Reliability for New Applications

IEA PVPS Task 13 workshop, September 26, 2022

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Task structure

Subtask 1: Reliability of novel PV materials, components and modules

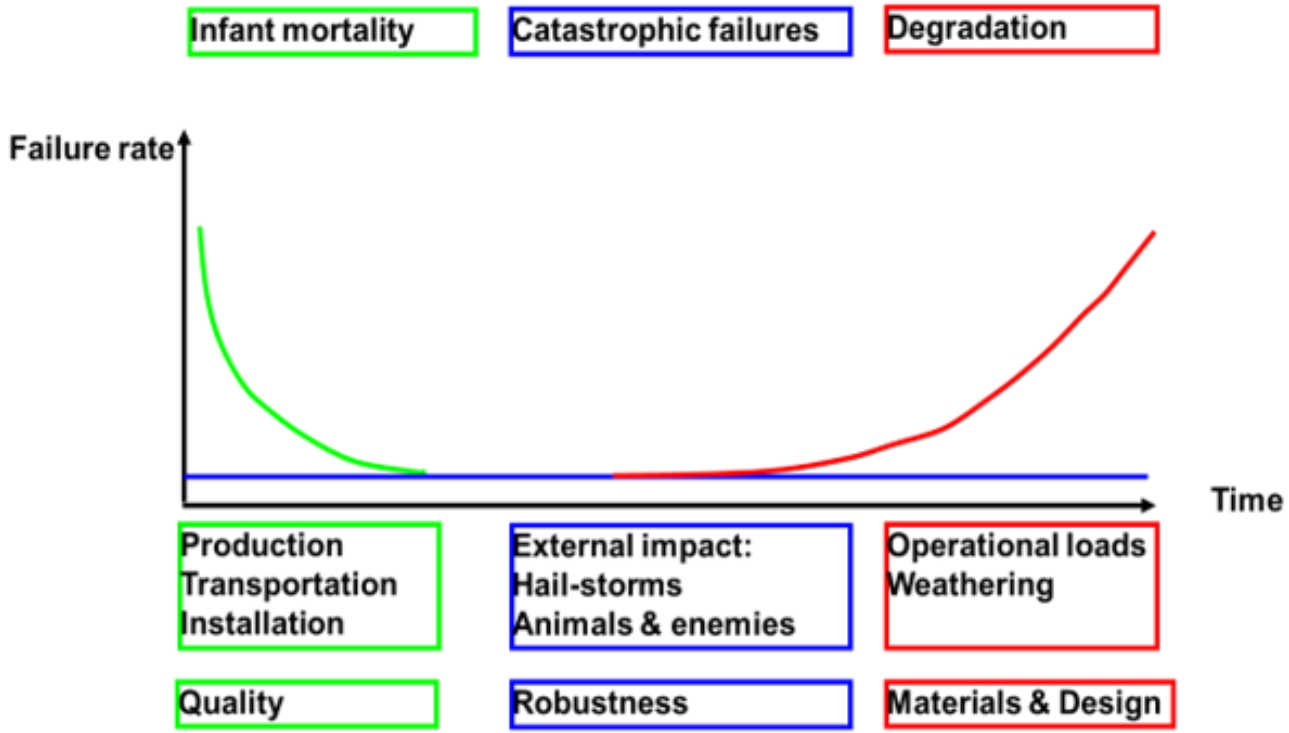
- 1.1: Degradation modes in new PV cell and module technology
- 1.2: Performance and Reliability of Second Life PV
- **1.3: Impact of Testing Strategies including application specific load conditions**
- 1.4: Reliability of PV+Storage

