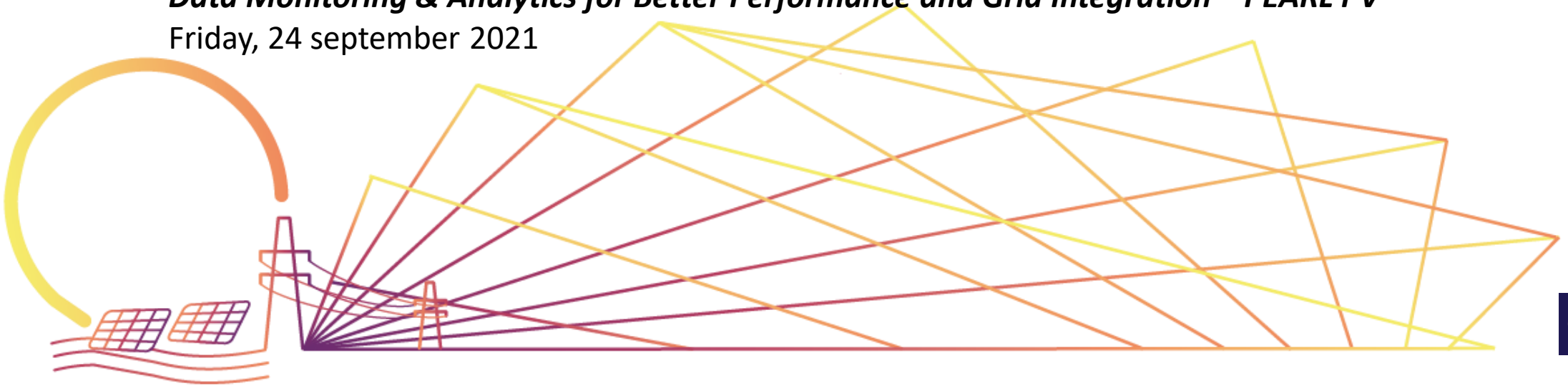
This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement № 953016

Smooth, Reliable and Dispatchable Integration of PV in EU grids H2020 SERENDI-PV

Dr. Monica Aleman for the SERENDI-PV consortium

Data Monitoring & Analytics for Better Performance and Grid Integration – PEARL PV

Friday, 24 september 2021



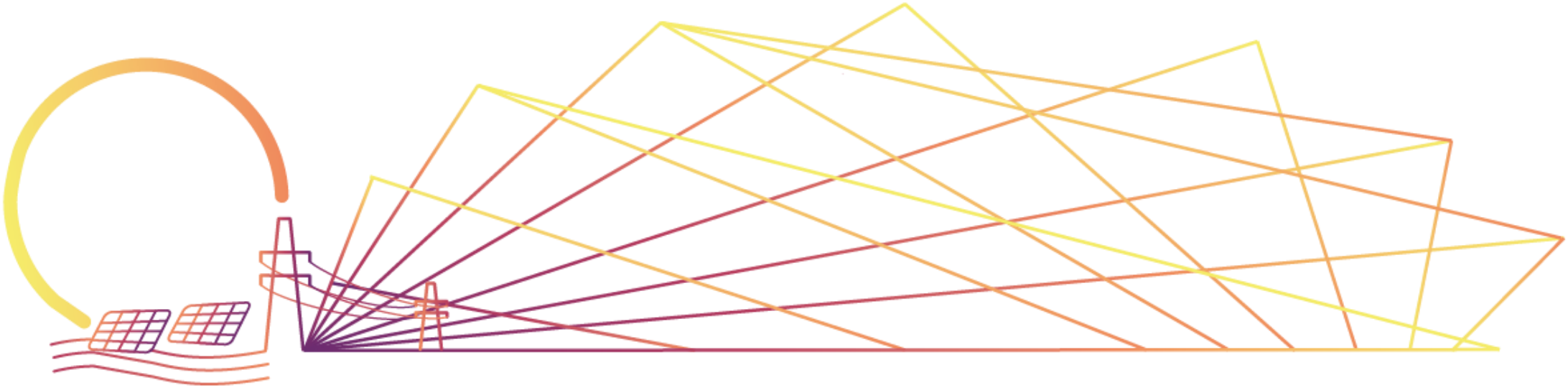
Becquerel Institute at a glance

- Est. 2014 in Brussels, Belgium
- **Applied research and strategic advisory firm**
- Specialized on solar photovoltaics and their ecosystem
- Global PV **Market** Analysis including competitiveness and economics
- **Industry** analysis including technologies as well as quality & reliability
- **Techno-economic** assessment & modelling
- Integration into electricity grids and markets

SERENDI-PV in a nutshell - facts

- 4 years project (2020-2024)
- 12 million €
- 19 partners from wide scope:
  - R&D centers & universities
  - Developers & PV plant owners
  - Inverter and storage manufacturer
  - Service providers
    - Operation and Maintenance (O&M)
    - Forecasting, modelling and consumption optimization
    - Energy traders/ Portfolio managers
  - Distribution System Operator (DSO)
  - Consultancy and communication

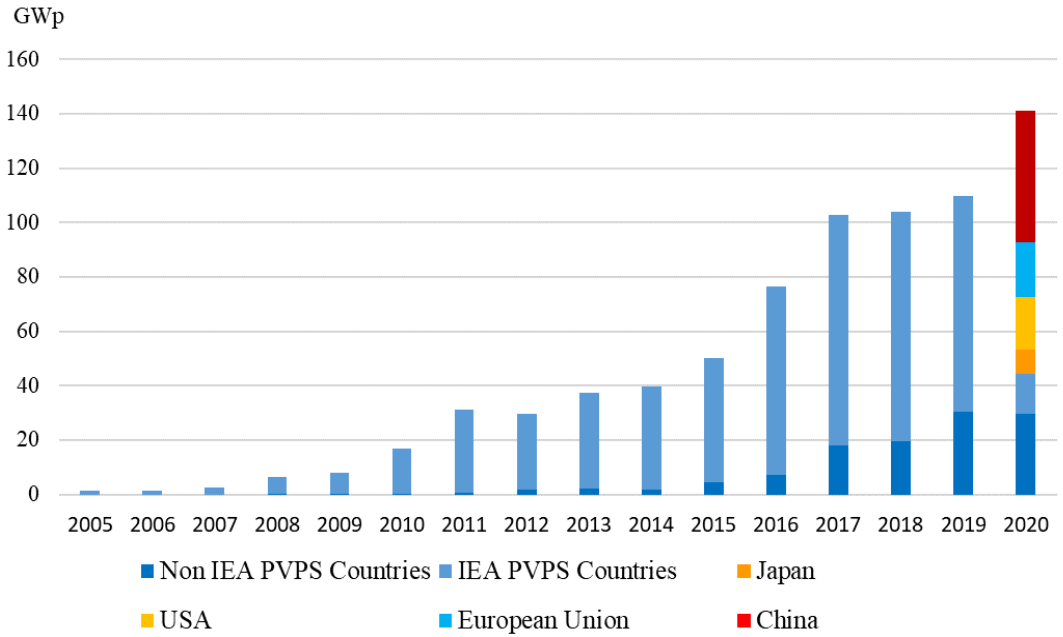
Project Partners



WHY SERENDI-PV?

