

RESEARCH AND DEVELOPMENT

11

CHAPTER



Research and Development

11.1 Status of Research Projects under S&T Grant of Ministry of Coal

The Research & Development (R&D) activities in the Coal sector are administered through an apex body namely, Standing Scientific Research Committee (SSRC) with the Secretary (Coal) as its Chairman. The other members of this apex body include Chairman, Coal India Limited (CIL), Chairman cum Managing Directors (CMDs) of Central Mine Planning and Design Institute (CMPDI), Singareni Collieries Company Limited (SCCL) and NLC India Limited (NLCIL), Director General (DG) of Directorate General of Mines Safety (DGMS), Directors of concerned CSIR Laboratories, Representatives from Department of S&T (DST), NITI Aayog and Research Institutions, Chairman of Technical Sub-committee, etc. The main functions of SSRC are to plan, programme, budget and oversee the implementation of research projects. The SSRC is assisted by a Technical Sub-Committee headed by the Head of Department (HoD) (Mining) of IIT- KGP/BHU/ISM on annual rotation basis.

The R&D projects are broadly covered under 7 thematic areas, viz. Advanced technology / methodology for improvement of production & productivity, Improvement of safety, Health and environment, Waste to wealth, Alternative use of coal and clean coal technology, Coal beneficiation

and utilization, Exploration, Innovation and indigenization (Under the Make-in-India concept).

CMPDI acts as the Nodal Agency for co-ordinating research activities in the coal sector. This involves identifying 'Thrust Areas' for research activities, identifying agencies that can undertake research work in the identified fields, processing the proposals for Government approval, preparing budget estimates, disbursing fund, monitoring the progress of implementation of the projects, etc.

11.1.1 Physical performance -

The status of Coal S&T projects during 2025-26 (till 01.12.2025) are as under:

Sl. No.	Parameters	Number
1	Projects ongoing as on 01.04.2025	19
2	Projects completed during 2025-26 (till 01.12.2025)	3
3	Projects approved by SSRC during 2025-26 (till 01.12.2025)	5
4	Projects ongoing as on 01.12.2025	21

11.1.2 Financial status -

Budget provisions vis-à-vis actual fund disbursement during the period are given below:

(in ₹Crore)

2023-24				2024-25				2025-26			
BE	RE	Fund from MoC	Actual	BE	RE	Fund from MoC	Actual	BE	RE	Fund from MoC	Actual (Prov.)
(till 01.12.2025)											
21.0	18.0	18.0	18.0	21.0	20.0	20.0	20.0	30.0	20.0	9.45	9.45

11.1.3 Following S&T projects were approved during 2025-26 (till 01.12.2025) -

- a) Coal to Chemical Sensors: Conversion of low-grade coal to carbon dots-based smart sensing strips for onsite monitoring of heavy metals in water bodies around the coalfields.
Implementing agencies: NIT Srinagar; NIT, Jamshedpur and BCCL Dhanbad.
- b) Development of Value-Added Abrasion Resistant Ceramic Tiles and Insulation Refractories using Coal Mine Overburden
Implementing agencies: Government College of Engineering and Ceramic Technology (GCECT), Kolkata; SCCL, Kothagudem and ECL, Sanctoria
- c) CO₂ Methanation over Green Bifunctional Metallic Catalyst to maximize the CH₄ production with stability.
Implementing agencies: SRM-IST, Ghaziabad, and CIMFR, Dhanbad
- d) An AI Enabled Platform for Diagnosis, Prognosis and Health Management of Mining Electrical Systems: A Case Study on the Dragline.
Implementing agencies: IIT, Kharagpur and NCL, Singrauli.
- e) Design and development of low cost indigenous imaging RADAR system for automatic slope monitoring and failure prediction in opencast coal mines
Implementing agencies: NIT, Rourkela; CMPDI, Ranchi; IIT, Kharagpur; VIT, Vellore and MCL, Sambalpur.

11.1.4 Following S&T projects were completed during 2025-26 (till 01.12.2025) -

- a) Assessing the Abiotic and Biotic Factors in Pit Lakes for Sustainable Management of Water and Environment.
Implementing agencies: BIT, Mesra, CMPDI, Ranchi, CCL, Ranchi and MCL, Sambalpur

- b) Indigenous Development of NIR spectroscope for instant prediction of Coal Quality Parameters.

Implementing agencies: Shri Ramdeobaba College of Engineering & Management (RCOEM), Nagpur; CIMFR, Nagpur and SCCL, Kothagudem.

- c) Development of Synthetic Lightweight Aggregates as Backfilling Material using Hydraulic Stowing Method

Implementing agencies: IIT (ISM), Dhanbad

11.2 Status of Research Projects under the R&D Fund of Coal India Limited -

An R&D board headed by the chairman, CIL also functions for CIL's in-house R&D work. CMPDI acts as the nodal agency for processing proposals for CIL approval, preparing budget estimates, disbursing funds, monitoring the progress of project implementation, etc.

