PERCISTAND

Development of all thin-film perovskite-on-chalcogenide tandem PV

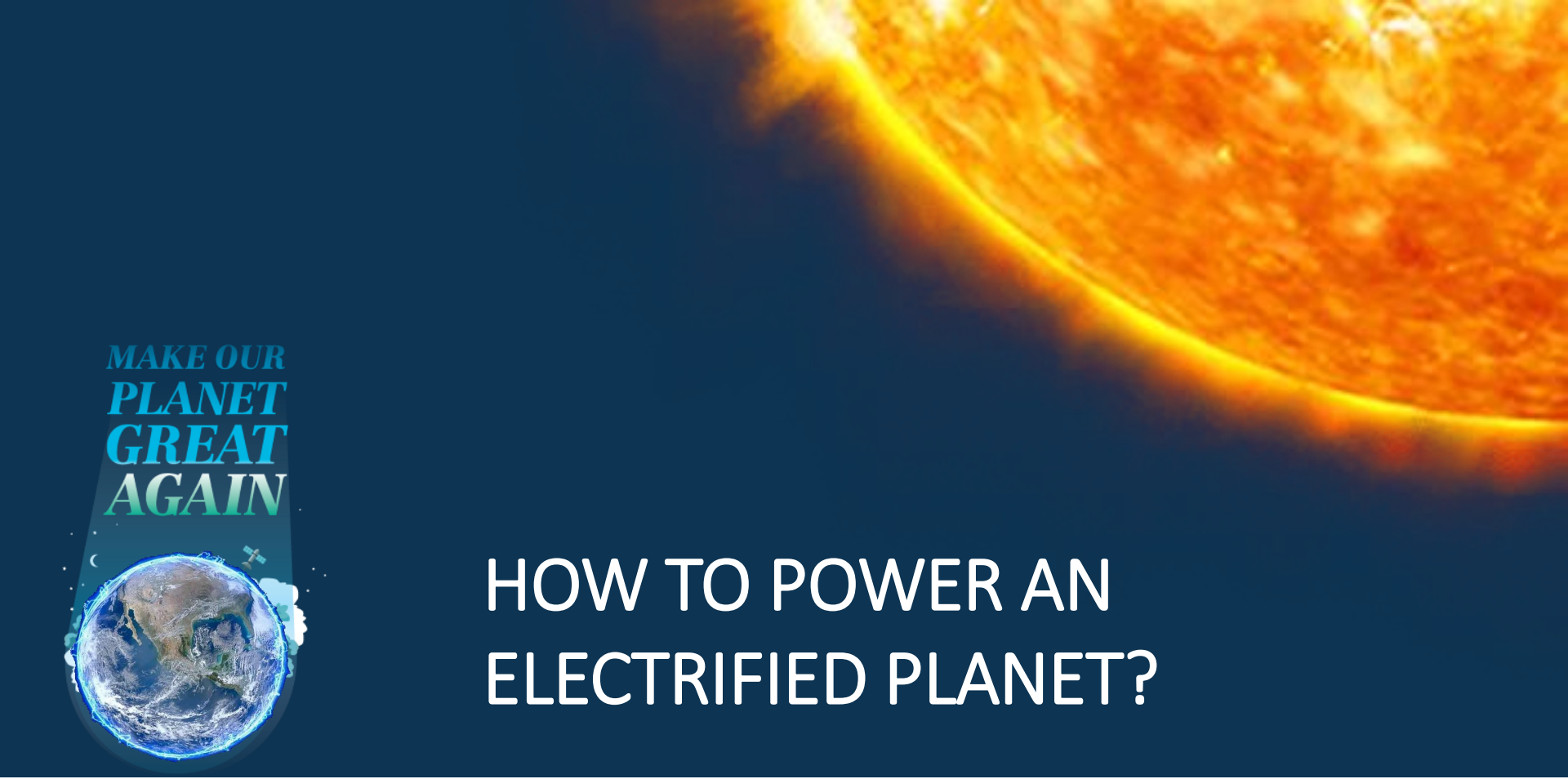
Philip Schulz (CNRS-IPVF)

Bart Vermang (imec, Project Coordinator)

2020 - 2023

European Union's Horizon 2020 research and innovation programme, grant agreement N° 850937.