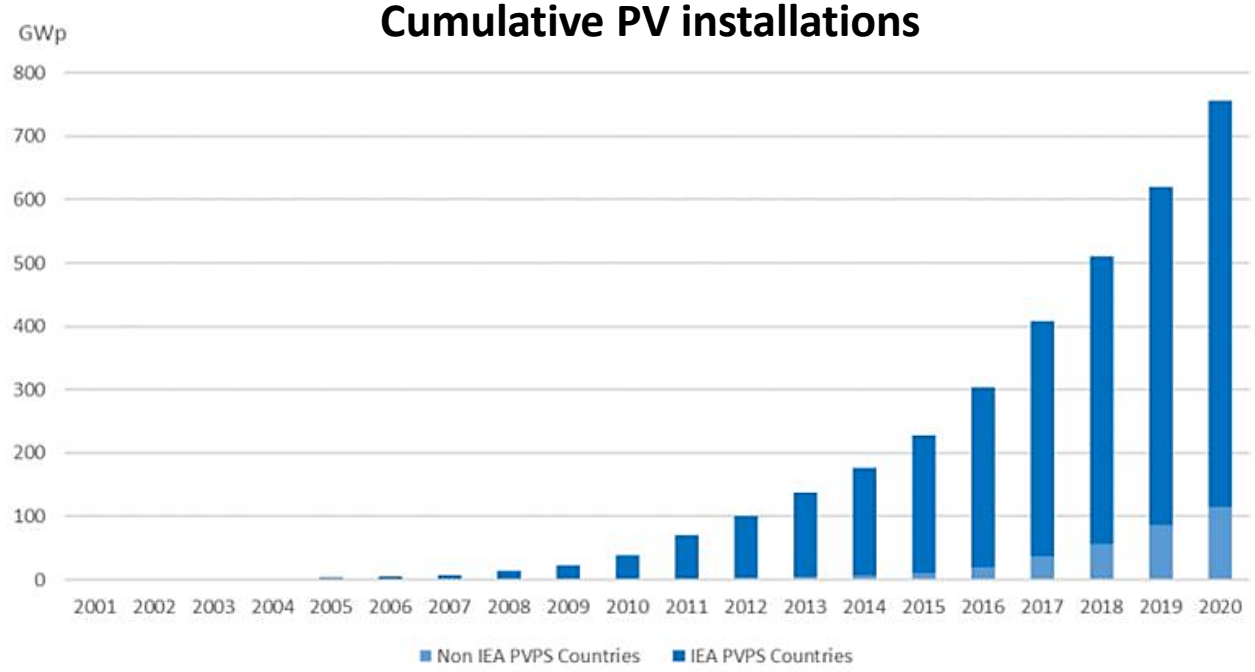
PV installations are steadily increasing

Evolution of annual PV installations (DC)



Snapshot of Global PV markets 2020- IEA PVPS

Cumulative PV installations



Source: IEA PVPS

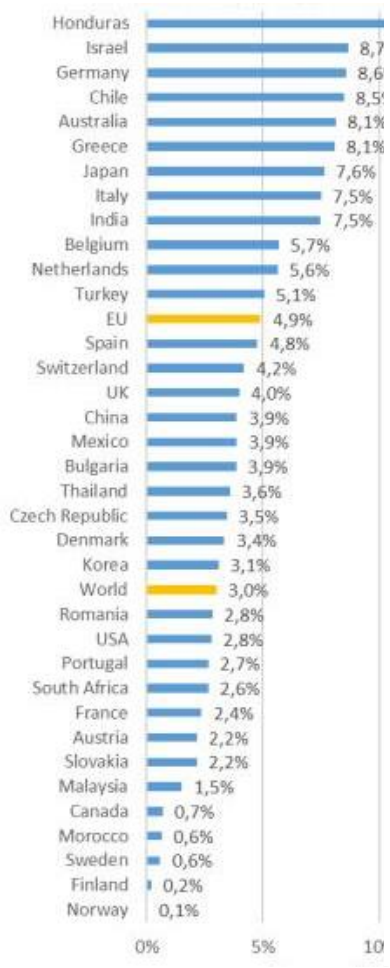
Snapshot of Global PV markets 2020 IEA PVPS T1

PV penetration

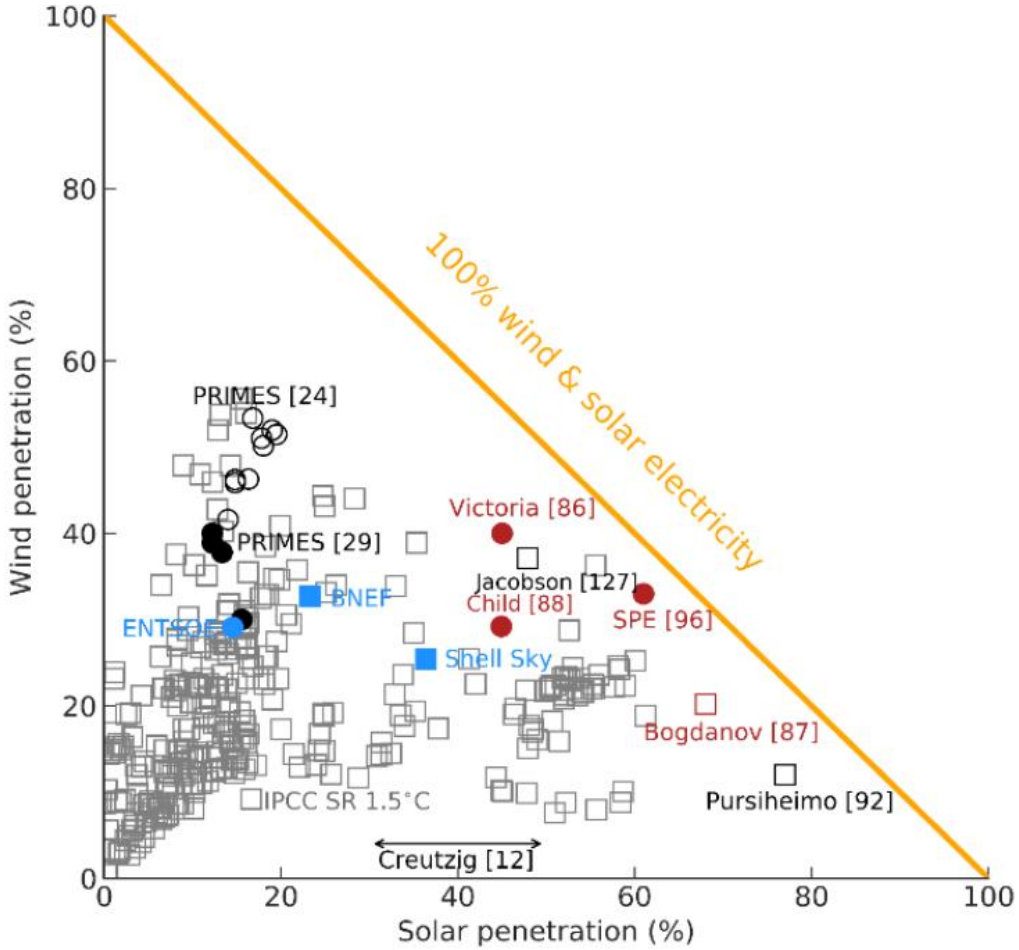
69% penetration by 2050 for PV

Intermittency of PV systems (and Renewables in general)

