CT EEB X1931 PSD Review (All Sectors) with x1941 Multifamily-Specific PSD Topics
7/15/2020
Measure Review Discussion
Part 2 – Batch 3 & Next Steps
AGENDA

- Study Background
- Results Overview *(updated with Batch 3)*
- Batch 3 Comments Discussion
- Appendices Discussion
- Baseline Discussion and Primary Research
- Next Steps
STUDY BACKGROUND AND RESULTS OVERVIEW
PHASE 1 STUDY BACKGROUND

- Last Friday and today’s discussion meetings conclude detailed measure review findings to inform the 2021 PSD draft
- Detailed Measure Reviews – 72 Measures – 3 Batches
- Majority of comments were resolved with responses emailed to commenters
- Comments on specific Batch 3 measures for today’s discussion
<table>
<thead>
<tr>
<th>Measure</th>
<th>Batch 1 – Delivered June 18</th>
<th>Batch 2 – Delivered June 26</th>
<th>Batch 3 – Delivered July 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Natural Gas Radiant Heaters</td>
<td>Chillers</td>
<td></td>
<td>Standard Lighting</td>
</tr>
<tr>
<td>Low Voltage Dry Type Distribution Transformers</td>
<td>Natural Gas Fired Boilers and Furnaces</td>
<td>Upstream Lighting</td>
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<tr>
<td>Lean Manufacturing</td>
<td>Natural Gas-Fired Domestic Hot Water Heaters</td>
<td>Unitary A/C and Heat Pumps</td>
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<tr>
<td>Commercial Kitchen Equipment</td>
<td>HVAC Variable Frequency Drives</td>
<td>Water and Ground Source Heat Pumps</td>
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<tr>
<td>Lost Opportunity Custom</td>
<td>Pipe Insulation</td>
<td>Dual Enthalpy Controls</td>
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</tr>
<tr>
<td>Cool Roof</td>
<td>Duct Sealing</td>
<td>Demand Control Ventilation</td>
<td></td>
</tr>
<tr>
<td>Refrigerator LED</td>
<td>Steam Trap Replacement</td>
<td>Variable Refrigerant Flow (VRF) HVAC System</td>
<td></td>
</tr>
<tr>
<td>Water-Saving Measures</td>
<td>Blower Door Test (Small C&amp;I)</td>
<td>Commercial Clothes Washers</td>
<td></td>
</tr>
<tr>
<td>Add Speed Control to Rooftop Unit Fan</td>
<td>Energy-Efficient Central Air Conditioning</td>
<td>Standard Lighting</td>
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<tr>
<td>Commercial Kitchen Hood Controls</td>
<td>Electronically Commutated Motor HVAC Fan</td>
<td>Duct Insulation</td>
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<tr>
<td>Custom Measures</td>
<td>Duct Sealing</td>
<td>Setback Thermostats</td>
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<tr>
<td>Cooler Night Covers</td>
<td>Quality Installation Verification</td>
<td>Lighting</td>
<td></td>
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<tr>
<td>Evaporator Fan Controls</td>
<td>Furnaces</td>
<td>Heat Pump</td>
<td></td>
</tr>
<tr>
<td>Evaporator Fans Motor Replacement</td>
<td>ECM Circulating Pump</td>
<td>Geothermal Heat Pump</td>
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</tr>
<tr>
<td>Door Heater Controls</td>
<td>REM Savings</td>
<td>Heat Pump – Ductless</td>
<td></td>
</tr>
<tr>
<td>Vending Machine Controls</td>
<td>Infiltration Reduction Testing (Blower Door Test)</td>
<td>Package Terminal Heat Pump</td>
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<tr>
<td>Add Doors to Open Refrigerated Display Cases</td>
<td>Infiltration Reduction (Prescriptive)</td>
<td>Duct Insulation</td>
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<tr>
<td>Boilers</td>
<td>Wall Insulation</td>
<td>WI-Fi Thermostat</td>
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</tr>
<tr>
<td>Boiler Reset Controls</td>
<td>Ceiling Insulation</td>
<td>Clean, Tune and Test</td>
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<tr>
<td>Fossil Fuel Water Heaters</td>
<td>Floor Insulation</td>
<td>Residential Appliances</td>
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<tr>
<td>Heat Pump Water Heaters</td>
<td>Showerheads</td>
<td>Electronics</td>
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<tr>
<td>Residential Custom</td>
<td>Faucet Aerators</td>
<td>Window or Sliding Glass Door Replacement</td>
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<tr>
<td></td>
<td>Pipe Insulation</td>
<td>Thermal Enclosure</td>
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<td></td>
<td>Solar Water Heater</td>
<td>Install Storm Window</td>
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<td></td>
<td>Behavioral Change</td>
<td>Insulate Attic Openings</td>
<td></td>
</tr>
</tbody>
</table>

