Market Report: Water-Waste Water Management, Industrial Waste & Environmental Monitoring in India

Final Report (Draft)

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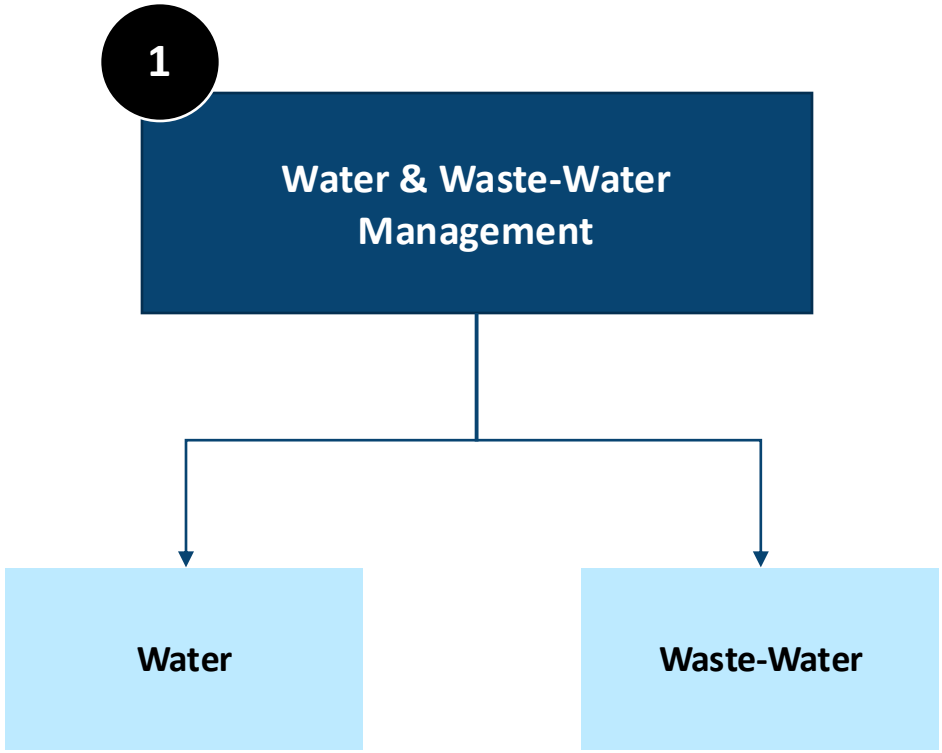
September, 2025

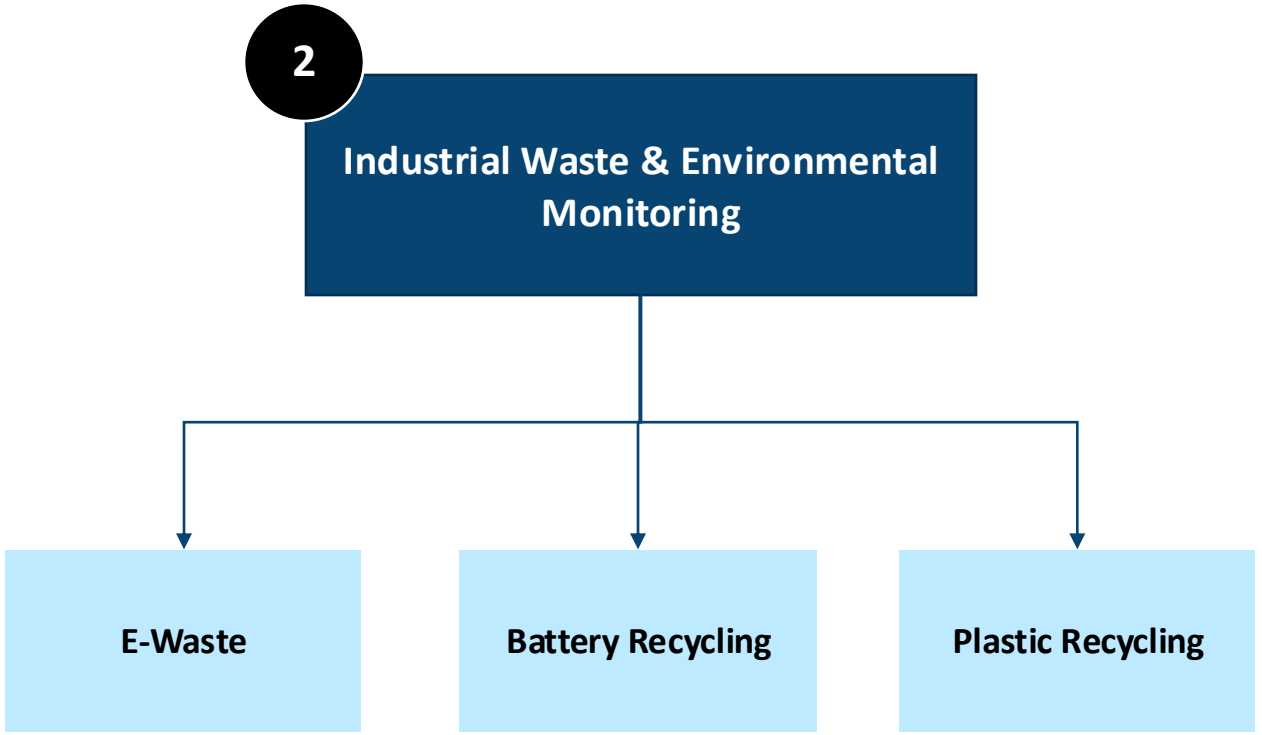
Feedback Advisory

JETRO
Japan External Trade Organization

FEEDBACK ADVISORY 2025

Sectors Covered in the Report





India Macroeconomics

- India's Macroeconomics: Fundamentals
- Growth Trajectory
- India – Japan Trade & Investment Snapshot

Key Macros & Fundamentals

Overall GDP
USD ~4.3 Tn.
(4th largest economy globally)

GDP Growth Rate
> 6.8%
(Expected Growth in FY'25)

Government CAPEX
~10 %
(FY'25 to FY'26 growth in CAPEX outlay)

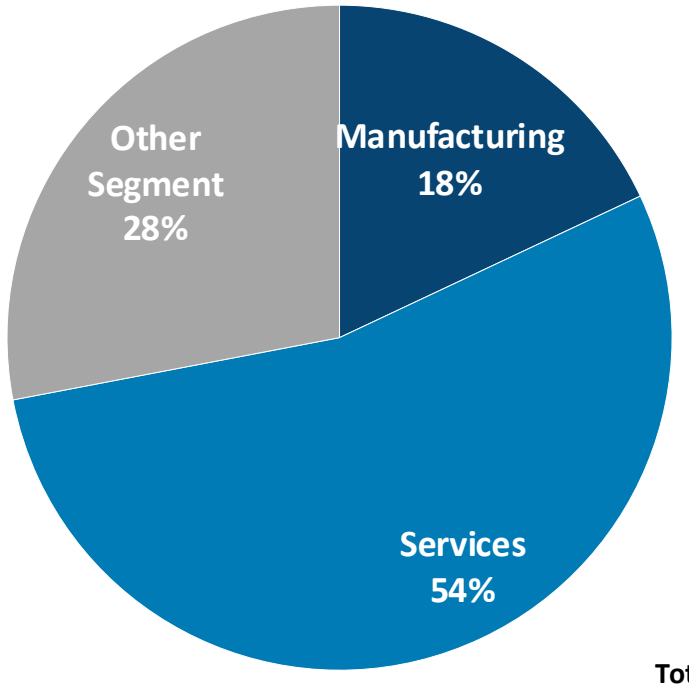
FOREX Reserve
USD ~700 Bn.
(June 2025)

Fiscal Deficit
4.74%
(of GDP for FY '25)

Inflation
1.55%
(Consumer Price Index (CPI) inflation in July 2025)

Source: Feedback Analysis

% Share of GDP (FY 2025)

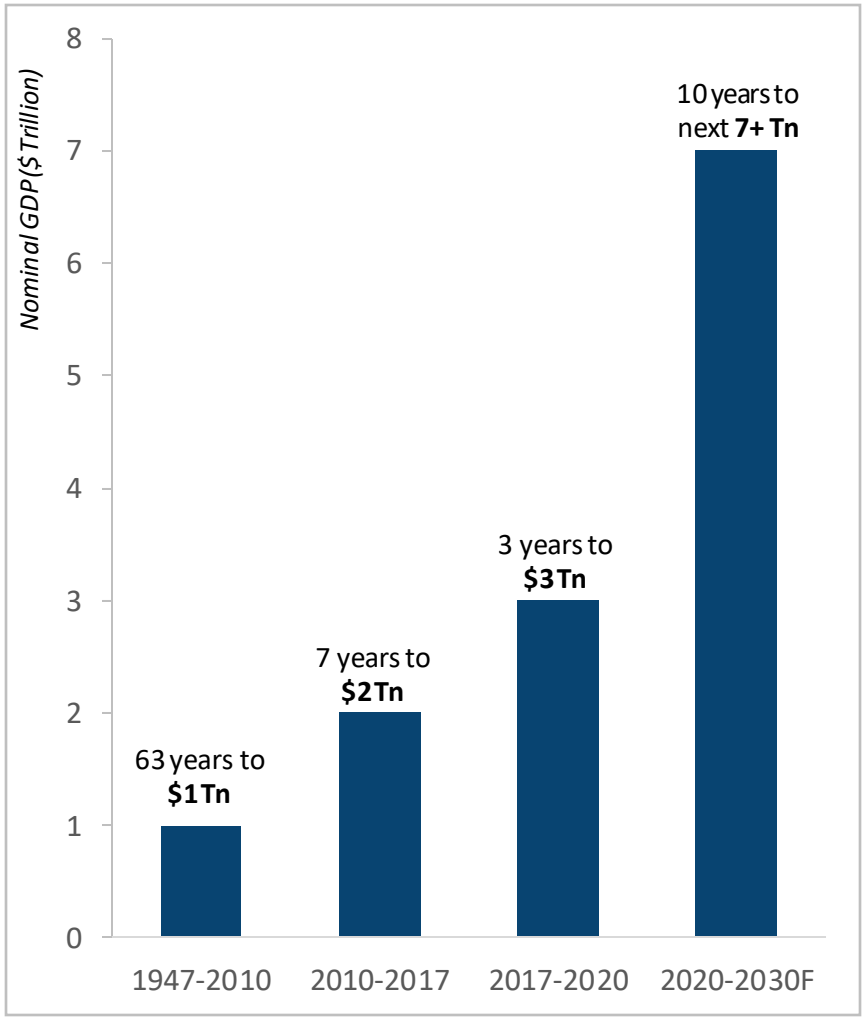


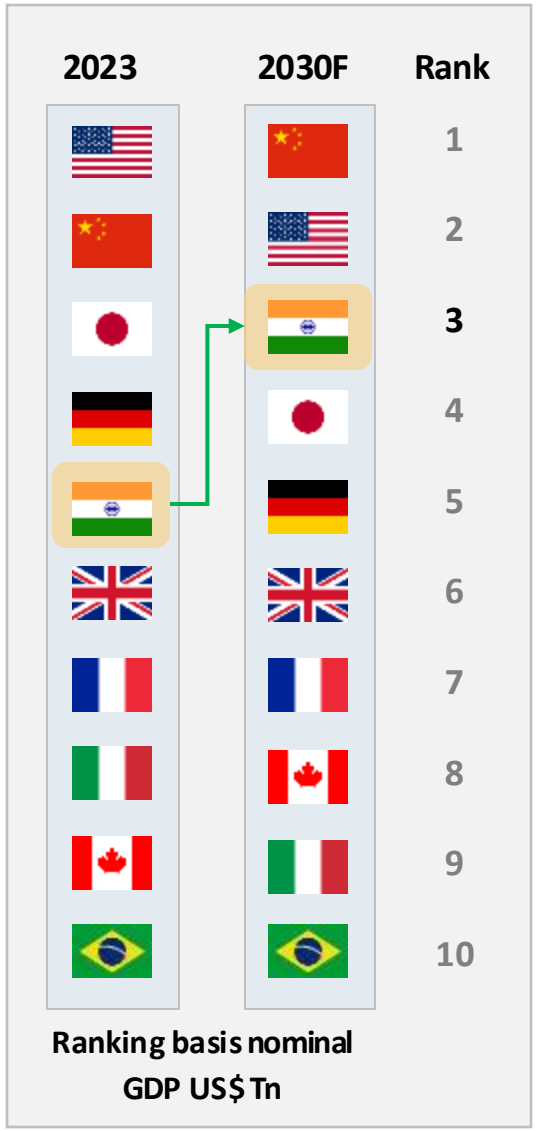
Total: USD 4.3 Tn

- Services' contribution to GDP will continue to increase, as well as manufacturing.
- The expansion of services will be driven by exports in information technology and IT-enabled services, as well as by domestic sectors such as retail, food services, trading, finance, and healthcare.

Growth Trajectory

India to be in Top 3 (US$ 7+ Tn by 2030)





Manufacturing – National and Global Context

3%
India's Share in Global Manufacturing Output

~20%
Manufacturing Share in Total Exports

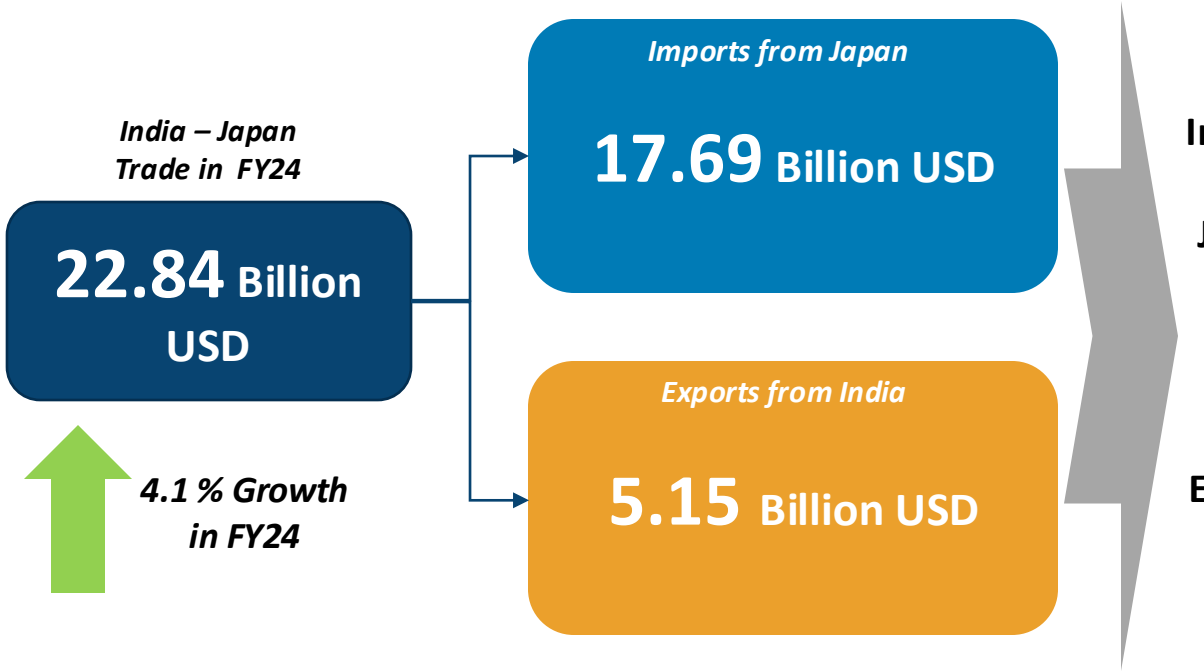
~18%
Manufacturing Share in Total FDI Inflows

Sectors which would drive the growth for India in the coming years[3]

Priority sectors	2047 GDP Share (%)	CAGR (%, Real GDP)
Agriculture	7-10%	3-5%
Manufacturing	17-20%	9-11%
Infrastructure	13-16%	8-10%
Utilities	1-3%	7-9%
Logistics	2-4%	7-9%
Financial Services	7-9%	8-11%
IT/ ITeS, Media, Telecom	6-8%	10-12%

Source: Feedback Analysis

India – Japan Trade & Investment Snapshot



Top Imports (from Japan)

- Machinery, nuclear reactors, boilers, mechanical appliances
- Copper and articles
- Electrical machinery & equipment (incl. sound recorders, TVs, parts)
- Inorganic chemicals—precious metal compounds, rare-earth elements, isotopes

Top Exports (from India)

- Organic Chemicals
- Vehicles (excluding rail, parts)
- Machinery, boilers, mechanical appliances
- Aluminium & articles
- Fish and aquatic products (marine)

Investment & Presence

Indicator	Value / Details
Portfolio Investments	Japan is among the top 5 portfolio investors in India with allocations in Indian equities and bonds
Japanese Companies in India	1,490 companies operating in India (2023, JETRO); major sectors: automobiles, electronics, engineering, trading
Japanese Companies Pursuing Business in India	Focus areas: EV, renewables, data centers, semiconductors, ICT
Indian Companies in Japan	~100+ firms, largely IT (TCS, Infosys, Wipro, HCL), plus pharma and textiles.

