

A decade of testing  
solar modules in  
**Australia:**  
Things we have seen.

**PV**  
**LAB**

# Why?

*“If a manufacturer thinks that their product will be tested,  
then 3% more power will be delivered on day 1”*

- Jürgen Arp, PV Lab Germany

4 – 5 GW of PV installed in Australia in the last 5 years. 3% = 135 MW!

Residential systems = distributed power station, with limited QA



# PV Lab Australia

## Managed by:

Lawrence McIntosh and  
Michelle McCann

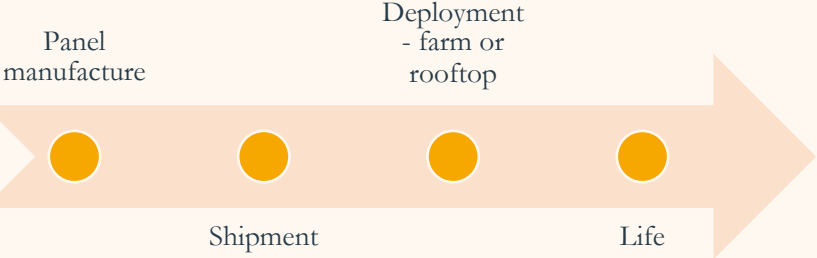
## Tests look at:

- Performance today
- Damage
- Longevity
- Safety



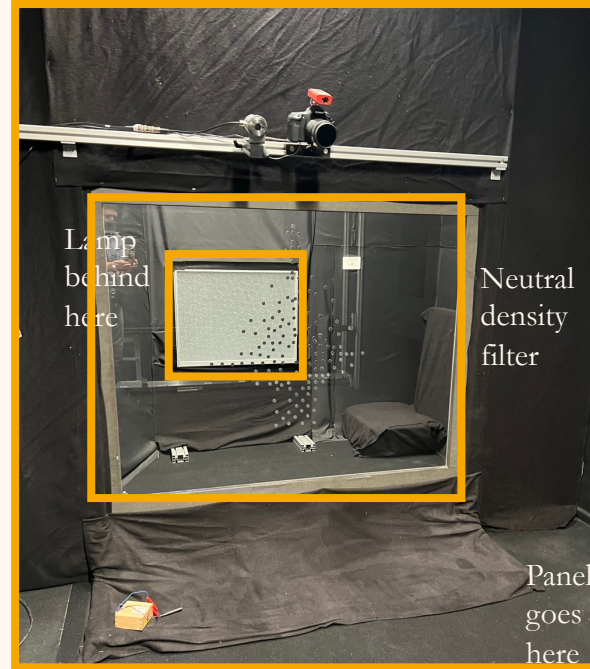
# Customers

## Semi-industrial



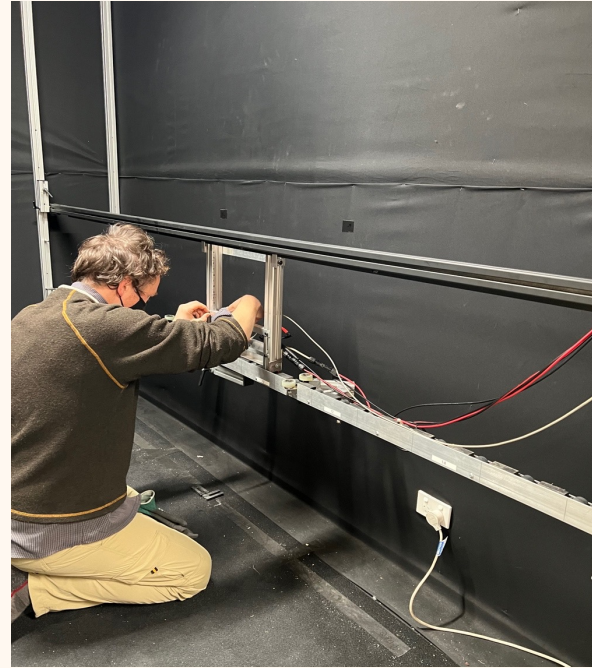
# STC power testing

- Power output at Standard Test Conditions:
  - 25°C
  - 1,000 W/m<sup>2</sup>
  - AM1.5G
- At the heart of our lab
- *Why?* tells you how much power the panel is really producing
- **Accurate Repeatable**



