boiler Modifications – tune-up requirements
  – Condensing Unit Heater - new
  – ERV – added kW savings
HVAC Gas and Electric

• Draft Workpapers
  – Parking Garage Fan Control
    • hp base unit (need to collect hp)
    • Electric and gas savings
  – Guest Room Energy Management (GREM)
    • Many equipment types possible
    • PTAC, PTHP, chilled/hot water covered
    • Required inputs are size, heating/cooling type and fuel
HVAC Gas and Electric

• Draft Workpapers
  – Duct Sealing – new, includes locations, requires cfm measurements
  – Furnace Tune-up – new, includes requirements list
  – Mini-Split – savings provided for multiple equipment and fuel types
  – Res GSHP
  – Commercial Air Conditioning – incorporates IEER
HVAC Gas and Electric

- Thermostats
- QI/QM
- General Items
  - HDD vs EFLHrs
  - Steam Trap Hours
Smart Thermostats

Three tiers:

I. Programmable
II. Communicating
III. Analytics Capable
Smart Thermostats

MN TRM

- Gas and electric programmable t-stat measures for heating only
- Current algorithm uses 6.2% savings with ISR = 100% for direct install or 56% for other

Tier I Findings

- Wide range of savings estimates
- 3.5% (= 6.2% x 56%) for non-direct install is within range of recent estimates in MI (2.0%), MA (3.6%), Xcel (3.9%), CenterPoint (4.2%)
- 6.2% (= 6.2% x 100%) for direct installs may be high if 1˚F average setback is assumed (Xcel and CPE)
- Lifetime estimates vary from 5-15 years. MN 10 year figure is within range.
Smart Thermostats

Tier II and Tier III Findings

- Not many 3rd party studies so far, no MN results
  - Different baselines (programmable, manual, or mixed)
  - Robustness varies
    - Modeling vs. billing analysis, sub-metering
    - Sample sizes
  - Studies have usually included just one product
    - Features vary by device and may impact savings
    - Bring Your Own Thermostat (BYOT) program designs include multiple devices

- No info on savings persistence yet
  - Fewer overrides because more customer engagement
Smart Thermostats

Tier II and Tier III Findings

– Only two TRM examples

• MI MEMD to adopt

<table>
<thead>
<tr>
<th></th>
<th>Tier I: Programmable Thermostats</th>
<th>Tier II: Communicating Thermostats</th>
<th>Tier III: Analytics Capable Thermostats</th>
</tr>
</thead>
<tbody>
<tr>
<td>% Savings of Heating and Cooling Energy Consumption</td>
<td>2.0%</td>
<td>5.4%</td>
<td>8.9% **</td>
</tr>
</tbody>
</table>

• MA (Tier II)
  – 6.6 MMBtu savings (gas heating)
Smart Thermostats

Savings results

– Generally cooling savings are larger than heating
– Not clear if Tier III > Tier II savings
– Savings vs. manual device are higher than savings vs. programmable tstat with one exception (Oregon heat pump study)

<table>
<thead>
<tr>
<th>Heat Savings % (excludes manufacturer studies)</th>
<th>vs Prog</th>
<th>vs Manual</th>
<th>vs Mixed</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tier I</td>
<td>N/A</td>
<td>2.0% (MI), 2.5% (ECW), 3.6% (MA), 6.2% (MN,IL)</td>
<td>N/A</td>
</tr>
<tr>
<td>Tier II</td>
<td>8% (NH)</td>
<td>10% (MA)</td>
<td>4.5% (Honeywell)</td>
</tr>
<tr>
<td>Tier III</td>
<td>3% (IL), 5.6% (N. IN), 6.5% (OR-HP), 7.5% (S. IN)</td>
<td>2.9% (OR-HP), 12.5% (S. IN), 13.4% (N. IN)</td>
<td>N/A</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Electric Cooling Savings % (excludes manufacturer studies)</th>
<th>vs Prog</th>
<th>vs Manual</th>
<th>vs Mixed</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tier I</td>
<td>N/A</td>
<td>Inconclusive</td>
<td>N/A</td>
</tr>
<tr>
<td>Tier II</td>
<td>16% (MA)</td>
<td>16% (MA)</td>
<td>1.5-3% (S. CA), 16% (MA), 19.4% (Honeywell)</td>
</tr>
<tr>
<td>Tier III</td>
<td>0.8% (S. IN), 1.1% (N. IN), 8.7% (IL)</td>
<td>13.9 (S. IN), 16.1% (N. IN)</td>
<td>N/A</td>
</tr>
</tbody>
</table>
Smart Thermostats

