ESIA European Solar PV Industry Alliance

Brussels, 02.08.2024

EUROPEAN SOLAR PV INDUSTRY ALLIANCE

RECOMMENDATION PAPER SERIES VII

Comprehensive Strategies for Carbon Footprint Assessment: Best Practices for European Sustainability Directives for PV modules

Endorsements, adoptions of opinions and recommendations in this paper do not necessarily represent the views of the European Commission. The Commission cannot be held responsible for any use which may be made of the information contained therein.

This document does not show the position of some of the ESIA members. See Annex I for more details.

Background

Photovoltaic (PV) modules play a critical role in decarbonizing the European Union's (EU) energy system. The EU's ambitious climate goals include a substantial reduction in global warming potential (GWP) by 2030, aiming for climate neutrality by 2050 1. PV technology, projected to deploy over 320 GWp annually by 2025 and nearly 600 GWp by 2030 2, is at the forefront of this initiative. The European Solar PV Industry Alliance (ESIA) supports these goals and recognizes that ensuring PV modules are environmentally sustainable and meet minimum required quality standards is paramount.

The Ecodesign directive by the European Commission aims to improve the EU's sustainability credentials by removing the least efficient products from the market3. This directive encourages industrial competitiveness and innovation by enhancing product environmental performance. Its core objectives include offering more durable, better-performing PV products with lower greenhouse gas (GHG) impacts from production, and empowering consumers to make sustainable choices at the point of sale.

The selected methodology to achieve this is critical and hence, the Ecodesign directive should enforce one that is efficient in combating greenwashing as well as combating the delivery of modules with inferior quality which do not meet certifications for market entry. The last proposal from the European Commission included an adaptation of the Product Environmental Footprint Category Rules (PEFCR)4 methodology. This proposal has raised concerns among the manufacturing industry and research institutes, as highlighted by the Fraunhofer Institute for Solar Energy Systems (ISE) during an ESIA webinar in October 20235 and an open letter to the European Commission on January 2024 by the European Solar Manufacturing Council (ESMC)6, European researchers, and NGOs. The letter underscored the importance of a rigorous methodology to support the solar industry's future.

Key issues include the methodology's functional unit of assessment, which could enable manufacturers to misleadingly classify their carbon footprint fraudulently through uncertain factors like:

- product lifetime
- degradation rates

Furthermore, concerns were raised regarding the potential misuse of green certificates/Power Purchase Agreements (PPAs) as well as the stringency of the carbon footprint thresholds.

This paper summarises key recommendations from the ESIA to the European Commission, highlighting best practices for accurately assessing the environmental impacts of PV products. The implementation of these recommendations will advance the EU's climate and targets with the deployment of sustainable products and ensure a sustainable and competitive future for the European solar industry, critical to address energy security concerns.

Comprehensive Strategies for Carbon Footprint Assessment: Best Practices for European Sustainability Directives for PV modules

The ESIA advocates for carbon footprint thresholds for PV modules entering the EU market, emphasizing the need for a robust and non-manipulable directive methodology. Moreover, as the Ecodesign directive is proposed as the foundation of the carbon footprint non-pricing criteria within the Net Zero Industry Act (NZIA), the ESIA emphasizes the necessity of adopting best practices. As observed in the EU Battery Passport, the Ecodesign directive may also influence the upcoming EU Digital Product Passport (DPP) for PV modules. 17 Effective implementation of the carbon footprint thresholds discussed within NZIA and DPP is contingent upon the appropriate methodology selection within Ecodesign. Therefore, it is imperative that Ecodesign prioritizes the development and definition of methodologies that enhance sustainability and resilience.

The following streamlined recommendations should be considered as best practices to eliminate the risk of fraudulency and misrepresentation in the Ecodesign directive:

1. Functional Unit

Silicon-based The overarching goal of the Ecodesign directive is overwhelmingly favoured to emphasize distinctions between modules to promote sustainable modules in the EU market rather than to differentiate PV technology from other energy sources. For PV modules, this is done most accurately through a kilowatt peak (kWp) functional unit and as a result, this approach is already being used in solar PV tenders (e.g. France[7], South Korea[8]) as well as in solar ecolabels such as Electronic Product Environmental Assessment Tool (EPEAT)[9], Environmental Product Declaration (EPD) labels by The Norwegian EPD Foundation (NPCR 029:2022) [10].

