**State of Illinois**

**Energy Efficiency**

**Technical Reference Manual V14.0**

**Residential Solar Water Heater**

**New Measure**

**Section 5.4**

**[Measure Code if applicable]**

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**On behalf of Ameren Illinois**

**May 15, 2025**

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Table 1 Work Paper Revision History

|  |  |  |  |
| --- | --- | --- | --- |
| **#** | **MM/DD/YY** | **Author, Company** | **Summary of Changes** |
|  |  |  |  |
|  |  |  |  |

# Overview

Brief summary of New Measure or Change proposed to Existing measure and the rationale behind the change:

We are proposing a new measure for solar water heaters. These devices collect thermal energy from the sun to preheat the inlet water in the domestic hot water system. The energy collected will offset a portion of the energy that would otherwise be provided by the standard water heater installed in the home.

**Income Qualified (IQ) Considerations:**

The following guiding questions were established by the IQ TRM Working Group to encourage TAC members developing TRM updates to consider whether there may be IQ specific assumptions or considerations:

* *Could the baseline efficiency of the measure differ for IQ communities?*
* *If there are any housing characteristics assumptions for this measure, would they differ in an IQ community?*
* *In an IQ community, could the run hours or operation behavior differ?*
* *Could the measure lifetime differ in an IQ setting?*

If the answer is yes to any of these questions, please describe how these considerations might be taken in to account. If you need help or would like to discuss, please contact the IQ TRM Working Group via [iltrmadministrator@veic.org](mailto:iltrmadministrator@veic.org).

It is unlikely that the measure would be characterized any differently in an IQ setting.

# New Measure Characterizations

Each measure characterization uses a standardized format that includes at least the following components. Measures that have a higher level of complexity may have additional components, but also follow the same format, flow and function.

Please provide text for each of the sections below with appropriate citations in footnotes (see section #4) and upload any references or calculation sheets to the Tracker item.

###### Description

*Brief description of measure stating how it saves energy, the markets it serves and any limitations to its applicability. Finish with the following text:*

“This measure was developed to be applicable to the following program types: [\*\*enter shorthand code from Table 2.4\*\*]. If applied to other program types, the measure savings should be verified.”

A solar water heater provides water heating by collecting solar thermal energy and transferring it to the domestic water heating system to offset energy needed from electricity or fossil fuels. The solar water heater consists of a solar thermal collection panel which heats an heat transfer fluid, a heat exchanger tank inside the home where the heat is transferred from the heat transfer fluid to the domestic hot water supply, and a pump to move the heat transfer fluid. The system “pre-heats” the domestic water before it enters a standard water heater.

This measure characterizes the installation of a solar water heater with a new electric resistance water heater in a home.

This measure was developed to be applicable to the following program types:  TOS, NC, RF.

If applied to other program types, the measure savings should be verified.

###### Definition of Efficient Equipment

*Clearly define the criteria for the efficient equipment used to determine delta savings. Include any standards or ratings if appropriate.*

To qualify for this measure the installed equipment must be an ENERGY STAR certified solar water heater with a Solar Uniform Energy Factor (SUEF) of 3.00 or greater. The solar water heating collectors must meet the Solar Rating and Certification Corporation (SRCC™) OG-100 standard and be designed for a minimum 50% Solar Fraction.

###### Definition of Baseline Equipment

*Clearly define the efficiency level of the baseline equipment used to determine delta savings. Include any standards or ratings if appropriate. If a Time of Sale measure the baseline will be new base level equipment (to replace existing equipment at the end of its useful life or for a new building). For Early Replacement or Early Retirement measures the baseline is the existing working piece of equipment that is being removed.*

The baseline condition is a new electric 50-gallon storage water heater meeting federal minimum efficiency standards. Assuming medium draw, the baseline efficiency is 0.9207 UEF.

