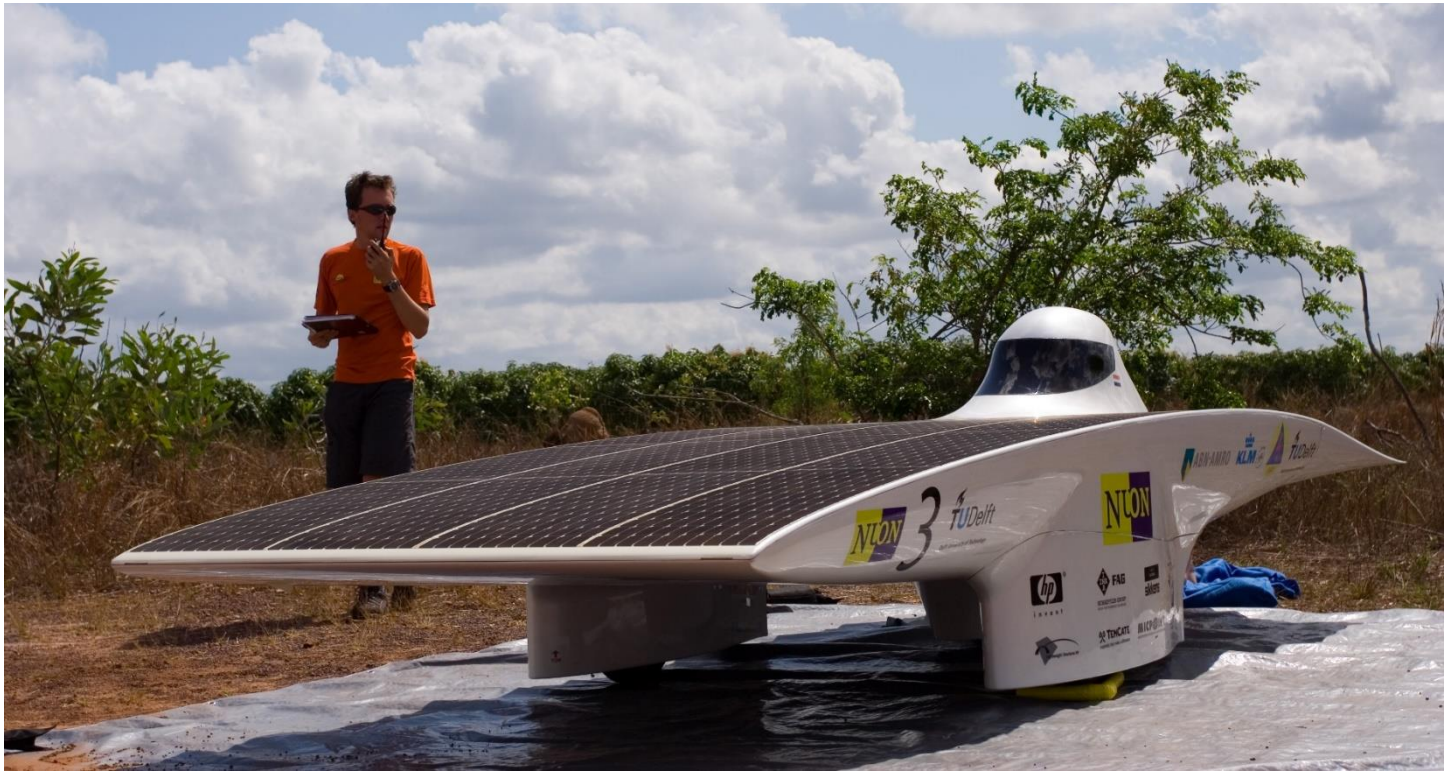
LeTID: Testing standardization and laboratory results of light exposure methods

S. Roest[1], E. Garcia Goma[1]

[1]Eternal Sun Spire, Den Haag, Wolga 11 2491 BK, The Netherlands

Introduction: Stefan Roest CTO of Eternal Sun Spire

Providing high-end solar testing technology, application knowledge and services



What will you see today?

