What about stability in the OPV industrialization process?

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RDI Project Manager

ISOS Conference– 29/09/22

Catch the light
Power your design

ASCA Presentation

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Power your design

We are ASCA

Flexibility of an agile structure

60 talents between France and Germany
Half engineers, half dreamers, we transform lives with energy for the better.

Strength of an industrial leader

ASCA is the world leader in organic photovoltaics
Industrial European capacity of 1M m²
10 years of R&D

Subsidiary of the ARMOR GROUP

An international industrial group
Expertise in ink formulation &
high precision coating on thin films

403 M€ Turnover in 2021	2,500 Employees
N°1 WW leader for thermal transfer	2,1 Md m² sold in 2020
20 Countries	42 Industrial and logistics sites

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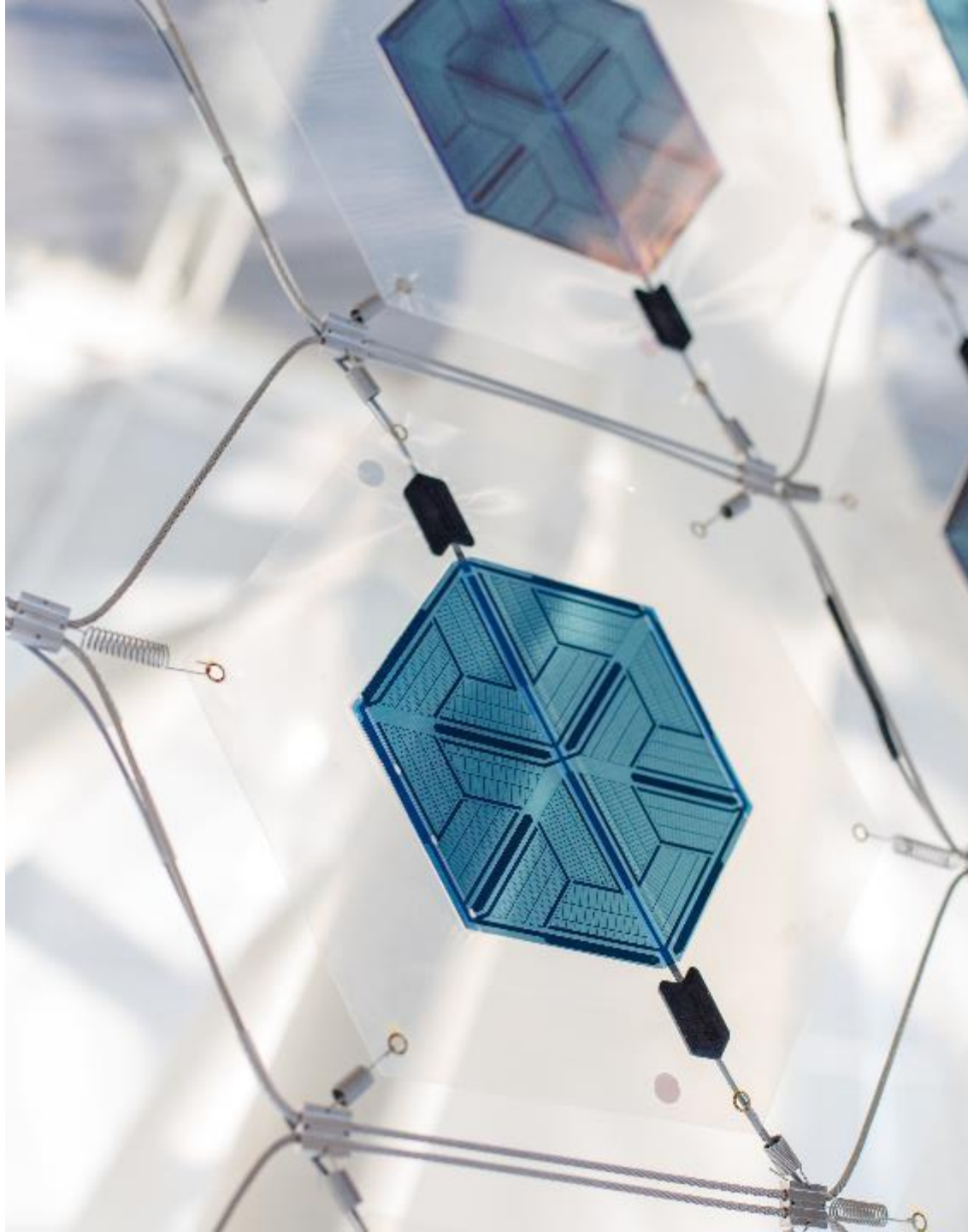
Maximize the use of solar energy

ASCA develops and manufactures **environmentally friendly customized solar solutions** on an industrial scale.

Thanks to its unique characteristics, the ASCA® solutions **can render almost any surface energy-active.**

They can be adapted to any shape or material, enabling **new applications for solar that previously seemed impossible.**



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OPV Production at ASCA

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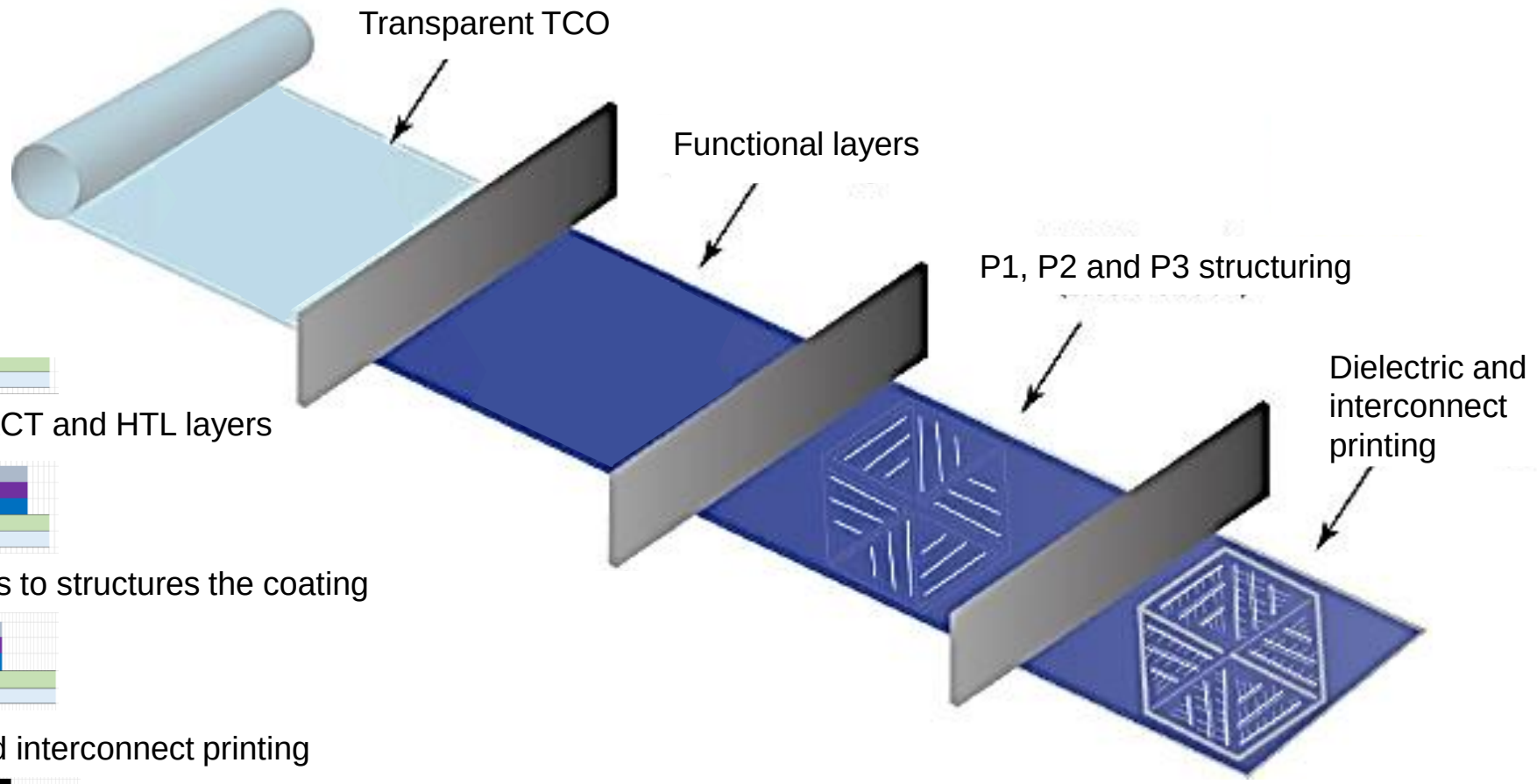
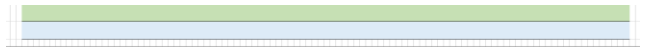
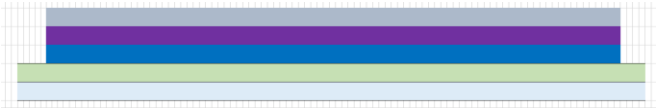
Late-Stage Customization Approach



