
FRAUNHOFER INSTITUTE FOR SOLAR ENERGY SYSTEMS ISE

PVT – Challenges for and by Certification for a well organized market penetration



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Status Quo & Challenges in the context of market entrance

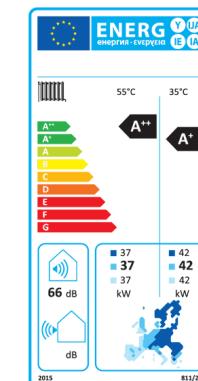
09th Oct. 2019, Lyngby
28th Oct. 2019, Toronto

www.collectortest.com
www.ise.fraunhofer.de

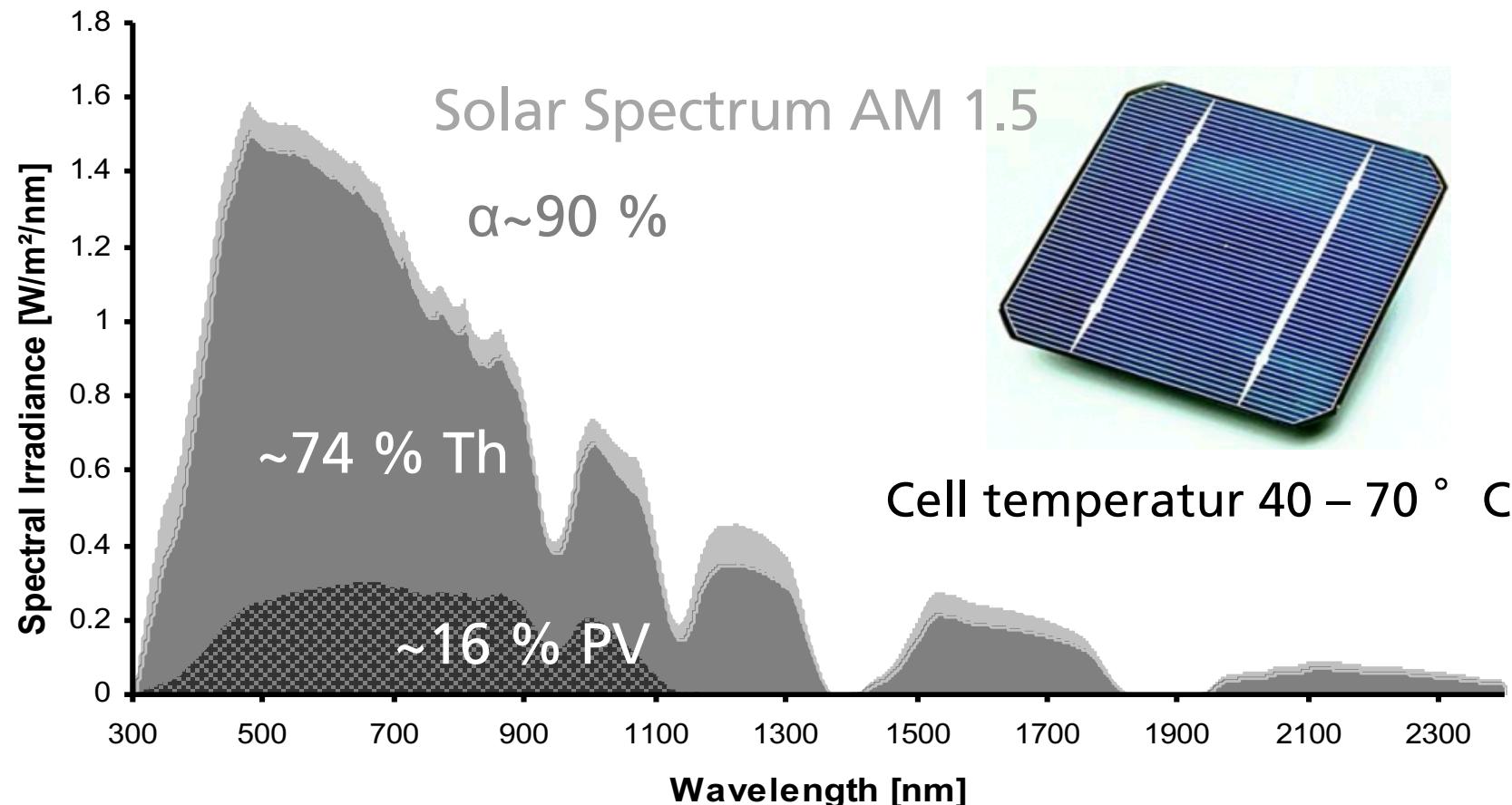


Innovation System and Quality Assurance

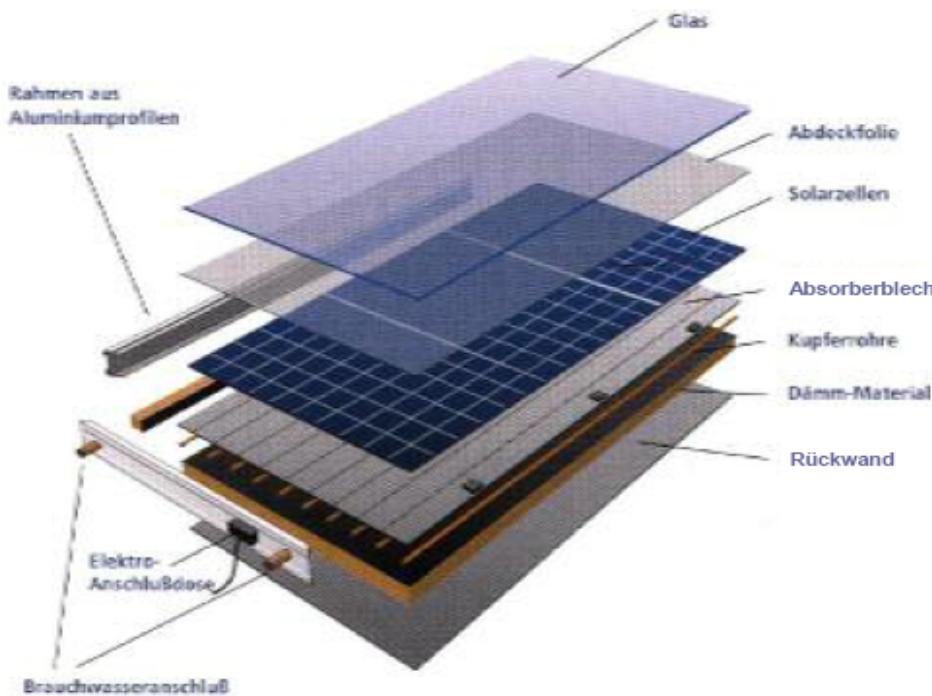
- **Multiple stakeholders** are involved in the **innovation system** for a technology like PVT, solar water heating or heat pumps
