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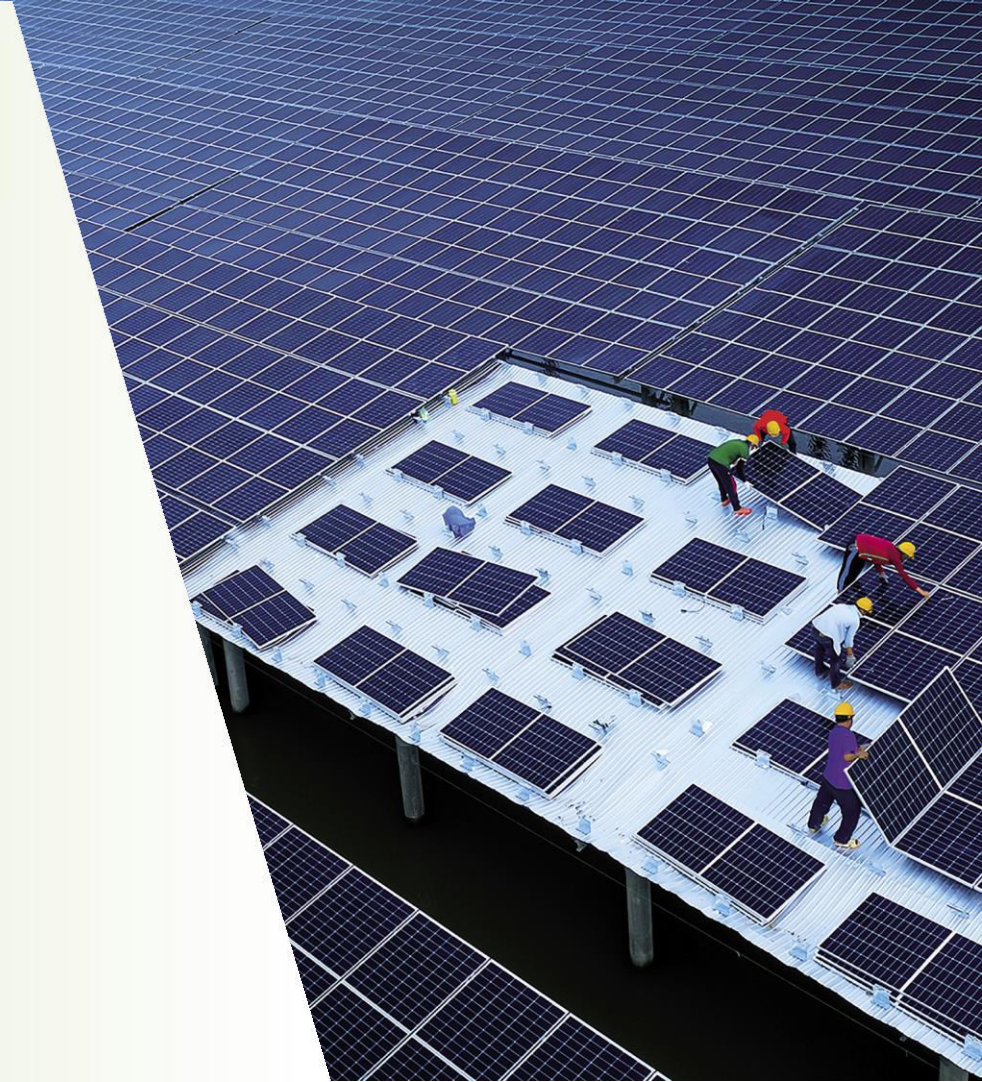
Supply Chain Working Group progress review

Christoph Podewils

June 14, 2023 Munich



Activity report

WG Chairs: Christoph Podewils, Meyer Burger & Federico Babera, Enel
WG Sherpa: Johan Lindahl, European Solar Manufacturing Council

70+ members from the supply chain and beyond

3 work streams formed (heads)

1. Raw materials (Luca Ogginau, Glass Europe)
2. Ingot/Wafer (Carsten Rohr, Norsun)
3. Cell/Modules (Salvatore Nicotra, Enel)

Meetings (selection)
Physical plenary meeting April 4, Brussels
Physical plenary meeting, Juni, 15, Munich
Weekly/Bi-Weekly Meetings of steering committee
Regular meetings of work streams

KEY FINDINGS OF THE WORKING GROUP

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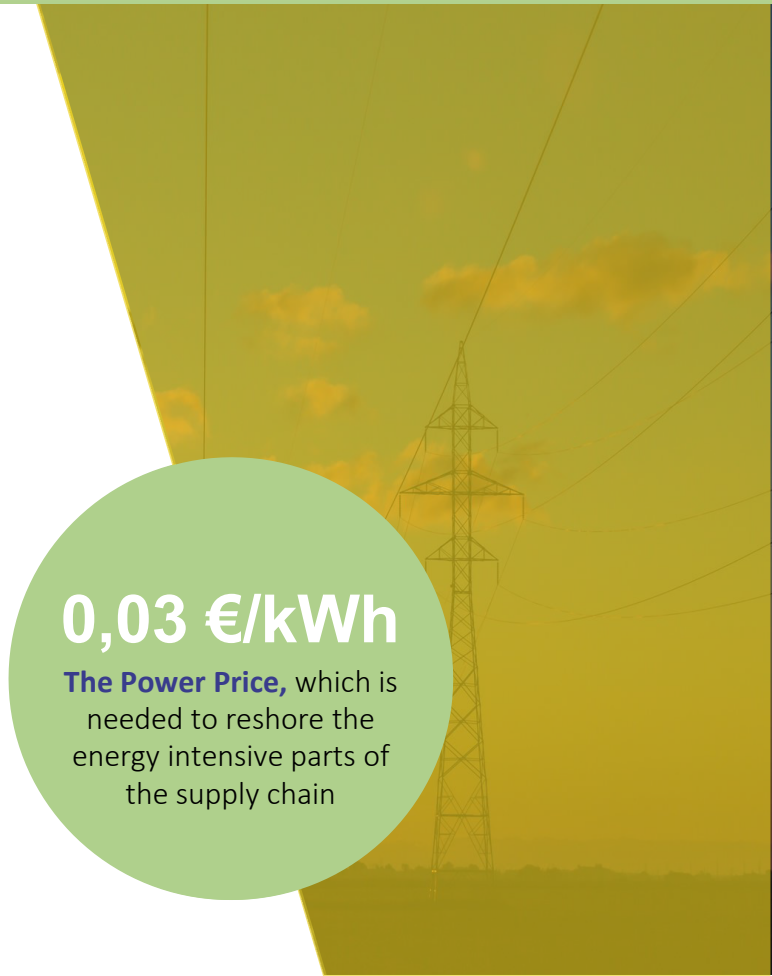
Lower Energy Prices

Prerequiste for EU-made solar silicon, wafers, glass, aluminum,

Current energy prices in Europe are 3-5 times higher in comparison to energy prices in the US and China. In both countries' energy prices of 0,03 €/kWh and lower are offered to producers in the PV value chain. Thus, almost 100% of the wafers and glass used for photovoltaics are produced in China.

