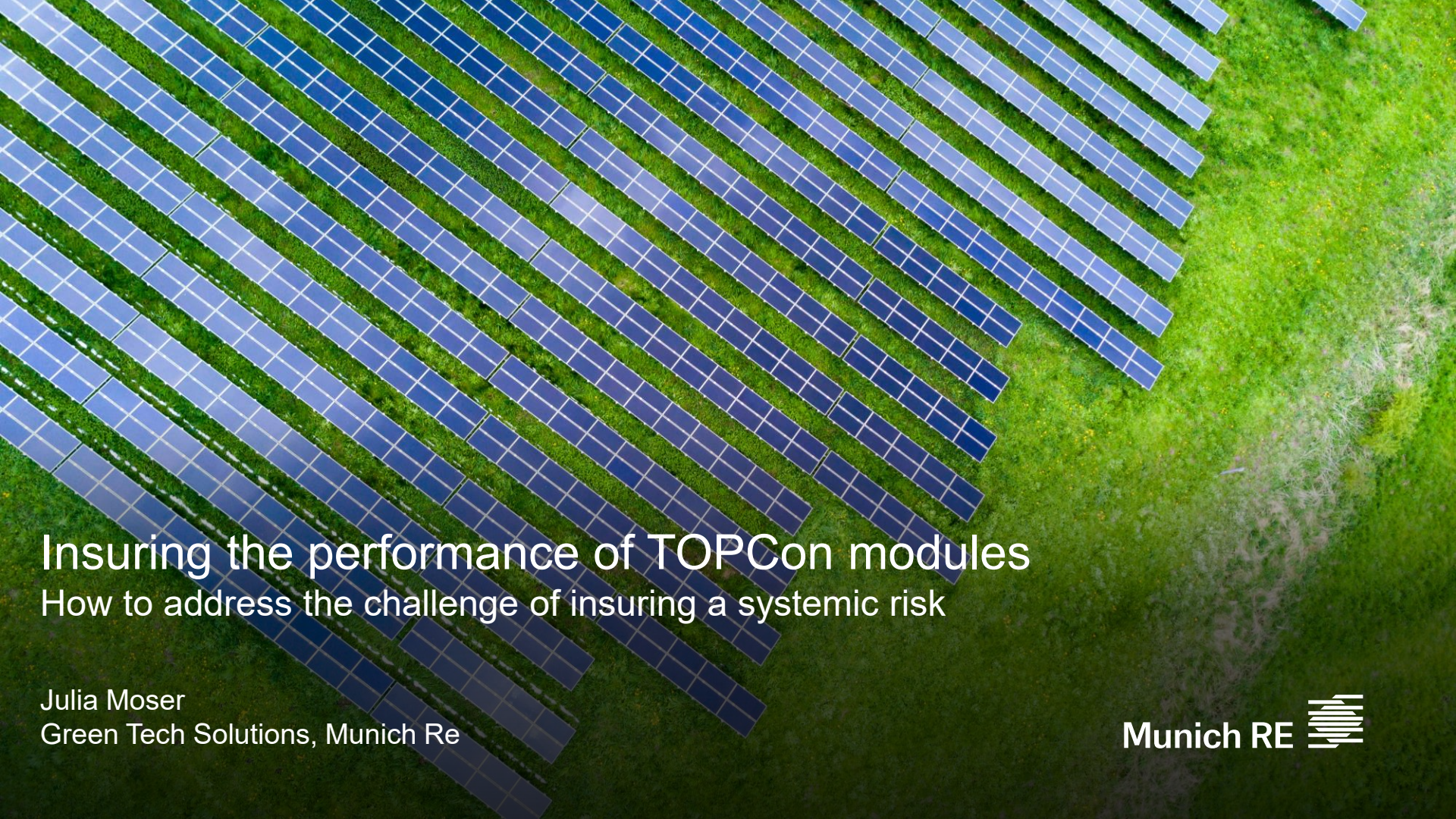

Insuring the performance of TOPCon modules

How to address the challenge of insuring a systemic risk

Julia Moser
Green Tech Solutions, Munich Re

Munich RE

The problem: UV induced degradation of TOPCon modules

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Fraunhofer ISE warnt vor Risiken durch unerwartet hohe UV-induzierte Degradation in Topcon-, Perc- und Heterojunction-Zellen

Die Forscher des Freiburger Instituts erklärten, dass UV-induzierte Degradation bei allen vorherrschenden Zelltechnologien, einschließlich Topcon-Bauelementen, größere Effizienz- und Spannungsverluste als erwartet verursachen kann. Die Wissenschaftler gehen davon aus, dass Siliziumnitridschichten verwend... könnten, um die UV-Stabilität von Topcon im Vergleich zu PECVD-Schic... verbessern, die üblicherweise in Perc- und Heterojunction-Zellen verw...

