



Subsidy free PV: Transforming the energy landscape

Quality Roundtable – Intersolar Europe 2019



Agenda

Part I



14:30

Introduction & NEW pv magazine Quality Roundtable Industry SnapShot Poll

14:40

Quality Case Study: Investigating poor soldering quality in modules – does auditing save money?

14:55

Quality Case Study: Analysis of glass-glass performance in the field

Agenda

Part II



15:00

DEEP DIVE DISCUSSION Glass-glass modules are gaining market share - are they really more reliable?

15:40

EXCLUSIVE INTERVIEW Accelerated testing protocols latest developments

15:50

Quality Case Study: The dispute over direct burial of cables - what is technical best practice?

16:05

PANEL DISCUSSION Identifying the key considerations to ensure optimum cable connector durability

Agenda

Part III



pv magazine group

16:25

Quality Case Study: Inverters service void - what expectations about manufacturer service are fair and justified?

16:30

PANEL DISCUSSION How can inverter manufacturers address after-sales service issues, and how can this be leveraged for subsidy free PV

16:55

NEW pv magazine Quality Roundtable Industry SnapShot Poll Results & Poster Session

Networking

Industry SnapShot Poll

1) MODULES: What quality risk for modules is the biggest concern for the industry

- Potential induced degradation (PID)
- Light induced degradation (LeTID and LID)
- Glass breakage and/or manufacturing faults
- Financial stability of the manufacturer

2) RISK ASSESSMENT: Besides faulty modules which risk do you consider the most severe?

- Inverter down time
- Faulty connectors and/or issues with cables
- Unstable mounting structure and/or poor installation
- Poor planning and design

Industry SnapShot Poll

3) RISK MITIGATION: Which of the following criteria for you is the most important for risk mitigation when purchasing modules

- Due diligence including production audit by a professional service provider
- Good warranty conditions provided by the manufacturer
- Financial stability of the manufacturer
- Confidence in the manufacturer

4) SUSTAINABILITY: Why do you think a sustainability initiative for the solar industry is important?

- To create positive PR by demonstrating holistic approach to reducing environmental damage
- To be part of a growing global consciousness of the climate crisis
- To help protect the planet for future generations
- To reduce costs or attract new investment into PV over the long term

Quality Case Study

Investigating poor soldering quality in modules – does auditing save money?