SUSTAINABLE PLACES 2022
Sep. 6 - Sep. 9, 2022 | Nice, France



HOW TO POWER AN ELECTRIFIED PLANET?

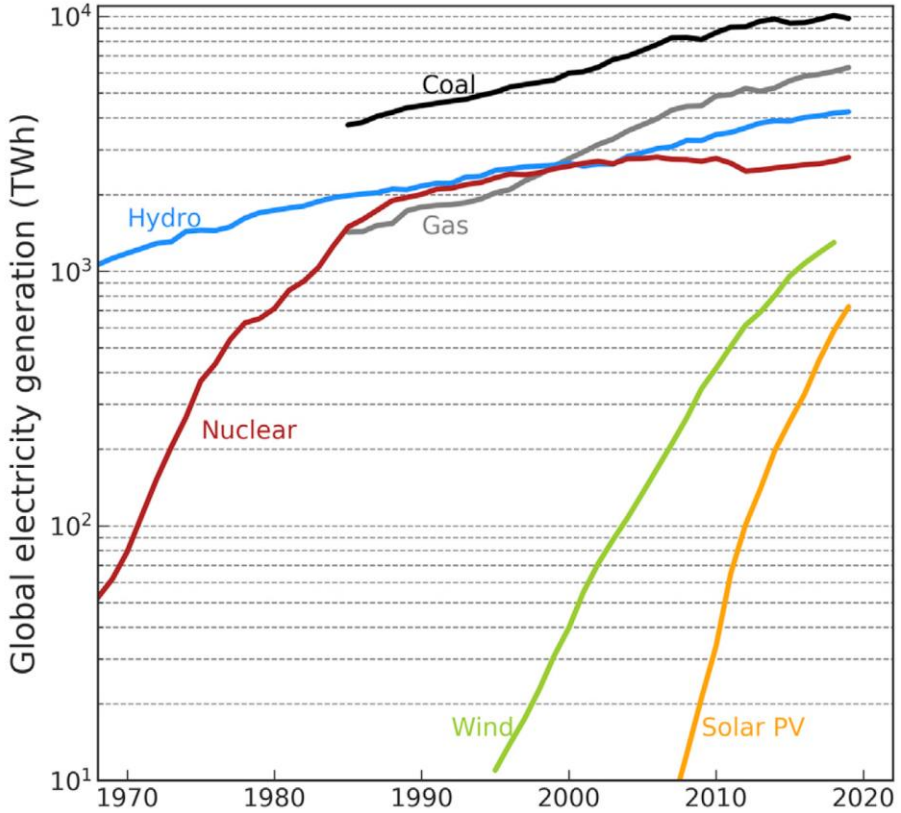
Capacity for Electricity Generation

- Solar Photovoltaics (PV):
  Highest growth rates for electricity generation

- How to increase the share of PV to electricity generation (**TWh**)

  → Increase installed capacity (**TW**)

Global milestone
1 TW reached (**2022**)



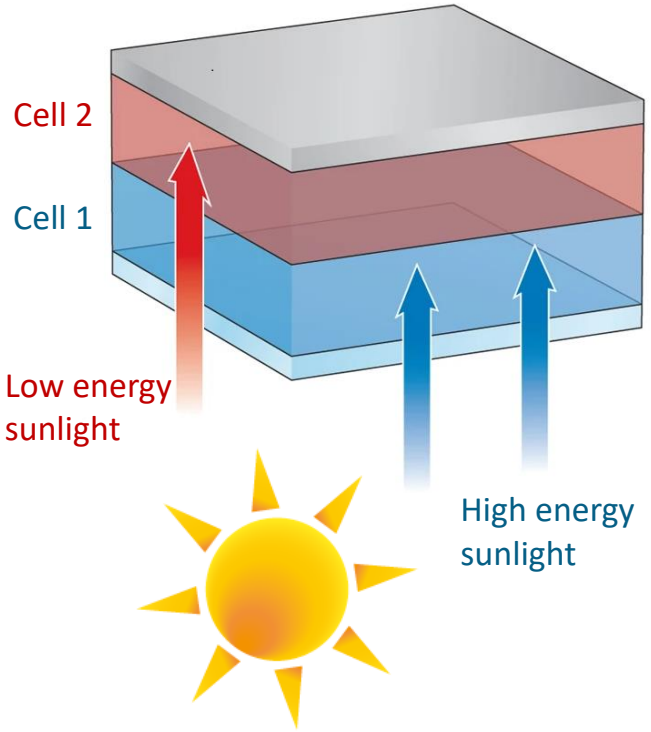
M. Victoria et al. Joule 2021

Knobs to Turn, to Beat the Limit!