To enhance the R&D base in command areas of CIL, the CIL Board in its meeting held on 24th March 2008 had delegated substantial powers to the CIL, R&D Board and the Apex Committee of the R&D Board. The Apex Committee is empowered to sanction individual R&D projects up to ₹5.0 Crore value with a limit of ₹25.0 Crore per annum considering all the projects together, whereas the CIL, R&D Board is empowered to sanction individual R&D projects up to ₹50.0 Crore.

11.2.1 Physical performance -

The status of CIL, R&D Projects during 2025-26 (till 01.12.2025) are as under:

Sl. No.	Parameters	Number
1	Projects ongoing as on 01.04.2025	18
2	Projects approved during 2025-26 (till 01.12.2025)	07
3	Projects completed during 2025-26 (till 01.12.2025)	06
4	Projects on-going as on 01.12.2025	19

11.2.2 Financial status -

Budget provisions vis-à-vis actual fund disbursement during the period are given below:

(in ₹ Crore)

2023-24		2024-25		2025-26	
RE	Actual	BE	Actual	BE	Actual (till 01.12.2025)
70.00	43.21	166.75	245.39	250	24.86

11.2.3 Following R&D projects were approved during 2025-26 (till 01.12.2025):

a) Carbon electrode based indigenous low-cost perovskite solar cells development.

Implementing agencies: IIT, Roorkee and NaCCER, CMPDI, Ranchi

b) Development of an Indigenous Optical Fiber Based Instrument for Measuring In-The-Hole Velocity of Detonation (VOD) and Analyze the Performance of Explosives & Accessories in Field Condition (Phase-II, TRL 5 to 8/9)

Implementing agencies: NaCCER, CMPDI, Ranchi; Blasting Division, CMPDI, Ranchi and Regional Institute - VI, CMPDI, Singrauli.

c) Indigenous Development of IoT-Enabled Technology for Monitoring, Analysis and Interpretation of Longwall Shield Pressures for Improving Safety and Productivity (Phase-II, TRL 5 to 8).

Implementing agencies: NaCCER, CMPDI, Ranchi; IIT, Kharagpur, and ECL Sanctoria.

d) Automation, Control & Wireless Communication in Underground Mines on 4G LTE/5G ready Communication Network in Jhanjhra Mines, ECL.

Implementing agencies: ITI, Lucknow; NaCCER, CMPDI, Ranchi, and ME Dept., CMPDI, Ranchi.

e) A Pilot Project on Underground Coal Gasification (UCG) to establish technology in Indian geo-mining conditions (Phase-2).

Implementing agencies: Clean Energy Dept., CMPDI, Ranchi; M/s Ergo Exergy Technologies Inc. (EETI), Canada and ECL, Sanctoria.

f) Sustainable Solutions for Removal of Fluoride from Groundwater in Mining Area of Coal India Ltd. in Jharkhand, Odisha and West Bengal for Safe Drinking Water. (Phase-1).

Implementing agencies: CSIR, Bhubaneswar; Reseapro Labs Pvt. Ltd., Bhubaneswar; RI-VII, CMPDI, Bhubaneshwar and RI-III, CMPDI Ranchi.

g) Non Invasive Health Screening and Smart Monitoring Systems for Coal Miners' Safety and well-being.

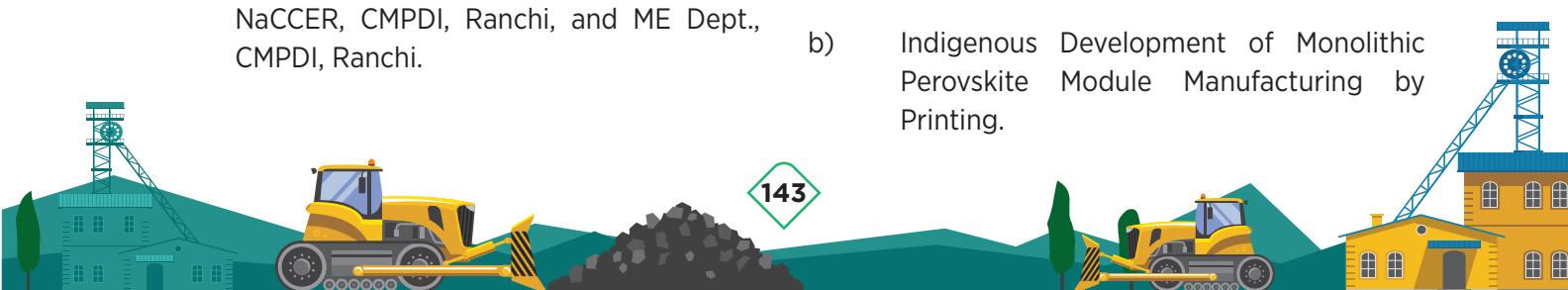
Implementing agencies: IEST, Shibpur & ECL, Sanctoria.

11.2.4 Following R&D projects were completed during 2025-26 (till 01.12.2025):

a) Real-time energy efficient cyber-physical intelligent system for mine slope health monitoring.

Implementing agencies: IIT-ISM, Dhanbad; CMPDI, Ranchi & ECL, Sanctoria.

b) Indigenous Development of Monolithic Perovskite Module Manufacturing by Printing.