Higher challenges for network management

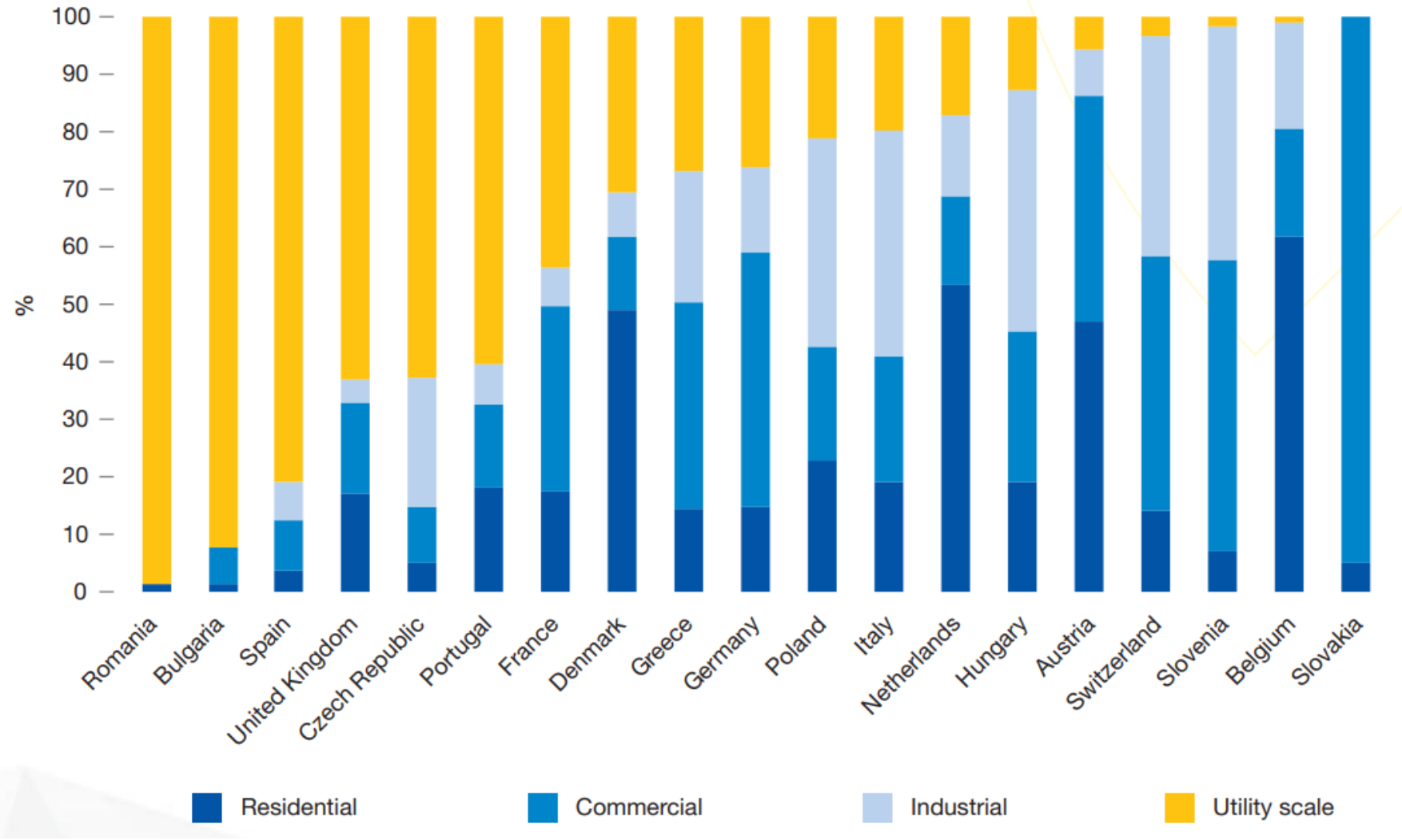


IEA PVPS 2019



Victoria et al. Joule Vol. 5. 2021

The diversified context of Solar PV in Europe



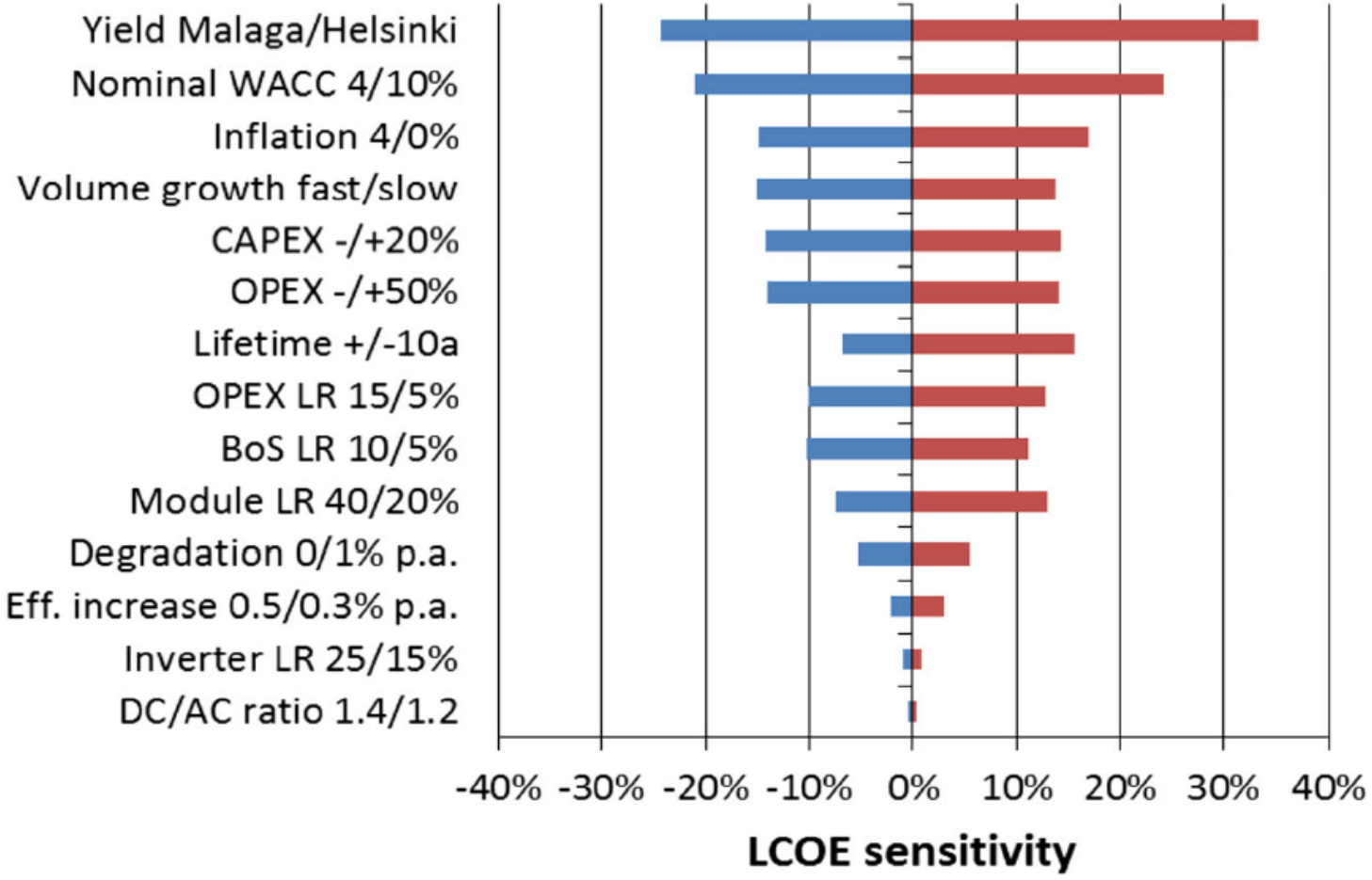
Total relative PV capacity until 2018. Source: Solar Power Europe, 2019

Parameters affecting the Levelized cost of electricity

LCOE ⇨Cost power produced over system lifetime

WACC ⇨ cost of capital (risk)

Vartiainen E., et al. PiP 2019 1– 15. https://doi.org/10.1002/pip.3189.



Decrease WACC = Increase trust in PV

How to increase trust in PV?

- Better quality controls
- Better component reliability
- Better system reliability
- Better energy yield assessments (lower uncertainty)
- Increase the lifetime of PV systems and components
- Increase the performance of PV systems