The ESIA recommends the kilowatt peak (kWp) functional unit and champions the alignment of the Ecodesign directive's methodology with internationally recognized carbon footprint assessment methods for PV modules.

There is a strong preference among the industry stakeholders for adopting the global EPEAT ecolabel methodology, recognized for its transparency and third-party verification, to address the raised concerns effectively.

It is recommended to not use the kilowatt-hour (kWh) for a market regulatory directive for PV modules. The risks of carbon footprint calculation on a kWh basis for a PV module include:

- Potential misrepresentation due to uncertainties in lifetime, degradation rates, varying site conditions, and other operational specificities, leading to inaccuracies and potential for manipulation. The influence of lifetime and degradation rates in carbon footprint is significant[11]. Different uncertainties influence the energy yield (kWh) assessments [12] and this can severely hamper the comparability of the labels.
- Not effective in minimizing manipulation risks unless parameters contributing to the energy yield calculation (such as lifetime, degradation rate) are set as fixed values. There is a strong potential for manipulation of the lifetime and degradation rate warranty certificates of PV modules around the globe. This concern resonated across different stakeholders. However, fixing parameters can result in methodologically prescribed misrepresentation leading to inaccurate carbon footprint for individual modules.
- Fixed lifetimes and degradation rates for all PV modules to minimize manipulation ignores module individuality and does not encourage market improvements. It must be noted that fixing lifetime, degradation rate, bifaciality and even solar irradiation results in methodologically prescribed misrepresentation of the carbon footprint of all modules that does not represent the fixed value for lifetime, degradation rate and solar irradiation to all EU clients.
    - A module with 15 or 40 year lifetime is required to calculate with fixed value, e.g., 30 years.
    - A module with 0.3%/a or 1.3%/a degradation rate is required to calculate with fixed value, e.g., 1%/a.
    - Different irradiation for different European locations[5]- such as Madrid (ES) with 2083 kWh/m^{2}a compared to Copenhagen (DK) with 1293 kWh/m^{2}a, which are not represented by the fixed 'Temperate Continental' value 1266 kWh/m^{2}a.

It is understood that if the parameters, such as lifetime and degradation rate warranty, are fixed then the kWh approach is not more granular than the kWp approach. The fixed parameters will not contribute to module differentiation and risk misrepresenting the module's carbon footprint to the EU market. Functional unit harmonization with other regulations, such as that of the battery carbon footprint methodology,[20] should never be preferred over choosing an adequate methodology that is fitting for the assessment of the product in scope. For PV modules, the kWp functional unit is

considered a more granular approach as the lifetime and degradation rate warranties can be regulated as separate parameters outside of the carbon footprint calculation.

ESIA strongly recommends keeping the product warranty and degradation warranty of the PV modules as minimum market-entry requirements, independent of the carbon footprint calculation due to associated uncertainties. Thresholds can maintain the market standard, provided that the thresholds are subject to periodic review to reflect state-of-the-art.

In addition, requiring stringent quality assurance measures as e. g. stipulated by the upcoming IECRE rating system[16] to ensure reliable and long-lasting products being deployed in the EU marketplace, which is a critical aspect when it comes to ensuring that true carbon footprint exposure is in line with expectations.

2. System Boundary

A cradle-to-gate system boundary is best suited to represent the carbon footprint of PV modules in Ecodesign directive. This includes raw material production to transportation of PV modules to market, keeping the scope specific to the PV modules. This is the system boundary for PV module that is specified in robust methodologies such as EPEAT[9], EPD-Norway (NPCR 029:2022)[10] as well as the Ecodesign adaptation of the PEFCR[4].

The ESIA recommends a cradle-to-gate system boundary for the PV module specific carbon footprint assessment within the Ecodesign directive.

However, a carbon footprint calculation in kWh basis is not recommended for a cradle-to-gate system boundary. This is because the cradle-to-gate system boundary does not include the balance of system (BoS), which includes different components other than the PV module such as inverter, mounting structures, cabling etc. The energy yield (kWh) is dependent on the BoS[12], and exclusion of those components from the scope leaves the carbon footprint on a kWh basis incomplete. Therefore, a carbon footprint calculation in kWp is best suited for a cradle-to-gate system boundary.