Anika Giller
**Senior Business Development
Manager, EMEA & APAC**





Quality Case Study

Analysis of glass-glass performance in the field





Lucie Garreau-Iles
Technical Manager, EMEA



Analysis of glass-glass module performance in the field

Lucie Garreau-iles

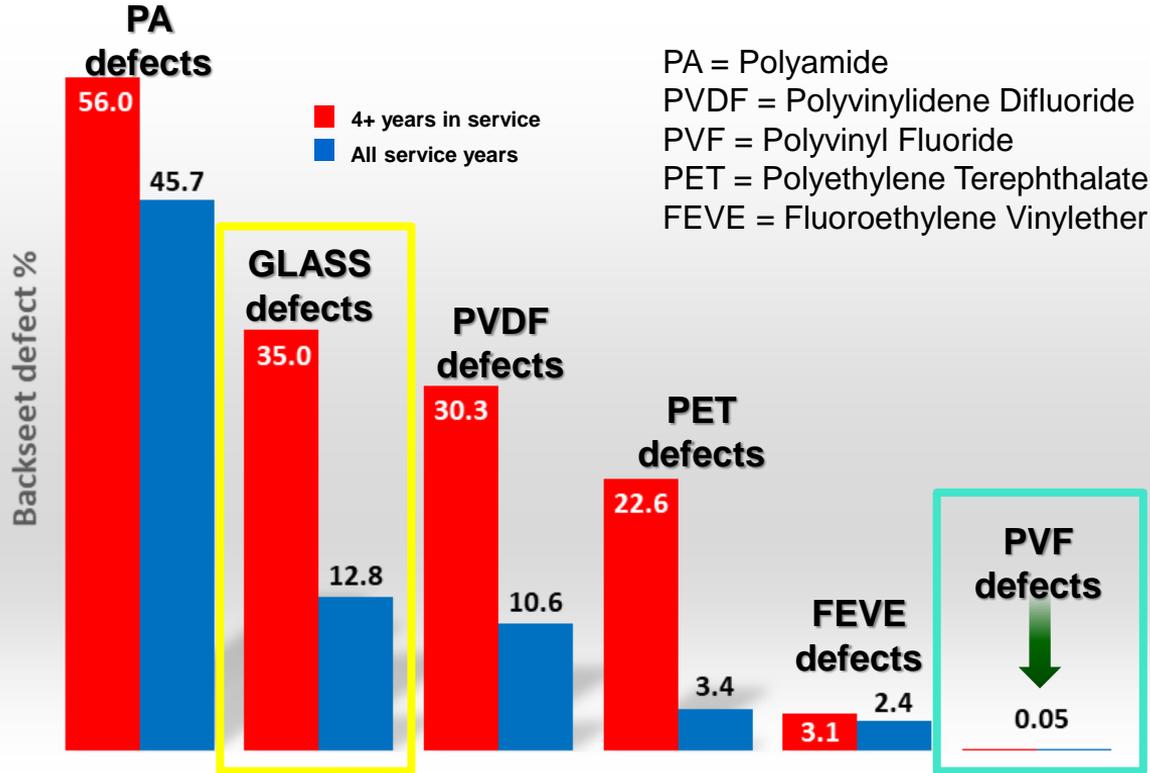
Technical Manager, EMEA

Lucie.garreau-iles@dupont.com

DuPont Photovoltaic Solutions

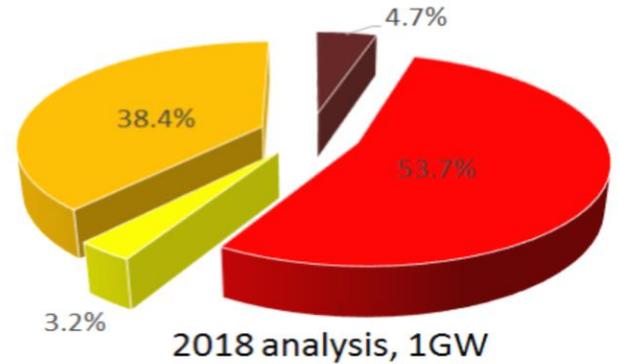


Material sensitivity in the field



Over the past 6 years, DuPont has gathered statistics of visual degradation:

- on +1GW of installed panels
- with an average age of 3.3 years in operation
- In Europe, Asia, America and the Middle East
- ✗ 22.5% of all panels display a visual defect
- ✗ 9.5% of all panels display a backsheet defect
- ✗ 58.4% of the backsheet defects are serious



- Air side yellowing
- Front side yellowing
- Delamination
- Cracking

Field examples of glass-glass modules

Location	Years in Operation	Main Degradation Issues
Danzhou, China	15	Corrosion, loss of power, EVA browning
Okinawa, Japan	11	Corrosion, loss of power
Yannan, China	10	Module breakage
Arizona, US	10	EVA yellowing, rear glass delamination and cracking
Shanghai, China	5	Corrosion, loss of power
West China	1	Bending of modules, cracking

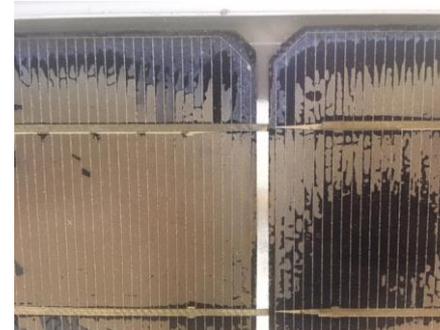
Glass-glass modules have higher power loss/year (JRC)¹

Backsheet	Average Power Loss/Year (%)	Years in Field	Source
Glass-Glass	1.3	20 - 23	JRC ¹ (2008)
All Other Backsheets	0.5 - 0.8	5 - 35	NREL ² (2016)

