

Report on

Study on Carbon Sequestration Status Including Carbon Emissions from Coal Mining in Cluster-III, Govindpur Area, BCCL

Submitted to:

CLUSTER-III, GOVINDPUR AREA, BCCL

Submitted by:

BISWAJIT SAMANTA
TAPAS BANDYOPADHYAY
DEBASHISH CHAKRAVARTY


Associate Professor
Department of Mining Engineering
I.I.T. Kharagpur - 721302, India

(Dr. D Chakravarty)


Associate Professor
Department of Mining Engineering
I.I.T. Kharagpur - 721302, India

(Dr. B Samanta)



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Disclaimer

It is appropriate to mention here that neither the day-to-day mining operations would be under the control of the authors of this report, nor it is possible to have any such control on the execution of the recommendations mentioned in this report. This report merely contains scientific analysis of some of the data and facts provided to the study team by the mine officials related to carbon dioxide sequestration and carbon emissions. Due to the dearth of data, some essential factors are assumed for this report. However, under the process of this study and preparation of the final report everything essential has been attempted to be considered and investigated based on their availability to the study team. The mine authorities have also been part of the final scrutiny of the results and interpretations. It is only after obtaining the acceptance from the mine authorities that the current report is being submitted. Calculation has been carried out with reasonable efforts and realistic assumptions wherever felt necessary. However, the authors and their organization is not anyway liable for any UN-intentional error in calculation and or analysis. The study team is willing to mention that the summary and suggestive methods drawn are purely based on the current scenario and the existing conditions which would definitely change in future as the activities progress. Thus the mining authorities need to get the similar scientific studies conducted in a regular manner for better understanding of the situations.



1.0 Introduction

Climate and environmental changes are becoming challenges day-by-day. Increase of greenhouse gases with toxic emissions including those due to anthropogenic activities, are among the major sources of environmental changes [1, 2, 3]. Although small amount of greenhouse gases is necessary for the formation and preservation of the life but increase in amount leads to violation of the ecological balance, both at the regional and global levels [1, 2, 3]. The greenhouse gas emissions directly or indirectly from human activity is commonly referred to as the carbon footprint [1, 2, 3], which is expressed in the carbon dioxide equivalent (CO₂e). It is considered to be the equivalent of carbon dioxide by multiplying the mass of a specific greenhouse gas by its global warming potential [3, 4]. Although different countries (Great Britain, the USA, France, etc.) and different international organizations (the UN, the World Resources Institute, the International Organization for Standardization, the World Bank, etc.) have different approaches to calculating the carbon footprint [3, 5, 6], but the goal is the same - to reduce the negative impacts of greenhouse gases.

Climate change has many health consequences for people around the world. There are three ways in which climate change affects human health. These are changes in weather conditions (heat, drought, heavy rains, etc.); the spread of diseases (vector-borne, water, and food); and social unrest (hunger, inequality, conflicts, etc.) [3, 7]. Thus, the increase in GHG emissions is considered as the cause of infectious and non-communicable diseases, negative consequences for nutrition, water security, and other social upheavals [3, 8].

In spite of the recent trend of a transition to “clean” energy, the coal industry still plays a significant role in the global energy and economy. The constant need for raw materials and energy for production leads to an environmental challenge - an increase in the content of greenhouse gases in the atmosphere. The extraction and use of coal are some of the main sources associated to this adventure.

The goal of this study is to analyze carbon footprint from the CLUSTER III mines of the BCCL and to provide suggestions on the ways to reduce the negative impacts of carbon footprint of the environment.



Electric power production organization and transport sector are the major sources of GHG emissions (like, sulphur dioxide, nitrous oxide, methane, sulphur hexafluoride, hydrofluorocarbons, perfluorocarbons, etc.). It has also been observed that deforestation and other changes in land use led to the release of carbon dioxide and methane into the atmosphere [3, 9].

Additionally, coal mines are also one of the largest sources of anthropogenic methane emissions [3, 10]. Coal mining releases methane trapped in the coal and surrounding formations.

The changes in global emissions are mainly caused by changes in the extraction and use of coal, while the growth in the use of oil and gas has not weakened since 1980 after the oil crises of the 1970s. Coal mining, processing enterprises, and the use of coal as fuel are among the sources of greenhouse gases that simultaneously pollute the environment with coal dust, emit toxic elements into groundwater, etc. [3, 10, 11].

Many analysts suggest that the use of coal may have reached its peak. The decline in the use of coal in the countries of the Organization for Economic Cooperation and Development (OECD) has decreased by 25% over the past decade. During the decade, a complete abandonment of fossil fuels, including hydrocarbons, as an energy source is unlikely, but the trend toward decarbonization is relevant and will continue, changing the economic structures of countries [3, 11].