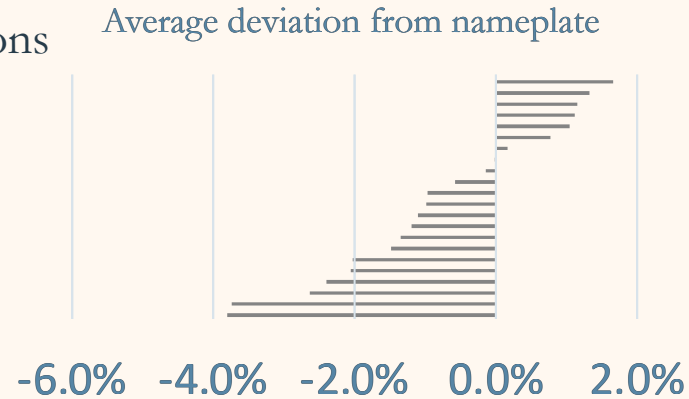
# STC power testing

- *How?* AAA rated h.a.l.m. (spatial uniformity, spectrum, temporal uniformity)
- *Use a WPVS reference cell*  
A primary calibration from the World PV Scale
- Same results as other labs around the world



# Case Study – ACT Government

- Sustainable Household Scheme
- Interest-free loans
- Money used for PV installations
- Independent testing
- 496 tests
- 121 modules
- 42 models
- 14 brands

