

Achieving Circular Economy in Residual Waste Management

Dr. Snigdha Goel
Young Professional
NITI Aayog

Shri. Avinash Mishra
Advisor (Environment and Water Vertical)
NITI Aayog



Overview of Global Waste Sector



NITI Aayog



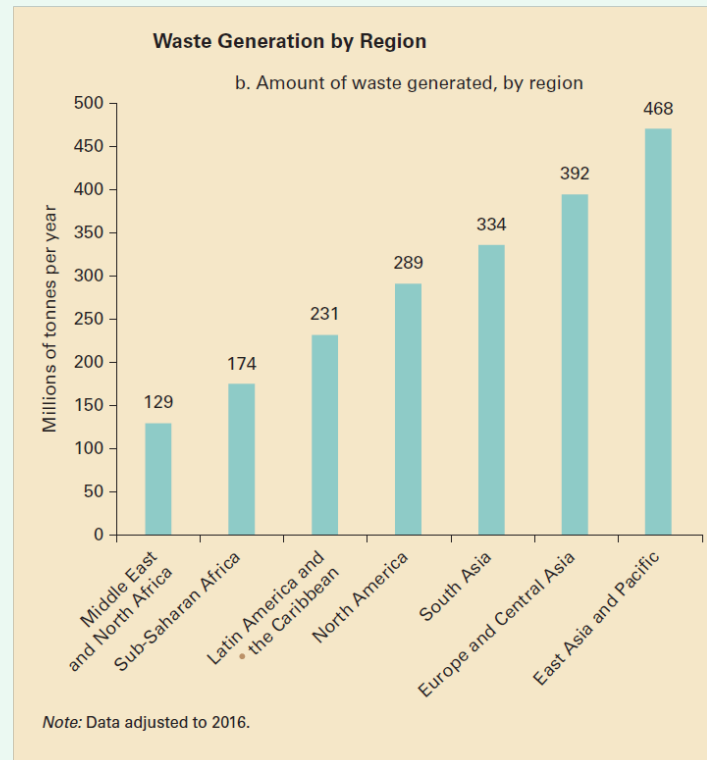
Globally, total waste generation is expected to reach 3.4 billion tonnes by 2050—a 69% increase from 2016 with increase in GDP and population



2.24 billion tons of municipal solid waste annually, of which only 55 per cent is managed in controlled facilities.



SWG increases following the economic advancement of countries from low-income to high-income as per a World Bank report



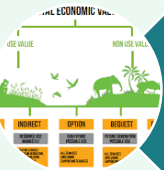
Overview of Indian Waste Sector



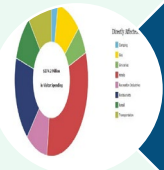
Due to the massive population, the total waste generated in India is more than 168,403.24 TPD, because of which India ranks seventh globally in SWG



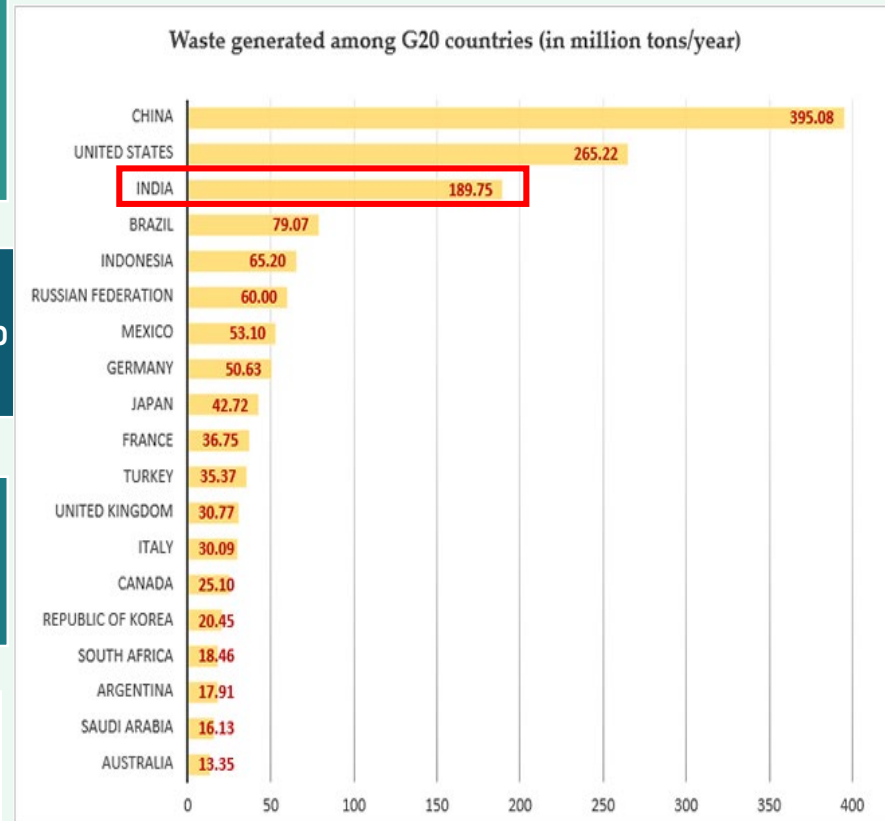
Present rate of SWG in India is 0.34 kg per capita per day, which is expected to reach up to 0.7 kg per day by 2025