Implementing agencies: IIT, Bombay; CIL, Kolkata and Mine Electronics Division, CMPDI, Ranchi

c) A Pilot Project on Underground Coal Gasification (UCG) to establish the technology in Indian geo-mining conditions-(Phase-1)

Implementing agencies: Clean Energy Dept., CMPDI, Ranchi; M/s Ergo Exergy Technologies Inc. (EETI), Canada and ECL, Sanctoria.

d) Development of guidelines for delineation of water-stressed areas and designing of environmental friendly water storage structure for meeting the water needs in mining areas.

Implementing agencies: IIT-ISM, Dhanbad and CCL, Ranchi.

e) Upgradation of high ash Indian coal through physical and chemical beneficiation.

Implementing agencies: IIT, Kharagpur; CMP Division, CMPDI, Ranchi; MCL, Sambalpur; BCCL, Dhanbad and CCL, Ranchi.

f) Development of guideline for prevention & mitigation of explosion hazard by risk assessment and determination of explosibility of Indian coal incorporating risk based mine emergency evacuation and re-entry protocol.

Implementing agencies: CIMFR, Dhanbad; IIT-ISM, Dhanbad; S&R Division, CIL (HQ), Kolkata and SIMTARS, Australia.

11.3 New Policies/Initiatives/Activities undertaken during the Year 2025-26 -

11.3.1 Hackathon on R&D 2025 -

As per the directives of MoC, CMPDI organized a “Hackathon on R&D” in the following (6) problem statements to harness a vital natural resource to meet the energy and chemical needs of the nation, fostering economic independence and environmental sustainability:

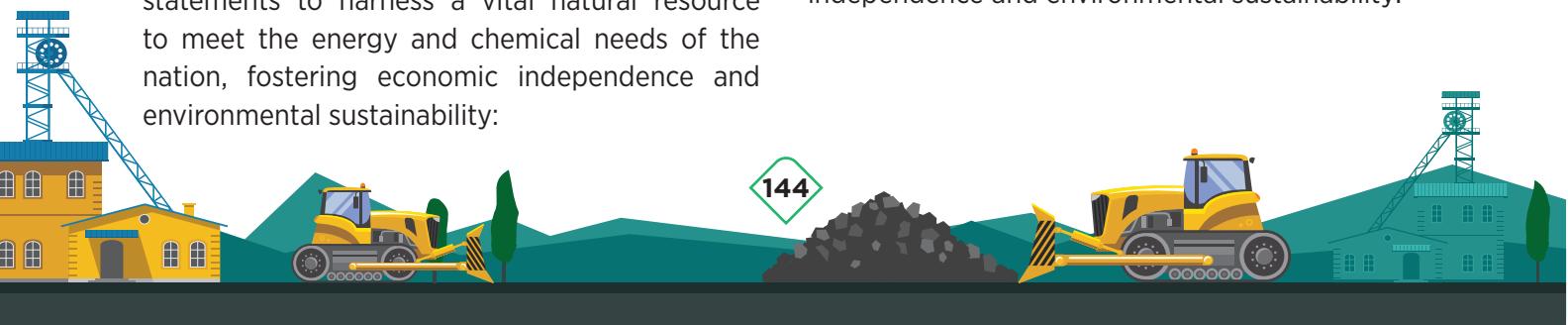
1. Application or Development of methodology/instruments for advance prediction of minor faults (especially 2m-5m), dykes, sills, and local water bodies etc. which are present 350m ahead of the UG mine panel face development.
2. Indigenous Development of Low cost Multi-gas Detector for underground coal mining for continuous monitoring.
3. Indigenous development of Intelligent Monitoring and Control System for Ventilation and Fire Management System in Underground Coal Mines.
4. Development of Exploration Methodology for unexplored lower coal seams in multi-seam working coal mines.
5. Dry Coal Beneficiation: Addressing Efficiency, Scalability, and Adaptability Challenges for Indian Coal.
6. Indigenous Development of Suitable Paste-fill Material for use in Underground (UG) and Highwall Mining.

The hackathon invited scalable solutions, poised for demonstration or commercial replication within the intricate tapestry of coal companies. It also provided opportunities to start-ups, research Organisations, academic institutes, etc. to innovate in the field of coal gasification.

The top 3 participants of each problem statement were declared Winners and they were felicitated on 04.09.2025 by the Hon'ble Minister of Coal and Mines.

11.3.2 Hackathon on Carbon Capture Technology -

As per the directives of MoC, CMPDI organized a “Hackathon on Carbon Capture Technology” in the following (3) problem statements to harness a vital natural resource to meet the energy and chemical needs of the nation, fostering economic independence and environmental sustainability:



1. Direct Air Capture (DAC) of GHG
2. Geological storage of captured CO₂ in the coal bearing regions of India.
3. Development of carbon capture-based

biofuel utilizing algae cultured in the mine pit lakes.

The top 3 participants of each problem statement were declared Winners and they were felicitated on 04.09.2025 by the Hon'ble Minister of Coal and Mines.



Hon'ble Minister of Coal and Mines, felicitated the winners of 'Hackathon on R&D' and 'Hackathon on Carbon Capture Technology' organised by CMPDI on 4.09.2025