Source: Feedback Analysis

1. Water & Waste-Water Management

India’s Water Landscape & Key Stakeholders

- India’s Water Landscape
- Waste Water Management Process
- Key Stakeholders and their role
- Regulatory Framework

India's Water Landscape

2.4 Million Water Bodies

- Ponds — 60%
- Tanks — 15%
- Reservoirs — 12%
- Others* — 13%

~97% are in rural areas

3% are in urban areas

**Water Conservation Structures*

Water Stress

4% of global water resources but **17%** of the world population

Per Capita Water Availability

1,486 cubic meter

Water Treatment

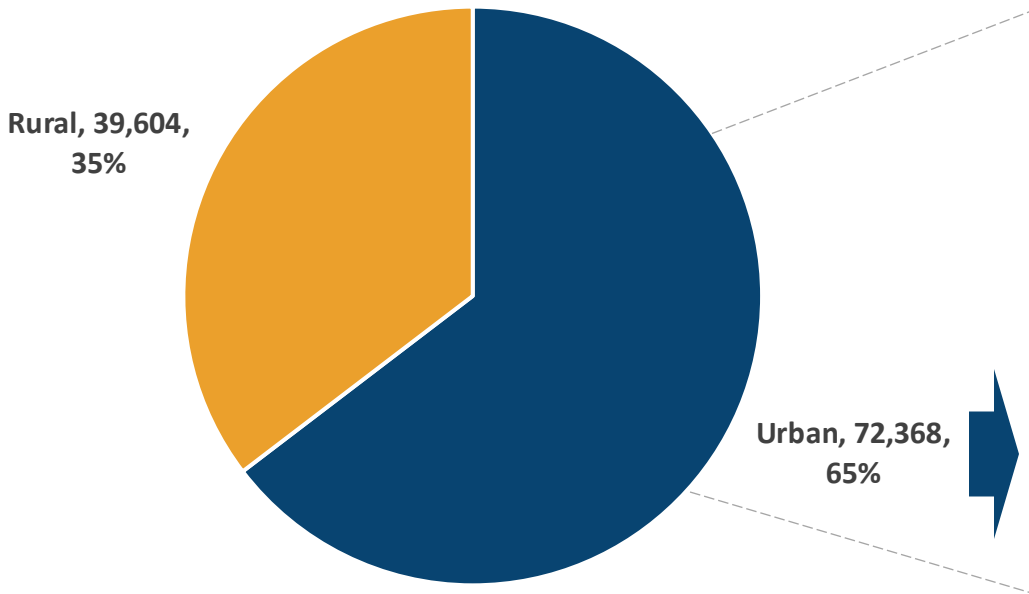
~70% of wastewater remains untreated

N = 111,972 MLD

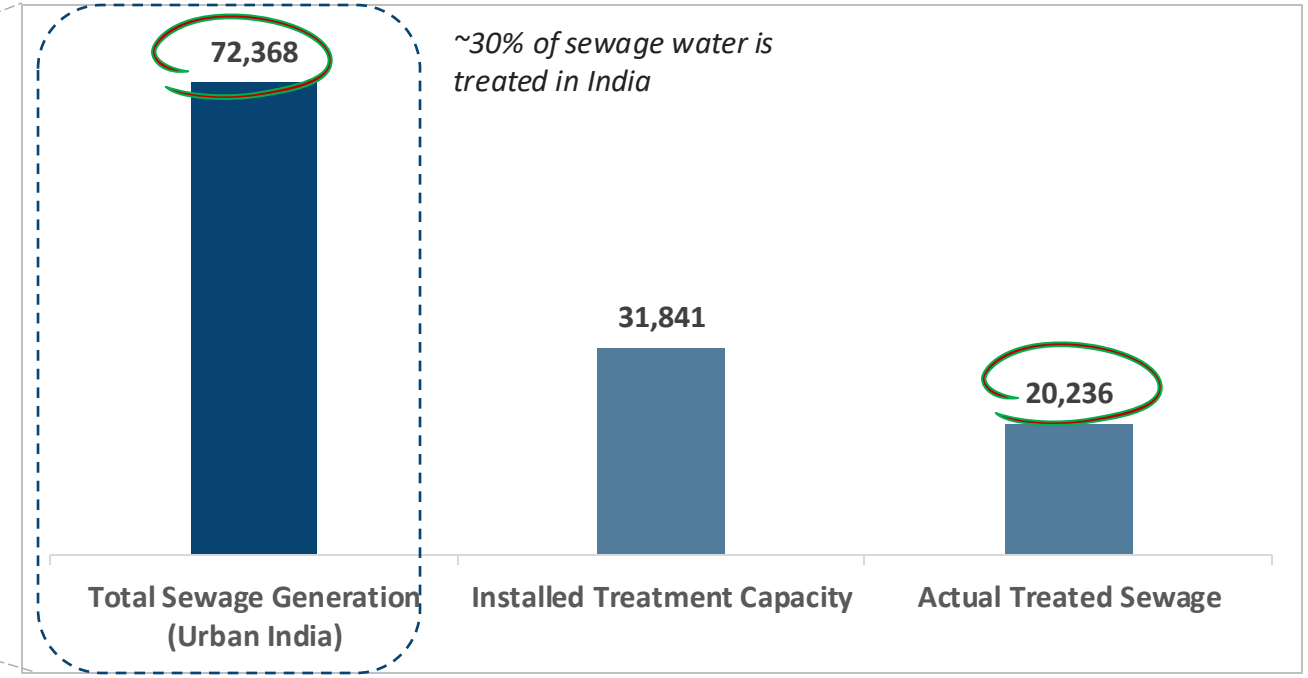
Source: Feedback Analysis, Ministry of Jal Shakti

Current scenario of Wastewater management in India

Total wastewater generated in India: Total 111,972 MLD (FY'24)



Wastewater generation and treatment capacity in urban India (in MLD)[1] (FY'24)



- Although rural India accounts for 63% of the total population, it generates only 35% of the country's wastewater
- Rural India lacks centralized sewage treatment and primarily relies on septic tanks, soak pits, and open drains for wastewater disposal

- 72% of urban wastewater goes untreated, directly polluting natural water bodies and groundwater
- Many existing Sewage treatment plants (STPs) operate below capacity due to power shortages, poor maintenance, and high operational costs

Note: MLD - Million litre per Day

Source: Feedback Analysis

Key Stakeholders

Regulatory Bodies

Government bodies responsible for water and wastewater management

- Central Public Health & Environmental Engineering Organization (CPHEEO)
- Central Pollution Control Board (CPCB)
- State Pollution control Board (SPCB)
- State Water Supply and Drainage Boards (SWSDBs)
- National Green Tribunal (NGT)
- Department of Water Resources, River Development and Ganga Rejuvenation (DoWR, RD & GR)

Project owners of treatment plants

- **Industries**
- **Municipal / State Government**

Hires/ Partners with

Project solution providers

Project owners hires or partners with solution providers to setup/ operate and Maintain the treatment plant

- **EPC** – Setup the entire plant which includes Engineering, procurement and construction
- **O&M-** The companies help the project owners in operation and maintenance of water/wastewater treatment plants

Water and wastewater treatment plant

Equipment

Technology providers

- Technology providers supply the required technology and the equipment to treat the wastewater

Source: Feedback Analysis

Role of stakeholders

1 Regulatory bodies

- **Central Public Health & Environmental Engineering Organisation (CPHEEO) –** Supports Ministry of housing and urban affairs (MoHUA) in policy formulation and provides states with technical advice, guidelines, and scheme appraisal. It also promotes new water supply, sanitation, and solid waste management technologies
- **Central Pollution Control Board (CPCB) –** CPCB, constituted under Ministry of environment forest and Climate change (MoEFCC), regulates pollution control and sets nationwide wastewater discharge standards. All Sewage treatment plant in India must comply with CPCB norms
- **State Pollution Control Board (SPCB) -** The SPCBs are responsible for implementing pollution control legislation at the state level, monitoring wastewater discharging entities, and enforcing stricter regulations beyond CPCB norms when necessary
- **State Water Supply and Drainage Boards (SWSDBs)** – Plan, design, and implement sewerage and wastewater treatment infrastructure using national and state funds, then transfer plants to Urban local bodies (ULBs) for operation and maintenance
- **National Green Tribunal:** The National Green Tribunal (NGT) is a specialized judicial body related to environmental protection and conservation of natural resources, including wastewater management and pollution control in India
- **Department of Water Resources, River Development and Ganga Rejuvenation (DoWR, RD & GR) -** Responsible for implementing the National River Conservation Plan (NRCP) and the National Plan for Conservation of Aquatic Ecosystems (NPCA). These initiatives focus on conserving and restoring rivers, lakes, and wetlands across India

2 Project owners of treatment plants

- **Industrial Companies** – Industries (e.g., power, chemical, textile, pharma, food processing) treat wastewater to meet environmental regulations and enable safe discharge or reuse
- **Municipal & State Governments** –They build wastewater treatment plants to treat public wastewater, meet pollution standards, and allow safe discharge and reuse

3 Project solution providers

- These are companies hired by project owners to set up and manage water and wastewater treatment plants. They include:
  - EPC contractors for engineering, procurement, and construction
  - O&M providers for plant operation and maintenance

4 Technology provider

- Technology providers supply the required technology and the equipment to treat the wastewater

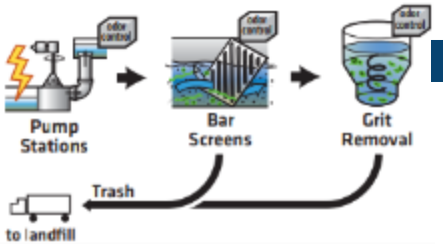
Source: Feedback Analysis

Wastewater Management Process in India

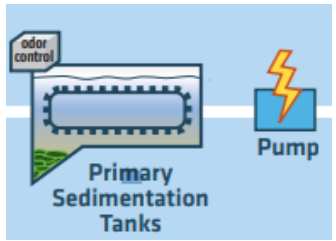
Wastewater

Residential, Commercial and Industry

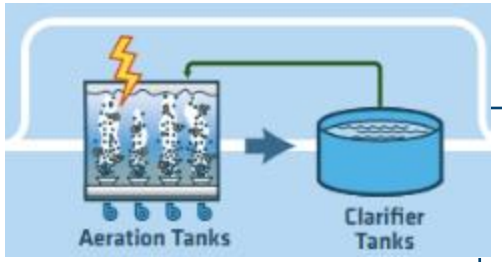
Pre- primary treatment



Primary treatment



Secondary treatment



Secondary treatment includes biological digestion to remove organic content, leading to a reduction in (BOD) Biological Oxygen Demand of up to 85%

Primary Sludge

Secondary Sludge

Sludge treatment or disposal

Treated effluent discharge

Treated effluent is discharged into the water bodies

Secondary-treated water undergoes tertiary treatment for further purification, making it suitable for industrial reuse

If not needed for reuse, it may be released into water bodies

Tertiary treatment

Treated wastewater reuse

*Some highly polluting industries implement **Zero Liquid Discharge (ZLD) process**, which includes advanced filtration methods beyond tertiary treatment to ensure complete water recovery and minimize waste discharge*

Source: Feedback Analysis

Technologies Used Across Various Stages Of Wastewater Treatment (1/2)

Pre- primary Treatment

- Bar Screen
- Grit Chamber
- Oil Skimmer
- Corrugated Plate Interceptors

Primary Treatment

- Clarifiers
- Coagulators
- Tube Settler/Lamella Clarifier
- Dissolved Air Flotation
- High Rate Solid Contact Clarifier
- Pipe Flocculator

Secondary Treatment

- Activated Sludge Process (ASP)
- Extended Aeration System (EA)
- Sequential Batch Reactor (SBR)
- Moving Bed Bio Film Reactor (MBBR)
- Membrane Bioreactor (MBR)
- Upflow Anaerobic Sludge Blanket (UASB)

Tertiary Treatment

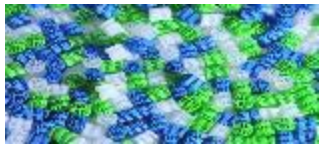
- Filtration
- Membrane Processes:
  - Multi Filtration
  - Ultrafiltration
  - Nano filtration
  - Reverse Osmosis
  - Forward Osmosis
- Ozonation

Zero Liquid Discharge

- Multi Effect Evaporators
- Mechanical Vapour Recompression
- Multiple Effect Distillation
- Agitated Thin Film Dryer
- Crystallizer

Source: Feedback Analysis

Technologies Used Across Various Stages Of Wastewater Treatment (2/2)

Treatment type	Name of technology	Technology type Conventional/ Advanced	Capacity (MLD)	Remarks
Secondary treatment	Sequencing Batch Reactors (SBR) 	Conventional	10,638	▪ India relies majorly on conventional technologies, but urban bodies are adopting advanced methods like MBBR, UASB for better treatment and cost efficiency
	Activated Sludge Process (ASP) 	Conventional	9,486	
	Moving Bed Biofilm Reactor (MBBR) 	Advanced	2,032	
	Upflow Anaerobic Sludge Blanket (UASB) 	Advanced	3,562	
Tertiary treatment	Filtration, Reverse Osmosis (RO), and Ozonation are some of the advanced technologies currently used in the tertiary treatment of sewage and industrial wastewater			

Source: Feedback Analysis

Regulatory Framework For Wastewater Treatment In India

The **Central Pollution Control Board (CPCB)** and **National Green Tribunal** set discharge standards for treated wastewater, which **State Pollution Control Boards** and **Urban Local Bodies** must enforce to ensure safe and environmentally friendly disposal or reuse. However, enforcement remains weak

Sewage treatment plant standards (STP)

(STP handle household and commercial wastewater)

Parameters	Location	Concentration not to exceed
pH	Anywhere in the country	6.5 - 9.0
BOD (Biochemical Oxygen Demand)	Metro cities, all state capitals except in Arunachal Pradesh, Assam, Manipur, Meghalaya, Mizoram, Nagaland, Tripura, Sikkim, Himachal Pradesh, Uttarakhand, J&K, and UTs of Andaman and Nicobar Islands, Dadar and Nagar Haveli, Daman and Diu, and Lakshadweep	20 mg/l
	Areas/regions other than mentioned above	30 mg/l
TSS (Total Suspended Solids)	Metro cities, all state capitals except in Arunachal Pradesh, Assam, Manipur, Meghalaya, Mizoram, Nagaland, Tripura, Sikkim, Himachal Pradesh, Uttarakhand, J&K, and UTs of Andaman and Nicobar Islands, Dadar and Nagar Haveli, Daman and Diu, and Lakshadweep	<50 mg/l
	Areas/regions other than mentioned above	<100 mg/l
Fecal Coliform *(Most Probable Number per 100 milliliter, MPN/100 ml)*	Anywhere in the country	<1,000

Note: mg/l - Milligrams Per Liter

Effluent treatment plant standards (ETP)

(ETPs handle industrial wastewater)

Key parameters for treated industrial effluent are:

- **Heavy Metals:** Strict limits on arsenic, lead, chromium, and other toxic metals to prevent contamination
- **TDS (Total Dissolved Solids):** Controlled to avoid harming soil and groundwater quality
- **Oil & Grease:** Limited to 10 mg/l to prevent water pollution