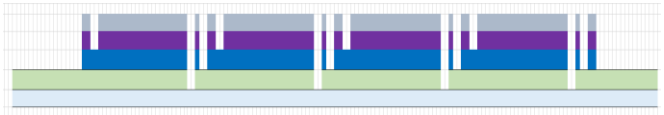
Step 1: Substrate PET/TCO



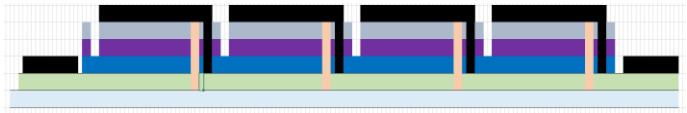
Step 2: Coating on full width, ETL, ACT and HTL layers



Step 3: P1, P2 and P3 lasering steps to structures the coating



Step 4: Dielectric + top electrode and interconnect printing



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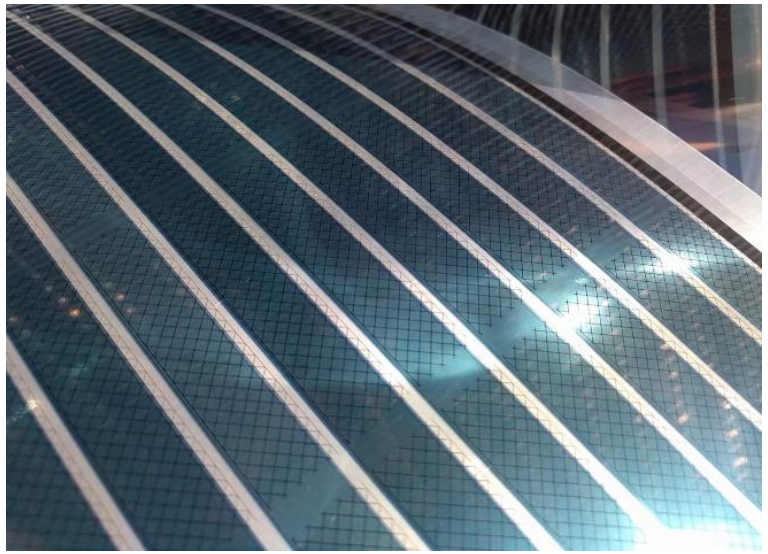
Free form production

Common OPV film



Take what you get

(stripy look, standard sizes)

ASCA OPV film

Power your Design

Full freedom in customization

and integration

Key markets

A wide range of possible applications:

Architecture

BIPV solutions integrated into the building envelope for sustainable architecture

Iconic buildings, textile & ephemeral structure, street furniture, residential building

Electronics

Energy harvesting solutions to power connected objects with ambient light

Smart cities, smart agriculture, home automation, health, asset tracking, wearables, Lifi

Mobility

Providing access to energy in mobile situations

Soft mobility, automotive, aeronautics, boating, nomadic accessories

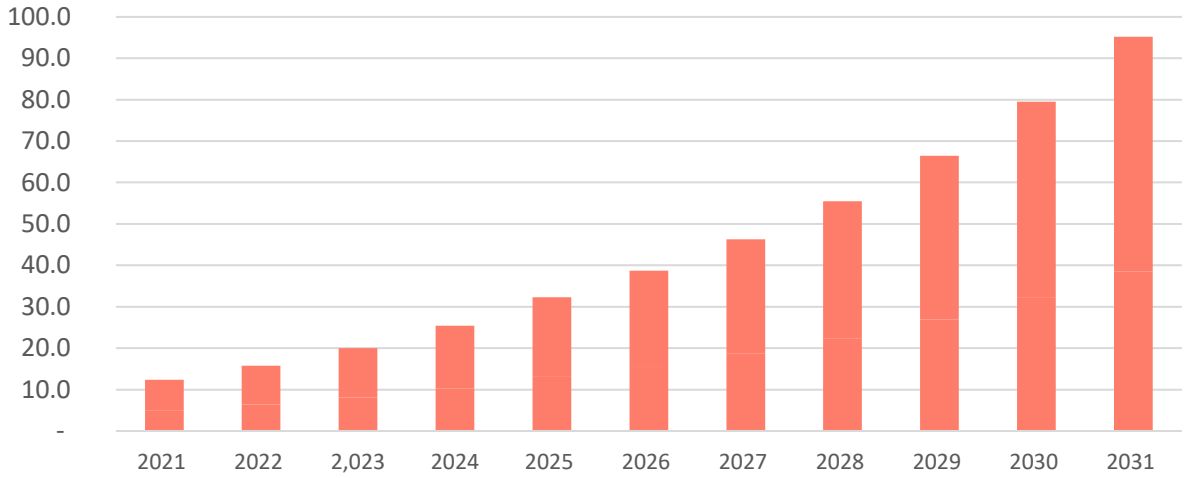
Art & Fashion

Multi-faceted energy solutions to explore new creative territories

Luxury goods, design objects, clothing /textiles, shoes, handbags/luggage, Art...