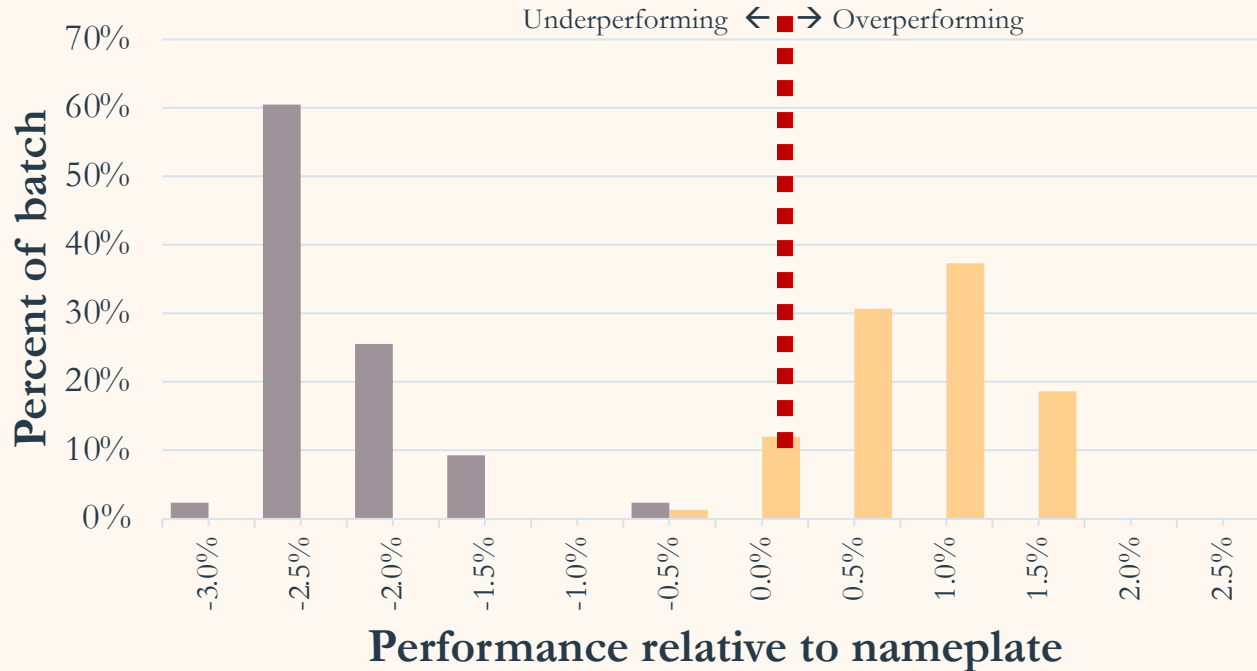


# Case Study – Solar Farm I and II

Batch results

Same, 'tier one' manufacturer

Two different clients of PV lab





# Electroluminescence (EL) testing

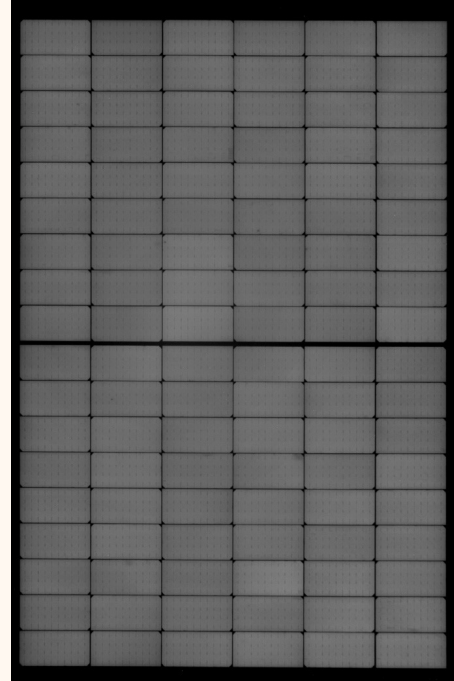
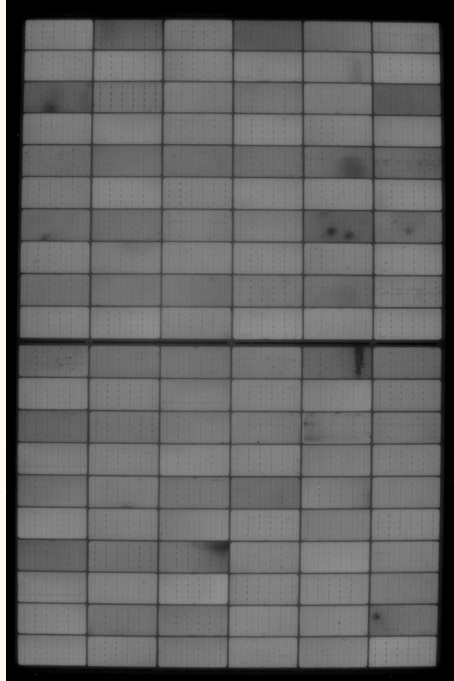
- **Why?** – Damage or defects
- **How?** – Run it backwards, take a photo in the near IR
- **When?** – At point of purchase, receiving, installation, after storm, periodically...

**Fun(?) fact.** Sometimes we have to fight against public perception

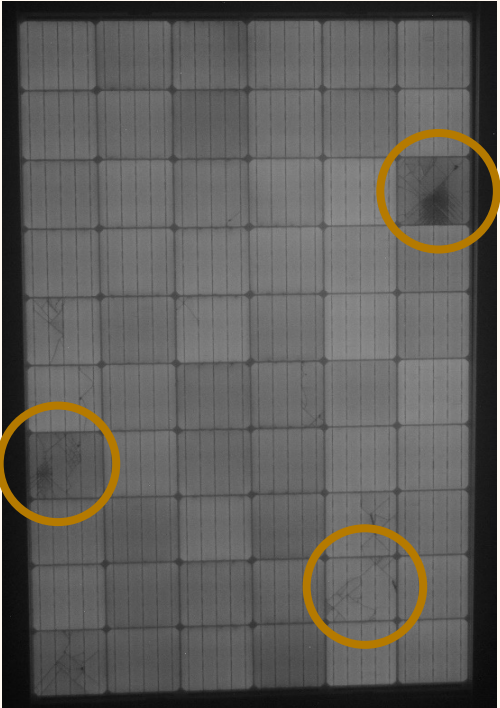
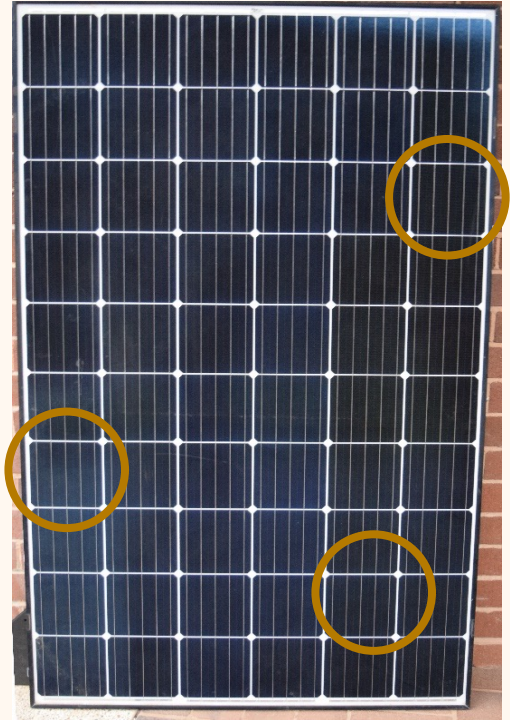
- Visual inspection
- Power output
- Thermography (with a drone!)