The effluent standards vary according to the industries

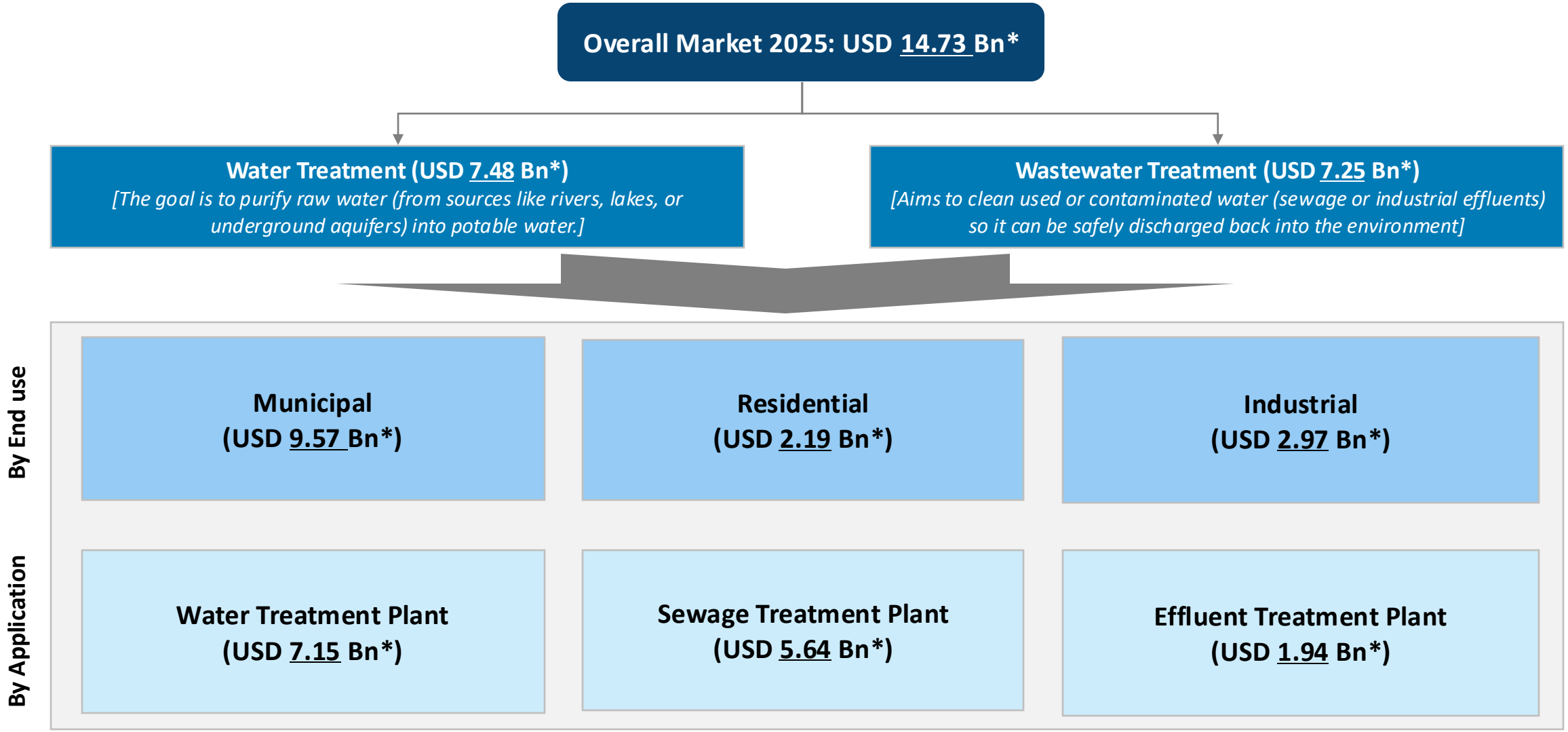
- ***Water (Prevention and Control of Pollution) Act, 1974 , Water (Prevention and Control of Pollution) Cess Act, 1974 , Environment (Protection) Act, 1986 are the regulations governing the wastewater treatment industry***

Source:Source: Feedback Analysis, CPCB

Market Overview

- Overall Market 2025
- Break up by Technologies, Chemicals Services
- Break up by Equipment
- Key Players

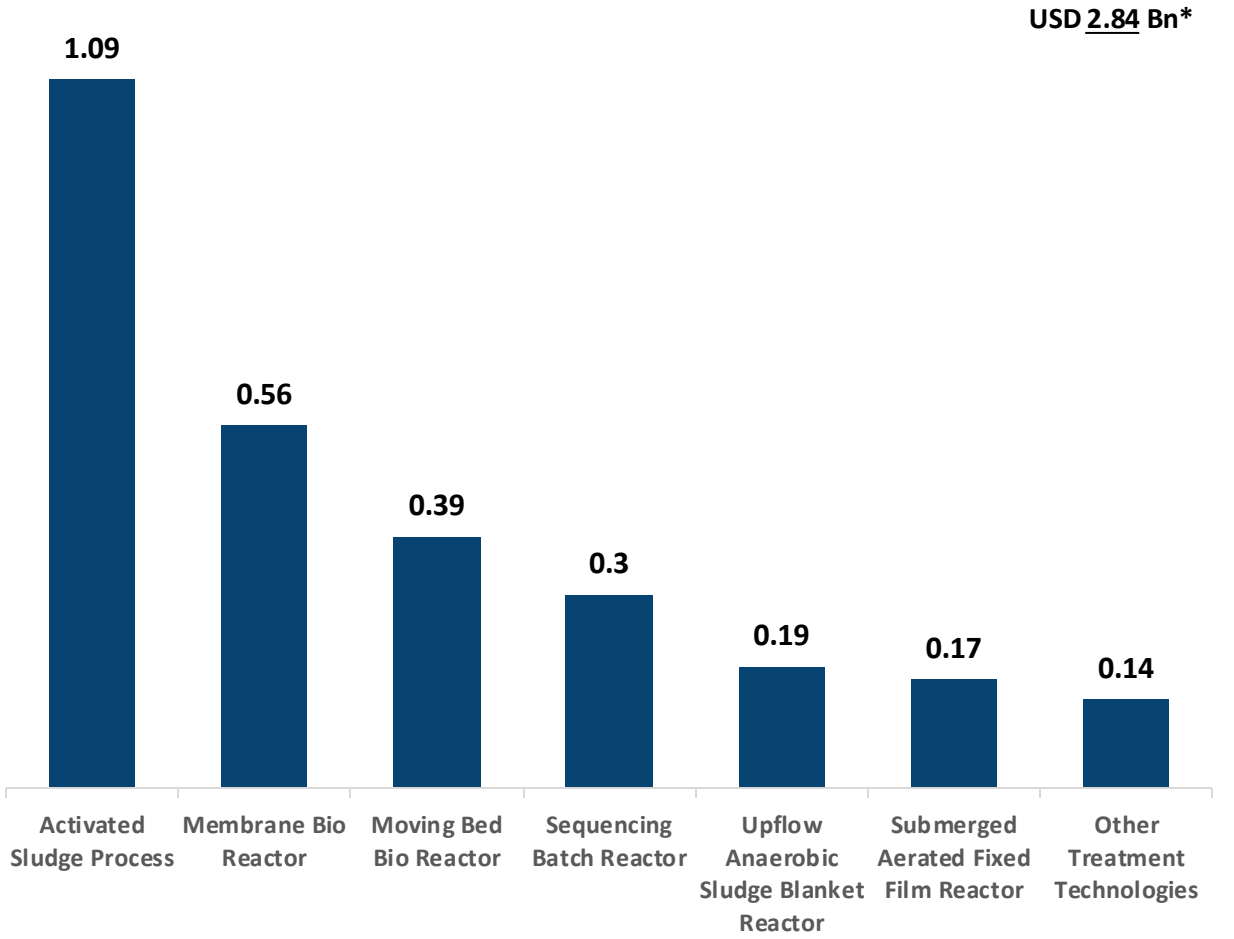
Overall Market (2025) for Water & Wastewater Treatment In India



Source: Feedback Analysis (International Water Association, Ministry of Jal Shakti, Central Water Commission, Water Quality Association, Department of Drinking Water & Sanitation, DRHP)

Break up By Technologies

Break up by : Types of Treatment Technologies (USD Bn) – 2025

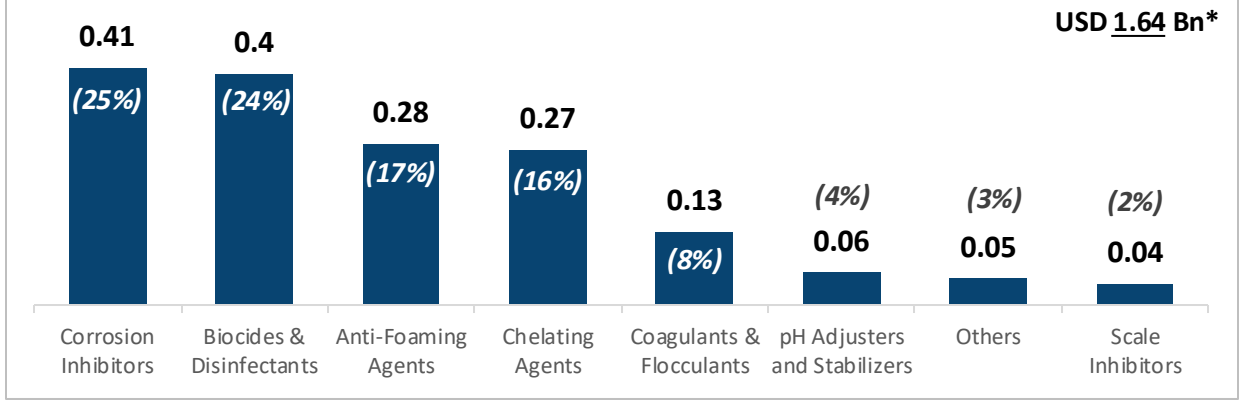


- **Activated Sludge Process (ASP)**:Backbone of municipal STPs across major Indian cities; preferred where land is available
- **Membrane Bio Reactor (MBR):**Rapidly growing in urban clusters for high-quality reuse in IT parks, high-rises, and industrial estates
- **Moving Bed Bio Reactor (MBBR):**Increasingly used for upgrading aging STPs under programs like Namami Gange; enables capacity expansion without land acquisition
- **Sequencing Batch Reactor (SBR):**Most common choice in Tier-2/3 cities under AMRUT and Smart City Missions due to low footprint & flexibility
- **Up flow Anaerobic Sludge Blanket (UASB):**Deployed in industrial clusters (sugar, distilleries, food processing) for biogas generation & low OPEX treatment
- **Submerged Aerated Fixed Film (SAFF):**Widely used in residential townships, hotels, and commercial complexes for cost-effective, low-maintenance treatment.

Source: Feedback Analysis (International Water Association, Ministry of Jal Shakti, Central Water Commission, Water Quality Association, Department of Drinking Water & Sanitation, DRHP)

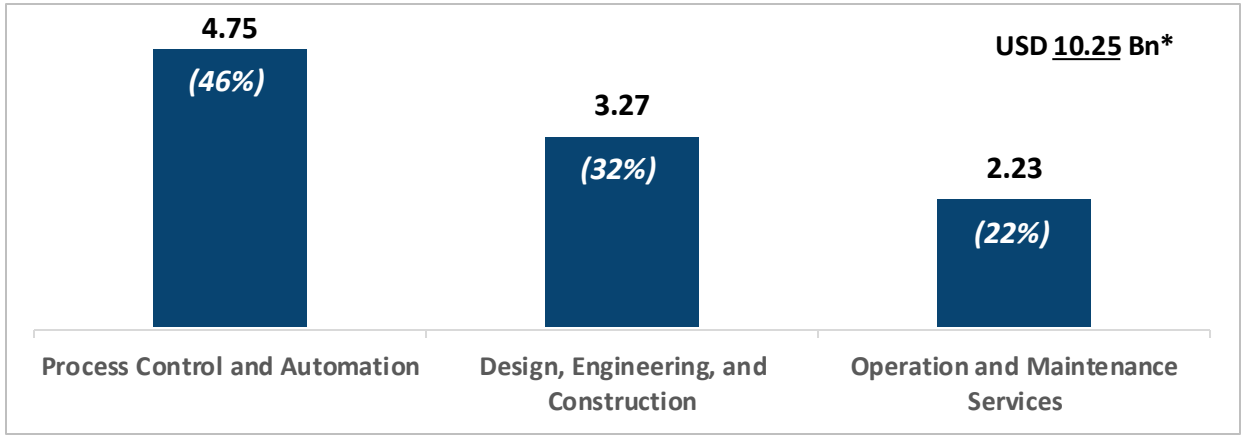
Break up By Chemicals, Services

Break up by : Types of Treatment Chemicals (USD Bn) – 2025



- **Corrosion Inhibitors:** Rising industrial activity and aging infrastructure driving need for asset protection
- **Biocides & Disinfectants:** Stricter hygiene regulations and growing municipal water safety requirements
- **Anti-Foaming Agents:** Expansion in textiles, paper, and chemicals; efficiency focus in process industries
- **Chelating Agents:** Increasing demand from pharma and food sectors for high-purity water
- **Coagulants & Flocculants:** Mandatory wastewater treatment norms and higher municipal STP adoption
- **pH Adjusters & Stabilizers:** Precision water quality needed in electronics, pharma, and specialty industries
- **Scale Inhibitors:** Growth in desalination, thermal power plants, and water recycling projects.

Break up by : Process Control, EPC & O&M Services (USD Bn) – 2025

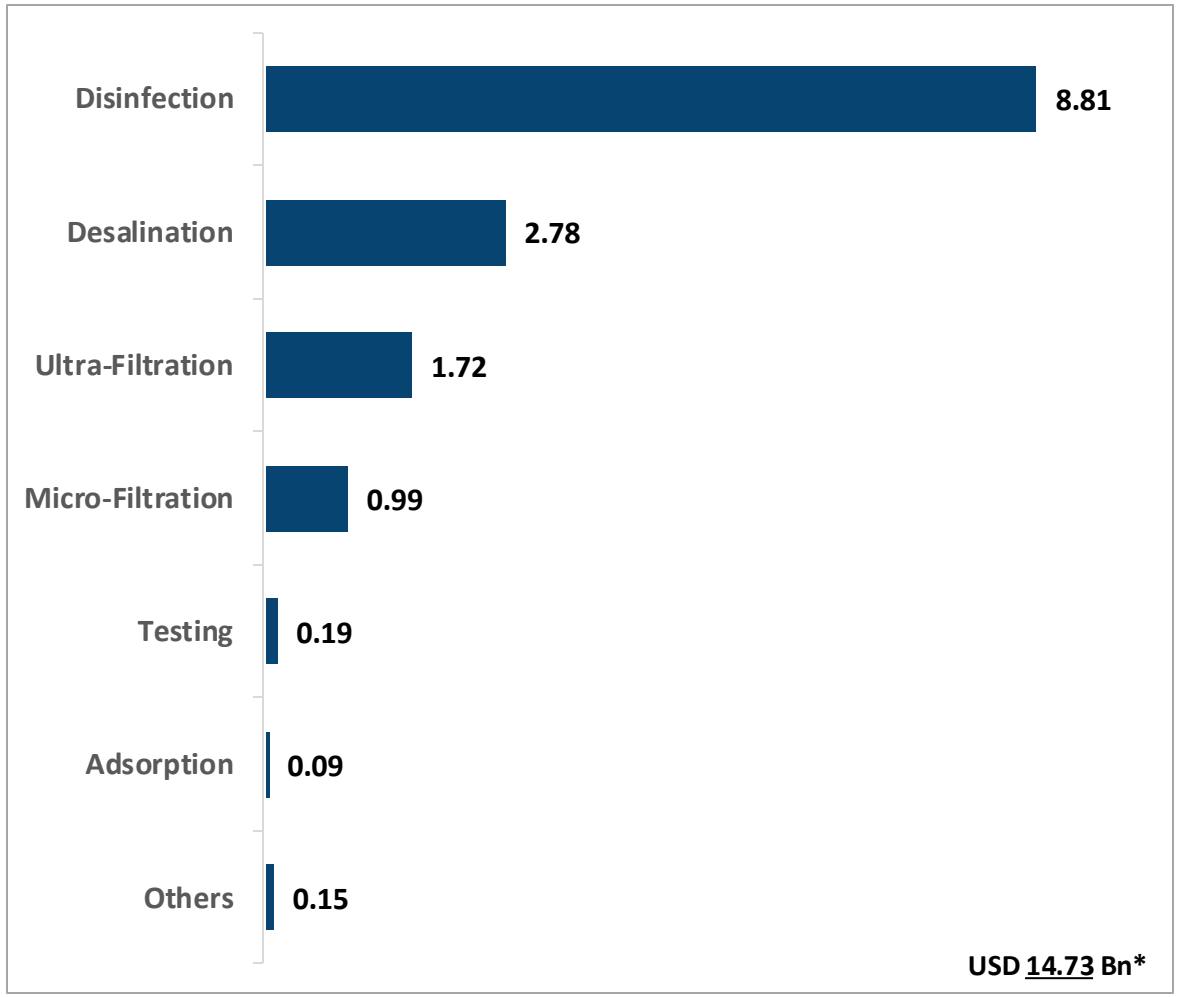


- **Process Control & Automation:**
  - Growing adoption in urban STPs and industrial plants for real-time monitoring (SCADA, IoT sensors)
  - Enabled by Smart Cities Mission & AMRUT, ensuring better compliance with CPCB norms
- **Design, Engineering & Construction (EPC) :**
  - Major demand from government-backed mega projects (e.g., Namami Gange, Jal Jeevan Mission, AMRUT).
- **Operation & Maintenance (O&M) Services :**
  - Critical for sustaining performance of over 4,000+ operational STPs in India.
  - Outsourced O&M rising due to capacity and compliance challenges in ULBs.

