

Connecticut Energy Efficiency Fund

Measures to Consider Updating for the Next
Revision of the Connecticut Program Savings
Document (PSD)

May 29, 2012



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Revision of the Connecticut Program Savings
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Draft

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This interim report summarizes the 2012 review of the Connecticut Program Savings Document (PSD). Included in this report are summaries of the review objectives, methods used in the review, and recommendations for measures that may warrant additional review.

1. OBJECTIVE OF PSD REVIEW

The overall project objectives are to provide recommendations for updates to the Connecticut Program Savings Document (PSD). To do this, the evaluation team conducted an initial review of the PSD, documented here. The initial review produced a prioritized list of measures based on set criteria. The prioritization identified which measures are recommended for a detailed review for possible revision. This initial review also identified proposed new measures.

2. METHODS USED TO PRIORITIZE MEASURES FOR REVIEW

1.

The PSD review team developed a list of criteria to review the measures in the PSD. The criteria are based around the reviewer's qualitative assessment of the following:

- Measure baseline definitions
- Measure efficient case definitions
- Methodology quality
- Data source origins
- Data source qualities
- Availability of other data sources that may be useful in revising and updating the measure
- How the measure's savings methodology and algorithms compare to other relevant literature and industry practices.

Each of these criteria had qualitative selections that were given numerical scores; the criterion score is then weighted based on a chosen level of importance for that criterion. The importance of the criteria depended on how significantly its selection would affect the reviewer's judgment in the relative urgency to update that portion of content in the measure. The criteria given higher weight (baseline change, data source origin, and available sources) were those that provided more impartial review (e.g., are baseline definitions following code, efficient standards, or standard practice? Is the data source an engineering judgment or based on primary research? Does the reviewer know of sources that can be readily obtained and, if implemented, beneficial to the accuracy (realization) of the measure savings?). The criteria given lower weight (measure change, methodology/data source quality, and algorithm) were those that did not necessarily provide information that would give actionable reason to update the measure, but still provided reviewer judgment and general perception of quality for the measure sources, methodology, and cohesion with industry standard methods for respective measures and technologies. No methodology or algorithm errors were found which would have increased the priority of those measures. All the criteria selection scores and criteria weights are shown in the tables below.



Table 1: Criteria Scoring

Criteria	Selection	Score
Baseline Change, Measure Change, Available Sources, and Algorithm	Yes	20
	No	0
	Need More Research	5
	Not Applicable	0
Methodology Quality and Data Source Quality	High	0
	Medium	5
	Low	10
	Very Low	20
Data Source Origin	Primary	0
	Secondary	10
	Judgment	20
	Custom	0
	Not Applicable	0

Table 2: Criteria Weights

Criteria	Weight
Baseline Change	25.0%
Measure Change	10.0%
Methodology Quality	10.0%
Data Source Origin	17.5%
Data Source Quality	7.5%
Available Sources	25.0%
Algorithm	5.0%

3. RECOMMENDATIONS

The following, in order of priority (from high to low), are the review team’s recommendations for measures to consider for updating for the next revision of the Connecticut Program Savings Document (PSD)¹. Following these measures is a list of new measures recommended by the review team for inclusion in the next revision of the PSD.

3.1 EXISTING MEASURES RECOMMENDED FOR REVISION

1. *Spray Valve Replacement (C&I Retrofit)*

¹ Residential light bulbs and luminaires were part of the top priority list but removed due to the concurrent studies conducted for this end use. Ground source heat pumps are also being reviewed in an existing study and may be removed from this list. One opportunity to review for the ground source heat pumps is baseline definition that may not be addressed by current study.



- **Baseline Definition** – The existing description does not take into consideration federal standard as of 2006 is 1.6 gpm. A different baseline should be considered for retrofit and lost opportunity (LO).
- **Measure Definition** – For lost opportunity (LO), the measure should be a low flow rate requirement (below fed standard) and currently it is set at 1.6gpm.
- **Methodology** – Savings are from secondary sources; however, there is an error in the gas savings value (PSD did not pull the correct number from the reference). It should be 11.5 CCF/year (not 42). Others use calculated methodology that is more regional in nature, too.
- **Available Sources** – Savings are from a 2004 California study. There are more recent data references and calculated methodology approaches.

2. *Heat Pump (Residential)*

- **Baseline Definition** – For early replacement, the assumed existing EER is based on judgment. Should verify what existing EER baseline should be used.
- **Data Source Quality** – PSD uses a 1989 ASHRAE reference for EFLH that has since been updated by ASHRAE. Need to use a more appropriate value that is using currently accepted methods.

