



Challenges and Solutions for Managing Solar PV Waste in India

For Prelims: PV Waste and its examples, Related initiatives

For Mains: Management of Solar Waste in India and other parts of the World, Challenges Posed by Solar Waste, Suggestions, and Related Initiatives.

Why in News?

Despite the efforts of Indian policymakers to transition to a [circular economy](#), there is currently a lack of clear directives for waste management in the solar photovoltaic (PV) industry.

What is PV Waste?

▪ About:

- [Photo-Voltaic waste](#) is the electronic waste generated by discarded solar panels. PV waste may contain hazardous materials, including heavy metals **such as cadmium, copper, lead, antimony, and selenium.**
- PV waste are sold as scraps in India. It can increase by at least four-five-fold by the next decade. India should focus its attention on drafting comprehensive rules to deal with solar waste.

▪ Composition of Solar PV:

- India's solar PV installations are dominated by **crystalline silicon (c-Si) technology. A typical PV panel is made of c-Si modules (93%) and cadmium telluride thin-film modules (7%).**
 - A **c-Si module mainly consists of a glass sheet, an aluminum frame, an encapsulant, a back sheet, copper wires, and silicon wafers.** Silver, tin, and lead are used to make c-Si modules. The thin-film module is made of glass, encapsulant, and compound [semiconductors](#).

▪ Status of India in PV Waste:

- Globally, India has the **world's fourth-highest solar PV deployment.** The installed solar capacity was nearly 62GW in November 2022. This leads to a huge amount of solar PV waste.
- According to a 2016 report by the [International Renewable Energy Agency](#), **India could generate 50,000-3,25,000 Tonnes of PV waste by 2030 and more than four million Tonnes by 2050.**

Can this Waste be Recovered or Recycled?

- As **PV panels near expiration, some portions of the frame are extracted** and sold as scrap, and junctions and cables are recycled according to e-waste guidelines.
- The glass laminate is partly recycled, while silicon and silver can be extracted by burning the module in cement furnaces. However, **approximately 50% of the total materials can be**

recovered, and only about 20% of the waste is recovered in general, with the rest being treated informally.

- This growing informal handling of PV waste has led to **waste accumulation at landfills, polluting the surroundings**. Incinerating the encapsulant also releases sulphur dioxide, hydrogen fluoride, and hydrogen cyanide into the atmosphere.

What are the Challenges in Managing PV Waste in India?

▪ Informal Handling of PV Waste:

- Despite some portions of the PV panels being extracted and recycled, a significant portion of the waste is treated informally, leading to the accumulation of waste in landfills and polluting the surroundings.

▪ Limited Market for Reusing Recycled PV Waste:

- The market to reuse recycled PV waste is currently extremely small in India due to a lack of suitable incentives and schemes in which businesses can invest.
 - The lack of central insurance or regulatory body to protect against financial losses incurred in waste collection and treatment.

▪ Lack of Specific Guidelines for PV Waste Treatment:

- Simply clubbing PV waste with other e-waste could lead to confusion, and there is a need for specific provisions to be formulated and implemented within the ambit of the e-waste guidelines.
 - Need for specific provisions for PV waste treatment within e-waste guidelines to avoid confusion.

▪ Hazardous Waste Classification:

- The waste generated from PV modules and their components is classified as 'hazardous waste' in India.
 - Conducting awareness campaigns and sensitization programs about managing PV waste can help people understand the importance of properly handling hazardous waste. This will encourage more people to participate in proper waste management and disposal practices.

▪ Limited Local Solar PV-panel Manufacturing:

- India **needs to pay more attention to domestic R&D efforts** as depending on a single module type will dis-uniformly deplete certain natural resources and stunt the local capacity for recycling and recovery of critical materials. The domestic development of PV waste recycling technologies must be promoted through appropriate infrastructure facilities and adequate funding.

What are India's Initiatives?

- [Draft EPR Notification: Plastic Packaging Waste.](#)
- [Plastic Waste Management Amendment Rules, 2021.](#)
- [E-Waste \(Management\) Rules, 2016.](#)
- [E-waste \(Management\) Amendment Rules, 2018.](#)
- [Central Pollution Control Board.](#)

What are the Initiatives of the other Countries?

▪ European Union:

- The **Waste Electrical and Electronic Equipment (WEEE)** Directive of the EU ([European Union](#)) imposes responsibility for the **disposal of waste on the manufacturers or distributors** who introduce or install such equipment for the first time.
 - **PV manufacturers are solely responsible for the collection, handling, and treatment of modules** at the end of their lifecycle, according to the WEEE Directive.

▪ UK:

- The UK also has an **industry-managed "take-back and recycling scheme"**, where all PV producers will **need to register and submit data related to products** used for the residential solar market (Business-to-Consumer) and non-residential market.

- **USA:**
 - While there are no federal statutes or regulations in the US that talk about recycling, **there are some states who have proactively defined policies to address end-of-life PV module** management.
 - Washington and California have come up with **Extended Producer Responsibility (EPR) regulations**. Washington now requires **PV module manufacturers to finance the take-back and reuse or recycling of PV modules** sold within or into the state at no cost to the end user.
- **Australia:**
 - The federal government in Australia has acknowledged the concern and announced a USD 2 million grant as **part of the National Product Stewardship Investment Fund** to develop and implement an industry-led product stewardship scheme for PV systems.
- **Japan and South Korea:**
 - Countries such as Japan and South Korea have already indicated their resolve to come up with **dedicated legislation to address the PV waste problem**.

Why should India Act now?

- India is expected to generate a vast amount of PV waste over the next 20 years, making it one of the **top five leading photovoltaic waste producers worldwide by 2050**.
 - Therefore, India needs to install clear policy directives, well-established recycling strategies, and greater collaboration to prepare for this new challenge. By addressing the gaps in PV waste management, India can achieve its goal of a circular economy and effective waste management while promoting sustainable development.

UPSC Civil Services Examination, Previous Year Question (PYQ)

Prelims

Q. With reference to solar power production in India, consider the following statements: (2018)

1. India is the third largest in the world in the manufacture of silicon wafers used in photovoltaic units.
2. The solar power tariffs are determined by the Solar Energy Corporation of India.

Which of the statements given above is/are correct?

- (a) 1 only
- (b) 2 only
- (c) Both 1 and 2
- (d) Neither 1 nor 2

Ans: (d)

- Silicon wafers are thin slices of semiconductor, such as a crystalline Silicon (c-Si), used for the fabrication of integrated circuits and, in photovoltaics, to manufacture solar cells. China is by far the world's largest producer of Silicon, followed by Russia, the United States, and Brazil. India does not figure among the top five producers of Silicon and Silicon wafers. **Hence, statement 1 is not correct.**
- Solar tariffs are determined by the Central Electricity Regulatory Commission and not by Solar Energy Corporation of India. **Hence, statement 2 is not correct. Therefore, option (d) is the correct answer.**

Mains

Q. Describe the benefits of deriving electric energy from sunlight in contrast to the conventional energy generation. What are the initiatives offered by our government for this purpose? **(2015)**

Source: [TH](#)

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