3. Electricity Used for Production

Recent studies have underscored the critical influence of the production electricity mix in the carbon footprint of PV modules, with significant variations observed due to the type of electricity used. A study by the Fraunhofer ISE showed that the electricity used in the production process accounted for over 50% of the carbon footprint for PV modules[14], while another highlighted a carbon footprint

variation of approximately 140% based on the electricity mix[13]. This points to the need for credible production-electricity attributes to prevent manipulation of carbon footprint calculations. This is necessary to eliminate the risk of fraudulent classification of PV modules to lower carbon footprint, preventing misrepresentation of the sustainability of the European market.

The inclusion of renewable energy attributes (REAs) characterized by their particularly low carbon footprint, in carbon footprint calculations has highly been debated, with severe concerns about their transparency and the challenges in tracking them outside the European Union and the United States. Uncertainties should be avoided in any market regulatory directive. The use of only national grid mix for calculation simplifies the verification process, reducing the massive workload, improving control and thus credibility while incentivizing countries to improve their national electricity grid. Overall, this approach reduces the dependency of the directive's success on the success of verification of the global certificates.

The ESIA cautions against the inclusion of renewable energy attribute certificates in carbon footprint calculations due to their unverifiable nature outside the EU and USA, and therefore the high potential for carbon footprint manipulation. The ESIA emphasizes the importance of relying on national grid emission factors, obtained from credible organizations like the International Energy Agency[15], as the sole method for carbon footprint assessment to ensure the integrity of carbon footprint claims in the European solar market.

This approach is used in the French tenders (calculation method 1), EPEAT (path A), the EPD-Norway (NPCR 029:2022) as well as EU's delegated regulation for the calculation of the carbon footprint of electric vehicle batteries.[20] The complete allowance of REAs on a regulatory scenario, as proposed by the Ecodesign adaptation of PEFCR (v2), is highly discouraged by all stakeholders. Granularity in the production mix should not come at the cost of credibility, which subsequently will jeopardize the goal of cutting out least sustainable products from the EU market.

4. Life Cycle Inventory (LCI)

Material purchase certificates cannot be reliably verified across the globe. This concern resonated throughout the value chain, and therefore, the ESIA strongly cautions against the use of such certificates in the carbon footprint calculation of a market regulatory scheme. While Müller et al. (2021) attributes ~50% of the carbon footprint of a c-Si module to the electricity use, the other ~50% can be associated the materials used. This means that if global material purchase certificates are

allowed, then ~50% of the carbon footprint can be categorized as uncertain due to the uncertainty associated with material purchase certificates. To avoid ineffectiveness of the directive due to manipulation of purchase certificates, the Ecodesign directive must enforce stricter controls on the sourcing of raw materials for PV module.

The ESIA strongly recommends grounding the life cycle inventory to tabulated values sourced from reputable organizations such as the International Energy Agency[15] in order to improve the transparency and credibility of the carbon footprint calculations.

5. Verification of Carbon Footprint Results

For independent third-party verification of carbon footprint result through *notified bodies,* the ESIA urges to involve two essential LCA review steps as observed in the global ecolabel EPEAT to ensure the verifiers' proficiency.

The two LCA review steps are:

- LCA REVIEW STEP 1 – Critical Review: Must adhere to the standards set by ISO 14044, ISO 14067, and NPCR 029 2021, conducted by an entity or individual qualified under ISO 14044 Section 7.3.2.
- LCA REVIEW STEP 2 – Review of Emission Coefficients by Designated Expert: Requires an expert with a minimum of ten years in LCA and engineering processes specific to PV module production.

6. Carbon Footprint Threshold

For the choice of electricity mix and LCI allowed in the Ecodesign directive draft v2[4], the carbon footprint thresholds for PV modules, 25 g CO_2-Eq./kWh initially and 18 g CO_2-Eq./kWh eventually, are rather high. **The ESIA calls for lower carbon footprint thresholds for PV modules.**

As a point of reference, it is clear that the guidelines established by the EPEAT global ecolabel are preferred. **The ESIA advocates for adopting PV module carbon footprint thresholds akin to those of the EPEAT global ecolabel, which do not use the kWh functional unit.** To enhance product sustainability in the EU market, the ESIA recommends reducing the PV module carbon footprint thresholds below those set by the EPEAT global ecolabel.