- Glass traps acetic acid
- Glass is incapable of preventing moisture ingress from edges³, acetic acid is generated
- Acetic acid then corrodes cell interconnects, increases resistance and reduces power



Glass-glass modules with busbar corrosion
Danzhou, China, 15 years



Busbar corrosion, delamination, and
EVA browning in JRC glass-glass
module study

1 Skoczek, A., et. al., "The Results of Performance Measurements of Field-Aged Crystalline Silicon Photovoltaic Modules", Prog Photovolt. Res. Appl. (2008). Wiley InterScience (www.interscience.wiley.com) DOI: 10.1002/pip.874

2 Jordan, D. C., et. al., "Compendium of Photovoltaic Degradation Rates", Prog Photovolt. Res. Appl. (2016). Wiley InterScience (www.wileyonlinelibrary.com) DOI: 10.1002/pip.2744

3 Kempe, M. D., et. al, "Control of Moisture Ingress into Photovoltaic Modules", 31st IEEE Photovoltaic Specialists Conference (2005)

Glass-glass modules, West China, 1 year

Frameless glass-glass modules bending, lead to breakage of glass and cells



- West China, 1 year in field
- 10%~20% of modules had bending issues
- 1.5% of modules cracked
- Installation type: clamping

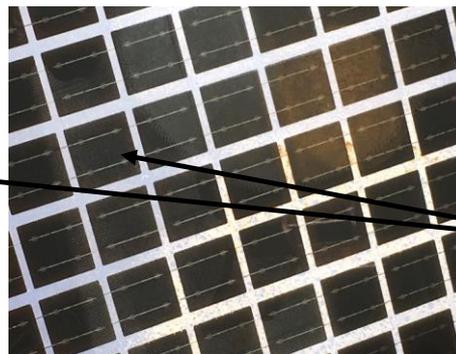
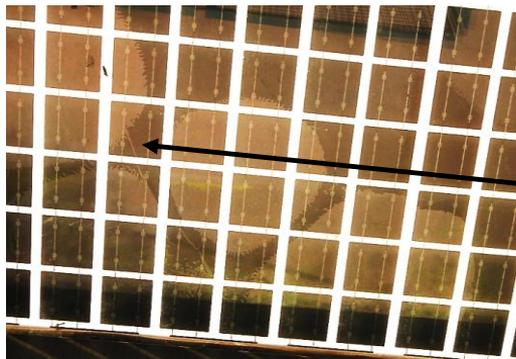
Glass-glass panels, Arizona, 10 years

BIPV Glass-glass modules with EVA encapsulant at DC Office system on ASU Polytechnic campus. The modules were installed in May 2003 and decommissioned after 10 years.

Glass-glass modules suffered



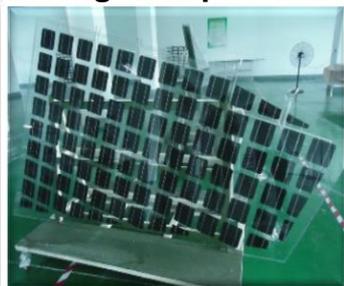
Severe
frontside
browning &
discoloration



Severe and
widespread
delamination on the
rear side of all
modules, some
cracking of rear glass

Glass-backsheet vs glass-glass: lower installation and O&M costs

Glass cracking during transportation



~0.3%

Glass cracking during installation



~3X

Glass bending in field



10~20%

Longer installation time



2~3X

Higher labor costs



~2X

Higher BoS costs



>20%



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Deep dive discussion

Glass-glass modules are gaining market share - are they really more reliable?





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Regional Field Manager
Germany, India, Middle
East, Africa
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Lucie Garreau-Iles

Technical Manager, EMEA



Andrea Viaro

Head of Technical Service
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Paul Grunow

Technology Consultant



Jonathan Govaerts

Researcher PV,
imec



Winfried Wahl

Head of Product
Management,
Chief Engineer



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Interview

Accelerated testing protocols latest developments



Karl-Anders Weiss

**Head of Service Life Analysis,
Fraunhofer ISE**

Quality Case Study

The dispute over direct burial of cables – what is technical best practice?