Source: Feedback Analysis (International Water Association, Ministry of Jal Shakti, Central Water Commission, Water Quality Association, Department of Drinking Water & Sanitation, DRHP)

Break up by Equipment

Break up by : Types of Equipment (USD Bn) – 2025



Disinfection

- Rapid expansion of UV systems, ozone generators, and chlorination units due to stringent water safety regulations and urbanization's push for sustainable solutions.

Desalination

- RO and MED (Multiple Effect Distillation) technologies are gaining traction, supported by coastal state initiatives, freshwater scarcity, and Zero Liquid Discharge (ZLD) adoption.

Filtration

- Growth driven by ultrafiltration, microfiltration systems for industrial, municipal, and residential use. Rising waterborne disease awareness and urban water treatment initiatives bolster demand.

Testing

- Increasing adoption of advanced sensors and analyzers for real-time monitoring of pH, TDS, turbidity, and contaminants, driven by stricter environmental regulations.

Adsorption

- Activated carbon systems dominate in organic compound and chlorine removal, with industrial wastewater treatment and discharge norms fueling demand.

Source: Feedback Analysis (International Water Association, Ministry of Jal Shakti, Central Water Commission, Water Quality Association, Department of Drinking Water & Sanitation, DRHP)

Key Technology Providers: By Country of Origin

India

ION EXCHANGE Refreshing the Planet
WABAG
THERMAX
Triveni ENGINEERING & INDUSTRIES LTD.
SFC
SUSBIO Giving back to Nature
MWM We Support Life.. MEMBRANE GROUP

US

DOW
EMERSON
xylem
ECOLAB
PENTAIR
HACH
HYDRANAUTICS Nitto Group Company
DUPONT

Europe

GRUNDFOS
FIVEBRO Superior Water Treatment Solutions
kemira
VEOLIA
BASF
suez
FLEXIM

Japan

TORAY
MITSUBISHI CHEMICAL
KURITA
Kubota
YOKOGAWA

Source: Feedback Analysis, Secondary Research

Key Project Solution Providers in India

Company Name	Description	HQ Office	Website
L&T Construction	▪ One of India's largest EPC players for water supply, wastewater treatment, desalination, and O&M.	Mumbai, Maharashtra	www.larsentoubro.com
WABAG	▪ Specializes in EPC for municipal & industrial water and wastewater projects.	Chennai, Tamil Nadu	www.wabag.com
ION EXCHANGE Refreshing the Planet	▪ Specializes in WTP, STP, ETP, desalination, recycling, and chemicals.	Mumbai, Maharashtra	www.ionexchangeglobal.com
meil	▪ Integrated water supply schemes, WTPs, pipelines & distribution networks.	Hyderabad, Telangana	www.meil.in
TATA PROJECTS	▪ Part of Tata Group; offers EPC solutions for water supply, sewage treatment, effluent treatment, and urban infrastructure.	Hyderabad, Telangana	www.tataprojects.com
Triveni ENGINEERING & INDUSTRIES LTD.	▪ Specializes in municipal & industrial water/wastewater EPC, including desalination, recycling, and O&M.	Noida, Uttar Pradesh	www.trivenigroup.com

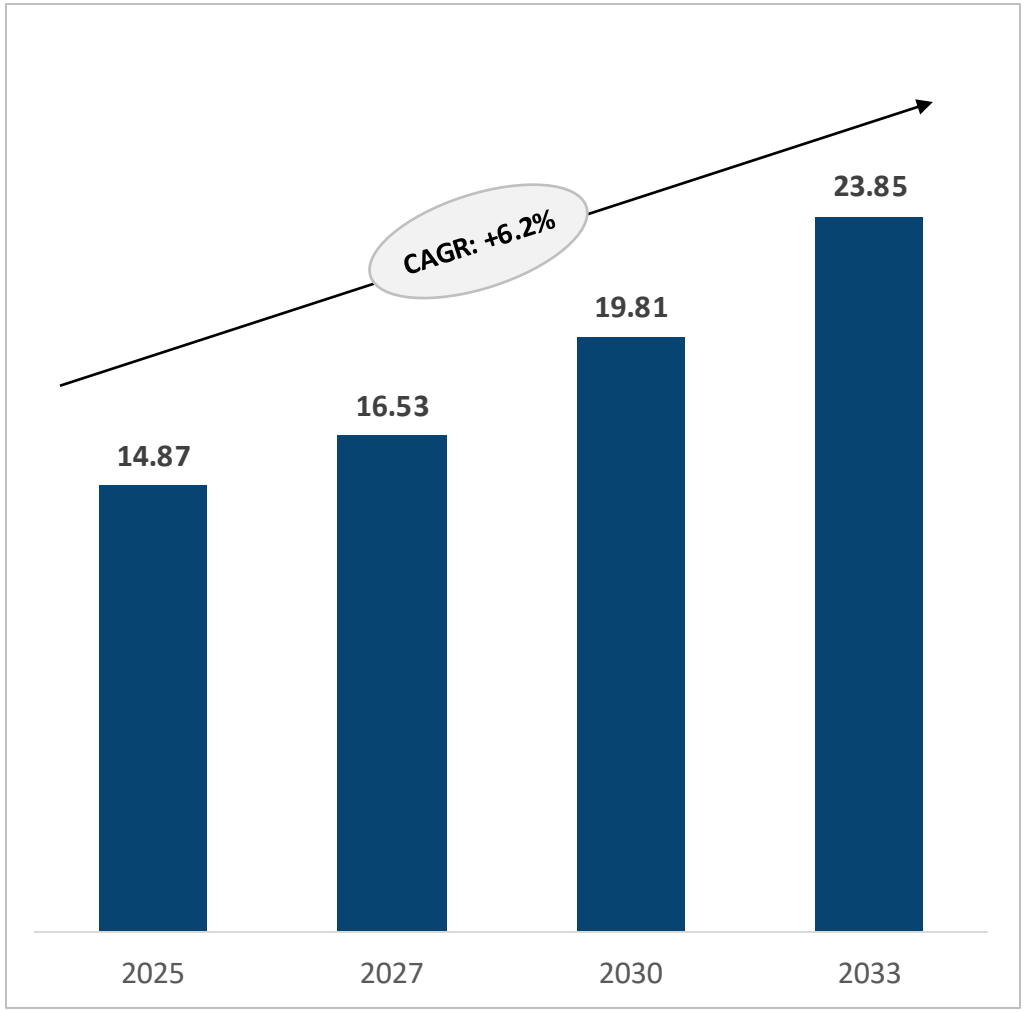
Source: Feedback Analysis, Secondary Research

Future Market, Key Drivers and Challenges

- Future Outlook & Key Trends
- Key Government Initiatives
- Overall Investments and List of projects
- Key Challenges & Market Restraints

Future Outlook & Growth Drivers

*Future Estimates (USD Bn)



*Includes – Treatment Technologies, Chemicals, Process Control & Automation, EPC & O&M Services

Growth Drivers

1. Rising Urbanization & Population Growth
2. Industrial Expansion & Stringent Regulations
3. Government Initiatives & Investments
4. Water Scarcity & Resource Stress
5. Zero Liquid Discharge (ZLD) & Advanced Treatment Adoption
6. Climate Change & ESG Commitments

Source: Feedback Analysis (International Water Association, Ministry of Jal Shakti, Central Water Commission, Water Quality Association, Department of Drinking Water & Sanitation, DRHP)

Key Government Initiatives

Jal Jeevan Mission (Rural & Urban)

- **Focus:** Functional Household Tap Connections (FHTCs) in rural households, 24x7 urban supply, smart metering,and reuse
- **Budget:** 8 Billion USD
- **Timeline:** 2019-2028

*AMRUT 2.0

- **Focus:** Urban water supply, sewerage, reuse, rejuvenation of waterbodies
- **Budget:** 36 Billion USD
- **Timeline:** 2015-2026

Atal Bhujal Yojana (ATAL JAL)

- **Focus:** Groundwater management, community-led, IoT-based monitoring
- **Budget:** ~720 Mn USD
- **Timeline:** 2020-2025

Namami Gange

- **Focus:** Comprehensive river rejuvenation program targeting the Ganga basin
- **Budget:** ~2.4 Billion USD
- **Timeline:** 2014 - Ongoing

***AMRUT - Atal Mission for Rejuvenation and Urban Transformation**

Source: Feedback Analysis

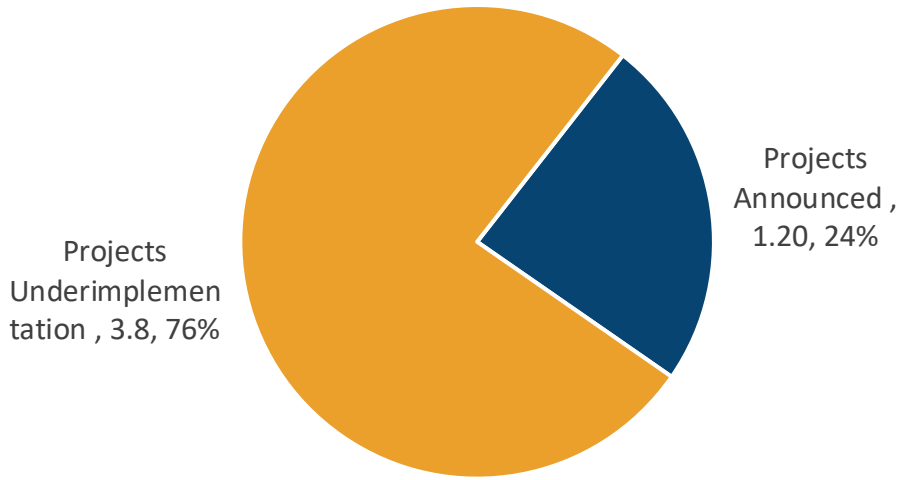
Key State Government Schemes

Scheme Name	State	Description	Timeline	Budget (USD)
Mission Bhagiratha	Telangana	▪ Provides piped drinking water to every household in rural and urban areas ▪ Focus on safe, sustainable drinking water	2016–Ongoing	~$900 million
Mukhya Mantri Jal Swavlamban Abhiyan (MJSA)	Rajasthan	▪ Focus on water conservation, rainwater harvesting, and groundwater recharge ▪ Community-driven approach with watershed works.	2016–Ongoing	~$1.5 billion
Jalyukt Shivar Abhiyan	Maharashtra	▪ Makes villages drought-free through decentralized water conservation ▪ Construction of check dams, ponds, and recharge wells.	2015–Ongoing	~$1.2 billion
Neeru-Chettu Programme	Andhra Pradesh	▪ Integrated water conservation and watershed management ▪ Promotes soil moisture retention and groundwater recharge.	2015–Ongoing	~$900 million
Sujalam Sufalam Jal Abhiyan	Gujarat	▪ Water conservation and irrigation capacity enhancement ▪ Focus on deepening ponds, desilting rivers, and creating reservoirs.	2018–Ongoing	~$800 million

Source: Feedback Analysis

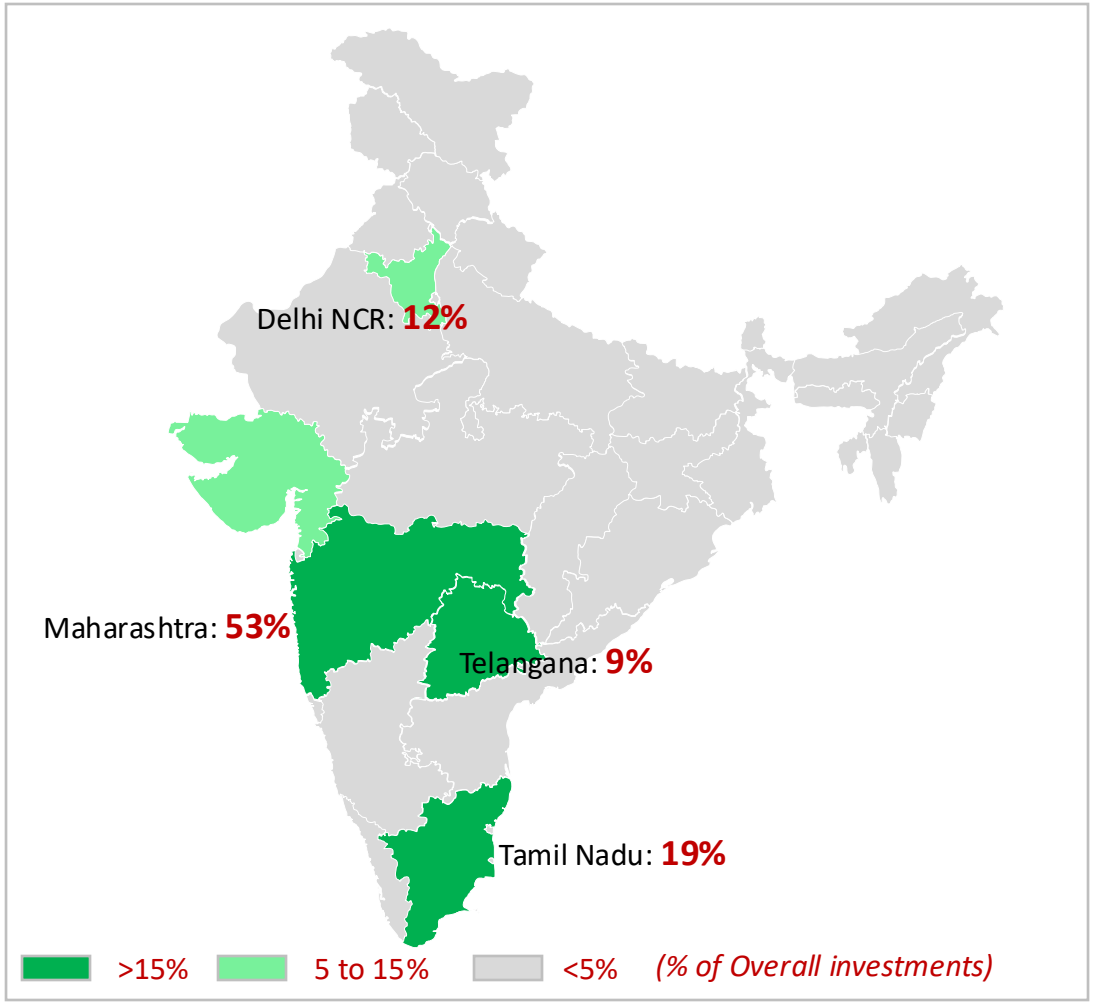
Overall CAPEX (Key Projects)

Overall CAPEX : USD 5 Bn



- Overall capital expenditure (CAPEX) amounts to USD **5** billion
- Most of these projects are government-driven and are spread across all key states
- Maharashtra, Tamil Nadu & Telangana constitute **~80%** of the overall capex
- Apart from the above there are private sector companies who are investing in new plants, where they have plans to have their own water / sewerage treatment plants

