RISKS EMBEDDED IN THE CURRENT QUALITY ASSURANCE SCHEME IN THE PV INDUSTRY

Ralph Gottschalg, Bengt Jäckel

Fraunhofer Center for Silicon Photovoltaics CSP

Halle (Saale), Germany

OUTLOOK

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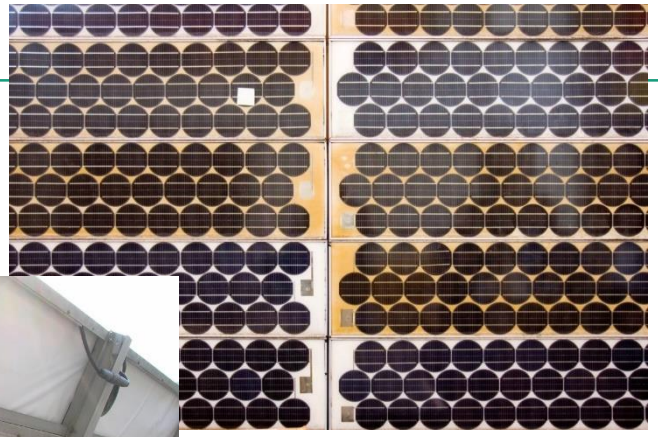
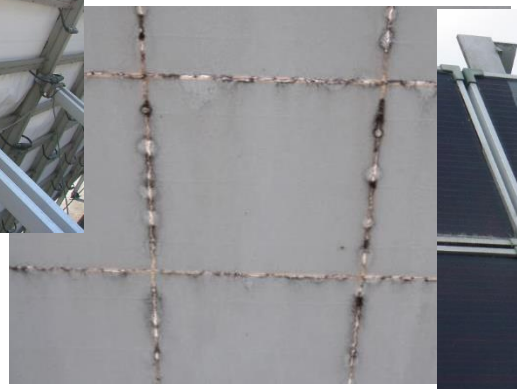
- What do standards actually mean?
- Towards a quality control -> learning from PA problems
- Summary

MOTIVATION

REPORTS OF POLYMER FAILURES

- ‘Snail Trails’
- Browning/ Yellowing
- Delamination
- Chalking
- Cracking
- There are reports of up to 30% of modules showing polymer issues (no key given, I would suspect mostly visual – still a scary number)





WHY DO WE SEE SO MANY POLYMER ISSUES?

- They are not semi-conductors, no active element, no p-n junction
- A fundamental misunderstanding of what standards mean
  - Type approval is seen as assurance that the ‘the product is good’
  - No understanding that different mission profiles mean different failures
- Lack of life-time relevant testing (under development → Nancy Phillips, Michael Owen-Bellini talks)
- Lack of quality assurance.

WHAT DO STANDARDS ACTUALLY MEAN?

MEANING OF TYPE APPROVAL STANDARDS

- Before sounding overly negative: type approval (e.g. IEC 61215) has been hugely successful of eradicating major failure mechanisms
- It is a design verification test
- It verifies that the design has the potential to achieve a certain lifetime for a given mission profile (stress condition)

WHAT IS WRONG WITH USING TYPE APPROVAL FOR QA?

- It is not universal – different locations show different behaviour
- It is not particularly harsh – so it is NOT a worst case
- It does not even stress-test UV – but that is a known failure mode

- It is NOT a lifetime test, it has NOTHING to say about a failure statistic or durability
  - It certainly does NOT warranty 100% failure-free
  - A 30% failure rate is deemed acceptable

→ Certification tests for the possibility of 2/3 of PV modules surviving for 25 years in a moderate climate (as long as no unknown failure mechanisms come into play)

- **Maybe most problematic: The aim of the test is not to proof that a product is reliable???**

WHY ARE WE TESTING?

THE ZYNIC'S POINT OF VIEW

Thesis

We do not test for reliability.
We test to make products bankable and bring them to the market quickly .

Justification

- Each time there is a massive outcry (on the committee) when we talk about extended test times
  - PV industry tests 1000h to proof 20 years lifetime (acceleration factor ~175)
  - Car industry accepts acceleration factors for paint systems of 10 (to avoid embarrassments)
- The cost of a test is more important than the robustness of the result. Examples:
  - PID testing
  - The AAA-disaster (lacking UV test)

TOWARDS A QUALITY CONTROL
-> LEARNING FROM PA PROBLEMS

WHAT IS THE PA DISASTER?