Architecture

Potential of solarizable area (million m²)



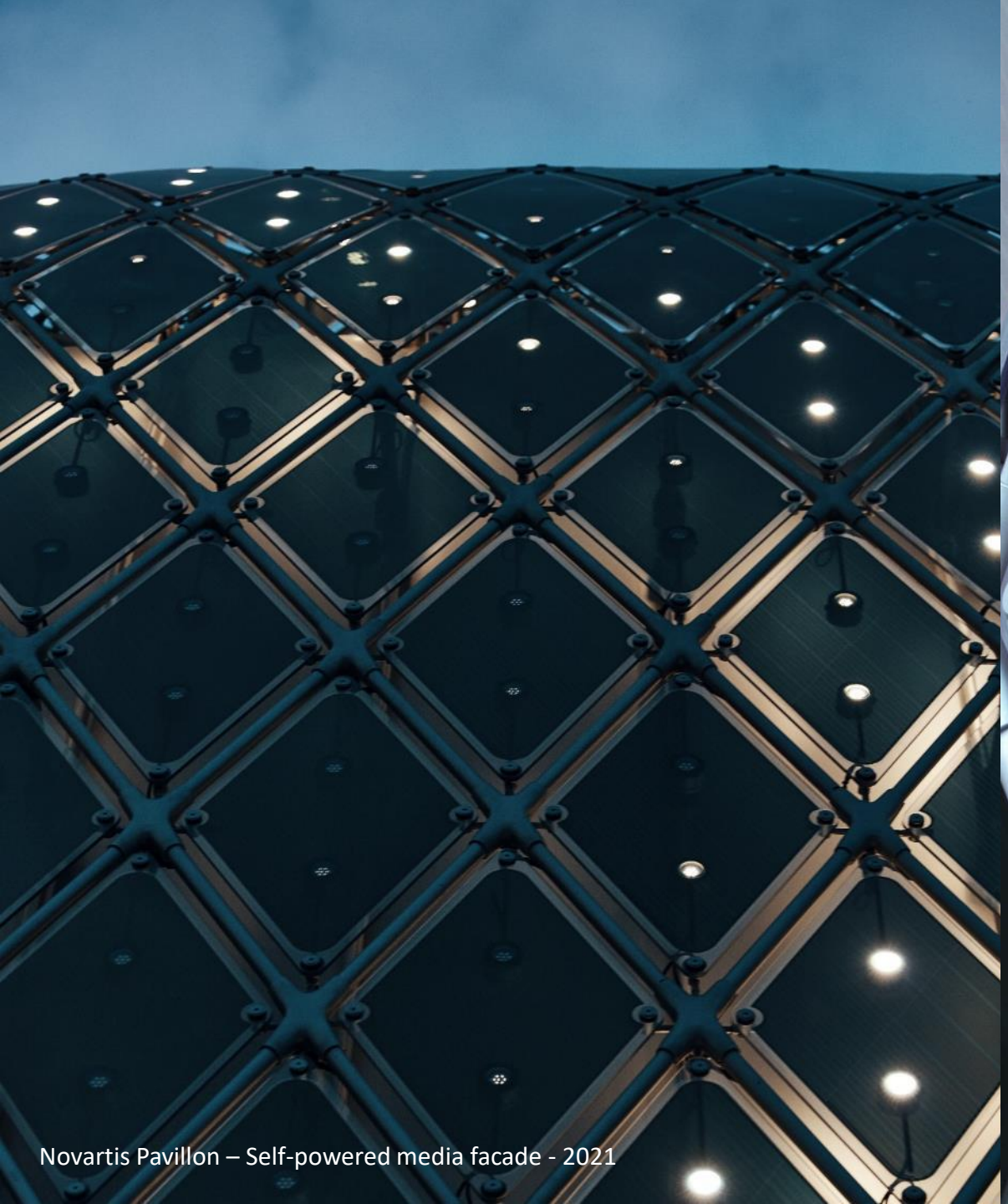
Références

- SUPSI, Building integrated photovoltaics Status report – 2020
- PV Boost,– Update on BIPV market – October 2018
- Osseweijer, Van den Hurk, Teunissen, Van Sark, Elsevier, A comparative review of building integrated photovoltaics ecosystems in selected European countries – 2018
- Defaix, van Sark, Worrell, de Visser – Elsevier, Technical potential for photovoltaics on buildings in the EU-27,- June 2011

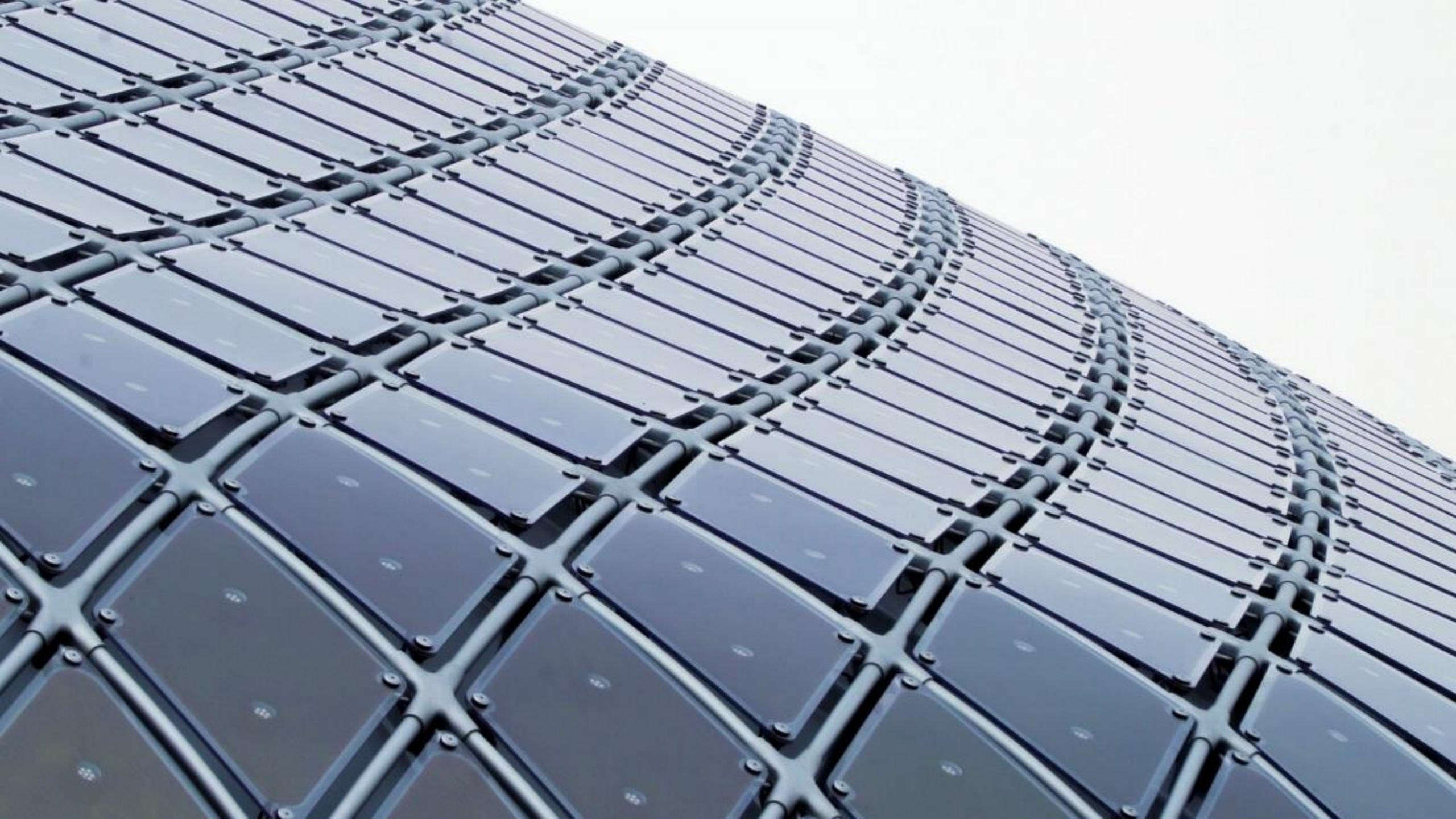
Energy-generating glass balustrades – Möhringen, Germany – 2021