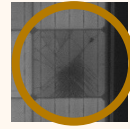
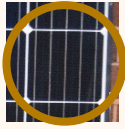
# Case Study I – variable quality



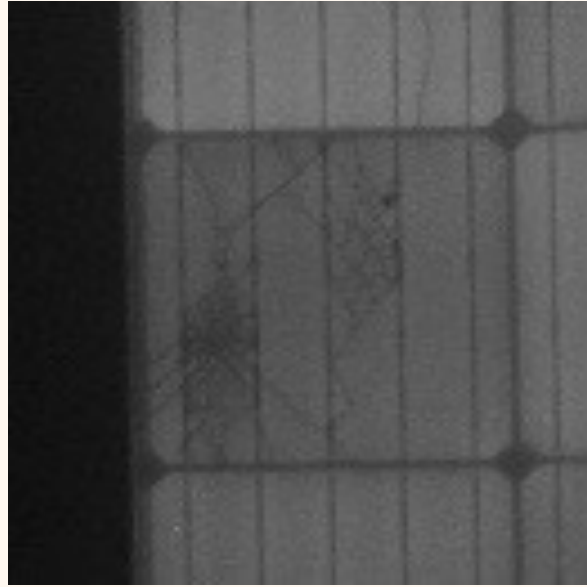
# Case Study II – Invisible damage (hail)



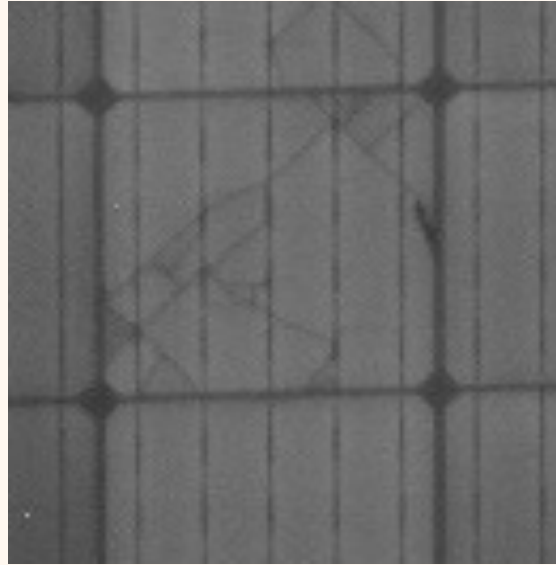
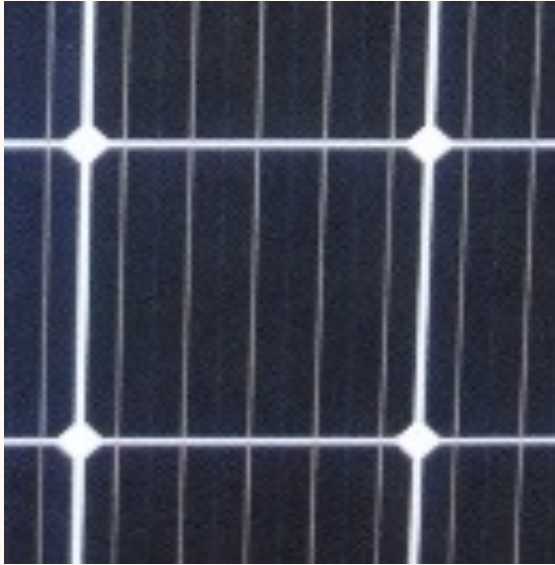
# Invisible damage