Today's focus: Batch 3.
**Measure Status after Review of All Batches**

- Existing measure, no change, 12
- Recommend measure removal / no longer offered, 3
- New measure, 1
- Existing measure, change recommended, 57

- Algorithm update, 21
- Editorial update, 1
- New methodology update, 6
- Parameter update, 23
- Updated reference, 4
- Updated program evaluation results available, 1
- Updated program evaluation results needed or additional research needed, 1

[Diagram showing the distribution of measure status]
**Batch 3 Comment Summary**

- 284 comments total

**Addressed via email**
- 83 No further action - Agreement
- 54 Consultant action required - Resolved
- 132 Consultant action required - Under Review

- 15 Further Discussion - Today
- Comments covering in three major topics
  - Multifamily Lighting Hours
  - Occupancy sensor/lighting controls
  - Ductless HP – ccHPs
  - GSHP – LO Baseline

![Pie chart showing the distribution of comments and actions]
<table>
<thead>
<tr>
<th>Measure ID</th>
<th>Measure name</th>
<th>Parameter</th>
<th>Current PSD Value</th>
<th>Recommended Value</th>
<th>Recommended action</th>
<th>Justification</th>
<th>Comment</th>
<th>ERS Response</th>
<th>ERS Response Category</th>
</tr>
</thead>
<tbody>
<tr>
<td>PSD2.1.1</td>
<td>Standard Lighting</td>
<td>CPL - lighting coincidence factor</td>
<td>Varies by building type. See PSD Table A-1-1.</td>
<td>0.80 summer, 0.61 winter</td>
<td>Parameter update</td>
<td>MA TRM uses a much newer study by DNGL (2017 vs 2007) and simplified coincidence factor calculation which streamlines program savings calculations.</td>
<td>C1635 EO Impact recommends CFs by building type, season. Based on analysis of multi-year, multi-program logger files.</td>
<td>ERS will review and incorporate recommendations of recent evaluations (C1635)</td>
<td>Action required/Resolved</td>
</tr>
<tr>
<td>PSD2.1.1</td>
<td>Standard Lighting</td>
<td>H - Facility lighting hours of use</td>
<td>Site specific, or as tabulated in AS-1</td>
<td>Update table AS-1 based on forthcoming evaluation</td>
<td>Awaiting Evaluation Results</td>
<td>Evaluation results on lighting hours are forthcoming. C1635 EO Impact Evaluation.</td>
<td>C1635 EO Impact results are now available, including lighting HOU.</td>
<td>Please ensure any factors here that change will remain compatible with the incorporate recommendations of recent evaluations</td>
<td>Action required/Resolved</td>
</tr>
<tr>
<td>PSD2.1.1</td>
<td>Standard Lighting</td>
<td>Sector (C&amp;I Residential)</td>
<td>C&amp;I</td>
<td>No change</td>
<td>Aligns with other TRMs</td>
<td>Reference both building area method and space by-space area method options. JW</td>
<td>Language earlier in the measure to clarify that space-by-space is an incorporated recommendations of recent actions</td>
<td>Action required/Resolved</td>
<td></td>
</tr>
<tr>
<td>PSD2.1.1</td>
<td>Standard Lighting</td>
<td>Baseline equipment</td>
<td>Energy code baseline</td>
<td>Energy code baseline, using either Space-By-Space method or Building Area method</td>
<td>Parameter update</td>
<td>Other TRMs use both space-by-space and building area methods</td>
<td>Reference both building area method and space by-space area method options. JW</td>
<td>Recommendation pending forthcoming evaluation results from NMR.</td>
<td>Action required/Under Review</td>
</tr>
<tr>
<td>PSD2.1.1</td>
<td>Standard Lighting</td>
<td>Energy efficient equipment</td>
<td>Exceeds current energy code with DLC- or EnergyStar-approved lighting equipment</td>
<td>Exceeds current energy code</td>
<td>Parameter update</td>
<td>Adds specificity to the kinds of equipment that should be incentivized. Forthcoming NMR Retail Lighting Study.</td>
<td>Recommendation pending forthcoming evaluation results from NMR.</td>
<td>Action required/Under Review</td>
<td></td>
</tr>
<tr>
<td>PSD2.1.1</td>
<td>Standard Lighting</td>
<td>Energy efficient equipment</td>
<td>Exceeds current energy code</td>
<td>Update efficacy based on forthcoming NMR Retail Lighting Study.</td>
<td>Awaiting Evaluation Results</td>
<td>Adds specificity to the kinds of equipment that should be incentivized. Forthcoming NMR Retail Lighting Study.</td>
<td>Recommendation pending forthcoming evaluation results from NMR.</td>
<td>Action required/Under Review</td>
<td></td>
</tr>
</tbody>
</table>
Multifamily Lighting Hours of Use

