

PVWatts Calculation Values with an Enphase Microinverter System

The PVWatts Calculator

The PVWatts Version 1 solar rebate calculator is maintained by NREL (National Renewable Energy Labs) for the purpose of ascertaining a solar system's performance, given certain environmental conditions and equipment used. For some states, such as Colorado's XCEL program, this is the sole criterion for determining the state's rebate amount.

Location:

<http://rredc.nrel.gov/solar/calculators/PVWATTS/version1/>

The PVWatts calculator makes several assumptions about a solar system, and those assumptions are made under the model of a traditional deployment using a central inverter.

The PVWatts calculator allows users to substitute its default input parameters with custom values. These derate factors involve:

- DC rating
- DC to AC derate factor
- Array type
- Tilt angle
- Azimuth angle
- Electricity cost

Our discussion centers on the DC to AC derate factor. For a detailed discussion of other factors, please reference the PVWatts page at:

http://www.nrel.gov/rredc/pvwatts/changing_parameters.html

Calculating the Overall DC to AC Derate Factor

Some of the DC to AC derate factors that make up the PVWatts overall assessment of a PV system's performance apply to Enphase deployments just as they would for a traditional solar deployment. These include the PV module manufacturer's DC Rating. Another example is Array Type, the alternatives being fixed, sun-tracking with one axis of rotation, or sun-tracking with two axes of rotation. Even Tilt-Angle and Azimuth Angle would affect an Enphase system much like a traditional, central-inverter deployment.

Enphase deployments deviate and improve on traditional assumptions in several areas. For instance, Module Mismatch on a DC string is not a negative factor on an Enphase Microinverter. This is because, with Enphase, each PV module is associated with a single microinverter, thereby eliminating any limitations to the other modules on the string or branch. Another example is DC wiring. There are no long DC homeruns with an Enphase deployment, nor are there MC taps at each stop along the way coming into a DC combiner box.

Defaults for DC to AC Derate Factor

The following reflects default derate factors from the PVWatts calculator:

Calculator for Overall DC to AC Derate Factor

Component Derate Factors	Component Derate Values	Range of Acceptable Values
PV module nameplate DC rating	0.95	0.80 - 1.05
Inverter and Transformer	0.92	0.88 - 0.98
Mismatch	0.98	0.97 - 0.995
Diodes and connections	0.995	0.99 - 0.997
DC wiring	0.98	0.97 - 0.99
AC wiring	0.99	0.98 - 0.993
Soiling	0.95	0.30 - 0.995
System availability	0.98	0.00 - 0.995
Shading	1	0.00 - 1.00
Sun-tracking	1	0.95 - 1.00
Age	1	0.70 - 1.00
Overall DC to AC derate factor	0.769	

Enphase Microinverter System Values for DC to AC Derate Factor

Below is a list of the same factors, with values adjusted for the Enphase Microinverter system:

Calculator for Overall DC to AC Derate Factor

Component Derate Factors	Component Derate Values	Range of Acceptable Values
PV module nameplate DC rating	0.95	0.80 - 1.05
Inverter and Transformer	0.96	0.88 - 0.98
Mismatch	0.995	0.97 - 0.995
Diodes and connections	0.995	0.99 - 0.997
DC wiring	0.99	0.97 - 0.99
AC wiring	0.99	0.98 - 0.993
Soiling	0.95	0.30 - 0.995
System availability	0.99	0.00 - 0.995
Shading	1	0.00 - 1.00
Sun-tracking	1	0.95 - 1.00
Age	1	0.70 - 1.00
Overall DC to AC derate factor	0.832	

KEY:

- The Enphase Microinverter's conversion efficiency is rated at 96%.
- Module Mismatch, Diodes and Connections, and DC Wiring are not factors with an Enphase system.
- Enphase System Availability is higher than the default as there is no single point of failure.

Conclusion

Taking into consideration the benefits of an Enphase Microinverter system, in terms of system availability, individual module Maximum Power Point Tracking (MPPT), minimal losses in DC wiring runs, and eliminating the idea of module mismatch, the values listed above represent those reflected in a real-world deployment of an Enphase solar system. Enphase has changed the model for solar installations and, by doing so, has changed some of the long-held assumptions about given site performance and energy production.

This information is meant to describe to the Solar Installer community, as well as individual states' rebate program administrators, the differences and improvements that an Enphase Microinverter system brings to the model of solar energy generation.

These modified values have been discussed with the designer of the PVWatts application.