→ Many key challenges at the **component and system levels**

PV systems are becoming more diversified

Floating PV plant, O'MEGA1, France,

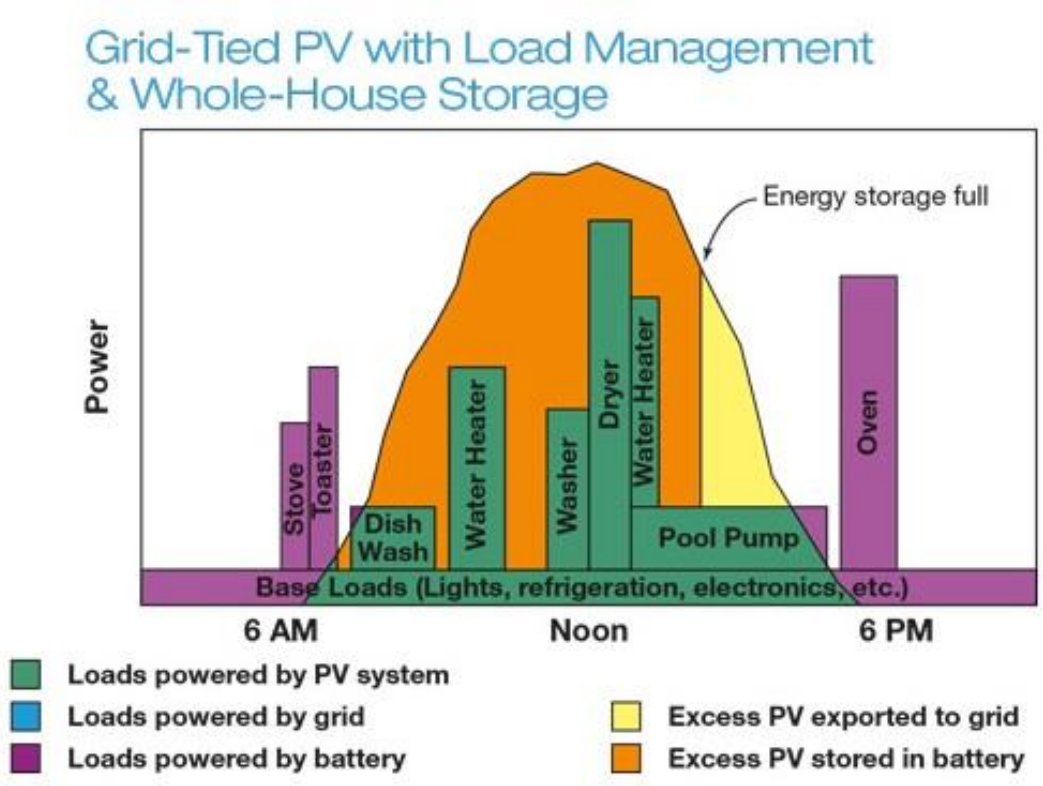
Bifacial PV plant, Egypt

Agri-voltaics, Germany

BIPV, International School of Copenhagen

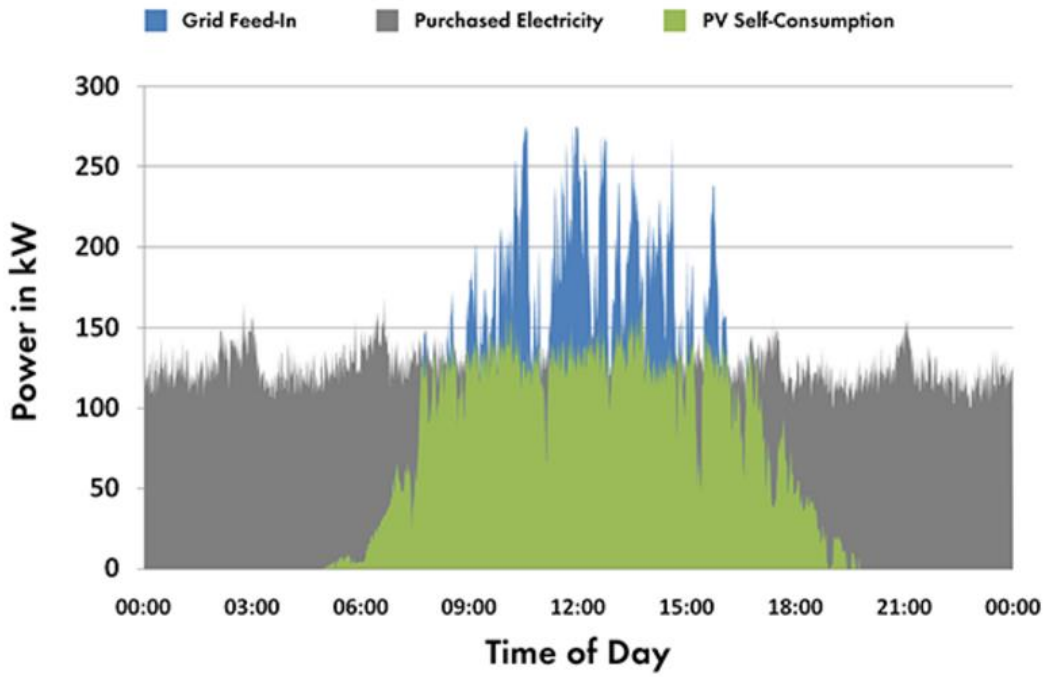
Grid-friendly PV by increasing self-consumption