- Justification for proposed change:
  - CT PSD value of 7,665 is not sourced, and is higher than other TRMs
  - MA applies 17.5 hrs/day (6,388 per year) for all Multifamily common area types. WI TRM has a value of 5,950 for multifamily common areas. That value reflects CFLs only, and most replacements are now LEDs. But the WI value does indicate that the current CT value is too high.
- Comment: “Specify interior common areas, or other assumption.”
- Response:
  - The MA value of 6,388/yr applies to all common area lights, including interior common areas
  - While it would be more accurate to have different values for different multifamily common areas, that is overly complicated
Occupancy Sensor Recommendations

- Note: This would apply to both commercial and multifamily common areas
- Comment: “need to understand why we are recommending separate occ sensor measure before comment here. In general, I think that it is better to keep occ included in lighting section.”
- Justification:
  - Lighting controls such as occupancy sensors may be installed independently of other lighting upgrades.
  - Other TRMs list Occupancy Sensors or Lighting Controls as an independent measure (e.g., MA and RI TRMs)
- If lighting controls are retained within Standard Lighting, language should clarify the base wattage ($W_n$) for the controls is the new (installed) fixture, if the retrofit includes a fixture replacement and lighting controls
INCLUDE SEPARATE ALGORITHMS FOR CCHP

- Middle ground between MA and NY TRMs
- MA TRM does not differentiate between non-cc and ccHP units leading to results such as WKW = 0, WCF = 0.
- NY TRM explicitly includes ccHP (both air-source and ground-source) with complex savings algorithms.
- How are cold-climate heat pumps being considered on implementation side?
- We recommend explicitly separate savings algorithms for ccHPs, which are not as complex as NY TRM.
Stakeholders comments suggest fossil fuel/central AC baseline.

We believe that a C&I customer planning to install GSHP system would not have installed a fossil fuel heat source.

It makes more sense to compare HP to HP
EVALUATION REPORTS
CT Evaluations to be Incorporated

- [C1635] Energy Opportunities (EO) Program Impact Evaluation
- ERS review left place holders for the following
  - Update Energy and Demand RR for EO Program End Uses
  - Update Seasonal Peak CF - Add new building types
  - Update Upstream Lighting kWh gross RR and ISR – Replace current RR table – PSD currently assumes 100% - Must also update algorithms to include ISR
  - Upstream Lighting HOU – Not for all building types
  - Add Lighting/HVAC Interactive Factors – Done through RRs
### [C1634] Energy Conscious Blueprint (ECB) Program Impact Evaluation

