



## Solar Waste Management

**For Prelims:** [Solar Energy](#), [Circular Economy](#), [National Solar Mission](#), [Solar Park Scheme](#), [Rooftop Solar Scheme](#), [Critical Minerals](#).

**For Mains:** Solar Energy and Development in India, Challenges Related to Solar Waste, Government Schemes to Enhance Solar Energy Production in India.

**Source:** [IE](#)

### Why in News?

Recently, a report titled '**Enabling a Circular Economy in India's Solar Industry - Assessing the Solar Waste Quantum**' shed light on India's escalating [solar waste](#) crisis.

- The study was conducted by the **Ministry of New and Renewable Energy (MNRE)** in collaboration with experts from the [Council on Energy, Environment and Water](#) (a leading not-for-profit policy research institution in Asia)

### What are the Key Highlights of the Report?

- **Solar Waste Projection:** The current solar capacity of India, as of FY23, has generated about **100 kilotonnes (kt)** of cumulative waste, which will increase to 340 kt by 2030.
  - This volume will increase 32 times by 2050 resulting in about 19000 kt of cumulative waste.
  - **77% of the cumulative waste generated by 2050** will be due to new capacities.
- **State-wise Contribution:** Around 67% of the projected waste by 2030 is expected to be produced by five states: **Rajasthan, Gujarat, Karnataka, Tamil Nadu, and Andhra Pradesh**.
  - Rajasthan will account for 24% of the waste generated by 2030, followed by Gujarat accounting for 16%, and Karnataka accounting for 12%.
- **Critical Minerals Content:** Discarded solar modules contain [critical minerals](#) essential for India's economic development and national security, including silicon, copper, tellurium, and cadmium.
  - The projected 340 kt of waste by 2030 is estimated to comprise **10 kt of silicon, 12-18 tonnes of [silver](#), and 16 tonnes of cadmium and tellurium.**
- **Recommendations:**
  - The MNRE should maintain and periodically update a database of the installed solar capacity (containing details such as module technology, manufacturer, commissioning date, etc.) for accurate mapping of plausible waste generation centres.
  - The Ministry of Environment, Forest and Climate Change should issue guidelines for **collecting and storing solar waste**.
    - Furthermore, it should **promote the safe and efficient processing of stored waste.**
  - Solar cell and module producers should start developing **waste collection and storage centres** to adhere to the responsibilities assigned in the [Electronic Waste Management](#)

## What is Solar Waste?

- **About:** Solar waste is any waste generated during the **manufacturing of solar modules, or discarded modules and scrap** from manufacturing processes.
  - Modules are discarded at the end of their functional life or due to damages from transportation, handling, and installation.
  - Improper handling and landfilling of solar waste should be avoided. Proper treatment is necessary to **reclaim valuable minerals and prevent** the leaching of toxic materials like lead and cadmium.
- **Potential Recyclability of Solar Waste:** Approximately **80% of solar panel components, including glass and metal frames, are recyclable**, according to the [International Renewable Energy Agency \(IRENA\)](#).
  - Solar waste can be recycled to recover materials like glass, aluminium, copper, silicon and silver.
  - Recycling can be broadly categorised into **mechanical, thermal and chemical processes**.
    - Each process helps in the recovery of specific minerals of varying purity grades.
- **Challenges of Solar Waste Recycling in India:**
  - **Lack of Policy Framework:** The absence of specific comprehensive laws governing solar waste management hinders the establishment of standardised recycling practices and may contribute to inconsistent recycling efforts.
  - **Complex Composition & Difficulty in Separation:** Solar panels contain various materials like silicon, glass, aluminium, and toxic elements like lead and cadmium.
    - Separating these components for effective recycling requires specialised technology, which is often expensive and not widely available in India.
  - **Informal Sector Involvement:** A large portion of solar waste ends up with informal recyclers who lack proper safety measures and often resort to environmentally harmful practices.
  - **Limited Market for Recycled Materials:** In India, lack of adequate demand for materials such as silicon wafers or glass cullet from recycled panels undermines the economic feasibility of recycling efforts.

## What are India's Initiatives Related to Solar Energy?

- [National Solar Mission](#)
- [Solar Park Scheme](#)
- [Rooftop Solar Scheme](#)
- [PM-KUSUM scheme](#)
- [PM-Surya Ghar Muft Bijli Yojna](#)
- [International Solar Alliance](#)

## How can India Manage Solar Waste Effectively ?

- **Stringent Regulatory Framework:** India can create a comprehensive regulatory framework to guide collection, recycling, and material-specific recovery targets for solar waste.
  - The framework can also encourage incentives like [green certificates](#) to encourage **recycling and mineral recovery**.
  - It should also include developing and implementing comprehensive policies to **promote circular economy principles** within the solar industry, encouraging resource efficiency, recycling, and reuse.
- **Formalisation of Informal Recyclers:** Integrating **informal recyclers into the formal system** through **training programs** and providing them with proper equipment. This ensures safe, environmentally sound practices and also provides them a secured employment.
- **Solar Panel Refurbishment and Second Life:** . By establishing dedicated refurbishment

facilities, India can **clean, repair, and retest slightly damaged panels**, diverting them from the waste stream and providing affordable options for consumers.

- **Solar-waste Entrepreneurship:** Encouraging and incentivising green innovators to design and prototype new sustainable products using recycled solar materials, thereby fostering creativity and effective utilisation.

## What are Electronic Waste Management Rules 2022?

- **About:** The management of E-Waste in India is presently regulated under E-Waste (Management) Rules, 2022 under the Environment Protection Act, 1986
  - It includes waste management of solar PV modules, panels, and cells.
- **Applicability:** These rules apply to everyone involved in the life cycle of e-waste, including manufacturers, producers, refurbishers, dismantlers, and recyclers.
- **Key Features:**
  - **Extended Producer Responsibility (EPR):** Producers are obligated to fulfil specific recycling targets for the e-waste they introduce into the market. This is achieved through a system of **EPR certificates**.
  - **Solar E-Waste Management:** Producers are mandated to store the waste generated from **solar PV modules and cells** up to 2034 – 2035 as per guidelines laid down by the **Central Pollution Control Board (CPCB)**.
    - The rules also mandate the filing of annual returns on the e-waste management portal up to 2034 – 2035.
  - **Hazardous Substances:** It mandates that every producer of Electrical and Electronic Equipment (EEE) and their components shall ensure that their products do not contain **lead, mercury and other hazardous substances** beyond the maximum prescribed concentration.
- **Exceptions:** The rules do not apply to the following:
  - Waste batteries regulated by the Battery Waste Management Rules, 2022
  - Packaging plastics governed by the Plastic Waste Management Rules, 2016
  - Micro enterprises defined in the Micro, Small and Medium Enterprises Development Act, 2006 (27 of 2006)
  - Radioactive wastes covered by the provisions of the Atomic Energy Act, 1962 (33 of 1962) and its rules.

### **Drishti Mains Question:**

Assess the consequences of limited recycling infrastructure on India's renewable energy objectives and sustainable development goals especially considering the increasing amount of solar waste.

## UPSC Civil Services Examination Previous Year Question (PYQ)

### **Prelims**

#### **Q. Consider the following statements: (2016)**

1. The International Solar Alliance was launched at the United Nations Climate Change Conference in 2015.
2. The Alliance includes all the member countries of the United Nations.

#### **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: (a)**

**Mains**

**Q.** India has immense potential of solar energy though there are regional variations in its developments. Elaborate. **(2020)**

PDF Refernece URL: <https://www.drishtiias.com/printpdf/solar-waste-management>