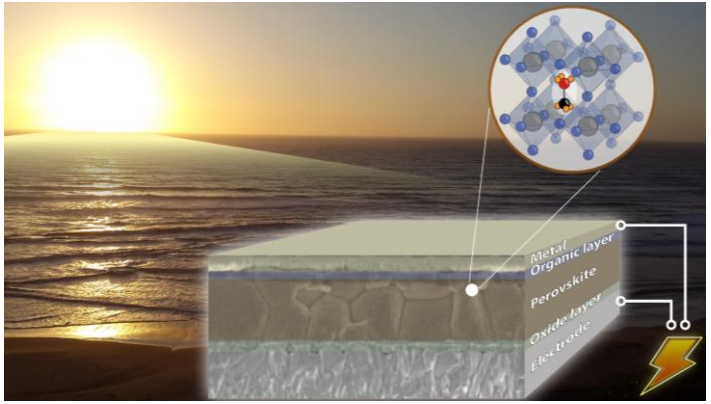
What is the efficiency limit of a solar cell?

Conventional silicon technology ≈ **30%**

Next-generation **tandem** devices ≈ **45%**

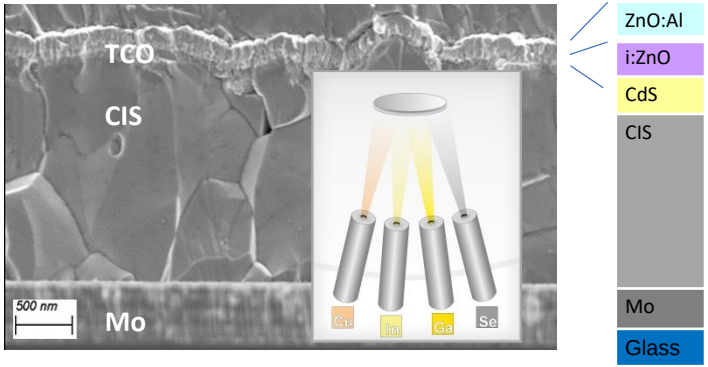


Next Generation PV Technologies – All Thin-film PV



Perovskite Solar Cells

Novel hybrid organic / inorganic materials



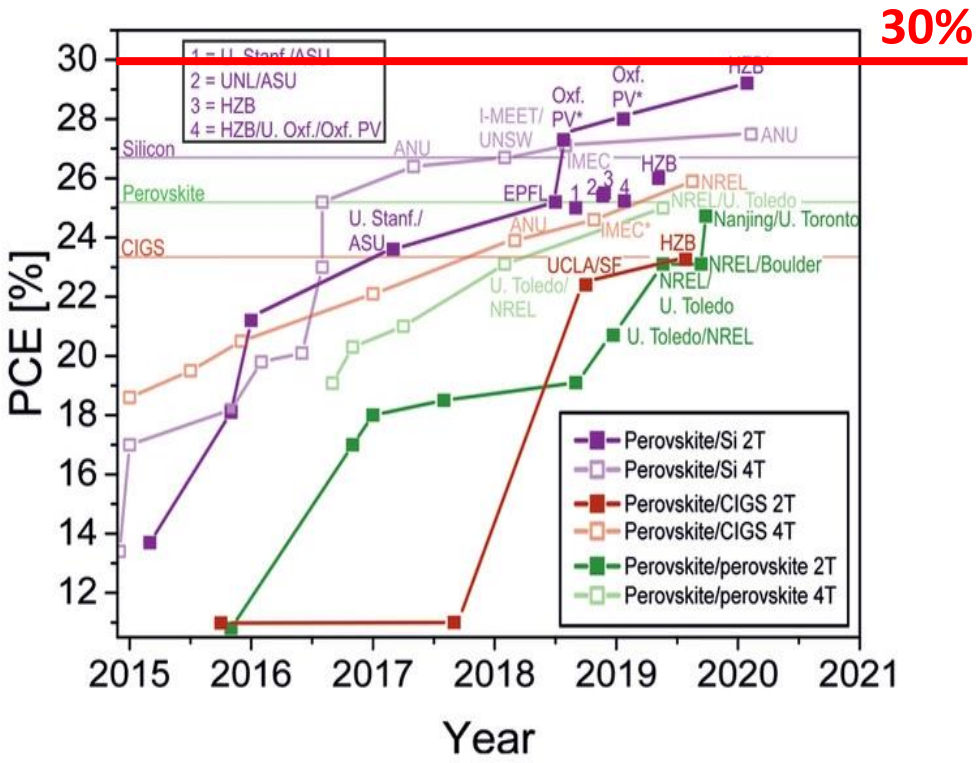
CIGS Solar Cells

High efficiency, energy yield and reliability

Next Generation PV Technologies – All Thin-film PV

- Utility scale, rooftop and BIPV applications, colored, patterned and/or flexible products
- Fully vertically integrated, low-cost production on a GW scale