The ESIA champions a robust threshold for the PV module carbon footprint, suggesting that a suitably rigorous threshold, lower than that of EPEAT Low Carbon Solar threshold, for the PV module carbon footprint, provided that factors such as the life cycle inventory (LCI) and the electricity mix emission factors used are based on internationally accepted look up tables such as the IEA PVPS.

These thresholds should follow a sliding scale that becomes progressively more demanding over time. Should kWh remain the unit for assessing the carbon footprint of PV modules, setting carefully assessed thresholds, which are lower than those stipulated by the Ecodesign draft v2 which is subject to aforementioned factors.

The ESIA advocates for a fast implementation of the carbon footprint thresholds through Ecodesign directive.

However, the current draft of this directive risks placing European manufacturers at a competitive disadvantage due to potential manipulations involving factors such as i. lifetime warranty, ii. degradation rate warranty, iii. REA certificates, and iv. material purchase certificates. These factors cannot be reliably verified globally and lack credibility outside of the EU and USA. As a result, exported PV modules could falsely claim a lower carbon footprint than those manufactured in the EU, undermining their primary selling point.

Implementing stricter regulations as proposed above would effectively counteract these manipulations and enhance the competitiveness of the European PV manufacturing industry.

Moreover, as the standardization study for the Ecodesign directive (as well as the Energy Label directive) has already started, the ESIA highlights the risk of duplicating standardization work as the methodology(ies) still have not gone through consultation and the final version may present a methodology that does not require the developed values. **Methodologies that have not undergone consultation and are thus not yet finalized should not move towards standardization.**

The ESIA warns that the current proposal for the Ecodesign directive is insufficient to promote a market driven by genuinely sustainable modules. Without the recommended adjustments, the directive risks failing to achieve EU's intended sustainability and energy security goals.

Further Recommendations

Energy Label Directive

Beyond Ecodesign, the ESIA cautions that the currently proposed Energy Label classes are determined based on energy output of only the first year of a module in kWh/m²/a and only based on efficiency. As evident through research[11,13], the lifetime plays a significant role in the energy yield of a PV module which is not reflected presently in the current proposed design of the Energy Label directive.

Looking into a simple example: while the label promotes a module with 22% efficiency over a module with 18% efficiency, this may mislead the module's energy performance in the eyes of end-users when the module with 22% efficiency has 15 years lifetime compared to 30 years lifetime of the 18% efficiency module. Therefore, the current approach may be deemed incomplete to provide customers the correct information on electricity bills savings as well as contribute to climate targets, severely undermining the objective of the Energy Label directive.

An Energy Label based strictly on energy yield, it would favour modules with high nameplate efficiency that are produced with heavy energy consumption rather than incentivizing the reduction of energy consumption. Since PV modules use energy during manufacturing and not in the use phase (unlike a refrigerator for example), an effective Energy Label for PV modules should be based on embodied energy or carbon.

Therefore, the ESIA urges to adapt the methodology behind the Energy Label directive to take manufacturing inputs into account through either a

a) **Rating according to the embedded primary energy being used for producing the PV module per Wp, including all ingoing materials.**
b) **Rating according to the embedded CO_2 footprint per Wp (based on the same methodology proposed above for the Ecodesign directive).**

If neither is possible, the ESIA strongly advocates for the elimination of the Energy Label directive for PV modules.

REFERENCES

[1] European Commission. (2021). Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions, "'Fit for 55': delivering the EU's 2030 climate target on the way to climate neutrality," Brussels.

[2] European Commission. (2022). Communication From The Commission To The European Parliament, The Council, The European Economic And Social Committee And The Committee Of The Regions. EU Solar Energy Strategy.

[3] European Council for an Energy Efficient Economy (ECEEE). Ecodesign Directive. Retrieve from: https://www.eceee.org/policy-areas/product-policy/ecodesign-directive

[4] European Commission, "Ecodesign requirements for photovoltaic modules and photovoltaic inverters" Working document, version 2. This methodology is under development; values may be different in the latest version.