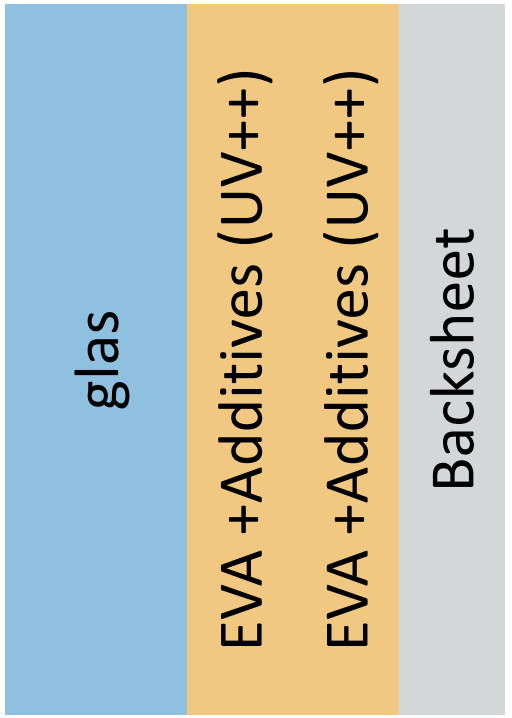
- There is a 100% failure rate of the back-sheet
  → inside-out cracking
  → outside-in cracking

- To everybodies ‘surprise’ UV eventually reaches the interface EVA-Backsheet and starts ‘eating’ the backsheet

→ Failure of the design qualification (i.e. certification)

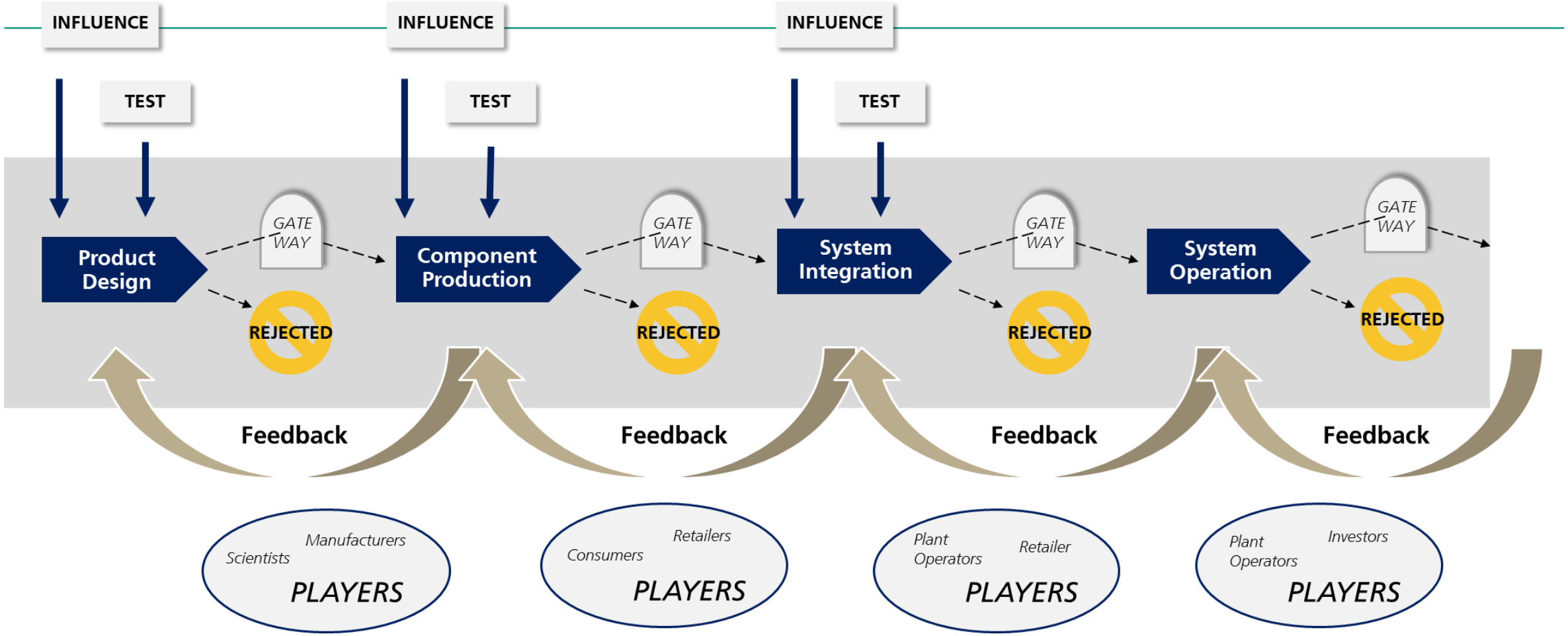
- Failure happens at different time scales for different BOMs (again not really a surprise)

→ Lack of meaningful quality control



Leaving out active circuit

WHAT WOULD BE A NORMAL QUALITY CONTROL?