3. *Duct Insulation (C&I Retrofit)*

- **Baseline Definition** – The baseline uses assumed temperature conditions for unconditioned space. Cooling and heating efficiencies used are based on judgment. No references are provided. Need to investigate if they are appropriate values.
- **Measure Definition** – Similar comments to baseline definition. In addition, savings are based on bare ducting to R-6. There are no alternatives offered.
- **Data Source Quality** – considered to be very low since not all assumptions are stated or referenced. Data and source for input to 3E Plus software may be available for review, so need to be requested from the Companies. EFLH used from the appendix 5 are not clearly documented on how they are derived².
- **Available resources** – Need to do more research to see what type of regional data is available for typical HVAC equipment efficiencies, temperature conditions for attic, basement, and ambient air for the calculations.

4. *Furnace (Residential)*

² Full load hours are based on a 2006 CT & MA school lighting study. The reasoning for extending lighting end use hours in to another end use is not documented.



- Baseline Definition – Need to investigate baseline heating factor and equipment efficiency sources to determine if there are available sources that could replace the existing ENERGY STAR source.
- Data Source Quality – Considered to be low based on need to investigate sources used in the ENERGY STAR calculator

Available sources – There are secondary sources available that can be used to update the savings methodology and baseline.

5. *Vending Machine Occupancy Controls (C&I Lost Opportunity)*

- Baseline Definition – Source study needs to be investigated. The study is 11 years old – baseline equipment in the study could be considerably less efficient than current vending machines.
- Data Source Quality – Considered low due to its age.

6. *Insulate Attic Openings (Residential)*

- Baseline Definition – Baseline insulation values are not referenced. Baseline infiltration is not defined.
- Measure Definition – Measure insulation values are not referenced. Measure definition needs to specifically include sealing for the infiltration portion of savings. Additionally, data used is not clearly referenced.
- Data Source Quality – Sources need to be reviewed in detail and savings methodology may be modified after review. The source of energy factor is not referenced and needs to be consistent across like measures. PSD uses a 1989 ASHRAE reference for EFLH that has since been updated by ASHRAE. Need to use a more appropriate value that is using currently accepted methods.

7. *Door Heater Controls (C&I Retrofit)*

- Measure Definition – Measure definition change related to modifying the estimate of off hours and developing an estimate based on local CT weather. Prescriptive savings may then be developed and tied to amperage of door heater or number of doors.
- Data Source Origin and Quality – There are unreferenced judgment assumptions made for savings parameters.
- Available Sources – There are secondary sources available that can be used to update the savings parameters and possibly savings methodology.

8. *Set Back Thermostat (C&I Retrofit)*

- Measure Definition – Currently there are no options or guidelines for selecting default values for setback times or setback temperatures or building type



dependency. Only a 10 degree setback is assumed for three different schedule types.

- Data Source Origin – The inputs used for the Trane simulator are not documented or referenced.
- Available Sources – There are secondary sources available that can be used to update or change the savings methodology.

9. *Motors (C&I Lost Opportunity)*

- Methodology Quality – Load factor is not considered for motors. There is a discrepancy in the use of the load factor term – it is treated as a peak factor in the savings approach.
- Data Source Quality – EFLH used from the appendix 5 are not clearly documented on how they are derived.
- Available Sources – There are many secondary sources available for updating load factors and building/motor hours that can be used for default.

10. *Heat Pump Water Heater (Residential)*

- Baseline Definition – The baseline energy factor is considered to be the 2004 Federal Standard for a 50 gallon tank electric heater and need to identify if the size and efficiency is market standard. The baseline hot water load is not documented completely and should be investigated.
- Measure Definition – The main source used for the heat pump water heater efficiencies needs to be reviewed in detail, as well as based on a 2002 study of HPWH. Also, the heating penalty and recovery adjustment assumptions are based on judgment and need to be looked at more closely in a detailed review.
- Data Source Quality – The peak hourly hot water flow rate and the peak summer and winter water temperatures do not have a clear reference. These values need to be investigated further. Above baseline and measure definition also address concerns in this area.
- Available Sources – A detailed literature review is necessary to determine potential sources for updating the input parameters or the savings methodology.

11. Dual Enthalpy Controls (C&I Lost Opportunity)

- Data Source Quality – Models were developed for only two building types and the model input assumptions are unclear and undocumented. Further review is necessary to determine if source assumptions are reasonable
- Data Source Origin – Cannot replicate model simulation and savings because source file not provided and spreadsheet doc (including DOE2 output) does not match PSD number per ton. Need to investigate further.
- Available Sources – Prototypical building models and model input assumptions are available to use as secondary sources.