In addition to the transition to renewable energy sources, in order to reduce the negative impact of coal mining enterprises on the environment and preserve the health of the local population, the following measures are relevant: efficient coal mining, intelligent mine construction, the development and modernization of key technologies and equipment for efficient coal processing, underground gasification, intelligent and flexible coal-based electricity generation technology, electricity production technology based on a new energy cycle, the development of special coal-based fuels, bulk and special coal-based chemicals, energy conservation and a reduction in consumption, large-scale and inexpensive carbon capture, and the utilization and storage of CO₂ [3, 11].

Mitigating measures for reducing greenhouse gas emissions initiated long back at the end of 20th century. For example, the Protocol on Greenhouse Gas Emissions (Kyoto Protocol) entered into force around 2005 with an aim of stabilizing the concentration of greenhouse gases (GHG)



through a quota-based protocol for GHG emissions [3, 12, 13]. The Paris Agreement of 2015 provided a new mechanism for international climate management after 2020 and set a goal to control the increase in the global temperature by no more than 2°C and strive to ensure that it does not exceed 1.5°C in order to protect the ecological safety of the Earth.

This study is aimed at assessing the current state of the cluster III mines, studying the degree of the environmental impact of coal mining enterprises through the carbon footprint, and considering possible ways to reduce the negative consequences arising from the extraction and use of coal.

2.0 Objectives

The objectives have been summarized as follows:

- (i) To determine and calculate CO₂ release from mining activities in Cluster III, Govindpur Area
- (ii) To estimate CO₂ mitigation measure through plantation drive
- (iii) To suggest suitable measures / steps to achieve net zero CO₂ emission

3.0 Scope of work

The following five becomes the scope for the present study:

- i. **Quantification of Carbon Emissions:** Estimation of carbon emissions from coal mining operations based on Direct Emissions from Coal Mining and Processing including transportation of coal. Indirect Emissions from Purchased Electricity for mining operations.
- ii. **Current Carbon Sequestration Estimation:** (a) Evaluation of the existing carbon sequestration activities undertaken by BCCL, including afforestation, land reclamation, and soil carbon enhancement. (b) Quantification of CO₂: absorbed through plantation programs based on species type, age, and density. (c) Assessment of carbon storage in rehabilitated mine-overburden dumps and reclaimed lands.
- iii. **Carbon Sequestration Potential Enhancement:** (a) identification of additional carbon sequestration techniques such as expanded afforestation, biochar application, and carbon capture and storage (CCS). (b) Potential for increasing sequestration through improved plantation models, agroforestry, and soil carbon enhancement practices.



- iv. **Compliance with International and National Standards:** Carbon accounting methodology aligned with ISO 14064-1:2018 (Greenhouse Gases Quantification and Reporting of GHG Emissions and Removals at the Organizational Level).
- v. **Policy and Strategic Recommendations:** Development of a carbon-neutral roadmap for coal mining operations in Cluster-III., BCCL.

4.0 Description of the mine

The CLUSTER III is in the westernmost part of the Jharia coalfield. It includes Jogidih Colliery, Maheshpur Colliery, South Govindpur Colliery, Teturiya Colliery, Govindpur Colliery, New Akasshkinaree Mine and Block IV Kooridih Mixed Mine as per E. C. No. J-11015/213/2010-IA. II(M) dated 06.02.2013 and later all seven mines are amalgamated to a single mine Named Cluster III with OC cum UG with Highway Mining method with no change in lease area and production capacity. The cluster - III is situated about 40 - 45 kms from Dhanbad Railway Station. The mines of this cluster - III are operating since pre nationalization period (prior to 1972-73). It is connected by both Railway and Road. The drainage of the area is governed by Khudia and Bagdighi Nala. The Project has Environmental Clearance from Ministry of Environment, Forest and Climate Change (MoEF&CC) for a rated capacity of 2.769 MTPA (normative) and 3.6 MTPA peak capacity of coal production vide letter No E. C. No. J-11015/213/2010-IA. II(M) dated 06.02.2013 later with E. C. No. J-11015/213/2010-IA. II(M) dated 03.03.2025.

5.0 Background approaches

5.1 Carbon emissions

The main sources of CO₂ emissions from coal mining include energy use, GHG emissions, spontaneous combustion of coal, waste rock and stock yard. Many gases formed as a result of combustion are formed during conventional coal mining, but the concentrations of these gases vary depending on environmental changes, so there is no unified approach to assessing greenhouse gas emissions during coal oxidation.