Solar tree – Löchgau, Germany – 2021

Novartis Pavillon – Self-powered media facade - 2021



Novartis Pavillon – Self-powered media facade - 2021



What about stability in the OPV industrialization process?

BOOSTER Project

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Boost Of Organic Solar Technology for European Radiance

BOOSTER project start	September 2020
BOOSTER project duration	48 month
Project call	Next generation of thin-film PV technologies

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Fraunhofer FEP

UNIVERSITY OF OXFORD

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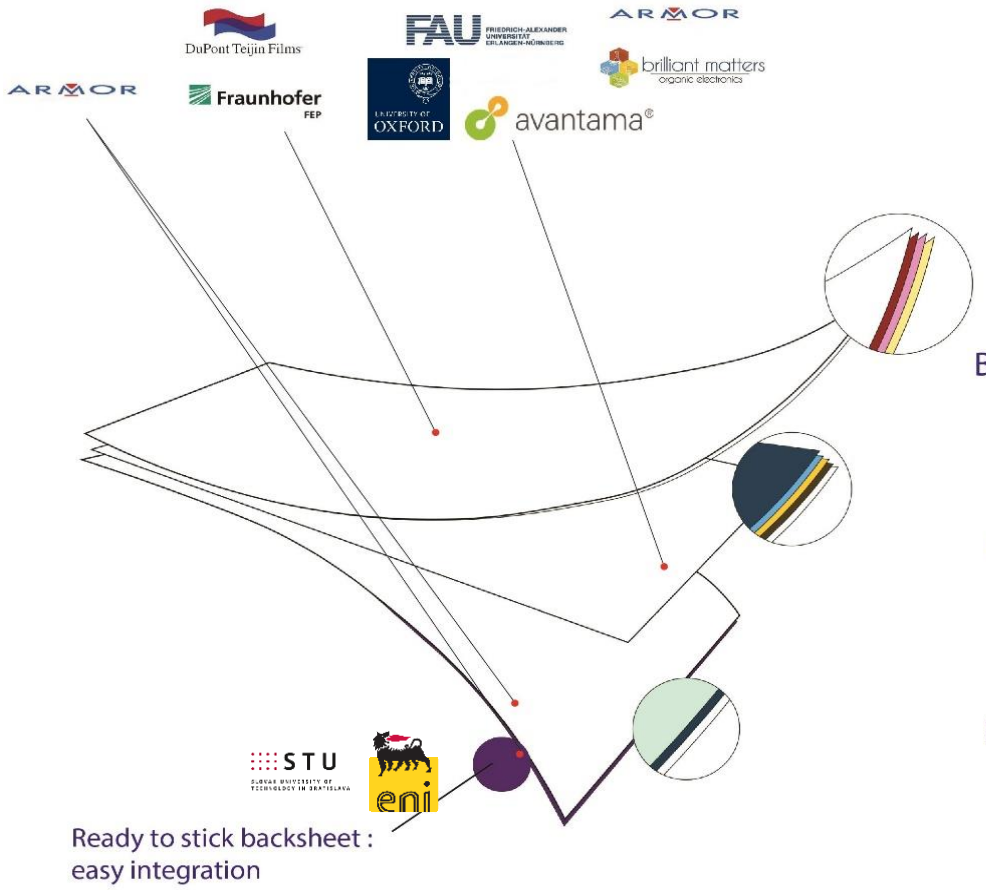
BOOSTER Concept



BOOSTER FRONTSHEET

HIGHER DURABILITY

BOOSTER OPV STACK

HIGHER PCE

BOOSTER BACKSHEET

LOWER COSTS

TRL 4 to TRL 7

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This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 952911

Objectives

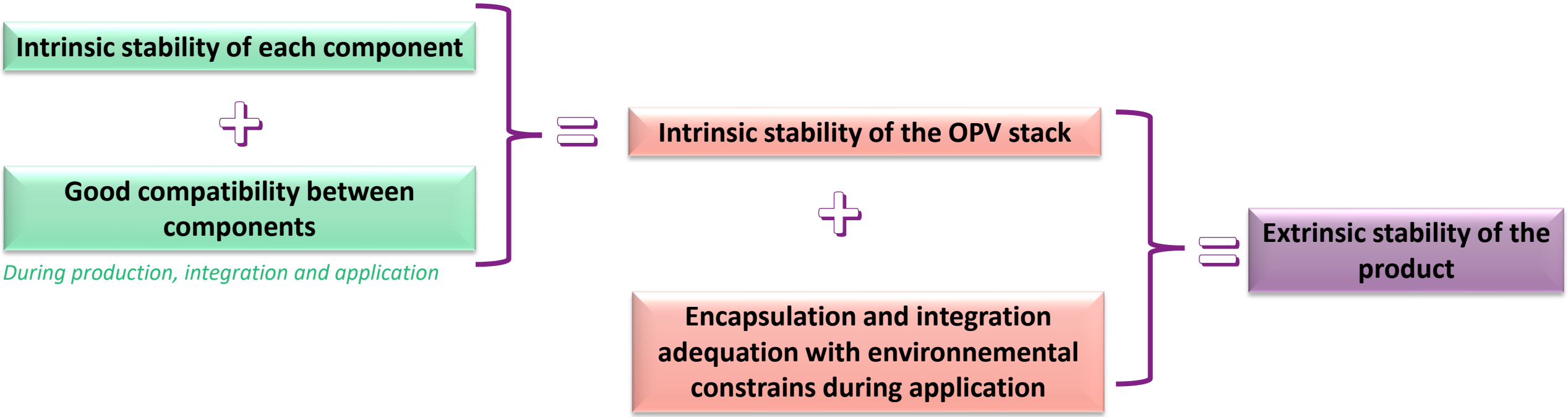
Objectives: Produce 2 BAPV demonstrators with improved lifetime and efficiency and monitore their performances for 1 year.