For re-shoring the PV industry to Europe, especially the energy intensive production steps, energy for such productions must be available at an internationally competitive level.



0,03 €/kWh

The Power Price, which is needed to reshore the energy intensive parts of the supply chain

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Glass recycling

Antimony in patterned solar glass prohibits recycling in float glass lines

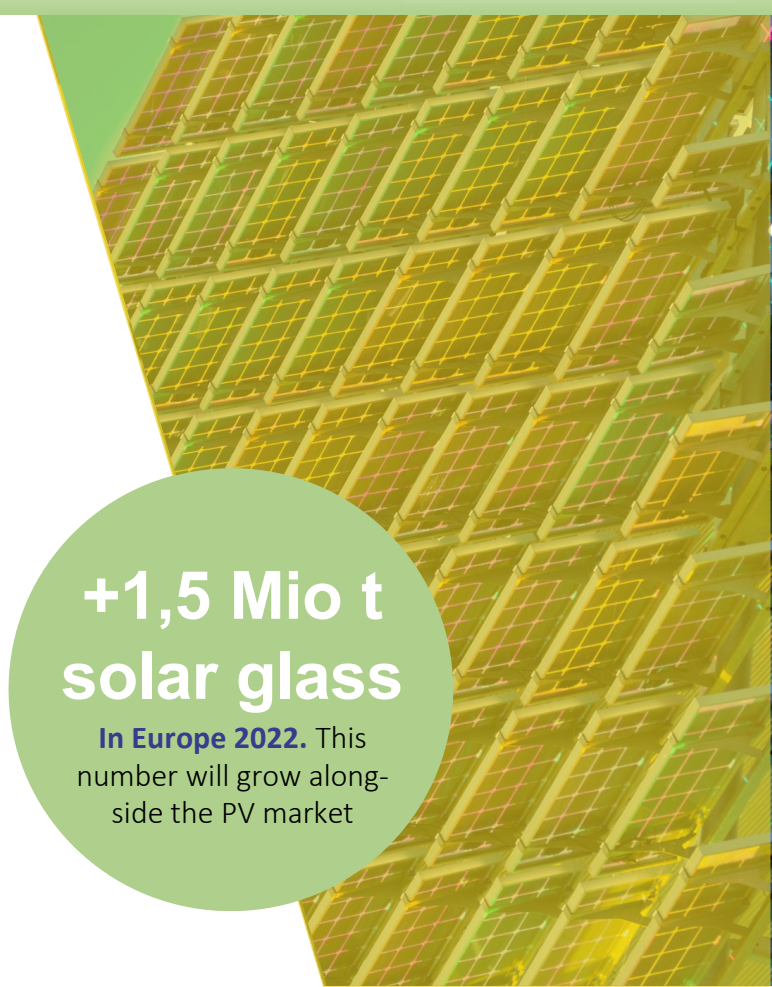
Today, the glass of the solar panels produced in China and installed in the EU cannot be safely recycled in float glass furnaces because of the presence of impurities (in particular antimony) and the lack of traceability of their composition.

Antimony is a rare material which improves light transmission in glass. However, it is toxic.

Contamination of float glass lines with antimony will drasticaly reduce their liftime.

Re-Use of patternd solar glass only by means of downcycling (e.g. insulation) or investments in patterned glass lines.

Ammounts are significant: +1,5 Mio t of solar glass being used in Europe in 2022



+1,5 Mio t solar glass

In Europe 2022. This number will grow along-side the PV market

KEY PROPOSALS OF THE WORKING GROUP

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Glass recycling

Develop measures to easen recycling and/or to pay for it (EcoDesign regulation)

Require that all solar glass sheets used in PV modules for the EU market should contain a type of QR-code label that reveal the composition and the manufacturing process of the solar glass.

Introduce a threshold for antimony in the solar glass of modules that are put on the EU market.

If the threshold is exceeded, the importer or EU manufacturer must pay an “antimony”-fee.

The threshold should be incrementally lowered, and the “antimony”-fee increased, over time so that the antimony in solar glass can be successively phased out of PV modules put on the EU market.

No Importban

as this would cut-off supply with modules

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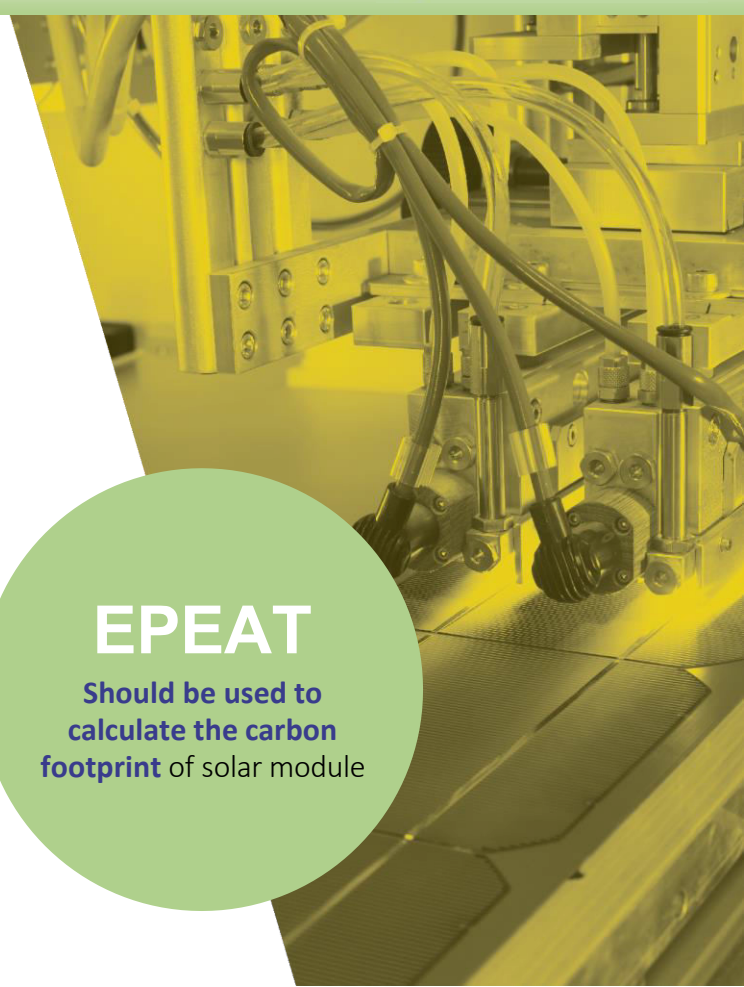
Reliable calculation of carbon footprint

EcoDesign regulation

The current proposed methodology of the EcoDesign, Product Environmental Footprint Category Rules (PEFCR), make it toothless, as polluters can easily buy their way around the regulation through market mechanisms such as green certificates or guarantees of origin.