###### Deemed Lifetime of Efficient Equipment

*The expected duration in years (or hours) of the savings. If an early replacement measure, also include the assumed life of the existing unit. Measure life may be represented in hours for products whose useful life is determined primarily by the amount of use they receive.*

The expected measure life is assumed to be 15 years.

###### Deemed Measure Cost

*For time of sale measures, provide incremental cost from baseline to efficient. Installation costs should only be included if there is a difference between each level. For Early Replacment the full equipment and install cost of the efficient installation should be provided in addition to the full deferred hypothetical baseline replacement cost.*

For Time of Sale or New Construction the incremental installation cost (including labor) should be used. Defaults are provided below. Actual efficient costs can also be used although care should be taken as installation costs can vary significantly due to complexities of a particular site.

For retrofit costs, the actual full installation cost should be used (default provided below if unknown).

Baseline Installed Cost

| **Item** | **Default Cost** |
| --- | --- |
| Baseline Installed Cost | $1,032 |
| New Solar Water Heater System | $8,146 |
| Incremental Cost | $7,114 |

###### Loadshape

*Define the appropriate loadshape to apply to electric savings. If a new loadshape is developed it should be added to section 3.5.*

Loadshape R18 - Residential Heat Pump Water Heater

###### Coincidence Factor

*Provide the summer coincidence factor to estimate the impact of the measure on the utility’s system peak – defined as 1-5PM on non-holiday weekdays, June through August.*

*For weather sensitive measures such as cooling, the summer peak coincidence factor should be provided in two different ways. The first is to estimate demand savings during the utility’s peak hour (as provided by Ameren). The second way represents the average savings over the summer peak period, consistent with the non-weather sensitive end uses, and is presented so that savings can be bid into PJM’s Forward Capacity Market.*

The summer Peak Coincidence Factor is assumed to be 26.7%.

Algorithm

###### Calculation of Energy Savings

*Provide algorithms followed by list of assumptions with their definition. Provide either a single deemed value, lookup table with deemed values based on input selection, or indicate if its an input variable. Use footnotes to indicate the source of the deemed variables. Use \* rather than x for multiplication and try to avoid nested algorithms.*

*If there are no Input Variables, there will be a finite number of Output values. These should be identified and listed in a table. Where there are custom inputs, it is often a good idea to provide an example calculation to illustrate the algorithm and provide context. It is imperative that it be labeled with “For example” and placed within a text box, such that it does not get mistaken for a deemed result.*

###### Electric Energy Savings

ΔkWh = ((1/UEFBASE – 1/SUEFefficient) \* GPD \* Household \* 365.25 \* γWater \* (TOUT – Tin) \* 1.0) / 3412

Where:

UEFbase = Uniform Energy Factor (efficiency) of standard water heater according to federal standards provided in table in baseline section and using the same draw pattern as the efficient equipment. For a deemed approach assume electric water heater:

= 0.9207 [[1]](#footnote-1)

SUEFefficient = Solar Uniform Energy Factor (efficiency) of solar water heater

= Actual, or

= If unknown use 3.00, ENERGY STAR minimum

GPD = Gallons Per Day of hot water use per person

= 45.5 gallons hot water per day per household/2.59 people per household [[2]](#footnote-2)

= 17.6

Household = Average number of people per household

= Assume Single Family, Non-IQ, 2.62**[[3]](#footnote-3)**

365.25 = Days per year

γWater = Specific weight of water

= 8.33 pounds per gallon

Tout = Tank temperature

= 125°F

Tin = Incoming water temperature from well or municiple system

= 50.7°F [[4]](#footnote-4)

1.0 = Heat Capacity of water (1 Btu/lb\*°F)

3412 = Conversion from Btu to kWh

###### Summer Coincident Peak Demand Savings

ΔkW = ΔkWh / Hours \* CF

Where:

ΔkWh = Electric savings (or increase) of measure

Hours = Full load hours of water heater

= 2,533 [[5]](#footnote-5)