12. Gas Fired Boiler and Furnaces (C&I Lost Opportunity)

- Measure Definition – Minor edits of nomenclature and units for savings parameters.
- Data Source Quality – Some tables and input assumptions need to be cited, such as oversize factor. EFLH used from the appendix 5 are not clearly documented on how they are derived³.
- Available Sources – Prototypical building models and model input assumptions are available to use as secondary sources.

13. Vending Machine Controls (C&I Retrofit)

- Data Source Quality – Some savings input parameters are judgments (for example, 45% of off hours to account for compressor cycling) or inputs from actual site observations; it is possible to update the values with secondary sources.
- Available Sources – There are several secondary sources that can be referenced and used for replacing some input parameters or changing the savings methodology.

14. Standard Lighting (C&I Retrofit)

- Methodology – Interactive effects typically are based on models using building simulation.
- Data Source Quality – Interactive effects use a HVAC COP value that is based on a dated source. The referenced paper that is used for determining COP and fractional interactive savings needs to be investigated to assess its reasonableness.
- Available Sources – There are secondary sources available that can be investigated to determine adopting interactive effects savings input assumptions or methodology.

³ Full load hours are based on a 2006 CT & MA school lighting study. The reasoning for extending lighting end use hours in to another end use is not documented.



15. Energy Efficient Central AC (Residential)

- **Baseline Definition** – Baseline and existing efficiency values need to be reviewed. It is believed that a more accurate approximation can be made for the existing efficiency value.
- **Available Sources** – Baseline and existing central AC studies are available to use as secondary sources.

16. Gas Radiant Heater (C&I Lost Opportunity)

- **Baseline Definition** – The baseline is considered a conventional gas-fired unit heater with no assumed efficiency and a savings fraction referenced based on this unit.
- **Data Source Origin** – There is no reference for demand savings fraction. The source used for the savings approach is 9 years old. A new source or methodology should be implemented.
- **Data Source Quality** – The savings fraction reference is outdated and indirectly uses base case and efficient equipment parameters that are inherent in the referenced study. EFLH used from the appendix 5 are not clearly documented on how they are derived⁴.
- **Available Sources** – A detailed literature review is needed to determine the availability of sources that may be used for updating this measure.

17. Refrigerators and Freezers (C&I Lost Opportunity)

- **Baseline Definition** – The baseline uses the current federal standard for commercial refrigerators and freezers (10 CFR 431 – Sec 431.66). The baseline could be weighted with market saturation estimates of ENERGY STAR rated equipment in order to reflect a more realistic market condition.
- **Methodology** – Peak definition does not take into consideration refrigeration end use load shape.
- **Available Sources** – Secondary sources are available to update the baseline definition and peak/coincidence factor.

18. Boiler (Residential)

- **Baseline Definition** – The contractor could not access the ENERGY STAR boiler calculator. The calculator and secondary sources used needs to be reviewed before judgment is passed on the savings approach and baseline.

⁴ Full load hours are based on a 2006 CT & MA school lighting study. The reasoning for extending lighting end use hours in to another end use is not documented.



- Data Source Quality – Considered to be low based on need to investigate sources used in the ENERGY STAR calculator
- Available Sources – A detailed literature review is needed to determine the availability of sources that may be used for updating this measure.

19. Evaporative Fan Controls (C&I Retrofit)

- Data Source Origin – Savings input parameters are not cited and appear to be based on judgment (vendor experience) such as off hours, COP, and power reduction factor.
- Available Sources – There are secondary sources available to update the current savings input assumptions or the savings methodology itself.

20. Evaporative Fans Motor Replacement (C&I Retrofit)

- Data Source Origin – Savings input parameters are not cited and appear to be based on judgment (vendor experience) such as off hours, COP, and power reduction factor.
- Available Sources – There are secondary sources available to update the current savings input assumptions or the savings methodology itself.

21. Duct Sealing (Residential)

- Baseline Definition – Related to the savings methodology and input assumptions used - REM/Rate input assumptions were not available. The input assumptions need to be determined and reviewed in order to assess the baseline definition.
- Measure Definition – Related to the savings methodology and input assumptions used - REM/Rate input assumptions were not available. The input assumptions need to be determined and reviewed in order to assess the measure definition.
- Available Sources – A detailed literature review is needed to determine the availability of sources that may be used for updating this measure. There may be code requirements on leakage rates for new construction.

22. Water and Ground Source Heat Pump (C&I Lost Opportunity)

- Data Source Quality – EFLH used from the appendix 5 are not clearly documented on how they are derived⁵.
- Methodology Quality – Uses a very simple methodology that could potentially be updated. A rigorous literature review could be conducted to determine the best solution for updating.