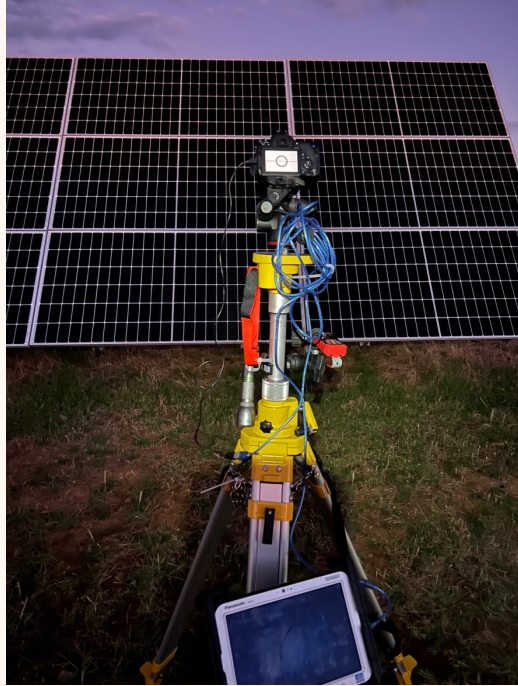
# Invisible damage



# Invisible damage

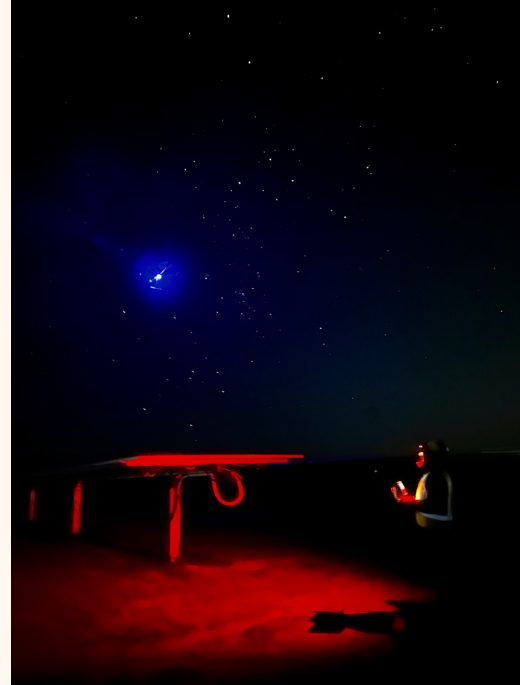


# Application: EL with tripod





# Application: EL with drone





# Wet Leakage/Insulation Resistance

- *Why?* Safety
- *Fun fact:* Water + high V = safety

Wet Leakage

- 1,500 V

Insulation Resistance

- 8,000 V
- *When?* At point of purchase
- New panels usually pass



STC

EL

WL

SMIL

PID

End-  
of-  
Life

PV  
Pass

# Static Mechanical Load Testing

- **Why?** Withstand static load
- **What?** Snow, wind
- **Fun fact:** 6,000 Pa = really heavy  
1,500 kg or 1/4 elephant
- **When?** Before purchase



First SML  
test rig  
looked like  
this



# Case Study



- Trackers in high wind zone
- Concern regarding projectiles
- Solution: Modified version of the Static Mechanical Load test