Subtask 2: Performance and durability of PV applications

Subtask 3: Techno-economic key performance indicators

Subtask 4: Dissemination and outreach

Reliability of PV- Modules



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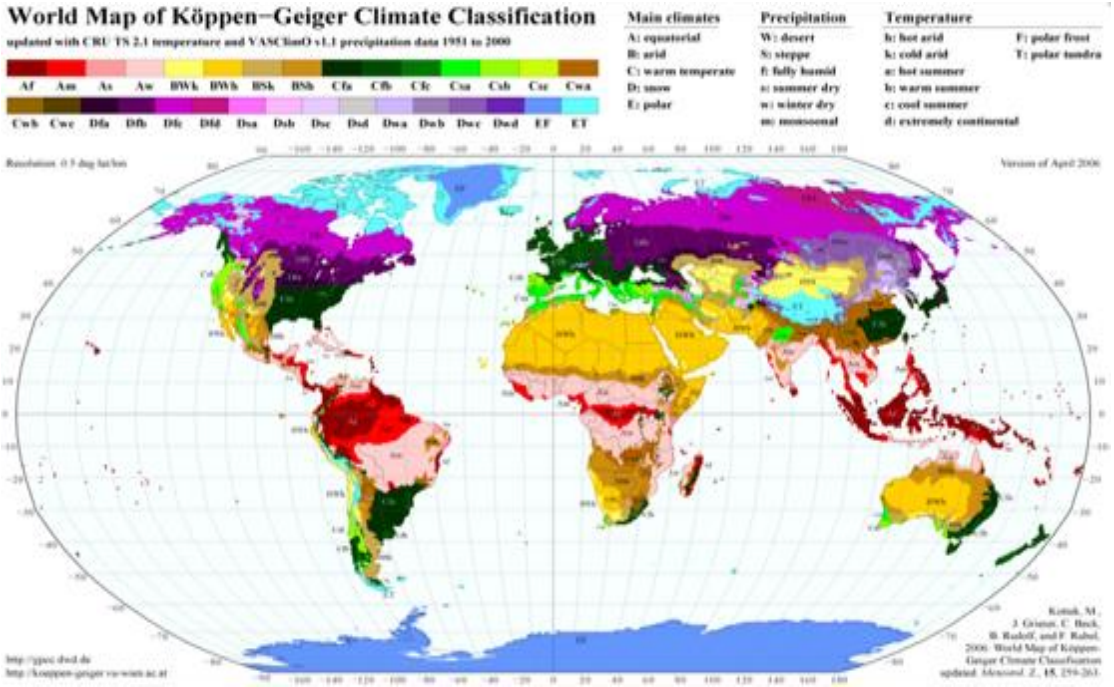
Climate

Stress factors

- Stress factors dependence of geographical position and time
- Material degradation as function of location and time

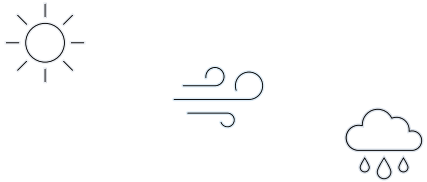
S = f (lat,lon,t)



Climate

Stress factors and effects

- Sun — Irradation
- Humidity — Condensation
- Wind — Mechanic Load
- Others — Dust, Salt, Gas



Location…

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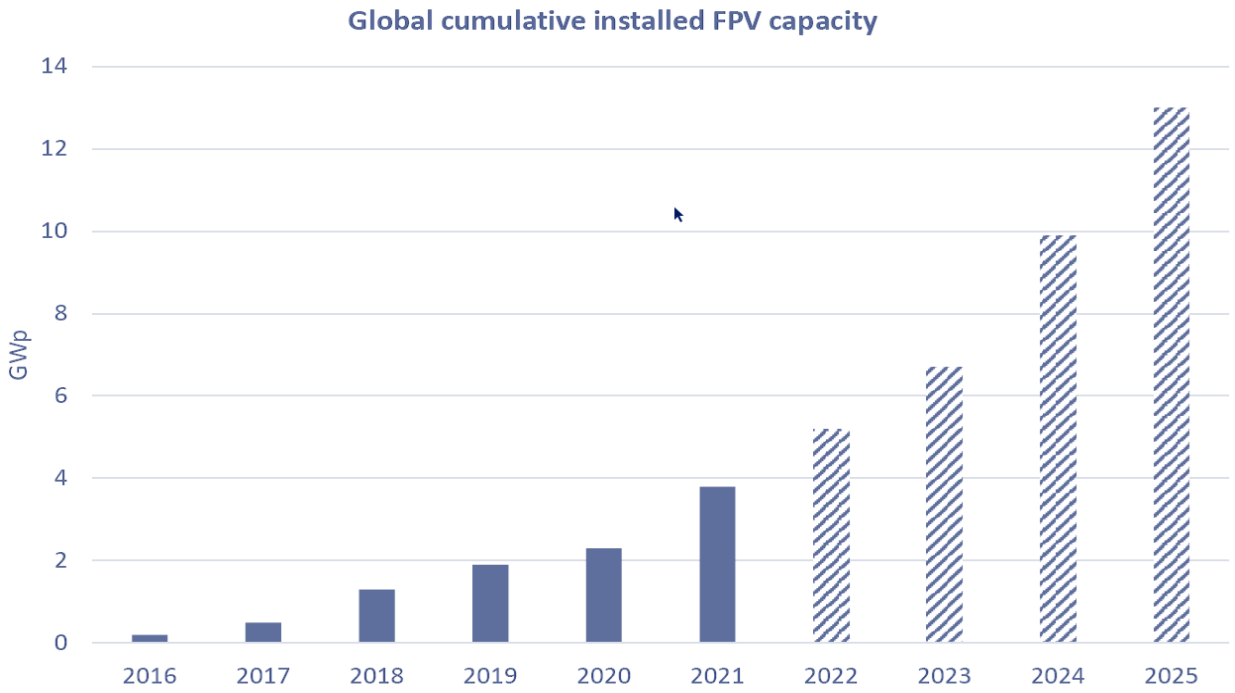
New applications