R2S installation on a canopy in ENI site – 150m²

ETFE installation on FAU building – 50m²

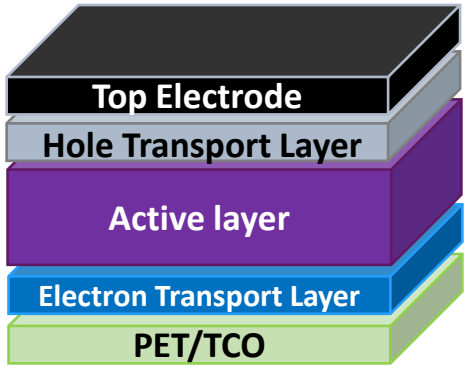
Stability a stepwise approach

Stability: a stepwise equation



Intrinsic stability of the OPV stack

Materials selection

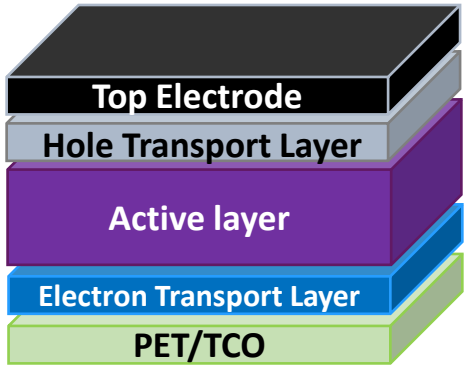


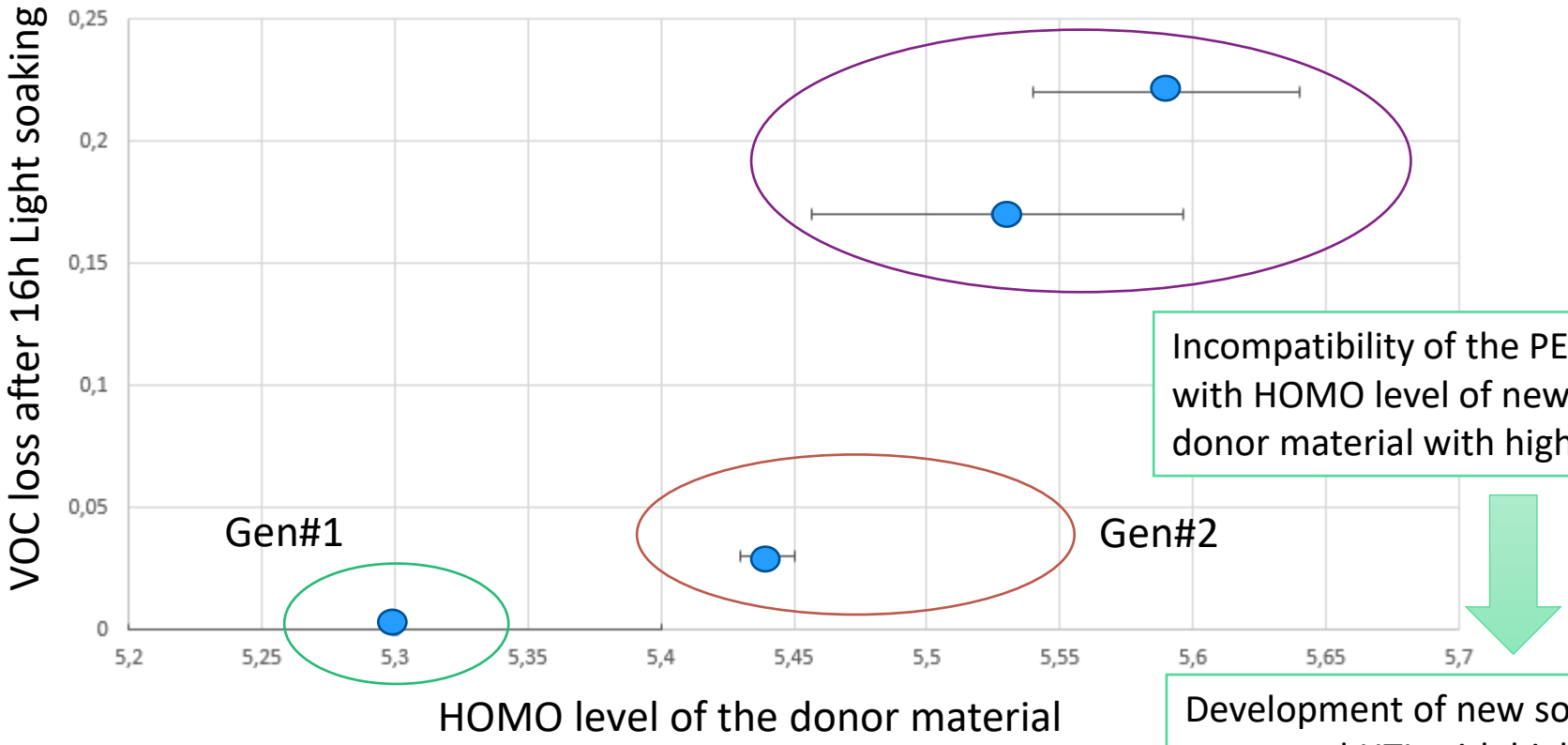
Specifications	
Compatibility with industrial scale up	Non toxic, non harmul, no dangerous for environment (green solvent)
	Available in industrial quantity at reasonable cost
	Batch to Batch reproducible
	Compatible with R2R and wet process: low drying temperature (<120°C) and short drying time (< 2 min)

Degradation Conditions	Selection criteria
Air/light exposure	No PCE loss after 8 to 10 h in air
Dark storage in N2	No degradation for months of storage
Photo-degradation in N2	PCE loss < 10% after 1000h
Dark Heat treatment at 120°C	No loss up to 2h heat treatment

Intrinsic stability of the OPV stack

Compatibility of Solution Processed HTL





Incompatibility of the PEDOT:PSS Wf with HOMO level of new generation of donor material with high performances