In an ideal world: load management at will



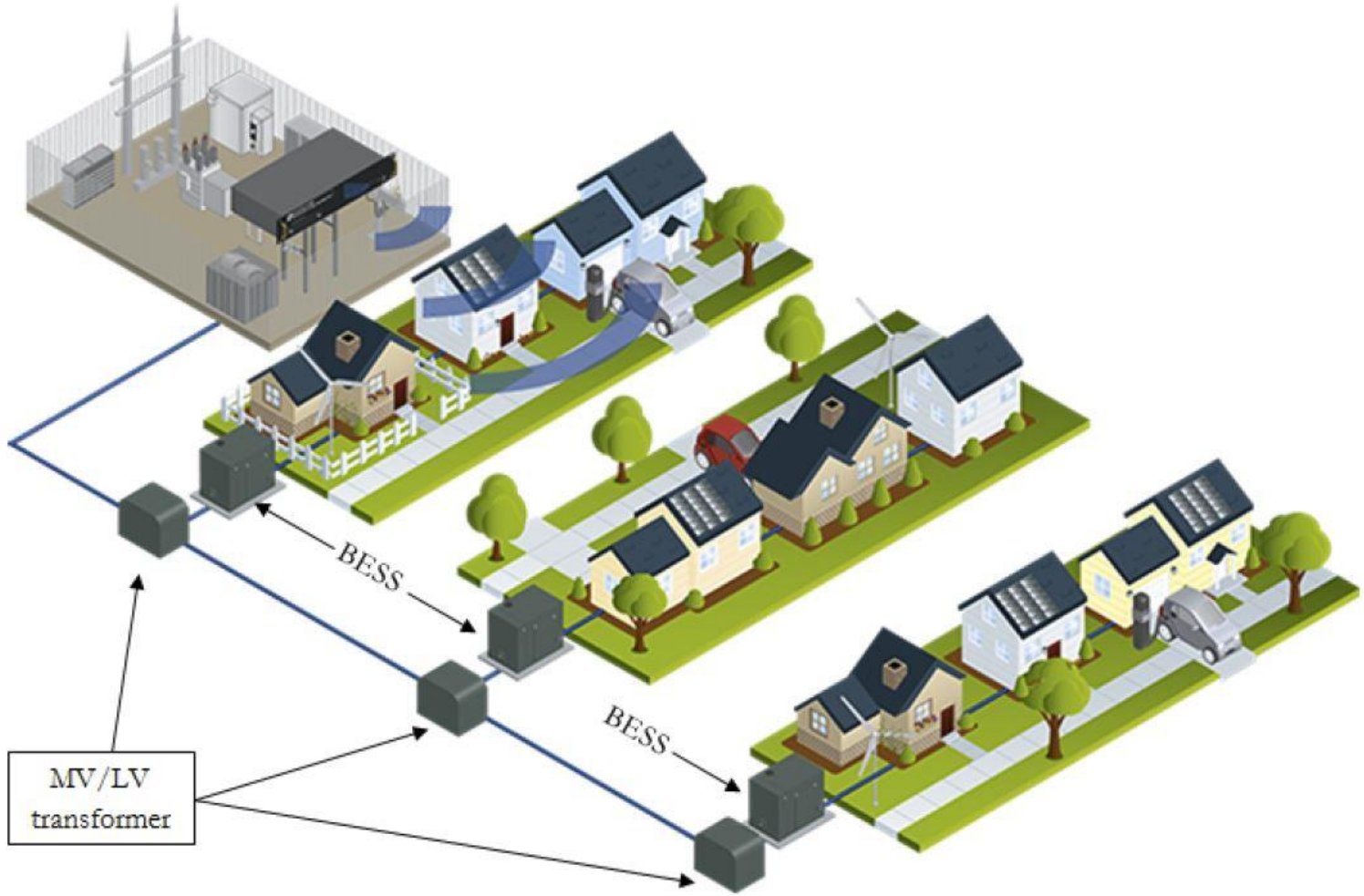
Source: Home Power Magazine 2018

In practice: need for forecasting



Source: SMA 2018

Mini grids and collective self-consumption



The smart (local) smart grid approach
Source: Sisovs 2016

BESS: battery energy storage systems

SERENDI-PV in a nutshell - Objectives

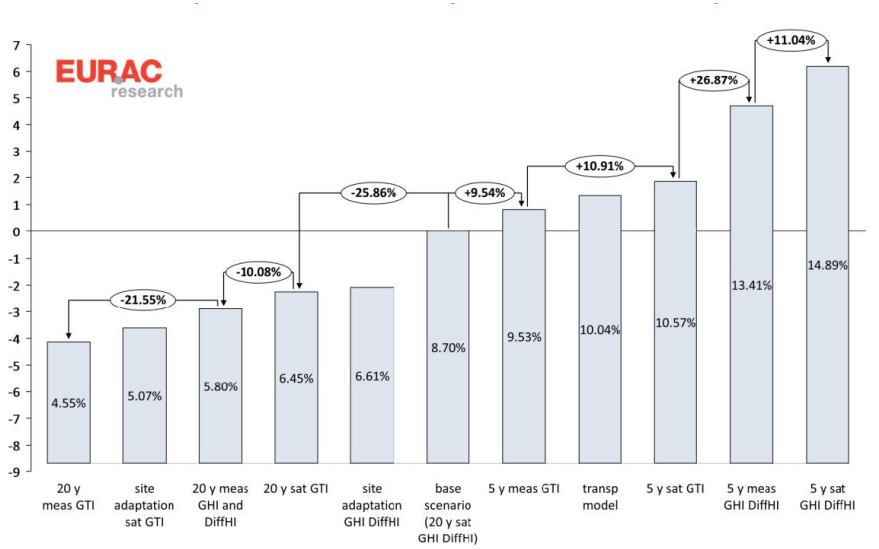
1. Increase reliability and performance of PV systems and components
2. Decrease LCOE from PV generation
3. Higher profitability from PV generation into the grids
4. Grid stability at high PV penetration levels
5. Lower barriers to enhance the development of the PV sector in EU

SERENDI-PV: Axes of work

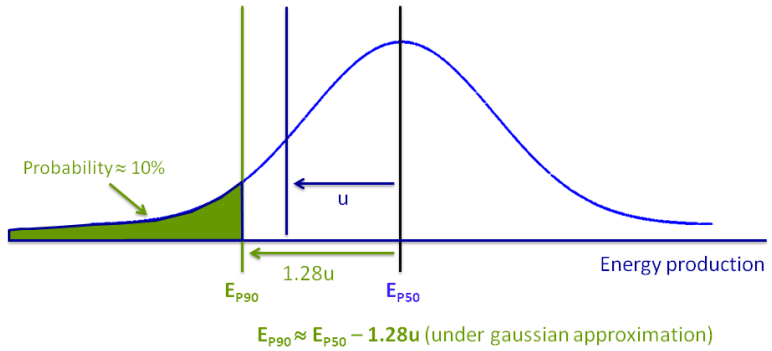
- **WP1** — **Global perspectives on PV reliability, performance and grid integration**
- **WP2** — **Simulation**, modelling for PV systems and components
- **WP3** — **Monitoring** and data analytics for fault diagnostics and O&M
- **WP4** — **On-site testing equipment ane procedures for Quality Control (QC)**
- **WP5** — Power Forecasting
- **WP6** — High **PV integration** into utilities and markets
- **WP7** — Collaborative **modelling and monitoring** platform

Simulation & modelling for PV systems and components design
⇨ for better PV reliability, performance and profitability

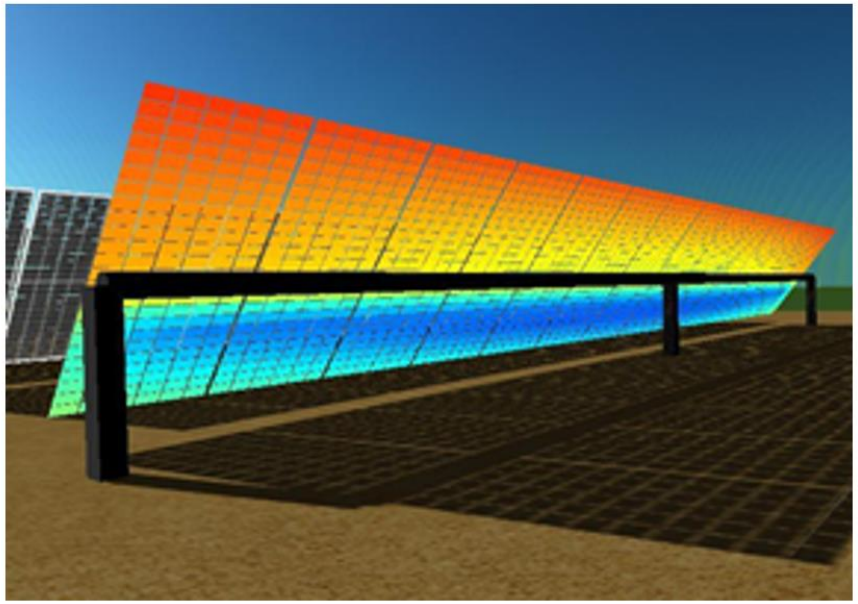
Mitigating the uncertainties on PV projects



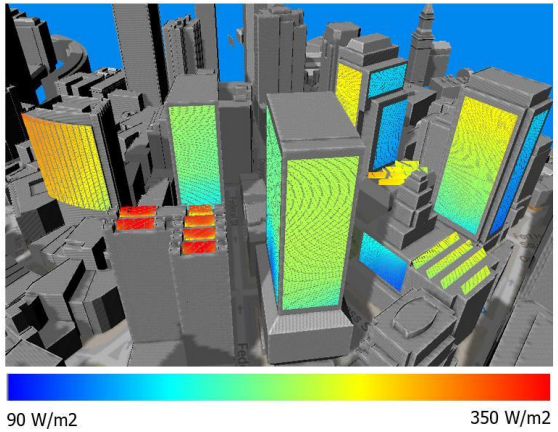
Source: Moser 2018



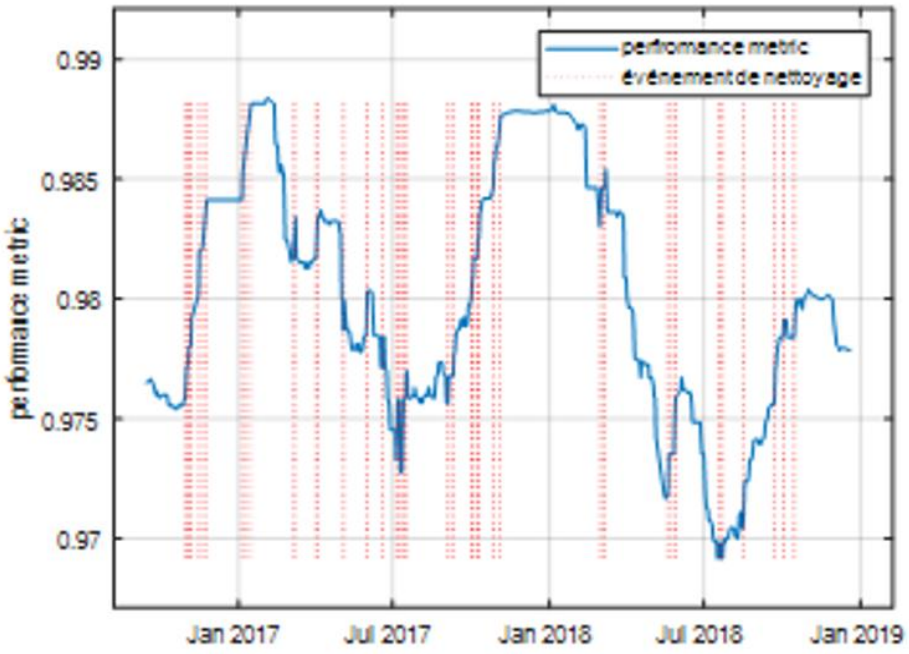
The classical P50-P90 approach for energy yield modelling



Images courtesy of Lucisun



Monitoring and data analytics for fault diagnostics and O&M
⇨ for higher PV performance and profitability