- A **structured exchange of information** and a **sound strategy** of interacting promotors is crucial for a **sustainable market development**
- **Quality assurance** plays a major role in this context, as it provides structure and rules to orientate and allows for politics to steer the **market development, but** bears the **risk of lock-in effects** as well



Motivation for Application of & Research on PVT



Photovoltaic Thermal Collectors (PVT)



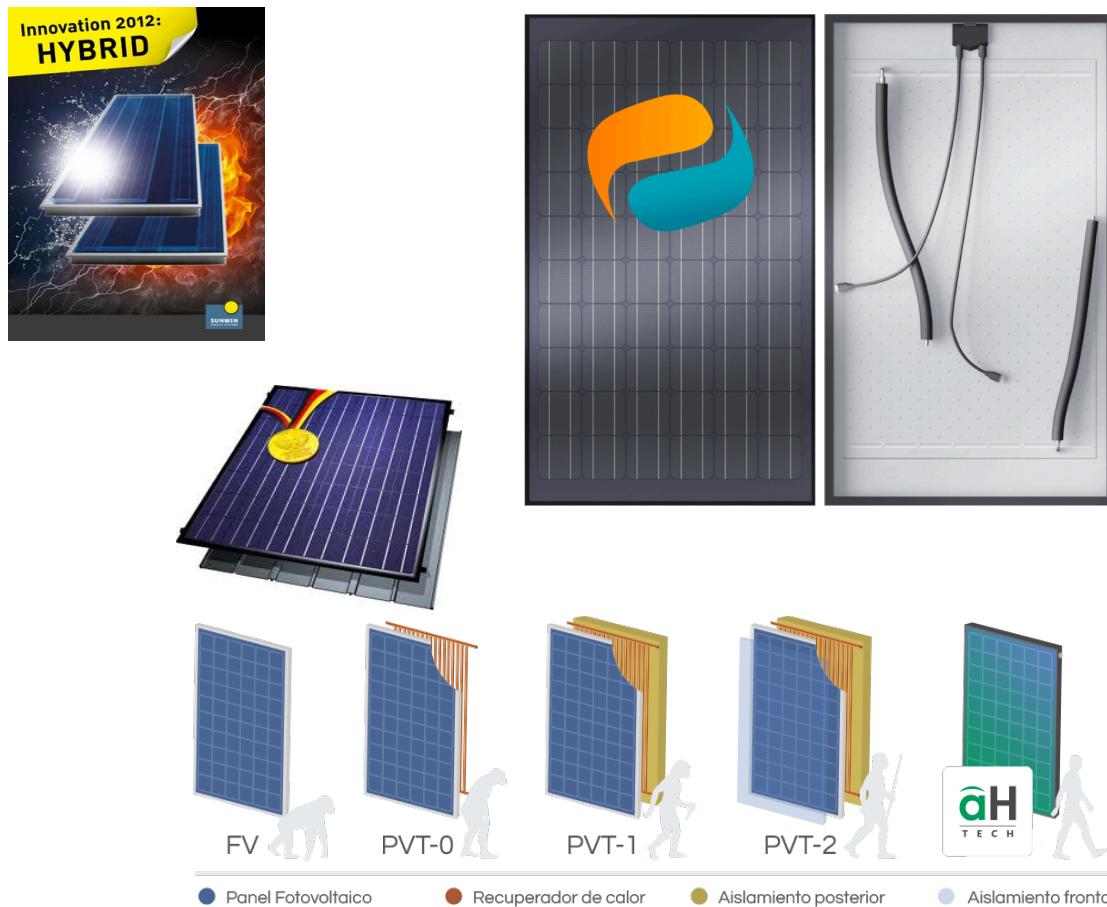
■ Aims

- Waste heat of solar cells is used in a thermal system (high overall efficiency)
- Cost reduction compared to separate systems (increased solar utilisation factor = reduced € per kWh)