ENERGY STAR certification

– Old certification for programmable t-stats removed 12/31/09 due to lack of savings evidence

– New specification for connected t-stats proposed 6/17/15

• Details TBD but will be based on demonstrated savings over aggregate data
Smart Thermostats

In summary...


– Options for Tier II/III

  1. Add to TRM now based on early study results, update next year
     – TRM as planning figures only?

  2. Wait and consider adding next year, leverage ENERGY STAR rating
Residential QI/QM

- MN TRM includes QI for A/C and ASHP, AC Tune-Up, Furnace Tune-Up
  - 25% savings factor for QI
  - 5% savings factor for AC tune-up
  - 2% savings factor for furnace tune-up
- Reviewed existing QI, tune-up measures and investigated creation of new QI and QM measures
Residential QI/QM

- Findings (cooling)
  - 25% QI savings seems high based on 2008 ECW report “Air-Conditioning in Wisconsin”
    - Refrigerant undercharging is prevalent but not much impact if thermostatic expansion valve (TXV). In 2008 > 50% of new AC’s sold in WI had TXVs.
    - Not much energy impact from over-sizing correction
    - Airflow correction can either increase or decrease EER
  - In addition modeling results show treatment effects are not always additive
  - 5% savings from AC tune-up seems reasonable however
    - Average savings of 7% in ECW study from condenser coil cleaning
  - Other studies found were based on modeling, lab testing, or took place in other regions with different climates and housing construction
Residential QI/QM

• Findings (heating)
  – HVAC Save field study in Iowa suggests most furnaces can reach 90% conversion efficiency (ratio of actual Btu’s delivered to theoretical Btu’s) through inexpensive fixes (airflow adjustments and combustion tuning)
    • Average starting conversion eff = 81%
    • Reaching 100% conversion efficiency requires more costly repairs: duct sealing and duct optimization
  – Furnace tune-up savings (2%) seem low given HVAC Save results
  – Early results from MN CARD study inconclusive
Residential QI/QM

• Decision Options
  – Move forward with QI and QM updates now or wait until CARD study completed end of 2015?
Lighting

• General Items
  – CI Lighting Format
  – T8 Ballast Standard
  – CF review
  – ISRs
  – Residential Motion Sensors
  – Costs
Lighting

– CI Lighting Format
  • General lighting section with common information
  • Algorithm, tables of values (IF, CF, Hrs, ML)
  • Specific technology sections
  • Plan to expand adding LED troffers, possible T8 baselines
  • Wattage table, mostly unchanged
Lighting

  • Effective 11/14/2014
  • Introduces Ballast Luminous Efficiency (BLE) standards
  • Minimum BLE levels comparable to Premium T8 / High Performance T8 levels
– Recommendation – Allow T8 technology as the baseline with reduced measure lives
Other Electric Measures

- Draft Workpapers
  - Ag Engine Block Heater
  - Ag High Speed Fans
  - Ag Lighting
  - Ag Livestock Waterer
  - Compressed Air Leak Repair
  - ECM Circulators
  - VSD Pool Pumps
Wrap-up

• Next Meeting/Next steps
• Questions/comments?

Thank you!

Mark.Garofano@state.mn.us
651.539.1864