ESIA European Solar PV Industry Alliance

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EUROPEAN SOLAR PV INDUSTRY ALLIANCE
PV PASSPORT

Paving the way: Recommendation for the Implementation of a Mandatory Digital Product Passport (DPP) for Solar Photovoltaic Modules in the European Union

Background

The European Union (EU) is at the forefront of implementing Digital Product Passports (DPP) as part of its broader circular economy and sustainability initiatives. These passports will soon be mandatory for several product categories, including batteries and textiles, as outlined in the Ecodesign for Sustainable Products Regulation that is part of the EU's Circular Economy Action Plan. A DPP serves as a digital record containing detailed information about a product such as its composition, origin, environmental impact, and lifecycle management. The information stored in the DPP is shared by the interacting actors in the value chain of a product.

Solar photovoltaic (PV) modules, while currently not included in the mandatory DPP framework, represent a product category with significant environmental and economic implications. The document "PV PASSPORT JOURNEY I: Paving the Way" provides a comprehensive understanding of the solar PV sector, setting the stage for this policy recommendation. Expanding the DPP framework to include solar PV modules aligns with the EU's goals for sustainability and transparency in product life cycles.

This policy paper seeks to recommend the inclusion of solar PV modules under the EU's mandatory Digital Product Passport framework. The objective is to outline the specific components that should be included in the PV passport and to detail the key raw materials, sustainability metrics, and traceability processes that need to be monitored. This will ensure that solar PV modules are produced, distributed, and responsibly managed at the end-of life in a manner that aligns with the EU's environmental and economic policies.

The proposed components for the PV passport are: product information, material inventory, carbon footprint (CO2) and circularity calculator, traceability, value chain process management, and circular economy tools. They provide a comprehensive approach to managing the lifecycle of solar modules. Each one of them will be hereby described.

1. Product Information

The Digital Product Passport for solar modules should prioritize transparent and accessible product information. When scanning the QR code associated with the DPP, the first details to appear should include the serial number, batch number, product model, power output, nameplate efficiency and annual degradation rate. This basic yet crucial information serves as the foundation for product identification and quality assurance.

Significance: Providing immediate access to detailed product information is essential for various stakeholders, including consumers, installers, recyclers, end-of-life managers, and regulators.

- For consumers, this transparency builds trust, as they can easily verify the authenticity and specifications of the solar modules they purchase.
- For installers, accurate product information ensures proper installation and maintenance, which is critical for the optimal performance and longevity of the modules.
- For recyclers, immediate access to detailed material composition, compliance, and handling data, enabling efficient recycling, improved material recovery, and adherence to environmental regulations, while supporting a circular economy.
- Regulators benefit from this transparency by having the necessary data to enforce standards and certifications, thereby maintaining market integrity.

Including this information in the DPP also supports anti-counterfeiting efforts. The global solar industry faces challenges with counterfeit products, which can undermine consumer confidence and lead to safety risks. A DPP that includes detailed product information serves as a digital authentication tool, ensuring that only genuine, certified products are used in the EU market.

2. Material Inventory

Material inventory is a critical component of the DPP for solar PV modules. It should include a full list of all raw materials used in the production of the solar module, with a particular emphasis on critical raw materials such as silicon, silver, and indium, as well as toxic components and heavy metals. To safeguard intellectual property and address similar concerns, economic operators can report raw material compositions in parts per million (ppm), within thresholds of ranges to protect sensitive information, or setting disclosure thresholds such as 0.1% weight-by-weight. Importantly, the reported quantities of these materials will be accessible only to regulators, ensuring that

proprietary data is safeguarded, while still providing necessary oversight. This inventory should also detail the sourcing and processing locations of these materials, offering a complete view of the supply chain while supporting compliance with environmental and ethical standards.