⁵ Full load hours are based on a 2006 CT & MA school lighting study. The reasoning for extending lighting end use hours in to another end use is not documented.



- Available Sources – There are regional secondary sources available that are specific to small commercial HVAC that could potentially be used to update the input assumptions.

23. Duct Sealing (C&I Retrofit)

- Baseline Definition – Related to the savings methodology and input assumptions used - REM/Rate input assumptions were not initially available. The input assumptions need to be determined and reviewed in order to assess the baseline definition, as well as if similar to residential.
- Measure Definition – Related to the savings methodology and input assumptions used - REM/Rate input assumptions were not initially available. The input assumptions need to be determined and reviewed in order to assess the measure definition and if consistent with residential.
- Available Sources – A detailed literature review is needed to determine the availability of sources that may be used for updating this measure. There may be code requirements on leakage rates for new construction which is the typical threshold for retrofit.

24. Unitary AC and Heat Pumps (C&I Lost Opportunity)

- Data Source Quality – The effective full load hours source is ambiguously referenced and needs to be investigated. EFLH used from the appendix 5 are not clearly documented on how they are derived⁶. The heating-to-cooling capacity ratio is not referenced.
- Available Sources – There are regional studies and secondary sources that could be useful in updating the EFLHs (NEEP, NE TRMs).

25. Ice Cube Makers (C&I Lost Opportunity)

- Available Sources – There are other TRMs that can be referenced as secondary sources for coincidence and load factors.
- Algorithm – The savings algorithm for this measure uses typical calculations; however, a load factor parameter is not used.

⁶ Full load hours are based on a 2006 CT & MA school lighting study. The reasoning for extending lighting end use hours in to another end use is not documented.



26. Cooler Night Covers (C&I Retrofit)

- Data Source Quality – The referenced savings factors could not be found in the referenced study. The study is also dated (1997).
- Available Sources – There are several secondary sources that can be used for their deemed savings values for this measure.

27. Standard Lighting (C&I LO)

- Methodology – Interactive effects are typically based on models using building simulation.
- Data Source Quality – Interactive effects use a HVAC COP value that is based on a dated source. The referenced paper that is used for determining COP and fractional interactive savings needs to be investigated to assess its reasonableness.
- Available Sources – There are secondary sources available that can be investigated to determine adopting interactive effects savings input assumptions or methodology.

28. Geothermal Heat Pump (Residential)*

- Baseline Definition – The baseline efficiency currently used by the measure needs to be investigated in order to assess if a new baseline may be more appropriate.
- Data Source Quality – The analysis used for the referenced report is not clearly documented. The study needs to be more thoroughly investigated to deem if appropriate and if correct.
- Available Sources – A detailed literature review is needed to determine the availability of sources that may be used for updating this measure.

29. Pipe Insulation (Residential)

- Baseline Definition – The variety of pipe diameters needs to be investigated to verify if 1/2" and 3/4" diameters are sufficient. Code requirements also need to be investigated to determine minimum insulation levels, if applicable.
- Data Source Origin and Quality – The measure savings is calculated using 3E plus simulation software with assumptions based on judgment. A detailed review will determine if these judgments are reasonable and if there are other secondary sources that can be referenced to replace the input assumptions that are based on judgment.
- Available Sources – A detailed literature review is needed to determine the availability of sources that may be used for updating this measure.



30. HVAC VFD (C&I Lost Opportunity)

- Data Source Quality – The source (ASHRAE 90.1 1989) is dated and there may be improved default performance curves. EFLH used from the appendix 5 are not clearly documented on how they are derived⁷. The EFLHs used are based on a school lighting study; the extension of the study's findings to other end use full load hours is not explained and needs to be investigated.
- Methodology – It is not clear on the source and set of data used for determining the load profile that is used to calculate the savings factors.
- Available Sources – Updated manuals may have improved default performance curves.

3.2 RECOMMENDED ADDITIONS FOR PSD

The following recommendations are currently part of the program offerings but are not in the PSD.

- Tankless gas water heater (Res and C&I)
- Lighting controls, not occupancy based (C&I)
 - Daylighting
 - Dimming
- Boiler reset controls (C&I)
- Window film (C&I)
- Pool cover (C&I)
- Dishwasher (C&I)
- Kitchen exhaust demand control ventilation (C&I)
- Electric kitchen equipment (C&I)
 - Convection oven
 - Steam cookers
 - Hot food holding cabinet
 - Fryer
 - Griddle
- Compressed air measures (C&I)

⁷ Full load hours are based on a 2006 CT & MA school lighting study. The reasoning for extending lighting end use hours in to another end use is not documented.