Lessons Learnt

Lessons Learnt Report: W_p validation and breakdown of module gains and losses

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

PV Lab Australia has validated the Watt peak (W_p) power output of a Tindo Solar Karra 250 module:

- The module was measured with a AAA rated sun simulator after shipping from the manufacturing fab in Adelaide to PV Lab's module test laboratory in Canberra.
- The module output was 4.5W higher than the name plate value, i.e 255 W_p.
- The accuracy of the tester is 3%, hence the measured value is 255 ± 8 W_p.
- When compared to Tindo's IV measurement, their recorded W_p was 253 W_p, while the nameplate rating was 250 W_p.

In addition, the ANU through theoretical calculations of optical and resistive losses based on simple measurements of module material properties, predicted a power of 255 W_p, agreeing with both the Tindo Solar IV tests and the AAA rated module flasher. From this test we see that Tindo's module is not over-rated.

Implications for future projects

Our results give us a high degree of confidence in our ability to measure and calculate the power output of a PV module. It also gives confidence in the scale up of mini module measurements to commercial sized modules (0.20 x 0.20 m^2 modules to the commercial 1.7 x 1 m^2 modules). Through the analysis of small area modules, we have identified where the current module technology can be improved.

Knowledge gap

Our theoretical calculations scale up measurements of mini modules. However, we must perform physical measurements with each new material. We have access to the PV Lighthouse module ray-tracer and are evaluating it for the prediction of module optical properties. Once this model is validated we will have the ability to simulate the optical properties of modules directly from the material properties, without the need to prepare mini modules.

Background

Objectives or project requirements

The project aims to model the performance of PV modules specifically designed for the Australian environment. Our analysis identified pathways for us to improve the module performance with respect to Australian environmental conditions.

Process undertaken

A commercial 250 W module was taken from the Tindo Solar production line (Mawson Lakes, Adelaide). The module was shipped to PV Lab (Acton, ACT). Equivalent module sub components were also shipped to ANU (Acton, ACT). The module power was measured at PV Lab. The sub-components were laminated at ANU to produce a 20 x 20 cm^2 mini-module. The mini-module power output was measured at ANU. The measured power output from Tindo, the IV measurement from PV Lab and the theoretical power determined form the ANU model were compared. Good agreement was achieved between all measurements.

Supporting information

Figure 1 plots the IV trace measured by PV Lab Australia. Figure 2 plots the predicted power for the Tindo Solar module, if it is produced with and without an anti-refection coating on the glass layer. The glass anti-reflection coating results in a 7.9% improvement in W_p.

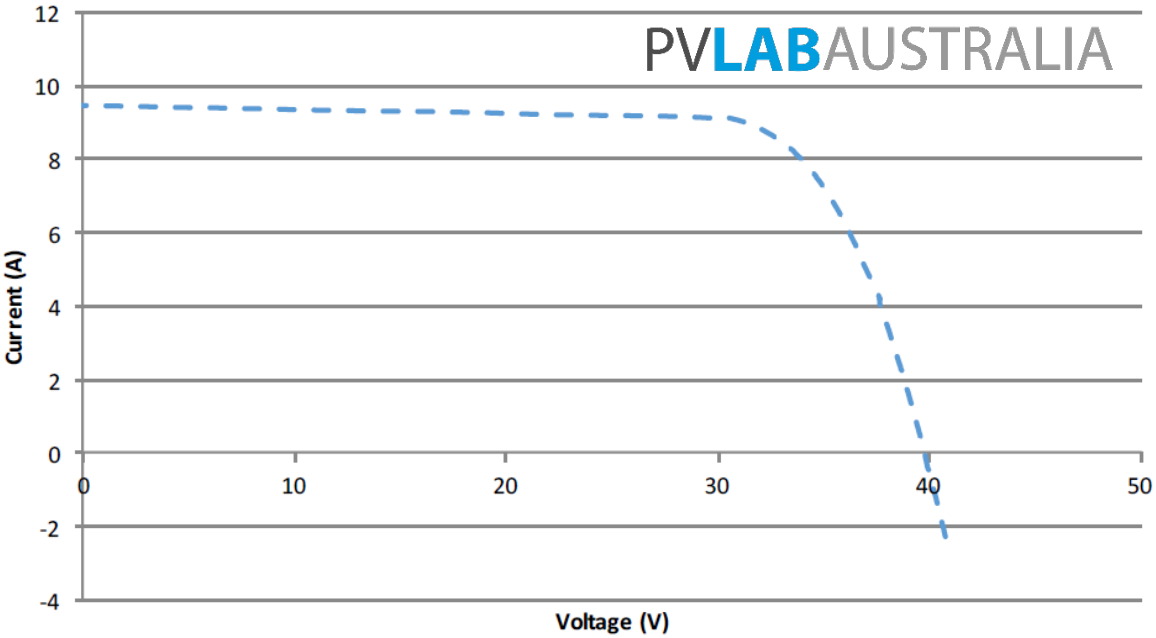

Figure 1: IV trace from Tindo Solar module 1576 produced in March 2015.