'Critical' TOPCon module degradation is 'in contrast' to long panel warranties

New research warns of unexpected UV-induced degradation in TOPCon solar cells from invisible light

Researchers from UNSW have found that invisible light accelerates UV-induced degradation in TOPCon solar cells, producing the same degradation effects as visible light but at a ... ate. This can lead to significant open-circuit voltage losses

Deep concern about TOPCon module quality

Source:
Fraunhofer ISE warnt vor Risiken durch unerwartet hohe UV-induzierte Degradation in Topcon-, Perc- und Heterojunction-Zellen – pv magazine Deutschland
New research warns of unexpected UV-induced degradation in TOPCon solar cells from invisible light – pv magazine International
TOPCon modules show 'critical' degradation - PV Tech
Deep concern about TOPCon module quality - PV Tech

The solution: Passivation, encapsulants, stabilization…?

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UVID of TOPCon solar cells: Effect of the front passivation Al_2O_3 layer thickness and recovery by different processes

UVID:

QUALITY RISKS AND LATEST MITIGATION STRATEGIES

UV-Induced Degradation in N-Type Modules:
Exploring Metastability and Recovery Pathways

Stabilization Procedures for TOPCon Modules after UV-Induced Degradation

Source:
UVID of TOPCon solar cells: Effect of the front passivation Al2O3 layer thickness and recovery by different processes – ScienceDirect Content
pvsc2025_uvid-metastability.pdf
💎 Don't forget Quality! 💎

Our PV Warranty Partners

Munich RE

Munich Re's challenge:

- We reinsure the warranties of many module manufacturers in various markets, with different technologies.
- Our portfolio of insured modules is in multiple climate zones owned by numerous project owners.
- We cover a significant TOPCon module portfolio with the respective cells being manufactured in different countries by players with varying maturity levels.

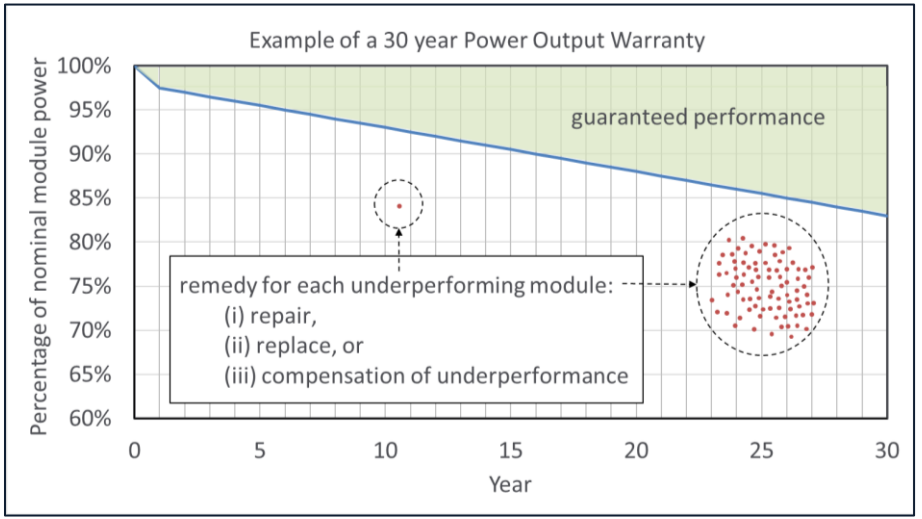
Source: www.munichre.com/pvwarrantypartner

What is PV warranty risk?