- Integrated PV BIPV
- Vehicle Integrated PV VIPV
- Floating PV FPV
- …
- All come along with specific operational conditions / requirements
- Methods for qualification are lacking

Market Development

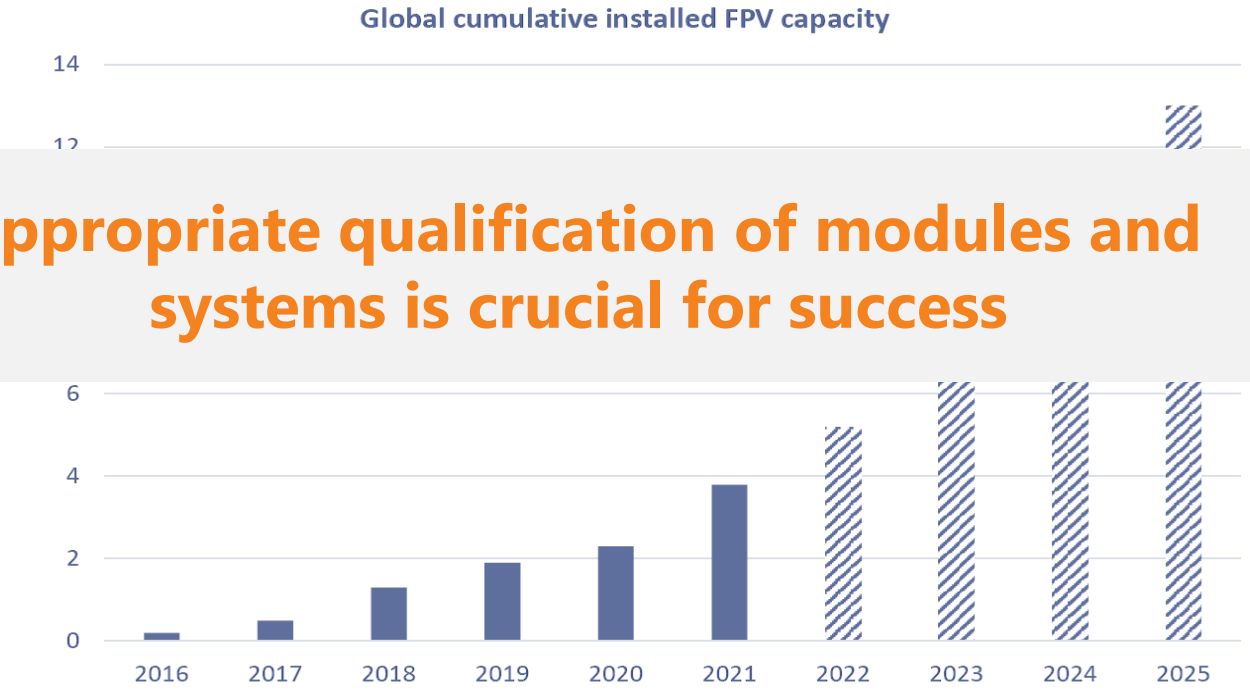
Example: Floating PV



Source: Deloitte

Market Development

Example: Floating PV



Appropriate qualification of modules and systems is crucial for success

Source: Deloitte

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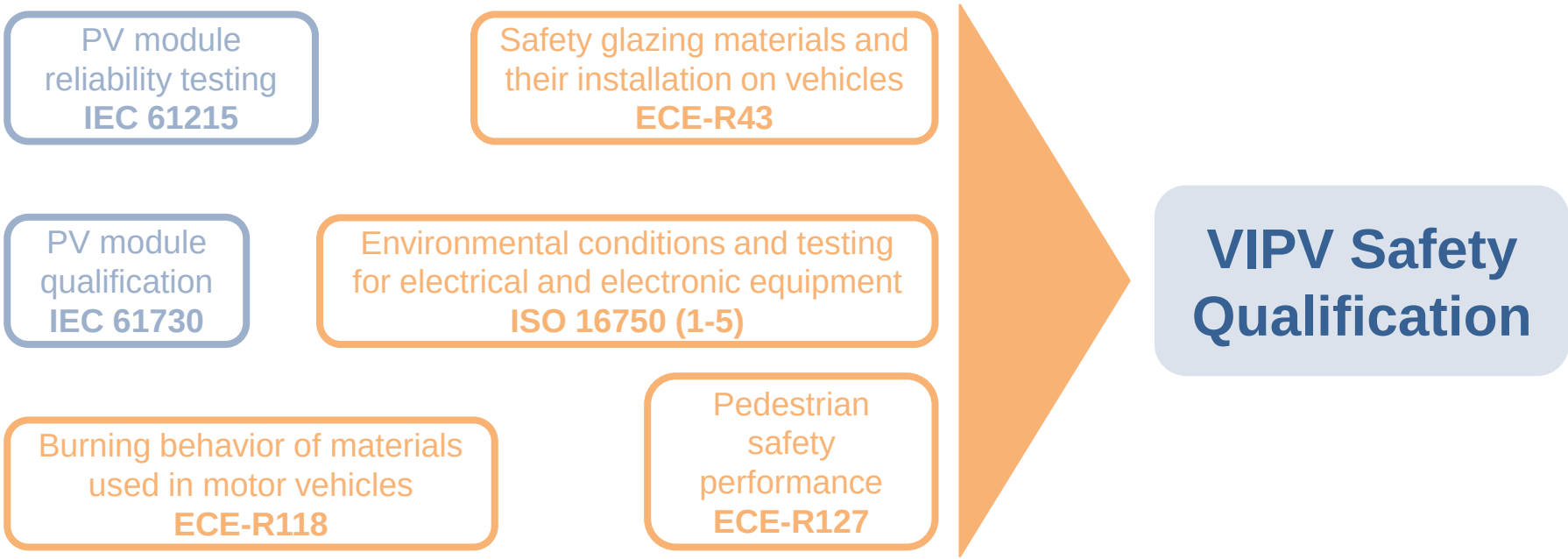
Applicable Standards

Example: VIPV



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Reliability of new applications

- Standards do not address life-time and degradation effects
- Standards have not been developed for the new applications
- Established qualification test do not address specific conditions

development of tests and model necessary

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Relevant environmental conditions

Example: Floating PV

• **Temperature**	lower than open rack
• Level of **humidity**	higher than open rack
• Presence of liquid **water**	not addressed in classical tests
• Presence of **salt**	higher than open rack
• **Mechanical loads** due to flexbile sub structure	not addressed by classical ML