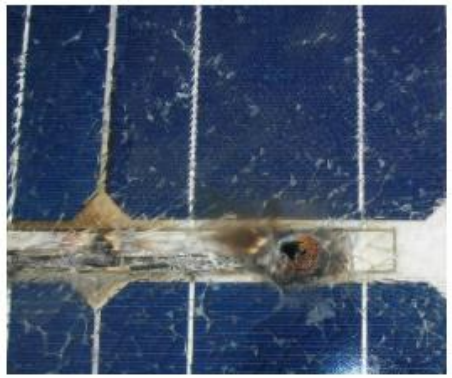
Soiling losses assessment procedure developed by CEA

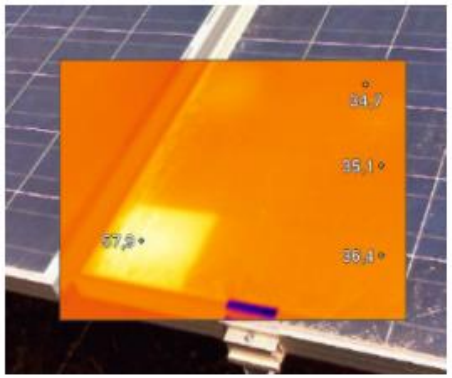
⇨ **Data availability**

⇨ **Data quality**

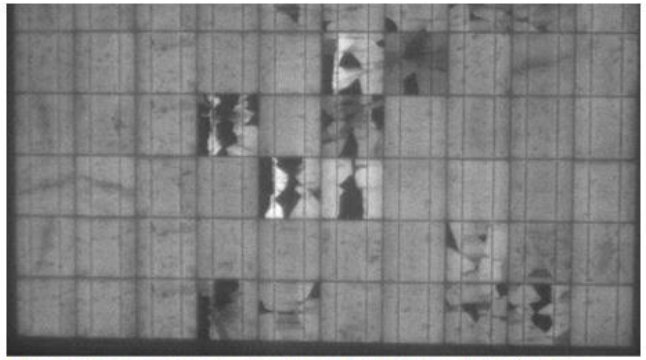
Quality Control (QC) equipment and procedures
⇨ for PV components and systems reliability

- **Laboratory facilities**, providing indoor quality controls at the component level;
- **Field testing toolboxes**, providing outdoor quality controls at the component and system level;
- **Quality control procedures**, providing a coherent frame to exploit field and laboratory testing.