Development of new solution processed HTL with higher work function is required

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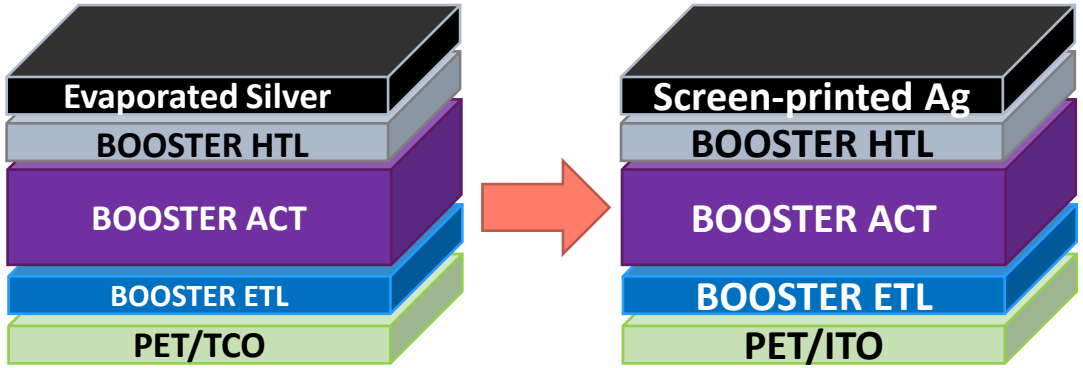
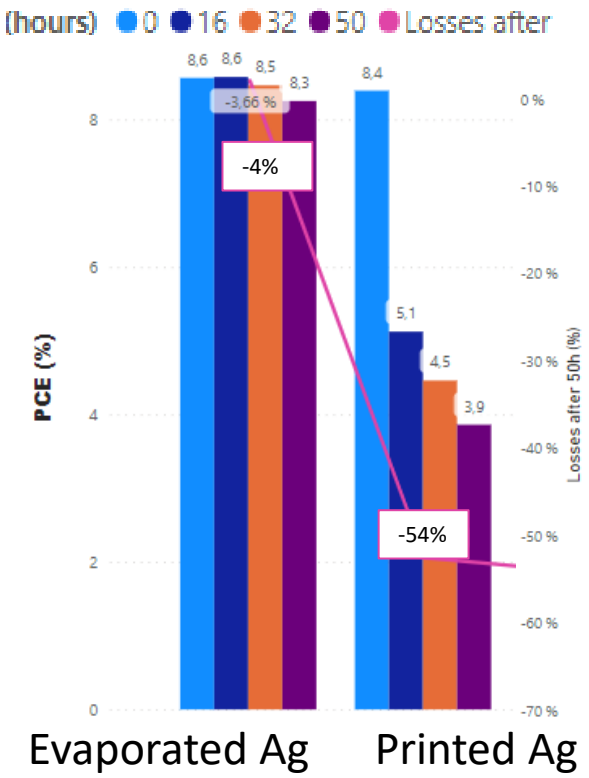
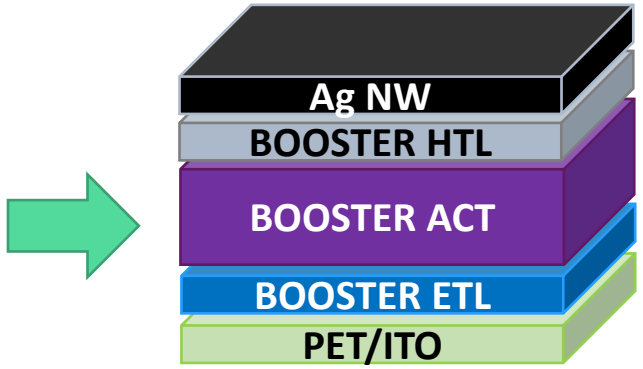
Compatibility of Solution Processed HTL + Printed Top Electrode

New solution processed HTLs
with high work function



Photostability





Ag NW is a promising Printed top electrode:

- ✓ **PCE loss after 200h of Light soaking<20%**

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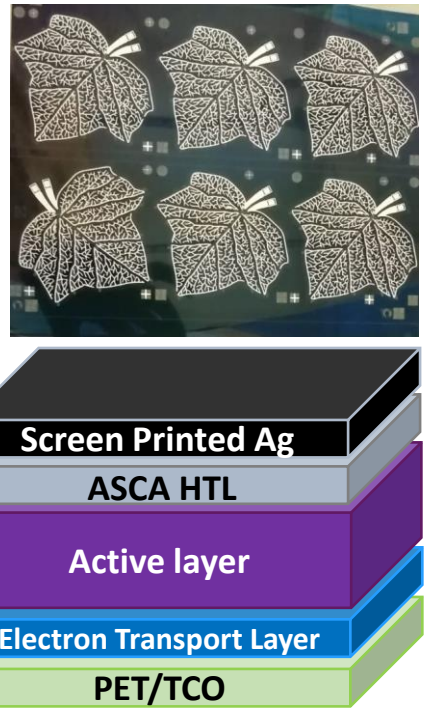
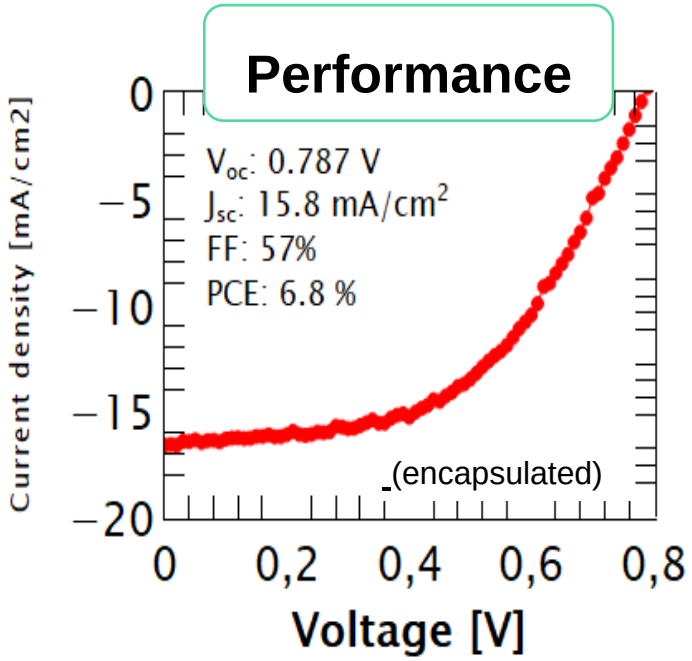
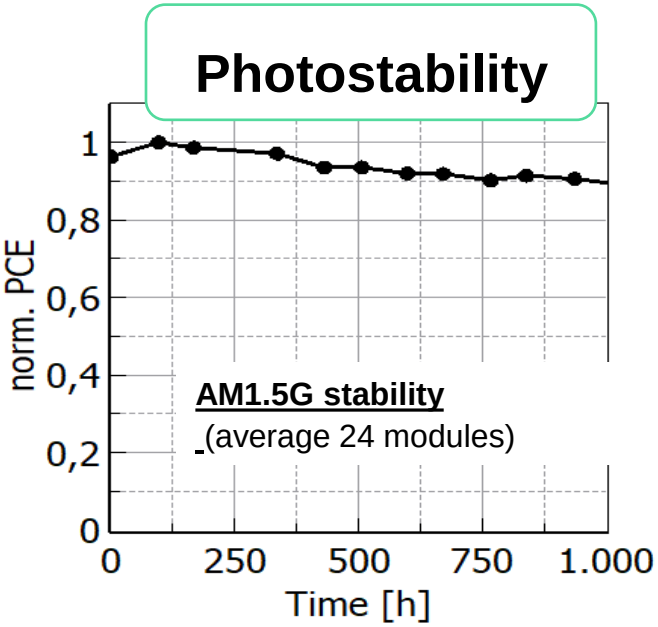
Intrinsic stability of the OPV stack



Fully printed Gen#2 at industrial scale developed by ASCA





- Reproducibility and close to 7% on R2R scale
- PCE maintained up to 6.8 % after 1000 hrs of continuous light exposure

