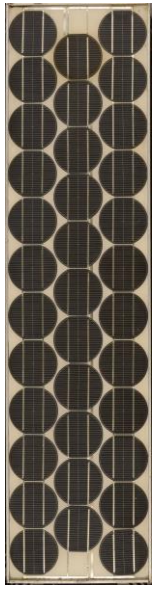
SUPSI PVLab: Quality, Research and Testing

Mauro Caccivio, Head of SUPSI PVLab
Yverdon, Solar Swiss Connect event, 4th November 2021

Evolution of PV modules

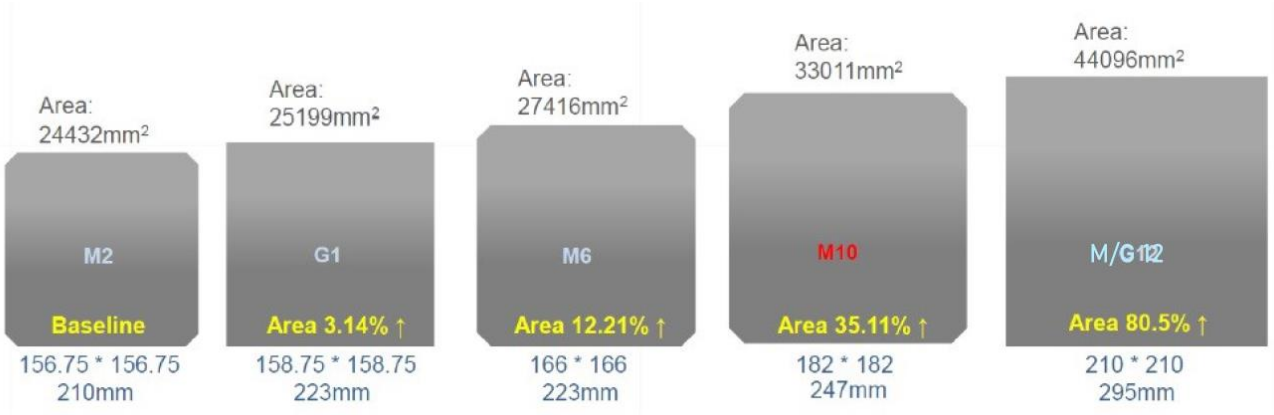


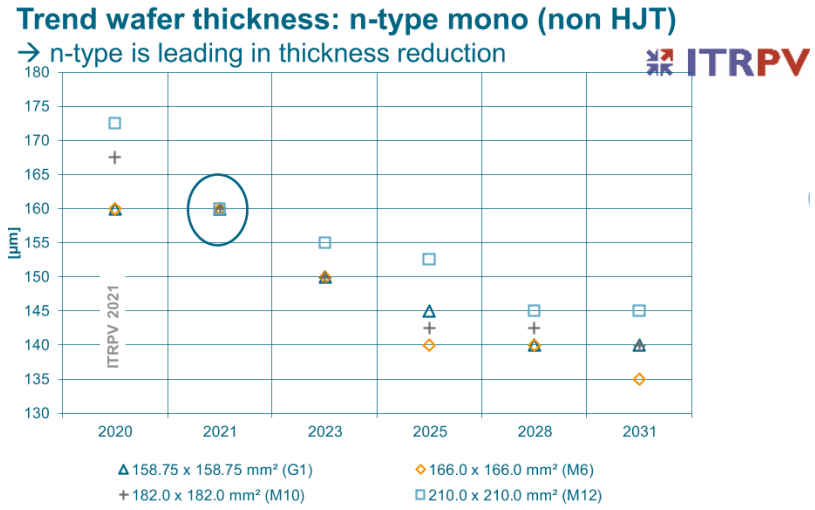
1982:
35W

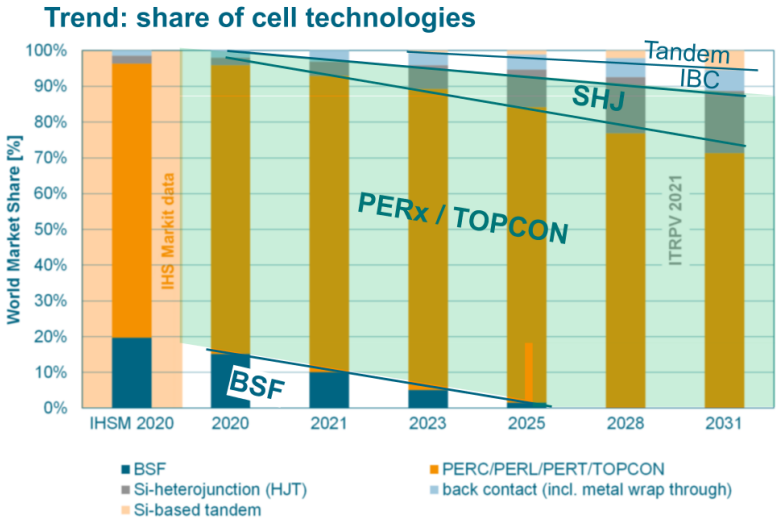
2018:
320W

2021:
670W

International Technology Roadmap: trends

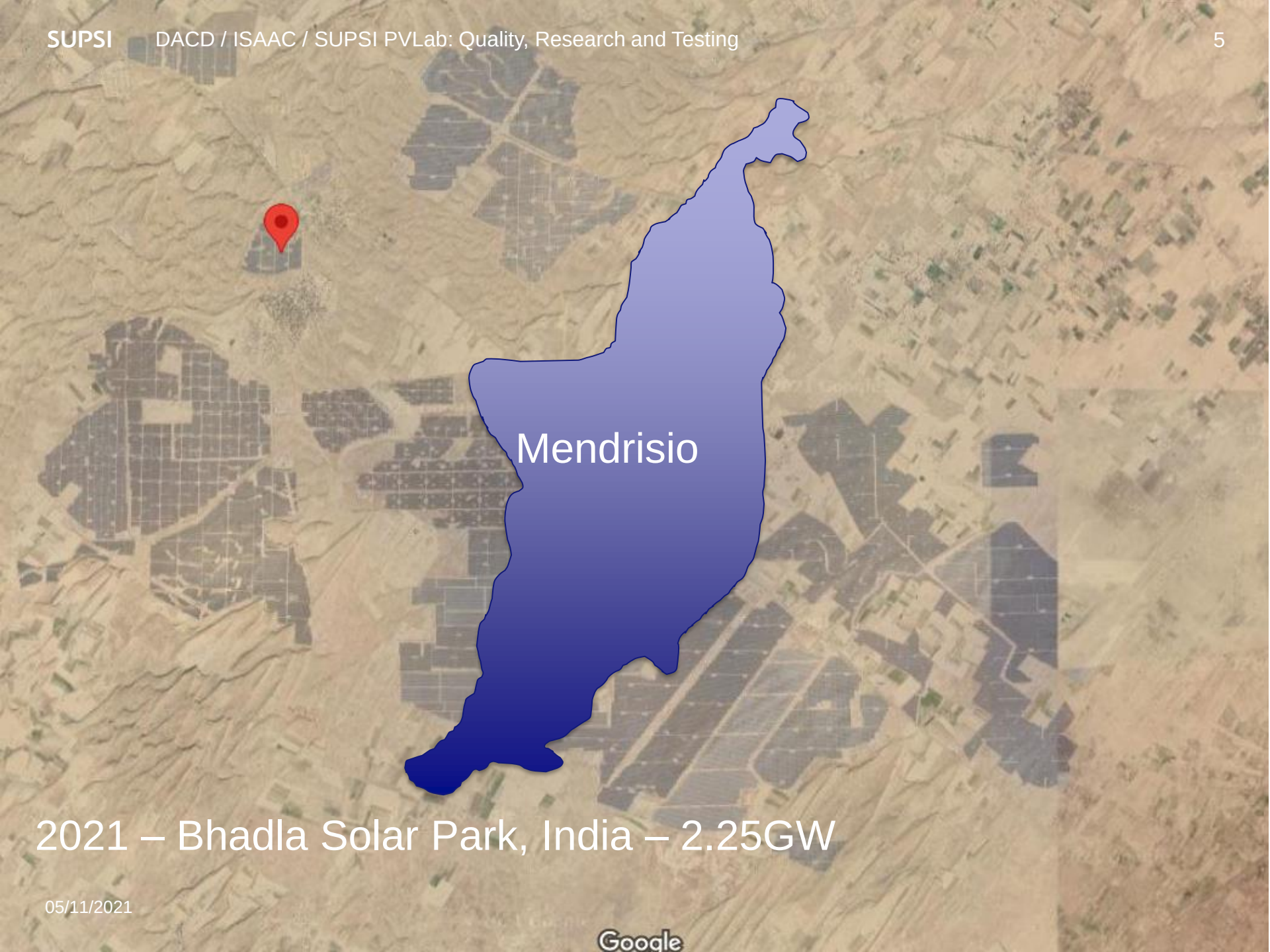




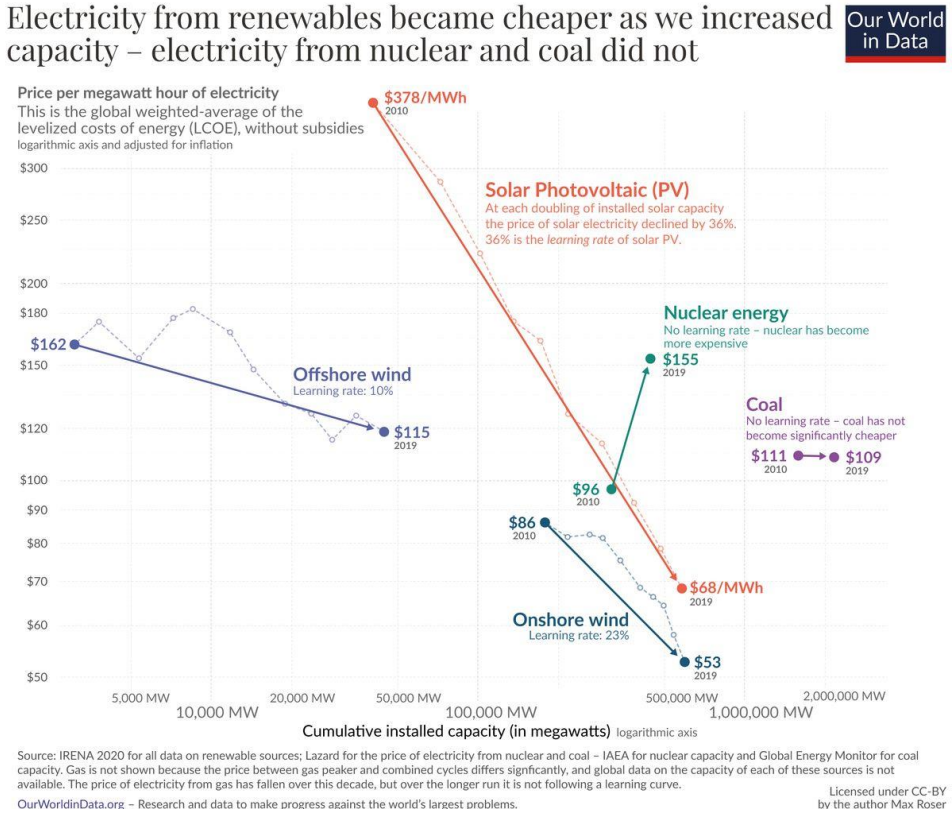


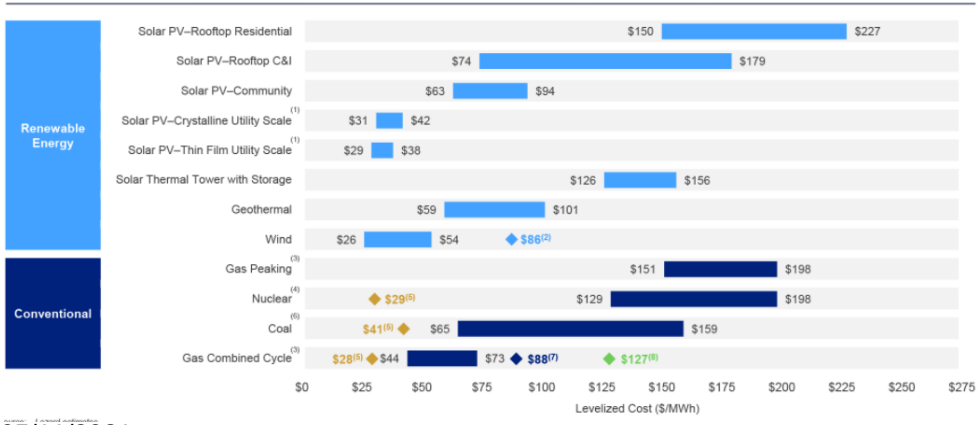
1982 - Lugano: TISO 10 kW PV plant

