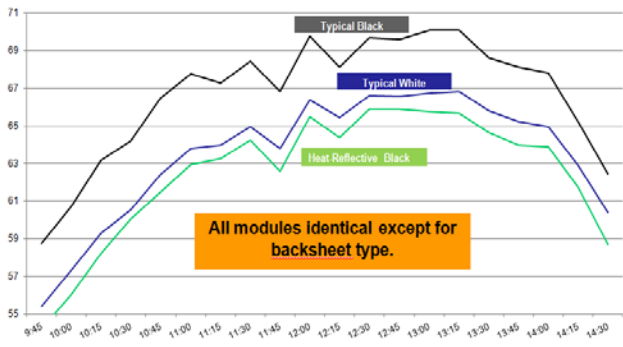


# Reducing c-Si Module Operating Temperature via PV Packaging Components

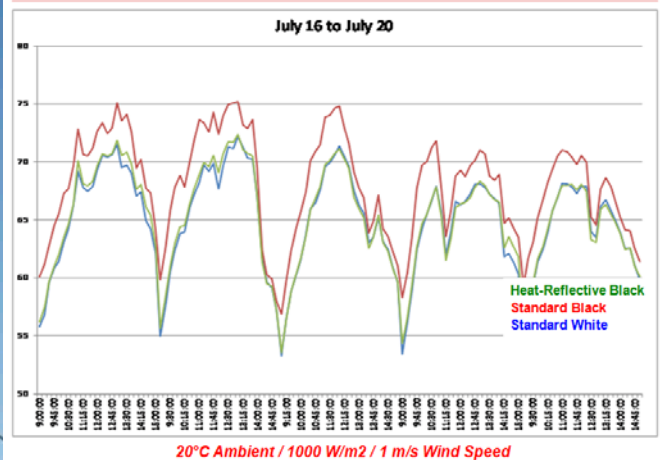
**Purpose of Work:** In theory, reducing average module operating temperatures should reduce the long term rate of degradation of module components, especially for polymer based materials, and lead to improved module reliability. As opposed to the recent common practice of “cost out” among most PV module producers, another approach is suggested where small changes in packaging materials could lower c-Si module operating temperatures by 2 to 10 degrees Centigrade. One such example is presented and potentially has additional benefits.

Honeywell

## Typical Daily Temperature Profile



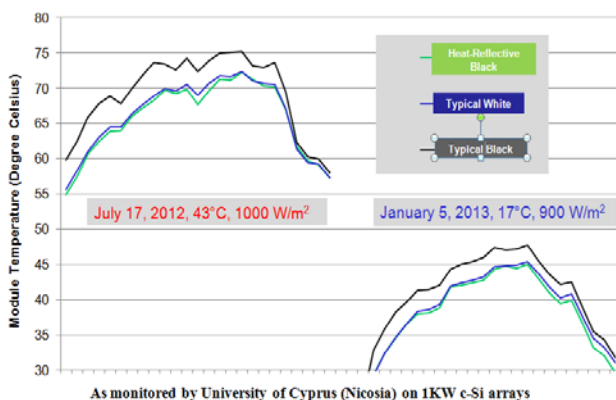
## Typical 1 Week Data



Typical daily and weekly comparisons of 3 independent grid-connected module arrays illustrating that the backsheets employed can impact NMOT. Note that the module with the “heat-reflective” black backsheets displays average operating temperatures closer to those of a typical white module.

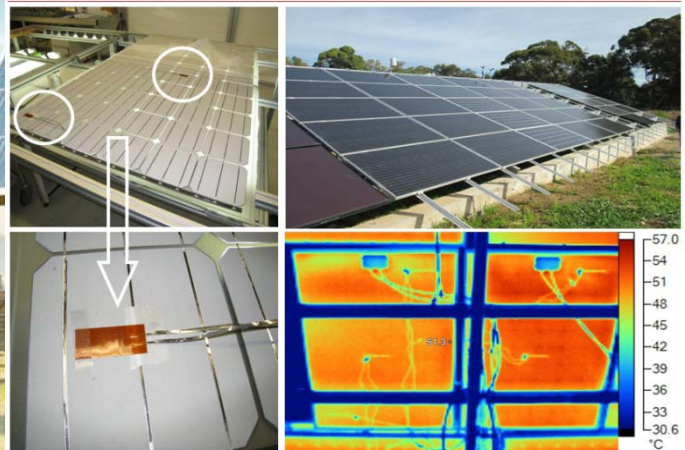
Honeywell

## Seasonal Comparison Backsheet Module Thermal Impact vs. Peak Ambient Temperature



Modules with heat-reflective backsheets still maintain lower NMOT despite seasonal variations in ambient temperatures.

## Direct NMOT Measurements + Thermal Image References



Data via embedded probes cross-referenced to IR images confirms lower temperature of modules equipped with heat-reflective backsheets.

**Conclusion:** Module packaging can influence NMOT. Lower NMOT's theoretically should improve module reliability. In BIPV / BAPV applications, where dark modules are often used, lower NMOT's can theoretically also result in higher system power and reduced impact on building envelope.

This presentation poster does not contain any proprietary or confidential information. This data is generated from preliminary testing only. Additional tests will need to be conducted to verify these results. While Honeywell International Inc. believes that the information presented is accurate, we make no representations or warranties (either expressed or implied) of any kind to the reliability of this data as incorporated into any specific product design. A number of factors may affect performance of any specific photovoltaic module, such as design, components, construction and manufacturing conditions, all of which must be taken into account by the customer in manufacturing its product. Information provided herein does not relieve the user from the responsibility of carrying out its own tests and experiments and the user assumes all risks and liability (including, but not limited to, risks relating to results, performance, patent infringements and health, safety and environment) for the results obtained by the use of this information.

Honeywell