<table>
<thead>
<tr>
<th>Item</th>
<th>Current Recommendation</th>
<th>Updated Recommendation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dual enthalpy economizer</td>
<td>Keep Measure - Align with NY DOE-2</td>
<td>Remove from PSD - minimal/no savings</td>
</tr>
<tr>
<td>Variable speed air compressor</td>
<td>No recommendation/Not current measure</td>
<td>Add measure/develop as part 2 of this study</td>
</tr>
<tr>
<td>Lighting HOU</td>
<td>Future study incorporating data from C1634</td>
<td>HOU recommended area of future study - aggregate collected raw (C1635) data and potentially obtain additional data</td>
</tr>
<tr>
<td>Chiller Analysis - 8760 for demand savings</td>
<td>BIN Analysis (No change from PSD)</td>
<td>Under Review</td>
</tr>
<tr>
<td>Baseline Study - Lighting/LPD, HVAC efficiency, boiler efficiency and ROF</td>
<td>Further research</td>
<td>Further research</td>
</tr>
</tbody>
</table>
CT Evaluations to be Incorporated

- [R1973] ESRPP and E-Commerce Retail Non-Lighting Evaluation
  - Update kWh savings – Appliances and electronics based on the VT TRM
  - Documentation of key factors and assumptions
  - Document consistent calculation approach
  - Consider deemed approach
APPENDICES
APPENDIX ONE: PEAK FACTORS

- Provides peak factors for 19 of the PSD’s 72 measures
- Remaining measure CFs are provided in individual measure chapters
- Peak factors supported by 14 references:
  - Two explicitly specify ISO-NE Seasonal Peak definition (account for 55% of factors)
    - These two studies are from 2007
  - Two references are not cited
  - Five references could not be accessed – broken link
- Seasonal peak has generally shifted since 2007
- Appendix One recommendations:
  - Specify ISO-NE Seasonal Peak only when confirmed
  - Expand Appendix One to include all measure CFs, even those not confirmed to be seasonal peak
  - Use evaluation studies, primary research to refresh seasonal peak CFs, as current peak is likely later than 2007’s
Appendix Four: Lifetimes

- References are generally old, with most from 2005-2009
  - Many of the technologies addressed have had a full lifecycle or more since
  - Commercial references are generally older than residential
  - Several references now inaccessible due to broken link, spreadsheet
- Commercial EULs cite “estimate” in 66 instances
- Example EULs recommended for revision after detailed measure review:
  - Residential: furnace, heat pump
  - Commercial: fan control, vending machine control
- RUL values provided for only 2 commercial and 6 residential measures
  - Related to dual baseline discussion today – credible RULs needed for early replacement claim
- Upcoming X2001 study provides opportunity for original research
- Appendix Four recommendations:
  - Revise links and embed PDFs and spreadsheets within PSD itself
  - Refresh obsolete references with new research (X2001) – secondary research is circular and dated
  - Secondary/primary research on RULs required for dual baseline claim
APPENDIX FIVE: HOURS OF USE

- Nearly all EFLHs cannot be cited to a specific source
  - “These hours have been developed over the years and are taken into account during program evaluations.”
  - References to prior evaluation studies, in CT or elsewhere, are unknown
  - Data request submitted 7/14/2020

- Unclear how EFLH changes have affected prospective RRs
  - “Any errors, whether positive or negative, are trued up in the realization rates.”

- Example EFLHs recommended for revision after detailed measure review
  - Residential: heat pump (ASHP, DMHP, GSHP), wifi thermostat
  - Commercial: door heater control, heating system components

- Appendix Five recommendations:
  - Support EFLHs with transparent, accessible citations
  - Leverage CT evaluation study results for EFLH update/pooling of data
  - Follow evaluators’ prospective RR guidance when EFLHs change
  - Consider coastal/inland differentiation for EFLHs when possible
    - Related to Friday’s discussion on degree days
Other Appendices

Appendix Two: Load Shapes
- PSD references Appendix Two only 4 times – natural gas peak factor
- References dated between 2011-2016

Appendix Three: Realization Rates
- Prospective RRs may require revision after PSD updates
  - Related to Friday’s discussion on criteria needed for prospective RR update
  - Including RR detail would allow more transparent revision of prospective RR:
    - Program-reported vs. evaluated savings underlying the RRs
    - Differentiation by sector when possible: e.g., SF vs. MF for HES/IE

Appendix Six: Non-Energy Impacts
- Residential NEIs addressed in aggregate – HES/IE, MF, Rebate (per R4 and R31 studies)
- Commercial: only PRIME/RCx/O&M programs addressed per C1641 study
- Measure-specific and commercial NEIs are lacking
- X1942 study provides an opportunity for primary research, priorities informed by DEEP B/C directions
Baseline Review
Baseline Review