05/11/2021



2021 – Bhadla Solar Park, India – 2.25GW





- Continuos reduction of the LCOE
- Lower maintenance cost than other sources
- Same request for plant lifetime: 40 years
- Huge quantities of modules: higher risk in case of problems

- Need for Reliability and Quality
- Need to characterise precisely the new technologies
- Need to demonstrate the PLR trends of new technologies

Team's activities, focus on:

- **Module characterisation**
  - Indoor: high precision measurements, alignment with worldwide roundrobins, accredited measurements since 2001, capability to measure new technologies.
  - Outdoor: Energy rating, comparison between indoor and outdoor data. High precision measurements
- **Quality at module and system level**
  - Collection of data, failures, experiences from the field. Monitoring of Swiss market
- **Reliability, accelerated testing, Failure modes**
  - Research on accelerated testing, long term performances and safety

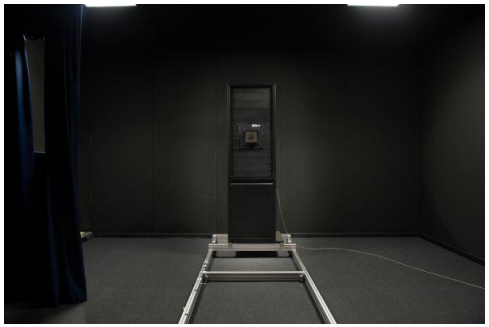
BIPV sinergies

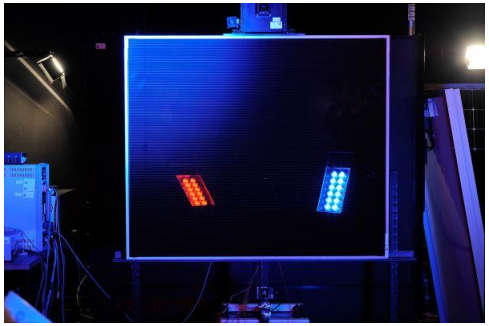
The Team

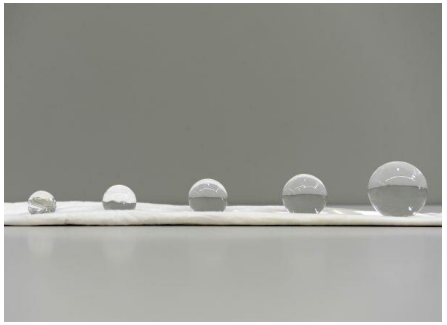
- Massive rise of PV installation, solar module will become a commodity
- Need in Switzerland to ensure the quality of PV system and the related financial investment
- The focus on systems aspects and quality ensure a clear positioning of the team in respect to other Swiss research groups historically oriented at PV cell level, inverters, thermal collectors
- A team of researcher with a long term experience on photovoltaics, prepared to answer to the new needs of the market actors, local and international: industry, installers, insurances and electrical utilities.

