Australian Government
Australian Renewable Energy Agency

ARENA

Lessons Learnt

Lessons Learnt Report: *Temperature losses of different silicon PV technology around Australia*

Project Name: *Photovoltaic Modules for the Australian Environment (PV-MATE)*

Knowledge Category:	Technical
Knowledge Type:	Technology
Technology Type:	Solar PV
State/Territory:	Canberra ACT, Adelaide ACT

Key learning

We simulated the performance of 5 varieties of commercially available modules in 15 locations around Australia, accounting for regional temperature and irradiance. Irradiance datasets, from the Australian Solar Energy Information System (ASEIS were utilised. Through our analysis, we find temperature losses directly correlate with mean ambient temperature, and that the difference in yield between module types is up to 3%, in the warmest climate. The best performing modules are the premium back-contact c-Si modules, and the worst is the standard mc-Si module. Importantly, the impact of a module technology on yield must be determined with site-specific irradiances and ambient temperatures.

Implications for future projects

Future projects can use this information to decide whether more careful module design to mitigate temperature losses is a valuable endeavour.

Knowledge gap

Solar panels are often marketed on parameters other than their $/kWh performance. In particular low-light performance and the module temperature coefficient impact the system derate, a factor to account for non-ideal losses in the system. How much is this derate attributable to the module temperature coefficient? The estimated derate factors of this work are useful when considering different module technologies or indeed designing modules specifically for Australia.

Background

Objectives or project requirements

We set out to determine the relative impact of temperature coefficient on module yield. We were required to build a computer model to assess the performance of modules in the field.

Process undertaken

The monthly hourly averaged direct normal irradiance DNI and global horizontal irradiance GHI was downloaded from ASEIS online for the locations depicted in Figure 1. We account for the module ambient temperature by using Bureau of Meteorology (BOM 2015) monthly mean min and max to give the ambient temperature, which we assumed varied sinusoidally with the ambient minimum and maximum temperatures aligned with the minimum and maximum GHI. We defined 5 categories of modules to model the derate. The 5 module categories studied are representative of commercially available panels, include 3 c-Si and two thin-film modules.

At each irradiance interval, the direct beam on a tilted plane was determined to calculate the direct irradiance of the solar panels. For this work, all modules were positioned facing North at a tilt equal to the latitude. The diffuse irradiance, and reflected irradiance was computed by subtracting the DNI from GHI accounting for the suns elevation. The reflectivity in this work is considered to be moderate 0.2. The module temperature was solved assuming steady-state temperature based on the NOCT of the module, the irradiance and the ambient temperature. The losses were computed and integrated over one full year.

Supporting information

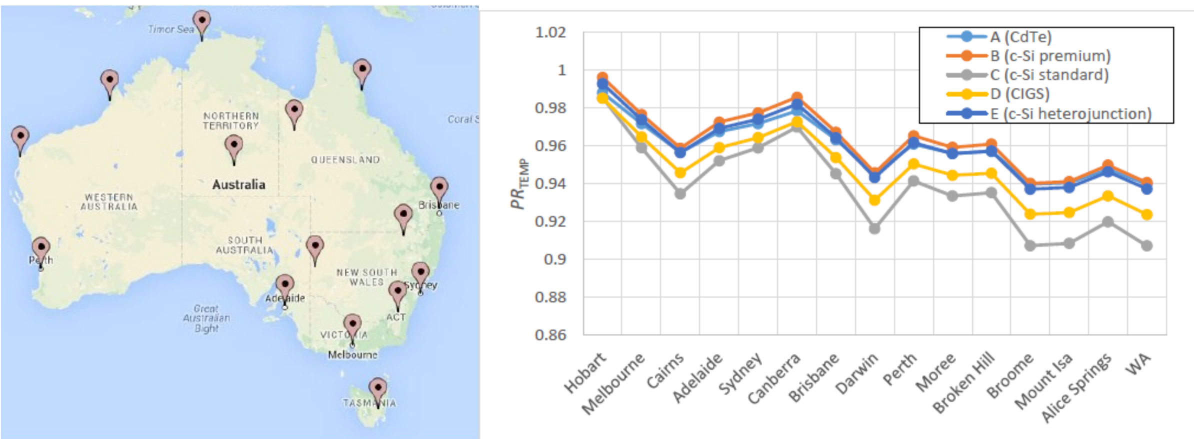

Figure 1: Map of locations studies for the impact of temperature on derate (left). (Right) Plot of the temperature derate for each module and location.

See http://apvi.org.au/solar-research-conference/wp-content/uploads/2015/12/A-Thomson_Peer-Reviewed_FINAL.pdf for a full summary of the work.