Waste Segregation and Waste-to-Energy Plant

For Prelims: **Solid Waste Management Rules, 2016**, **Central Pollution Control Board (CPCB)**, **Waste-to-Energy Plant**, **Domestic Hazardous Waste**, **Biogas**, **BioCNG**, **Syngas**, **Refuse-Derived Fuel (RDF)**, **Methane**, **Circular Economy**, **Greenhouse Gas (GHG)**

For Mains: Significance of waste segregation at source and waste-to-energy plants in environmental conservation.

Source: TH

Why in News?

The **Supreme Court (SC)** emphasised the importance of **waste segregation at source** and questioned **National Capital Region (NCR) states** on the implementation of segregation of waste at source as per the **Solid Waste Management Rules** **(SWM Rules, 2016).**

- The SC directed the **Central Pollution Control Board (CPCB)** to report on the public health and environmental impact of **waste-to-energy plants.**

Note: NCR comprises **Delhi** and certain districts of **Haryana, Uttar Pradesh and Rajasthan**.

Click Here to Read: What are the Solid Waste Management Rules 2016?

What is Waste Segregation at Source?

- **About Solid Waste:** It refers to any type of **garbage, trash, refuse or discarded material** generated from **households, industries, businesses**, and other human activities.
  - They require **proper management** to prevent environmental and health hazards.
- **Waste Segregation at Source:** It refers to the **process of identifying, classifying, dividing, and sorting waste at the point of generation** to facilitate proper disposal, recycling, and management.
  - It categorizes waste based on its **biological, physical, and chemical properties**.
- **Provisions in SWM Rules, 2016:** SWM Rules, 2016 categories waste into **3 categories** i.e., **biodegradables, non-biodegradables, and domestic hazardous waste**.
  - **Biodegradables:** Organic waste that can be **degraded by micro-organisms** into **simpler stable compounds** like **food scraps, soiled wrappers, paper** etc. **Non-biodegradables**: Recyclable/non-recyclable items like **plastic, glass, metal, etc**.
  - **Domestic Hazardous waste: Diapers, napkins, mosquito repellants**, cleaning agents etc.

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- **Significance:**
  - **Prevents Contamination**: Keeps hazardous and non-hazardous waste separate, **reducing pollution**.
  - **Reduces Landfill Waste**: Sends only **non-recyclable** waste to **landfills.**
  - **Enhances Recycling**: Improves **resource recovery** and reduces raw material use. Enables composting, recycling, and waste treatment.
  - **Minimizes Health Risks**: **Prevents disease** from medical and hazardous waste.
  - **Promotes Responsibility**: Encourages **community participation** in waste management.

Solid Waste Generation

- As per **Annual Report** of CPCB for the year 2021-22, the **average quantity** of solid waste generated in India is **1,70,338 tonnes per day (TPD)**, of which **91,512 TPD is treated.**
- **Delhi** generates over **11,000 metric tonnes** of solid waste daily, while waste **treatment** plants can process only **8,073 metric tonnes.**
- In **FY 2014-15**, India processed **only 18%** of its total waste, which **rose** significantly to over **78% in FY 2024**.

What is a Waste-to-Energy Plant?

- **About:** Waste-to-energy (WtE) plants **convert municipal solid waste (MSW)** into energy in the form of **electricity, heat, or fuel** through various technologies like **pyrolysis, anaerobic digestion** etc.
  - It also generates **Biogas/ BioCNG/Syngas** from urban, industrial and agricultural wastes/residues.
- **Related Provisions in SWM Rules, 2016:**
  - **Utilization of Non-Recyclable Waste:** Waste with a **calorific value of 1500 Kcal/kg**

or more must be used for energy generation and **cannot be disposed of in landfills.**
        - **High-calorific waste** should be **co-processed** in **cement or thermal power plants.**
    - **Mandatory Use of RDF:** Industrial units using fuel and located within **100 km of a solid waste-based Refuse-Derived Fuel (RDF) plant** must replace **at least 5% of their fuel** with RDF.
        - RDF is made from **municipal and industrial waste** by removing non-combustibles, leaving **plastics, paper, textiles, and biomass.**
- **Methods of WtE Conversion:**
    - **Incineration:** Waste is burned at **ultra-high temperatures**, producing heat that generates steam to **spin turbines** and **create electricity**.
    - **Gasification:** Biomass is processed at high temperatures **without combustion** to produce syngas, which serves as **fuel for electricity generation or industrial use.**
    - **Anaerobic Digestion: Microorganisms** break down **organic waste** in an **oxygen-free** environment, producing **biogas rich in methane.**
    - **Fermentation and Distillation:** Organic biomass is **fermented and distilled to produce ethanol**, an **alternative fuel for engines.**
    - **Pyrolysis:** A **thermo-chemical process** that converts **waste into clean liquid fuels** (bio-oil, syngas, and char) under high temperatures in the absence of oxygen.
    - **Landfill Gas Recovery:** Methane and other gases released from landfills are captured through **wells using blowers and vacuums**, then treated for energy production.
- **Significance:**
    - **Utilization of Waste:** Converts waste into **heat and electricity**, reducing the need for fossil fuels.
    - **Reduction in Landfilling:** Reduces landfill waste and related environmental risks like **emissions, land use, and groundwater contamination**.
    - **Resource Recovery:** Enables **metal recovery** after incineration and retains valuable materials in the **circular economy**.
    - **Reduction in GHG Emissions:** Landfills produce **methane** emissions, a potent **Greenhouse Gas (GHG)** while waste-to-energy reduces them by diverting waste.

Draft SWM Rules, 2024

- The **Draft SWM Rules, 2024** were issued by the Central Government in exercise of the powers conferred by the **Environment (Protection) Act, 1986**.
- **Key Provisions:**
    - **Provision for Fines: 'Safai Karamcharis' (Sanitation Workers) will be authorized to levy fines and penalties** on unsegregated waste and **refuse collection** if segregation rules are ignored.
    - **Segregation of Solid Waste: Segregate** and store the **waste generated by them in four separate streams** at source namely **wet waste, dry waste, sanitary waste and special care waste.**
    - Agricultural Waste Management: **Gram Panchayats must prevent open burning of agricultural waste**, impose penalties for stubble burning, and **facilitate agri-residue collection and storage for use.**

Conclusion

Effective solid waste management through **source segregation and waste-to-energy** solutions is crucial for **sustainable urban development**. While **SWM Rules, 2016** provide a framework, challenges in enforcement, integration of the informal sector, and environmental concerns over waste-to-energy plants highlight the need for **stricter monitoring and decentralized waste processing.**

Drishti Mains Question:

Analyze the role of waste-to-energy plants in India’s waste management strategy.

UPSC Civil Services Examination, Previous Year Question (PYQ)

Prelims

Q. As per the Solid Waste Management Rules, 2016 in India, which one of the following statements is correct? (2019)

(a) Waste generator has to segregate waste into five categories.

(b) The Rules are applicable to notified urban local bodies, notified towns and all industrial townships only.

(c) The Rules provide for exact and elaborate criteria for the identification of sites for landfills and waste processing facilities.

(d) It is mandatory on the part of waste generator that the waste generated in one district cannot be moved to another district.

Ans: (c)

Mains

Q. What are the impediments in disposing of the huge quantities of discarded solid waste which are continuously being generated? How do we safely remove the toxic wastes that have been accumulating in our habitable environment? (2018)

Q. “To ensure effective implementation of policies addressing the water, sanitation and hygiene needs the identification of the beneficiary segments is to be synchronised with anticipated outcomes.” Examine the statement in the context of the WASH scheme. (2017)