Overall Capex Spread by State: USD 5 Bn



Source: Feedback Analysis

List of Key Project: Announced

Organization	Project Name	State/UT	Region	Ownership	Status	Cost (USD MN)
State Industries Promotion Corporation of Tamil Nadu (SIPCOT)	Tuticorin 60 MLD Desalination Plant	Tamil Nadu	South	PPP (HAM)	Announced	267
Greater Visakhapatnam Municipal Corporation (GVMC)	Visakhapatnam 100 MLD Desalination Plant	Andhra Pradesh	South	PPP	Announced	145
Delhi Jal Board (DJB)	27 Decentralised Sewage Treatment Plants	Delhi (NCT)	North	Public	Announced	361
Delhi Jal Board (DJB)	Decentralised Sewage Treatment Plants – Zone Package	Delhi (NCT)	North	Public	Announced	34
Delhi Jal Board (DJB)	Decentralised Sewage Treatment Plants at Galibpur, Saranpur and Shikarpur	Delhi (NCT)	North	Public	Announced	19
Pune Municipal Corporation (PMC)	Sewerage in 23 Merged Villages incl. 8 STPs	Maharashtra	West	Public (AMRUT 2.0)	Announced	173

Source: Feedback Analysis

List of Key Project: Announced

Organization	Project Name	State/UT	Region	Ownership	Status	Cost (USD MN)
NMCG / Govt of Uttar Pradesh	Agra Sewerage Management	Uttar Pradesh	North	Public (DBOT)	Announced	15
NMCG / Govt of Bihar	Arrah 47 MLD STP + 19.5 km Sewer Network	Bihar	East	Public (HAM)	Announced	40
NMCG / Govt of Bihar	Munger Sewerage Network + 30 MLD STP	Bihar	East	Public	Announced	63
Delhi Jal Board (DJB) / Municipal Corporation of Delhi (MCD)	AMRUT 2.0 Sewer Expansion & 2.5 Lakh New Connections	Delhi (NCT)	North	Public (AMRUT 2.0)	Announced	96

Source: Feedback Analysis

List of Key Project: Under Implementation

Organization	Project Name	State/UT	Region	Ownership	Status	Cost (USD MN)
Brihanmumbai Municipal Corporation (BMC)	7 Mega Sewage Treatment Plants (citywide)	Maharashtra	West	Public (EPC / Hybrid Annuity Model)	Under Implementation	2,048
Hyderabad Metropolitan Water Supply and Sewerage Board (HMWSSB)	31 Sewage Treatment Plants (1,570 MLD)	Telangana	South	PPP (HAM)	Under Implementation	466
Chennai Metropolitan Water Supply and Sewerage Board (CMWSSB)	Perur 400 MLD Desalination Plant	Tamil Nadu	South	Public	Under Implementation	515
Municipal Corporation of Gurugram (MCG)	Tertiary Treated Water Network Augmentation	Haryana	North	Public	Under Implementation	10
National Mission for Clean Ganga (NMCG) / Govt of Maharashtra	Nag River Rejuvenation and Pollution Abatement	Maharashtra	West	Public	Under Implementation	232
Pune Municipal Corporation (PMC)	11 New STPs (396 MLD) – JICA Mula–Mutha Project	Maharashtra	West	Public (JICA)	Under Implementation	119

Source: Feedback Analysis

List of Key Project: Under Implementation

Organization	Project Name	State/UT	Region	Ownership	Status	Cost (USD MN)
Bangalore Water Supply and Sewerage Board (BWSSB)	Bengaluru: Upgradation of 20 STPs	Karnataka	South	Public	Under Implementation	119
Chennai Metropolitan Water Supply and Sewerage Board (CMWSSB)	Nemmeli 150 MLD Desalination Plant (Phase-II)	Tamil Nadu	South	Public	Under Implementation	152
Delhi Jal Board (DJB)	Chandrawal Water Treatment Plant Upgrade	Delhi (NCT)	North	Public (JICA)	Under Implementation	72
Pune Municipal Corporation (PMC)	6 STP Upgrades (City Areas)	Maharashtra	West	Public	Under Implementation	54

Source: Feedback Analysis

Key Challenges & Barriers

Challenges

Groundwater Depletion & Untreated Water Discharge

- Excessive extraction and insufficient replenishment of groundwater lead to scarcity and contamination.
- Increased levels of pollutants (e.g., heavy metals, pesticides) in remaining groundwater exacerbate water quality issues.
- Urgent need for advanced water treatment solutions to meet safety and quality standards.

Limited Funds in Underdeveloped Regions

- Unequal regional growth in India affects infrastructure development.
- Low-income states (e.g., Bihar, Odisha) face limited central funding, prioritizing basic needs over industrial development.
- High costs of water treatment technologies hinder adoption and infrastructure upgrades.

Lack of Techno-Commercial Awareness

- Stakeholders often lack expertise in evaluating treatment technologies for efficiency and cost-effectiveness.
- Limited awareness leads to suboptimal investments, prioritizing short-term costs over long-term sustainability.

Barriers

Lack of Water and Infrastructure Management

- Inefficient use and distribution of water resources increase pressure on treatment facilities.
- Aging infrastructure causes leaks, bursts, and water losses, reducing supply efficiency.
- Outdated facilities struggle to meet rising demand, necessitating modernization and investment.

High Installation, Equipment, and Operations Costs

- Substantial capital investment is required for infrastructure, advanced equipment, and new technologies.
- Financial constraints deter stakeholders, especially in resource-limited regions.
- **High NRW** due to leaks, theft, and poor metering reduces treated water availability, lowers revenues, and hinders infrastructure investment.

Source: Feedback Analysis

2. Industrial Waste & Environmental Monitoring

- E-Waste
- Battery Recycling
- Plastic Recycling

E-Waste

Introduction

- Introduction to E-Waste
- Stakeholders

Introduction to E-Waste

- Electrical and electronic equipment (EEE), whole or in part, discarded as waste by consumers (individual or bulk) as well as rejects from manufacturing, refurbishment and repair processes are classified as E-Waste.
- Batteries, unless used to power EEE, are not considered a part of e-waste for regulatory purpose and are governed by its own waste management rules.
- E-Waste Management Rules 2022, 106 items from the following categories are covered:

Category of Electronic & Electrical Equipment	Examples
Information technology and telecommunication	Centralized data processing: Mainframes, Minicomputers, Personal Computers, Printers including cartridges etc..
Consumer Electrical and Electronics and Photovoltaic Panels	Television sets, Refrigerator, Washing Machine, etc..
Large and Small Electrical and Electronic Equipment	Large cooling appliances, Electric cookers, Microwaves, Microwave Oven, etc..
Electrical and Electronic Tools (except large-Scale Stationary Industrial Tools)	Drills, Saws, Sewing Machines, etc..
Toys, Leisure and Sports Equipment	Electrical trains or car racing sets, Video games consoles, Coin slot machines, etc..
Medical Devices (except of All Implanted and Infected Products)	Radiotherapy equipment and accessories, Cardiology equipment and accessories, etc..
Laboratory Instruments	Gas analyser, Equipment having electrical and electronic components

Source: Feedback Analysis

Key Stakeholders

1 Regulatory Bodies

Government bodies responsible for E-waste management

- Ministry Of Environment, Forest And Climate Change (MoEFCC)
- Central & State Pollution Control Board and Pollution Control Committee (PCC)
- Ministry of Electronics and Information Technology (MeitY)
- Bureau of Indian Standards (BIS)

E-waste generation

EEE Manufacturers

EEE Consumers

Waste Generators

Individuals (Households)
Bulk (IT companies, government)

Mismanaged E-waste

Mismanaged e-waste usually ends up in landfill

2 Formal & Informal waste collection

Formal Waste Collection

Manufacturer's Buy Back Scheme and Exchange Offers

Municipal Collection

Producer Responsibility Organization (PRO)

Rag Pickers & Scrap Dealers

Informal Waste Collection

Recycling and Refurbishment

3 Refurbishment

Carried out by OEMs and their Authorized Refurbishers

4 Recyclers

Players involve in recycling and extraction of useful metals from E-waste

Source: Feedback Analysis

Role Of Stakeholders

1

Regulatory Bodies

- **Ministry Of Environment, Forest And Climate Change (MoEFCC) –** MoEFCC is responsible for formulating and updating the E-Waste (Management) Rules aimed at managing e-waste in an environmentally sound manner and promote a circular economy through Extended Producer Responsibility (EPR)
- **Central Pollution Control Board (CPCB) –** CPCB regulates e-waste by estimating generation via sales/lifespan data, enforcing EPR registration, monitoring compliance with SPCBs, and maintaining approved recyclers
- **State Pollution Control Board (SPCB) & Pollution Control Committee (PCC) –** SPCBs or PCCs authorize recyclers, monitor e-waste compliance, conduct audits, issue SOPs, raise public awareness, and collaborate with local authorities to ensure proper e-waste handling and disposal.
- **Ministry of Electronics and Information Technology (MeitY) –** MeitY promotes e-waste recycling technologies, supports a circular economy, raises awareness, collaborates with ministries, and aids SMEs in adopting sustainable e-waste management practices.
- **Bureau of Indian Standards (BIS) –** Bureau of Indian Standards along with Ministry of Electronics and Information Technology shall also develop guidelines for refurbishers with respect to Compulsory Registration Scheme.

2

Formal & Informal waste collection

- Collection of e-waste is at authorized collection points, take-back programs by manufacturers and Producer Responsibility Organization (PRO) in the formal sector; scrap dealers & waste pickers in the informal sector.

3

Refurbishment

- Refurbished EEE is re-introduced into the market as used/2nd hand products in tier 2 & tier 3 cities.
- Recovered materials from the recycling process is re-introduced into the manufacturing eco-system therefore reducing dependency on import for some essential materials.

4

Recyclers

- Re-useable materials are recovered from EEE that have reached the end of life or damaged beyond repair.
- Recovered materials from the recycling process is re-introduced into the manufacturing eco-system therefore reducing dependency on import for some essential materials.

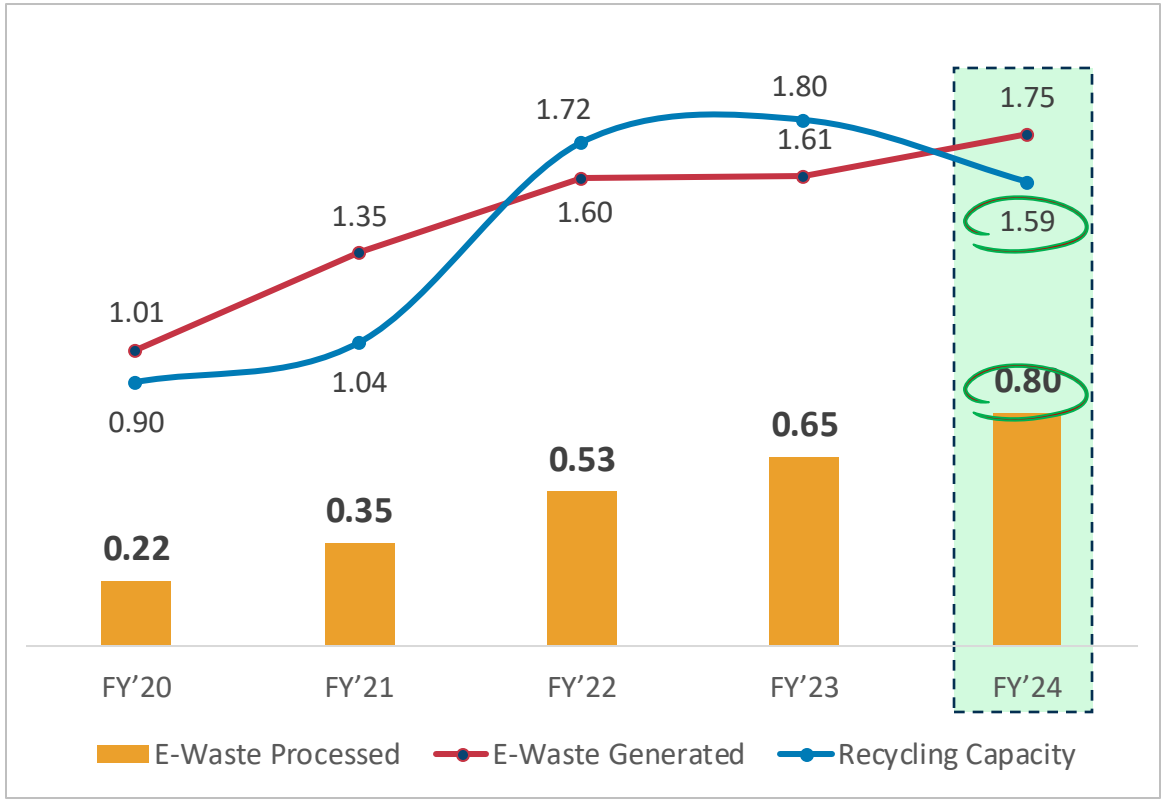
Source: Feedback Analysis

Market Overview

- Overall Market
- Key Players

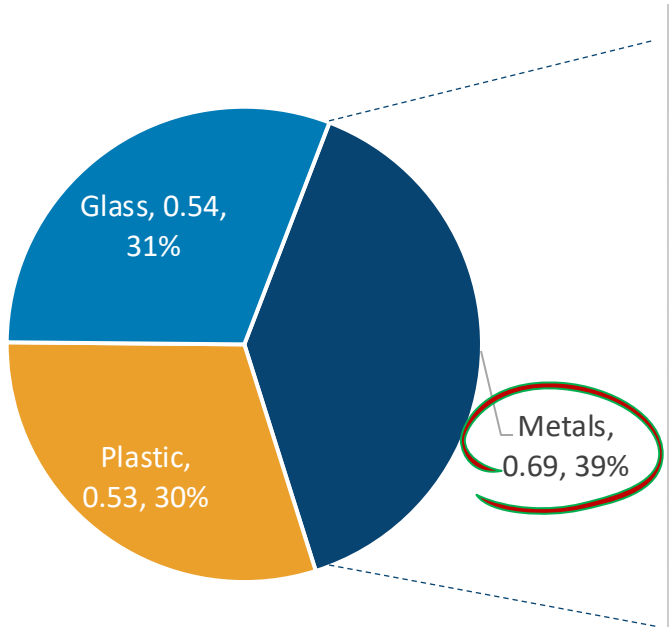
Current scenario of E-Waste recycling in India

Generation, Processed & Recycling Capacity (in MMTPA)



- E-waste rule changes implemented in FY'24, reduced recyclers from 519 in FY'23 to 216 in FY'24 resulting in the reduction of 0.21 MMT in Recycling capacity.

Estimated re-useable metals from e-waste (in MMTPA)



Metals	Weight of Metals
Copper	0.35
Iron	0.14
Nickel	0.04
Tin	0.07
Aluminium	0.04
Zinc	0.02
Others*	0.0453
Total	**0.69**

* Other metals include Gold, Silver, Palladium & Lead

E-waste Generated: **1.75** MMTPA

Above mentioned are an approximation as the materials used in the manufacturing of EEE may wary.

Note - E-waste generation is estimated using national sales data and the average life of electrical and electronic equipment

Source: Source: Feedback Analysis, Ministry of Housing and Urban Affairs, Indian Council for Research

Key Players in India

Major player by business operations

Recyclers

Explanation

- Recyclers must register with both CPCB and SBCBs/PCCs.
- They generally carry out dismantling, segregation and material recovery.

Key players

- Attero Recycling Pvt Ltd
- TES AMM Pvt Ltd
- Endeavor Recyclers India Pvt Ltd
- Greenscape Eco Management Pvt Ltd
- Cerebra Integrated Technologies Ltd
- Z Enviro Industries Pvt Ltd
- Egnus Ewaste Solution Pvt Ltd

Refurbishers

Integrated

Some recyclers may offer refurbishing services as well. Eg: Endeavor Recyclers India Pvt Ltd, Cerebra Integrated Technologies Ltd, Egnus Ewaste Solution Pvt Ltd, etc.

