

**GOVERNMENT OF INDIA
MINISTRY OF SCIENCE AND TECHNOLOGY
DEPARTMENT OF SCIENCE AND TECHNOLOGY
LOK SABHA
UNSTARRED QUESTION NO. 4524
ANSWERED ON 20/08/2025**

TECHNOLOGIES FOR RECYCLING NON-ORGANIC SOLID WASTE

4524. SHRI KESINENI SIVANATH:

SHRI DAGGUMALLA PRASADA RAO:

Will the Minister of SCIENCE AND TECHNOLOGY be pleased to state:

- (a) the details of all technologies developed and currently being developed for the recycling and repurposing of non-organic solid waste, including glass, plastics, e-waste, metals and other materials, along with the entities involved;**
- (b) the details of the funds allocated, released, and disbursed by the Government for these projects and for the research and development of new technologies for recycling and repurposing of non-organic solid waste;**
- (c) the details of the amount of revenue generated so far and the estimated revenue to be generated in future through the commercialization and large-scale adoption of recycled non-organic solid materials;**
- (d) whether the Government has undertaken or plans to undertake pilot projects or demonstration plants to test and validate these recycling technologies; and**
- (e) if so, the details thereof and if not, the reasons therefor?**

ANSWER

**MINISTER OF STATE (INDEPENDENT CHARGE) OF THE
MINISTRY OF SCIENCE AND TECHNOLOGY AND EARTH SCIENCES
(DR. JITENDRA SINGH)**

विज्ञान और प्रौद्योगिकी तथा पृथ्वी विज्ञान मंत्रालय के राज्य मंत्री (स्वतंत्र प्रभार)
(डॉ. जितेंद्र सिंह)

- (a) With support from various departments of Government of India, several advanced technologies have been developed for the recycling and repurposing of non-organic solid waste including glass, plastics, e-waste, metals, and other materials. These technologies aim to promote sustainability, reduce environmental impact, and facilitate the efficient management of waste resources. A detailed list of the developed technologies is provided in Annexure-I.**

(b) to (c): Under the Waste Management Technologies (WMT) programme, the Department of Science and Technology (DST) has supported numerous projects in key focus areas such as e-waste management, plastic waste recycling, processing of industrial hazardous & non-hazardous waste, and utilization of urban and rural solid waste. A total allocation of ₹44.72 crore has been made under this programme, out of which ₹40.09 crore has been released and disbursed to implementing agencies for technology development in the domain of non-organic solid waste management.

Council of Scientific and Industrial Research (CSIR) has allocated ₹71.12 crore to its constituent laboratories for the development of innovative technologies aimed at recycling and repurposing non-organic solid waste.

As part of the Circular Economy Action Plan, the Ministry of Electronics and Information Technology (MeitY) has sanctioned projects worth ₹165.28 crore under a public-private partnership (PPP) model. These initiatives include:

- Establishment of a Centre of Excellence (CoE) on E-waste Management at C-MET, Hyderabad.**
- Development of pilot-scale facilities for processing and recovery of rare earth materials (Neodymium, Praseodymium) from spent magnets, including preparation of Nd, Pr metals, NdFeB alloy, and magnets.**
- Implementation of a project on Informal Sector Capacity Building and Upgradation, including the formation of recycling clusters under the MSME scheme.**

Against the sanctioned outlay, MeitY has released ₹46.06 crore to respective implementing agencies.

In terms of commercialisation, constituent laboratories under CSIR have generated ₹12.72 crore, and MeitY-supported projects have realised ₹16.50 crore in revenue through the deployment and sale of technologies related to the recycling of non-organic solid materials. Many of the developed technologies are currently at the pilot or pre-commercialisation stage.

The technologies for recycling of non-organic solid waste have potential to significantly contribute to the national goals of *Viksit Bharat* and *Atmanirbhar Bharat* by fostering domestic R&D, promoting resource recovery, and enabling sustainable waste management practices.