[5] European Solar Industry Alliance. (October, 2023). ESIA Webinars: Carbon footprint calculation methodologies. Retrieve from https://solaralliance.eu/news/esia-webinars-carbon-footprint-calculation-methodologies/

[6] European Solar Manufacturing Council. (February, 2024). From the European PV manufacturing industry: A request for Ecodesign and Energy Label legislation that serves the environment and European solar PV manufacturing. Retrieved from https://esmc.solar/wp-content/uploads/2024/02/From-the-European-PV-manufacturing-industry-A-request-for-Ecodesign-and-Energy-Label-legislation-that-serves-the-environment-a.pdf

[7] Commission de régulation de l'énergie (CRE). (September, 2023). Specifications for the call for tenders relating to the construction and operation of electricity production installations from solar energy and located in non-interconnected areas. Retrieved from www.cre.fr/documents/appels-doffres/appels-d-offres-portant-sur-la-realisation-et-l-exploitation-d-installations-de-production-d-electricite-a-partir-de-l-energie-solaire-et-situees-d.html

[8] Korean Ministry of Economy and Finance (2021). Government Announces Korean New Deal 2.0. Retrieved from https://english.moef.go.kr/pc/selectTbPressCenterDtl.do?boardCd=N0001&seq=5173.

[9] Green Electronics Council dba Global Electronics Council (GEC), EPEAT (2023), Criteria for the Assessment of Ultra-Low Carbon Solar Modules.

[10] The Norwegian EPD Foundation. NPCR Construction products and services Part A (April 2017), NPCR 029 Part B for photovoltaic modules used in the building and construction industry, including production of cell, wafer, ingot block, solar grade silicon, solar substrates, solar superstrates and other solar grade semiconductor materials version 1.2 (March, 2022). Also adopted by The International EPD® System as c-PCR-016 Photovoltaic modules and parts thereof (April, 2022).

[11] Khan, A. A., Molina, P., Reichel, C., Protti, A. A., Neuhaus, D. H., Rentsch, J., & Nold, S. (2024). The EU Ecodesign Directive – Analysis of Carbon Footprint Assessment Methodology and Implications for PV Module Manufactures. Solar Rapid Research Letters (RRL). Retrieved from https://onlinelibrary.wiley.com/doi/abs/10.1002/solr.202301011 .

[12] Reise, C., Müller, B., Moser, D., Belluardo, G., Ingenhoven, P., Driesse, A., Razongles, G., & Richter, M. (2018). Uncertainties in PV System Yield Predictions and Assessments. IEA Photovoltaic Power Systems Programme (IEA PVPS) Task 13, Report IEA-PVPS T13-12:2018. International Energy Agency. ISBN 978-3-906042-51-0

[13] Khan, A. A., Reichel, C., Molina, P., Friedrich, L., Subasi, D. M., Neuhaus, H., & Nold, S. (2024). Global warming potential of photovoltaics with state-of-the art silicon solar cells: Influence of electricity mix, installation location and lifetime. Solar Energy Materials and Solar Cells, 269, 112724.

[14] A. Müller, L. Friedrich, C. Reichel, S. Herceg, M. Mittag, D.H. Neuhaus. (2021). A comparative life cycle assessment of silicon PV modules: impact of module design, manufacturing location and inventory, Sol. Energy Mater. Sol. Cell. 230 ,111277, https://doi.org/10.116/j.solmat.2021.111277.

[15] Frischknecht, R., Stolz, P., Heath, G., Raugei, M., Sinha, P., & de Wild-Scholten, M. (2020). Methodology Guidelines on life cycle assessment of photovoltaic. IEA PVPS Task, 12.

[16] Sauer, T., Taylor, R., et al. (2024). Business Case for the Establishment of a Rating System for PV Power Plants within the PV Sector of IECRE (includes separate sections for modules), issued by the IECRE TF006 in cooperation with the IECRE PV SWG

[17] Rizos, V., and Urban, P. (2024). Implementing the EU digital battery passport. CEPS. Retrieve from: https://circulareconomy.europa.eu/platform/sites/default/files/2024-03/1qp5rxiZ-CEPS-InDepthAnalysis-2024-05_Implementing-the-EU-digital-battery-passport.pdf

[20] ANNEX to the Commission Delegated Regulation supplementing Regulation (EU) 2023/1542 of the European Parliament and of the Council by establishing the methodology for the calculation and verification of the carbon footprint of electric vehicle batteries, Ref. Ares(2024)3131389 - 29/04/2024.