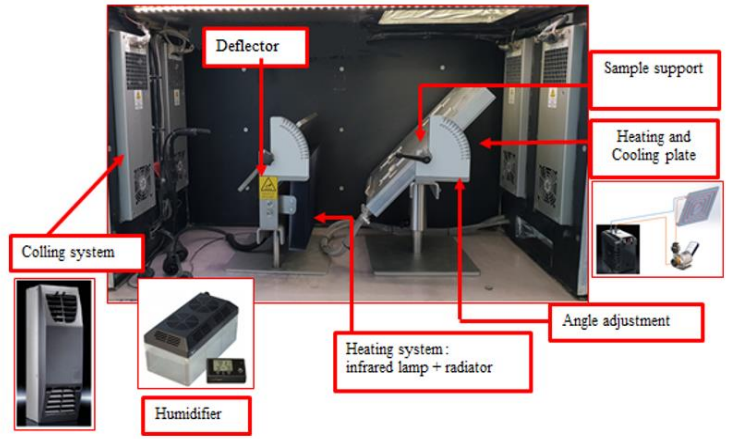




PID sensitivity test

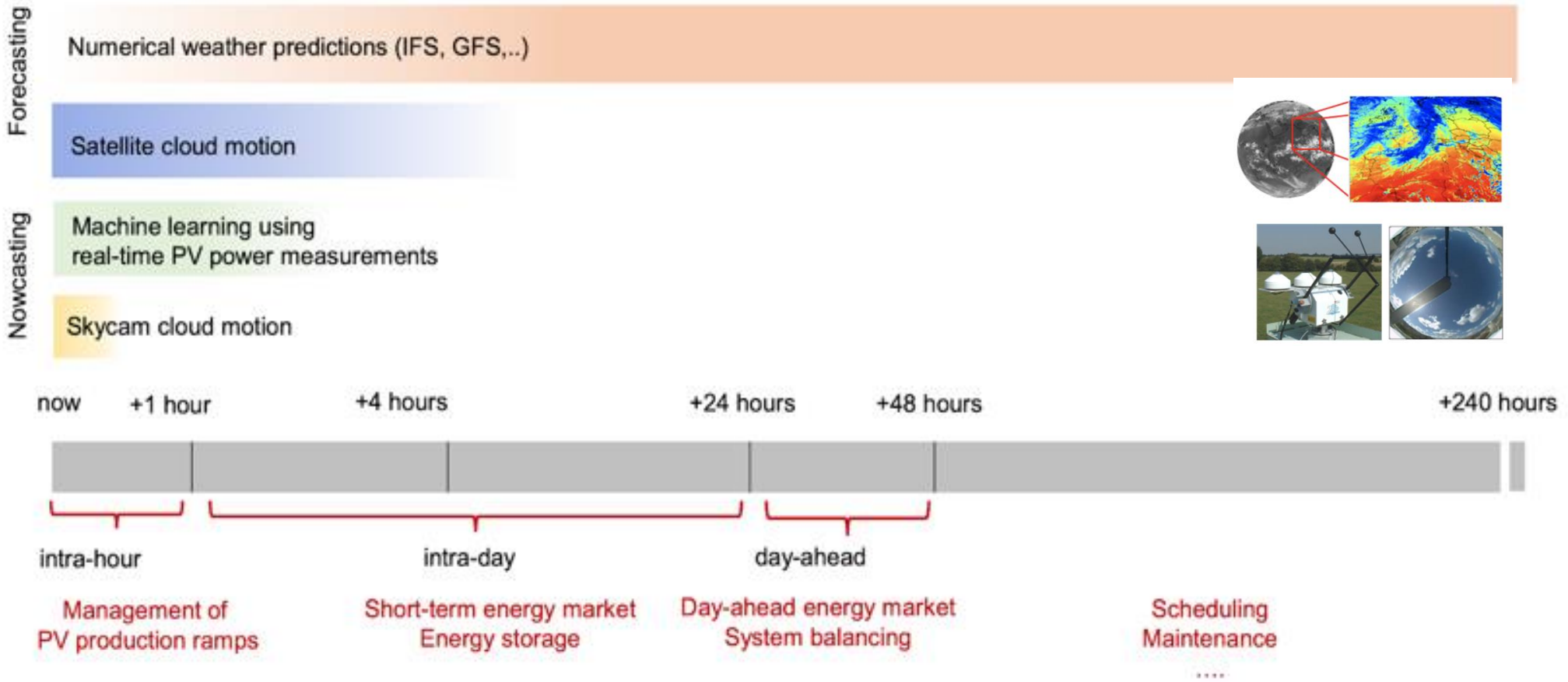


Electroluminescence of a module with fractured cells



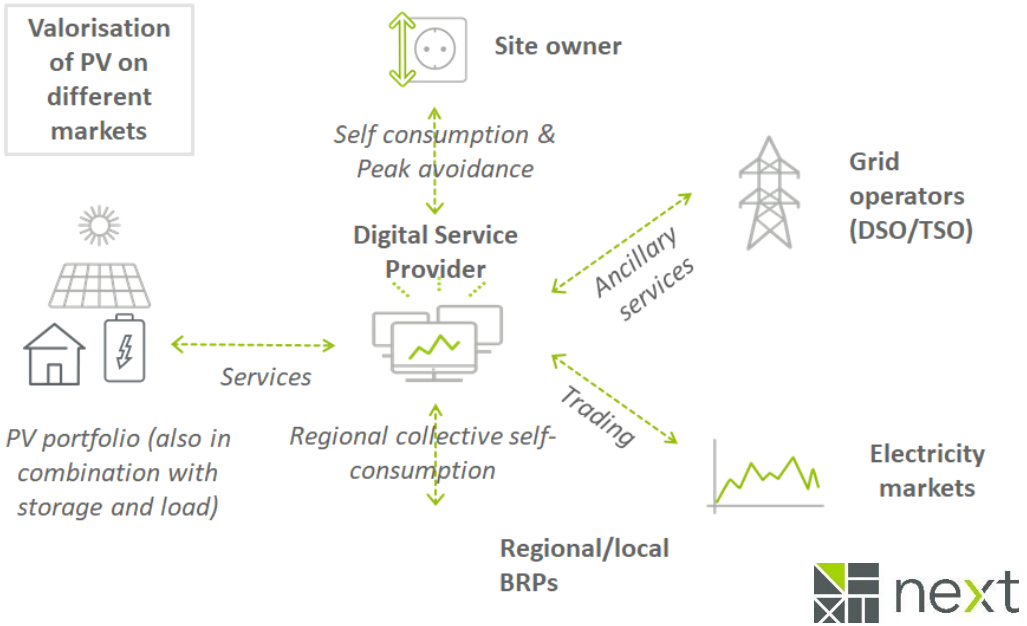
Uniform soiling chamber at CEA

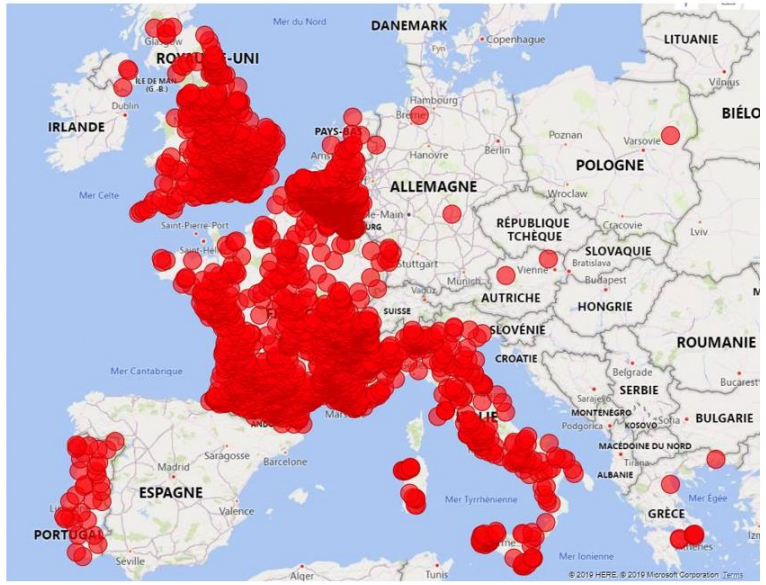
Mid-term, short-term forecasting, and nowcasting
⇨ for PV system aggregations



Data and methods for nowcasting and forecasting implemented at Solargis and Fraunhofer ISE

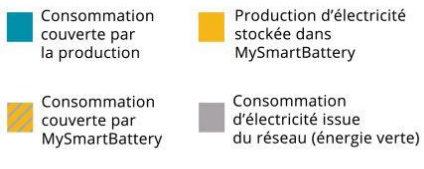
New business models
⇨ for added PV revenue at high-penetration levels

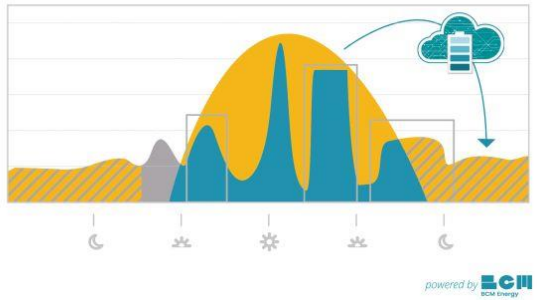




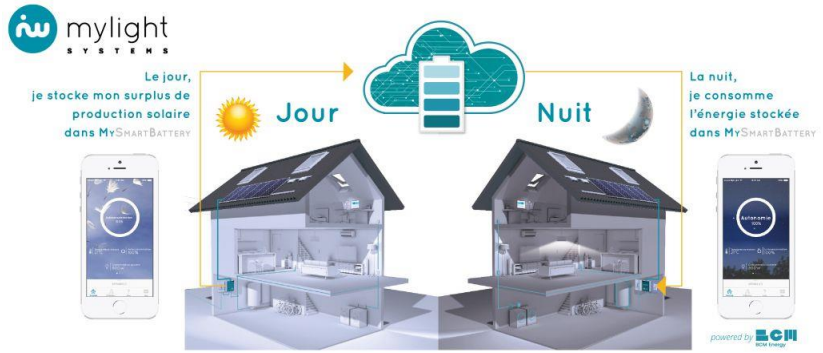
Residential PV systems monitored by Mylight Systems in Europe (around 18,000)

mylight SYSTEMS





mylight SYSTEMS

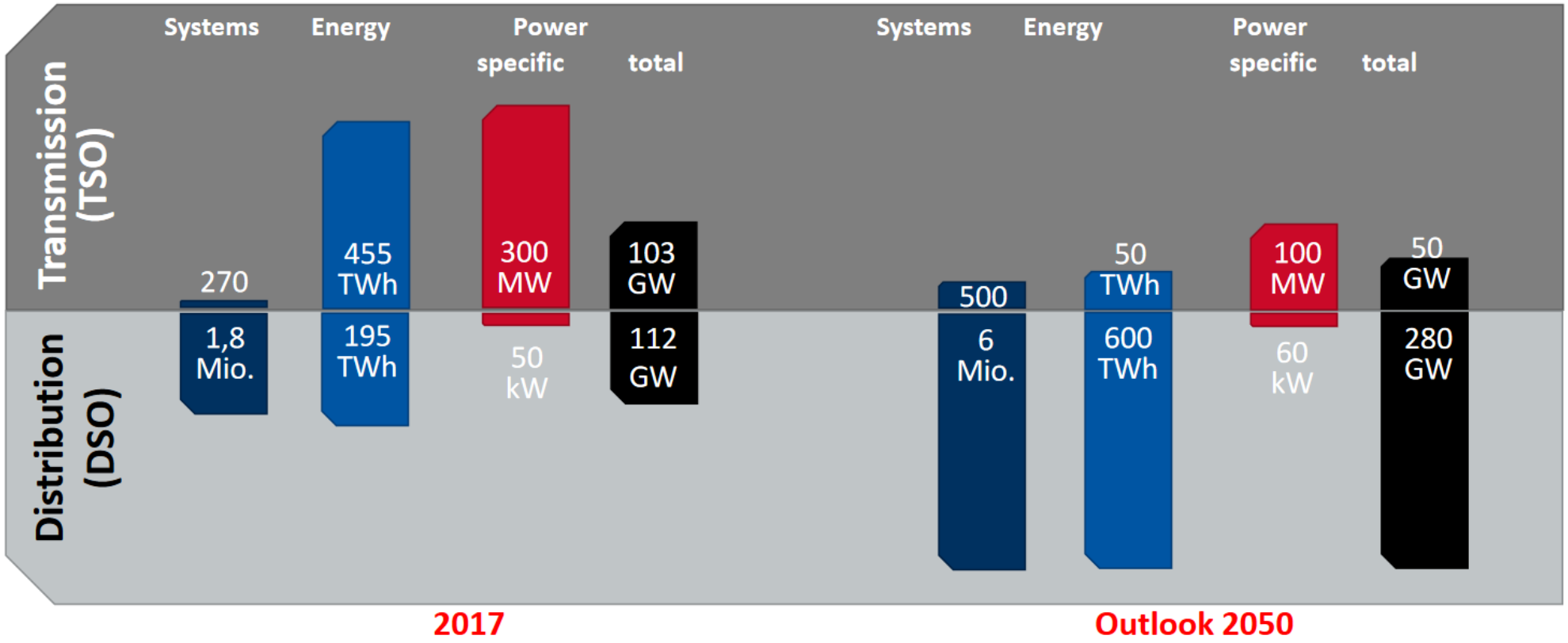


Removing technical constraints
⇨ for the integration of large volumes of PV in the grids