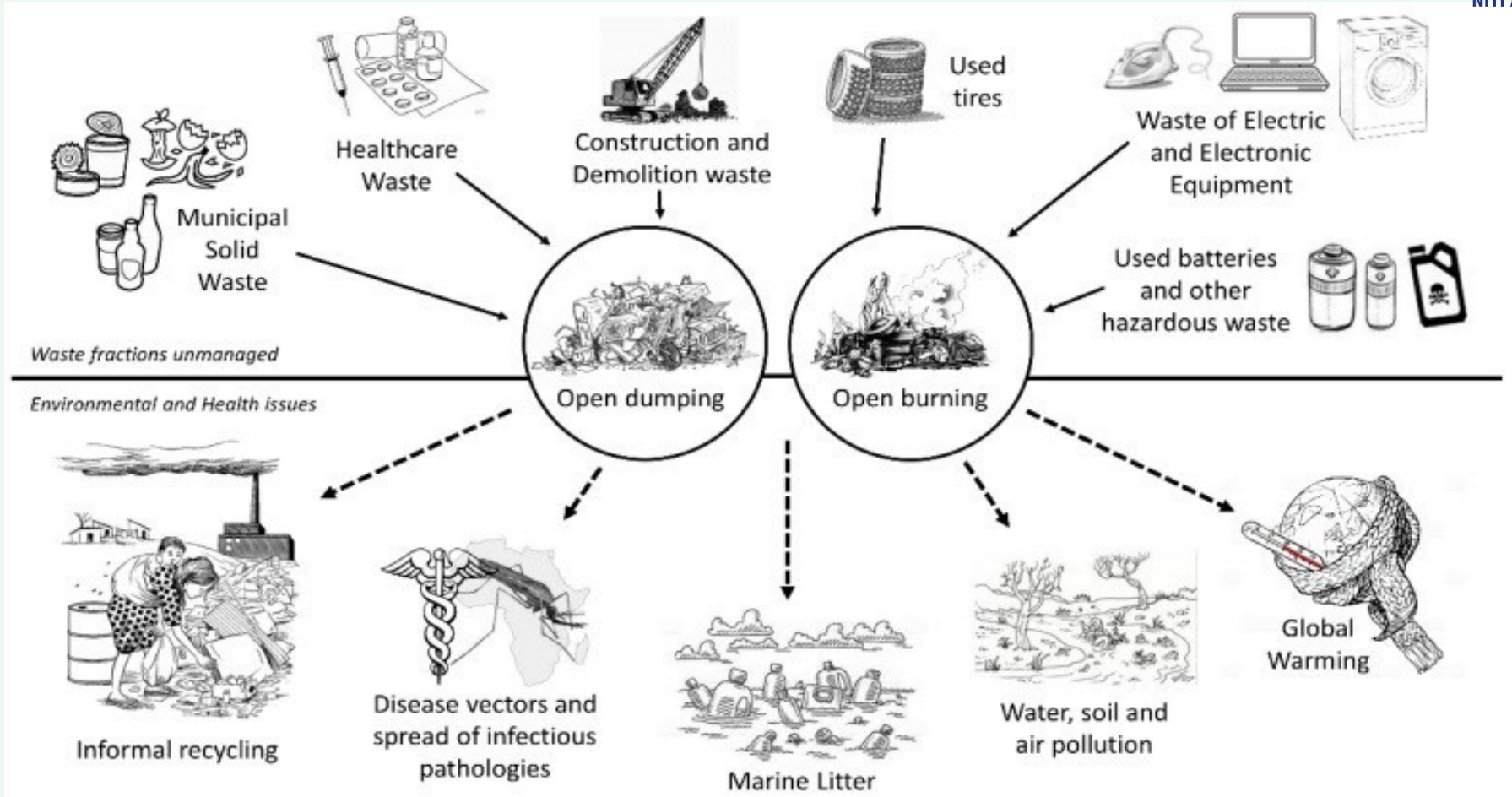
Annual greenhouse gas emissions from MSW are expected to go up to 41.09 million tonnes by 2030.



India will generate 165 million tonnes of waste by 2030 and 436 million tonnes by 2050.



Inappropriate waste disposal



Residual waste



- ❖ Waste that is neither recycled nor reused, i.e. waste material not collected separately for recycling or composting /digestion, and residues from sorting processes.
- ❖ Nonhazardous industrial waste including waste material (solid, liquid or gas) produced by industrial, mining and agricultural operations. It excludes certain coal mining wastes and wastes from normal farming activities
- ❖ Materials that are difficult to be recycled either due to technological limitations, costs, natural resources, and human resources.

Examples

contaminated soil, ceramics, gypsum board, linoleum, leather, rubber, textiles, glass, industrial equipment, electronics, storage tanks, filters, fertilizers, pesticides, pharmaceutical waste, detergents and cleaners, photographic film and paper; and residues such as sludge from the treatment of public water supplies

• What is happening in other countries ? •

EU has set two targets for municipal waste targeted at 2030:

- At least 60% of MW should be reused or recycled (Waste Framework Directive)
- Residual (non-recycled) MW should be reduced by half (circular economy action plan and zero pollution action plan)

EPA published the National Recycling Strategy Nov, 2021 and reaffirmed the goal to increase the U.S. recycling rate to 50 percent by 2030.

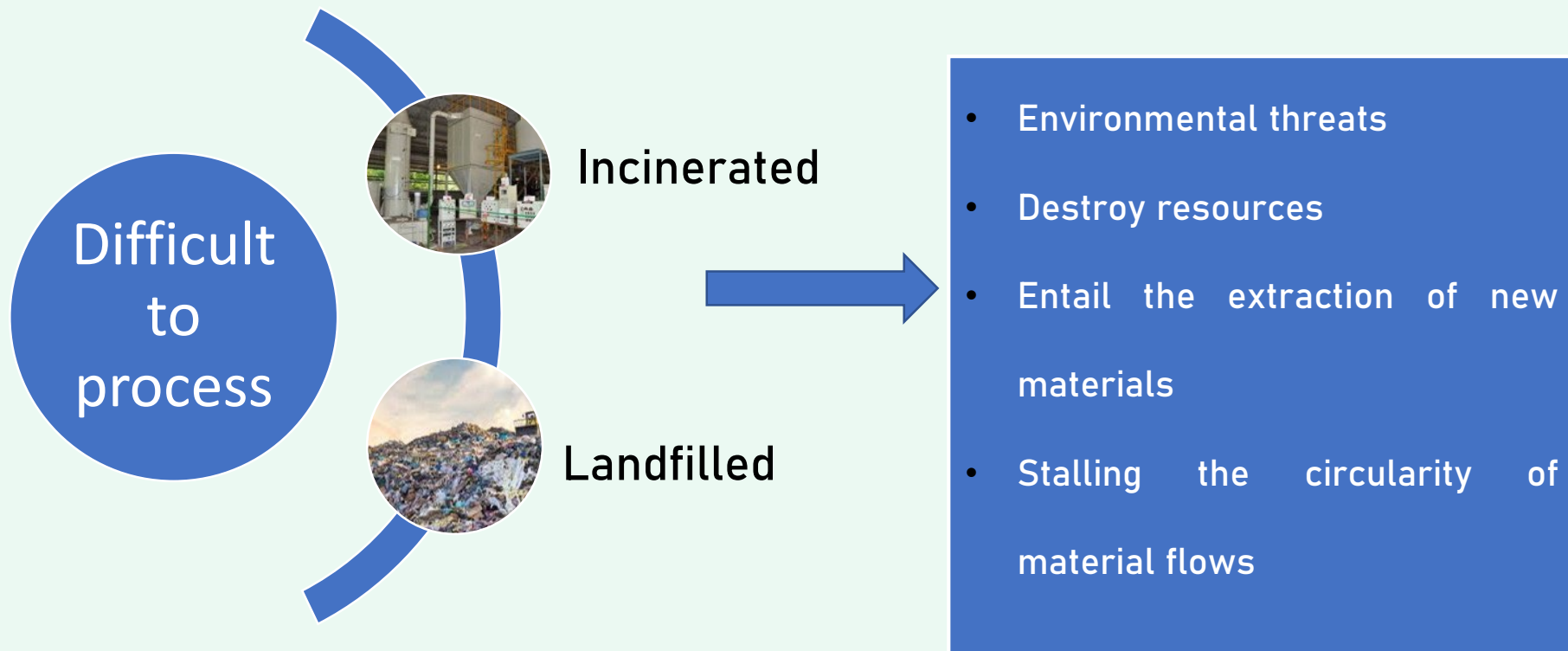
Scotland has placed a ban on the disposal of biodegradable municipal waste to landfill, which is expected to be implemented in December 2025.

