PV Manufacturing in Europe: ensuring Resilience through industrial policy

pv magazine webinar

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ETIP Photovoltaics

The European Technology and Innovation Platform for Photovoltaics

etip-pv.eu

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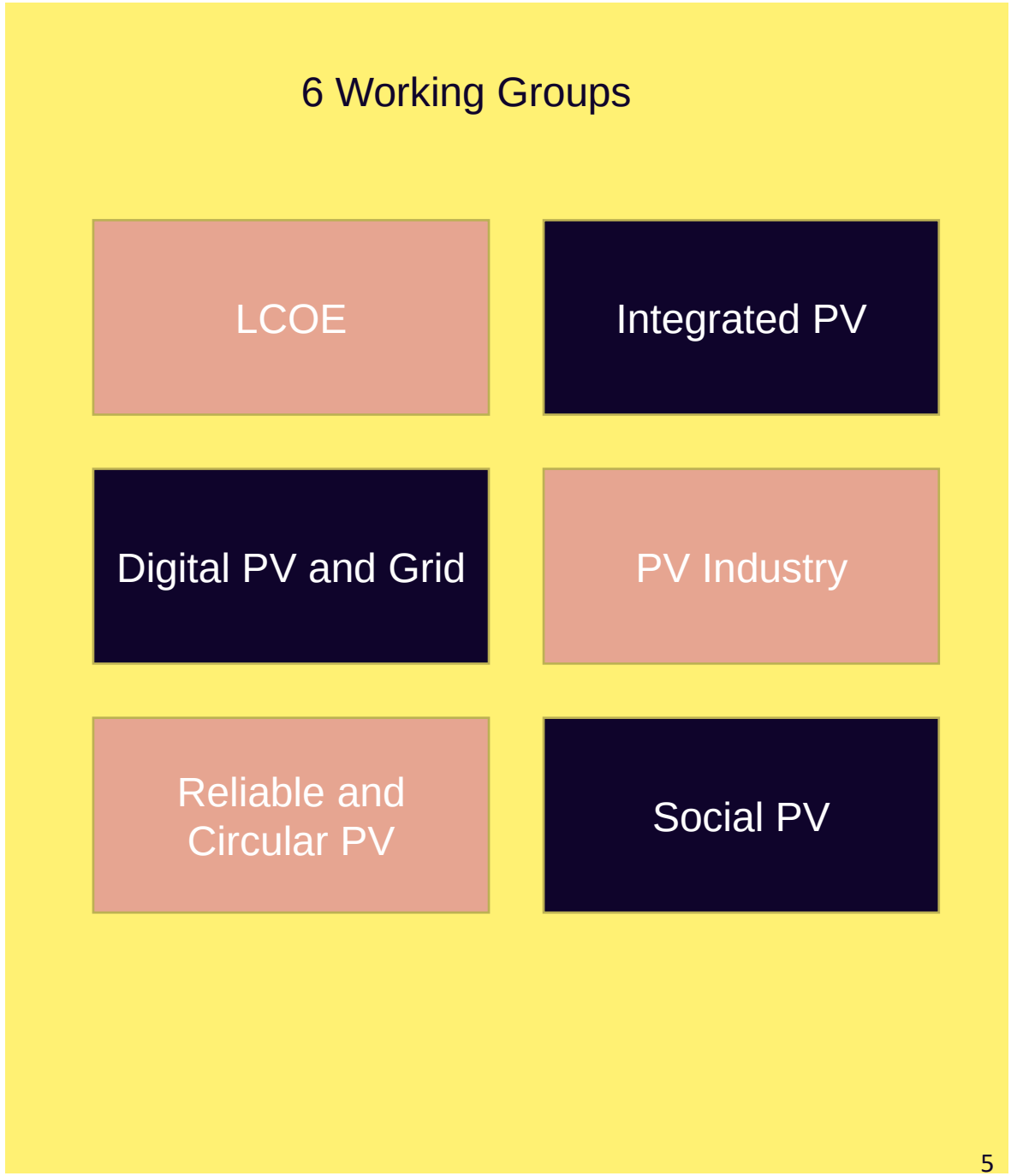
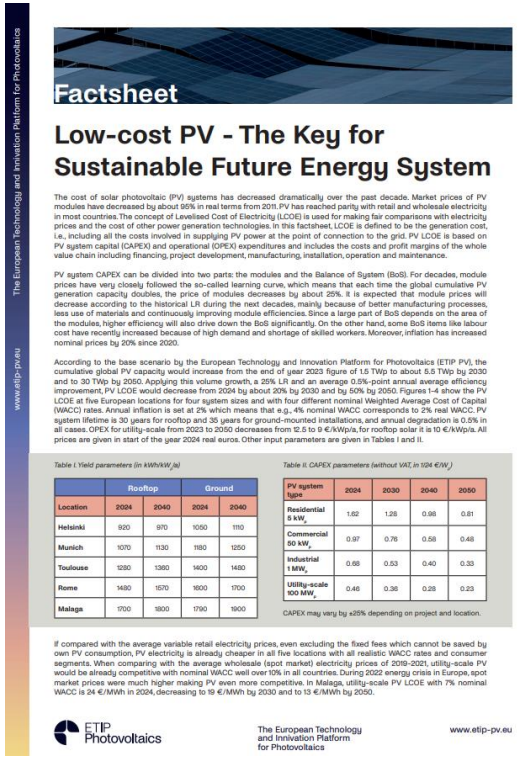
The ETIP PV (European Technology and Innovation Platform for Photovoltaics) is a European Union-funded platform that brings together industry, research, and policy representatives to develop and promote a sustainable and competitive photovoltaics (PV) sector in Europe. Its main goal is to support the deployment of PV technologies and to increase the share of PV in the EU's energy mix. The ETIP PV works on research and innovation, market deployment and integration, and international cooperation.