(d) to (e): Yes, Sir. The Government has supported and continues to support the establishment of pilot-scale demonstration plants to validate and commercialize innovative recycling technologies. Details of some key initiatives are provided below:

- **Thermochemical Conversion of Municipal Solid Waste:** A solar pre-heated pilot plant with a processing capacity of 5 tonnes per day (TPD) has been commissioned at Gati Shakti Vishwavidyalaya (formerly National Rail and Transportation Institute), Vadodara. The plant facilitates the thermochemical conversion of mixed municipal solid waste into high-quality plasto-fuels, suitable for transportation and industrial heating applications.
- **Plastic-to-Fuel Conversion Technology (Vehicle-Mounted):** A mobile, vehicle-mounted pilot-scale demonstration unit has been developed at the Institute of Chemical Technology (ICT), Mumbai. This system processes up to 100 kg/day of plastic waste to produce *Poly Urja Oil*, a potential alternative fuel.
- **Zero-Discharge E-Waste Recovery Plant:** A zero-discharge pilot plant has been commissioned at IIT Madras for processing up to 100 kg of printed circuit boards (PCBs) with funding support from the Department of Science and Technology (DST). The facility enables the recovery of valuable metals such as lead, tin, and copper.
- **Recycling of Lithium Iron Phosphate (LFP) Batteries:** CSIR-National Metallurgical Laboratory (CSIR-NML) has commissioned a pilot plant for the recycling of spent/discarded LFP batteries. The facility focuses on the recovery of critical materials, including lithium, iron, and phosphorus.
- **Plastic Waste to Diesel:** A 1 TPD pilot-scale facility, equipped with essential pre-treatment systems, has been established at CSIR-Indian Institute of Petroleum (CSIR-IIP), Dehradun. The plant is designed for the chemical recycling of plastic waste into diesel fuel.
- **Steel Slag Utilization in Road Construction:** CSIR-Central Road Research Institute (CRRI) is actively supporting both pilot-scale and commercial road construction initiatives using steel slag. This work is being undertaken in collaboration with leading steel industries (TATA Steel, JSW, AMNS India, RINL) and public infrastructure agencies such as NHAI and BRO, with a focus on sustainable infrastructure development.

**ANNEXURE REFERRED TO IN REPLY TO PART (a) OF THE LOK SABHA
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S. No.	Name of Technology	Entity Involved
1	Process for making fly ash-based Geopolymer Concrete using solid form ingredients for construction purposes	CSIR-Advanced Materials and Processes Research Institute (AMPRI), Bhopal
2	Eco-friendly red mud-based X-ray radiation shielding panels	
3	Utilization of Zero Liquid Discharge Plant Residue (ZLDR) for the development of a new class of wall tiles/wall cladding panels	
4	High volume fly ash- Gypsum composite Plaster	CSIR- Central Building Research Institute (CBRI), Roorkee
5	Extraction of SiO_2 from various industrial and domestic waste and conversion to armor grade SiC and Si_3N_4	CSIR-Central Electrochemical Research Institute (CECRI), Karaikudi
6	Extraction of Magnesium Chloride and metal from secondary sources such as Fe-Cr slag and agro waste	
7	Light-weight porous Glass Foam Bricks from building glass waste	CSIR-Central Glass Ceramic Research Institute (CGCRI), Kolkata
8	Waste material utilization technology for road and allied construction using plastics and steel slag as aggregate substitutes	CSIR-Central Road Research Institute (CSIR-CRRI), New Delhi
9	ECOFIX Technology – a ready-to-use pothole repair mix based on iron and steel slag aggregates	
10	Industrial waste utilization technology for embankment construction using Jarofix, Red Mud, Copper Slag, and Phosphogypsum	