- Low material consumption, short energy payback times, low carbon footprint

Project Goal and Consortium



Jost *et al, Adv. Energy Mater.* **2020**, *10*, 1904102

PERCISTAND

academic (BE, NL, DE, FR, CH)

imec · KIT Karlsruhe Institute of Technology · Empa Materials Science and Technology · TNO SOLLIANCE · cnrs IPVF · ZSW · UHASSELT

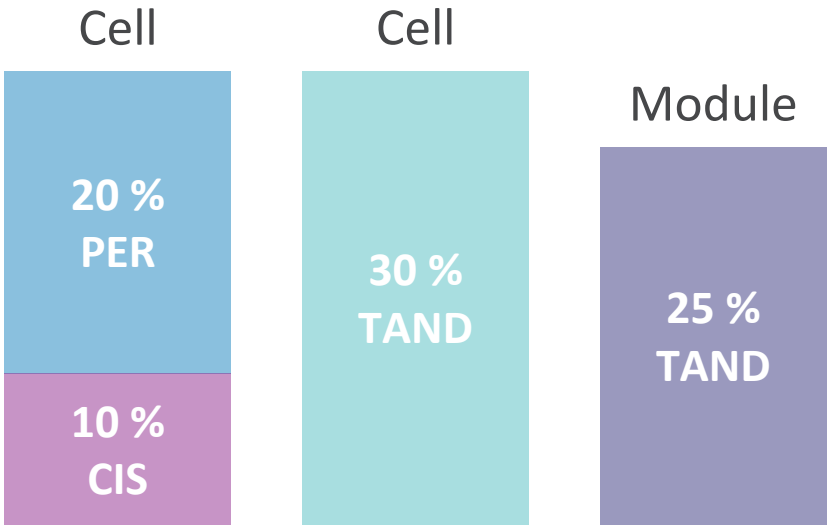
Industry (BE, NL, CH)

Energy Ville · vito · SOLARONIX

non-EU (US, AU)

NREL Transforming ENERGY · Australian National University

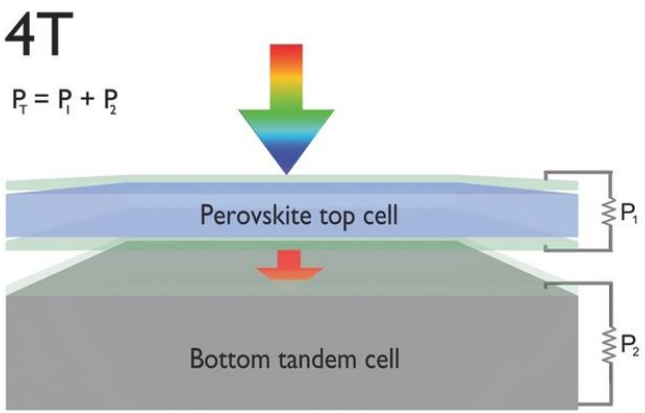
Project Targets (by the end of June 2023)