ETIP PV: Bringing together research and industry experts

- **Steering committee** takes strategic decisions, with 30 experts from industry and academia
  - Chair: Rutger Schlatmann, Helmholtz HBZ
  - Vice Chairs: David Moser, EURAC – Jutta Trube, VDMA
- **Key outputs**: Strategic Research & Innovation Agenda, ETIP PV Vision, Annual ETIP PV Conference



ETIP PV Publications


Factsheet

Low-cost PV - The Key for Sustainable Future Energy System

The cost of solar photovoltaic (PV) systems has decreased dramatically over the past decade. Market prices of PV modules have decreased by about 95% in real terms from 2011. PV has reached parity with retail and wholesale electricity in most countries. The concept of Levelised Cost of Electricity (LCOE) is used for making fair comparisons with electricity prices and the cost of other power generation technologies. In this factsheet, LCOE is defined to be the generation cost, i.e., including all the costs involved in supplying PV power at the point of connection to the grid. PV LCOE is based on PV system capital (CAPEX) and operational (OPEX) expenditures and includes the costs and profit margins of the whole value chain including financing, project development, manufacturing, installation, operation and maintenance.

PV system CAPEX can be divided into two parts: the modules and the Balance of System (BoS). For decades, module prices have very closely followed the so-called learning curve, which means that each time the global cumulative PV generation capacity doubles, the price of modules decreases by about 25%. It is expected that module prices will decrease according to the historical LR during the next decades, mainly because of better manufacturing processes, less use of materials and continuously improving module efficiencies. Since a large part of BoS depends on the area of the modules, higher efficiency will also drive down the BoS significantly. On the other hand, some BoS items like labour cost have recently increased because of high demand and shortage of skilled workers. Moreover, inflation has increased nominal prices by 20% since 2020.