The WG suggest the Electronic Product Environmental Assessment Tool (EPEAT) criteria, recently launched for PV modules by the Global Electronic Council (GEC), is instead used for calculating the carbon footprint.



EPEAT

Should be used to calculate the carbon footprint of solar module

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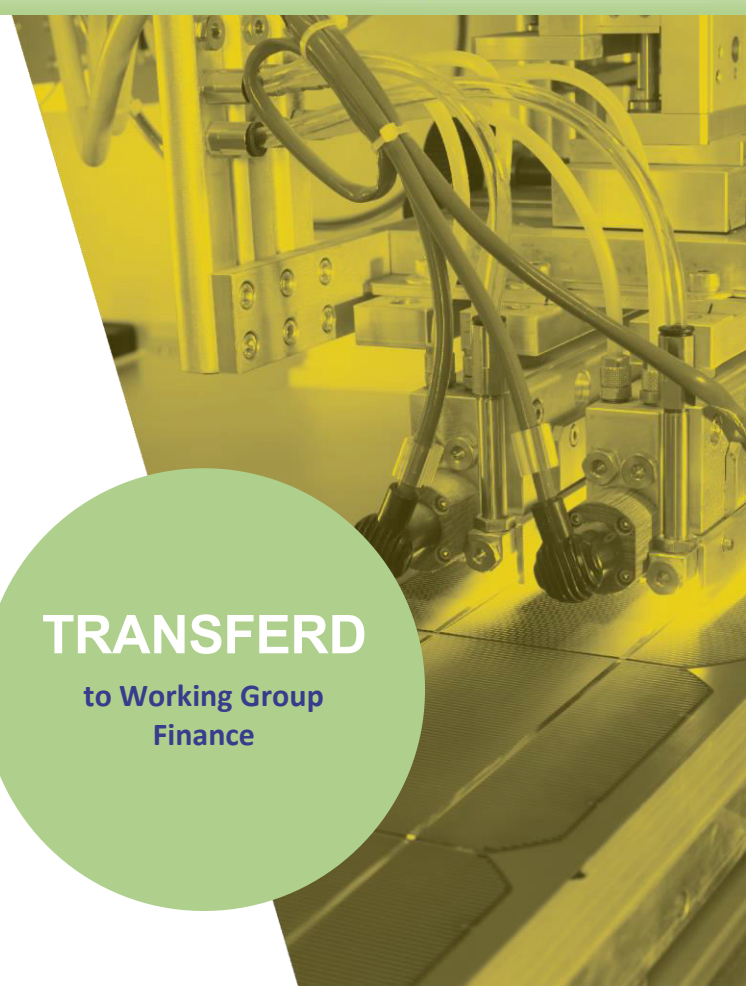
IRA-Type support scheme

On the EU-level

The United States passed the Inflation Reduction Act (IRA) in August 2022, which includes tax incentives for solar-panel manufacturers, applicable from 1 January 2023 [2]. The funding intensity of the IRA is up to more then 60% of the factory gate prices.

The proposed action aims to establish a support framework modeled after the US IRA, which is essential for enhancing European competitiveness. Since the IRA provides non-refundable OPEX support, on a per product delivered basis, a similar support mechanism would need to be implemented in Europe through general and direct incentives or grants for manufacturers.

The time component of the program is critical, and it must be at least ten years long to reduce investment risks and create a level playing field for the European stakeholders.



TRANSFERD

to Working Group Finance

NEXT STEPS

The net zero resilience bonus system (NZIA)

There currently exist some shortcomings in the proposed NZIA, such as (1) lack of definitions of sustainability and resilience, (2) no explicit EU content definition (due to WTO), (3) height of incentives is very limited and might even favour Chinese modules (10% max), and (4) financing of NZIA (draft) originating from national budgets or renewable energy schemes

WG will draft a Net-Zero Resilience Bonus System, and the process includes:

- Defining, what a resilient PV product is
- Defining criteria for a ecological sustainable PV product
- Defining a reward system for those criteria
- Reward system is based on the idea to concrete the „15-30%“ overweight (Art 19, 20) and the price premium (Art 21)

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Thank you, any questions?

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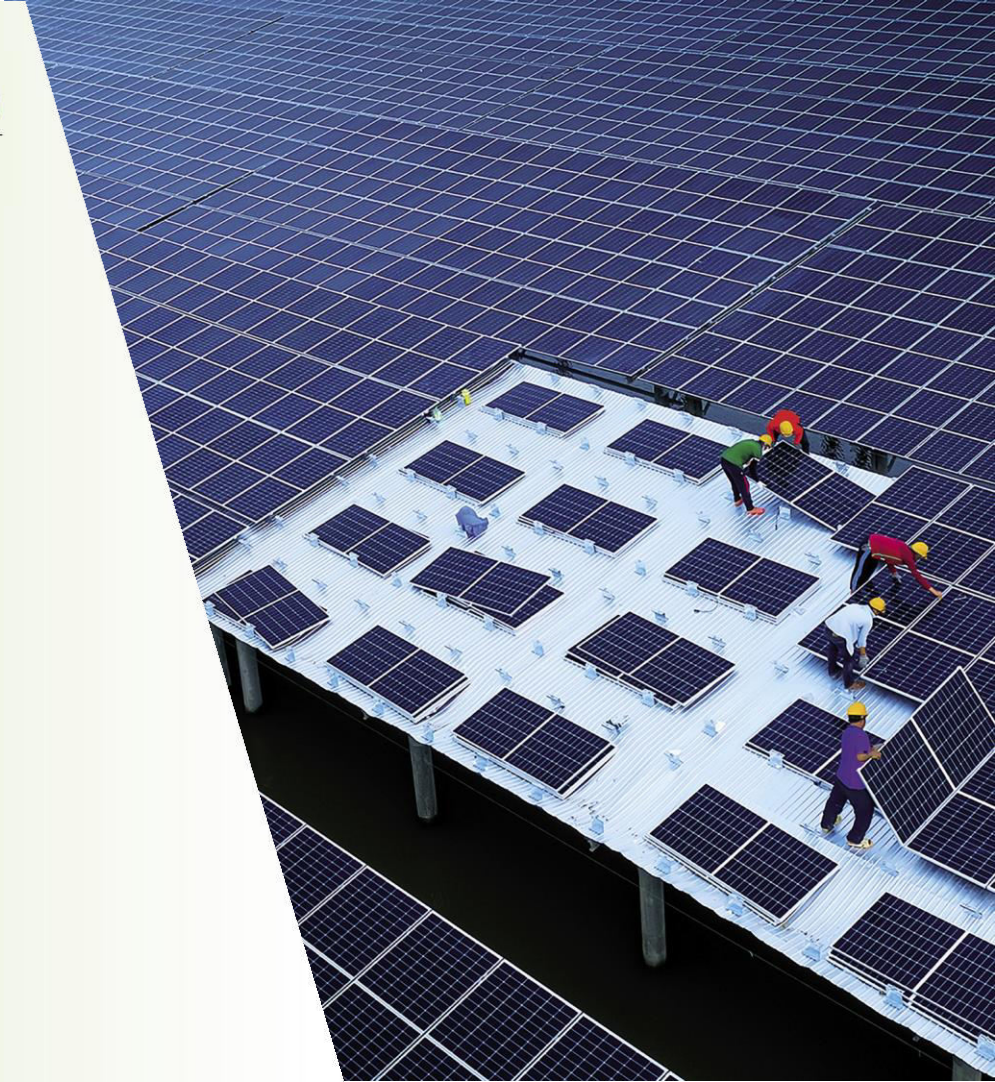