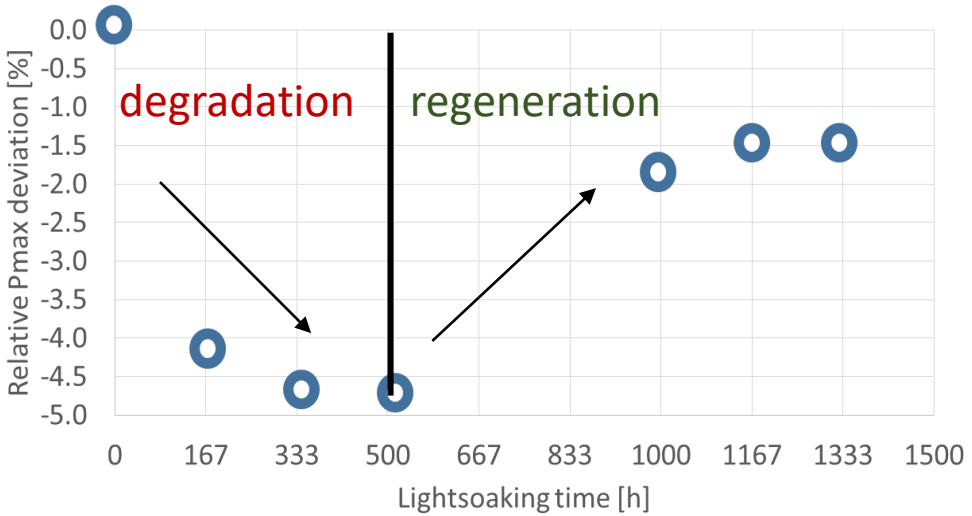
	Discussion point	Conclusion
Test methods & IEC norm development	Temperature	100 C can **accelerate x4** LeTID compared to 85 C
	IV performance during test	**In-situ IV measurements** avoid missing data and errors from handling
LeTID light method test results	Cell type (mono or poly)	Different materials **regenerate faster/slower**
	Module designs	Different designs **suffer different LeTID**

Development of a LeTiD testing standard is challenging

- LeTID tests require output relatable to outdoor conditions.
- Reproducible among test laboratories (round robin).
- IEC WG2 project team has submitted draft standard.

IEC 61215-2 draft MQT23 LeTID proposed test

- Degradation step:
  - 75 ºC
  - 162h cycles (min x2)
- Regeneration step:
  - 85 ºC
  - 500h initial cycle
  - 162h cycles (min x2)
- IV measurement between cycles
- Two possible methods:
  - Light method -> 1 sun @ Impp,stc
  - Dark method -> apply Isc-Impp,stc
- In-situ IV measurements optional