ANNEX I: Members not endorsing the paper and reasons behind

- **Bundesverband Solarwirtschaft e.V. (BSW-Solar):**

As an association representing over 1,100 stakeholders across the entire value chain, BSW does not support this paper in its publicized form. While we agree with the principle of Ecodesign to improve the environmental footprint of PV technology, such measures should not counteract the overarching goal of climate protection through CO_2 reduction.

As core aspects of the paper run counter to the spirit of Ecodesign, they require a rebuttal. This is despite the paper's valuable technical expertise on adapting Ecodesign concepts to the case of solar PV.

Most importantly, BSW warns against utilizing Ecodesign to introduce industrial policy through the back door. There exists a different instrument for this in the form of the NZIA, which should be used towards that goal. Specifically, BSW cautions against "relying on national grid emission factors […] as the sole method for carbon footprint assessment" within Ecodesign as proposed on p. 7, since this disincentivizes investments into renewable energy PPAs.

There is an **imminent danger of collapse of growing PV markets in Europe**, if thresholds were to be applied to the entire market via Ecodesign that erect prohibitive barriers based on the country of origin. While BSW acknowledges the important role of Ecodesign in improving ecological footprints, any GW of PV deployment prevented by market collapse in Europe would negate CO_2 savings manifold – causing a Pyrrhic victory for climate-policy.

While the reliance on the country of origin as main factor for the computation of footprints violates the spirit of Ecodesign, BSW continues to advocate non-price criteria based on origin when designating limited "resilience segments" for the diversification and important reshoring of PV supply as warranted by the NZIA.

Hence, BSW does not condone the implementation of all adjustments suggested in the paper as called for on p. 9.

Given the diverging stances within its membership, BSW would like to abstain from taking a position on various other aspects of the paper. Notwithstanding, BSW commends the valuable discussion of applicable functional units in Chapter 1 and supports the notion that an Energy Label purely based on nameplate efficiency would convey little supplementary information. On the contrary, it might prevent the purchase of systems with advantageous lifetime energy footprints - for example by unfairly disadvantaging thin film technologies with reduced mounting equipment needs. Such a rushed implementation of a misleading label would be prone to create absurd outcomes.

- **Joint positioning by Engie, Iberdrola, Lightsource bp and RWE:**

Engie, Iberdrola, Lightsource bp and RWE are amongst the largest solar PV developers in Europe. As such, we support the spirit of the upcoming EU EcoDesign legislation for increasing the sustainability of solar PV equipment in Europe. This includes the **support of a reasonable and robust carbon footprint methodology** such as the Product Environmental Footprint Category Rules (PEFCR), as suggested by the European Commission in their EcoDesign regulation draft and Recommendation (EU) 2021/2279. This needs to be complemented by **realistic and transparent minimum carbon footprint threshold** developments over time, as foreseen in the EcoDesign regulation draft by the European Commission as well. However, further consideration could be given to the functional unit, as a value of kW peak may be meaningful.

However, we **strongly oppose the ESIA recommendation paper** on 'Comprehensive Strategies for Carbon Footprint Assessment: Best Practices for European Sustainability Directives for PV modules'. This is based on **substantial concerns about the suggested carbon footprint methodologies** (section 3 'Electricity Used for Production') **and carbon footprint thresholds** (section 6 'Carbon Footprint Threshold').

Within this context, we find that the proposed recommendations diverge from other EU Legislation related to provisions in the Directives (EU) 2018/2001 and (EU) 2023/2413 on renewable energy and Directives (EU) 2019/944 and (EU) 2024/1711 on the internal market of electricity, defining the use of Guaranties of origin to and supporting the promotion of PPAs to link the production of renewable energy to its consumption. **This legislation sets the basis to label the use of energy in final consumption.**

In our view, related proposals in the paper impose **severe risks for the future solar PV build-out in Europe**, as subsequently elaborated in further detail:

- **Section 3 'Electricity Used for Production'**: Basing a carbon footprint methodology on the **country-specific electricity mix** (such as EPEAT) prevents taking into account any individual site-specific decarbonization efforts. This approach is not target-oriented, as it misrepresents the actual carbon footprints of site-specific operations, disincentivizes the decarbonisation and electrification of manufacturing sites, and results in a structural disadvantage for several countries inside and outside the EU as manufacturing location. In addition, this prevents a level playing field and destroys incentives for markets for PPAs, guarantees of origin and renewables self-consumption inside and outside the EU. The initial purpose of EPEAT was introduced as ecolabel methodology for enhancing the sustainability of solar PV products by rewarding additional contributions going beyond minimums standards. The application of EPEAT as minimum standard for general market access is therefore conceptually incompatible and risks major solar PV supply chain disruptions.