WG Skills
Progress review

Kris Ignaciuk
Advisor to EIT InnoEnergy

Munich, 14th June 2023

KEY FINDINGS OF THE WORKING GROUP

Re-shoring 30 GW of solar PV capacity may require up to 90,000 new workers in manufacturing & recycling

	Polysilicon	Ingots	Wafers	Cells	Modules	Inverters	Installation	O&M	End of Life
FTEs 2021	4,530	54		914	7,724	30,956	367,307	40,101	14,009
Missing FTEs for 30GW HI	1,116	7,075		23,360	17,520	target met			
Missing FTEs for 30GW LI	744	3,679		11,680	8,760	target met			
Missing FTEs for 750 GW							396,000**	84,800**	41,545**

~25,000 — ~50,000

In line with 750 GW target; ** Direct + indirect FTEs; HI = High Labour Intensity; LI: Low Labour Intensity; Source: Industry survey by SolarPower Europe, calculations: IGN Research

Key challenges exist across three clusters: Training & Education, Attractiveness & Awareness, and Mobility

Training & Education

- Lack of thorough industry's workforce needs mapping
- Unstandardised job profiles and curricula
- Insufficient reflection of digital/automation skills
- Education & TVET insufficiently match and slowly adapt to industry needs, leading to much internal training
- Unstandardised accreditation and certification
- Insufficient options for (micro)-credentials and remote (up)skilling
- Need for additional training funding

Awareness & Attractiveness

- Low awareness of possibilities in PV manufacturing
- Insufficient interest in STEM and technical training
- Low interest from women
- Under-utilisation of existing job / training platforms

Mobility

- Lack of instruments in place to speedily bring in global talent
- Insufficient mobility of lower-certification workforce

KEY PROPOSALS OF THE WORKING GROUP

Road Map, revised curricula, and Solar Academy

Mapping needs and road map for skills

- Input collection and analysis, review existing work in other sectors (e.g. semiconductors); focus groups and surveys
- Road map for skills aligned with current needs and longer-term vision

Revise job profiles and define curricula

- Establish a PV industry board of education
- Ensure representation of whole manuf. value chain; define knowledge/skills that can be clustered and can be replicable on each qualification level

A new Solar Academy

- Build a new Solar Academy modelled on EBA Academy for wider access to new curricula and remote upskilling
- Incorporate existing resources; plug into training programmes

Fund professional training

- Identify funding from European Social Fund, Erasmus+, etc.
- Advocate for national and private funding to be complemented by it, as outlined in EU Solar Energy Strategy

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Ensuring awareness of high-impact climate tech careers and great working conditions

Communications and best practice guidance

- Europe-wide public communication campaign encouraging (re)training for PV manufacturing jobs, likely within RE Skills Partnership
- Propose best practice guidelines on jobs / (re)training marketing and professional development

Develop and promote existing platforms

- Identify platforms (e.g. solarworksplatform.org) and improve their active outreach and functionality

Dismantling barriers for global talent and intra-EU mobility

Attracting global talent

- Define instruments to attract global key talent, esp. process engineers and operations specialists
- Outline possibilities for simplifying skills recognition and non-EU hiring procedures for qualified workers

Fostering intra-EU workforce mobility

- Embed stays in other European countries as part of PV manufacturing TVET / degrees: a *PV Manufacturing Erasmus*

Photo: Thor Nielsen

NEXT STEPS

NZIA promises support for qualifications definition, recognition, a Solar Academy, adequate working conditions, and mobility

Developing occupation profiles

- Development of European occupation profiles consisting of a common set of knowledge, and competences (Net-Zero Europe Platform (Art. 25(5))

Ease of mutual recognition

- Advocate for fast-tracking the definition of minimum criteria for automatic recognition of regulate professions (Dir. 2005/36/EC)
- High thresholds for non-automatic recognition (with Net-Zero Europe Platform to-be; Art. 24 NZIA)

Solar Academy as part of NZ Industry Academies

- Solar Academy should be developed within the Net-Zero Industry Academies framework (Art. 23 NZIA)

Working conditions, activation & mobility

- Identify funding from European Social Fund, Erasmus+, etc.
- Advocate for national and private funding to be complemented by it, as outlined in EU Solar Energy Strategy

Other actions may need to be implemented as stand-alone initiatives

Road Mapping

- Precise needs identification
- Road Mapping

Training development

- Promoting training cooperation
- Building new training programmes and (degree) courses in consultation between TVET providers and universities and industry

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Thank you, any questions?