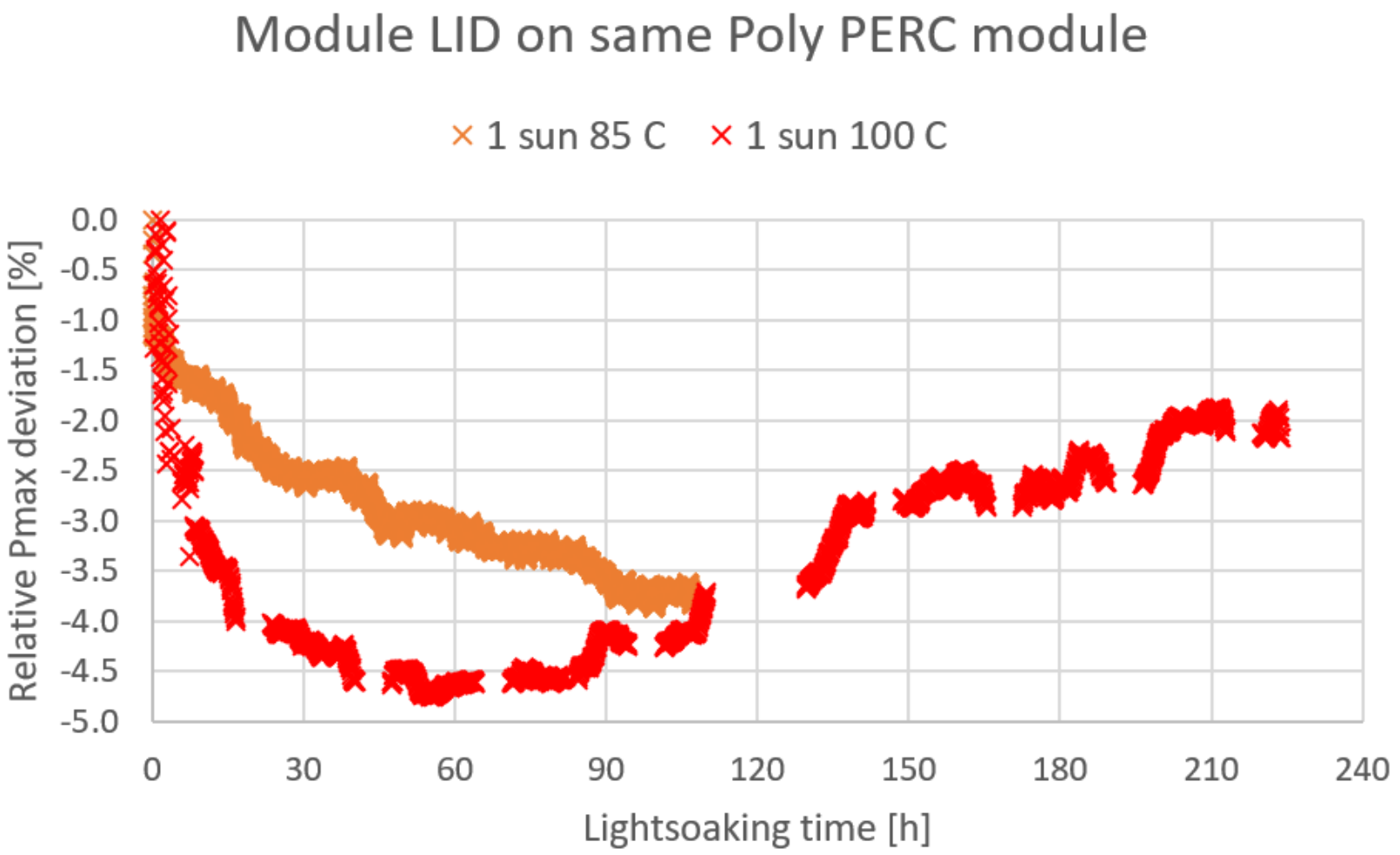


Experimental setup used for the module L(eT)ID tests

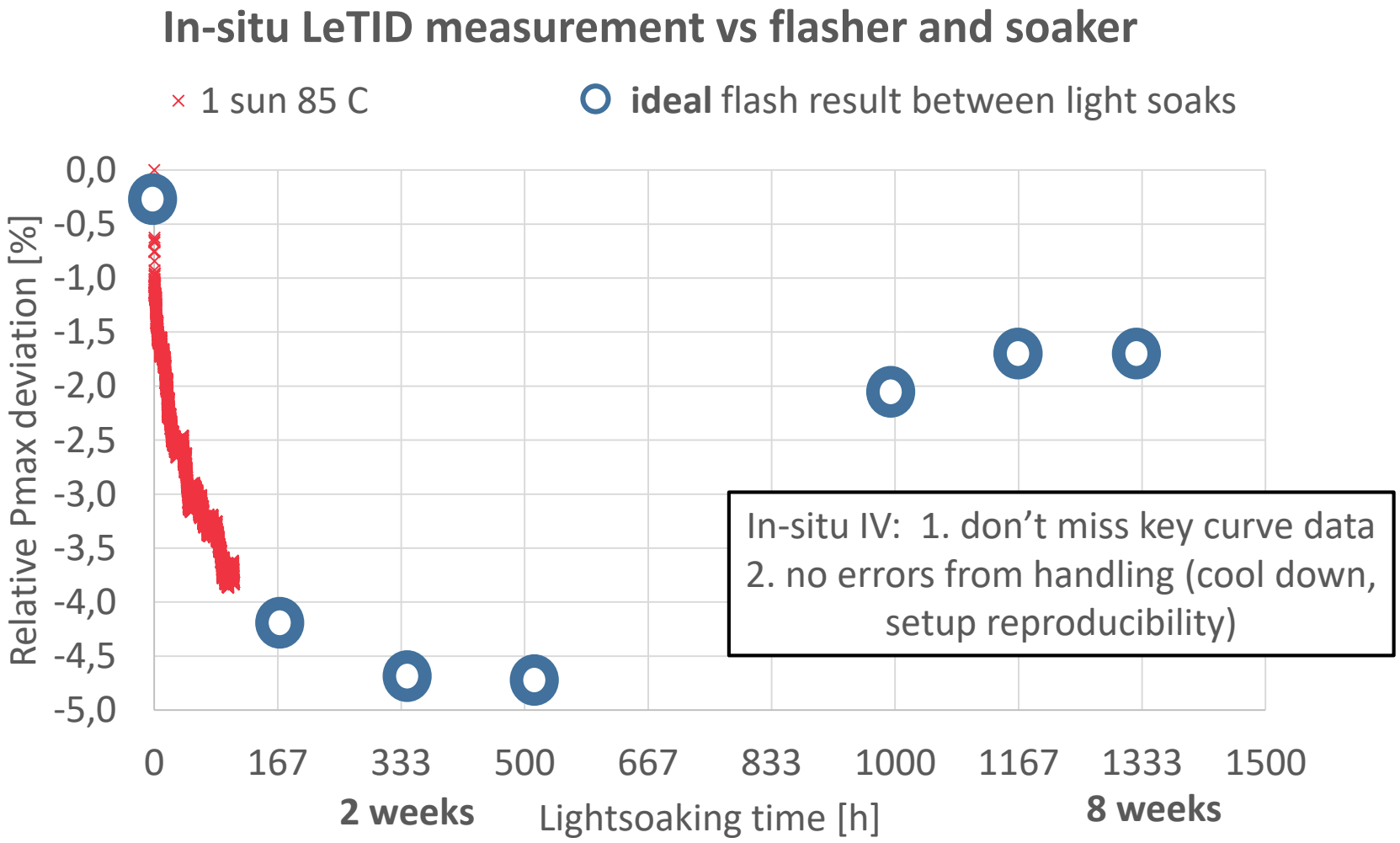
- 1 sun Class AAA illumination
- 300 to 1200 nm spectrum
- 2 modules simultaneously
- -40 to 105 °C air temperature
- Custom IV setpoints (such as mpp)
- in-situ IV measurements

Effect of temperature

Testing at **100 C** instead of 85 C can accelerate LeTID test by **a factor of 4**



