



Phono[®] Solar

REVIEW: Lifetime testing

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How long will your solar panels last? And how well will they perform until then?

Recently released investigation shows Phono Solar and Kyocera Solar top list of highly-accelerated lifetime tests.

Millions of low-quality solar panels have been installed on Australian roofs in the past decade. This unfortunately occurred because our solar market was primarily comprised of residential installations, and because mums and dads lack the expertise to differentiate panel quality.

Therefore a great deal of responsibility for selling good quality product falls onto the heads of PV retailers. And any PV retailer interested in remaining profitable for more than six months has some self-interest in choosing a good quality panel manufacturer, as:

- 1 If the solar panels you sell fail in early years, then you will face labour, material, and back-office costs in replacing them and supporting your customers
- 2 If the solar panels you sell underperform, you customers will be unhappy, and unlikely to recommend your business. Depending on the performance claims you made, under Australian Consumer Law you may even be financially liable to pay your customers for the energy you failed to deliver.
- 3 If your solar panel manufacturer goes bust - which can happen from selling poor quality product, selling below cost, being small and unable to compete, or for any myriad of commercial reasons - then you may be left unable to service warranty claims yourself.

Given this apparent self-interest, why does Australia have a large proportion of Tier 3 solar panels - as much as 40% in recent years, according to Green Energy Trading. I believe that "PV retailers wanting to make a quick buck" is too simplistic an answer. Competitive pressure to sell a low-cost product certainly is certainly part of the reason, but there are plenty of quality solar panel brands that are impressively affordable - as we'll see clear example of in a moment. Consumer preferences certainly play a part. But I think I think one of the major reasons is because solar industry professionals don't have enough information to make an informed decision - in summary, **a lack of a universal testing standard for solar panel longevity and whole-of-life performance means solar companies and their customers are making sub-optimal decisions.**

At present, for a solar panel to be sold in Australia, it has to meet a set of minimum standards that ensure its safe operation, catches infant mortality failure mechanisms, and which grade its power production levels under standardised test conditions. Meeting these product standards is pretty much a requirement of being installed in any developed country. But these "golden panel" tests don't provide any information about how the panel will perform over time, in real life conditions, nor how long the panel will last. Indeed, as a recent bulletin from the CEC illustrated, some of the panels sold internationally contain different components or don't meet the rated power output of the 'golden panels' they supplied when meeting their IEC minimum requirements.

Last week, the CEC presented problems uncovered by its PV module testing program. Our 2016 testing program targeted seven manufacturers based on complaints and reports received by the CEC. We purchased the modules from local trade suppliers and sent them to be tested at a university laboratory.

The tests revealed a number of issues:

- Modules from four manufacturers measured an average of 4.4% below their rated output.
- More seriously, five manufacturers had substituted components during the production of the modules. Their modules were subsequently de-listed.

These findings reinforce the need for retailers and installers to use quality modules to protect themselves and their customers. Please consider getting your own tests done to confirm the modules you use are compliant.

The lack of a universal testing standard for solar panel longevity and whole-of-life performance is an issue not constrained to Australia - it's something that is being addressed globally; albeit at a slow pace. One of the leaders in independent testing is DNV-GL, and its "PV Module Reliability Scorecard Report 2016" provides illuminating reading for anyone interested in product longevity.

DNV-GL's report summarises the various studies on panel degradation rates, and provides a great summary illustration on the many ways which panels can fail or wear out - shown below. The report highlights an NREL study that shows the median panel degradation rate is 0.4-0.5%/year for high quality panels, but 0.9-1.0%/year for all panels tested.

“ **Considering solar panels are commonly sold as having a 25+ year performance warranty, as well as a 10+ year product warranty. But considering "85% of the 234 GW of installed global PV capacity has been in the field for less than five years" how confident can you be that the solar panels you're buying (or selling) will last the distance?** - DNV-GL ”

DNV-GL's testing simulates the real-life conditions that solar panels will face over their entire lifetime. It does this by subjecting the panels to thousands of hours of testing through thermal cycling, damp heat, humidity-freeze, dynamic mechanical loads, and PID - more extreme, extended, and lengthy tests than occur in the IEC minimum standards. The testing was performed on panels sourced from the market (rather than 'golden panels' used in IEC testing), but was constrained to manufacturers who volunteered to be tested: CSUN, Hanwha, JA Solar, Jinko, Kyocera, Phono Solar, Q-Cells, REC, RECOM, Tenksolar, Trina, Yingli, and ZNShine.

The results indicate a wide variation between the best and worst panel in each test. For example, the top-performing panel after the Thermal Cycling test suffered only 1% degradation; the worst suffered 35% degradation; for the Damp Heat Test and the PID test, the range of results was from 0% degradation at best to 58% degradation at worst. The range of degradation that occurs after some tests should be cause for alarm - though there are many panels that pass the tests with flying colours, there are some panels out there that simply won't last the distance.

Of course, these tests don't perfectly replicate the conditions that an individual panel will encounter, but they provide a far better indication of how a panel will respond to the environmental stresses that nature could throw at it over its lifetime. For example, most panels in Australia won't encounter the snow-focussed environment simulated by the Humidity-Freeze test, and some of the tests emulate humid or desert locations.