According to the base scenario by the European Technology and Innovation Platform for Photovoltaics (ETIP PV), the cumulative global PV capacity would increase from the end of year 2023 figure of 1.5 TWp to about 5.5 TWp by 2030 and to 30 TWp by 2050. Applying this volume growth, a 25% LR and an average 0.5%-point annual average efficiency improvement, PV LCOE would decrease from 2024 by about 20% by 2030 and by 50% by 2050. Figures 1–4 show the PV LCOE at five European locations for four system sizes and with four different nominal Weighted Average Cost of Capital (WACC) rates. Annual inflation is set at 2% which means that e.g., 4% nominal WACC corresponds to 2% real WACC. PV system lifetime is 30 years for rooftop and 35 years for ground-mounted installations, and annual degradation is 0.5% in all cases. OPEX for utility-scale from 2023 to 2050 decreases from 12.5 to 9 €/kWp/a, for rooftop solar it is 10 €/kWp/a. All prices are given in start of the year 2024 real euros. Other input parameters are given in Tables I and II.

Table I. Yield parameters (in kWh/kW$_p$/a)

	Rooftop		Ground	
Location	2024	2040	2024	2040
Helsinki	920	970	1050	1110
Munich	1070	1130	1180	1250
Toulouse	1230	1380	1400	1480
Rome	1480	1570	1600	1700
Malaga	1700	1800	1790	1900

Table II. CAPEX parameters (without VAT, in 1/24 €/W$_p$)

PV system type	2024	2030	2040	2050
Residential 5 kW$_p$	1.62	1.28	0.98	0.81
Commercial 50 kW$_p$	0.97	0.76	0.58	0.48
Industrial 1 MW$_p$	0.68	0.53	0.40	0.33
Utility-scale 100 MW$_p$	0.46	0.36	0.28	0.23

CAPEX may vary by ±25% depending on project and location.

If compared with the average variable retail electricity prices, even excluding the fixed fees which cannot be saved by own PV consumption, PV electricity is already cheaper in all five locations with all realistic WACC rates and consumer segments. When comparing with the average wholesale (spot market) electricity prices of 2019-2021, utility-scale PV would be already competitive with nominal WACC well over 10% in all countries. During 2022 energy crisis in Europe, spot market prices were much higher making PV even more competitive. In Malaga, utility-scale PV LCOE with 7% nominal WACC is 24 €/MWh in 2024, decreasing to 19 €/MWh by 2030 and to 13 €/MWh by 2050.

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White Paper -
ETIP PV Social PV Working Group

Towards Sustainable and Massive Deployment of Photovoltaics: The Nexus of Socio-Economic and Technological Challenges

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ETIP PV Industry Working Group White Paper

PV Manufacturing in Europe: understanding the value chain for a successful industrial policy

→ Reports, White Papers, Factsheets, Paper, etc

Strategic Research and Innovation Agenda (2021)

- Document with international relevance
- Used to «inspire» new calls for funding
- Used to assess the impact and ambition of projects
- Used to showcase the importance of PV and the vision towards 2030 and beyond

White paper presentation

We have strong EU (and national) commitment to **Reshore PV production!**

REPowerEU, EU Solar Energy Strategy

Establishes objectives for EU PV deployment and for the consolidation of a European PV Manufacturing supply chain, setting up the European Solar PV Industry Alliance

EU Net-Zero Industry Act (NZIA)

Provides tools to scale up net-zero technology manufacturing (notably PV) to cover 40% of EU annual demand by 2030

- Simplified regulatory framework
- List of strategic net zero technologies including PV
- non-price and prequalification criteria to be applied in 20% of all auctioned volumes per year per Member States (European Council Proposal)
- Prequalification criteria based on resilience and proposed import limitation based on GPA (European Parliament)

Manufacture

20 GW
Minimum production of solar photovoltaics by 2025

Deploy

320 GW
by 2025

600 GW
by 2025

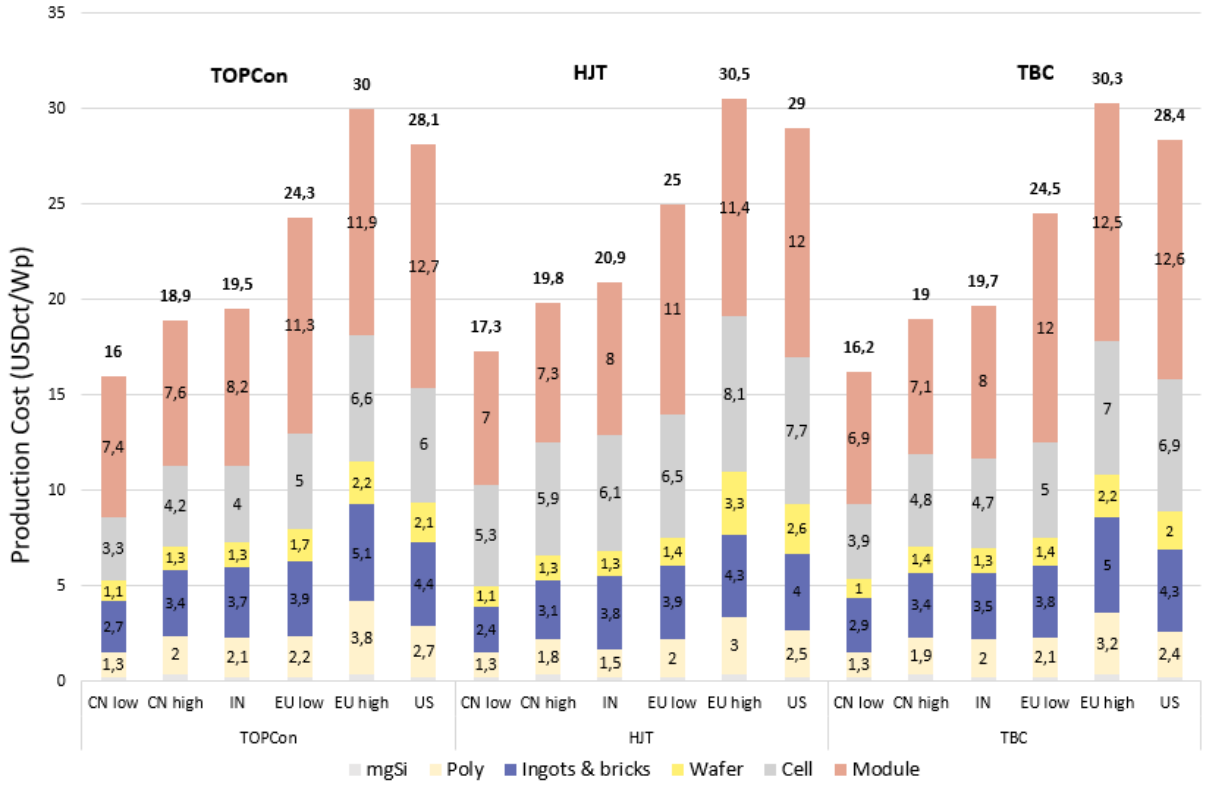
Temporary Crisis and Transition Framework (TCTF)

Easing the State Aid Rules to enable European Member States to deliver CAPEX support for up to 40% of relevant costs to clean energy technology manufacturing, notably for PV (Used by Germany, France…)

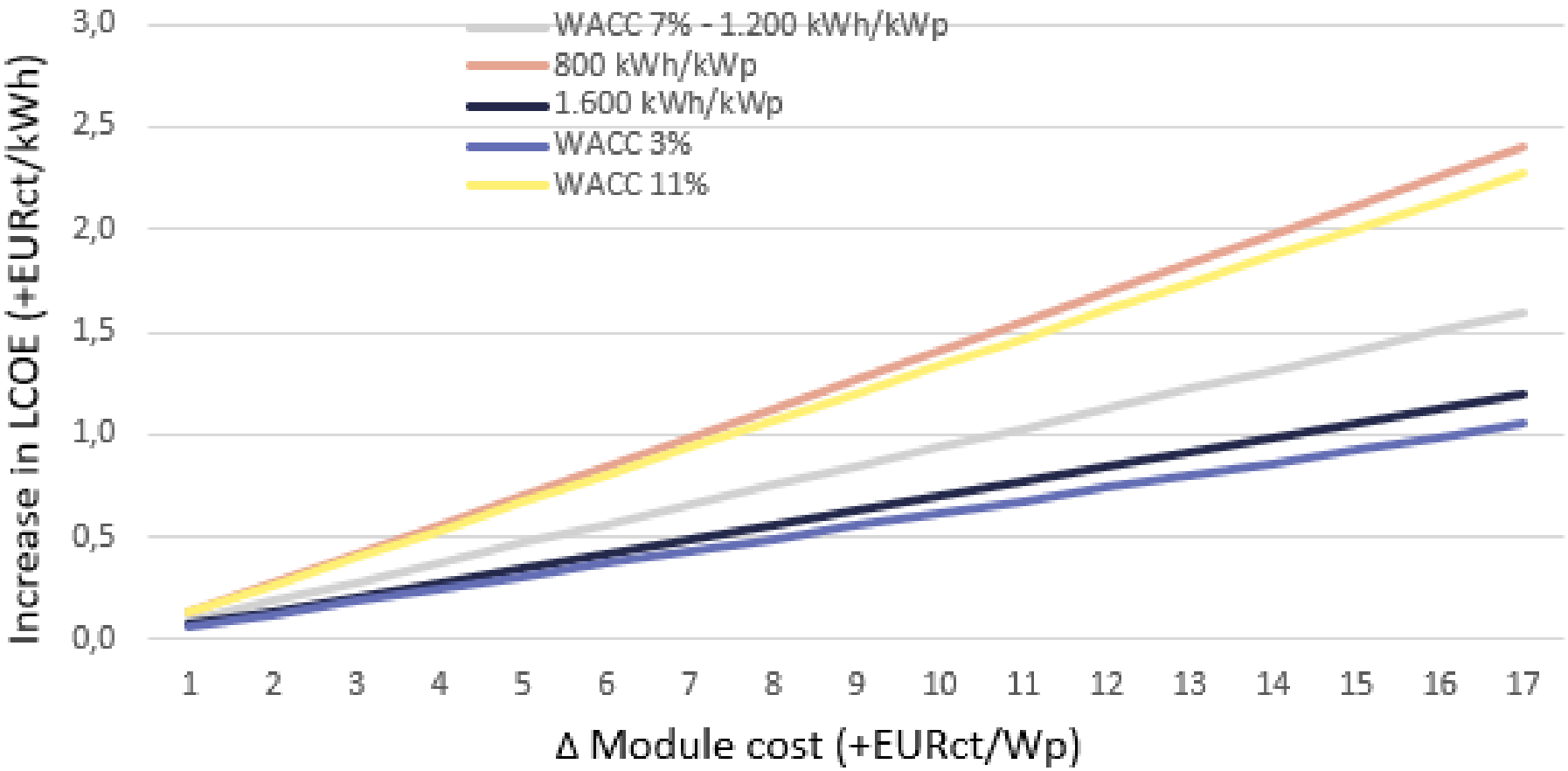
Current situation
production cost gap compared to other global regions

Significant variations in the material costs, labor costs and the equipment & building depreciation costs from one region to another

- Up to 30% difference in material costs from shipment, economies of scale and import taxes in certain countries.
- Labor cost can vary by a factor of 8
- Electricity cost in Europe or the USA can be up to 5 times higher compared to China.
- Equipment CAPEX can be higher by 40% for western equipment including the imposed import duties.
- Building costs for a manufacturing plant are around 2 times higher in Western markets compared to China



The cost of resilience
Influence of higher module prices on LCOE



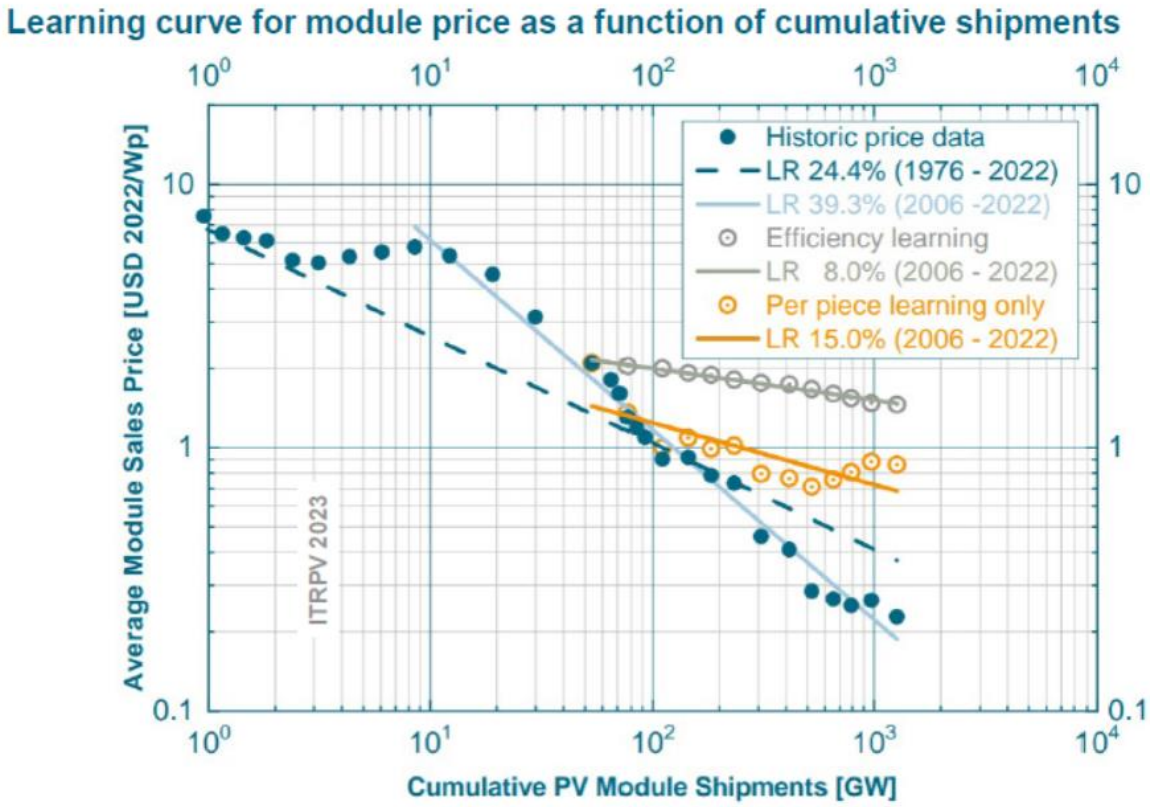
Resilience gaps in the European PV value chain

Industrial & technology gaps	**Upstream manufacturing:** Equipment availability & OPEX	**Solar Cells:** Standardisation & industrialisation of new technologies	**Modules:** OPEX challenge & component costs
General	Need for predictable, clear & long-term support Innovation: low pilot lines capacity as a challenge to upscaling Challenging financing framework Purchase agreements (off-takers for emerging industrial production)		
Structural factors to reduce manufacturing costs	Economies of scale Supply chain integration Automation Supply from RES for low energy-OPEX of production		

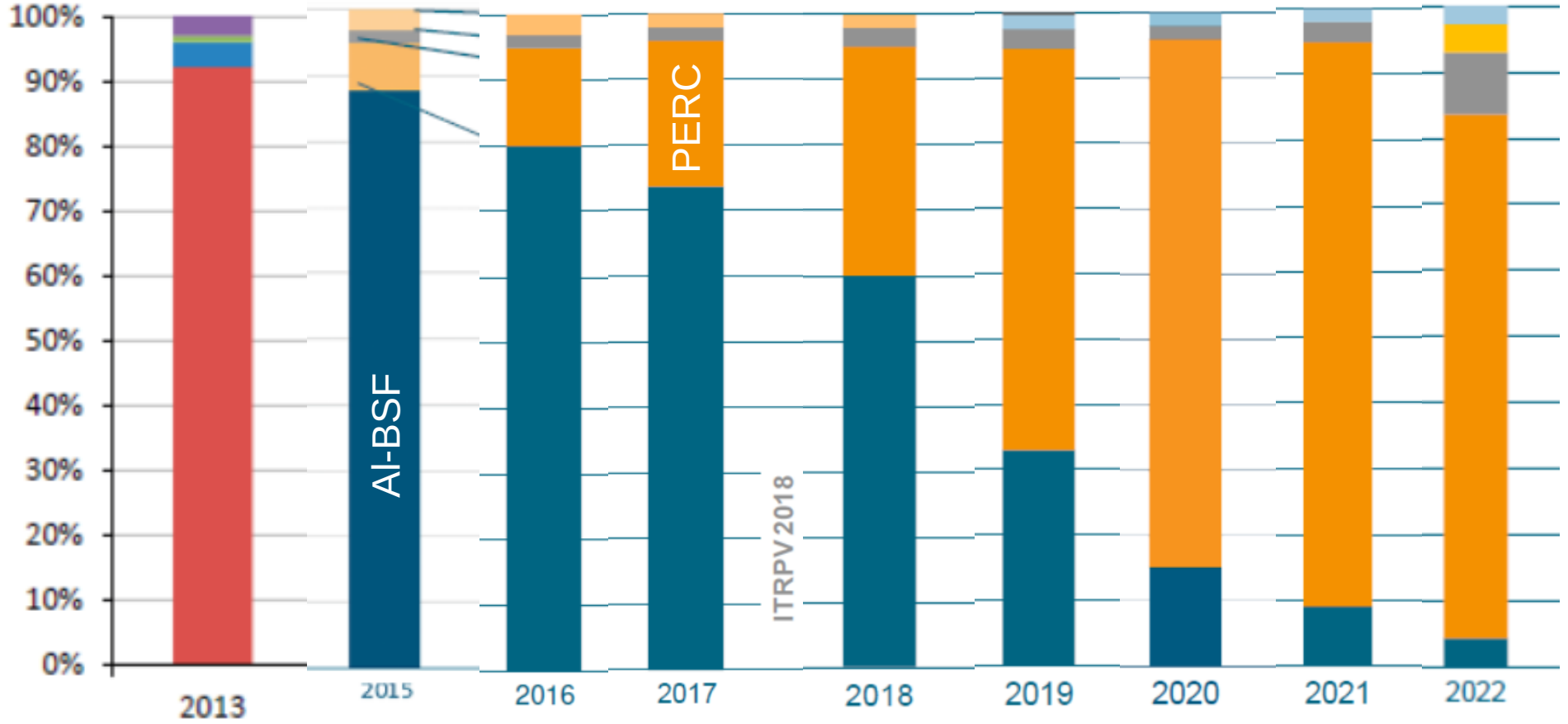
Innovation
Key to achieving and maintaining competitiveness

- Learning curve for PV is a result of maturing industry and supply chain, scaling effects **and technology / efficiency improvements**
- Many of these improvements were developed in Europe through close collaboration between industry and strong R&D centres.
- European R&D community continues to innovate* but competitors are scaling up their R&D as well.
- Innovation is key to continue the learning curve and one important aspect in achieving and maintaining global competitiveness.

*for more details see „ETIP PV Industry Working Group White Paper: PV Manufacturing in Europe: understanding the value chain for a successful industrial policy" (2023)

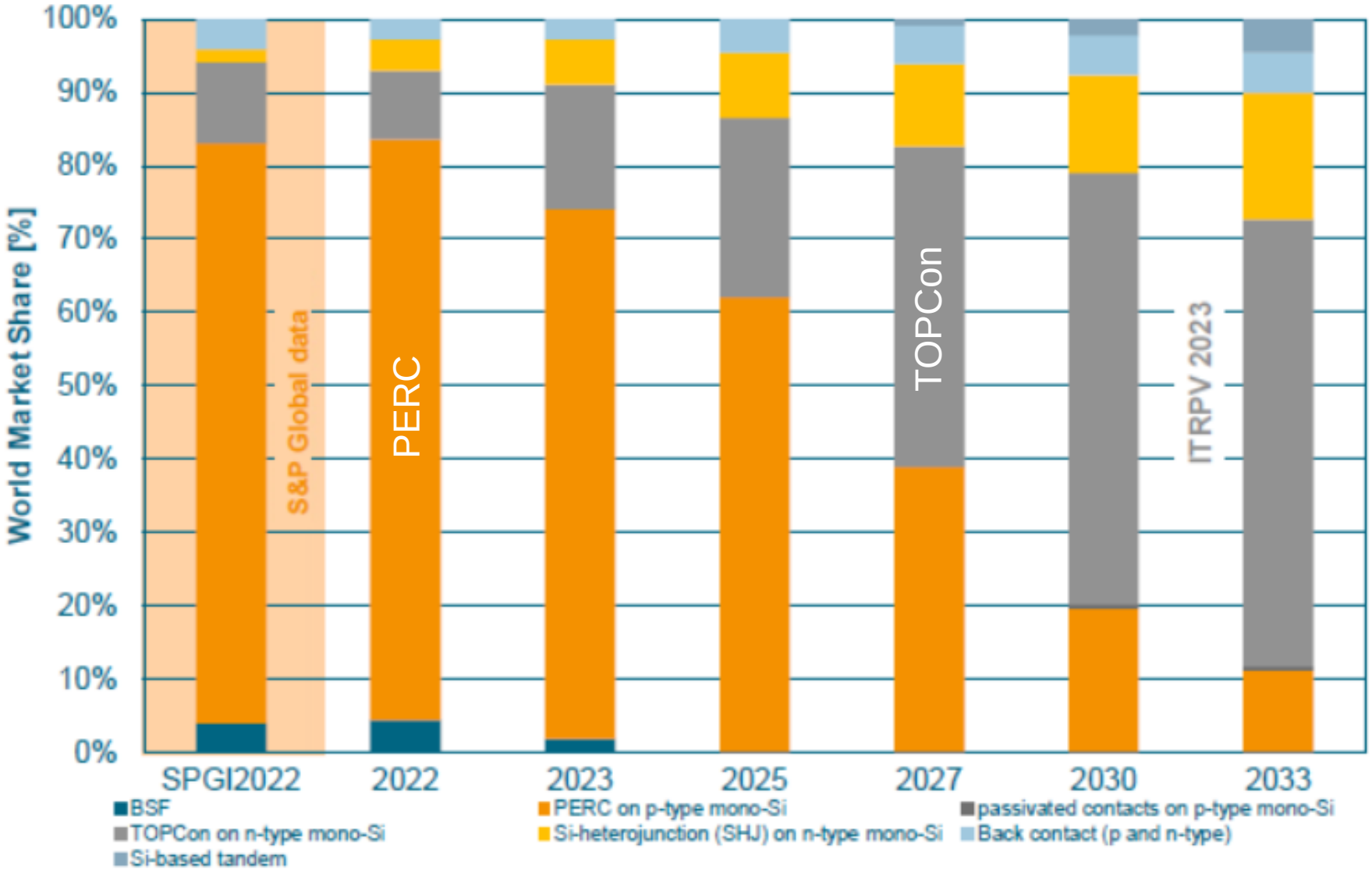


PV technology cycles
The last one lasted 6 to 8 years



Data taken from ITRPV editions 2014 to 2023

PV technology cycles – TOPCon is main choice for new fabs (in CN)
HJT, Back Contact and Tandem are on the horizon



Public R&D&I budgets need to grow
Instead of shrinking

- LONGi reported an R&D spending of USD 689 million in 2021, Trina Solar reported USD 370 million in 2021 and Tongwei reported USD 300 million in 2021, amounting to 2% to 4% of their budget.*
- These spendings are of the same order of magnitude (or far greater) than the total public EU spending on PV R&I for the 2014-2020 period under the Horizon 2020 programme.*

Current developments:

- **European level**: proposals for a EUR 2.1 billion cut to the general Horizon Europe budget (on a total of EUR 95.5 billion). These cuts are not limited to PV but would affect PV R&I as Horizon Europe represents EUR 40-50 million per year for PV R&I funding.
- **Germany**: federal budget for 2024 was „stopped“ by Federal Constitutional Court ruling; there is a multi-billion Euro „gap“ which puts pressure on PV R&I funding

*see „ETIP PV Industry Working Group White Paper: PV Manufacturing in Europe: understanding the value chain for a successful industrial policy” (2023)

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