Kris Ignaciuk

Advisor to EIT InnoEnergy

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ESIA Demand side / Non-pricing policies Working Group

Pierre-Emmanuel Martin
Co-founder and chairman of CARBON and its board of directors

Jörg Ebel
Vice President Corporate Affairs IBC SOLAR AG

"As chairs of the Demand side Working Group we have been working closely together in defining a set of non-price criteria that give effective market signals for solar systems produced in Europe while at the same time not impacting the pace and cost-effectiveness of solar PV deployment. In direct reflection of the COM Net Zero industry Act proposal currently discussed with European policy-makers, the WG has developed a proposal on what criteria and metrics could be used to define Best-in-Class (BiC) solar and how to relate this to bonus points in whole public procurement and specific tenders to facilitate and support the consolidation and development of the European solar industry".

ESIA Demand side / Non-pricing policies Working Group

- Purpose: defining non-price criteria that give effective market signals for solar systems produced in Europe without impacting the pace and cost-effectiveness of solar PV deployment.
- Constellation: the diversity of organisations in the WG, including solar manufacturers to solar developers, represents a good basis to find that balance.
- Deliverable: Definition of Best-in-Class (BiC) solar, in direct reflection of the European Commission proposed Net Zero Industry Act on non-price criteria. This EU Regulation is currently in legislative co-decision process.

Key points:

- BiC criteria is about rewarding PV products with higher overall performance (bonus points). It is not about setting standards for general market access. The WG calls for an early adoption of the EU Forced Labour Ban Regulation, and refers to multi-stakeholder initiatives like the Solar Stewardship Initiative to ensure highest transparency across the supply chain, continuous improvement of ESG performance and full compliance with EU legislation
- BiC criteria should be based on ambitious thresholds periodically revised to be adjusted to market and industry developments, and subject to rigorous third-party verification
- BiC criteria need to be harmonised at EU level to avoid bureaucratic complexity and patchwork application, for example through a dedicated Delegated Act
- BiC criteria should be applied in specific tenders, in reflection of the growing EU-production capacities
- The cumulative weight of BiC criteria shall be 40 %;
- The WG supports the principle of a cost proportionality clause to kick-in from the entry into force of the regulation, but urges the European Commission to clarify the rationale and methodology for the proposed 10 % threshold as soon as possible and no later than the end of June 2023. Until then, the WG reserves judgement on whether that threshold is appropriate and highlights that any threshold needs to be technology-specific and adapted to the real market conditions for solar PV.

Demand side policies Working group proposal:

Category	Sub-category	Application level	Pre-qualification (for access to markets)	Bonus Points (for awarding best performing BiC)	Weight	Metric / threshold
Forced labour	Based on proposed EU regulation on forced labour	All imported products PV module, inverter, and sub components thereof, etc	No market entrance if non-compliance	No		Due Diligence verified by a Third Party
Environmental (module level)	Carbon footprint	PV module level	Eco-design compliance	Yes (based on EPEAT)	High	Below [400/630] kgCO2e/kWp
	Energy yield	PV module level	Eco-design compliance	Yes	Low	Equivalent to PV Energy Label class B or above under temperate coastal climate zone.
	High-value material content	PV module level	Eco-design compliance	Yes	Low	[for c-Si modules] Material intensity is 10 % lower than average product: Ag: less than 9 mg/W Si: less than 180 mg/W [for thin film modules] Cd, In, Ga, Te: TBD by PV-Thin
	Recycled content	PV module level	Eco-design compliance	Yes	High	Recycled content of a given material is 10 % above than industry average, based on default parameters used in PV Ecodesign Circular Footprint Formula
	Hazardous substances	PV module level	Eco-design compliance	Yes	High	Avoidance of regrettable substitutions (REACH) Pb: lead-free soldering in cells and modules
	Warranted lifetime	PV module level	Eco-design compliance	Yes	High	Performance warranty above 25 years awards minor bonus, performance warranty above 30 years additional bonus points.

Demand side policies Working group proposal:

Category	Sub-category	Application level	Pre-qualification (for access to markets)	Bonus Points (for awarding best performing BiC)	Weight	Metric / threshold
Environmental footprint (factory level)	Circularity of processes (use & recycling of water, use & recycling of raw materials…)	Factory level	Compliance with relevant legislation	Yes	Low	ISO: 9001 Quality management, 14001 Environmental management, 45001 Occupational health and safety management systems, 50001 Energy management, 27000 Information security management
	Best EU standards for respect for local environment and biodiversity	Factory level	Compliance with relevant legislation	Yes	Low	Directive 2014/52/EU of the European Parliament and of the Council of 16 April 2014 amending Directive 2011/92/EU on the assessment of the effects of certain public and private projects on the environment
	Best EU standards in terms of GES emissions and water/air/soil pollution	Factory level	Compliance with relevant legislation	Yes	Low	Revised Industrial Emissions Directive (IED) and the 'Best Available Techniques' (BAT) from Sevilla process: https://ec.europa.eu/commission/presscorner/detail/en/qanda_22_2239
Social & Governance	Respect for human rights	PV module level	Verified compliance with Solar Stewardship Initiative (SSI) standards[3]	Yes	High	Due Diligence verified by a Third Party EU Charter of Fundamental Human Rights
	Workers' rights; Extra-legal benefits, free choice of union	PV module level	Verified compliance with Solar Stewardship Initiative (SSI) standards, in line with International Labour Organisation	Yes	High	International Labour Organisation

Demand side policies Working group proposal:

Category	Sub-category	Application level	Pre-qualification (for access to markets)	Bonus Points (for awarding best performing BiC)	Weight	Metric / threshold
Social & Governance	Local job creation from EU manufacturing	PV module level	No	Yes	High	60 %/90 % of local FTEs out of total manufacturing value chain FTEs Based on the following assumptions from SPE Jobs Study 2022: FTE creation per MW produced Poly 6 % Ingot/wafer 12 % Cell 41 % Module 41 % In practice: to reach first threshold, EU manufacturing of cells + modules is needed; to reach second threshold, ingots/wafers is also needed[##] % of local FTEs out of total manufacturing value chain FTEs
	Profit sharing among local community	PV system level	No	Yes	Low	10% of profits shared among local community out of total profits
Security of supply	Dependence on main source of supply for more than 65 %	PV module level	No	Yes	High	Percentage of economic value / Gross Value Addition of solar PV supply chain that comes from a different source than the main source of supply. GVA methodology reference: https://www.nrel.gov/solar/market-research-analysis/solar-manufacturing-cost.html