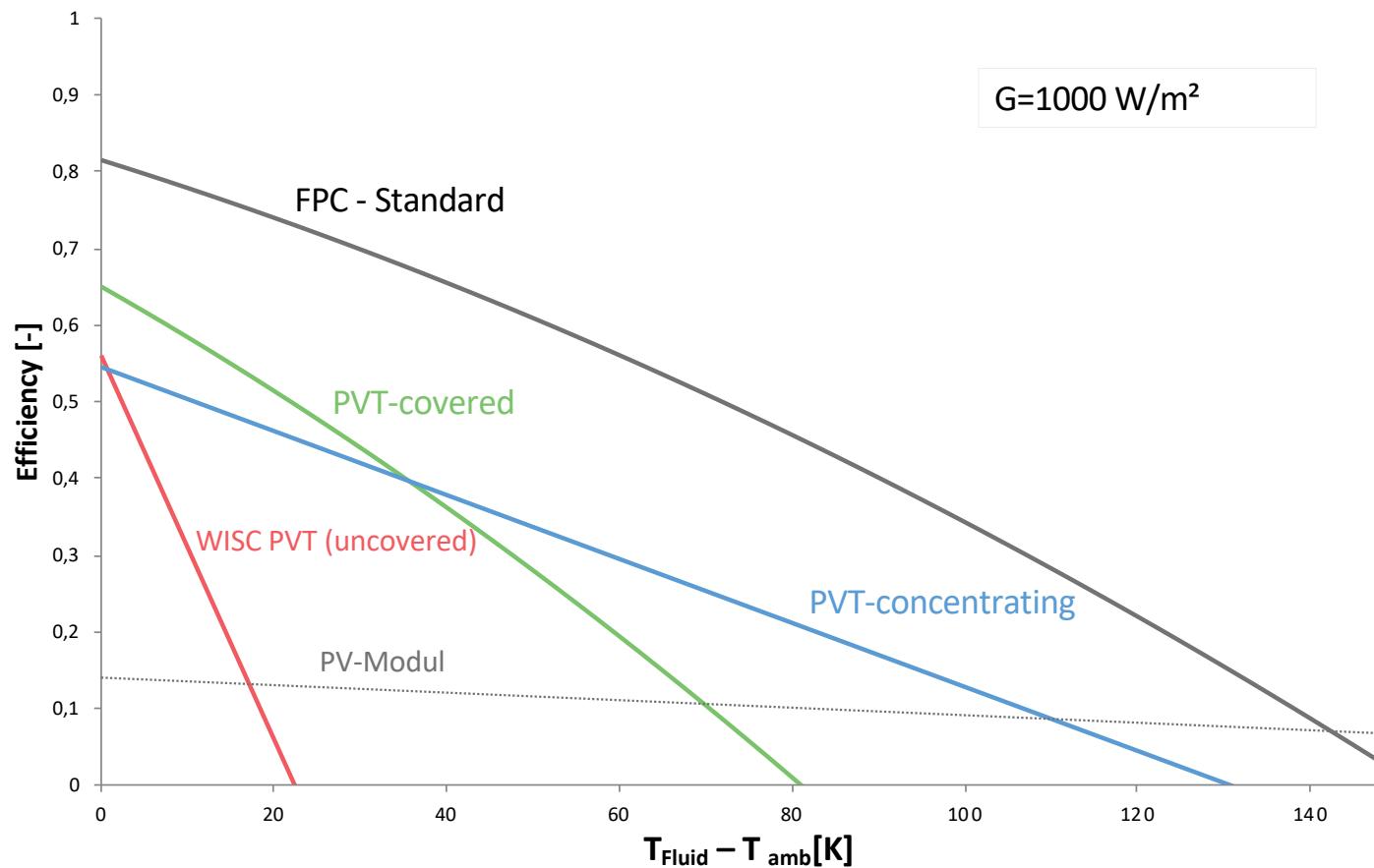
■ Questions

- Thermal system efficiency in application
- Durability of components in application
- Complexity including sales process