Benefit in-situ IV vs 2 setups method



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LeTID light method
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LeTID Round robin in progress 1. Which improvements can be done on the test procedure 2. Do the labs and different methods get same results - > updated draft IEC 61215-2 MQT23	
LeTID light method test results	
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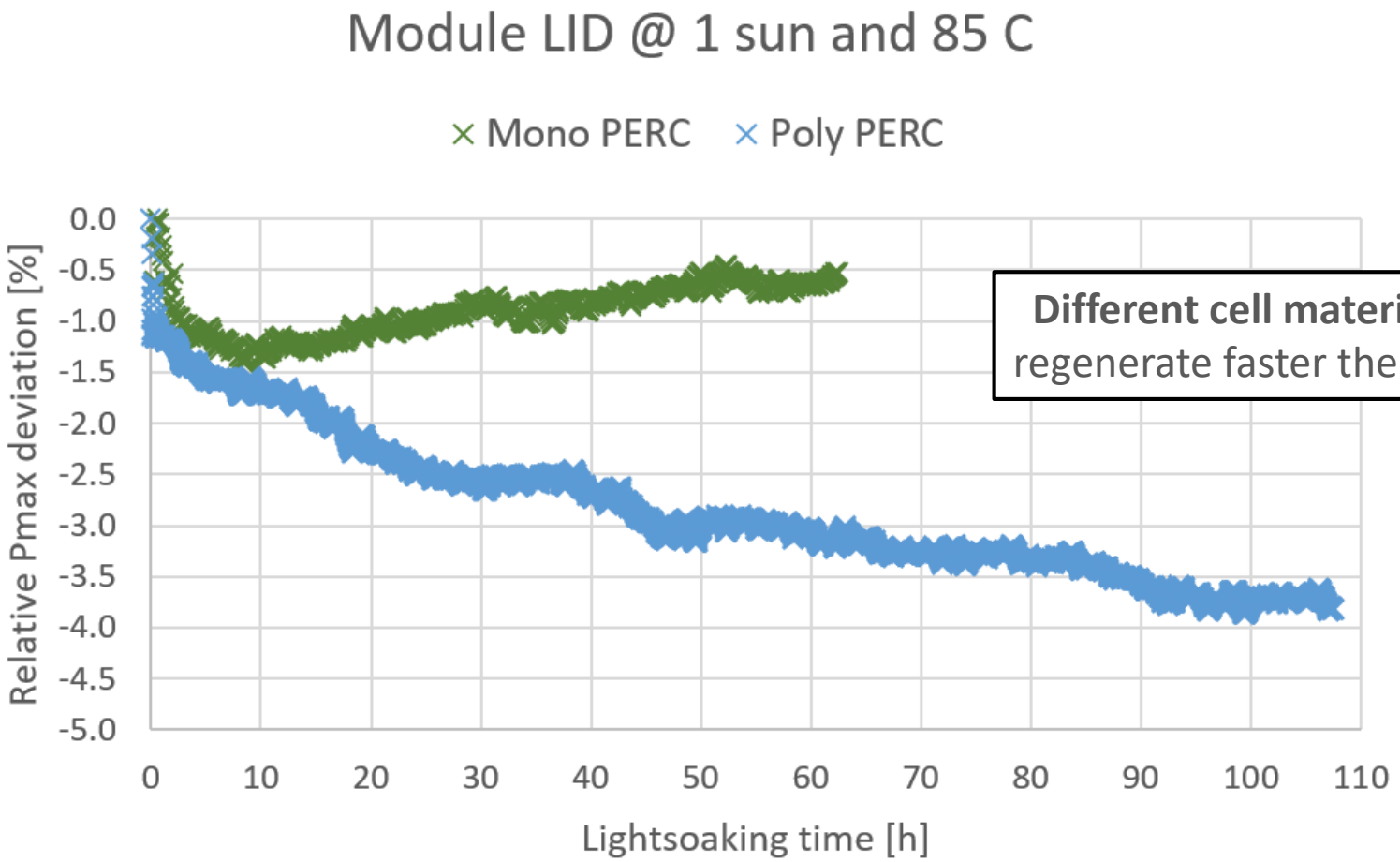
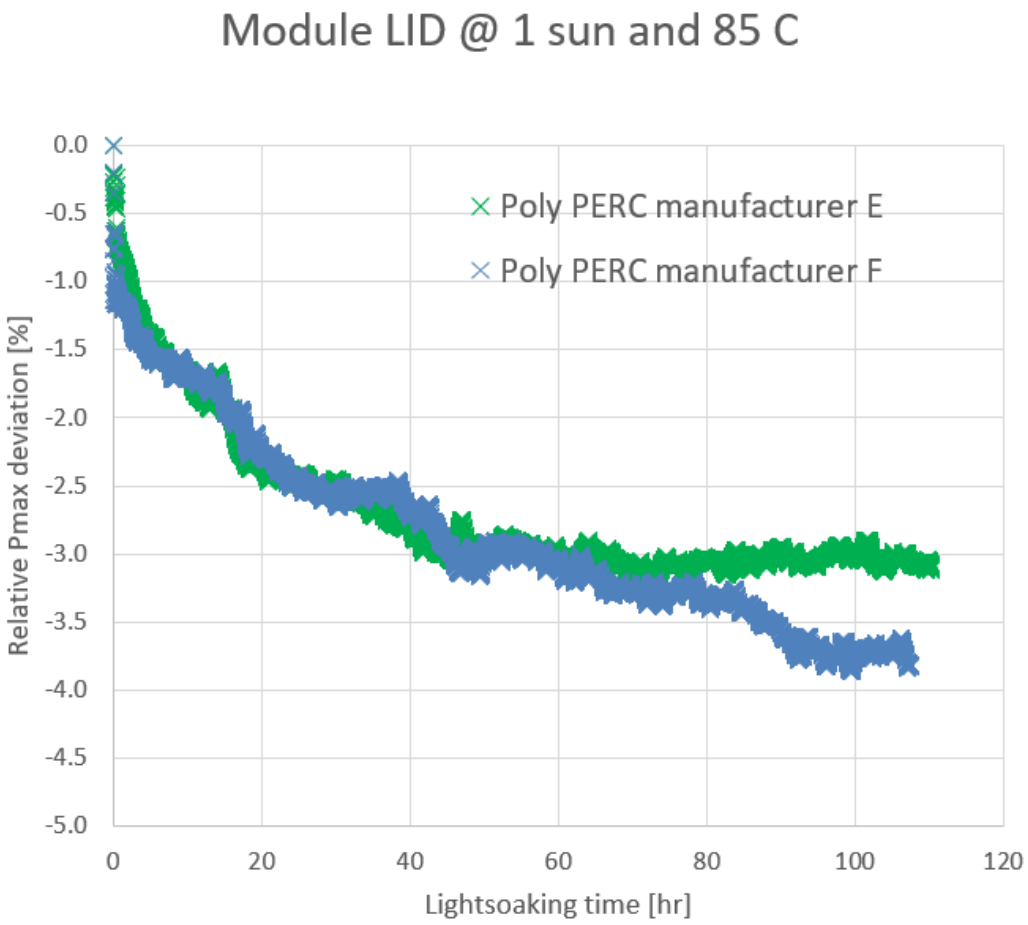
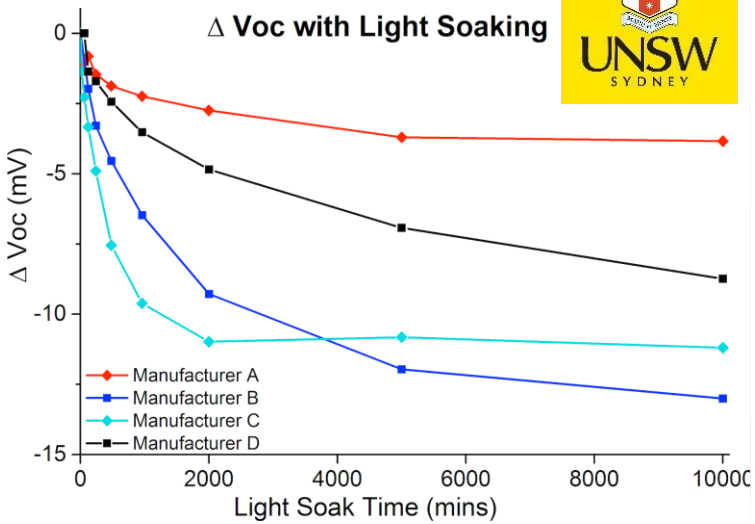
Cell type: Mono vs Poly PERC