30 years power output warranty: a unique risk to the PV industry

Munich RE

- such a strong warranty is a great chance for the solar industry, but also a great risk
- **PV warranty insurance** protects
  i. manufacturers, and
  ii. buyers (in case of manufacturer's default)
- **Manufacturers** require warranty insurance for
  i. risk management, and
  ii. sales & marketing support
- **Buyers** require warranty-insured PV modules for
  i. risk management, and
  ii. fulfilling requirements of regulators, lenders, and tenders



PV warranty insurance has become a standard in the industry, but **must be requested in the procurement process**

Rapid evolution and adaption of PV technologies poses significant long-term risk for warranty insurance

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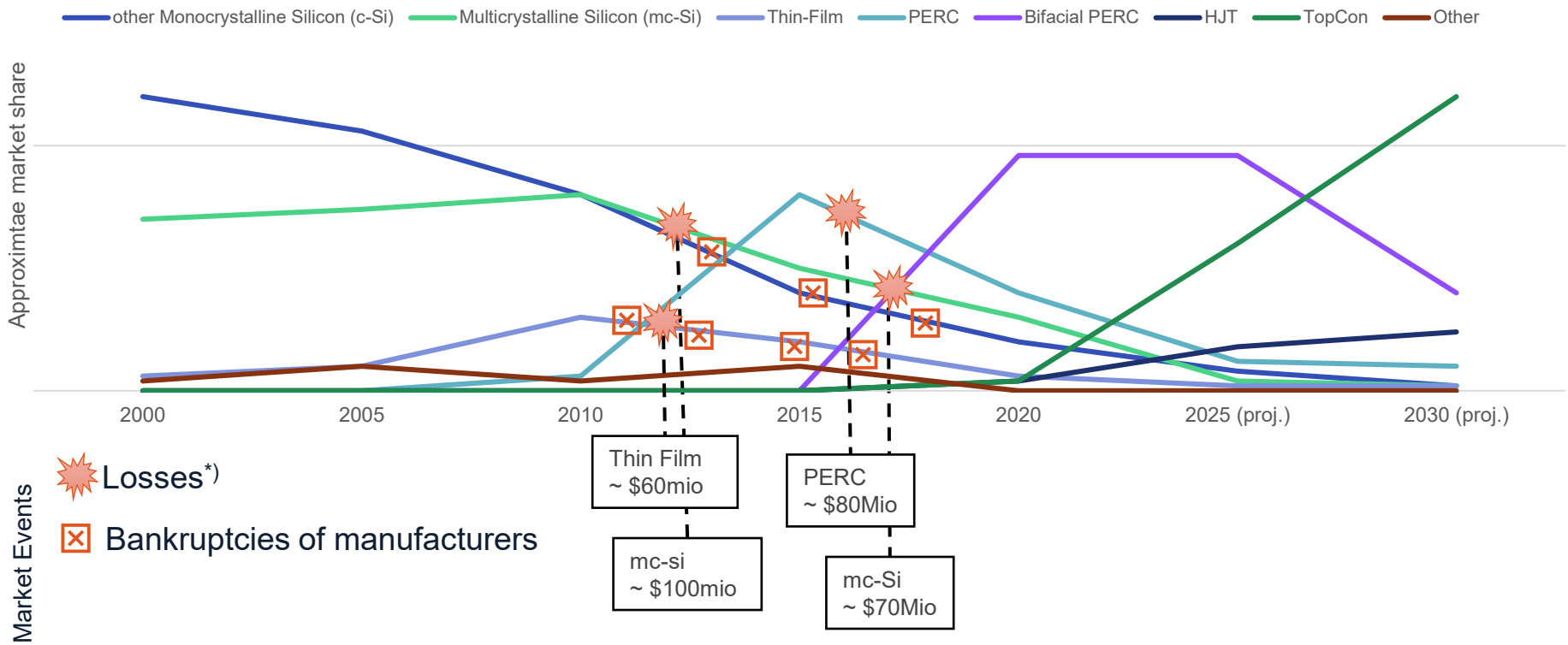


*) based on reported warranty provisions by manufacturers

Technology risk: covered by PV Warranty Insurance

Munich RE

Munich Re's PV warranty insurance covers "PV technology risk" and thus all inherent failure and degradation modes, such as UVID, PID (potential induced degradation), LeTID (light and elevated temperature induced degradation), spontaneous glass breakage, and others.

Our challenge: De-risking a vast, global portfolio consisting of countless different product types