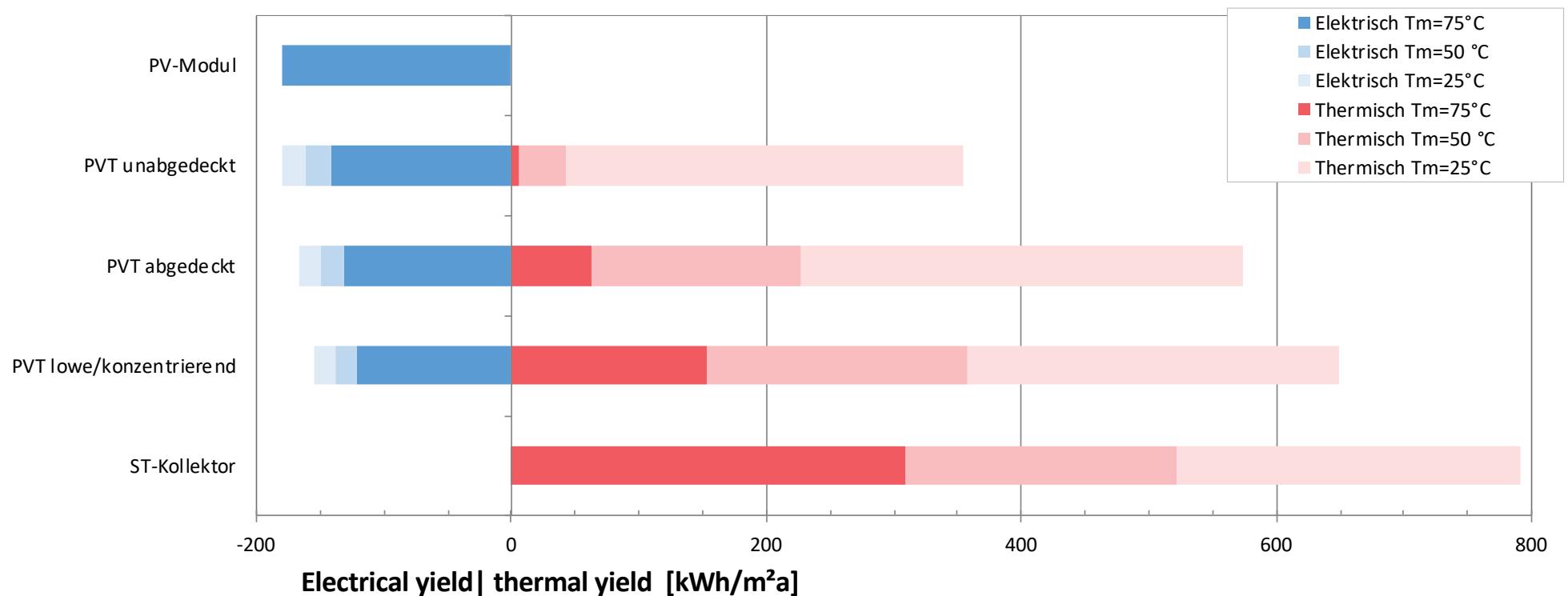
PVT Collectors – Technologie Review



Example Efficiency Curves to Orientate

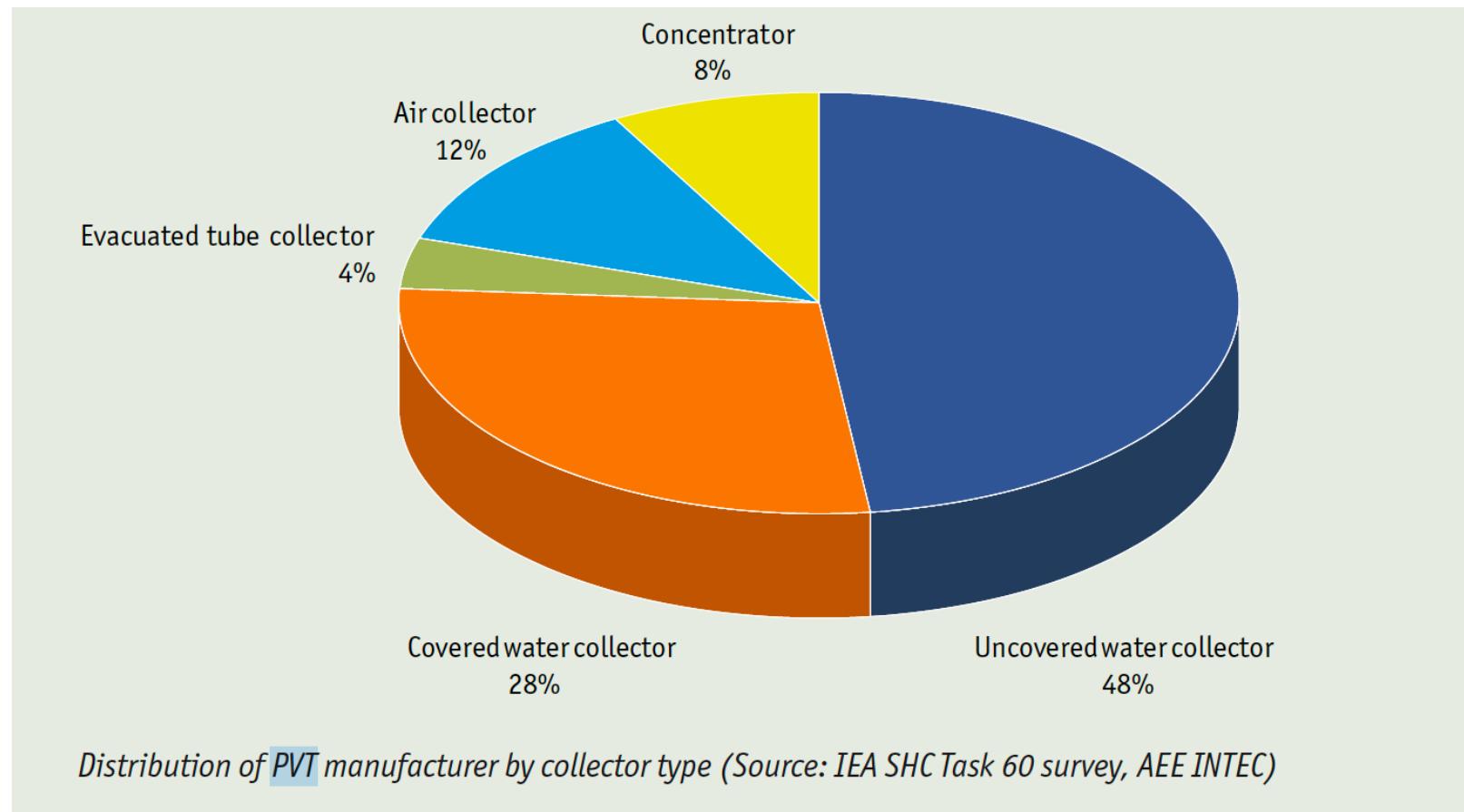


PVT- Yield Calculation



→ Strong influence of the absolut operating temperature level on the yield,
more on the thermal application than on the electrical yield

PVT Collectors – Market Development



PVT Collectors – Market Development

Country	Water Collectors [m ²]			Air Collectors [m ²]	Concentrators [m ²]	TOTAL [m ²]
	unglazed	glazed	evacuated tube			
Australia	0	0	0	8	0	8
Austria	300	573	0	0	0	873
Belgium	524	0	0	290	15	829
Chile	0	0	0	0	10	10
China	133,721	25	0	0	171	133,916
Denmark	73	0	0	0	0	73
Egypt	0	0	0	0	21	21
France	9,204	0	0	433,300	0	442,504
Germany	107,927	1,232	0	87	135	109,380
India	0	4	0	0	240	244
Israel	53,488	0	0	0	0	53,488
Italy	9,038	6,400	0	0	0	15,438
Korea	280,814	0	0	0	0	280,814
Luxembourg	635	0	0	145	0	780
Maldives	0	0	0	0	21	21
Netherlands	5,588	7,579	0	0	1,773	14,940
Norway	200	0	0	0	0	200
Pakistan	0	4	0	0	0	4
Paraguay	0	0	0	0	51	51
South Africa	0	0	0	0	750	750
Spain	0	3,334	0	0	0	3,334
Sri Lanka	0	0	0	0	31	31
Switzerland	6,846	0	0	2,030	0	8,876
United Kingdom	15	0	38	348	0	400
United States	4,800	0	0	0	0	4,800
Others	162	3,300	0	0	0	3,462
TOTAL	613,334	22,449	38	436,208	3,218	1,075,247

Total installed PVT collector area worldwide. (Source: IEA SHC Task 60 survey, AEE INTEC)

PVT Collectors – Certification for Market Entrance

Legal aspects (Europe):

■ PV module (and PVT)

- Low voltage directive for PV arrays with U-DC > 75V
- Confirmation (Declaration of conformity) of fulfilling requirements of EN IEC 61730
- Full PV EN IEC 61730-1/-2 test
- Additional possible tests due to modification to PVT
- This confirmation does not cover performance issues!

■ Solar Collector

- Currently „pressure equipment directive“ for collectors above specific Volume/Pressure ratio
- In the future also „construction product directive“
- Machinery directive for concentrating and or tracked systems