SUPSI PVLab: facilities

- N.2 Pasan Flasher, class AAA, for the electrical characterisation with best uncertainty of **+/-1.6%** (non destructive spectral response measurement at module level, spectrum fine tuning with LEDs)
- N.3 continuos simulators, with visible light (2) and UV light (1), for characterisation, stabilisation and accelerated degradation of materials
- N.2 thermal chamber, 3 m^3 volume, for environmental testing with humidity and thermal cycling.
- PID testing
- N.1 mechanical load test setup up to **18.000 Pa** in pressure, with optional inclination up to 30°
- N.1 hail test set up, with max diameter of hailstone of **70mm**
- N.1 mechanical test machine for shear, pull test, 4 point bending test on materials and components (JB, connectors, laminates)
- N.1 megaohmeter for dry and wet insulation test
- Bypass diode thermal and reverse breakdown testing.
- N.2 IR camera systems for electroluminescence and thermal mapping
- Outdoor stand for the energy yield evaluation and comparison to other reference technologies
- Meteo station, with calibrated spectroradiometers, pyranometers and reference cells for a precise monitoring of composition and quantity of light, further to environmental parameters
- N.2 IV curve tracers for string performance measurements on the field (calibration with reference modules for uncertainty reduction)
- N.1 PV system performance checker
- N.1 Insulation, short circuit current and open circuit voltage tester for PV system analysis







Research projects / 1:

ATTRACT: Advanced Techniques for The chaRACTerisation of photovoltaic modules

Exploration of new procedures, stability issues, repeatability and measurement uncertainty, and implementation of new equipment

2020-2023

Schweizerische Eidgenossenschaft
Confédération suisse
Confederazione Svizzera
Confederaziun svizra

Bundesamt für Energie BFE
Swiss Federal Office of Energy SFOE

REBI PV: REliaBility of PV Systems Integrated in the built environment

Accelerated and not accelerated testing of a set of innovative BIPV products at the early stage on the market, in order to trigger known and unknown failure modes, analyze them in terms of causes and occurrence and, finally, determine a model for the most relevant of them, in order to predict the reliability in different conditions and different engineering margins.

In partnership with EPFL ÉCOLE POLYTECHNIQUE FÉDÉRALE DE LAUSANNE

2019-2022

FNSNF
FONDS NATIONAL SUISSE
SCHWEIZERISCHER NATIONALFONDS
FONDO NAZIONALE SVIZZERO
SWISS NATIONAL SCIENCE FOUNDATION

Schweizerische Eidgenossenschaft
Confédération suisse
Confederazione Svizzera
Confederaziun svizra

Swiss Confederation

Innosuisse – Swiss Innovation Agency

RACONT 2050: Reliability And COmparison of New PV Technologies

Verify in the field and in the laboratory the lifetime, reliability and energy yield of recent new technologies of high efficiency photovoltaic cells and in particular PV modules with PERC/PERT/PERL, HJT, Half-cut, BiFi cells, made with various possible multi-busbar interconnections.

2021-2024

Schweizerische Eidgenossenschaft
Confédération suisse
Confederazione Svizzera
Confederaziun svizra

Swiss Confederation

Innosuisse – Swiss Innovation Agency

Research projects / 2:

MARIE: Reduction of measurement uncertainties of PV modules and systems in the field

Improvement of the accuracy and reliability of power measurements in the field and demonstration of the effectiveness through real case studies.