# Cyclone Testing Results

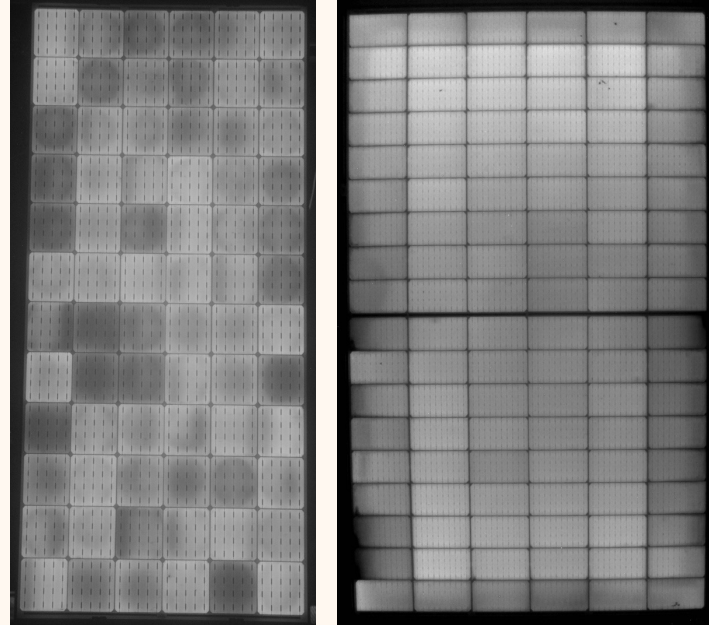


- Wind events were tested
  - 1 in 10 year
  - 1 in 100 year
- **Outcomes:**
  - Design iteratively modified
  - Final design passed testing for both wind events
  - Tracking given the ok – higher farm output



# Potential Induced Degradation

- *Why?* To look for PID OR accelerated aging test
- *Fun Facts:*
  - 85°C
  - 85% RH,
  - 96 hours,
  - 1,500 V ( $\pm$ )
- *When?* At point of purchase



# Potential Induced Degradation

- Tests for an Australian consumer organisation
- Chamber can also do damp heat (85°C, 85% RH, 1,000 + hours)





# End-of-Life



# Case Study – Micropilot with CPVA

## Panel Testing Micro-Pilot Project



All safe  
96% power output  
Negligible micro-cracking

REC  
Trina  
Ningbo  
Lightway

PV  
LAB

Visual inspection  
Wet leakage  
STC power output  
Electroluminescence

Proof of concept –  
used panels can be  
reused





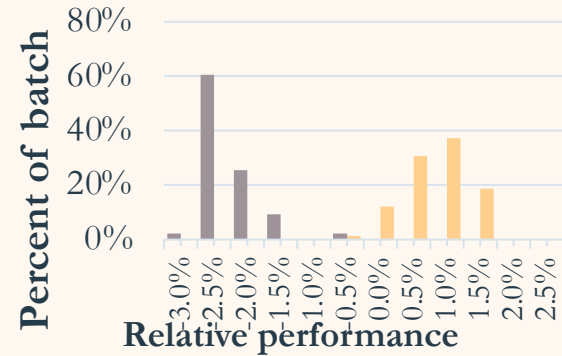
# Case Study – R2 Project

- ACT Government funding
- R2: Reduce and Reuse – Keeping PV Panels out of waste streams
- Procure higher quality and longer lasting panels in the first instance (reduce)
- Refurbish old panels for re-use (reuse)
- PV reuse report
- Backsheet



# The residential market problem

- Quality control for the residential market would be nice
- What is available publicly? Does it go ‘beyond the label’?
- What would be useful?  
True independent numbers, not marketing
- ACT Government, Clean Energy Council, Aust consumer organisation
- Problems around point-in-time tests



# Solution – PV Pass

## PHONO SOLAR

February 2023

Model: PS390M7GFH-18/VH  
Power: 390W, Tolerance: 0 to +3%  
Cells: 108



www.pvpass.com.au  
By PV Lab Australia

### Power Measurement :

#### MEASURED POWER VS LABEL



The power output of three solar panels from Phono Solar, shown as % relative to the manufacturer's labeled value.

### Performing to Specification

Measured Power % of label value  
**394W 101.1%**

A result of 100% means the average power output of the panels matches manufacturer's stated power.



Performance relative to nameplate of Phono Solar PS390M7GFH-18/VH relative to other popular solar panel models

### Manufacturing and Shipping Defects:

Panel	Individual Grades	Average Grade on Defects
Panel 1:	A	A
Panel 2:	A	
Panel 3:	A	



This grading, from A to E, assesses each panel for defects which are likely to have originated in the manufacturing process and/or during shipping and handling.

### Visual inspection:

**PASSED**



There were no visual defects that may cause a risk of reliability loss or power output.