What are India's targets ?

Despite having a population greater than United States, India is in process of notifying targets for solid and residual waste management

- Swacch Bharat Mission, 2014
- Waste Management Rules, 2016
- Bio-Medical Waste Management Rules,
- E-Waste Management Rules
- Construction and Demolition Waste Management Rules, 2016

- Hazardous and Other Wastes (Management and Transboundary Movement) Rules, 2016
- Plastic Waste Management Rules Amendment 2022



Residual waste dumping in India- a glimpse

Crude dumping of waste occupies ~1250 hectares of precious land in India each year.

There are 2120 existing dumpsites (CPCB annual report 2016-17)

Landfills were originally located outside of the cities, but as cities expanded, dumpsites are now almost inside the cities.

Delhi's open dumps at Ghazipur (69 metres high), Okhla (55 metres high) and Bhalswa (56 metres high), have resulted in garbage dumps of 13 MMT, 7 MMT and 6 MMT respectively.

Estimated that more than 10,000 hectares of urban land is locked in these dumpsites in India.

Waste management and SDG linkages

SDG- National Indicator Framework 2022 (India) Target

Global SDG Indicators

Target 11.6: By 2030, reduce the adverse per capita environmental impact of cities, including by paying special attention to air quality and municipal and other waste management

Indicator 11.6.1: Proportion of municipal solid waste collected and managed in controlled facilities out of total municipal waste generated, by cities

Target 12.4: By 2020, achieve the environmentally sound management of chemicals and all wastes throughout their life cycle, in accordance with agreed international frameworks, and significantly reduce their release to air, water and soil in order to minimize their adverse impacts on human health and the environment

Indicator 12.4.1: Number of parties to international multilateral environmental agreements on hazardous waste, and other chemicals that meet their commitments and obligations in transmitting information as required by each relevant agreement

Indicator 12.4.2: (a) Hazardous waste generated per capita; and (b) proportion of hazardous waste treated, by type of treatment

Target 12.5: By 2030, substantially reduce waste generation through prevention, reduction, recycling and reuse

Indicator 12.5.1: National recycling rate, tons of material recycled



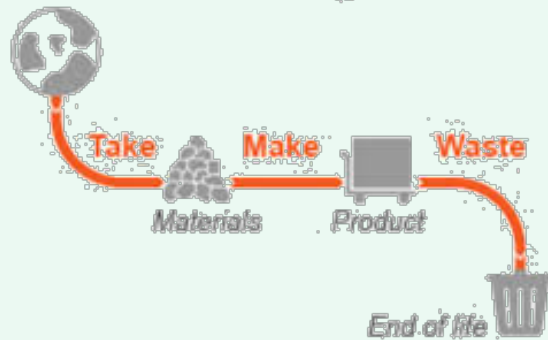
Development model based on the **CIRCULAR ECONOMY** approach that looks at sustainable waste management and optimum utilization of resources

Circular economy

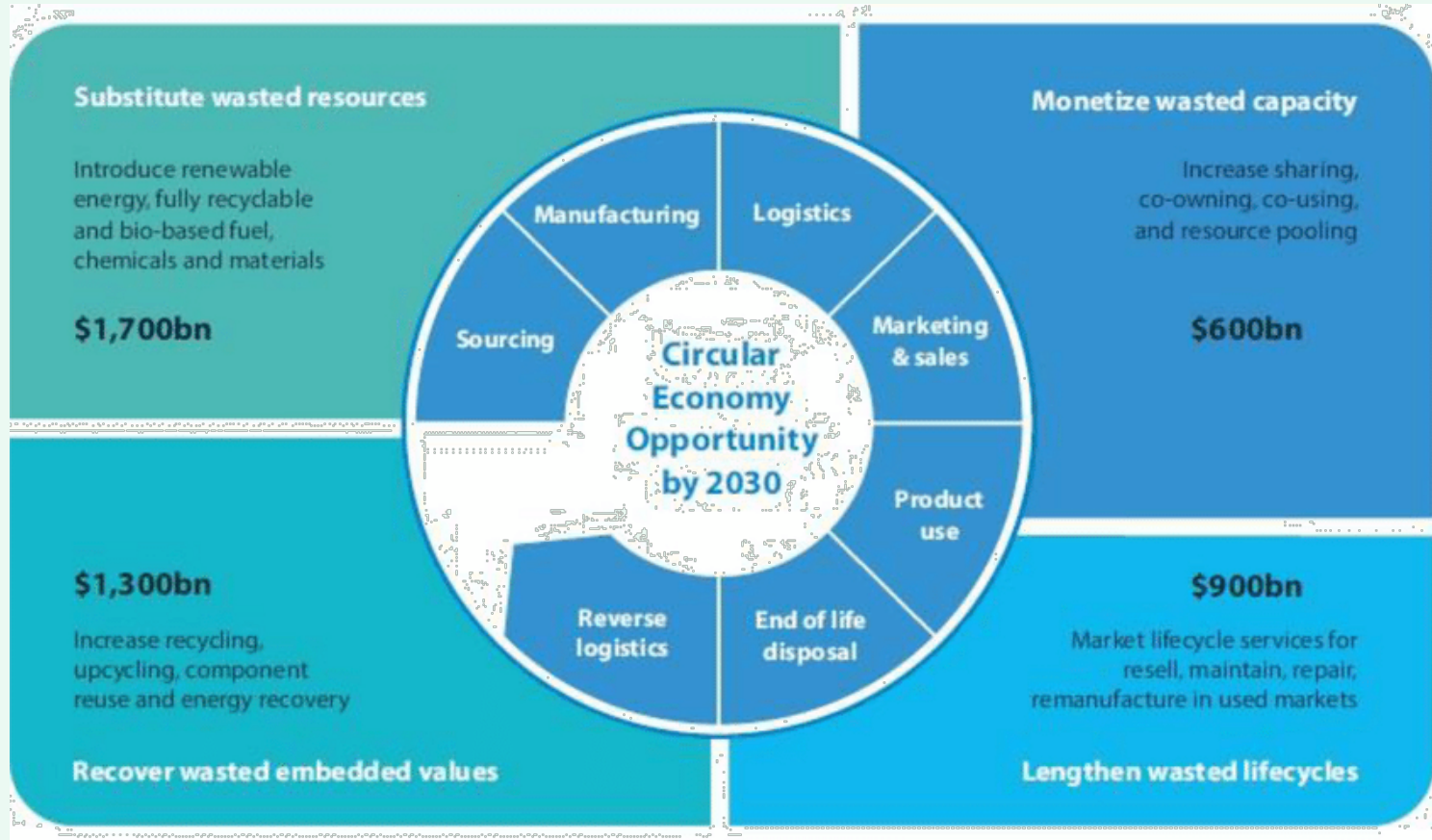
Circular economy-based development approach is one of the key strategies being adopted for achieving the 2030 Agenda for Sustainable Development Goals (SDGs).