In partnership with SPF INSTITUT FÜR SOLARTECHNIK

2020-2021

Schweizerische Eidgenossenschaft
Confédération suisse
Confederazione Svizzera
Confederaziun svizra

Bundesamt für Energie BFE
Swiss Federal Office of Energy SFOE

IEA Task 13:

Coordination and dissemination of the Swiss research activities in the frame of reliability of PV

2018-2021

Schweizerische Eidgenossenschaft
Confédération suisse
Confederazione Svizzera
Confederaziun svizra

Bundesamt für Energie BFE
Swiss Federal Office of Energy SFOE

METRO PV

Improvement of the electrical measurent precision, with particular focus on calibration chain, uncertainty assessment and shading characterisation

2020-2023

EMPIR EURAMET

The EMPIR initiative is co-funded by the European Union's Horizon 2020 research and innovation programme and the EMPIR Participating States

SUPSI PVLab: competence for quality

Support to activities on quality testing, verification and improvement in competence

2020-2023

energieschweiz

Research projects / 3:

BIPVBOOST

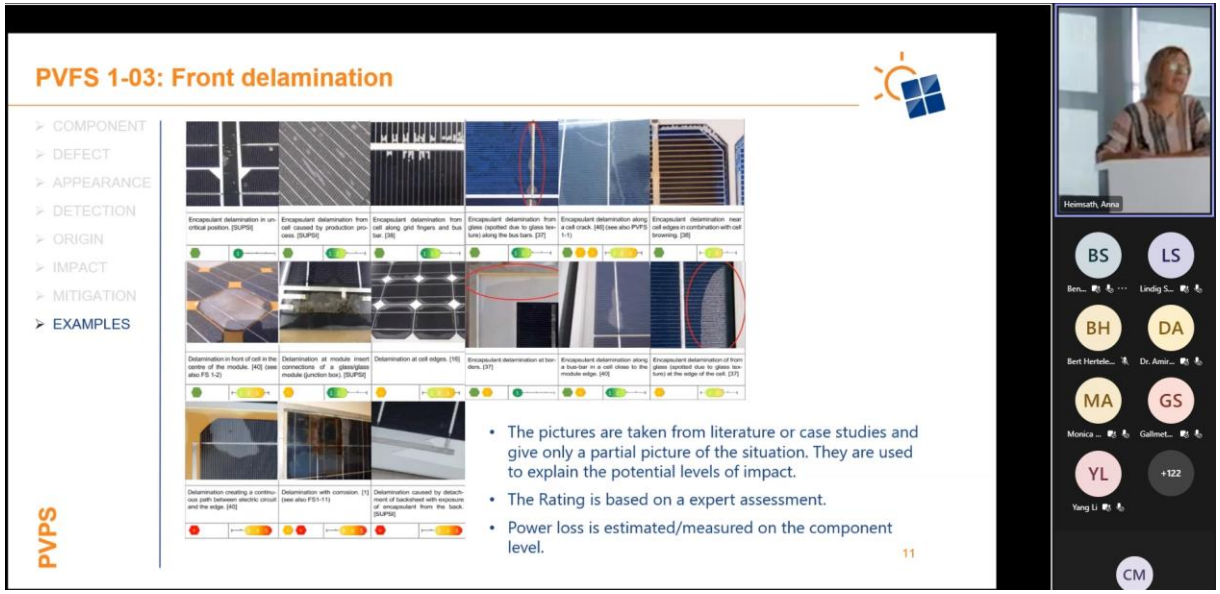
The project aims to bring down the cost of multifunctional building-integrated photovoltaic (BIPV) systems, limiting the overcost with respect to traditional, non-PV, construction solutions and non-integrated PV modules, through an effective implementation of short and medium-term cost reduction roadmaps addressing the whole BIPV value chain and demonstration of the contribution of the technology towards mass realization of nearly Zero Energy Buildings.