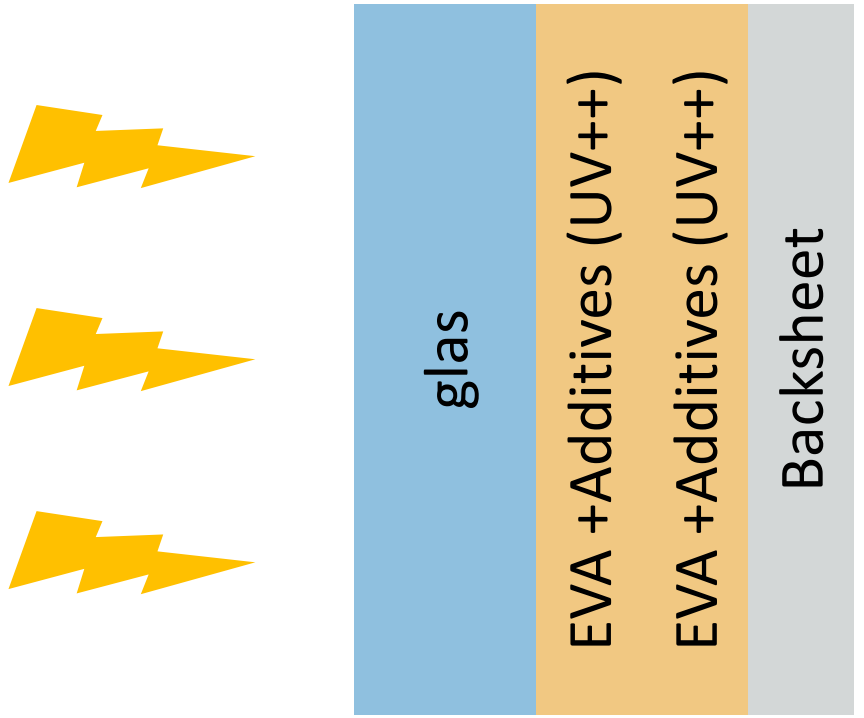


WHAT ROLE DID STANDARDS PLAY IN THE PA DISASTER?

- Modules passed certification, even multiple times
- It was not picked up because there is no UV-stress test
  - UV absorption is sacrificial (additive works once)
  - Eventually UV will reach inner BS
- There is no UV test because it costs €€€
- Impact in Germany 2-4 GWp of PV will not make it