Material consumption at the urban level alone is expected to climb from 40 billion tonnes in 2010 to 90 billion tonnes in 2050, with the primary driver being the demand for construction materials.^[12]

The linear economy



Value Realization Potential from Circularity



Revenue Generation in Circular Economy

Compost and Bio-CNG

365 crores and `1,679 crores per annum respectively



Treated sludge and wastewater

6,570 crores and 3285 crores respectively

C&D

`416 crores per annum



Dry recycling

11,836 crores per annum

Focus areas in residual wastes

Municipal solid waste (Dry and wet)

Biomedical waste

Hazardous waste

C&D waste

E-waste

Plastic waste

Municipal wastewater

Municipal sewage sludge

End-of-life vehicles



• Municipal Waste – Dry waste •



India SWG

Approximately 1.45 Lakh metric tons of solid waste, 35% of which is dry waste

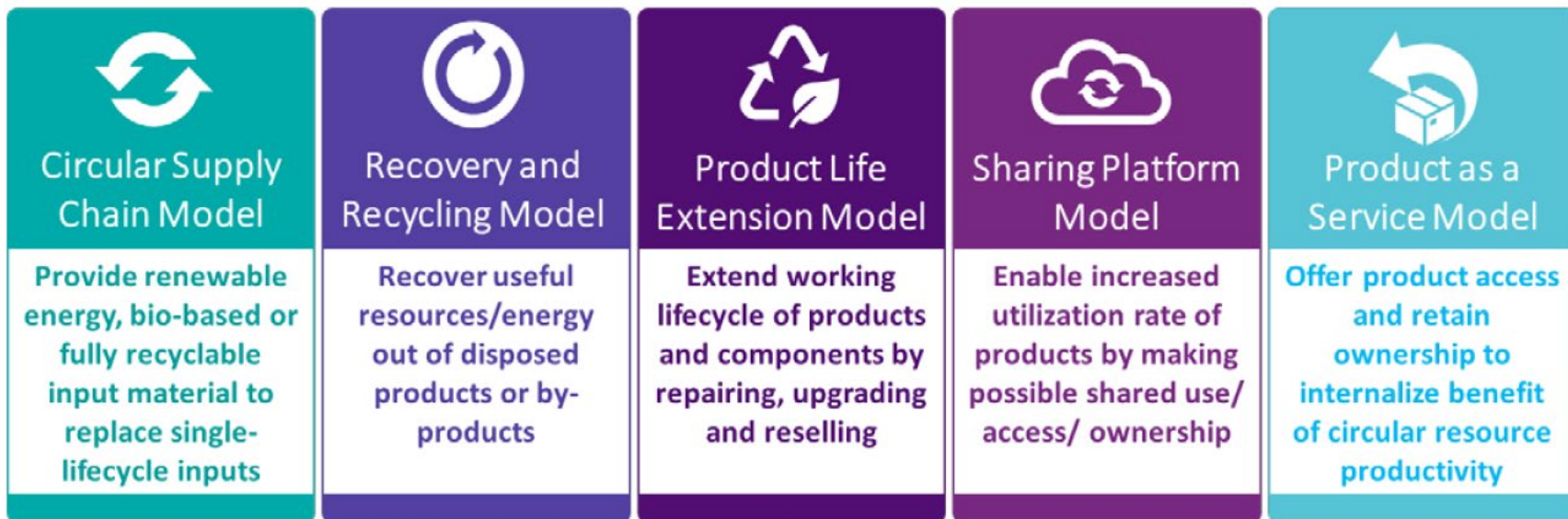
Increase in SWG

85 kg of CO₂ per tonne of solid waste disposed in 1954-60 to 227 kg of CO₂ per tonne disposed in 2005-2015)

GHG emissions

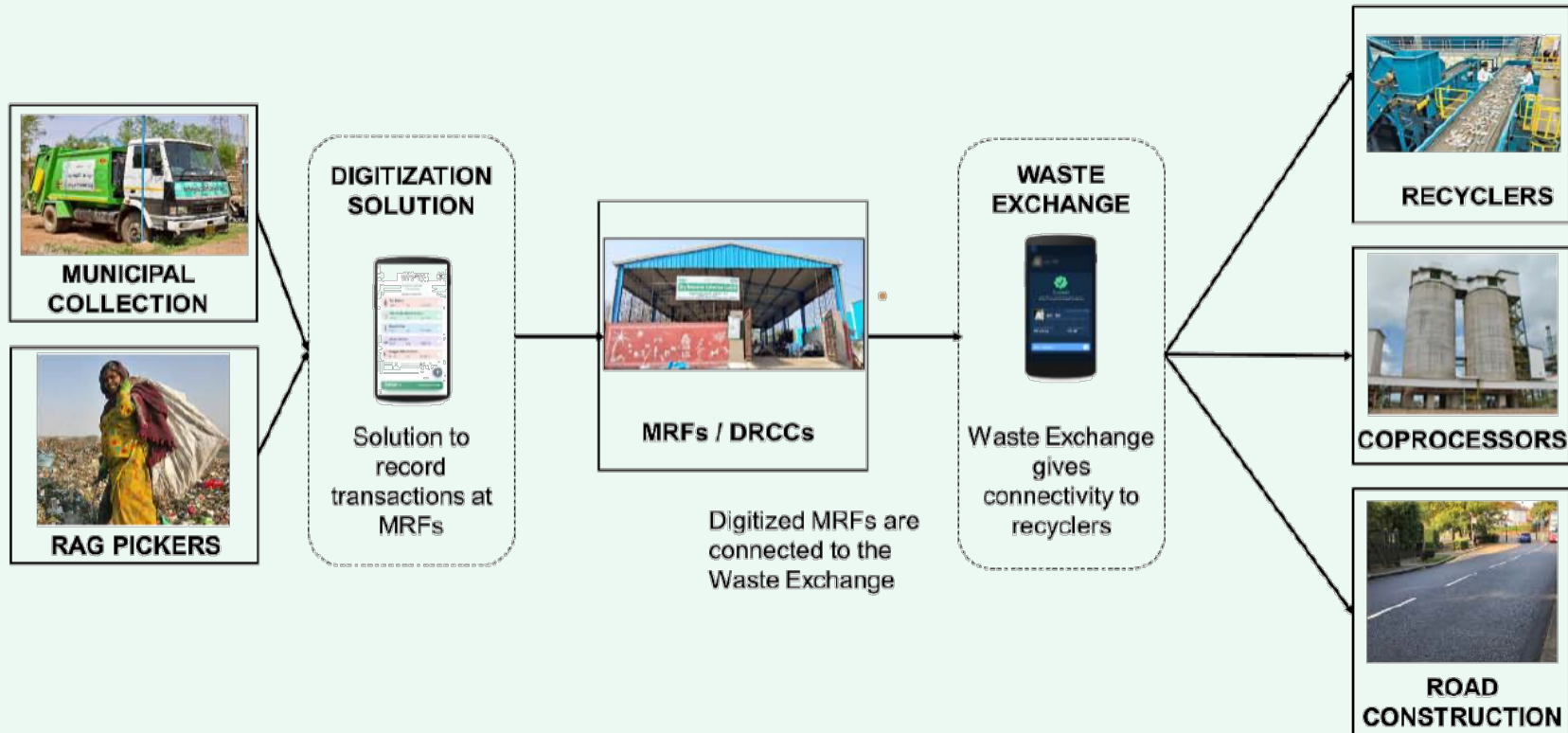
GHG emissions per ton of solid waste disposed have increased by 2.7 times. The waste sector accounts for 3.7% of India's total national GHG emissions.