PVT Collectors – Certification for Market Entrance

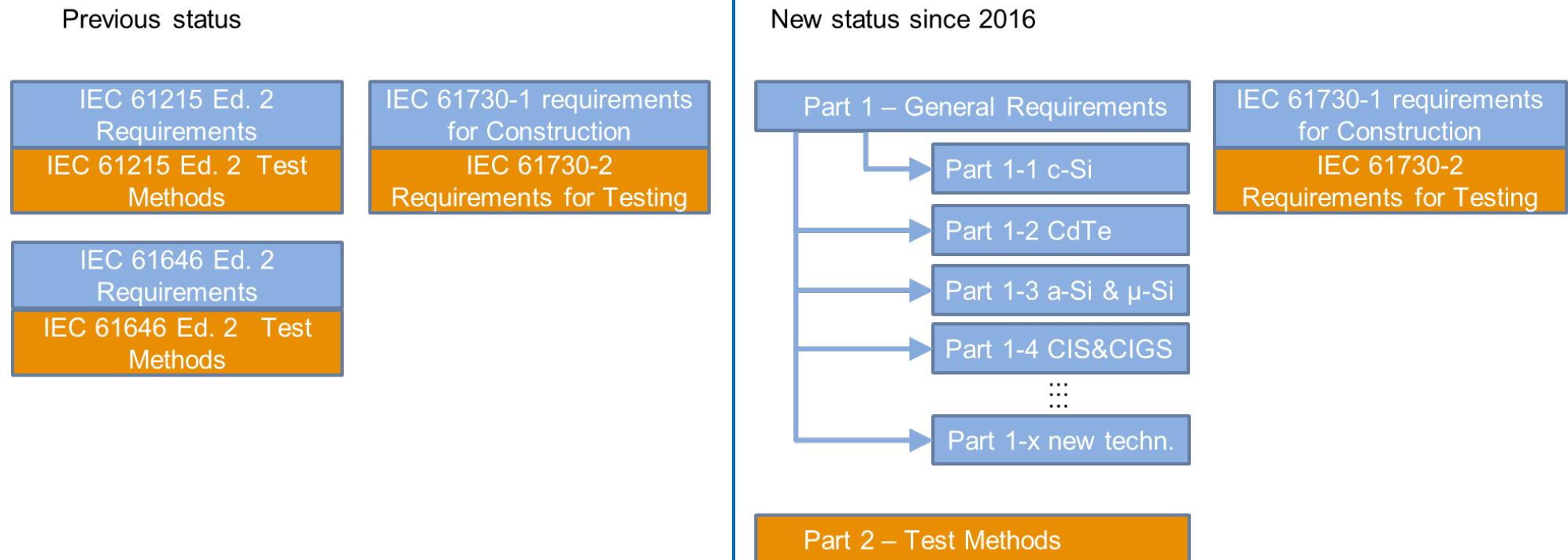
...

- according to product liability act, the distributor (PVT assembler) is responsible for the product
- initial IEC 61215 certification is not valid for modified product (like PVT)
- the product and performance warranty given by the PV manufacturer expires
- **On full responsibility and risk of the PVT manufacturer!**

Voluntary but necessary Information:

- PV module (as well as total PVT's) according to IEC 61215/ 61730
- PVT's and it's thermal behavior according to Solar KeymarkScheme Rules (for Europe, SRCC for the USA or water mark for Australia)
- Regular factory inspections in PV and PVT factory side
- Valid for the tested combination of materials (PV module family)
- Safety and performance issues covered!

Structure of the PV standards



Drawing by TÜV Rheinland

PVT Collectors – Certification for Market Entrance

Voluntary certification according to IEC 61215/ IEC 61730 on the full PVT is foreseen, but..

- the certification will be valid for the tested product (family) only
- there has to be a clear agreement with the PV manufacturer about
 - Information if the construction (laid down in a CDF Constructional data form) will be changed
 - Information about regular performed factory inspections
 - Warranty issues related to product and performance
 - General changes in the initial certificate

Certification of the total PVT could be successful only, if there's a strong relation between PV and PVT manufacturer.

A change of the PV supplier will result in new tests and certification!

PVT Collectors – Certification for Market Entrance

■ IEC TS 62915:

- Supersedes the former retesting guideline
- All conventional changes for pure c-Si and TF PV modules are covered
- Changes from PV to PVT not explicitly covered!
- Need for amendments for PVT's
- Until then:

It provides assistance; at some level engineering judgement may be needed.



IEC TS 62915:2018

Photovoltaic (PV) modules - Type approval, design and safety qualification - Retesting

TC 82 | [Additional information](#)

Abstract

[PREVIEW](#)

IEC TS 62915:2018(E) sets forth a uniform approach to maintain type approval, design and safety qualification of terrestrial PV modules that have undergone, or will undergo modification from their originally assessed design. Changes in material selection, components and manufacturing process can impact electrical performance, reliability and safety of the modified product. This document lists typical modifications and the resulting requirements for retesting based on the different test standards. This document is closely related to the IEC 61215 and IEC 61730 series of standards.

What's in there?

■ 4.2.5 Modification to backsheet

For the following modifications:

- Different material, i.e. any change in specification of the material or any of its layers
- Different surface treatments (inside or outside)
- Change of amount of adhesives, primers or other additives
- **Addition** or removal of **adhesives**, primers or additives

Repeat for IEC 61730:

- Insulation thickness test (MST 04)
- Cut susceptibility test (MST 12)
- Impulse voltage test (MST 14)
- Temperature test (MST 21)
- Ignitability test (MST 24)
- Module breakage test (MST 32)
- Materials creep test (MST 37)

15

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■ 4.2.10 Modification to frame and/or mounting structure