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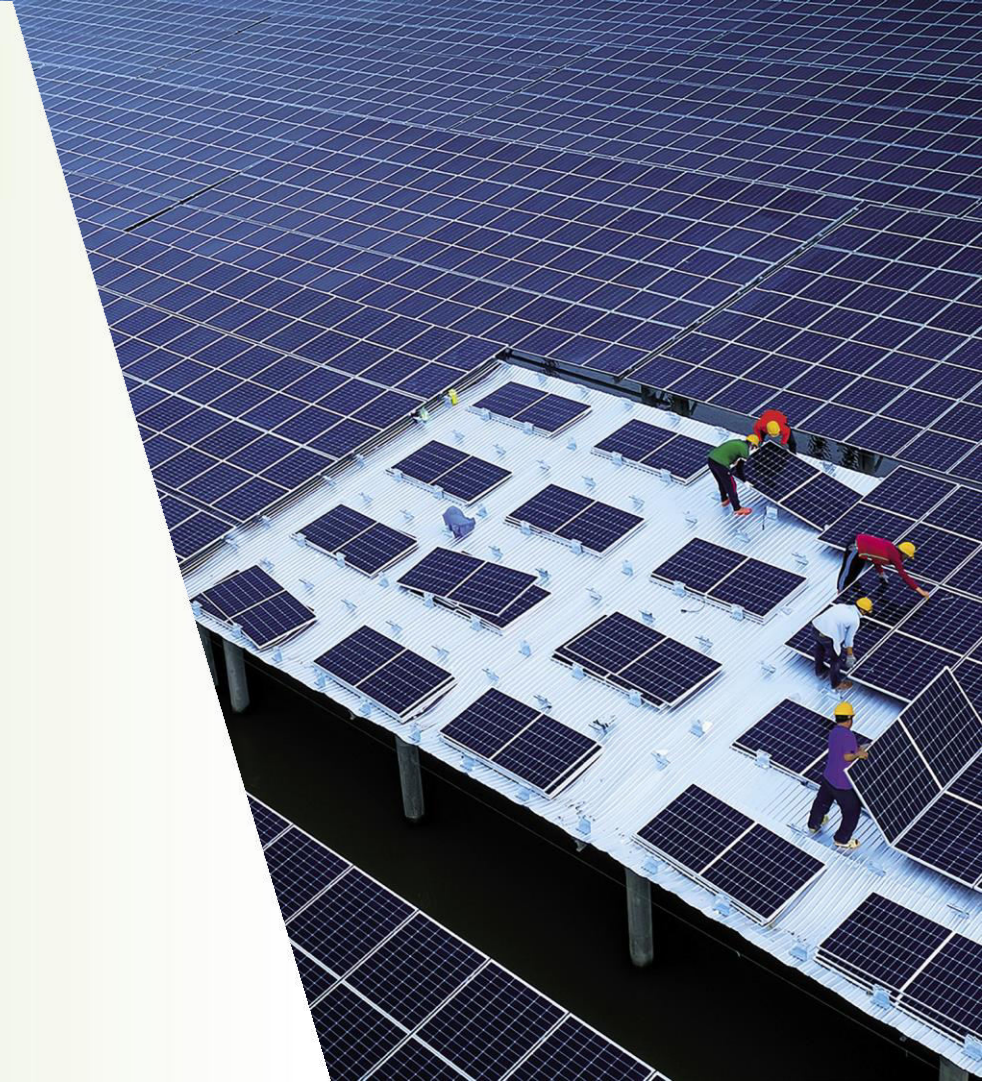


