



PV WASTE MANAGEMENT IN INDIA

Comparative Analysis of State
of Play & Recommendations



EU- India: Technical
Cooperation – Energy Project
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ABOUT EU-INDIA TCP

The EU-India Technical Cooperation Project: Energy (EU-India TCP) was set up by the Government of India and the European Commission in 2014 as an effective instrument for working together on renewable energy and energy efficiency.

The project supports the government's efforts to promote clean energy and facilitates the uptake of sustainable technologies by the public and private sectors. The project complements, and is supportive to building the capacity of the Ministry of New and Renewable Energy (MNRE), Bureau of Energy Efficiency (BEE), and partner states through identification, evaluation, and implementation of need-based work as directed by MNRE or BEE.

- technical advisory services
- reviewing model documents
- developing web-based applications and providing IT assistance
- conducting training workshops and seminars
- facilitating study tours

The primary activities performed by the project are listed here: The continuous assessment of the effectiveness of the project permitted the evolution of the activities to address the changing priorities of the partner states.

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EXECUTIVE SUMMARY

This study aims to analyse the current state of play of the PV waste management landscape in India and to provide recommendations on how to enhance the policy framework around it. A comparison of the EU and Indian regulatory settings and main policy drivers is carried out, as well as an analysis of the PV module waste market in India, including the amount of waste generated and current waste treatment practices. Based on these assessments, a number of short-, mid- and long-term policy recommendations are included.

There are important similarities and differences between both regions for waste treatment regulations relevant for waste generated from PV systems. In both regions, PV modules are considered as “one product, one equipment” – one does not apply a waste law to “components” of an equipment.

Whereas PV modules and inverters are under the scope of the EU WEEE Directive, the Indian E-Waste (Management and Handling) Rules are not applicable to PV modules and inverters because these E-Waste Rules only apply to two categories of electrical and electronic equipment that do not include PV products. In contrast, in the EU there is a so-called “open scope” whereby each electrical and electronic equipment falls under the scope of the WEEE Directive since August 2018.

Both the European WEEE Directive and the Indian E-Waste Rules are based on the Extended Producer Responsibility (EPR) principle, foresee mandatory collection targets and are mainly focused on “consumer electronic waste”.

There are comprehensive Industrial Solid Waste Rules in place in India, but they do not include solar PV within their scope, whilst the European Union has its Waste Framework Directive which settles the basis requirements for each waste type irrespective of Extended Producer



Responsibility legislation or other specific legislation which might come on top. Crystalline silicon (c-Si) PV modules are not considered as hazardous waste under the Indian Hazardous and Other Waste Rules.

Looking at the current policy framework around end-of-life PV products in India, findings show that the following measures should be explored in the short term:

01

Impose a landfill ban for solar PV modules;

02

Implement a legislative framework for a mandatory Extended Producer Responsibility (EPR) for equipment coming from the Renewable Energy Industry whereby the industry proposes through a five-year management plan its objectives and how to achieve these under supervision of the MNRE and/or MOEF;

03

Create a self-standing EPR legislation for PV modules (potentially for all PV equipment or all Renewable Energy equipment) separately from the E-Waste Rules. As PV technology, which is currently not included in the scope of the E-Waste Rules, will become the cornerstone of the energy transition, it is recommended to set out a separate piece of legislation instead of being included in the E-Waste Rules legislation;

04

Allow the Indian PV industry to propose a sustainable and long-term solution for the waste generated by a PV system taking into account that PV modules have a very long lifetime and today's generated waste is by far not attractive to enable big industrial waste treatment capacity for PV modules.

Based on the results and recommendations of this report, the development of a draft piece of legislation for PV end-of-life management should be carried out. The new legislative framework could include in the scope modules, inverters and other PV system components. While it is too early to determine whether inverters and other PV components should be part of the same legislation for PV modules or rather be part of the E-Waste Rules, it will be key to ensure synergies across the different pieces of legislation and to optimise the economic, social and environmental dimensions in waste collection and treatment.

The Indian PV recycling legislation could be inspired by lessons learned in Europe, the EU being the only region with an existing regulatory framework for the end-of-life management of PV modules. Therefore, it is important to remember that the European WEEE Directive (similar to its Indian counterpart) is a piece of legislation, which was originally established for purely household appliances and consumer electronics. The WEEE legislation is not specifically designed for PV appliances or commercial or industrial electrical and electronic equipment. Therefore, it is recommended to invite first the Indian PV Industry to propose a management plan for the end-of-life phase of their products such as PV modules, inverters and batteries, to allow its assessment by the MNRE and to conclude based upon the accompanying discussions if and how legislative support would benefit for the Indian society.

Compared to current installation levels, the annual Indian PV market is expected to grow significantly across all three scenarios investigated in the study. Assuming that PV systems installed in 2020-2030 have a lifetime of at least 30 years, any capacity installed during this period will reach the end-of-life stage not before 2050.

Given that ground-mounted solar constitutes the vast majority of PV capacity, and that the residential segment is only a fraction of rooftop installations, it can be concluded that the greatest bulk of end-of-life PV waste will be deriving from business-to-business (B2B) relations.

According to the analysis carried out in the context of this study, by the year 2030 India will generate a cumulative mass of PV module waste of 11 kilo tonnes (kt) in the Low scenario, 21 kt in the Medium scenario, and 34 kt in the High scenario. These waste streams are relatively very small compared to waste volumes generated from modules reaching their expected end of life. The latter would start accumulating only around after the year 2040 and will become rapidly the most relevant waste source.

Different overall policy approaches and a range of EPR policies, instruments and measures are available for PV waste management in India. A general overview of possible business models, EPR scheme options and financing options for the EPR scheme as well as for addressing orphan and existing products is provided in the table below.

Overall policy approach						
Business-as-usual (BAU)		Improved Business-as-usual (BAU+)			Extended Producer Responsibility (EPR)	
EPR scheme options						
Take-back requirements	Economic instruments				Performance standards	Other
Product take-back	Deposit/refund	Advance disposal fee	Product/material tax	Combined upstream tax/subsidy	Minimum recycled content requirement	Industry-based measures, government measures
EPR financing options						
Internalisation of waste management costs				Visible fee		
Financing options for orphan and existing products						
Advance disposal fees	Fees paid at the time of purchase	Last owner pays		Insurance		Phase-in

Compared to a BAU scenario or to an improved BAU (BAU+) scenario whereby a landfill ban is introduced, this study recommends the Extended Producer Responsibility approach as the best one for the Indian context, as it constitutes the most effective means to perform sound PV waste management. It is advised to implement an EPR law for PV modules which sets the principle of a Producer Responsibility for PV modules and – where required – other products of a PV system, such as inverters and batteries.

Several EPR policy instruments and measures are available to governments to help them meet their stated goals and objectives. They are product take-back, deposit/refund, advance disposal fees, product/material taxes, combined upstream tax and subsidy and minimum recycled content requirements. Policymakers should review these different instruments to identify which might best meet their particular needs. The point of intervention for the instrument selected depends on the point where the market fails to internalize the impacts from the disposal of products at their post-consumer stage. The instrument or mix of instruments that would best meet policy goals should be selected.

Governments need to select the responsibility model and assign precise responsibilities to both physical and financial responsibility. Decisions on the allocation of responsibility should be made in view of the policy goals, product characteristics, market dynamics, actors in the product chain and resources needed to implement the policy. The national government, state and local authorities, the retailer, the consumer and the final owner of the waste all play important roles under EPR – measures should take into account all these stakeholders. In several cases, a Producer Responsibility Organisation (PRO) could be a useful option for managing and collecting products in lieu of each producer establishing its own separate system.