Business models for circular economy

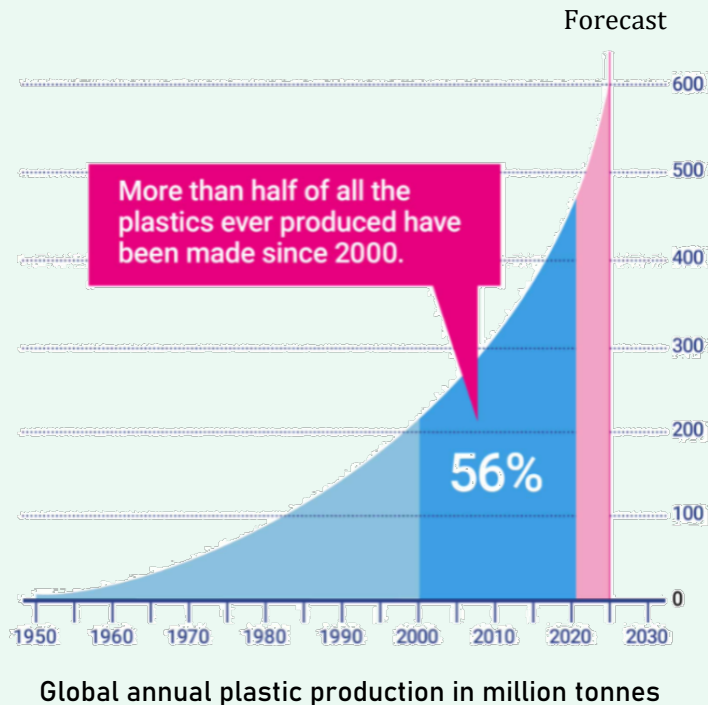


Savings from circular economy are estimated at US\$ 624 billion in year 2050, for the current development trend (KPMG study)

Digitalization in waste management



Plastic Pollution



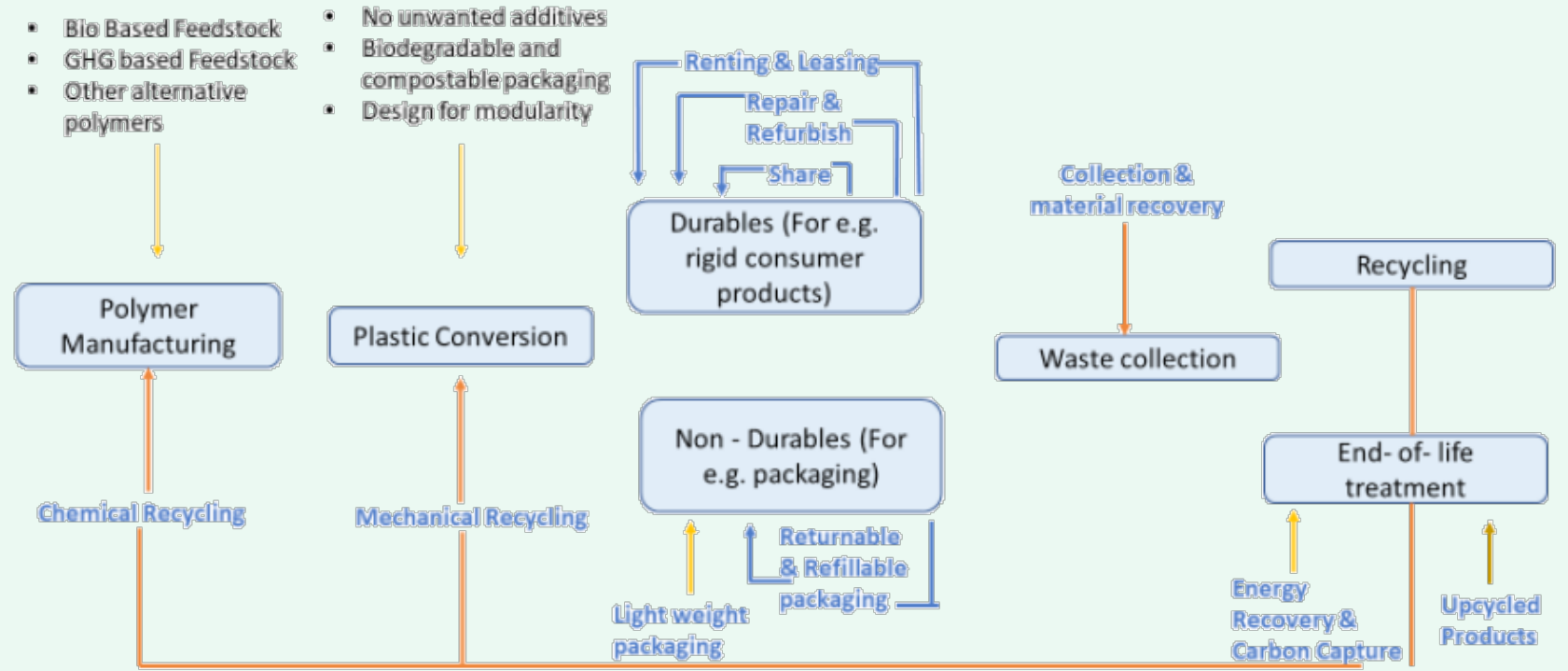
Approximately 3.4 million tons per annum of plastic waste was generated in India in 2019-20 while the per capita waste generation from 2016 to 2020 almost doubled

If plastic production and use grows as currently planned, by 2030, the GHG emissions could reach 1.34 gigatons per year, equivalent to 295 new 500-megawatt coal-fired power plants.

Out of 8 million tonnes of plastic waste in the world's oceans, Meghna-Brahmaputra-Ganges river system dumps close to 73 thousand ton making it the 6th most polluting river system contributing to marine plastic waste in the world.

Circular economy – Plastic waste

Circular Supply Chain → **Product Life Extension** → **Sharing platforms** → **Product as a service** → **Recovery and Recycling**



Plastic Pollution



Plastic Waste Management Amendment Rules, 2021 prohibited manufacture, import, stocking, distribution, sale and use of plastic carry bags having thickness less than 120 microns with effect from the 31st December, 2022.