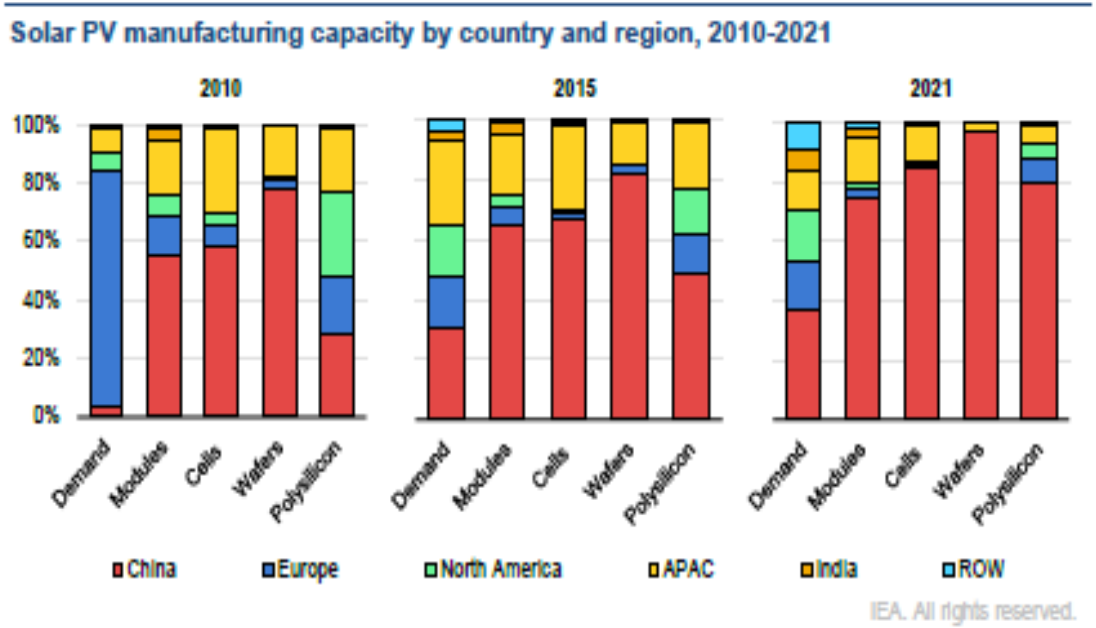
Finance Working Group progress review

Dr. Westermeier, Christian June 14th 2023. Munich, Wacker Chemie AG

KEY FINDINGS OF THE WORKING GROUP

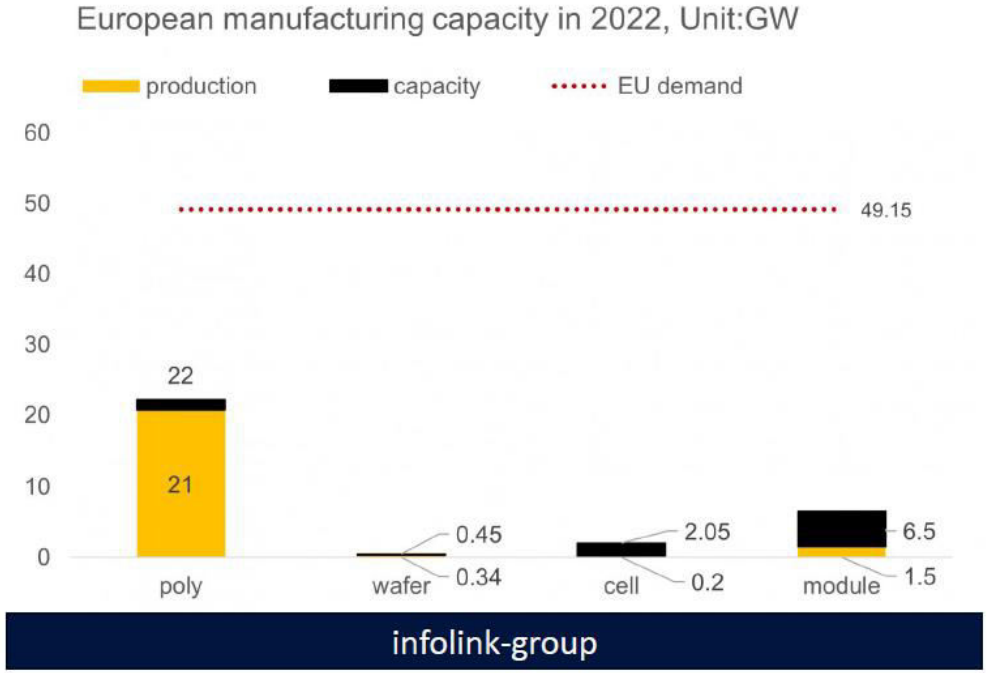
Distribution of Global Demand and Manufacturing

- Diversified demand distribution
- Manufacturing capacities concentrated in one country
- High dependencies and risks for supply disruptions



Europe´s solar manufacturing capacities are insufficient

- Europe far away from the targeted 30 GW solar capacity
- Beyond cell/module ingot/wafer is most critical
- Towards end of the decade even more capacity needed
- **Fast and committed action is needed now !**



Assumptions and Premises for the Working Group: Finance

a) Cost analysis driver

- Energy: China: Assumed a stable pricing of 30 €/MWh
  Europe: 3 different scenarios (50 €/MWh, 150 €/MWh, and 250 €/MWh)
- Supply of goods (only if procurement volume is relevant)
- Labor
- Amortization of investments
- Raw materials not included yet in the Gap analysis:
  Silicon Metal: only reflected as part of the materials for polysilicon
  Glass: to be added if glass industry is to be re-shored.

b) Price analysis drivers

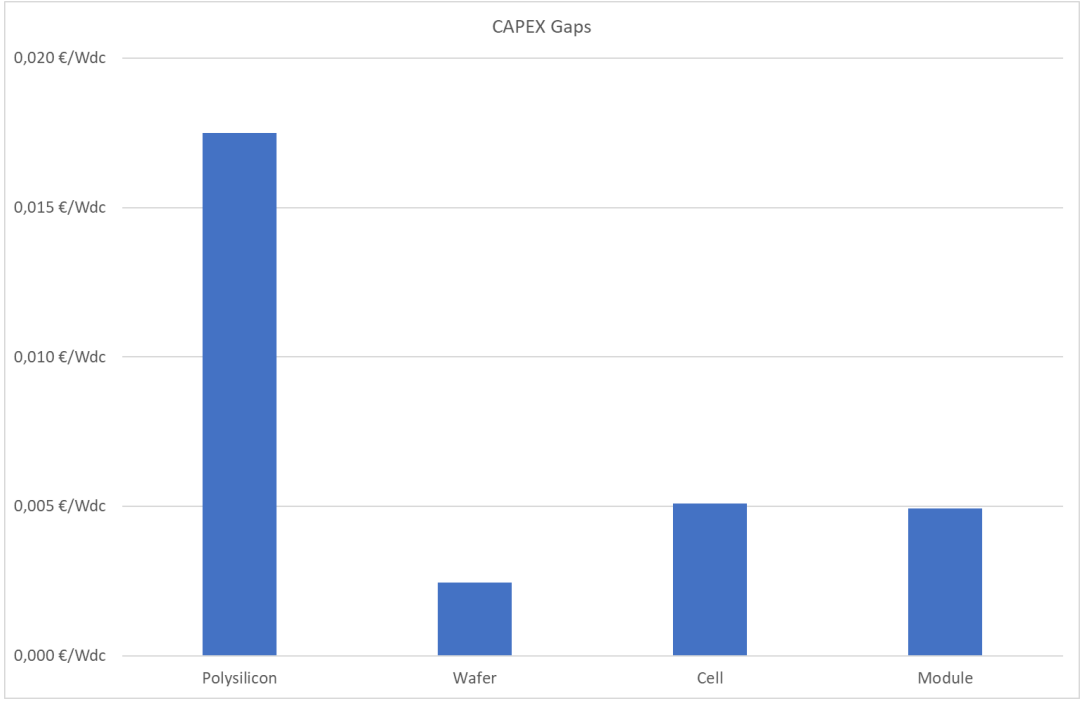
- 10% as EBIT target
- Public price data as per Infolink or other public sources

CAPEX Gap vs. China for 30 GW

Funding Gaps:

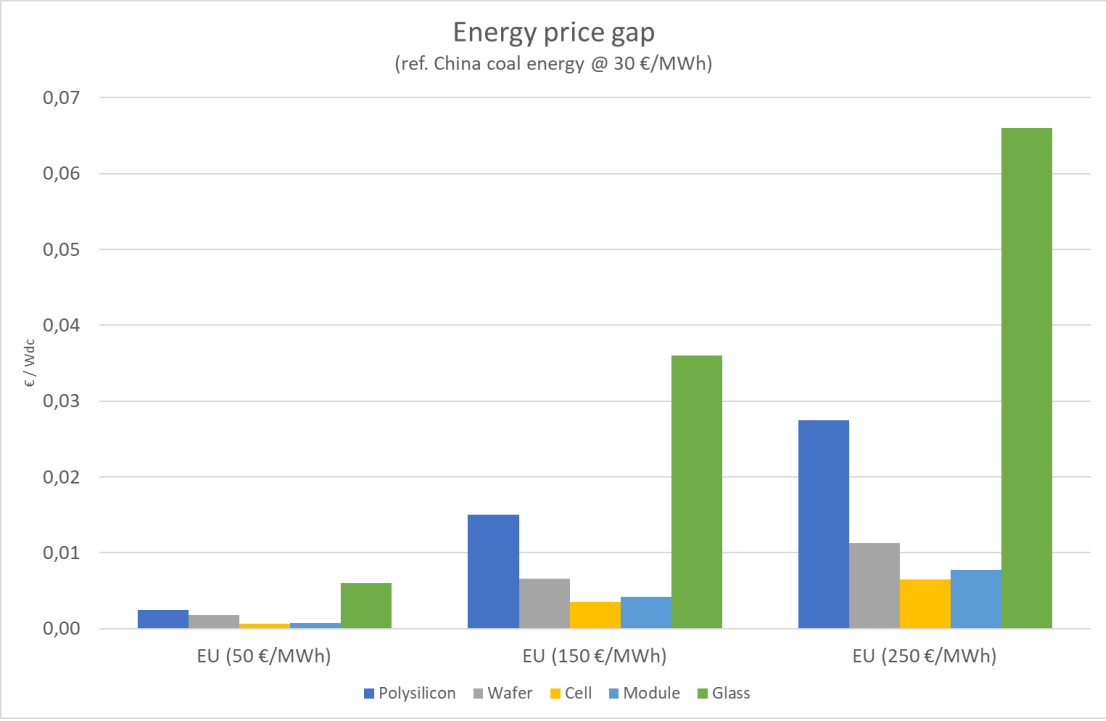
- Polysilicon is the most capital intensive step: 5,3 bn €
- For ingot/wafers: app. 1 bn €
- For cell: app. 1,5 bn €
- For modules: app. 1,5 bn €