OEMs and their authorized refubishers

Selection of companies based on the top 4-5 revenue-generating firms from the segment

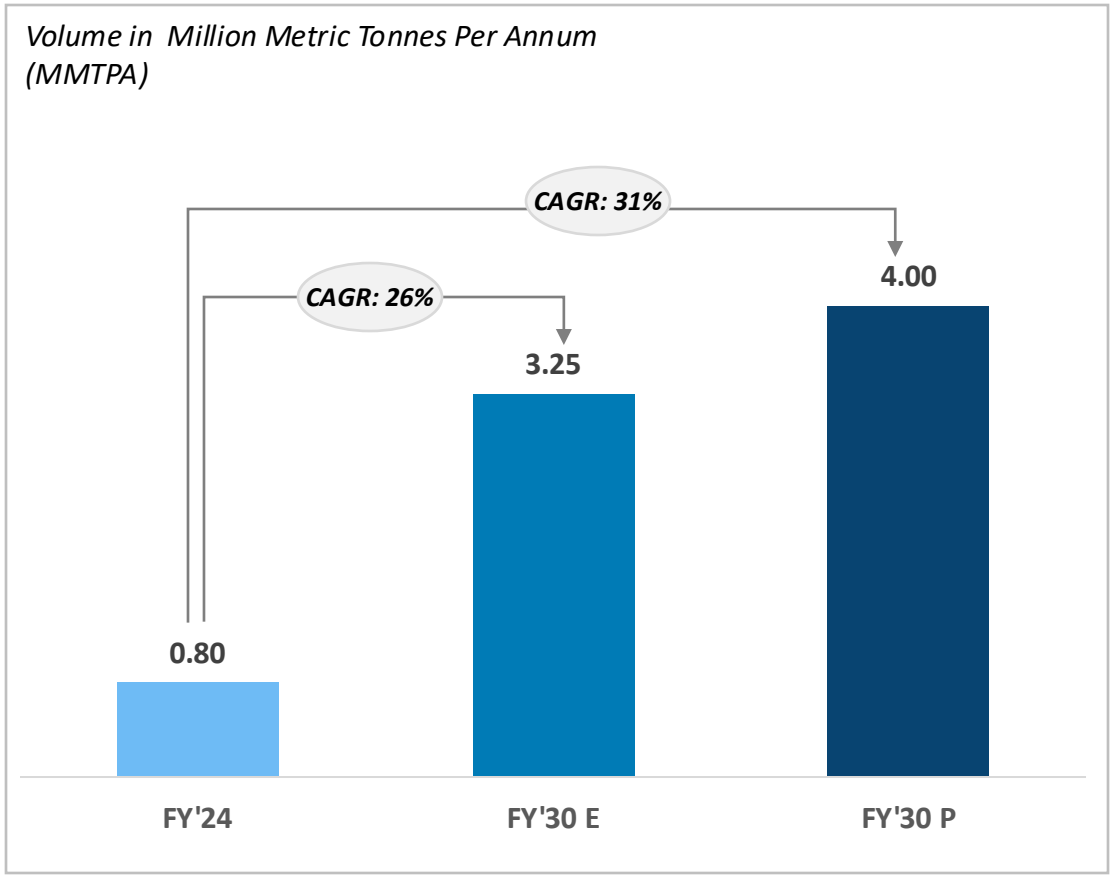
Source: Feedback Analysis

Future & Key Trends

- Future Estimates & Challenges
- Key Government Regulations

Future Trends - Electronic Waste Recycling

Future Estimate of Recycled E-Waste (in MMTPA)



Future Projection : *Is assessed based on government support policies, current achievements, and investments.*

E: Expected | P: Projection

Challenges hindering the achievement of projected targets

- **Dominance of informal sector:** The informal sector collects inventories; e-waste due to convenience and incentives.
- **Lack of reliable e-waste data:** No state has created mandated e-waste inventories; estimates rely on national-level sales data and average product lifespan.
- **Market barriers for private investment :** Inconsistent e-waste supply discourages private sector entry, low consumer awareness and limited info on recycling costs hinder growth.

Source: Feedback Analysis, PIB

The E-Waste Management Rules (EWM) rules, 2022

These rules apply to manufacturers, importers, brand owners, local bodies, waste processors, retailers, and the general public

Registration and Authorization
- All producers, recyclers, and refurbishers must register with and obtain authorization from the CPCB and SPCBs/PCCs to handle e-waste

Extended Producer Responsibility (EPR)
- Manufacturers are required to ensure the recycling or safe disposal of e-waste generated from their products. They must also collect e-waste and ensure its proper recycling

Hazardous Substance Reduction
- The rules mandate the reduction of hazardous substances like lead and mercury in the manufacturing of electrical and electronic equipment (EEE)

Bulk Consumers' Responsibilities
- Bulk consumers must ensure that e-waste is handed over only to registered producers, refurbishers, or recyclers.

Storage and Handling
- The maximum time allowed for storing e-waste is typically 180 days, and may be extended by the SPCB up to 365 days.

Reporting and Monitoring
- Companies are required to file annual and quarterly returns detailing their e-waste management activities.

Skill Development and Worker Safety
- The rules emphasize the importance of skill development and ensuring safety and health for workers involved in e-waste dismantling and recycling.

Source: Feedback Analysis, CPCB

Key Initiatives (1/2)

Government support for setting up a state-of-the-art E-Waste recycling facilities

- Ministry of Electronics and Information Technology to provide support of 25% on capital expenditure for setting up of state-of-art e-waste recycling facilities. The incentives will be available for investment made within 5 years from the date of acknowledgement of application

Policies promoting E-Waste recycling as per Budget 2026

- The Ministry of Mines has proposed a Production Linked Initiative (PLI) scheme with a budget of INR 150 Bn (~USD 1.8 Bn) to encourage e-waste recycling, incentivize the production of recycled critical minerals and promote investments in advanced recycling technologies.
- Industry leaders are also advocating for a rollback of the GST hike from 5% to 18% on waste management

Source: Feedback Analysis, NSGM, PIB

Key Initiatives (2/2)

Impact of technological growth on E-waste

- Rapid technological advancements reduce the lifespan of electronic devices, typically to 2-3 years, driving the need for e-waste management

Rising incomes driving increased electronics consumption in India

- India has seen a growth of 9.3% in income annually, meaning people have more disposal income to spend on newer electronics

E-waste recycling to address rising demand of copper

- In FY'24 India consumed 0.86 MMTPA of Cu of which 42% was imported, as copper demand grows by 13% y-o-y, recycling and metal recovery from e-waste can play a huge role to reduce copper imports

Investments in infrastructure development in e-waste management

- Considering the last 4 years, with a total value of INR 77.4 Bn (~USD 0.94 Bn), 8 projects have been announced and are under various stages of implementation; Of which 2 projects are govt. projects and 6 are private projects valued at INR 500 Mn (~USD 6 Mn) & INR 76.9 Bn (~USD 0.93 Bn) respectively

Future Projection : Is assessed based on government support policies, current achievements, and investments.

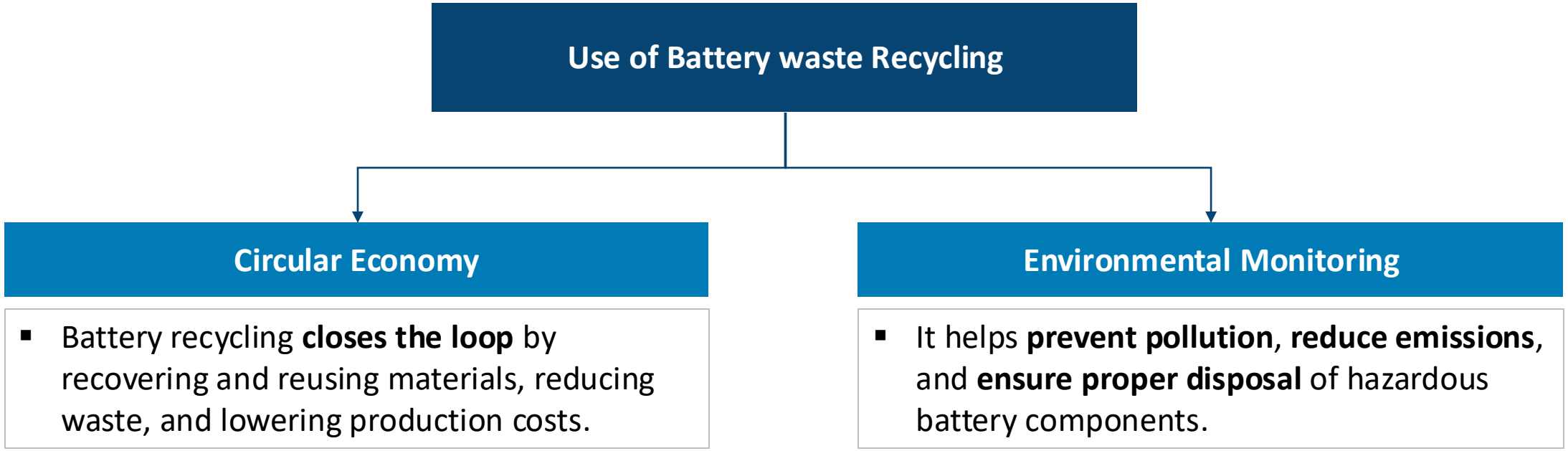
Source: Feedback Analysis, NSGM, PIB

Battery Recycling

Introduction

- Introduction to Battery Waste
- Stakeholders

Uses of Battery waste recycling



- Battery recycling **closes the loop** by recovering and reusing materials, reducing waste, and lowering production costs.

- It helps **prevent pollution**, **reduce emissions**, and **ensure proper disposal** of hazardous battery components.

Source: Feedback Analysis

Battery Waste

Definition of Battery Waste as per Indian Government Waste Management Rules :
Battery waste includes used or end-of-life batteries, their components, parts, or consumables, which may be hazardous or non-hazardous. It also covers defective (off-spec) batteries, expired batteries, and batteries discarded by users.

Types of Battery Waste

Conventional

Battery waste Type	Commonly Used in
Lead-Acid	Cars, Inverters, UPS, Industrial Backup
Nickel-Cadmium (Ni-Cd)	Power Tools, Emergency Lighting, Medical Devices
Nickel-Metal Hydride (Ni-MH)	Hybrid Cars, Rechargeable AA/AAA Batteries
Alkaline (AA, AAA, C, D)	Remote Controls, Clocks, Flashlights
Zinc-Carbon	Basic Household Electronics
Button-Cell (Silver Oxide, Mercury, Zinc-Air)	Watches, Hearing Aids, Calculators

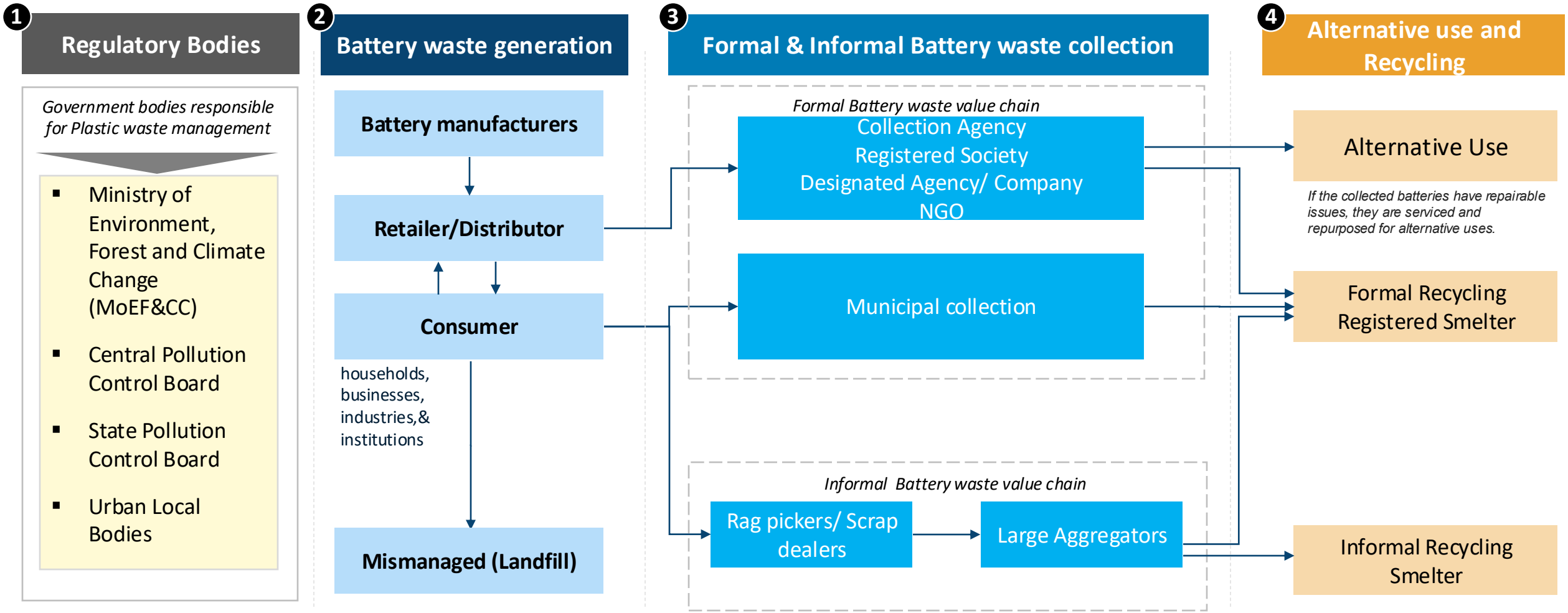
ACC (Advanced Chemistry Cell) Batteries

Battery waste Type	Commonly Used in
Lithium-Ion (Li-ion)	Cell Phones, Laptops, EVs, Power Banks
Solid-State Batteries (SSB)	Next-Gen EVs, Wearables, Energy Storage
Lithium-Sulphur (Li-S)	Future EVs, Aerospace, Defence
Sodium-Ion (Na-ion)	Grid Storage, EVs, Industrial Applications

- **Lead-Acid Batteries** are the most recyclable (~99%) with a well-established recycling process.
- **Lithium-Ion Batteries & ACC Technologies** are harder to recycle but crucial for EV & energy storage sustainability.
- **Alkaline & Zinc-Carbon Batteries** have **low recyclability** due to low economic value and lack of infrastructure.

Source: Feedback Analysis

Key Stakeholders



Source: Feedback Analysis

Role Of Stakeholders

1 Regulatory bodies

- **Ministry of Environment, Forest and Climate Change (MoEF&CC):** MoEF&CC sets environmental regulations, including the Plastic Waste Management (PWM) Rules, 2016
- **Central Pollution Control Board (CPCB) –** The CPCB under PWM Rules, 2016, frames standard operating procedure, certifies compostable carry bags/films manufacturers/sellers, regulates plastic waste through disposal guidelines, ensures proper waste processing, and submits an annual report to the Central Government
- **State Pollution Control Board (SPCB)** – The SPCB is responsible for implementing and enforcing the Plastic Waste Management Rules, 2016, monitoring the processing and disposal of plastic waste

2 Battery waste generation

- Battery Manufacturer : Produces and supplies new batteries while ensuring compliance with recycling regulations.
- Retailer Sells batteries and facilitates collection of used ones for proper disposal.
- Consumer : Uses batteries and returns them to designated collection points for recycling.

3 Formal & Informal Battery waste collection

- Formal : Collection Agency, Registered Society, Designated Agency/Company/NGO - Ensure **safe and compliant recycling** by directing waste to **authorized recycling units** while minimizing environmental hazards.
- Informal Recycling : Rag Pickers, scrap dealers **recover valuable materials** but often **lack proper environmental safeguards**, causing pollution and health risks.