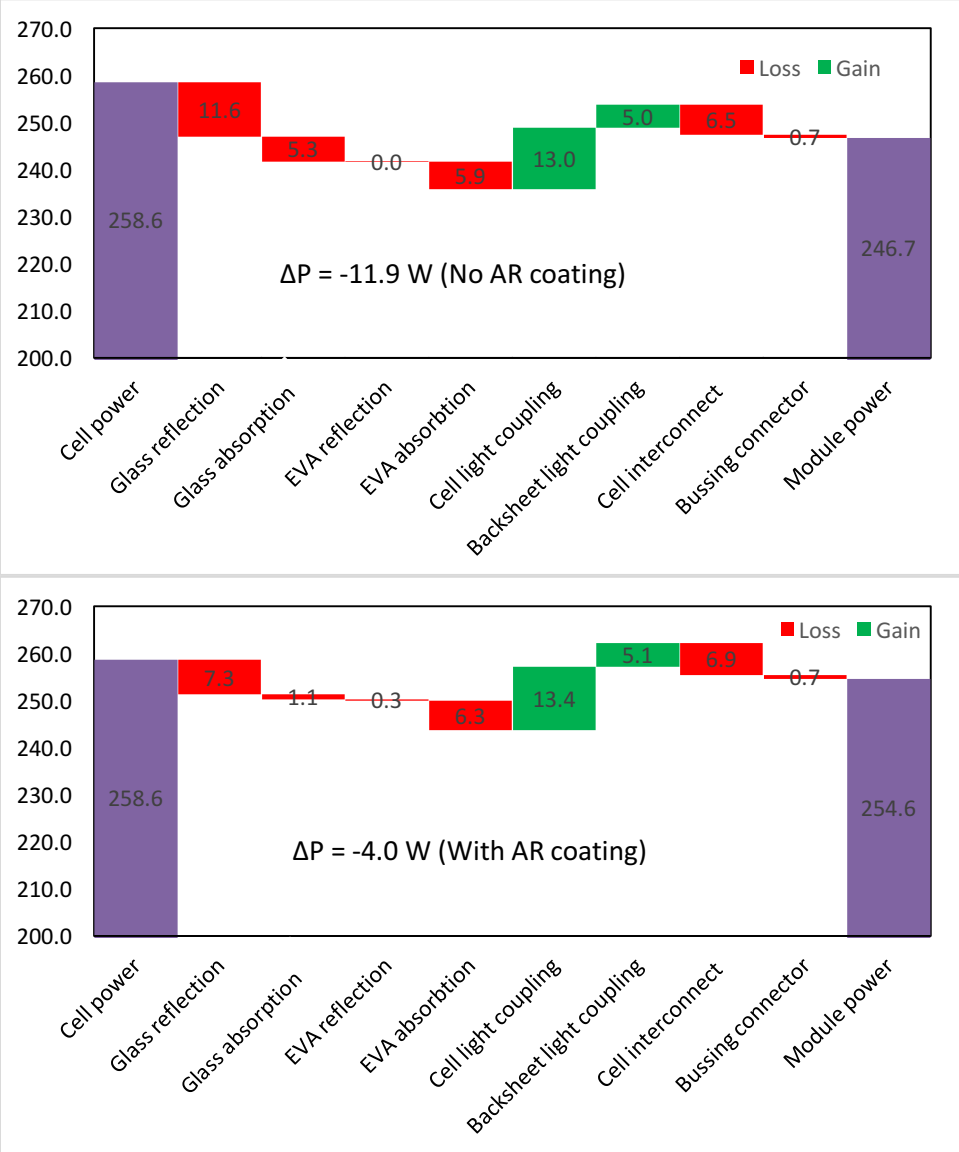

Figure 2: Waterfall diagram for power gains and losses for a Tindo Solar module with (top) and without (bottom) anti-reflection coating on the glass. Analysis based on a procedure developed by Haedrich et al (Search: Unified methodology for determining CTM ratios: Systematic prediction of module power)