Panel discussion

Identifying the key considerations to ensure optimum cable connector durability





Guido Volberg

Global Head of Technical
Competence Center,
TÜV Rheinland



Eric Ast

Head of Global Business
Development Photovoltaics

STÄUBLI



Moritz Ilg

Portfolio Manager
Foresight Group



Faruk Yeginsoy

Head of Operations, Business
Unit Solar & Windpower

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Quality case study

Inverters service void – what expectations about manufacturer service are fair and justified?

Panel discussion

How can inverter manufacturers address after-sales service issues, and how can this be leveraged for subsidy free PV





Neil Yu

Product Manager



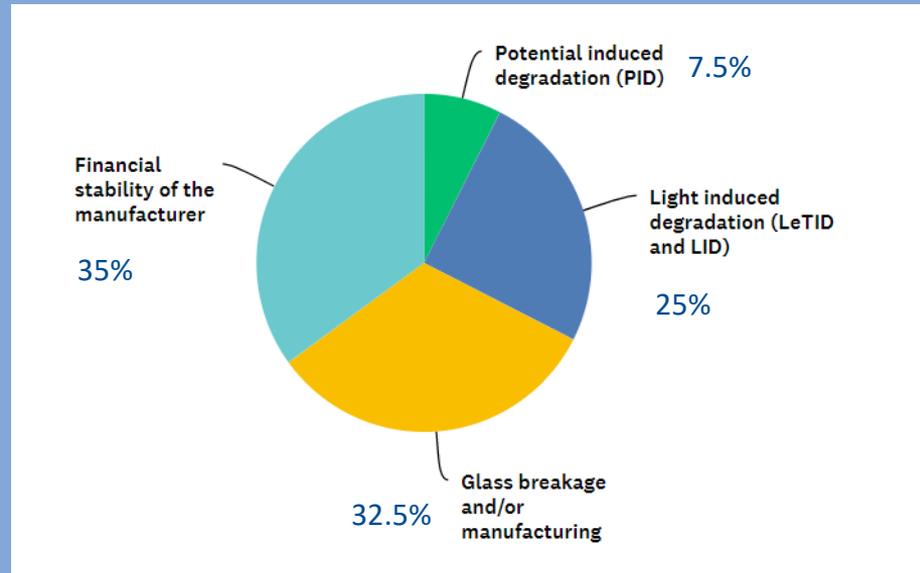
Michael Mills-Price

**Head of Inverter & Energy
Storage Business**



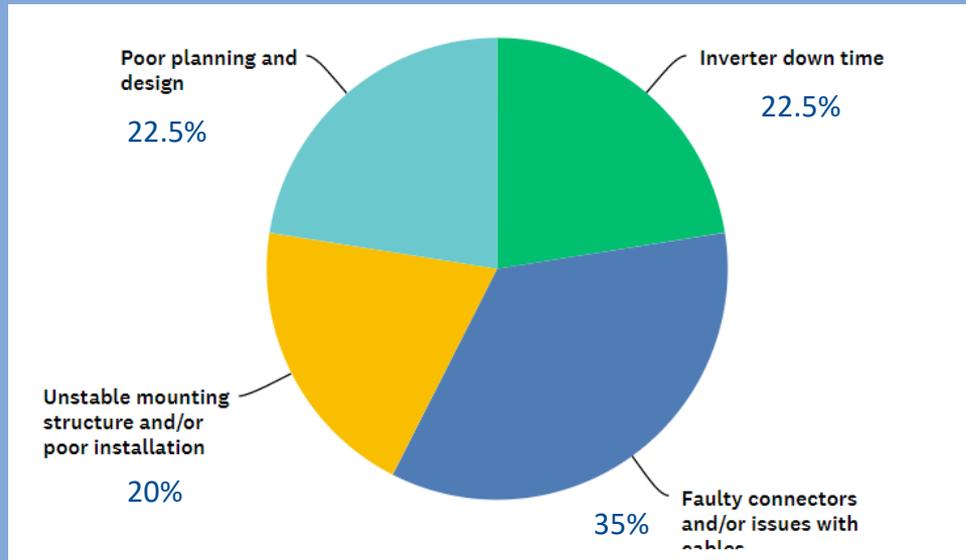
Industry SnapShot Poll

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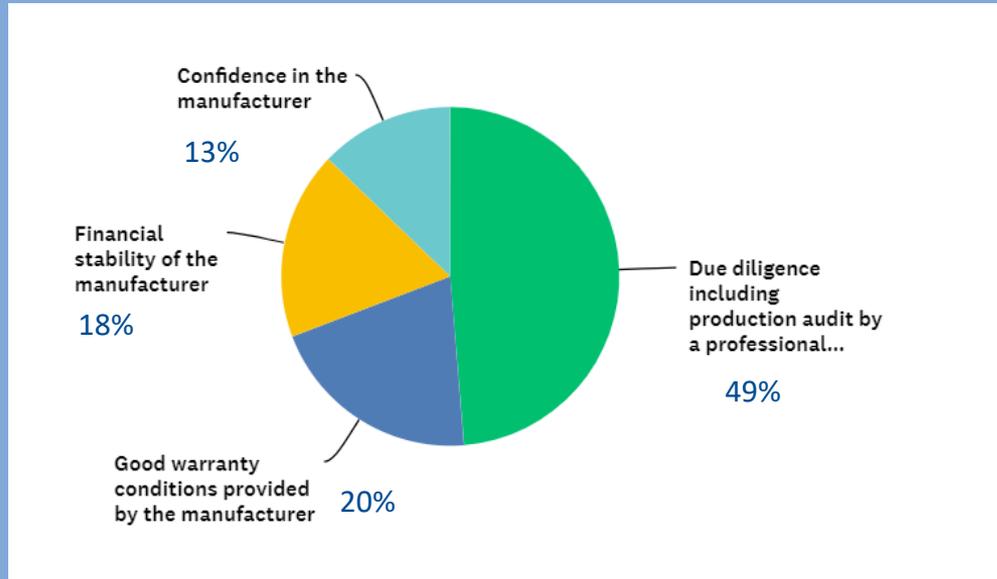
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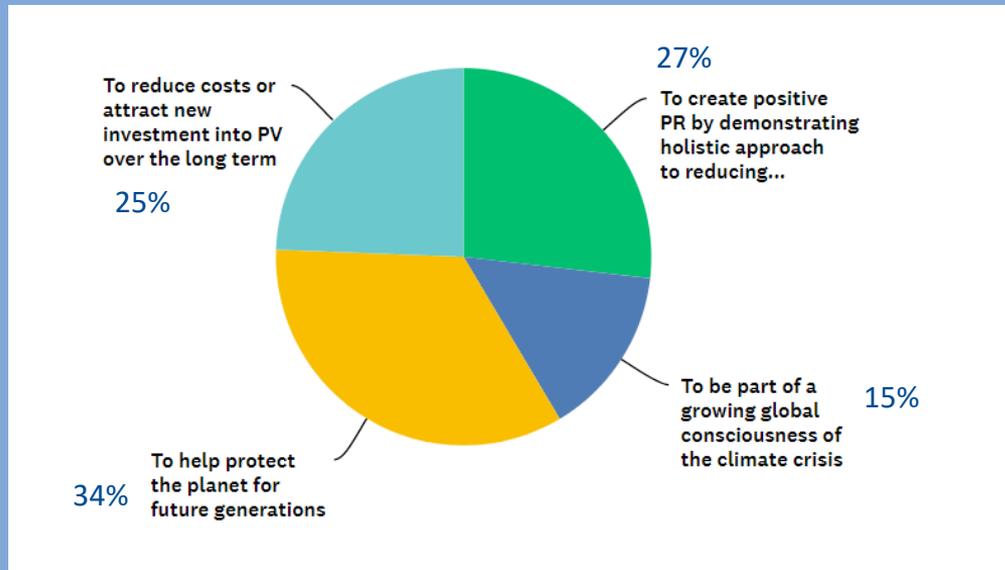
Industry SnapShot Poll

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Industry SnapShot Poll

4) SUSTAINABILITY: Why do you think a sustainability initiative for the solar industry is important?



Poster session





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