Energy Centre's Solar Power Web-based Map - documentation

Kiti Suomalainen

k.suomalainen@auckland.ac.nz, Energy Centre, University of Auckland, Auckland, New Zealand

Background

Solar power has been rapidly growing in New Zealand with the total installed capacity increasing five-fold over the last three years (2014 - 2017). Most of the growth has taken place in the residential sector. Auckland Council has a goal of 970 MW installed capacity of solar photovoltaics by 2040. To assess this in number and size of solar installations we need to assess the solar energy potential on Auckland rooftops. In this study we have used LiDAR data to develop a digital surface model of the city, including topography, buildings and trees. With this model the ArcGIS solar radiation tool has been used to calculate the annual solar radiation on each square meter of roof area, taking into account latitude, time of year, time of day, average climatic conditions, surface orientation and slope, and shading from nearby buildings and trees. **The results show a roughly 5% underestimation in comparison to NIWA's SolarView tool for north-facing unshaded surfaces** [we need to correct this with new results], which should be taken into account when planning a solar PV investment. This webtool can be used as a first approximation for solar potential on a rooftop, but the results should be considered case by case, as more complex rooftops may not be accurately represented at a one square meter resolution.

System options

The ArcGIS solar radiation calcutaions give the total annual amount of solar radiation per square meter. To estimate an annual electricity output, we need to make assumptions on

1) The size of the PV system installed
2) Efficiency of the panels and system losses

In the first dropdown menu, the user has the option to choose between three system sizes:

1) 20 m2, corresponding to a standard PV system of roughly 3 kW
2) 35 m2, corresponding to a standard PV system of roughly 5 kW
3) 50 m2, corresponding to a standard PV system of roughly 7 kW

A standard PV system refers to a poly- or mono-crystalline PV technology with a 14-17% panel efficiency.

In the second dropdown menu, the user has the option to choose a PV technology, with a given panel efficiency.

1) Standard PV (poly- or mono-crystalline PV technology), with an average efficiency: 15%,
2) Premium PV (high-efficiency monoi-crystalline PV with anti-reflective coating), average efficiency: 19%,
3) Thin film PV, average efficiency: 10%

To each technology system losses of 12% are added, following the system losses specified in National Renewable Energy Laboratory's user manual for their PVWatts calculator[1], with the elimination of losses from chading, which are accounted for in the solar radiation calculation. These losses include soiling, mismatch, wiring, Connections, light-induced degradation, nameplate rating, availability and the inverter. Assuming 12% system losses is a general approximation, and the exact figure for a specific system will need to be adjusted according to individual system specifications and conditions.

The efficiency assumptions are summarized in table 1.

Table 1: PV technology options and corresponding efficiency assumptions.

Technology	Panel efficiency	System losses	Overall system efficiency
Standard PV	15% (14-17%)	12%	13.2%
Premium PV	19% (18-20%)	12%	16.7%
Thin films	10%	12%	8.8%

Additional losses not accounted for here include temperature related losses. Reference [1] quantifies these losses as 0.47% per ◦C above 25◦C for standard PV, 0.35% / ◦C for premium PV and 0.20% / ◦C for thin films.

References

[1] Dobos, A.P., *PVWatts Version 5 Manual*, National Renewable Energy Laboratory (NREL), Technical Report, NREL/TP-6A20-62641, September 2014.