Critical Raw Materials:

Critical raw materials (CRMs) are essential for solar modules production. The EU Commission defines CRMs as "Those raw materials that are most important economically and have a high supply risk". These materials are often associated with environmental degradation, geopolitical risks, and ethical concerns, particularly in their extraction and processing. For example, silicon, the primary material in solar cells, requires significant energy to process, often sourced from regions with high carbon footprints. By including the mandatory disclosure of Critical Raw Materials (CRMs) in the Digital Product Passport, the EU can more effectively monitor and manage the sustainability of these essential resources, ensuring that they are sourced responsibly and ethically. This inclusion will also enable the EU to more accurately regulate and track the use of CRMs as outlined in the Critical Raw Materials Act, thereby enhancing oversight and supporting strategic initiatives aimed at securing a stable, sustainable supply of these vital materials. Moreover, disclosure of CRMs also encourages their recycling, recovery and reuse.

Data Collection and Integration: The material inventory should be dynamic, allowing updates throughout the product's lifecycle as new data becomes available. This requires a collaborative approach, where suppliers, manufacturers, and recyclers contribute to the DPP, ensuring that the information remains accurate and up to date. This transparency in the supply chain helps identify opportunities for reducing environmental impact, such as sourcing materials from regions with lower carbon footprints or investing in alternative, more sustainable materials.

3. CO_2 emissions reporting

The CO2 and circularity section embedded within the DPP should provide a comprehensive lifecycle assessment of the solar PV module, focusing on key environmental metrics. It should be mandatory to report the scores of Eco-Design and Eco-Label certifications, while also noting that further guidance on these standards is pending. We encourage that these regulations be strict to prevent greenwashing and ensure meaningful transparency regarding the module's environmental performance. Additionally, the calculator should track the actual CO2 emissions generated during the manufacturing and transportation of the solar module. It is important to standardize the

calculation methods, as CO2 values can vary based on the approach used. We recommend that the calculations be made on a watt peak basis, following the methodology presented in the ESIA recommendation paper series VII. This data, combined with the module's energy payback time, will give a holistic view of some aspects of the product's environmental impact and adherence to circular economy principles.

Importance:

As the EU continues to pursue its climate goals, reducing the carbon footprint of products is crucial. Solar PV modules, despite their role in renewable energy generation, have significant global warming potential associated with their production, transportation, and disposal. The CO2 report will enable manufacturers to provide precise data on the greenhouse gas emissions at each stage of the product's lifecycle, including real emissions data from manufacturing and transport. This information is critical for consumers and regulators to make informed decisions and for manufacturers to identify areas where emissions can be reduced. Additionally, calculating the energy payback time of the solar module will help evaluate its overall climate impact and efficiency.

4. Traceability and shipments

The DPP should also include a detailed record of the product's journey from manufacturing to its final installation. Similar to tracking a package, this component will allow stakeholders to see where the solar module has been at each stage of its lifecycle, from raw material extraction to assembly, shipping, final deployment, and disposal.

Transparency in the Supply Chain: Supply chain transparency is crucial for ensuring that the solar modules reaching consumers are of the highest quality and have been produced and transported in compliance with both environmental and ethical standards. The traceability feature of the DPP can prevent the circulation of substandard or counterfeit products and ensure that all materials and components used in the modules meet the necessary certifications. Moreover, by providing detailed information on the entire supply chain, the DPP will support the European Commission's efforts to enforce the forthcoming Union regulations against forced labor. This feature will enable the Commission to conduct an early assessment into the product´s supply chain, by crosschecking the information in the DDP with that in the forced labor single portal. The DPP will help ensure that all

products entering the EU market are produced under fair labor conditions, thereby strengthening the overall integrity and accountability of the supply chain.

This feature also supports the EU's goal of improving the sustainability of global supply chains. By tracking the movement of solar modules and their components, the EU can identify inefficiencies and areas where the carbon footprint can be reduced, such as by optimizing transportation routes or sourcing materials closer to manufacturing facilities.

5. Value Chain Process Management & Optimization

The DPP should facilitate value chain process management by providing tools for documentation, monitoring, and optimizing business processes across the supply chain. This component will support the identification of potential improvements in both inter- and intra-organizational processes.