Different cell materials can regenerate faster then others

Differences between designs





Different designs/ manufacturers can have different **LeTID extent**

[3] Ciesla, Alison & Wenham, Stuart & Chen, Ran & Chan, Catherine & Chen, Daniel & Hallam, Brett & Payne, David & Fung, Tsun & Kim, Moonyong & Liu, Shaoyang & Wang, Sisi & Kim, Kyung & Samadi, Aref & Sen, Chandany & Vargas Castrillon, Carlos & Varshney, Utkarshaa & Vicari Stefani, Bruno & Hamer, Phillip & Bourret-Sicotte, Gabrielle & Abbott, Malcolm. (2018). Hydrogen-Induced Degradation.

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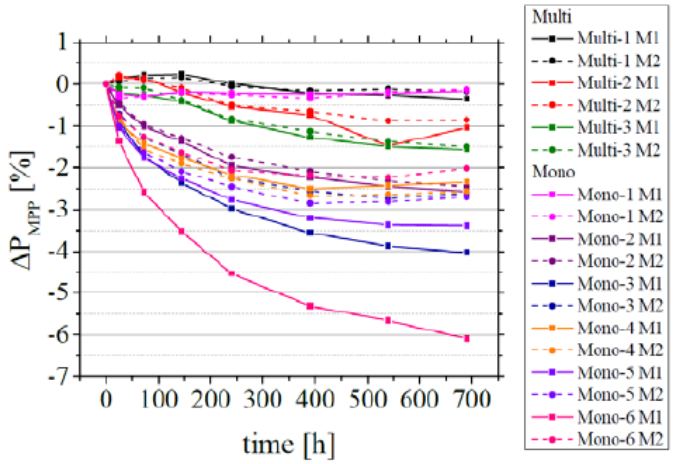
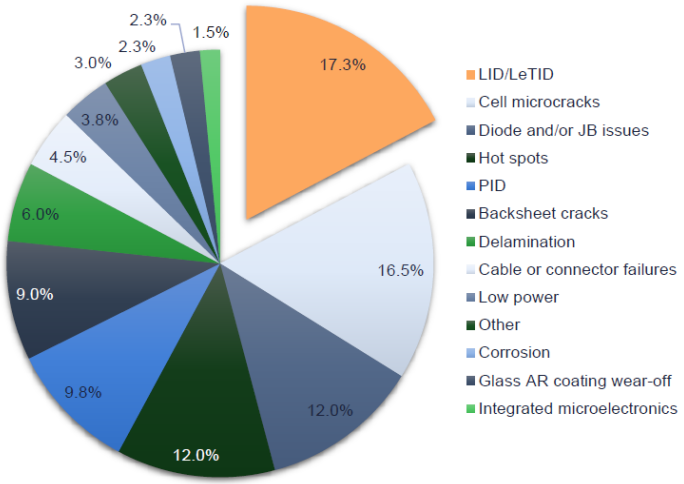
PV investors perspective on LeTID: proof with module data

- Effect better understood and controlled but still between 1%-4% in first year(s) in recent data
- 1 year outdoor relates to 300-600 hr lab testing
- L(eT)ID actual nr 1 PV investors concern, we need to address with module testing data -> **valorizing manufacturers' efforts in LeTID reduction**.



Benchmarking commercially bought modules for LeTID
(75°C, Isc-Imp, 690 hrs.)

Source: Pander et al., 2018



Responses to PVEL Survey of Downstream Partners:
What module defect(s) concern you the most?

Source: PVEL survey, 2018

Questions?

Steady State AAA Sun Simulators
Integrated Climate Chambers

A+A+A+ Flash Sun Simulators
Advanced Temperature control

IV and EL test services at
Rotterdam harbour warehouse

Ir S. Roest

CTO

sroest@eternalsun.com

Website www.eternalsun.com

www.spiresolar.com

www.odinspire.com