**State of Illinois**

**Energy Efficiency**

**Technical Reference Manual V14.0**

**Solar as Energy Efficiency**

**Residential**

**New Measure**

**Elder Calderon, Commonwealth Edison**

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Table 1 Work Paper Revision History

|  |  |  |  |
| --- | --- | --- | --- |
| **#** | **MM/DD/YY** | **Author, Company** | **Summary of Changes** |
|  | 05/15/25 | Elder Calderon, ComEd | Initial Release |
|  |  |  |  |

# Overview

On-premise photovoltaic (PV) solar systems reduce grid energy requirements by offsetting building energy loads with on-site generated energy. In accordance with the definition of energy efficiency in Illinois, ComEd proposes that savings claimed through this measure will be limited to generated energy used to offset concurrent building loads and exclude energy fed onto the local power grid through net metering.

Thus, the proposed methodology outlined in this whitepaper applies an adjustment factor to estimated annual solar production to account for simultaneous offset of building loads only. We propose a simulation-based approach for estimating solar array energy production using PVWatts or similar tools, simulated with the actual physical characteristics of each participating PV system.

ComEd proposes that the TRM measure be limited to PV system smaller than 25 kW, with or without a battery storage system. A custom savings analysis would be required for larger arrays.

**Income Qualified (IQ) Considerations:**

N/A

# New Measure Characterizations

###### Description

Photovoltaic (PV) solar systems consist of an array of panels or thin-film substrates that generate direct current (DC) power when exposed to sunlight. Typically, multiple panels are networked together into a single circuit. The DC power output is converted to alternating current (AC) power through inverters that transform the electricity into the type of power used in residential buildings. In accordance with the definition of energy efficiency in Illinois, savings claimed through this measure will be limited to generated energy used to offset concurrent building loads and exclude energy fed onto the local power grid through net metering. Charging of on-site battery systems is permitted, however peak demand savings as defined by this measure assumes non-tracking arrays without battery backup.

This measure was developed to be applicable to the following program types: RF and NC. If applied to other program types, the measure savings should be verified.

###### Definition of Efficient Equipment

The efficient system is any on-premise PV system (with or without a battery) less than 25 kW in capacity.

###### Definition of Baseline Equipment

The baseline assumes no photovoltaics/solar arrays.

###### Deemed Lifetime of Efficient Equipment

The useful life is 25 years.Source 1

###### Deemed Measure Cost

If known, the actual material and labor cost of installation should be used. If unknown, the cost for this measure is assumed to be $2.72 per watt installed.The estimated material cost for a photovoltaic array is $1.11/watt. The estimated labor cost for installation is $1.61/watt. Source 2

###### Loadshape

|  | **On Peak** | **Off Peak** |
| --- | --- | --- |
| **Summer** | *35%* | *14%* |
| **Non-Summer** | *35%* | *16%* |

###### Coincidence Factor

| **Utility** | **Coincidence Factor** |
| --- | --- |
| **Ameren** | *TBD* |
| **ComEd** | *TBD* |

Algorithm

###### Calculation of Energy Savings

###### Electric Energy Savings

Savings should be calculated using PV Watts or similar tool to estimate annual system energy generated with an adjustment factor in order to account for concurrent building energy loads.

ΔkWh = kWhGenerated \* Simul\_ADJ

Where:

kWhGenerated = Annual energy generated by photovoltaic array, as estimated by PV Watts or similar simulation model

Simul\_ADJ = Adjustment factor to account for concurrent building energy load only

= 50%

Input Parameters for PVWatts Simulation:

Location = Latitude and longitude of installation location

= Actual

DC System Size = Rated capacity of PV array, kW

= Actual

Module Type = PV type: Standard, Premium, or Thin Film

= Actual

Array Type = PV mounting and tracking type

= Actual

Model Losses = System energy losses

= Actual or 14.08% Default

Array Tilt = Angle of the panels relative to the horizontal ground

= Actual

Array Azimuth = Direction in which the panels face, 0° = North, 90° = East, 180° = South, 270° = West