- Stability
  - IEC standards
- Manufacturability
  - Scalable to 20×20 cm^2
- Cost and environmental footprint
  - ISO standards

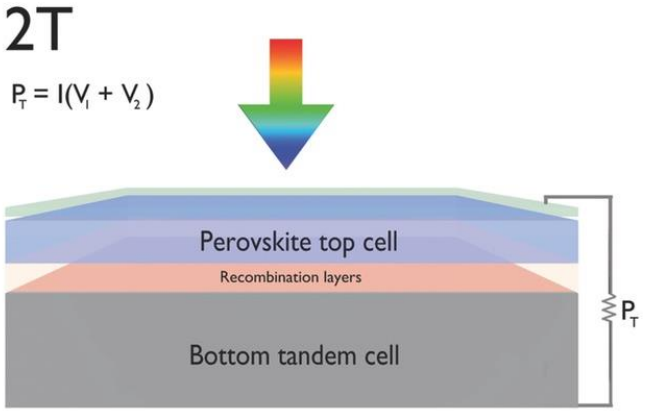
Technological Approaches

4-Terminal (4T) – Higher efficiency and independent processing windows



PERCISTAND – Validation of technology in controlled environment **(TRL 4)**

2-Terminal (2T) – Ultimately more compact implementation and modularization



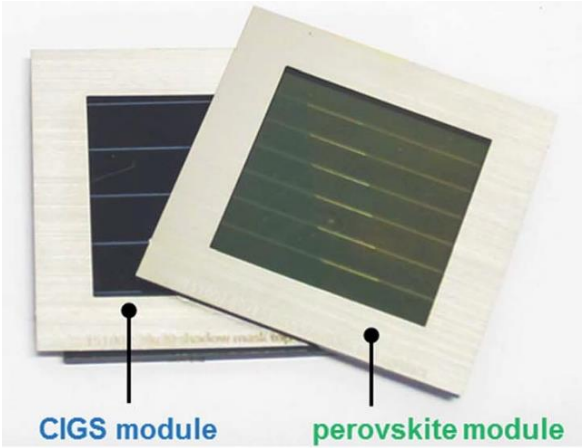
PERCISTAND – Experimental proof of concept **(TRL 3)**

Perovskite/CIGS Tandem Results in PERCISTAND

4-Terminal (4T) – Higher efficiency and independent processing windows

Joint results with German CAPITANO project:

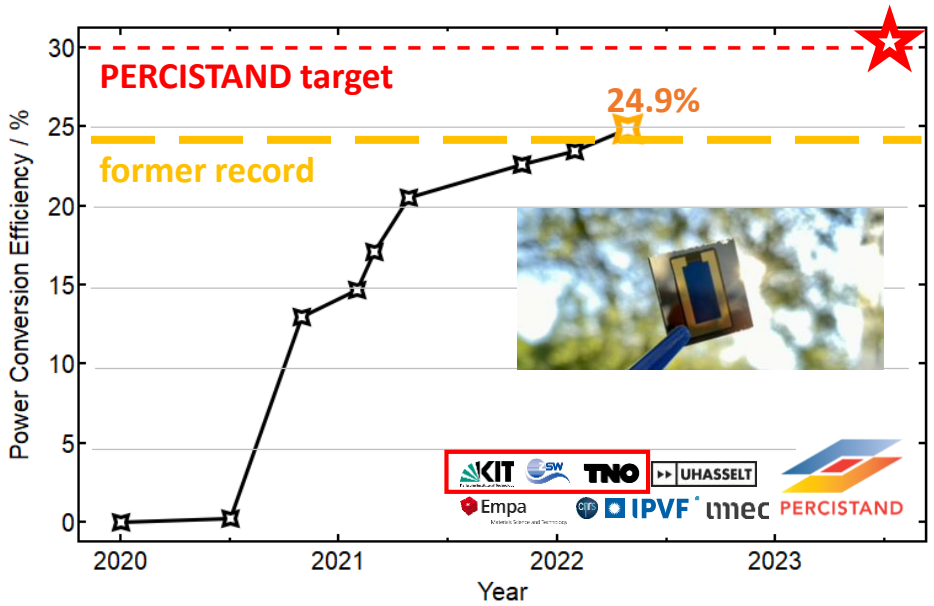
CIGS (8.8%), PER (18.5%), Tandem (**27.3%**)