→ **Transfer to production scale and commercial availability by end of 2022**

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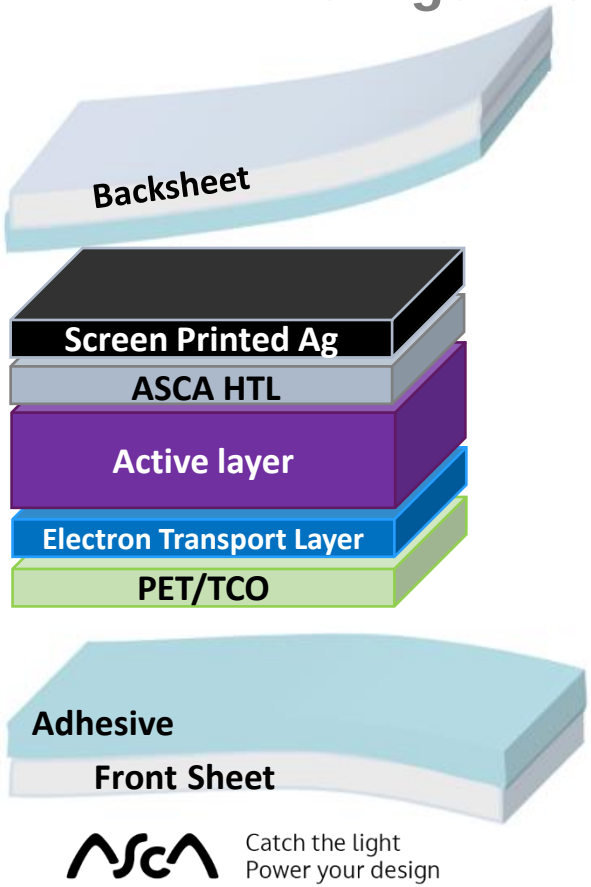
Extrinsic stability of the OPV stack

Next generation encapsulation developed in BOOSTER project



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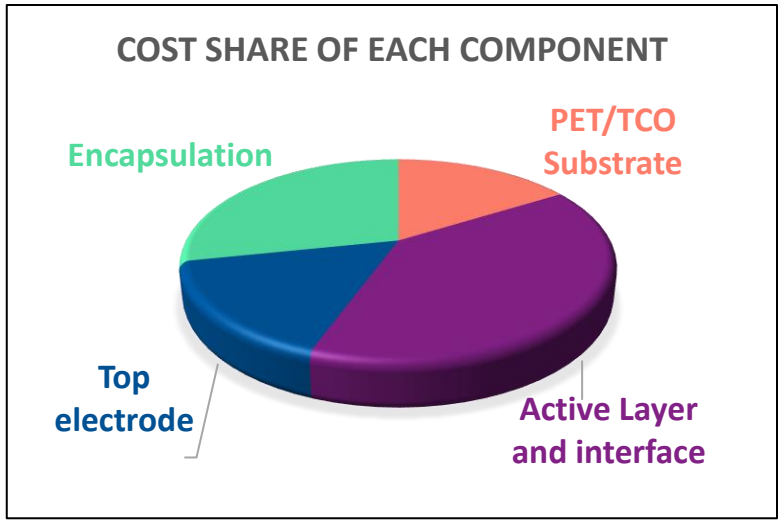
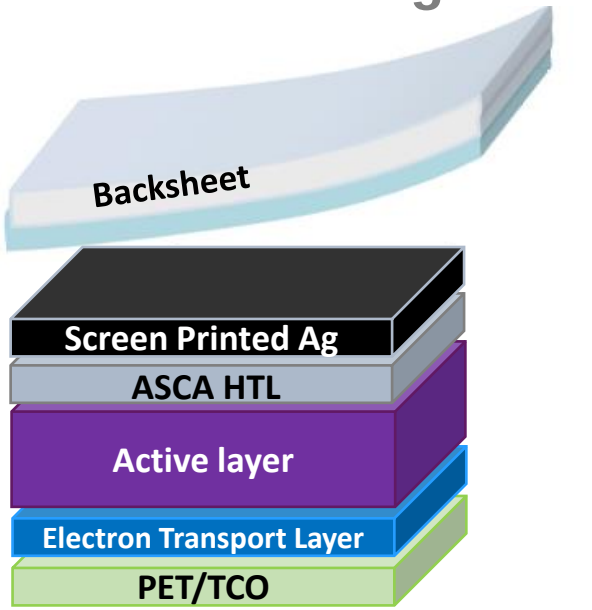
	Item	Target
Requirement for performance stability	Transparency	90 %
	UV-cut-off	380 nm
	Water vapor transmission rate	< 10^{-4} g/(m²d)
	Oxygen transmission rate	< 0.1 cm³/(m²d bar)
	Interfacial adhesion	>10 N/cm
	Mechanical flexibility (bending radius)	< 10 cm
Requirement for compatibility with lamination process	Transparency at 405 nm	85 %
	Thickness of frontsheet	60 to 200 µm
	Max. Shrinkage	< 0.2 %
	Surface energy	45 nN/m



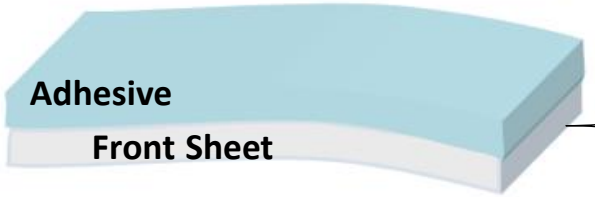
Extrinsic stability of the OPV stack

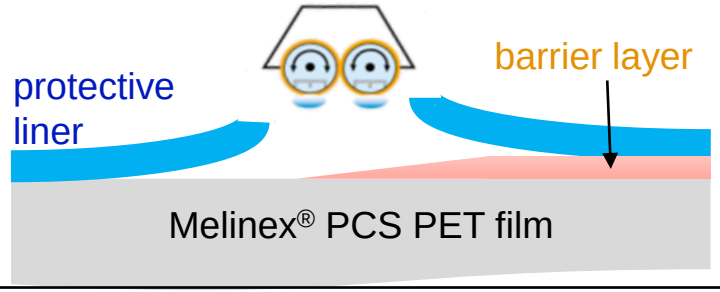
Next generation encapsulation developed in BOOSTER project



Objective : Maximize lifetime to reach 35 years of lifetime

Frontsheet Barrier film prepared with different oxides and different sputtering parameters on upgraded PET (improved UV-protection + hydrolysis stability + Light scattering)





Front sheet produced by reactive sputtering:
large area roll-to-roll
commercially available Process