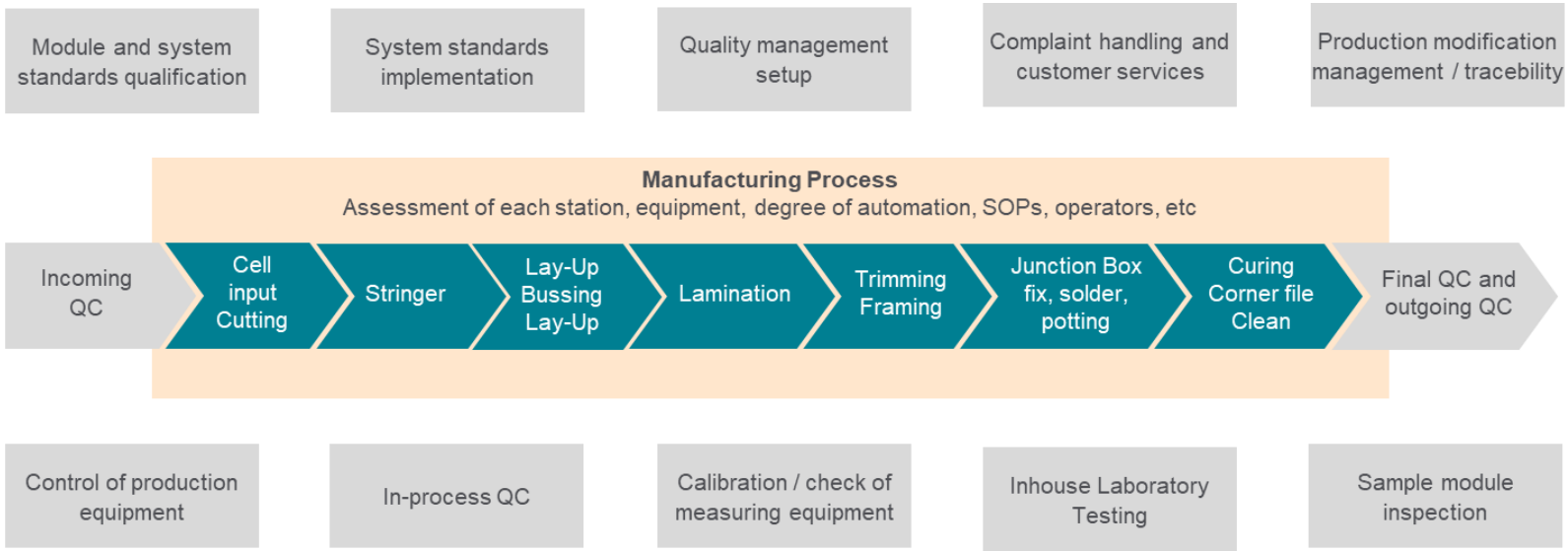
- we cannot inspect each individual batch or project, so how can we de-risk our portfolio?
- should we just insure all standard PV modules? Are PV modules now a standardised commodity product? Our answer is "no…"

Goal of Munich Re's factory inspections

- addition to reliability tests such IEC 61215 and 3x IEC
- assess ability of a PV module maker to consistently produce high-quality with low deviation
- vast majority of cell-to-module factories use similar process: reveal differences between very similar factories
- identify and sort out sub-standard factories

The Munich Re factory inspection scoring system

Munich RE



- Detailed scoring system developed and implemented in cooperation with Sinovoltaics
- Overall score is based on 13 weighted categories, with numerous sub-scores
- Detailed criteria is published in a paper downloadable from the web

SINO VOLTAICS

How has our risk assessment changed taking into account UVID for TOPCon?

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Adaptation of Extended IEC tests criteria

Third party 'extended IEC 61215' on most common BoM, and if TOPCon is insured, then it must be on TOPCon modules including at least:

- DH3000, and
- HF30, and
- TC600, and
- UVID (UV induced degradation) under an
  - UV irradiation of 130 - 200 W/m2,
  - with a spectrum of UVC <1%, UVB 3-6.5% (up to 10%), UV>30%,
  - a dose of at least 60 kWh/m2
  - under a temperature of 60+/-5 C
  - under open-circuit
  - on the front side of the module
  - before performance measurement: post light soak under 300-1000 W/m2 of 1000 Wh/m2 and dark storage < 4h

+

Inspections of cell production

Inspections of solar cell production lines – in addition to the already rigorous module factory inspections together with ISC Konstanz. This cell-level diligence accounts for the large collection of commercial, mass-produced cell technologies currently in the market with its numerous variations even within one category.

ISC

Summary

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- Thanks to close links to research community and early warnings from R&D partners, Munich Re was able to react quickly.
- In mid 2024, we tightened our Underwriting and due diligence process and introduced a mandatory UV60 test for all PV Warranty Partners.
- We have started to strictly monitor our TOPCon exposure.
- This additional requirement is seen positively by project owners, banks and investors and adds a quality seal to insured modules.
- By enforcing stricter standards, Munich Re not only protects its own portfolio but also drives improvements in reliability and quality across the PV industry.

Thank you for your attention

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