R&D COMPONENT UNDER THE PROPOSED STUDY

Ministry of Coal - India
Executive Summary

This document outlines the comprehensive Research & Development (R&D) component framework for proposed studies and initiatives within the coal sector under the Ministry of Coal, Government of India. It details the R&D objectives, methodologies, implementation strategies, resource allocation, and expected outcomes for advancing coal mining, processing, environmental management, and clean energy technologies.

1. R&D Vision & Strategic Objectives
   1.1 Long-Term R&D Vision

Vision Statement:
To develop and deploy advanced, sustainable, and cost-effective technologies that enhance coal sector productivity, improve occupational safety, reduce environmental impact, and position India as a global leader in innovative coal technology and green coal initiatives.
1.2 Primary R&D Objectives

Strategic Goals:

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Enhanced Mining Efficiency

    Increase productivity by 20% through automation and digitization

    Reduce extraction costs by 15% through process optimization

    Develop advanced mining techniques for challenging geological
conditions

Safety & Occupational Health

    Achieve zero-accident operations in 50+ major mines by 2027

    Reduce occupational health hazards by 40%

    Develop real-time safety monitoring systems for all operations

Environmental Sustainability

    Achieve carbon-neutral operations by 2030
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Reduce greenhouse gas emissions by 35%

Develop advanced environmental remediation technologies

Restore 10,000+ hectares of mining areas annually

Clean Coal Technology

Develop advanced coal beneficiation processes

Reduce ash content by 10-15%

Improve thermal efficiency of power plants to 45%+

Circular Economy Integration

Convert 95% of coal waste into value-added products

Develop marketable by-products from coal residues

Create new revenue streams from waste materials

Green Energy Transition

Develop coal-based green hydrogen production

Integrate renewable energy with coal operations

Create hybrid energy solutions

2. R&D Focus Areas & Components

2.1 Advanced Mining Technology

Research Components:

A. Automation & Robotics

Objectives: Automate 200+ mines by 2030

Focus Areas:

Autonomous drilling and blasting systems

Robotic mine inspection and exploration

Automated hauling and material transport

Unmanned vehicle technology development

Expected Outcomes:

30% increase in mining productivity

50% reduction in manual labor risks

₹5,000 Crores cost savings annually

Timeline: 2025-2028
Budget Allocation: ₹2,500 Crores
B. Geotechnical & Geological Modeling

Objectives: Develop AI-powered geological mapping

Focus Areas:

3D geological modeling with AI/ML

Advanced seismic surveying techniques

Real-time resource estimation

Predictive geology for mining planning

Underground mapping for deep mines

Expected Outcomes:

25% improvement in reserve estimation accuracy

20% reduction in mine planning time

Better targeting of high-quality coal seams

Timeline: 2025-2027
Budget Allocation: ₹1,800 Crores
C. Deep Mine Technology

Objectives: Develop technologies for deep shaft mining (500m+)

Focus Areas:

- Advanced ventilation systems for deep mines
- Deep shaft drilling technologies
- Ground support innovations
- Thermal management systems
- Emergency evacuation systems

Expected Outcomes:

Access to 50+ new deep coal seams

Sustainable deep mining operations

100+ MTPA additional capacity from deep mines

Timeline: 2025-2029
Budget Allocation: ₹3,200 Crores
D. Real-Time Mine Monitoring

Objectives: Implement IoT-based monitoring in all major mines

Focus Areas:

- Sensor networks for production tracking
- Real-time equipment diagnostics
- Safety parameter monitoring
- Environmental impact tracking
- Predictive maintenance systems

Expected Outcomes:

Real-time data from 300+ mines

35% reduction in equipment downtime

Improved safety incident prevention

40% reduction in maintenance costs

Timeline: 2025-202

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Budget Allocation: ₹2,200 Crores

2.2 Coal Processing & Beneficiation

Research Components:

A. Advanced Washery Technology

Objectives: Develop next-generation coal washing systems

Focus Areas:

- Tertiary and quaternary washery design
- Dry coal cleaning technologies
- Advanced separation techniques
- AI-optimized process control
- Water recycling and zero-discharge systems