- Industry standard practice baseline vs. code, when both exist & differ
  - Boilers already reflect higher ISP baseline (*next page*)
  - Furnaces will have updated recommendations (*next page*)
  - Known: Furnaces, custom lighting, need to review new C1634 ECB results

- Dual baseline / early retirement
  - X1939 focus
  - Integrating effort with X1931

- Market event characterization review
  - Replace on failure versus retrofit baseline
  - How to best apply:
    - One or other
    - Both
    - Blended average


## Baseline Review in PSD

<table>
<thead>
<tr>
<th>Category</th>
<th>Measure</th>
<th>MA Baseline</th>
<th>PSD Baseline</th>
</tr>
</thead>
<tbody>
<tr>
<td>Boilers Residential</td>
<td>HVAC - Forced Hot Water Boiler, Gas</td>
<td>ROF: 82% AFUE rated boiler (79.3% AFUE actual). ER: 80% AFUE rated boiler (77.4% AFUE actual).</td>
<td>ROF: 85% AFUE rated boiler, ER: 80% AFUE rated boiler.</td>
</tr>
<tr>
<td>Boilers Residential</td>
<td>HVAC - Forced Hot Water Boiler, Oil/Propane</td>
<td>ROF AFUE of 84% for oil boiler. ROF AFUE of 79.3% for propane boilers (code-compliant AFUE of 82% adjusted by a degradation factor of 0.967)</td>
<td>ROF AFUE of 84% for oil and 85% for propane, with ER baseline AFUE of 80%.</td>
</tr>
<tr>
<td>Furnace Residential</td>
<td>HVAC - Furnace, Gas</td>
<td>ROF: 85% AFUE furnace, ER: 78% AFUE furnace (Actual 78.9% AFUE).</td>
<td>ROF: 85% AFUE furnace, ER: 78% AFUE furnace.</td>
</tr>
<tr>
<td>Furnace Residential</td>
<td>HVAC - Furnace, Oil/Propane</td>
<td>ROF: AFUE of 83% for oil and AFUE of 85% for propane furnace. ER: 78% AFUE furnace (both oil and propane)</td>
<td>For oil: 82% AFUE furnace for ROF and 76% AFUE for ER.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>ISP instead of code.</td>
<td>For propane: 85% AFUE furnace for ROF and 78%</td>
</tr>
<tr>
<td>Furnace Commercial</td>
<td>HVAC - Furnace, Gas</td>
<td>&quot;Recommended baseline is code except the Warm Air, Gas-fired &lt;225 MBH = 85% AFUE</td>
<td>ASHRAE and 2015 IECC minimum efficiency requirements</td>
</tr>
</tbody>
</table>
FUTURE PRIMARY RESEARCH
**PSD Review Phase 2: Primary & Secondary Research**

- Preliminary prioritized list based on PSD review, stakeholder interviews, and literature review – to be refined and discussed further in next call (after modeling work)

<table>
<thead>
<tr>
<th>High</th>
<th>Medium</th>
<th>Low</th>
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</thead>
<tbody>
<tr>
<td>*Baseline: Code vs. ISP</td>
<td>*ACOP/COP - Refrigeration Measures</td>
<td>*Savings Fractions - Natural Gas Radiant Heaters</td>
</tr>
<tr>
<td>*Hours of Use</td>
<td>*Interactivity of HVAC anc Air Sealing</td>
<td>*Measure Development (new additions to PSD) - Passive house, refrigerant leak, codes and standards</td>
</tr>
<tr>
<td>*Peak Factors (Measure specific)</td>
<td>*Infiltration Reduction (Blower Door Test)</td>
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</tr>
<tr>
<td>*Prospective Realization Rates</td>
<td>*Measure Development (new additions to PSD) - Integrated Controls/Home Automation, EMS, ALC, Variable speed air compressor</td>
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<tr>
<td>*Strategic Electrification</td>
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</tbody>
</table>
Next Steps
Next Steps

- Finalize measure recommendations
  - 99% Complete by Wednesday 7/22/2020
  - Any stragglers before the end of the month (HDD/CDD, Heat Pump)

- Follow up meeting to address primary and secondary research recommendations for Phase 2 of this X1931 PSD project with the committee
Thank You