Potential for Optimization: The solar PV industry involves complex value chains, with multiple actors in production, assembly, distribution, installation, and decommissioning of modules. By integrating digital tools within the DPP, businesses can streamline operations, reduce waste, and improve efficiency. For example, better coordination between suppliers and manufacturers can reduce lead times and minimize resource wastage.

This section of the DPP should also include a module for suggesting optimization potentials for the manufacturers, leveraging data analytics and artificial intelligence to propose improvements in production processes, logistics, and supply chain management. Such optimizations can lead to cost savings, reduced environmental impact, and improved product quality, benefiting all stakeholders in the value chain.

6. Circular Economy Information Tool

The circular economy information tool within the DPP should provide detailed guidance on the recyclability and end-of-life management of solar PV modules. This includes information on how to properly dispose of or recycle the product, partnerships with recyclers, and instructions for installers and end-users. The circularity section should assess how well the product aligns with circular economy principles, including the recyclability of materials, the use of recycled content, and the potential for refurbishing or repurposing the product at the end of its life.

Partnerships with Recyclers: Effective recycling of solar PV modules is crucial for reducing waste and recovering valuable materials. The DPP should list partnerships with certified recyclers who can handle the specific materials used in the modules. This information ensures that end-users and installers know where and how to recycle the product at the end of its life, reducing the environmental impact and supporting the circular economy.

Additionally, the DPP should provide clear instructions on disassembly and recycling processes. This guidance is essential for ensuring that the materials are recovered in a way that maximizes their value and minimizes environmental harm. Importantly, the DPP should also recognize the potential for a second life of solar panels once they are removed from service. In many cases, panels can be repaired and reused, or repurposed following system upgrades, where older but still functional panels may be installed elsewhere. This not only extends the lifespan of these products but also aligns with the principles of a circular economy, ensuring that valuable resources are reused rather than wasted. To support this, the DPP should mandate compliance with the Waste from Electrical and Electronic Equipment (WEEE) Directive, requiring solar module manufacturers to include detailed information on both the proper disposal and the potential for reusing or refurbishing panels. By enforcing the inclusion of Eco-Design, Eco-Label, and PV Recyclability Index scores within the DPP, along with clear guidance on WEEE-compliant disposal practices, the EU ensures transparency in sustainability efforts and drives continuous improvement across the industry. This comprehensive approach will bolster the EU's broader objective of transitioning to a more sustainable, resource-efficient economy, ensuring that solar modules contribute positively throughout their entire lifecycle. By including this information, the DPP supports the EU's circular economy goals and helps move the solar industry towards a more sustainable future.

Conclusion

The integration of solar PV modules into the EU's mandatory Digital Product Passport framework is a necessary step for enhancing transparency, sustainability, and circularity within the industry. The proposed components—product information, material inventory, CO2 reporting, traceability, value chain process management, and circular economy tools—provide a comprehensive approach to managing the lifecycle of solar modules.

The DPP will be a vital tool for the European Union in monitoring and implementing upcoming legislation. By acting as a self-reporting mechanism, the DPP will allow manufacturers to certify that their solar modules comply with EU regulations, such as the forthcoming legislation under the Forced Labor Law. This system will enable quick and efficient assessments to determine if any part of the supply chain involves regions flagged by the EU for using forced labor, thus helping to prevent these products from entering the EU market.

Additionally, the DPP can be utilized to evaluate whether solar modules meet the necessary criteria for participation in auctions and tenders under the Net-Zero Industry Act (NZIA), ensuring that only region-compliant, high-quality products are considered. The DPP will also streamline quality assurance processes, allowing regulators to easily verify that solar modules adhere to EU standards throughout their lifecycle, from manufacturing to end-of-life disposal. Overall, the DPP will be an essential instrument for ensuring compliance, enhancing transparency, and supporting the EU's broader regulatory and sustainability objectives.

The European Union should take immediate action to include solar PV modules in the DPP mandate.

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