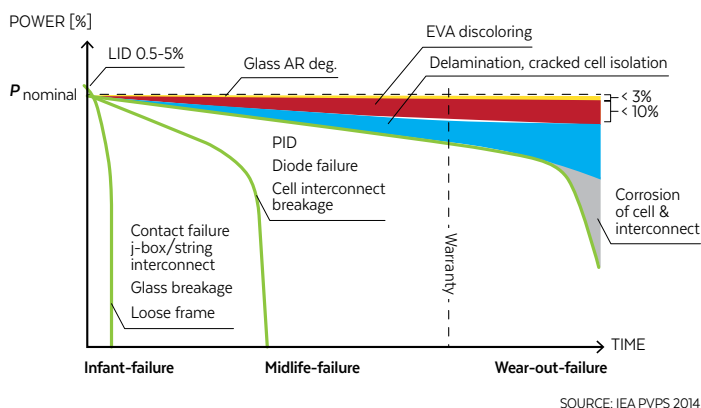
But in my mind, simply volunteering your panel to be subjected to this more rigorous test indicates a manufacturer is serious about panels that will perform well for a long life. In DNV-GL's words, "The mere participation in the PVEL Product Qualification Program indicates already the importance that the participating manufacturers place on the reliability of their products. Because of this the average and median results presented here may be better than the average and median results of the industry taken as a whole."

Multiple Choice Question:

A solar panel, sold today will last for 25 years.

1. TRUE
2. FALSE
3. We don't know yet

The table below summarises where each brand was listed as a top performer against a test, or whether it was listed as having passed the test. (Where a manufacturer isn't listed against a test indicates they either didn't submit to that test in the first place, or they didn't wish to be named in the results for that test). The table illustrates that the top performers across the range of tests were Kyocera and Phono Solar.



Manufacturer	Damp Heat (humid locations)	Dynamic Load (windy locations)	Thermal Cycling (desert locations / Large temp difference between day & night)	PID (Potential induced degradation Commercial)	Humidity -Freeze (snowy locations)
Kyocera	Great	Great	Great	Great	Great
Phono Solar	Good	Good	Great	Great	Good
RECOM	Good	Great	Good	Great	unclear
Tenksolar	Good	Great	Good	unclear	Great
JA Solar	unclear	Good	Good	Great	unclear
CSUN	Good	unclear	unclear	Great	unclear
Hanwha	unclear	Good	unclear	Great	unclear
Jinko	Good	unclear	unclear	Good	Good
Q-Cells	unclear	Good	unclear	Good	Good
REC	Good	unclear	unclear	Great	unclear
Trina	Good	Good	Good	unclear	unclear
Yingli	unclear	Good	unclear	Good	unclear
ZNShine	unclear	unclear	unclear	Good	unclear

What stands out at me from these results:

1. Now, having visited Japan a couple of times, I'm impressed at Japanese mastery at whatever they set their mind to, whether it be knives, solar panels, or whisky J. But Japan's solar market has been soaking up most of Japanese-made solar panels for quite a few years now, making it difficult to get your hands on Kyocera panels at a reasonable price.

2. Phono Solar's has excellent results for a panel that is very affordable - indeed it's about half the price of Kyocera panels.
3. The location of the manufacturer doesn't necessarily indicate quality - Chinese manufacturers perform quite well in the list.

In DNV-GL's words: "We find three key takeaways from the Scorecard's test results.

- Overall, many module vendors performed well across all tests. For example, 8 manufacturers degraded less than 3% after 4 times the IEC duration in Thermal Cycling (the IEC pass/fail criteria for 200 cycles is 5% degradation).
- Two manufacturers performed in the top group on every test: Kyocera and Phono Solar.
- Roughly 55 - 60% of top group modules were manufactured in China. This is roughly equivalent to the ratio of Chinese module participation in the full PV Module Reliability Scorecard. This demonstrates that manufacturing location is not a good proxy for reliability."

Now, DNV-GL's isn't the only scorecard out there. BNEF's tiering system is another product evaluation method that is often misunderstood to directly assess product quality. Indeed, BNEF's Tier 1 List states explicitly "We strongly recommend that module purchasers and banks to do not use [BNEF's Tier 1] list as a measure of quality, but instead consult a technical due diligence firm such as DNV-GL" (and others). BNEF is actually a quantitative measure of bankability, not quality. There are also ratings schemes that measure manufacturer's environmental sustainability and financial viability, which can also be considerations for module purchasers. In Australia, we also have some local schemes operating:

- The CEC (which manages the list of panels that meet the minimum standard) also publish which panels have met some additional independent quality measures. Look for "independent quality measures" in the list of approved solar modules.
- The CEC has recently updated the terms and conditions of listing a solar panel, which place more stringent requirements upon panel manufacturers or importers, in particular to provide appropriate levels of customer support and meet warranty requirements. Look for "Meets new CEC T&Cs" in the list of approved solar modules
- The CEC has also been testing independently-sourced products to ensure they meet the claims made on their international certificates, and de-listing products that produce less power than quoted, or use different materials to those originally specified.
- There are some reference sites where in-field performance of a number of panel brands is tested and compared, in a single environment. The DKA solar centre is an example of this.
- We also have the Positive Quality scheme (run by the Australian Solar Council), which unfortunately hasn't reached critical mass with four manufacturers listed.

To summarise,

It's in the self-interest of a PV retailer to sell product that will perform well over a long life

The only way we will know the actual performance of a solar panel over 25 years is by monitoring it for 25 years. But by that time the technology will have evolved and improved, and so the outcome will be meaningless.

Highly-accelerated lifetime testing can identify which panels are more likely to survive the environmental extremes solar panels could be exposed to over their full life.

BNEF's bankability list is not a measure of panel quality.

There is no universal test of panel quality, so it is up to solar retailers to do their due diligence, using tests such as DNV-GL's.

DNV-GL's test rates Kyocera and Phono Solar panels as likely to perform best for many years of typical environmental exposure.