Review of PV Sustainability Standards

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Executive Summary

As of 2025, less than 3,000 days remain for countries to achieve the Sustainable Development Goals (SDGs), a global initiative aimed at eradicating poverty and hunger while ensuring equal opportunities for all. Sustainability standards and frameworks are useful in reaching these targets, as they help companies apply the SDGs to benefit the environment, economy, and communities, as well as to identify business opportunities. This report offers a comprehensive review of the status of sustainability standards and organized schemes in the photovoltaics (PV) sector, covering the entire value chain.

The PV value chain, like any industrial sector, operates within a complex web of societal, regulatory, technological and economic contexts. Meaningful evaluation of performance indicators across the value chain requires codification and harmonization of methodologies and metrics. This harmonization provides a framework for granting, maintaining, or withdrawing operating licenses for value chain participants. Implementation of these frameworks can occur through commercial avenues (e.g., procurement requirements), regulatory measures (e.g., product policy instruments), and social mechanisms (e.g., stakeholder engagement in community-based initiatives).

We categorize the standards and frameworks into three main sections, noting that some standards have attributes leading to their inclusion in multiple sections:

1. Sectoral Reporting:
   - This section addresses industrial reporting obligations, further divided into corporate reporting, environmental performance declarations, and other industry standards and benchmarks.

2. Product-Related Standards:
   - This section covers typical standards associated with the PV industry, including harmonized documents that set requirements and rules for production, processes, and services. Examples include the NSF 457 PV ecolabel, developed by NSF International; and the horizontal0F[1] standards series EN 4555x, developed by the CEN-CENELEC, supporting the introduction of ecodesign requirements on material efficiency aspects across energy-related products by providing horizontal methods.

3. Regulatory Frameworks:
   - This section classifies standards related to regulatory frameworks, further divided into mandatory (e.g., EU Ecodesign), voluntary (e.g., Ecolabel), and waste-related frameworks (e.g., WEEE Directive).

[1] Horizontal standards apply to several industries, while vertical standards apply to just a specific industry.

In section 3 of the report, we evaluate the effects and impacts of these standards using methodologies such as the Organisation for Economic Co-operation and Development (OECD) six criteria, which provide a comprehensive framework for assessment:

1. **Relevance**: The extent to which the standards meet the needs and priorities of stakeholders.
2. **Effectiveness**: The degree to which the standards achieve their intended outcomes.
3. **Efficiency**: The measure of how efficiently resources are used to achieve the standards' objectives.
4. **Impact**: The broader, long-term effects of the standards on the sector and society.
5. **Sustainability**: The likelihood that the benefits of the standards will continue over time.
6. **Coherence**: The alignment and synergies between different standards and policies.

This evaluation provides insights into how these standards influence the PV sector's sustainability performance and highlights areas where improvements can better align with the SDGs.

Key Conclusions

From our analysis, several top-level insights emerge:

- **Gaps and Overlaps**: There are noticeable gaps in the existing standards, particularly in addressing the end-of-life management of PV products. Conversely, some areas show significant overlap, such as reporting requirements, which can be both beneficial for robustness and burdensome due to redundancy. Streamlining overlapping standards could enhance efficiency without sacrificing comprehensiveness.
- **Maturity of Standards**: The maturity of these standards varies widely. For example, regulatory frameworks like the EU Ecodesign are well-established and mature, whereas newer ecolabels and product-specific standards are still in nascent stages of development. This maturity spectrum indicates the PV industry's evolving approach towards comprehensive sustainability.
- **Novelty and Comparison with Other Sectors**: This analysis appears to be one of the first comprehensive reviews of sustainability standards specifically for the PV sector. While similar analyses have been conducted in other industries, such as electronics and automotive, the scope and application differ significantly. For instance, the automotive industry has more mature life cycle assessment standards, while the PV sector could be catching up.

Conclusions and Future Work

Given the dynamic nature of the PV industry and the rapid advancement of sustainability goals, periodically updating this analysis would be useful for tracking progress and incorporating new standards and frameworks. Continuous monitoring could help ensure that the PV sector remains aligned with the SDGs and adapts to emerging sustainability challenges and opportunities.

By mapping the connections between standards and the SDGs, this report aims to facilitate a deeper understanding of how the PV industry can contribute to a more sustainable future. We used the SDG Mapper tool, developed by the European Commission, to visualize the relationships between policies and the SDGs, helping stakeholders identify which goals and targets are addressed in their documents. This tool provides visualizations that enable users to make informed decisions and mainstream the SDGs into policy and decision-making processes.

Overall, this report serves as a resource for industry stakeholders, policymakers, and researchers, providing a structured overview of sustainability standards in the PV sector and select those that help in their alignment with global sustainability goals. This foundational analysis sets furthermore, the stage for future research and development in harmonizing and advancing sustainability standards within the PV industry.