• **Water spray**	??

Service Life and Yield Prediction

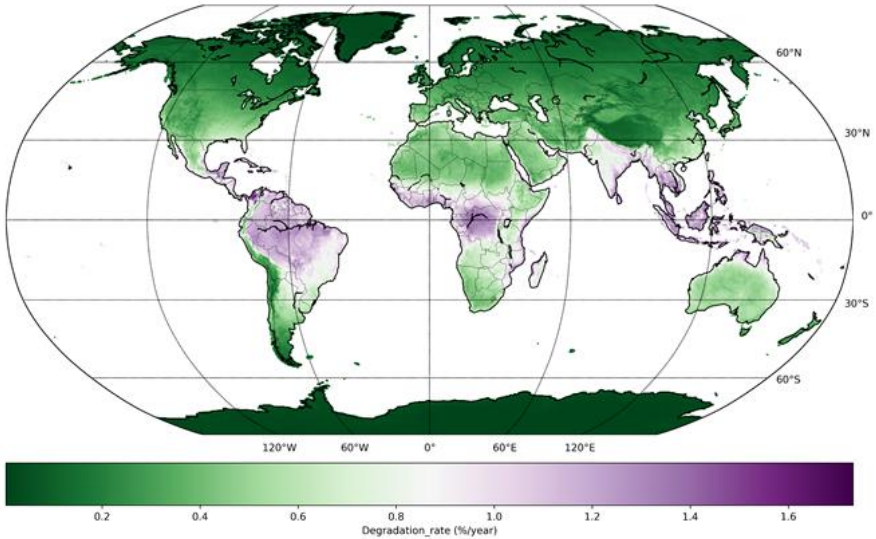
- Modelling approaches – Models for PV performance

→ Physical degradation rate models

$$k_T(T, RH, UV, \Delta T, T_{max}) = A_N \cdot (1 + k_H(T, RH)) \cdot (1 + k_P(UV, T, RH)) \cdot (1 + k_{Tm}(\Delta T, T_{max})) - 1$$

Useful to relate climate impacts but still based on basic assumptions and don‘t include all the stressors (e.g salt impact near oceans)

Adaptation to specific parameters and conditions of new applications!!



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Conclusion

- Several new applications are emerging in PV market
- New applications grow fast in market volume
- New applications come along with operational conditions which are (partly) not covered by established standards and (qualification) tests
- Type approval and safety standards do not address long term reliability
- Specific assessment of operational conditions of new applications necessary
- Adaptation of tests and degradation models necessary

Come and join us in Activity 1.3 of Task 13

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Thank you!

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