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**

Rules 2022.

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)**