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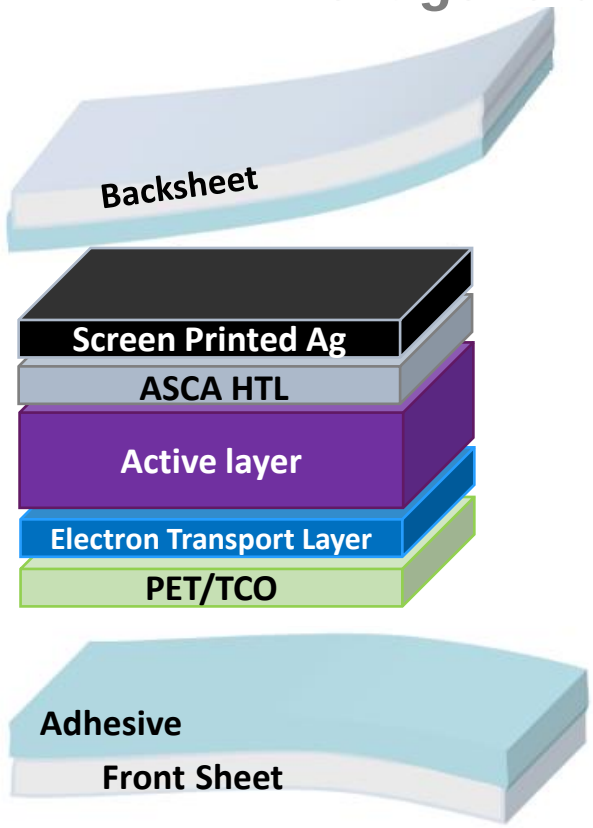
Extrinsic stability of the OPV stack

Next generation encapsulation developed in BOOSTER project



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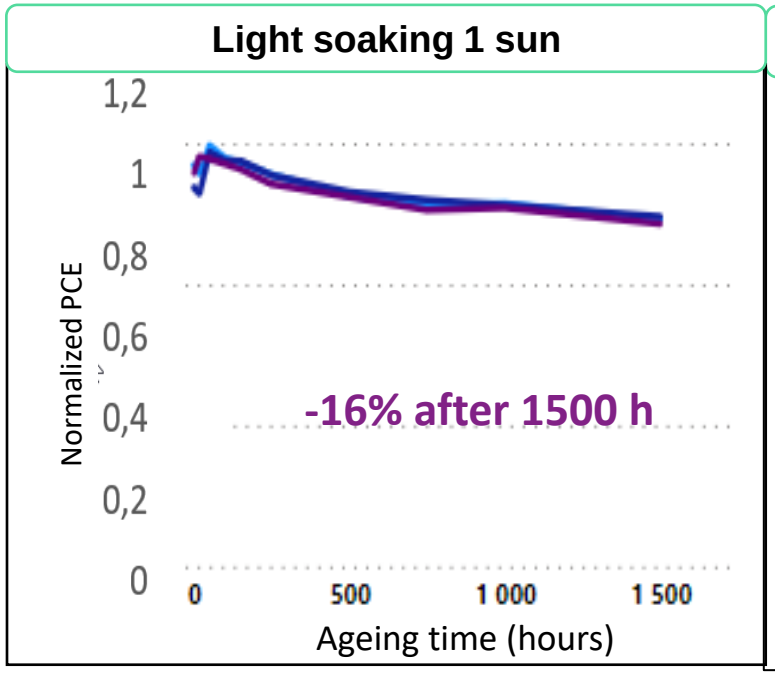
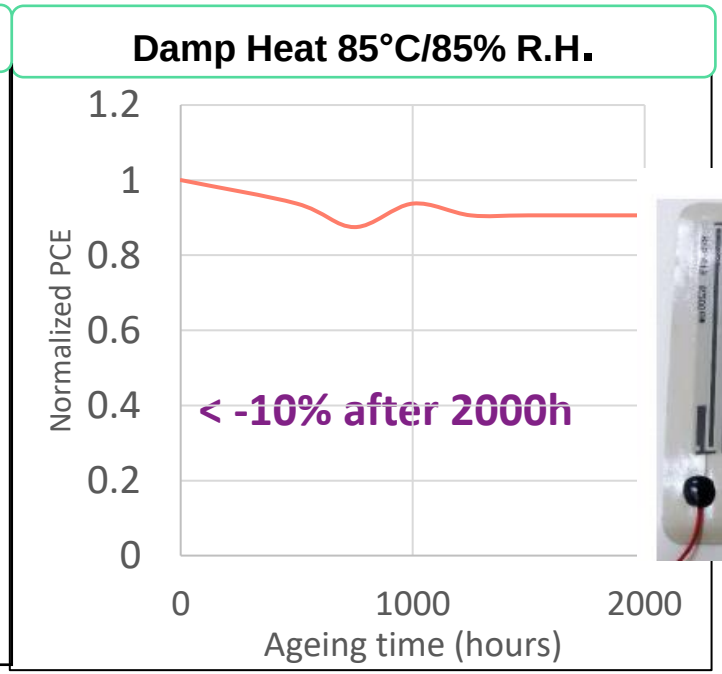
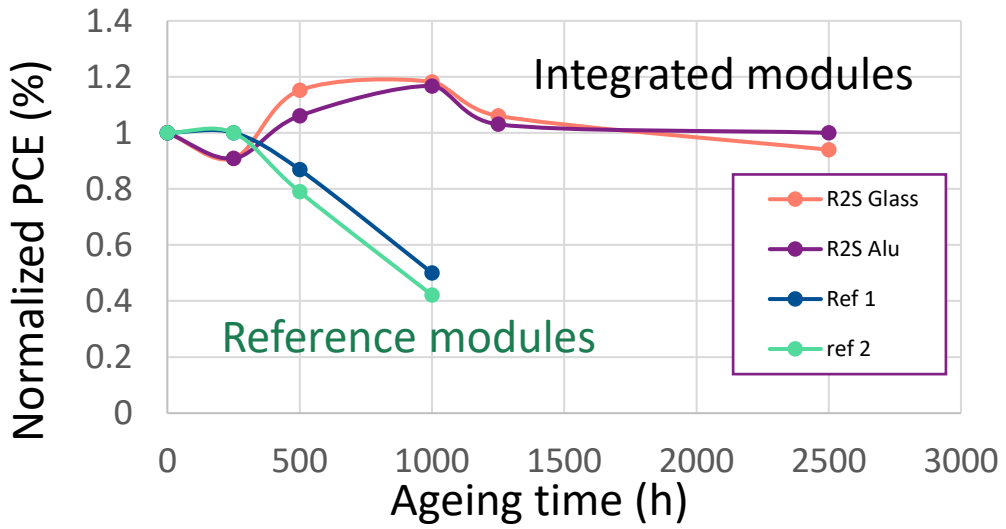
Results using low cost high performing Backsheet with FEP reference barrier film





Extrinsic stability of the OPV stack

Development of BAPV: Ready to stick modules



- Damp heat stability is determined both by primary encapsulation + Integration (2nd encapsulation)

R2S on Aluminium

R2S on Glass

Conclusions

Production of stable OPV products require to

- Take into account the production and applications constrains
- Rigourously select materials to fullfill industrial requirement
- Work with components suppliers in order to improve materials properties
- Test in relevant conditions to mimic application
- Make Failure Analysis to gain knowledge about degradation mechanism
- Improve version after version

The project BOOSTER receives funding from the European Union's Horizon 2020 research and innovation programme under Grant Agreement No. 952911.
https://booster-opv.eu/

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Thank you for your attention

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