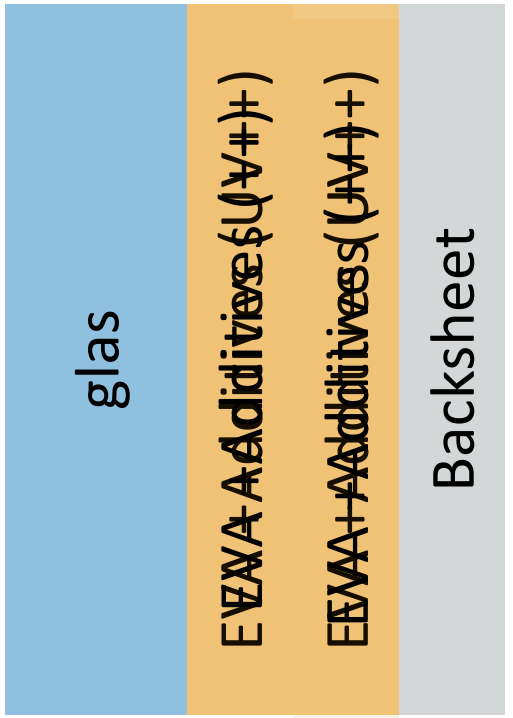
→ Module manufacturer saved <1M€

→ End customer has damages >1bn€

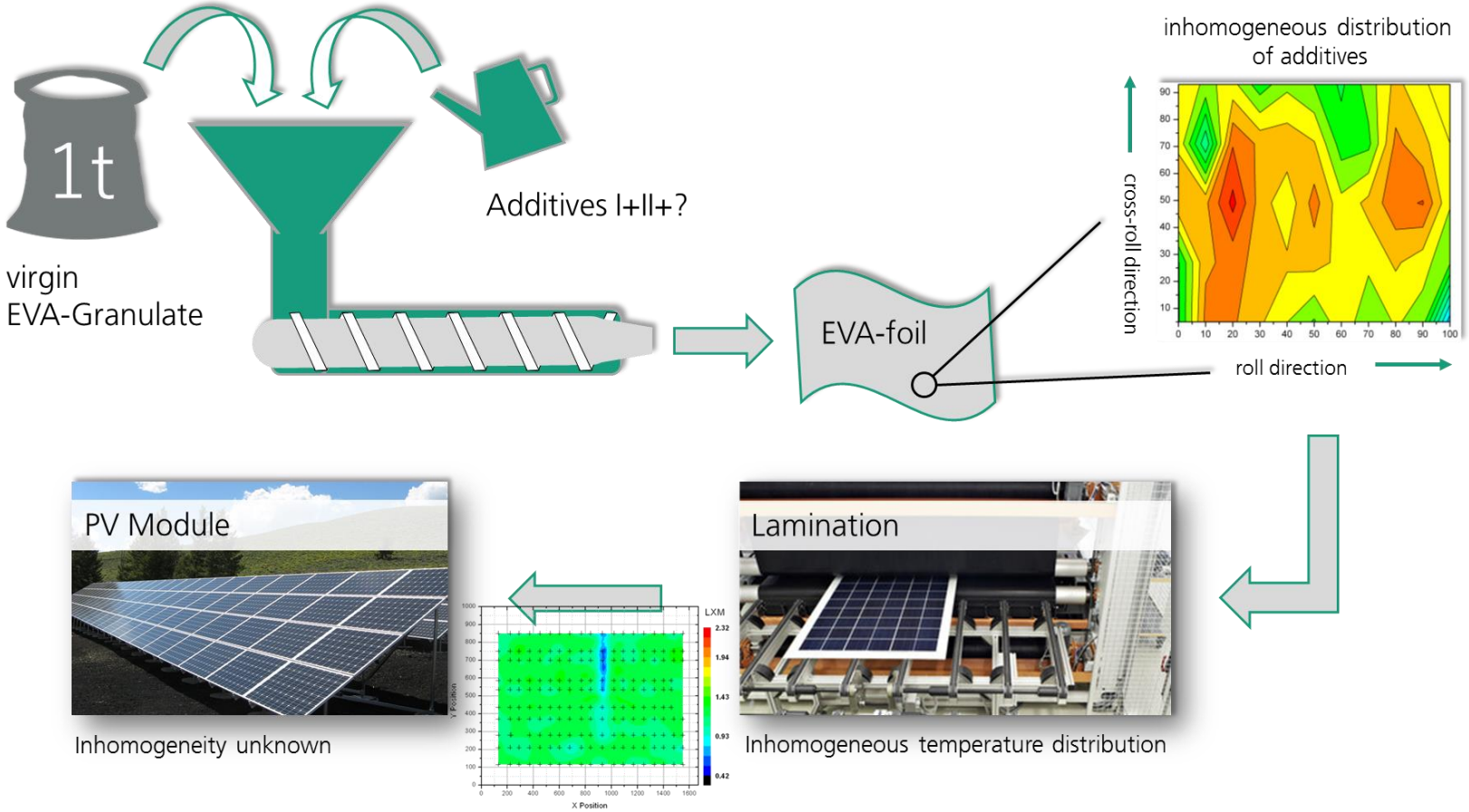


POSSIBLE EXPLANATION OF WHY IS THERE A DIFFERENCE IN TIME-SCALE IN CRACKS SHOWING IN PA FOILS?

- Best case: module is being built with ‘normal’ configuration
- Not having UV absorber in the front EVA improves power
  (but increasing UV absorber in other sheet costs money)
- Not having UV absorber in the front foil made life cheaper
  → why not leave it out altogether?
- Manufacturer saves, costumer pays



WHY WE NEED QUALITY CONTROL



SUMMARY

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- Standards have been a most successful certification test
- Certification has nothing to do with reliability
- Root cause of certification not picking up PA problems was inappropriate cost savings
- Timing variability may be down to cost savings.

If we want to increase reliability

→ the biggest bang for the buck would be verifying manufacturing consistency

→ Combined cycles are really not that expensive in comparison to the damage they may cause.