Single Use Plastics such as Ear buds with plastic sticks, Plastic sticks for balloons, Plastic bags, Candy sticks, Ice - cream sticks, Polystyrene (Thermocol) for decoration, Plastic plates, cups, glasses, cutlery such as forks, spoons, knives, straw, trays and wrapping or packing films, were banned completely from 1st July 2022 onwards

Currently, NITI Aayog along with several industries, academia and ministries is engaged in testing of biodegradable plastics and developing associated standards.

Several innovative technologies for disposal of Plastic Waste are

- Utilization of Plastic Waste in Road Construction
- Co processing of Plastic Waste in Cement Kilns
- Conversion of Plastic Waste into Fuel oil: Refused derived Fuel (RDF)
- Disposal of plastic waste through Plasma Pyrolysis Technology (PPT)

• Municipal Waste – Dry waste •

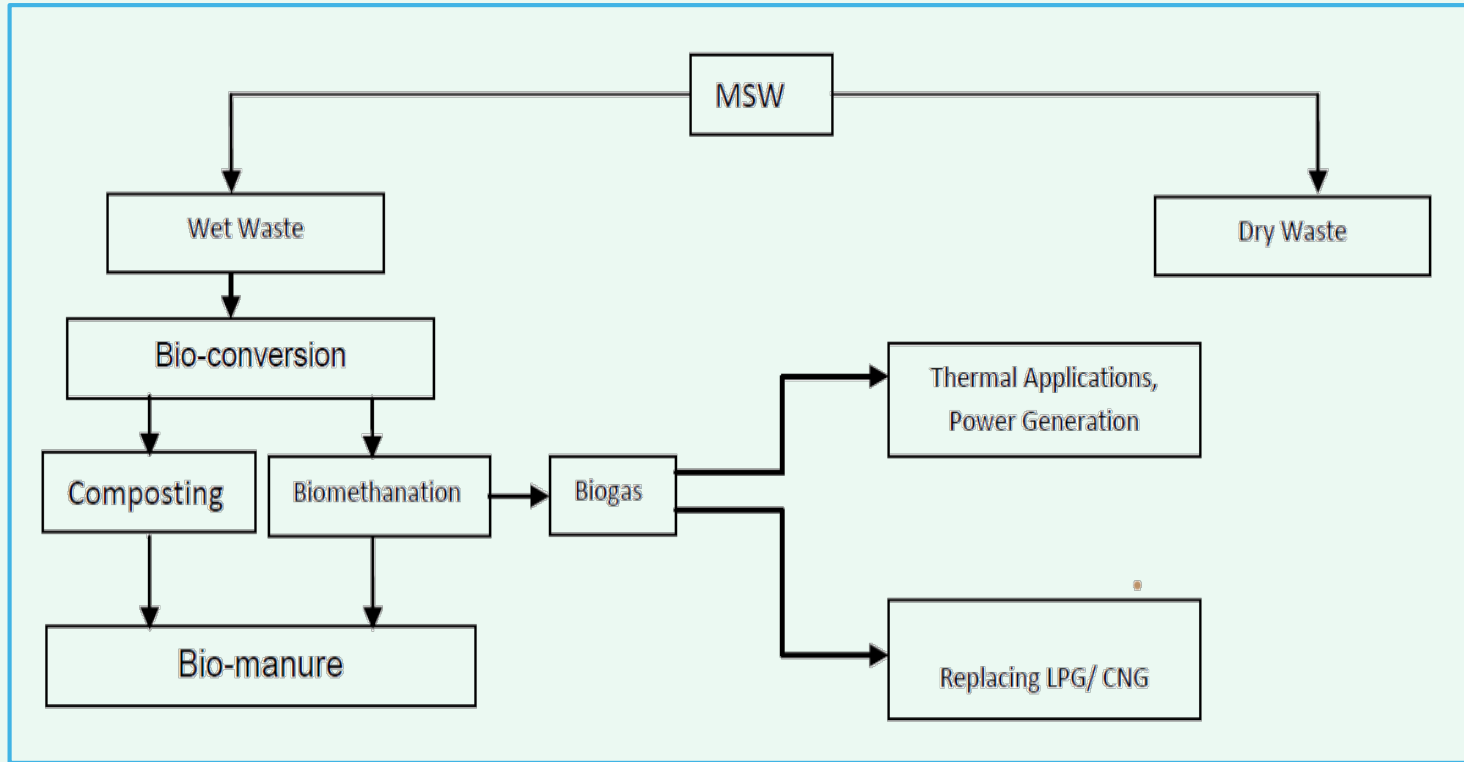
About 75,000 TPD of wet waste generated daily. Under SBM (U), about 68% is being processed, leaving a gap of 32%.



Projections for SBM (U) 2.0 indicate a requirement of 45,000 TPD processing facilities for wet waste, out of which the compost plants are planned for 30,800 TPD and bio-methanation plants for 15,200 TPD

- Inadequate infrastructure to transport segregated wet waste to processing facilities
- Non-Compliance of SWM Rules 2016 by bulk waste generators
- Data on waste generation in terms of composition and quantities is still lacking
- Production of compost from mixed waste leads to quality challenges in final product.

Circular Economy: Wet Waste Management



Circular Economy: Wet Waste Management

Benefits of circular economy model in wet waste processing through bio-methanation

• Net additional contribution to economy of ₹2,460 crores per annum if 50% wet waste is processed by bio-methanation

• Employment generation of about 1 crore man-days during construction and about 0.60 crore man-days for O&M, in perpetuity.

• Reduction in GHG emissions by about 10.36 million tonnes CO₂ equivalent

Policy Interventions – Wet Waste

Compost

Market Development Assistance of ₹1,500 per tonne compost by M/o Chemicals & Fertilizers

Waste to Energy

Financial Assistance as follows:

Biogas

capital subsidy of ₹1 crore per 12000m³ biogas/day [up to Rs.10 crore/project]

Power projects

subsidy of ₹3 crore per MW [up to ₹10 crore/project]

Bio-CNG

subsidy of ₹4 crore for 4800kgs/day of CBG generated per day [up to ₹10 crore/project].

Existing biogas units switching to CBG

subsidy of ₹3 crore.

Major Challenge for ULBs

Dealing with legacy of neglect which has resulted in garbage heaps built up at dumpsites.

Objective of Legacy Waste Management

To reduce environmental and social externalities through leachate discharges, gaseous emissions, loss of visual amenity, foul odours, and harbouring of disease-carrying pests.



Sanitary landfills are the ultimate means of disposal for unutilised municipal solid waste from waste processing facilities and other types of inorganic waste that cannot be reused or recycled

Swachh Survekshan 2020

- As part of Swachh Survekshan 2020, the emphasis is laid on remediation of legacy waste dumpsites and scientific sanitary land fill.
- A total weightage of 110/700 (i.e 16%) is earmarked for remediation of dumpsites and scientific disposal of waste.
- Under Swachh Survekshan 2019, 345 Legacy Waste dumpsites have been remediated.