Horizon 2020
European Union Funding
for Research & Innovation

Research projects : outdoor mockups, under construction

Networking

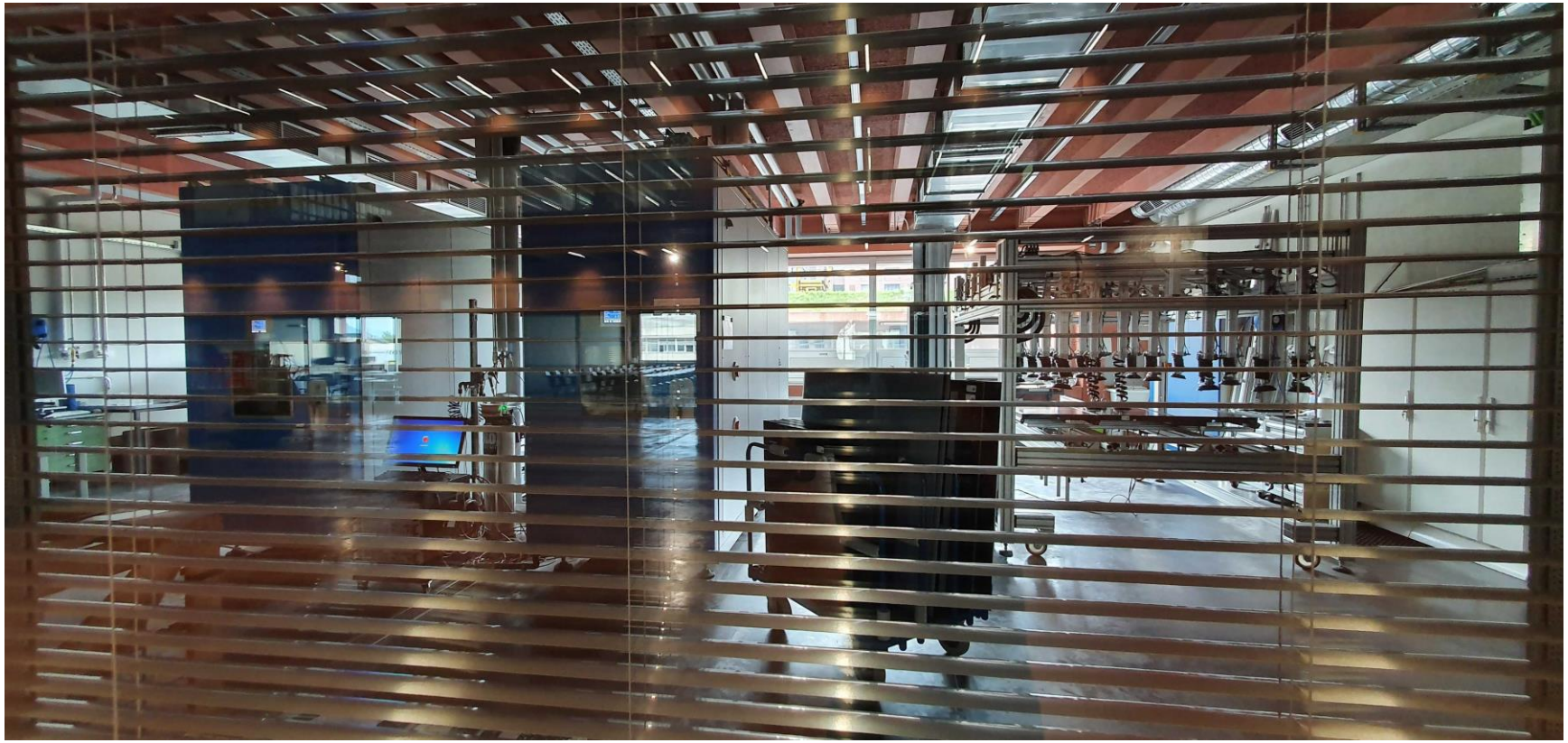
- Participation to IEC TC 82 working group at national and international level (M.Caccivio, G. Bellenda)
- Technical Assessment within IECEE – CB Scheme of IEC (International Electrotechnical Commission), in the Photovoltaic product category (G.Bellenda)
- Participation to IEA Task 13: Performance and Reliability of Photovoltaic Systems (G.Friesen, M.Caccivio)
- Partecipation to IEA Task 15: Acceleration of BIPV (F. Frontini)
- Partecipation to PEARL PV COST action: “Performance and Reliability of Photovoltaic Systems: Evaluations of Large-Scale Monitoring Data”



SUPSI Industry days

WEBINAR 29-30 NOVEMBER, 16:00-18:00 (CEST)

Quality of production, production of energy



Thanks for your attention!