4 Alternative use and Recycling

- Alternative Use - If the collected batteries have repairable issues, they are serviced and repurposed for alternative uses.
- Formal Recycling Registered Smelter - Batteries are collected and sent to licensed recycling facilities. Proper environmental controls are in place to safely extract metals and materials.
- Informal Recycling Smelter - Informal or unregistered smelters often use unsafe methods to extract lead and metals.
  These setups may lack proper pollution control, leading to toxic emissions and environmental hazards

Source: Feedback Analysis, Secondary Research

Market Overview

- Market Overview
- Technologies Used in India
- Key Players

Current Scenario Of Battery Waste

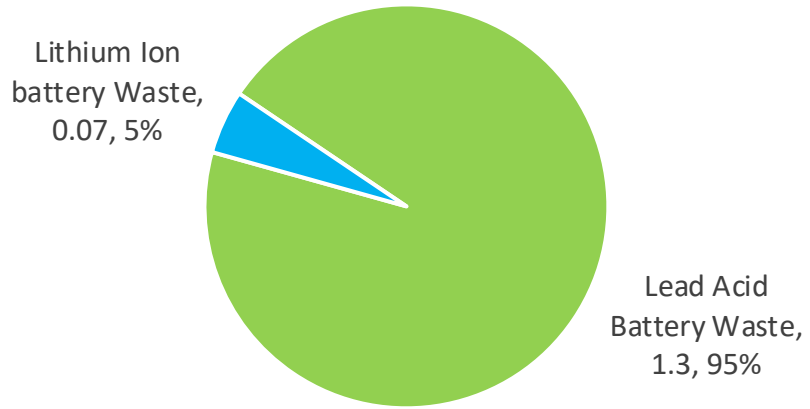
Total Waste Batteries Generated for **FY'24: 1.37 MMTPA**

76% is Recycled

Total Waste Batteries Recycled in **FY'24: 1.04 MMTPA**

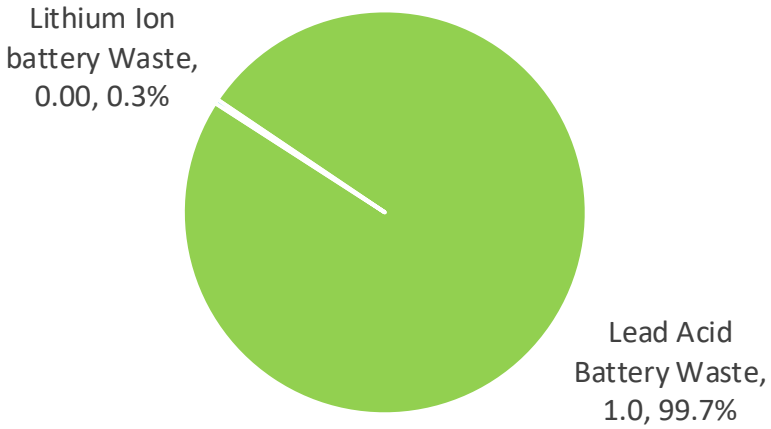
Considering only recyclable battery waste generated,

Split by Battery waste generated



Total: **1.37** MMTPA

Split by Battery Waste Recycled



Total: **1.04** MMTPA

- Sizeable portion of the population is unaware of proper battery disposal methods, most batteries end up in the unregulated sector/Landfills , leading to unsafe recycling practices that harm both workers and the environment.

Source: Feedback Analysis, Gravita India

Current Scenario Of Lead Acid Battery Waste Recycling In India

Total Lead acid waste Batteries Generated for FY'24:

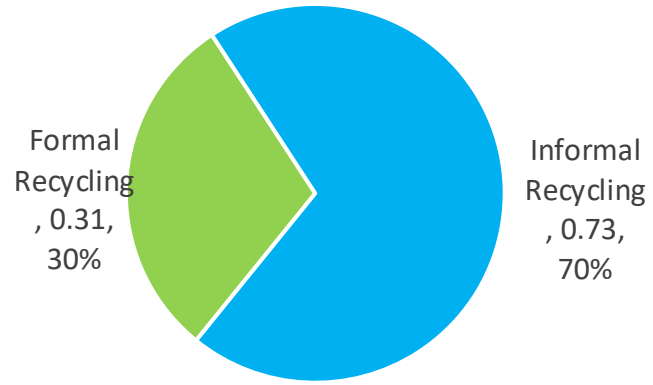
1.3 MMTPA

80% Recycled

Total Lead acid waste Batteries recycled for FY'24:

1.04 MMTPA

Split of Lead acid Batteries by the type recycling (MMTPA)



- **Lead Acid Battery waste recycling** is still dominated by the **informal sector**.
- **Lead-acid batteries** 70% recycled informally, 30% formally, up from 10% formal in 2016, showing significant formal sector growth.

- **Components recovered during the recycling of lead-acid batteries :** Lead recovery rate of informal smelters ranges from 50% to 70%,whereas the formal recyclers have recovery rates upwards of 98%,though the recovery rates of the formal players are higher, the informal players have a larger market share at present

Components	Percentage (%)	Use After Recycling
Lead (Plates & Grids)	~65%	Reused in new batteries, lead products
Sulfuric Acid	~20%	Neutralized or converted to sodium sulfate
Plastic (Polypropylene)	~10%	Recycled into new battery casings, plastic items
Electrolyte Residues & Other Metals	~5%	May include tin, antimony, calcium, and require further processing
Total	**100%**	

Source: Feedback Analysis

Current Scenario Of Lithium- Ion Battery Waste Recycling In India

Total Lithium- ion Battery waste Generated for FY'24:

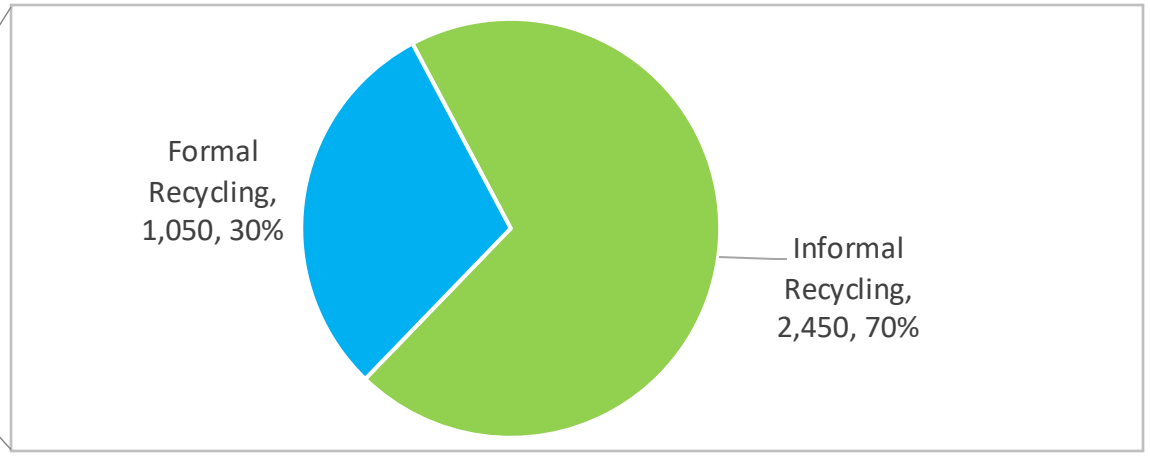
70,000 Metric Tonnes (**0.07** MMTPA)

<5% Recycled

Total Lithium- ion Battery waste recycled for FY'24:

3,500 Metric Tonnes (**0.0035**)MMTPA

Split of Lead acid Batteries by the type recycling(Metric Tonnes)



Lithium- ion Battery waste Composition

Component	Materials Used	Composition (% by weight)	Material Recovery
Cathode	Lithium (Li), Nickel (Ni), Manganese (Mn), Cobalt (Co), Iron (Fe)	~40%	▪ **Nickel, Cobalt, and Copper have the highest recovery rates** because they are valuable and easier to extract. ▪ **Lithium recovery is improving** (~60-90%) but depends on the process used. ▪ **Graphite recovery is challenging** which is often lost in the process. ▪ **Electrolyte and separators are difficult to recycle** and are often burned or discarded.
Anode	Graphite (C), Silicon (Si) (optional)	~20%	
Electrolyte	Lithium salt ($LiPF_6$), Organic Solvents (EC, DMC, DEC)	~10%	
Separator	Polyethylene (PE), Polypropylene (PP)	~5%	
Current Collectors	Copper (Cu) foil (Anode), Aluminum (Al) foil (Cathode)	~10%	
Casing & Others	Battery casing, connectors, electronic components	~15%	

Source: Feedback Analysis, PIB

Major Technologies Used in India

Technology	LAB Process & Usage	LIB Process & Usage	Viability & Comment
Pyrometallurgy	Smelting at 1000-1400°C to recover lead.	Extracts Co, Ni, Cu but loses lithium in slag.	**Pyrometallurgy** is well-established for LABs but not ideal for LIBs due to lithium loss.
Hydrometallurgy	Acid leaching + electrowinning for high-purity lead.	Leaching + solvent extraction for Li, Co, Ni, Mn.	**Hydrometallurgy** is more efficient and eco-friendlier for both LABs and LIBs.
Mechanical Separation	Crushing + gravity separation for plastics, lead grids, and electrolyte.	Shredding + sieving for Cu, Al, cathode/anode materials.	**Mechanical separation** is an essential step but does not recover high-value metals directly
Electrochemical	Electrowinning to recover pure lead.	Electrolysis to selectively extract lithium and metals.	**Electrochemical methods** are promising for LIBs but still developing for LABs.
Biotechnological	Bioleaching with bacteria to dissolve lead.	Bioleaching for Li, Co, Ni recovery.	**Biotechnological methods** are eco-friendly but not viable on an industrial scale yet.
Direct Recycling	Not applicable. Lead is re-melted.	Cathode-to-cathode reuse via re-lithiation.	**Direct recycling is not used for LABs**, but for LIBs, it is a game-changer for sustainable recovery

Source: Feedback Analysis

Key Players in India

Major player Recyclers by type of Business operation

	Battery - Manufacturer (2)	Recyclers (11)
Explanation	▪ *These companies produce batteries and buy them back on exchange through their collection centers/Dealers*	▪ *These companies are solely in battery recycling these either take the batteries waste collected by the manufacturers/they collect them through various sources and recycle them.*
Key players	▪ Amara Raja - Circular solutions ▪ Exide- Chloride Metals	▪ Gravita India Limited ▪ Lohum ▪ Attero Recycling ▪ Sungeel ▪ E-Parisaraa ▪ Exigo ▪ Ecoreco ▪ Batx ▪ Ziptrax ▪ Tes-Amm ▪ Tata Chemicals

No. of key players

Selection of companies based on the top 4-5 revenue-generating firms from the segment

Source: Feedback Analysis

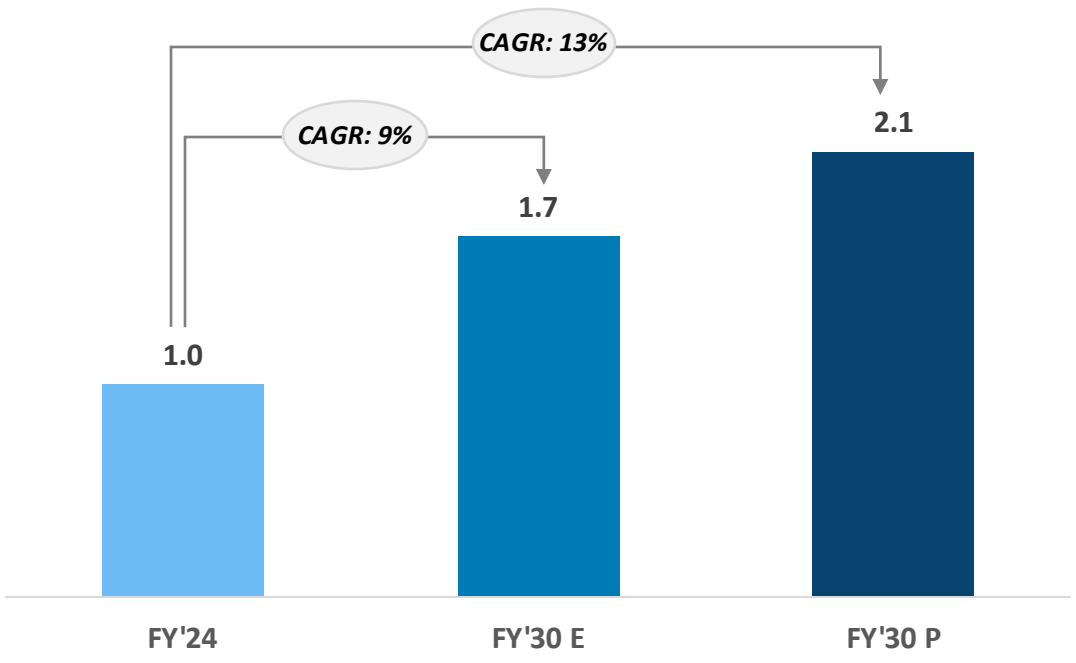
Future & Key Trends

- Future Estimates & Challenges
- Key Government Regulations

Future Estimates Of Battery Waste Recycling

Future Estimates of Battery waste Recycle (in MMTPA)

Volume In Million Metric Tonnes Per Annum (MMTPA)



Future Projection : Is assessed based on government support policies, growth drivers of end-user segments, and upcoming investments

E: Expected | P: Projection

Challenges Hindering the Achievement of Projected Targets

- **Informal Sector Dominance (Lead-Acid) :**
  Over 70% of lead-acid battery recycling happens in the informal sector, using polluting and unsafe methods. This causes 30–40% metal loss, toxic emissions, and discourages formal investments in safe recycling practices.

- **Low Collection Efficiency (Lithium-ion) :**
  Less than 5% of lithium-ion batteries are collected for recycling due to the absence of formal reverse logistics systems,

Source : Feedback Analysis

Key Initiatives (1/2)

Policies to improve local manufacturing/ safe recycling

- **Removal of Customs Duties on Critical Mineral Waste and Scrap (2025):** In February 2025, the Indian government announced the removal of customs duties on waste and scrap of twelve critical minerals, including lithium-ion battery waste to secure the availability of these materials for domestic manufacturing and promote the recycling industry.

Policies promoting the use of recycled materials

- **Mandatory Use of Recycled Materials: 5% in FY'28, increasing to 20% by FY'31 in new batteries**

Policies reducing environmental and public health hazards

- **Ban on landfill disposal (2022 rule)** prevents soil and water contamination from hazardous battery chemicals.
- **Chemical marking exemptions (2025 amendment)** encourage the production of batteries with low cadmium (≤0.002%) and lead (≤0.004%), reducing toxic emissions.

Policies enhancing transparency & digital monitoring

- **QR/barcode labeling (2025 rule)** ensures traceability of batteries and compliance with EPR obligations.
- **Quarterly reporting to CPCB** via an online portal (2025 rule) allows for real-time tracking of waste collection and recycling efforts

Source: Feedback Analysis

Key Initiatives (2/2)

Recycling a sustainable and economically viable alternative to mining driving battery waste recycling growth.

Less Waste, More Materials

- Mining needs **300 tonnes of ore**
- Recycling old batteries needs just **5-15 tonnes**

To get 1 ton of lithium:

- Mining needs **250 tonnes of ore** or **750 tonnes of brine**
- Recycling needs only **28 tonnes of old batteries**

Government plans to mandate battery energy storage for renewable power projects to drive the battery waste recycling.

- The government aims to achieve 500 GW of renewable energy, driving the need for a strong 60 GW energy storage system by FY'30. This will require a larger battery ecosystem, leading to a significant increase in battery waste in the coming decade.

Investments & infrastructure development in Battery waste recycling

- Companies like Exide and Amara Raja are setting up new battery recycling units with a project cost of approximately **INR 9 Bn (~USD 0.11 Bn)**, while existing players like Lohum and Gravita are expanding their capacities.

Source : Feedback Analysis

Plastic Waste Recycling

Introduction

- Introduction to Plastic Waste
- Stakeholders

Overview Of Plastic Waste Industry

Plastics are categorized into two types

Thermoplastics

- Thermoplastics are the plastics which soften on heating and can be molded into desired shape
- They can be recycled and reused

Thermoplastics include:

1 PETE	2 HDPE	3 PVC	4 LDPE	5 PP	6 PS
Polyethylene terephthalate	*High-density polyethylene*	*Polyvinyl chloride*	*Low-density polyethylene*	*Polypropylene*	*Polystyrene*

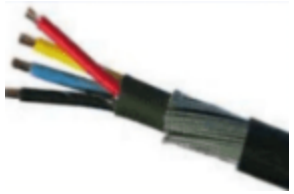
Thermosets

- Thermoset once heated and molded, undergo a chemical change and cannot be remelted or reshaped
- They are rigid, heat-resistant, and non-recyclable.

Thermoset plastics include:

7 Other

Sheet Molding Compounds (SMC), Fiber Reinforced Plastic (FRP), Bakelite, and epoxy resins.



Source: Feedback Analysis

Key Stakeholders

1 Regulatory Bodies

Government bodies responsible for Plastic waste management

- Ministry of Environment, Forest and Climate Change (MoEF&CC)
- Central Pollution Control Board
- State Pollution Control Board
- Urban Local Bodies

- India Plastics Pact

2 Plastic waste generation

Plastic resins manufacturers

Plastic consumers - brands

Waste generators

households, businesses, industries,& institutions

Mismanaged plastic waste (Landfill)

3 Formal & Informal waste collection

Formal/ Municipal waste value chain

Municipal collection

Waste collection centers

Material recovery facilities (MRF)

Rag pickers

Large Aggregators

Informal waste value chain

4 Recycling and Alternate use

Recycling

Recycling of plastic waste by the players

Alternate use

Plastic waste is utilized by industries in applications such as waste to energy, road construction/ lumber making, co-processing in cement kilns etc.