SERENDIPV

The TSO/DSO challenge

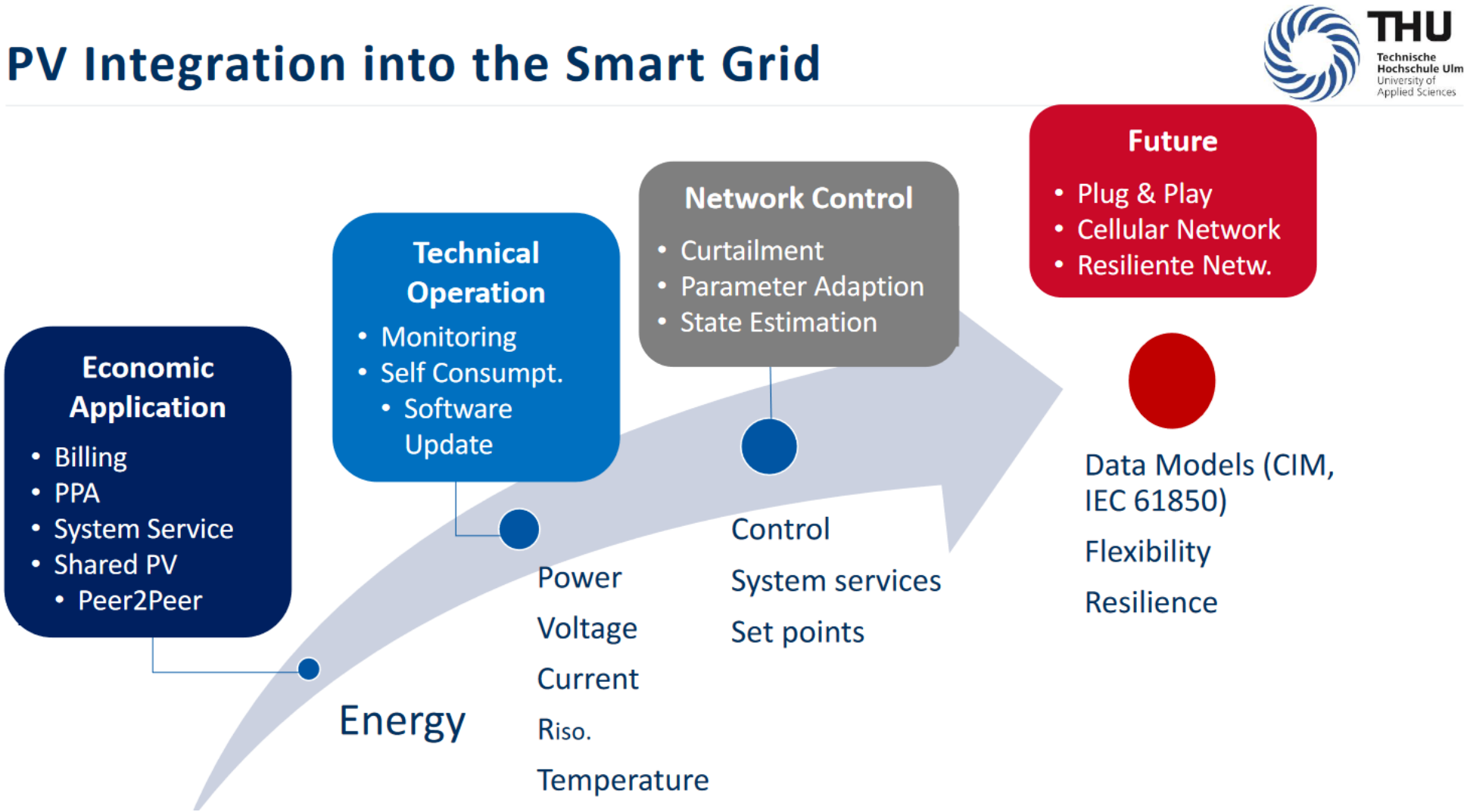
Fundamental transformation of electricity network planning and operation (DE)



Quellen| BnetzA, AGEE-Stat, BMWI

Our target: increase automated processes for distributed energy system registration to the SCADA system
- Develop architectures for data transmission

Integration of PV into the smart grid



WP1 Global perspectives
⇨ Defining Key Performance Indicators

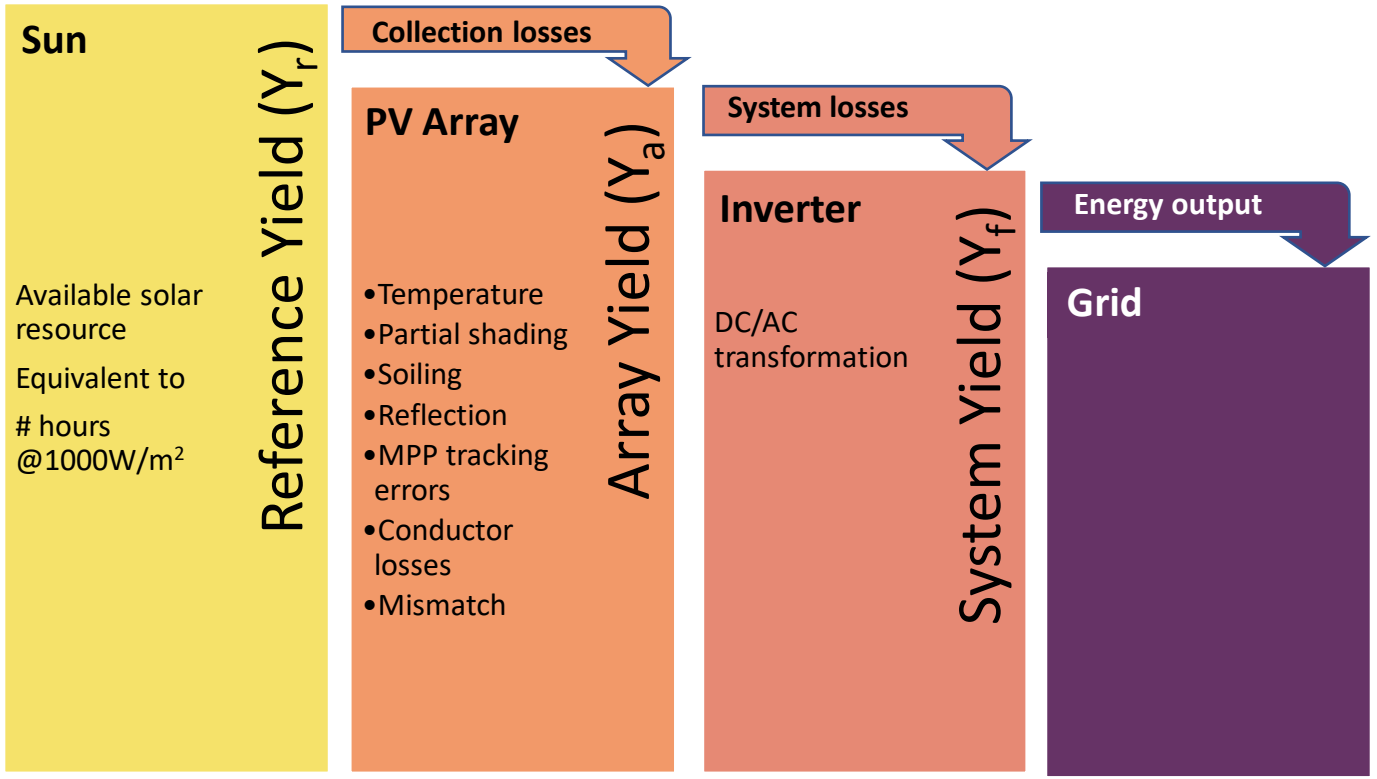
SERENDI-PV KPIs category	SERENDI-PV KPIs
Performance	Performance ratio (PR)
	Temperature-corrected performance ratio (CPR)
	Soiling ratio
Reliability	Performance loss rate (PLR)
	Energy-based availability (A_E)
	Time-based availability (A_R)
Monitoring	Energy Performance Index
	Data quality
	Data availability
Profitability	Levelized cost of electricity (LCOE)
	Profile factor
	WACC
	Net present value (NPV)
	(Modified) internal rate of return (IRR)

Example:

Performance Ratio:

Which source for the reference yield data?

- Pyranometer
- Reference cell
- Satellite



Our first report including details about the KPIs definition will be available soon at the SERENDI-PV website https://serendipv.eu/

Thank you!

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SERENDIPV

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