### Wet leakage test:

SAFETY TEST: **PASSED**



Details of tests conducted and grading criteria available at <https://pv-lab.com.au/pvpass-grading-criteria>

## Q CELLS

March 2023

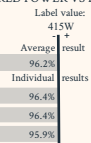
Model: Q-PEAK DUO ML-G10+ 415  
Power: 415W, Tolerance: 0 to +3%  
Cells: 132



www.pvpass.com.au  
By PV Lab Australia

### Power Measurement :

#### MEASURED POWER VS LABEL

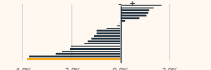


The power output of three solar panels from Q CELLS, shown as % relative to the manufacturer's labeled value.

### Underperforming

Measured Power % of label value  
**399W 96.2%**

A result of 100% means the average power output of the panels matches manufacturer's stated power.



Performance relative to nameplate of Q CELLS Q-PEAK DUO ML-G10+ 415 relative to other popular solar panel models

### Manufacturing and Shipping Defects:

Panel	Individual Grades	Average Grade on Defects
Panel 1:	C	C
Panel 2:	C	
Panel 3:	B	



This grading, from A to E, assesses each panel for defects which are likely to have originated in the manufacturing process and/or during shipping and handling.

### Visual inspection:

**PASSED**



There were no visual defects that may cause a risk of reliability loss or power output.

### Wet leakage test:

SAFETY TEST: **PASSED**



Details of tests conducted and grading criteria available at <https://pv-lab.com.au/pvpass-grading-criteria>

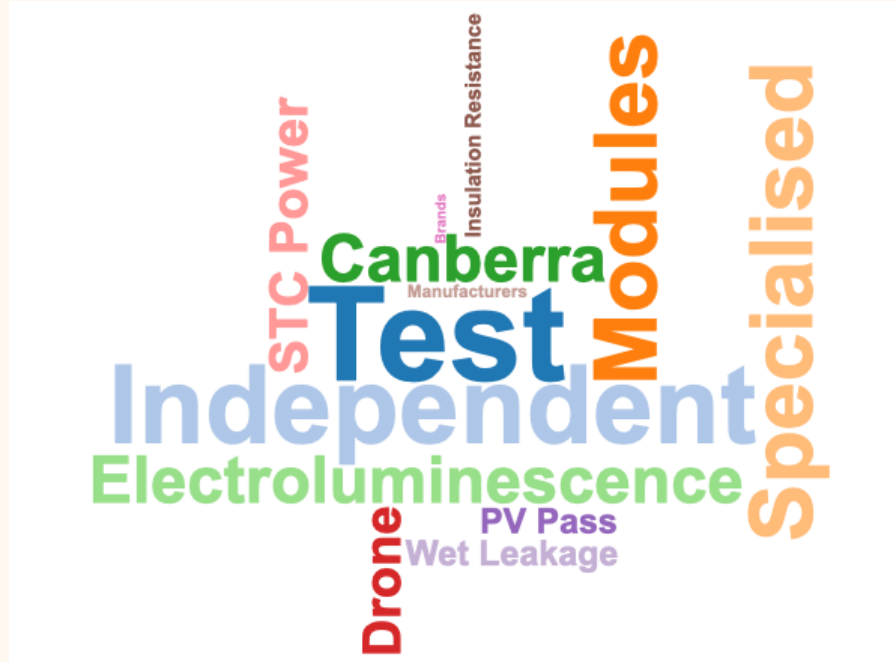
# Solution – PV Pass

- None were a disaster
- Differentiation possible
- ~1/2 consistently high score over the two rounds
- 1 consistently moderate score over the two rounds
- 2 variable quality
- Kind of simple <\$5 / system

Brand	Round 1	Round 2
Canadian Solar	76	92
Chint Solar	95	88
EGing PV		77
Hyundai	100	79
JA Solar	78	89
Jinko Solar	86	89
Phono Solar	99	96
Q cells	72	74
Risen Energy	95	86
SolarEdge	89	96
SunPower	99	99
Talesun Solar		75
Tindo	95	
Trina Solar	85	85



# PV Lab Australia



# Questions