Source: Feedback Analysis

Role Of Stakeholders

1 Regulatory bodies

- **Ministry of Environment, Forest and Climate Change (MoEF&CC):** MoEF&CC sets environmental regulations, including the Plastic Waste Management (PWM) Rules, 2016
- **Central Pollution Control Board (CPCB) –** The CPCB under PWM Rules, 2016, frames standard operating procedure, certifies compostable carry bags/films manufacturers/sellers, regulates plastic waste through disposal guidelines, ensures proper waste processing, and submits an annual report to the Central Government
- **State Pollution Control Board (SPCB)** – The SPCB is responsible for implementing and enforcing the Plastic Waste Management Rules, 2016, monitoring the processing and disposal of plastic waste
- **Urban Local Bodies (ULBs) -** ULB implement plastic waste management rules by ensuring segregation, collection, transportation, processing, and disposal in an environmentally sound manner. They enforce bans, conduct awareness programs, impose penalties, and report to SPCBs

- **India Platic Pact**: India Plastics Pact is a part of a global network of 13 Plastics Pacts and is managed by CII. It brings together businesses, governments, NGOs, and the public to promote plastic waste reduction, recycling, and sustainable packaging

2 Plastic waste generation

- **Plastic Resin Manufacturers:** Companies that produce raw plastic materials in the form of resins
- **Plastic Consumers – Brands:** Businesses that use raw plastic materials to manufacture products and packaging
- **Waste Generators:** Includes households, businesses, industries,& institutions

3 Formal & Informal waste collection

- **Municipal waste collection:** Organized waste collection by local authorities through door-to-door services, bins, and designated collection points
- **Material recovery facility (MRF):** Centers where collected waste is sorted, processed, and sent for recycling and alternate use
- **Rag pickers:** Individuals who collect, sort, and sell recyclable plastic waste from streets, landfills, and bins
- **Large aggregators:** Middlemen who buy plastic waste from rag pickers and small collectors, then supply it for further processing and recycling

4 Recycling & alternate use

- **Recycling:** Players involve in recycling of plastic waste into a useful product
- **Alternate use:** Industries make use of plastic waste for the application such as waste to energy, road construction etc.

Source: Feedback Analysis

Market Overview

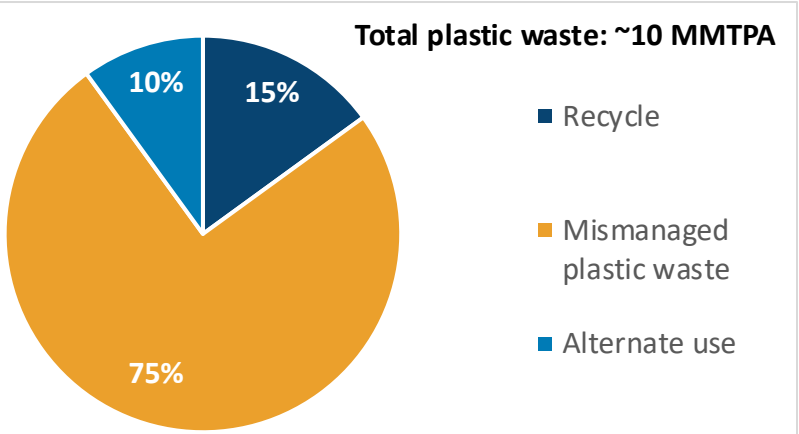
- Market Overview
- Technologies Used in India
- Key Players

Current Scenario Of Plastic Waste Generation In India

Total Plastic waste generation

~10 Million Metric Tonnes Per Annum (MMTPA)

Plastic waste end use



- ***Mismanaged plastic waste*** *includes landfill dumping, street littering, drain clogging, dumpsite disposal, and open burning*
- **Alternate use:** Includes plastic waste used in applications such as waste to energy, road construction/ lumber making, co-processing in cement kilns, and plasma pyrolysis

Source: Feedback analysis

Composition of plastic waste

Plastic waste composition	Usage	% Share	Level of recyclability category
 Polyethylene terephthalate (PET/ PETE)	Water and soft drink bottles, Food jar	9%	Easy
 High-density polyethylene (HDPE)	Milk, Detergent bags, Carry bags, Containers, Personal care bottles	66%	Easy
 Low-density polyethylene (LDPE)	Grocery bags, Wrappings (Dry Cleaning Bags), Squeezable bottles, Bubble foil		Manageable
 Polypropylene (PP)	Containers for takeout meals, Medicine bottles, Bottle caps, Yogurt containers	10%	Manageable
 Polystyrene (PS)	Disposal cups, Cutlery, Packaging foam, Plastic tableware, Compact CD jackets	5%	Difficult
 Polyvinyl chloride (PVC)	Cables, Pipes, Floorings, Medical field (Blood, Urine) bag, Films	4%	Very difficult
 Others	Electronic goods, Reusable water cans, Defence, Gadgets, Fishing nets, ropes	6%	Very difficult

Note: India recycles ~15% of its plastic waste, but some sources report a 60% recycling rate, which may apply only to some valuable plastics. such as PET at 90%. The overall rate of plastic recycling in India is poorly documented

Technology Used For Plastic Waste Recycling

Parameter	Mechanical recycling	Chemical recycling
Definition	Converts plastic waste into reusable granules or flakes without altering its chemical structure	Breaks down plastic waste into monomers, fuels, or base chemicals for high-value reuse
Market share in recycling	99% (Most widely used recycling method in India)	1% (Emerging)
Process	Sorting & segregation → Cleaning & shredding → Thermo-mechanical extrusion (melting and converting into granules)	Sorting & segregation → Cleaning & shredding → Chemical Breakdown (Based on method used)
Application	Granules are used in packaging films, pipes, plastic furniture, textiles, and consumer goods or blended with virgin plastics	Produces food-grade, medical-grade, and automotive-grade plastics, as well as fuels and chemicals
Method	Single screw, twin screw, and blown film extrusion	Pyrolysis (Convert plastic to fuel oils), Depolymerization (Breakdown PET to monomers), Polyolefin Recycling (Produces base materials for new plastics)
Most used method	Single screw extrusion is the most used due to low cost, simple design, and reliability	Pyrolysis is gaining traction as it can process hard-to-recycle plastics, driven by EPR (extended producer responsibility) mandates
Limitation	Cannot process contaminated, multi-layered, PVC, or Type 7 plastics; suffers from down cycling, reducing quality over multiple cycles; high energy and water consumption	High capital & operational costs, lacks scalable technology, and is still least preferred due to economic feasibility challenges

Source: Feedback Analysis

Key Players In Plastic Waste Recycling

Recyclers process plastic waste into reusable materials and offer Extended Producer Responsibility (EPR) services to help businesses meet sustainability and compliance goals

S.no	Company name	Founding year	HQ Location	Collaboration/ Joint venture
1	Ganesha ecosphere ltd.	1987	Kanpur, Uttar Pradesh	Race Eco Chain (51%) and Ganesha Ecosphere (49%) have formed a JV, Ganesha Recycling Chain Pvt. Ltd., to establish PET washing plants across India
2	Pashupati group (pashupati polytex private limited)	2008	Kashipur, Uttrakhand	Pashupati Group partners with Borouge (UAE) to enhance plastic waste collection, sorting, and recycling in India and with SABIC (Saudi Arabia) for advanced recycling to produce certified circular polymers
3	Dalmia polypro industries pvt. Ltd.	2006	Mumbai, Maharashtra	-
4	Srichakra polyplast pvt ltd.	2010	Hyderabad, Telangana	Austria-based Starlinger has collaborated with Srichakra Polyplast to supply two recoSTAR PET 165 iV+ recycling lines for PET bottle-to-bottle recycling in India
5	Banyan sustainable waste management pvt ltd.	2013	Sangareddy, Telangana	-
6	Rungta greentech ltd.	2005	Kolkata, West Bengal	Rungta Eco Extrusions has partnered with NGR GmbH (Austria) to implement cutting-edge recycling technology at its facility to enhances the production of high-quality, food-grade rPET granules
7	The Shakti plastics industries	1969	Mumbai, Maharashtra	LyondellBasell (Netherland) and Shakti Plastic Industries have signed an MoU for a JV to advance mechanical recycling in India, building a fully automated plant to process post-consumer rigid plastic waste

Selection of companies based on the top 5-6 revenue-generating firms from the segment

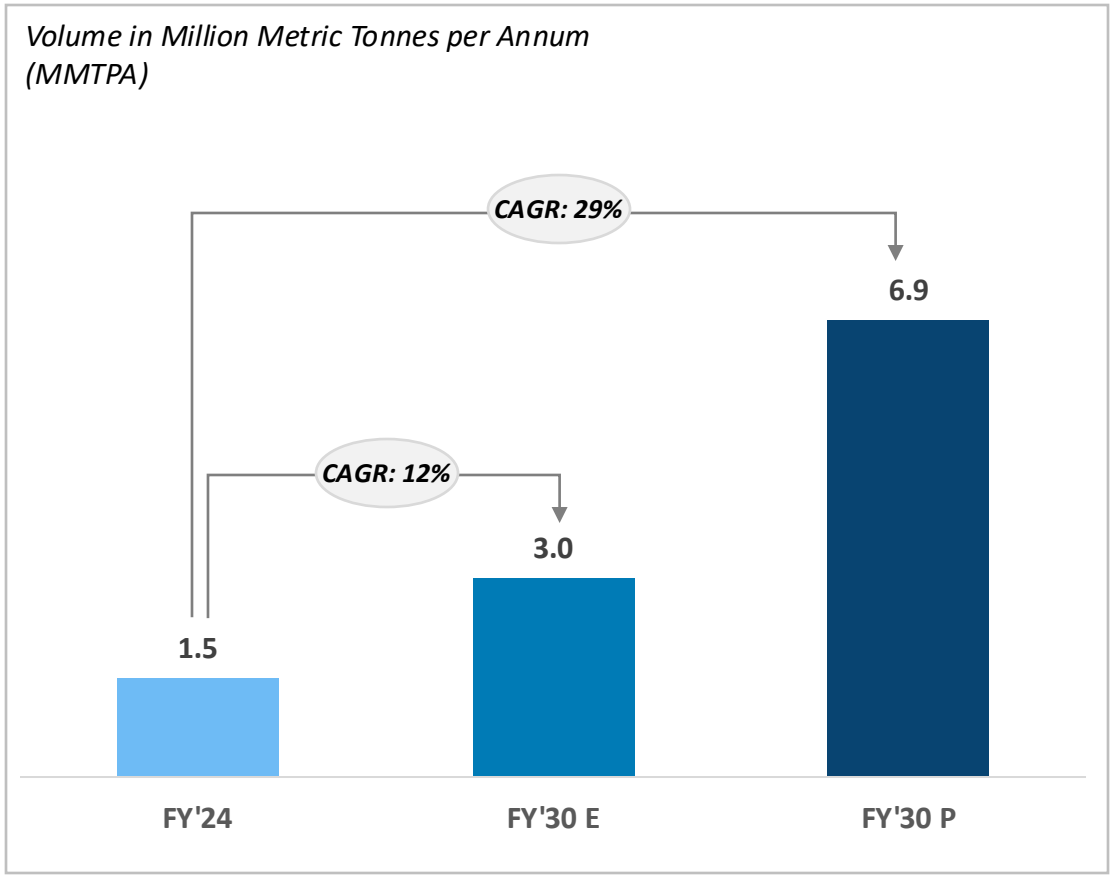
Source: Feedback Analysis

Future & Key Trends

- Future Estimates & Challenges
- Key Government Rules & Initiatives

Future Estimates Of Plastic Waste Recycling

Future estimates of recycled plastic waste (in MMTPA)



E: Expected | P: Projection

Challenges Hindering the Achievement of Projected Targets

- **Fluctuating Oil Prices** -When oil prices drop, virgin plastic becomes 20–40% cheaper than recycled plastic, reducing demand for recyclables and increasing landfill waste.
- **Informal Sector Dependency** -The informal sector handles 42–86% of India's plastic waste. Its unregulated nature causes inefficiencies and hampers traceability in recycling.
- **Poor Segregation at Source** -Only ~10–15% of plastic waste is properly segregated at source. Mixed waste lowers recycle quality and increases processing costs.
- **Inadequate Material Recovery Facilities (MRFs)** -India has fewer than 250 functional MRFs for over 4,700 urban local bodies (ULBs), forcing recyclers to manually sort and process mixed waste.

Source: Feedback Analysis

Plastic Waste Management (PWM) Rules, 2016

These rules apply to manufacturers, importers, brand owners, local bodies, waste processors, retailers, and the general public

Ban on plastic bags & single-use plastics (SUPs)

- The manufacture, sale, distribution, and use of plastic bags below 120 microns is banned across India. Compostable & biodegradable plastic carry bags are including but manufacturers are required to take certification from the CPCB before marketing complying with IS 17088:2008
- Ban on single-use plastics (SUPs), including: Plastic cutlery; Packaging films around invitation cards, cigarette packets, and sweets boxes; Plastic flags, earbuds, balloon sticks, thermocol decorations etc.

Certification, quality standards & labelling

- Plastic used in food, pharmaceutical, and water packaging must follow IS 9833:1981 colorant and pigment safety standards
- Recycled plastics can be used for food packaging but must meet FSSAI standards
- Plastic carry bags must be labeled with recycling status, thickness, and manufacturer details

Waste management & recycling

- Extended Producer Responsibility (EPR): Producers, importers, and brand owners must take responsibility for the entire life cycle of plastic packaging, ensuring collection, recycling, and reuse
- Recycling Standards: Plastic waste must be recycled as per IS 14534:1998.
- Ban on Non-Recyclable Multi-Layered Plastics (MLP): Non-recyclable, non-energy-recoverable MLPs must be phased out

Responsibility of local bodies & businesses

- Urban Local Bodies (ULBs) must ensure proper segregation, collection, processing, and disposal of plastic waste
- Retailers & Vendors can only sell plastic bags and packaging complying with the regulations. Non-compliance leads to fines

Online registration & reporting

- Producers, Importers & Waste Processors must register on the CPCB's online portal for tracking compliance
- Annual Reports must be submitted by manufacturers, brand owners, and processors, detailing the amount of plastic produced, recycled, and managed

Some states and cities have stricter bans on plastic bags and single-use plastics, with variations in thickness limits and penalties

Source: Feedback Analysis, CPCB

Key Initiatives (1/2)

Government policy ensuring accountability in plastic waste management

Extended Producer Responsibility (EPR)

- EPR mandates Producers, Importers, and Brand Owners (PIBOs) to manage post-consumer plastic waste through:
- **Recycling targets:** In FY'25, PIBOs are required to meet 30-50% plastic waste recycling targets across plastic categories, with 100% compliance already mandated for compostable plastics since FY'24. Going forward, by FY'28 the targets will increase to 60-80%
- **Reuse of recycled content in packaging target:** Importers and brand owners must include recycled plastic in new packaging, with targets ranging from 5-30% in FY'26, increasing up to 10 - 60% by FY'29 depending on the packaging type

Non-compliance results in financial penalties,to meet these obligations, companies can partner with authorized recyclers, fund waste collection initiatives or trade EPR certificates

Government policies encouraging use of plastic waste across various industries

- **Road Construction:** The Ministry of Road Transport & Highways mandates the use of plastic waste in bituminous road construction to enhance durability and sustainability
- **Energy Recovery and Industrial Use:** Encouragement for co-processing in cement kilns, waste-to-oil conversion, and energy recovery to minimize landfill waste

Government mission to eliminate plastic waste through awareness program

- **Swachh Bharat Mission 2.0** promotes plastic waste reduction through source segregation, Material Recovery Facility (MRFs), and waste processing in urban areas. It provides financial support for waste management projects and runs awareness campaigns

Source: Feedback Analysis, CPCB, PIB

Key Initiatives (2/2)

Industries commitment to use recycled plastic

- Leading FMCG companies aim to incorporate 25-50% recycled plastic in packaging by FY'25, while the automotive and textile industries are integrating rPET into production

Integration of technologies in plastic waste management

- The government and private sector are improving waste management like collection, segregation with the help of tech-driven solutions like -
  - Mobile apps that connect waste producers to collectors
  - Block chain for tracking recycling compliance
  - AI for better waste sorting, and software for optimizing waste collection routes

Investments & infrastructure development in plastic recycling

- In the last three years, only two private projects, worth INR 2,153 Mn (~USD 23 Mn), have been announced and are currently under implementation

Source: Feedback Analysis

Thank You

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