But still: Financing is not easily accessible !



CAPEX is already a hurdle but OPEX is crucial

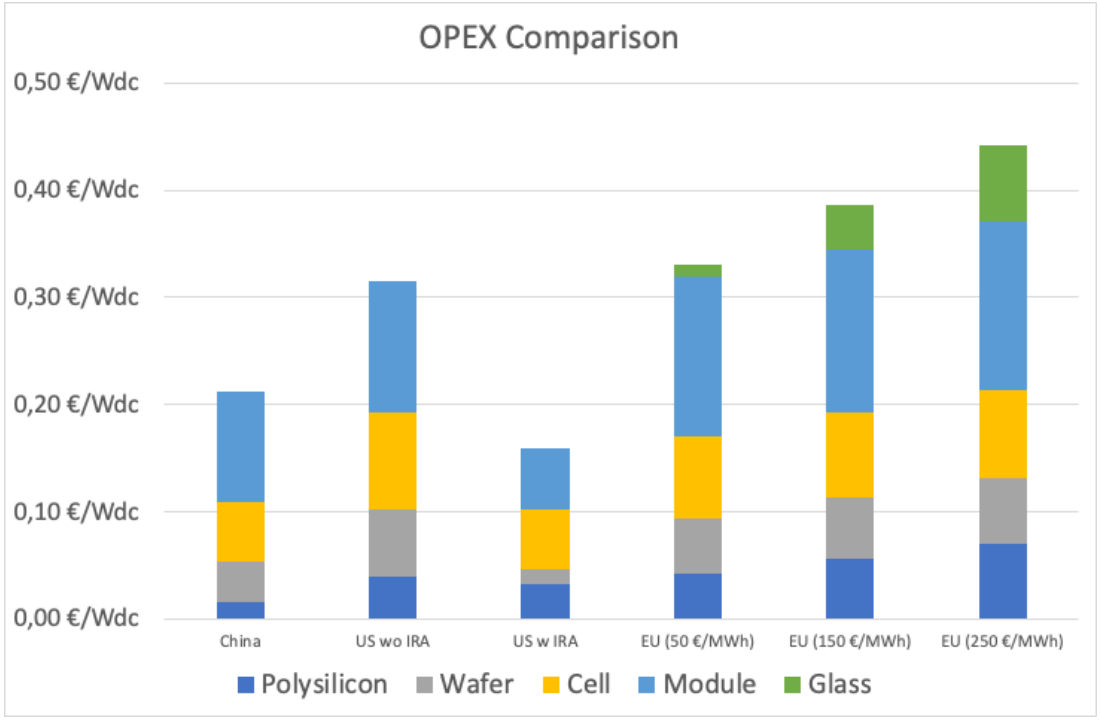
- Silicon, Polysilicon, wafer and glass production are the most intensive steps in the value chain. Energy prices < 50 MWh could be acceptable in terms fair competition.
- CO2 footprint of the energy mix could be a relevant tool to close this gap if applied properly.



Comparison: OPEX + CAPEX by region

Higher OPEX/CAPEX due to:

- higher labour costs.
- limited access to CAPEX funding.
- energy prices, especially for energy-intensive sectors as wafers, polysilicon, glass.
- lack of economy of scale
- higher raw material prices, due to energy prices or duties on imported raw material.



EU OPEX + CAPEX GAPS vs. China and comparison with IRA

Conclusion:
€4,7 bn to €6,4 bn of annual support for 8-10 years needed to ensure a competitive 30 GW PV value chain in Europe.

This is the unique opportunity for EU to develop a resilient and competitive industry !

	IRA	EU Gap vs. China		
Value Chain	€	@ 50 €/MWh	@ 150 €/MWh	@ 250 €/MWh
Polysilicon	0,61 c€/Wdc	2,96 c€/Wdc	4,52 c€/Wdc	6,08 c€/Wdc
Wafer	4,35 c€/Wdc	3,12 c€/Wdc	3,64 c€/Wdc	4,16 c€/Wdc
Cell	3,48 c€/Wdc	3,98 c€/Wdc	4,37 c€/Wdc	4,76 c€/Wdc
Module	6,09 c€/Wdc	5,55 c€/Wdc	5,97 c€/Wdc	6,39 c€/Wdc
Total	14,52 c€/Wdc	15,60 c€/Wdc	18,50 c€/Wdc	21,39 c€/Wdc
Funding/Year in bn €	**4,36**	**4,68**	**5,55**	**6,42**

Note: Exchange rate EUR/USD = 1,15

KEY PROPOSALS OF THE WORKING GROUP

TCTF and NZIA needs revision to fix the funding gaps

- **TCTF and NZIA** are a step in the right direction but **too burdensome and too complicated compared to IRA. Simplify and shorten procedures.**
- **TCTF Points 85 and 86 in Section 2.8 need to be revisited:**
  - Facilitate aid for OPEX and CAPEX e.g. electricity costs; matching clause; cap for capex; geographical restrictions etc.
- **NZIA:** Extend support of Net Zero Technologies to the **entire solar value chain incl. components**
- **NZIA falls short to create a level playing field e.g. Art. 19 and 20:**
  - It is good to give more weight to ESG criteria in auctions/GPP but no clear reference to an ESG systems e.g. EPEAT; Omission of ESG at price difference > 10 % in auctions

NEXT STEPS

The proposals/initiatives to be implemented during NZIA adoption and potentially TCTF revision processes

- **Working group to come with concrete proposals what needs to be changed in TCTF and NZIA by end of June.**
- **Results to be presented and discussed with EU COM beginning of July.**

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Thank you, any questions?

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