S. No.	Name of Technology	Entity Involved
11	Technology for converting polyethylene and polypropylene type waste plastics into fuels and chemicals like gasoline, diesel, toluene and xylene	CSIR-Indian Institute of Petroleum (IIP), Dehradun in collaboration with Gas Authority of India Ltd. (GAIL)
12	Utilisation of aluminium dross for the production of Alum	CSIR-Institute of Minerals and Materials Technology (IMMT), Bhubaneswar
13	Development of a process for recovery of valuable materials from End-of-Life Solar Panel waste	CSIR-National Environmental Engineering Research Institute (CSIR-NEERI), Nagpur
14	Flux bonded flyash technology developed by CSIR-NIIST for making clay tiles and bricks	CSIR-National Institute for Interdisciplinary Science and Technology (NIIST), Thiruvananthapuram
15	Yellow Tungsten Oxide and Tungsten metal powder from heavy alloy scraps	CSIR-National Metallurgical Laboratory (NML), Jamshedpur
16	Ferrite and Pigment grade high purity Monodispersed Iron Oxide from waste Chloride Pickle Liquor and other Iron rich sources	
17	Recovery of Lead from Zinc Plant residue	
18	Recovery of Nickel from Spent Nickel Catalyst	
19	Conversion of hematite fines to magnetite using Compressed Natural Gas (CNG)	
20	Recovery of vanadium as ammonium meta-vanadate and vanadium pentoxide from spent sulfuric acid catalysts	

S. No.	Name of Technology	Entity Involved
21	Hot-stage engineering technology for recovery of Iron from Copper Smelter Slag and utilization of residual slag in blended cement	
22	Pyro-hydrometallurgical Scale-up Technology for Holistic Recycling of Variable-grade Zinc Dross to Recover Zinc Metal and Salts	
23	Waste Derived Self-healing and redox action based advanced anti-corrosion coating materials	CSIR-National Physical Laboratory (NPL), New Delhi
24	Eco-friendly recycling technology for plastics and metallic components from Waste Electrical and Electronic Equipment (WEEE)	CIPET- Bhubaneswar, Odisha
25	Petroleum Pitch-based Anode Technology for High-Temperature Electrolysis	Anna University, Chennai
26	Marble slurry waste utilization technology for Flue Gas Desulfurization and production of Plaster of Paris or Cement	Malviya National Institute of Technology, Jaipur, Rajasthan
27	Production of high purity Copper Oxide nanoparticles from depopulated Printed Circuit Boards (e-waste) using novel Cu-selective ligand grafted polymeric resins, for recycling of e-waste.	Bhabha Atomic Research Centre (BARC), a constituent unit of Department of Atomic energy (DAE)
28	Geopolymer-based precast building product technology using Fly Ash and GGBS	SRM Research Institute SRM University Kattankulathur, Tamil Nadu
29	Zero-discharge pilot plant technology for processing Printed Circuit Boards (PCBs) to recover Lead, Tin, and Copper	IIT-Madras

S. No.	Name of Technology	Entity Involved
30	Black powder utilization technology for manufacturing radiation shielding materials from E-waste recycling	Shriram Institute for Industrial Research, New Delhi
31	Solar pre-heated thermochemical conversion technology for municipal mixed solid waste to produce high-quality plasto-fuels for transportation and industrial heating	Gati Shakti Vishwavidyalaya (Erstwhile National Rail and Transportation Institute), Vadodara
32	ICT-Poly Urja mobile plant technology for converting plastic waste into fuel – Pilot-Scale demonstration	ICT Mumbai
33	Applying mobile Modular solutions to Rejuvenate the Indian landscape by Treating plastic waste. (AMRITA)	Savitribai Phule Pune University, Ganeshkind, Pune
34	Recycled PET and plastic waste-based filament technology for 3D printing and other applications	Canara engineering college, Karnataka
35	Automobile industry grinding waste utilization technology for sustainable construction materials	Rajalakshmi Engineering College, Thandalam, Chennai
36	Assorted aluminium alloy scrap recycling technology for producing 1 TPD aluminium alloy ingots suitable for SMEs	Sri Ramakrishna Engineering College, Coimbatore
37	Industrial waste utilization technology for Dense and Gap-graded Asphalt Mixes as fillers	Indian Institute of Technology (BHU) Varanasi, Uttar Pradesh
38	Sustainable Green Technology for recovery of rare earths from Phosphor materials of electronic display and lighting products	CSIR-IICT, Hyderabad