- **Section 6 'Carbon Footprint Threshold'**: Combining a carbon footprint methodology based on the country-specific electricity with low minimum thresholds of the carbon footprints could be perceived as a trade defence measure, as it prevents the general market access of

non-European solar PV equipment. As current European solar PV supply chains can only satisfy a small share of equipment needs across the whole value chain – particularly not for ground-mounted modules - this risks a standstill of the European solar PV build-out and therefore, a failure of meeting European renewable energy and climate targets. Therefore, any adjustments of carbon footprint thresholds should require in-depth impact assessments on the solar PV development in the EU beforehand.

However, we acknowledge the need for green attributes outside Europe to comply with certain minimum reliability standards. For tackling this, **recognition of third country self-consumption, renewable attributes and PPAs** could ensure the compliance with EU quality standards.

To check compliance with EU quality standards, a procedure similar to the "RFNBOs Delegated Act: art. 9 Certification of Compliance" can be applied to take into account third country self-consumption and PPA in the Carbon Footprint calculations, avoiding to account low credibility certificates. For this and similarly to the RFNBOs Certification of Compliance, it is needed to define assessment protocols to recognize voluntary or national certification schemes in third countries to accept the evidence obtained by authorized certification bodies which will verify and ensure the compliance of those certificates and PPA.

Only if suppliers cannot effectively ensure decarbonization contributions through self-consumption, renewable attributes or PPAs, the country-specific electricity mix should be applied as a calculation method as a last resort option. All suppliers within the EU should be allowed to demonstrate their individual electricity mixes based on existing frameworks and audits.

- **SolarPower Europe**

SolarPower Europe is the premier association for the European solar PV sector that unites 300+ organisations. SolarPower Europe's members are companies in the solar energy sector belonging to all segments: from polysilicon manufacturers, ingots, wafers, and modules & cells assembling to large energy developers.

While we agree with the principle of Ecodesign to improve the environmental footprint of PV technology, we reject the "RECOMMENDATION PAPER SERIES VII: Comprehensive Strategies for Carbon Footprint Assessment: Best Practices for European Sustainability Directives for PV modules" in its current version for three main reasons:

- **Increasing carbon footprint thresholds and tightening implementation timelines:** Such standards could disrupt supply chains, hinder solar PV deployment, and negatively impact the EU's renewable targets and solar sector jobs.

- **Using exclusively the grid mix to calculate the energy use in CO2 footprint LC analysis:** SolarPower Europe recommends considering the active efforts of supplies for reducing their carbon footprint by engaging in Power Purchase Agreements and Renewable Energy Certificates (e.g. Guarantees of Origin). Not representing these site-specific behaviours would misrepresent carbon footprint in cases where supplies have proactively implemented measures to reduce CO2 emissions. Acknowledging the role of European PPAs and GOs would also ensure regulatory consistency with previous EU legislation (Renewable Energy Directive, Electricity Market Design, Carbon Border Adjustment Mechanism).

- **The numerous recommendations throughout the paper that the Ecodesign should adopt the EPEAT ecolabel methodology:** The paper highlights that carbon footprint thresholds should be ambitious and aligned with existing PV ecolabels. This is not in line with the purpose of the Ecodesign measures, which are meant to raise the sustainability bar of products by setting minimum sustainability requirements that can be met by most of the products today on the market. Ecodesign is not meant to be an industrial policy tool – there are other policy options that are better suited for that purpose. SolarPower Europe suggests in its position on non-price criteria for renewable energy auctions for the Implementing Act to the Net-Zero Industry Act, that better performing PV modules should be rewarded with bonus points in public auctions (e.g. kwp/EPEAT). The Ecolabel methodology cannot serve as a market entry standard due to fundamental constraints. It would rather create additional market obstacles.