CF = Summer Peak Coincidence Factor for measure

= 0.267

###### Fossil Fuel Savings

N/A

###### Water and Other Non-Energy Impact Descriptions and Calculation

N/A

###### Deemed O&M Cost Adjustment Calculation

*Only required if the operation and maintenance cost for the efficient case is different to the baseline. If so, provide the frequency and cost of any replacement parts or maintenance. For a select number of measures the O&M cost may change significantly over the life of a measure (e.g. the replacement baseline bulbs due to EISA impacts). In these cases it is advisable to calculate an equivalent annualized payment that provides the same net present value as the actual stream of costs over the measure life.*

# Proposed Changes to Existing Measures

Copy existing TRM measure from the IL-TRM Version 13.0 dated September 20, 2024, accessible on the [SharePoint site](https://portal.veic.org/sites/illinoistrm/SitePages/Illinois%20Statewide%20TRM.aspx?RootFolder=%2Fsites%2Fillinoistrm%2FShared%20Documents%2FTRM%20Version%2013%2FTechnical%5FTRM%5FEffective%5F010125%5FVersion%5F13%2E0%2FFinal%20v13%2E0&FolderCTID=0x012000675522ABCE9A66489E6C6D1F41134967&View=%7B0AD2C983%2D07CB%2D4C3B%2D9D86%2D3E2B6A050827%7D), and paste the existing measure characterization below in its entirety, then turn on tracked changes and provide proposed edits in redline with appropriate citations (see section #4 below). Upload any new references or calculation sheets to the Tracker item. If a change requires further explanation that should not be in the characterization itself, use a comment bubble to provide.

# References

Please refer to the Chicago style for variances on format citations. Please upload any new references or calculation sheets to the Tracker item.

<http://www.chicagomanualofstyle.org/tools_citationguide.html>

EXAMPLES:

**Paper presented at a meeting or conference (Including internal work papers)**

Author Name, “Paper title” (paper presented at the annual meeting for the Organization Name, City, State, Month Day, Year).

**Website**

“Title,” last modified Month Day, Year, URL

**E-mail**

Author Name, e-mail message to author, Month Day, Year.

**Item in a commercial database**

Author Name. “Source Title” Publisher, Year. Database Name

**Book: Chapter or other part of a book**

Author Name, “Chapter,” in Title, City: Publisher, Year, page range

**Book: Published electronically**

Author Name, “Chapter,” in Title, City: Publisher, Year, Accessed Month Day, Year. URL.

**Journal Article in a print journal (Use this for program evaluations.)**

Author Name, “Article Title,” Journal Name edition (Year): page

Author Name, “Evaluation Title,” Utility Name, Program or Measure Name (Date): page

**Journal Article in an online journal**

Author Name, “Article Title,” Journal Name edition (Year): page, accessed Month Day, Year, dio:xx.xxxx/xxxxxx.

# Stakeholder Comments

If adding comments to an existing work paper, add note in “Progress Notes” section of the tracker item stating *“(Author, Company) added comments to workpaper, (date)*”. This will send an alert to VEIC and others that a new comment has been added.

Author, Company and Date:

Comment:

1. Assuming a 50 gallon tank baseline at Medium Draw. [↑](#footnote-ref-1)
2. Deoreo, B., and P. Mayer. Residential End Uses of Water Study Update. Forthcoming. ©2015 Water Research Foundation. Reprinted With Permission. [↑](#footnote-ref-2)
3. Assumptions are taken from the draft unadjusted 2024 Baseline Study evaluation data provided in 07/2024 by GDS Associates. [↑](#footnote-ref-3)
4. Table 4 in Chen, et. al., “Calculating Average Hot Water Mixes of Residential Plumbing Fixtures”, June 2020, reports a value of 50.7°F for inlet water temperature for U.S. Census Division 3. [↑](#footnote-ref-4)
5. Full load hours assumption based on Efficiency Vermont analysis of Itron eShapes. [↑](#footnote-ref-5)