= Actual

∆Azimuth = Difference between Array Azimuth and closest, smaller cardinal direction

= Actual

DC to AC ratio = Array's DC rated size to the inverter's AC rated size

= Actual, or 1.2 Default

Inverter Eff = Efficiency of the inverters

= Actual, or 96% Default

Ground Coverage = Ratio of module surface area to the area of the ground or roof occupied by the array

= Actual, or 0.4 Default

Albedo = A measure of the amount of sunlight reflected by the ground

= Actual, or PV Watts Weather File Default

Bifacial = Whether the module converts both direct sunlight and sunlight reflected by the ground

= Actual, “No” Default

Irradiance Loss = The monthly reduction in incident solar irradiance caused by environmental factors

= Actual, 0 for all months Default

###### Summer Coincident Peak Demand Savings

ΔkW = Preferred method to calculate average summer peak demand is using 8,760 output aligned with peak demand definitions per utility. If this is unavailable demand estimates can apply the ETDF approach below.

= ∆kWh \*ETDFsummer

ETDFsummer = Summer Energy to Demand Factor, see table below

=ETDFsummer,ordinal + (∆Azimuth\*ETDFsummer,increments)

∆Azimuth = Difference between PV array azimuth and closest, smaller cardinal/ordinal direction (90, 135, 180, or 225)

ETDFsummer,ordinal  = Summer Energy to Demand Factor, East to West facing Cardinal/Ordinal Values

= See table below

|  | **Array Azimuth** | | | | |
| --- | --- | --- | --- | --- | --- |
| **Climate Zone (City based upon)** | **90° (E)** | **135° (SE)** | **180° (S)** | **225° (SW)** | **270°(W)** |
| 1 (Rockford) | 0.0001696 | 0.0001771 | 0.0002221 | 0.0002838 | 0.0003384 |
| 2 (Chicago) | 0.0001843 | 0.0001954 | 0.0002467 | 0.0003128 | 0.0003688 |
| 3 (Springfield) | 0.0001901 | 0.0002013 | 0.0002522 | 0.0003159 | 0.0003690 |
| 4 (Belleville) | 0.0002144 | 0.0002314 | 0.0002902 | 0.0003589 | 0.0004131 |
| 5 (Marion/Murphysboro) | 0.0001761 | 0.0001849 | 0.0002331 | 0.0002980 | 0.0003553 |

ETDFsummer,increments = Summer Energy to Demand Factor, East to West facing Cardinal/Ordinal Values

= See table below

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | **Array Azimuth Range** | | | |
| **Climate Zone (City based upon)** | **90° to 135° (E to SE)** | **135° to 180° (SE to S)** | **180° to 225° (S to SW)** | **225° to 270° (SW to W)** |
| 1 (Rockford) | 0.00000017 | 0.00000100 | 0.00000137 | 0.00000121 |
| 2 (Chicago) | 0.00000025 | 0.00000114 | 0.00000147 | 0.00000124 |
| 3 (Springfield) | 0.00000025 | 0.00000113 | 0.00000142 | 0.00000118 |
| 4 (Belleville) | 0.00000038 | 0.00000131 | 0.00000153 | 0.00000120 |
| 5 (Marion/Murphysboro) | 0.00000020 | 0.00000107 | 0.00000144 | 0.00000127 |

###### Fossil Fuel Savings

N/A

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

N/A

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

N/A

# References

Source 1: Wisler, R. Bolinger, M. Seel, J., “Benchmarking Utility-Scale PV Operational Expenses and Project Lifetimes: Results from a Survey of U.S. Solar Industry Professionals”, Energy Markets & Policy Berkeley Lab (June 2020).

Source 2: NREL U.S. Solar Photovoltaic System and Energy Storage Cost Benchmarks, With Minimum Sustainable Price Analysis: Q1 2023, 2026 dollars

Source 3: Calculated through the ratio of PV Array total summer peak demand savings (aligned with PJM peak demand definitions) and the annual electric generation for a given array azimuth installed at 20° tilt. Incremental ETDFsummer calculated assuming linear changes between two ordinal values.

# 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: