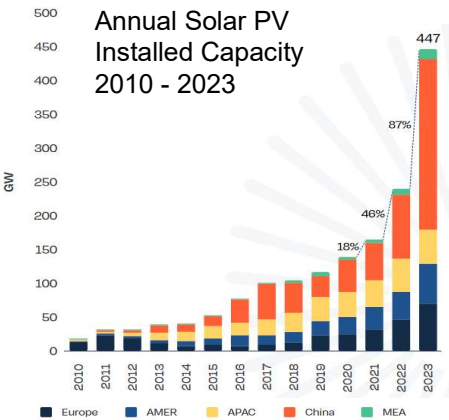


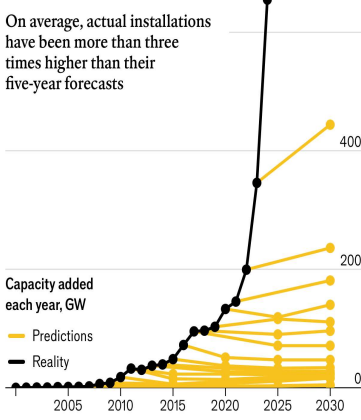
Cross-border innovation in European and global photovoltaics

Rutger Schlatmann
Head Solar Energy Division at Helmholtz Zentrum Berlin
Chair European Technology and Innovation Platform PV

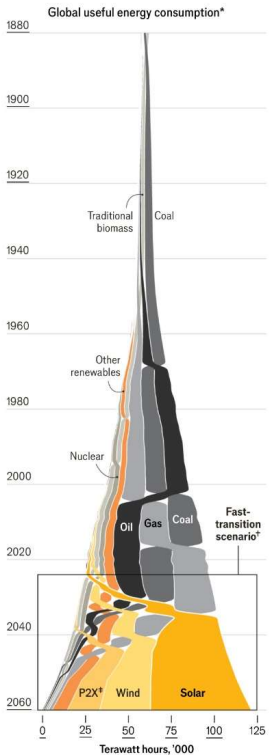
Market size and growth



Source: SolarPower Europe, Global Market Outlook, 2024



Source: The Economist, Sun Machines, 2024



Innovation opportunities

still enormous, especially with novel technologies entering the market

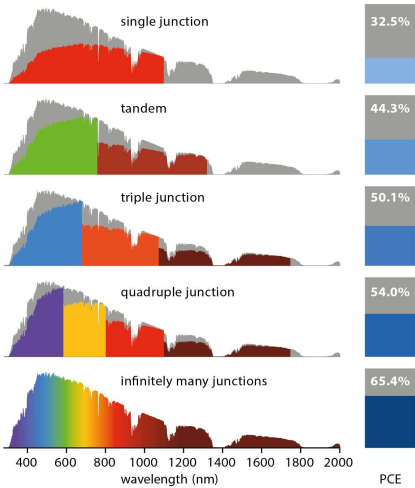


Image courtesy: Klaus Jäger (HZB),
Values from Marti et al., DOI:
10.1016/0927-0248(96)00015-3

Oxford PV starts commercial distribution of perovskite solar modules

Oxford PV is delivering its first commercial perovskite solar modules to US customers. The 72-cell solar modules have an efficiency of 24.5% and, according to the company, can generate up to 20% more energy than conventional silicon modules.

SEPTEMBER 5, 2024 PATRICK JOWETT

MANUFACTURING ANALYSIS MARKET ANALYSIS & SUPPLY CHAIN ANALYSIS TECHNOLOGY ANALYSIS COMPANY ANALYSIS



Image: pv magazine

Longi claims 34.6% efficiency for perovskite-silicon tandem solar cell

The European Solar Test Installation (ESTI) has confirmed Longi's achievement of a world record-breaking efficiency rating of 34.6% for a perovskite-silicon tandem solar cell.

JUNE 14, 2024 VINCENT SHAW

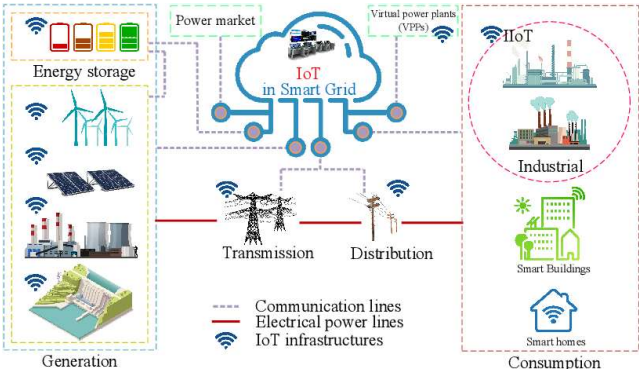
MANUFACTURING ANALYSIS MARKET ANALYSIS & SUPPLY CHAIN ANALYSIS TECHNOLOGY ANALYSIS COMPANY ANALYSIS

Innovations opportunities

with new types of integration, smart grids, and virtual power plants



Source: Fraunhofer ISE, Utilising surfaces 2019, re-adjusted

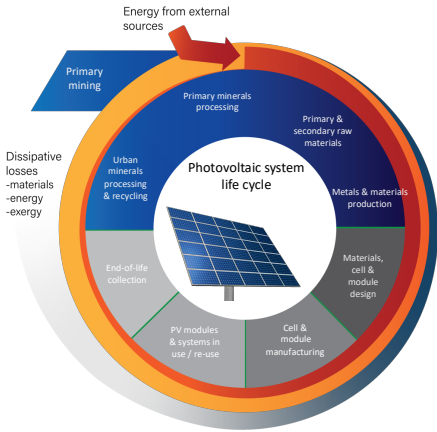


Source: Shahinzadeh et al., IoT Architecture for Smart Grids, 2019

Innovation opportunities

HZB Helmholtz Zentrum Berlin

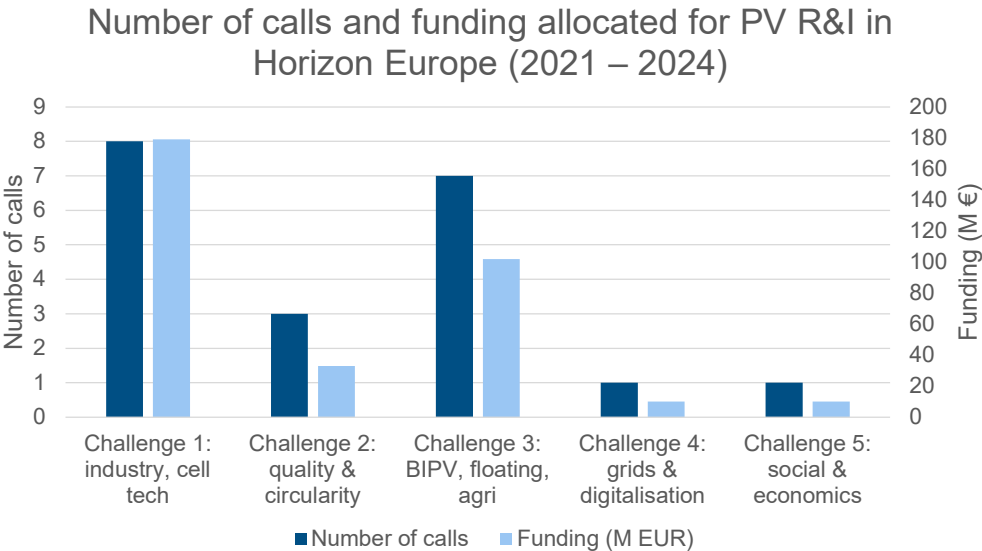
Life-cycle and supply chain research is needed, incl. social aspects, e.g. with regards to non-price criteria



Source: Bartie et al., Mineral Economics 2022

Collaborations via EU Horizon Projects

HZB Helmholtz Zentrum Berlin



Data from Thomas Garabetian, ETIP PV

HZB Helmholtz
Zentrum Berlin

Collaborations beyond Horizon Projects

1. Terawatt Workshops

Terawatt-scale photovoltaics: Trajectories and challenges

Coordinating technology, policy, and business innovations

POLICY FORUM

RENEWABLE ENERGY

Photovoltaics at multi-terawatt scale: Waiting is not an option

25% annual PV growth is possible over the next decade

POLICY FORUM

RENEWABLE ENERGY

Terawatt-scale photovoltaics: Transform global energy


Improving costs and scale reflect looming opportunities

Fraunhofer ISE

NREL
Transforming ENERGY

AIST

2. IEA PVPS working groups




International Energy Agency
Photovoltaic Power Systems Programme


Integrating Solar and Wind

Global experience and emerging challenges

Technology report — September 2024



3. VDMA international technology roadmap

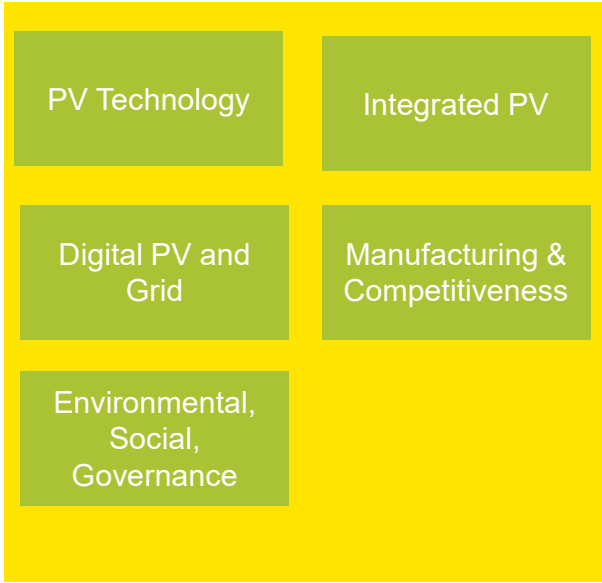


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Collaboration: ETIP PV

European Technology and Innovation Platform PV

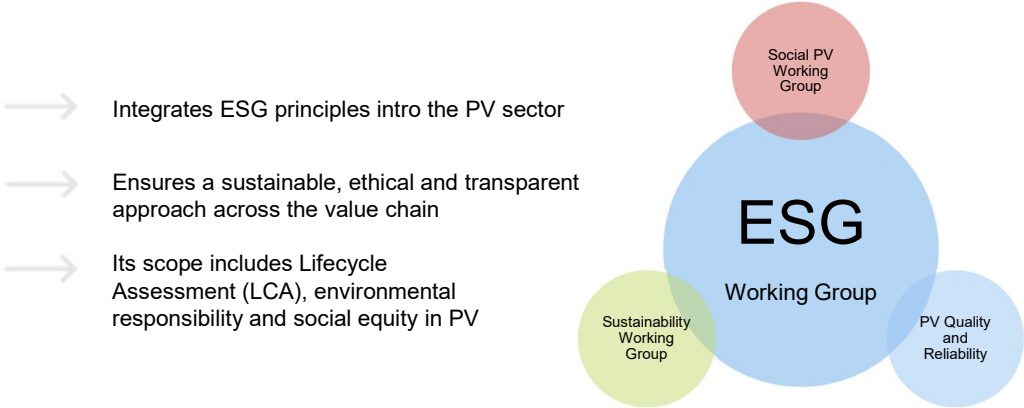
- **EU Advisory Body:** for research and innovation (R&I) policy. ETIP PV Secretariat funded by EU and run by SolarPower Europe and WIP
- **Industry Expertise:** Industry representatives bring practical insights and market expertise to address real-world challenges in the photovoltaics sector.
- **Academic Expertise:** Academics contribute their knowledge and research findings to ensure the scientific rigor of ETIP PV's recommendations.
- **Independence:** ETIP PV stands out in the PV advocacy landscape due to its independent nature. Experts (academia/industry) working voluntarily, not to further the interest of their organizations



ETIP PV ESG Working Group

(Environmental, Social, Governance)

HZB Helmholtz Zentrum Berlin



Chair: Ivan Gordon (IMEC)
Vice-Chair: Ulrike Jahn (Fraunhofer)

Challenges related to social aspects

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Social Acceptance

of European PV Deployment

- Critical raw materials (CRM)
- Potentially toxic materials
- Pricing grid tariff schemes

Public engagement

- Citizen's involvement deployment
- Enabling citizens and communities

Skills and Workforce

- Enabling the workforce
- Gender diversity

Recommendations

- Sustainable CRM
- Supply chain coordination
- Recyclability
- True-cost pricing grid tariff schemes
- Enable citizen-led PV projects
- Capacity building
- Policy and regulations
- Education standards
- Comprehensive European plan for addressing the skills gap

Multifaceted hurdles for e.g. BIPV

seen accross Europe and globally

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- Cost-efficiency of BIPV products
- Regulatory hurdles (different in different countries!)
- Missing design tools for architects
- Lack of knowledge and awareness on many levels
- `Architects vs. Engineers`

Strategic Research & Innovation Agenda:

ETIP-PV + EERA-PV:
Defining the European R&I priorities since 2007

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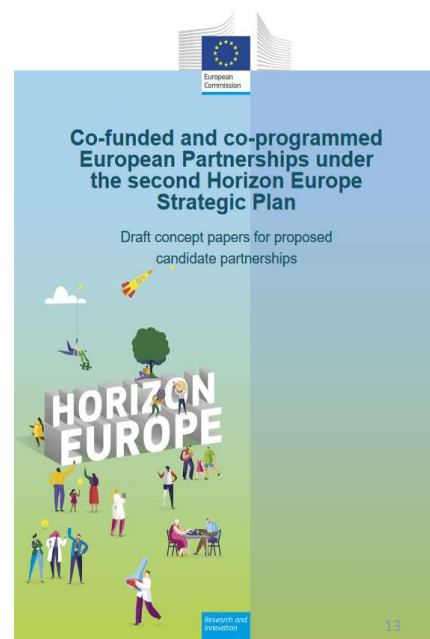
Challenge 1	Challenge 2	Challenge 3	Challenge 4	Challenge 5
Performance Enhancement and Cost Reduction through Advanced PV Technologies and Manufacturing	Lifetime Reliability and Sustainability Enhancements (through advanced PV technologies, manufacturing and applications)	New Applications through integration of PV (for diversified and dual-purpose development and enhanced value)	Smart Energy System Integration of Photovoltaics (For large scale development and high penetration)	Socio-economic Aspects of the Transition to High PV Contribution

Co-programmed partnership

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Joint shaping of the Horizon Europe program

- Part of Horizon from 2026
- Public (EC) - Private (PVindustry) partnership to speed up the transfer of innovation to industry and enable PV industry boost and PV deployment
- 80 mil. € / year (part of Horizon calls)
- Focused on:
 - ✓ Advanced solar PV architectures
 - ✓ Manufacturing processes & machinery
 - ✓ Grid integration and flexibility
 - ✓ Integrated & novel PV systems
 - ✓ Substitution of critical-raw materials
 - ✓ ESG & Traceability
 - ✓ Novel recycling methods

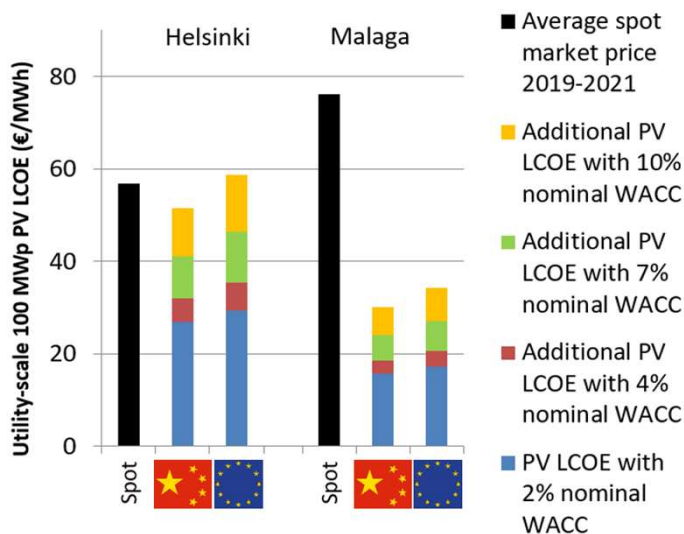


Politics: national, EU, and global

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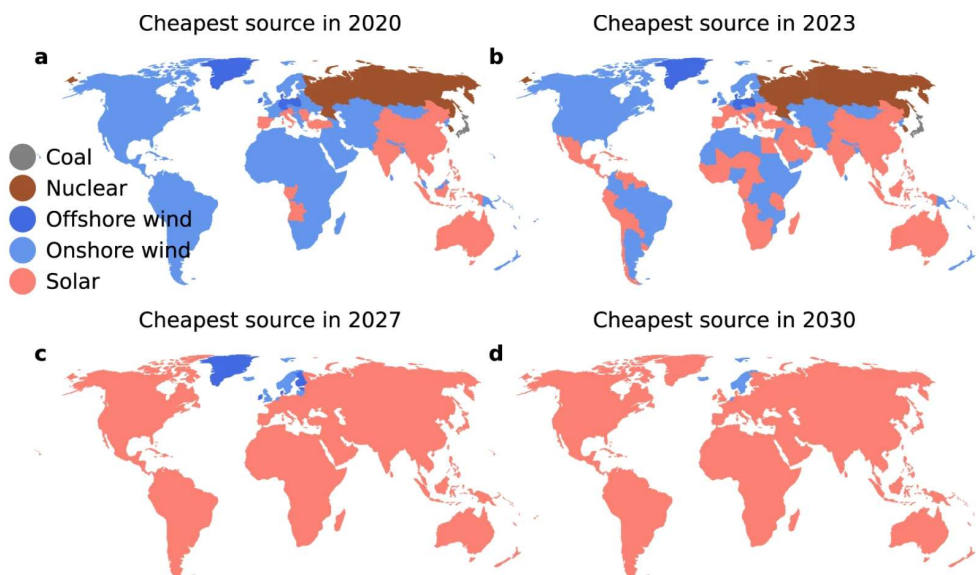
- REPowerEU
- EU Green Deal
- Green Deal Industrial Plan
 - **Net-Zero Industry Act:** "Strategic net-zero technologies manufacturing capacity in the EU approaches or reaches at least **40% of annual deployment needs by 2030.**"
- FEB 26th 2025: Clean Industrial Act
- Strong ambition for local PV manufacturing, but little tangible effect so far

- Manufacturing in China is ~50% cheaper than in the EU, but **the effect on LCOE is not very pronounced!**



PV will soon be the technology with the lowest LCOE globally

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15

PV is now a major global energy technology

- The opportunity for further innovation is enormous
- International collaboration is strong
- ETIP PV funnels Europe's combined industrial and academic PV R&I
- Co-programmed Partnership for PV
- Ambitious EU policies, but big gap between ambition and reality for regional production
- Consumer LCOE effect of higher local production costs small!

All these aspects directly affect what R&D should be done by all of us here!



16