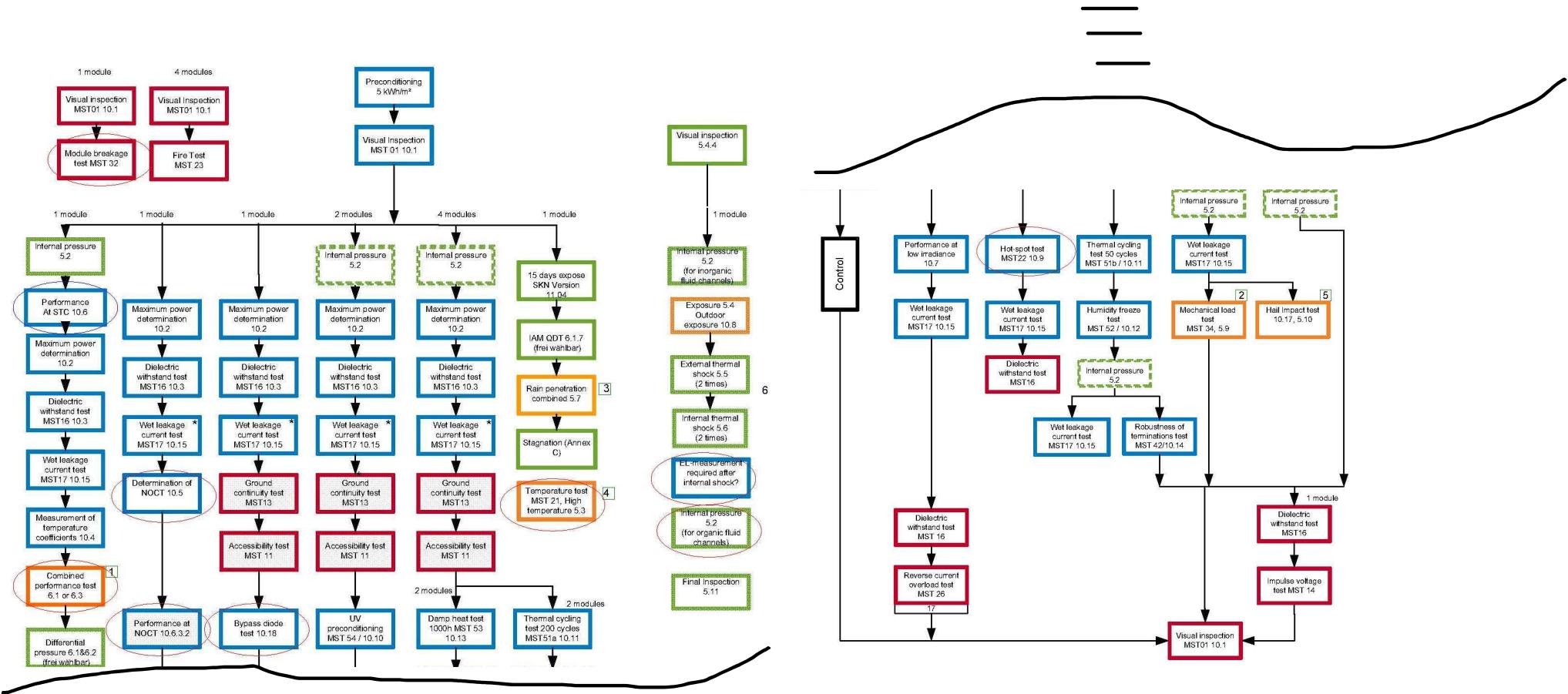
For the following modifications:

- Shape and/or cross-section of frame (no)
- Different material including adhesive or mounting material (yes)
- Different mounting method (as defined in installation manual) (maybe)

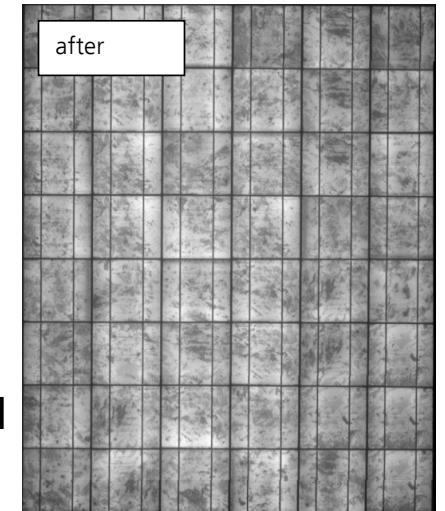
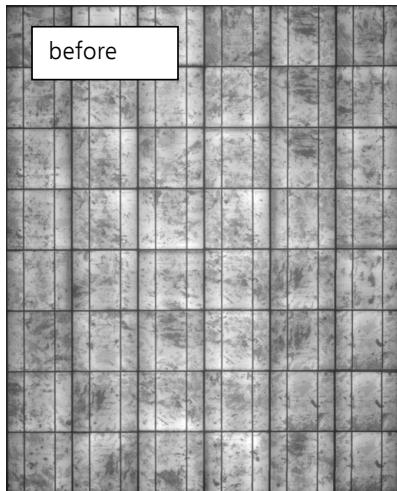
Repeat for IEC 61730:

- Continuity test of equipotential bonding (MST 13) if change in method of assembly (can be omitted if change in adhesive)
- Ignitability test (MST 24) for polymeric frames
- Module breakage test (MST 32)
- Screw connections test (MST 33) if applicable
- Mechanical load test is covered by IEC 61215 retests!