Star Rating Protocol for Garbage Free Cities

For a city to achieve at least 3 star rating:

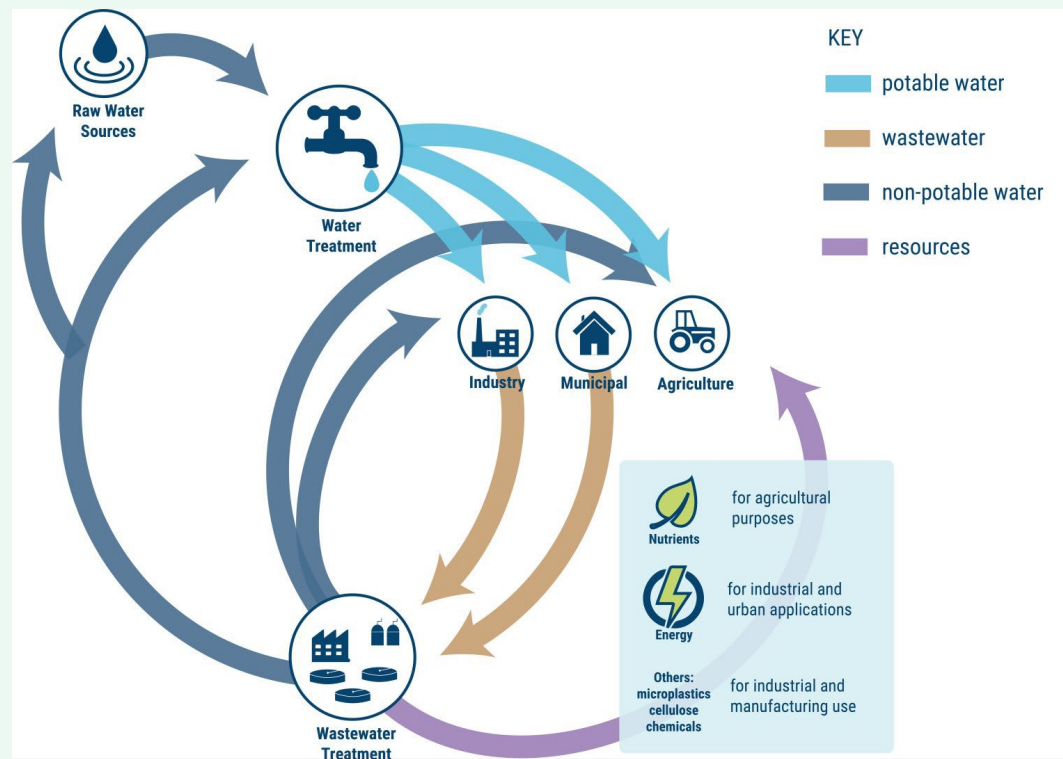
- 60% of the mandatory components are to be achieved(which include scientific disposal of different streams of waste e.g. dry waste processing, wet waste processing etc. 34% weightage)
- At least 50% of the essential components are to be achieved (which include Scientific Land fill, availability, Use and disposal 20% weightage) and
- A minimum of 30% of desired components are to be achieved(which includes dumpsite remediation 20% weightage).
- In view of the above, the Ministry has given utmost importance to ensure remediation of dumpsites and encouraging scientific processing of waste streams, thus resulting in Zero Land Fill.

Waste Water Management

- Urban India generates 72,368 MLD of municipal sewage estimated to increase to 1,20,000 MLD by 2050.

Benefits

- Recycled wastewater: additional source of water
- Source of revenue for utilities
- Economic and environmental benefits
- Incentives for ULBs to strengthen sewerage and treatment infrastructure
- Social benefits

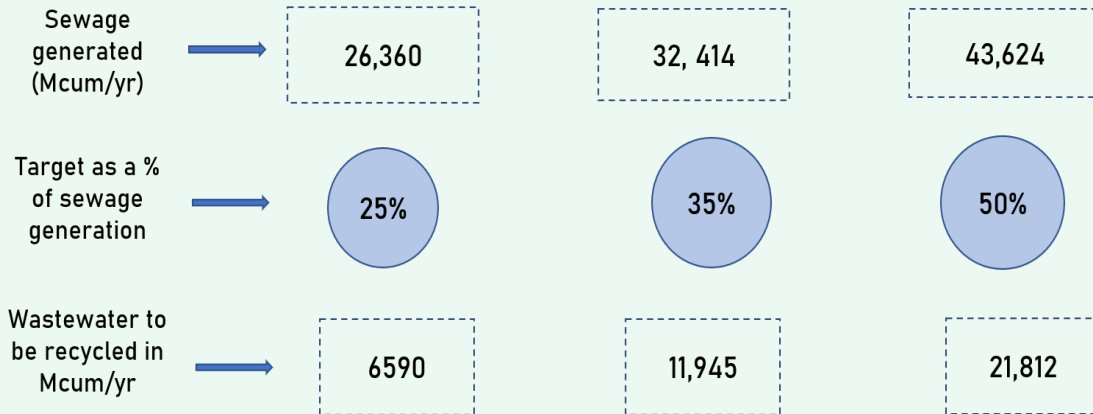


Circular economy: Waste water management

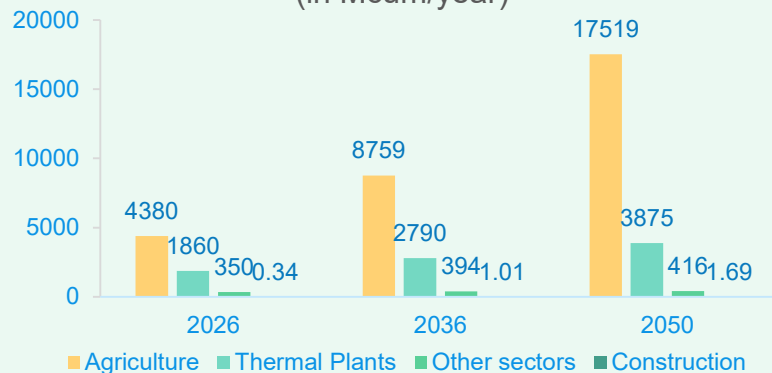
Short-term (2021-26)

Mid-term (2026-2036)

Long-term (2036-2050)



Sector wise wastewater to be reused
(in Mcum/year)



To bring circularity in wastewater management, NITI Aayog has taken steps towards:

- Framework for reuse of treated wastewater in irrigation
- Development of standards for water neutrality in industries

C&D waste

Approximately 95% of C&D waste can be reused or recycled if processed scientifically.



Circular economy brings opportunities for innovations in cutting down on raw materials and reducing residual and waste matter, quality improvement and cost reduction throughout the lifecycle of structure and its various components.