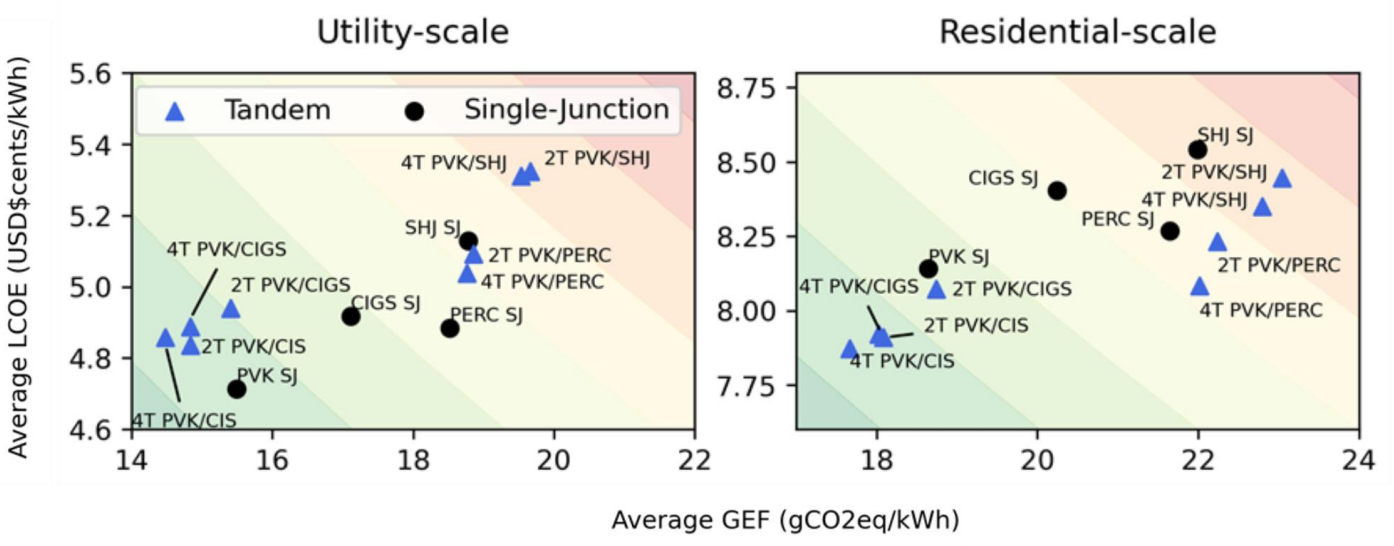
- 3.8 cm^2 module with 21.3 % efficiency

PhD thesis M. Jaysankar; DOI: 10.1002/pip.3153

2-Terminal (2T) – Ultimately more compact implementation and modularization



Impact Assessment – Costs and Environment



- Analysis supported by realistic energy yield data at three climatic locations (desert, tropical, oceanic)

- On average perovskite/CI(G)S tandems:
  - Similar LCOEs than conventional silicon-based PVs(PERC)
  - Considerable reduction of GHG emissions per kWh

philip.schulz@cnrs.fr
@Hybridinterface

SUMMARY

Opportunities and Design Principles

Key technology for flexible modules, BIPV, VIPV, and Agrivoltaics

Presently 4T devices reach >27%

Monolithic Tandem Integration

Optimized solar cell layer stack for current matched tandems

Current PERCISTAND in-consortium record 2T: 24.9%

Economic Outlook and Environmental Impact

LCOE on par with standard silicon modules

Reduction in GHG emissions compared to other PV technologies

PERCISTAND

https://www.linkedin.com/groups/8931403/

ACKNOWLEDGEMENTS

European Union's Horizon 2020 research and innovation programme, grant agreement N° 850937.

The **PERCISTAND** consortium
01/2020 – 06/2023
Coordinator: Bart Vermang (imec)

imec, Empa, cnrs IPVF, ZSW, NREL, UHASSELT, TNO SOLLIANCE, vito, Energy Ville, KIT, SOLARONIX, Australian National University