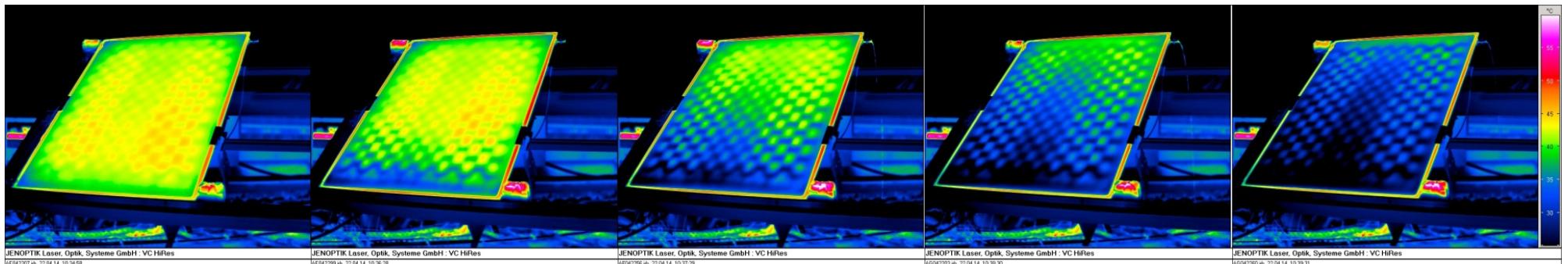
Overlap is quite sorted out, when working with professional labs



Specific Test on Function



Electro-luminescence
photography, before and
after a thermal shock



Thermographic Picture of an interal thermal schock test

PVT Collectors – Things to work on ST

ST Side:

- SolarKeymark:
 - ISO 9806:2018 covers PVT ST
 - Revision of former Annex J Solar Keymark Scheme Rules about PVT certification, vote on 23rd October
 - Temperature levels and ErP eta in ScenoCalc not suitable for HP Source
- SRCC Standard 100
 - Revision on-going, WG open for engagement (Contact: Martin Shawn)
- SolErgy Label not adopted in Temperature class for HP+PVT



PVT Collectors – Things to work on PV

PV side:

- Definition of minimum IEC requirements for SK certification, invited WG 2 TC 82 Meeting Stratin 27th October (contact me)
 - Substitution of PV modules possible (e.g. new supplier, higher performance, color)
 - Certify a whole range of products
 - Assembly on side, possible
- Amendments for common PVT design changes in IEC TS 62915

- Separate part within IEC 61215 (...Part 1-5 PVT)
- What about 150°C, concentrating PVT?
- Differentiation between full certification and (as basic procedure) a certificate of conformity only according to IEC 61730
- Retesting guides for already certified PV modules used in PVT assemblies for glass-glass and glass-foil modules
- Retesting guides for exchange of PV modules within already tested PVT assemblies (G-G and G-F)

YOU want a solution? Be part of it!

- New Marketing Initiative: integraTE!
 - See extra slide show. (contact me)
- New WG of ESTIF for PVT (contact; Pedro Dias)
 - First meeting online: 21st october 14:00
 - Second meeting 28th or 29th November 2019 together with ESTIF/SHE GA, Brüssels
- Come to the meeting of your national Standardisation Group or to the next CEN TC 312 meeting.
- Come to the next SKN meeting (as obserber, invitation needed-contact me)
- Join the Task 60 meetings!



PVThank you for your attention!

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- Cp. : Kramer, K., Helmers, H., The interaction of standards and innovation: Hybrid photovoltaic–thermal collectors, Solar Energy 98 (2013) 434–439, <http://dx.doi.org/10.1016/j.solener.2013.08.042>
- IEC 61215 (all parts), *Terrestrial photovoltaic (PV) modules –Design qualification and type approval*
- IEC 61215-1:2016, *Terrestrial photovoltaic (PV) modules –Design qualification and type approval –Part 1: Test requirements*
- IEC 61215-2:2016, *Terrestrial photovoltaic (PV) modules –Design qualification and type approval –Part 2: Test procedures*
- IEC 62108:2016 *Concentrator photovoltaic (CPV) modules & assemblies –Design qualification and type approval*
- IEC 62688:2017 *Concentrator photovoltaic (CPV) module and assembly safety qualification*
- IEC 61730 (all parts), *Photovoltaic (PV) module safety qualification*
- IEC 61730-1:2016, *Photovoltaic (PV) module safety qualification –Part 1: Requirements for construction*
- IEC 61730-2:2016, *Photovoltaic (PV) module safety qualification –Part 2: Requirements for testing*
- IEC TS 62915:2018, *Photovoltaic (PV) modules –Type approval, design and safety qualification –Retesting*
- ISO 9806:2018, *Solar Thermal Collectors*