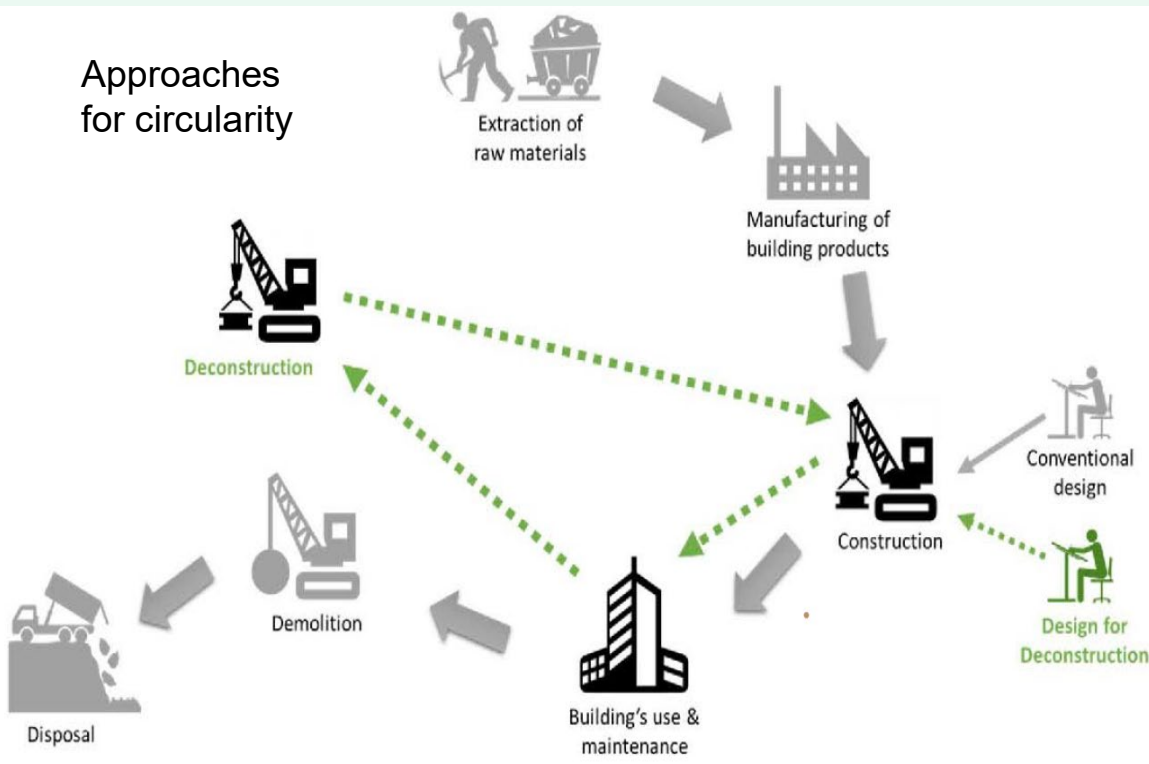
Adaptive reuse- It is a method that reuses whole or part of a structure that is redundant.

Design for reuse (DfR)- It incorporates the use of reclaimed components in the design of new structures.

Design for deconstruction (DfD)- It is a designing method that enables quality and quantity of materials that can be re-used at the end of a building's life

Design for longevity (DfL)- It is a principle that current buildings in planning phase should be planned for long-term use. The construction material should be of top quality which could enhance the life of the building.

Approaches for circularity



Construction approach

- Design and construct for recycling and reuse
- Reduce use of virgin materials
- Reduction in the overall waste generation
- Integration of a demolition plan

Waste management approach

- Decentralized cluster based approach for recycling waste
- Data collection through ICT technology

Legislative approach

- Mandate use of certain % of recycled waste
- Reduce GST on recycled materials
- Setting green building standards

- NITI Aayog has formulated the Model Concession Agreements (MCAs) and Model Request for Proposals documents (RFPs) for Integrated Solid Waste Management (including BioRemediation of Legacy Waste) and Integrated Liquid Waste Management (including Faecal Sludge Management) on Hybrid Annuity Model (HAM) of Public-Private Partnership (PPP). Hon'ble NGT has ordered all the states and ULBs to adopt this model concession agreement framed by NITI Aayog
- NITI undertook mainstreaming of approaches and measures for building resource efficient and circular Indian Economy in line with the SDGs
- NITI Aayog and EU unveiled Status Paper and Way Forward on Resource Efficiency & Circular Economy” and “Four Sectoral Strategy Papers on Resource Efficiency on Steel, Aluminium, Construction & Demolition Waste, Secondary Materials Management in Electrical & Electronics Sector”.

The status paper on Resource Efficiency & Circular Economy brings out 30 recommendations out of which 14 recommendations have identified as priority actions.

- a. Formulation of a National Policy on RE/CE
- b. Establishment of Bureau of Resource Efficiency (BRE),
- c. Mainstreaming RE&CE in existing flagship missions,
- d. A Modern Recycling Industry with level playing between primary and secondary producers,
- e. R&D for development of scalable technologies for RE & CE, and
- f. Development and promotion of skill and capacity building programmes for informal sector.

THE SUCCESS STORIES

Municipal wastewater recycled and reused as process water for Pandesara Textile Industrial Estate in Surat

being utilized for production of power through biogas engine. The average electrical energy production from biogas is **2 KWh/m³** of biogas

Chennai Metropolitan Water Supply & Sewerage Board applies anaerobically digestion of sludge to produce biogas from it. Volume of gas produced is in the range of **523.92 m³ per hr** (12,574 m³ per day) and is



MRF plant established in Indore on PPP model with an investment of **₹30 crores** helps reduce the financial burden on municipal body. It attracts more recyclers to

better quality products with **98%** purity levels

Source: Circular economy in municipal solid and liquid waste, MoHUA

Way Forward

Better data will give better information on waste generation which will lead the policy makers to take decisions on RRRR (Reduce, Reuse, Recycle and Recover).

Replace with other materials that are easier to decompose in nature- sustainable products initiative

Improving the recycling process so that it does not accumulate and cause pollution in nature - EPR initiatives

stimulate recycling through the implementation of the waste directives.

strong waste prevention policies targeting municipal waste increasing waste prevention

Waste to energy initiatives (exploring newer avenues)

Right to repair initiative

- Swachh Bharat (Clean India) Mission, which aims to provide access to solid and liquid waste management treatment to all villages, cities, and states.
- ‘Waste to Wealth’ initiative - working to identify, develop, and deploy technologies to treat waste to recycle materials, generate energy, and extract resources of value.
- As initiated by CPCB, an MIS portal for fetching the information from grassroot level will help to aggregate the information at any level and also to answer questions like who generate, what type and what treatment is being given.

**THE BEST WAY TO DEAL WITH
TRASH IS TO NOT HAVE ANY!**

t h a n k y o u