Other sources of CO₂ emissions also include drainage systems, ventilation systems, staff energy consumption per day, office space consumption, transport systems, etc. In open-pit coal mining, the following stages at which carbon dioxide emissions are generated must be taken into account: use of materials (concrete, steel, etc.), as well as appropriate machines (road builder, excavator, etc.). It is necessary to take into account the processes of crushing, loading, transporting, fixing the roof, and processing coal on site. All processes generate a large amount of carbon dioxide.

The use of machinery, explosive and blasting are the main sources of carbon emissions considered for the mine. Spray-type pumping stations that consume electricity are widely used in the face to reduce the amount of dust; they produce GHG emissions.

Types of carbon emissions

Understanding the different types of carbon emissions is essential for developing effective measurement and mitigation strategies. Carbon emissions largely impact climate change, environmental health, and regulatory compliance. By recognizing the two primary categories—direct and indirect emissions—one can better assess the contributions to global warming. The following sections will delve into each type, highlighting the distinctions, implications, and their relevance in carbon accounting.

Direct Emissions

Direct emissions refer to greenhouse gases released from sources owned or controlled by an entity. This includes emissions from fossil fuels, combustion in vehicles, heating systems, and production operations in mining. Measuring these emissions is relatively straightforward. Organizations can directly tally the amount of fuel used and the corresponding emissions produced. Key considerations for direct emissions include:

Source Identification: Companies must identify specific operations contributing to emissions.

Measurement Accuracy: Reliable data collection methods are required to ensure that calculations reflect actual emissions.

Regulatory Compliance: Organizations must adhere to local and international regulations governing emissions reporting.



Direct emissions are critical in determining an entity's overall carbon footprint. As such, they are often the initial focus for environmental initiatives aimed at reducing impact. By reducing direct emissions, organizations can make significant strides in achieving their sustainability goals.

Indirect Emissions

Indirect emissions arise from the generation of purchased electricity, steam, heating, and cooling consumed by an entity. Unlike direct emissions, these emissions occur at facilities not owned or controlled by the entity. They reflect energy usage rather than the immediate control of emissions sources. They often represent a significant portion of an organization's total carbon footprint. Addressing indirect emissions is crucial for a comprehensive climate strategy. It reflects the entire lifecycle of a product, from production to disposal. Different measurement techniques are used to assess carbon emissions. Understanding these techniques are crucial in managing, monitoring and assessing emission level. Proper analysis and interpretation of collected data would help in policy development measures. By employing precise measurement methods, stakeholders can better assess their carbon footprints and the resulting implications on sustainability efforts. The accuracy of these methodologies, as mentioned below, helps to ensure that resources are allocated effectively, thus maximizing the impact of any initiated solutions.

Top-down Approaches

Top-down approaches for measuring carbon emissions primarily involve aggregated data collection. This technique uses national or sector-wide statistics to estimate emissions. The process often relies on existing government databases and broad economic indicators. For instance, a country might analyze its total energy consumption to estimate the resulting greenhouse gas emissions. One of the main benefits of top-down methodologies is their efficiency. They can provide quick estimates without needing specific data from every individual source. However, this method has drawbacks. It may overlook localized emission sources, leading to significant discrepancies in understanding actual emissions.

Bottom-up Approaches

Bottom-up approaches, conversely, focus on more granular data collection. These methodologies gather specific data from individual sources, like factories or businesses, to



create a more detailed picture of emissions. For example, a corporation may track its energy usage and waste processes closely to calculate its total emissions. The precision of bottom-up approaches means they often yield more accurate emissions estimates. However, they can be resource-intensive and time-consuming. Businesses may need to invest in robust data collection systems to compile and analyze this detailed information.

Hybrid Approaches

Hybrid approaches combine aspects of both top-down and bottom-up methodologies. This integration allows for comprehensive data collection and representation of emissions across various scales. For instance, national-level estimates might be adjusted based on sector-specific data to fine-tune accuracy. Hybrid methodologies aim to leverage the strengths of both techniques, offering a more balanced view of emissions. They not only increase reliability but also promote better policy formulation. Nevertheless, implementing hybrid approaches can be complex, as they require coordination between various agencies and stakeholders. Nonetheless, the potential for a more informed understanding of carbon emissions makes this approach valuable in the fight against climate change.

5.2 Carbon sequestration potential

According to reported literature [14], about 11.5 % of the global terrestrial area is affected by mining activities. Ecologically damaged mining areas are usually featured by soil depletion and low organic carbon content, and ecological restoration may help improve carbon sequestration potential in these regions. Vegetation restoration is considered to be an effective method to increase the organic matter input to soils and promote the soil carbon sequestration. Mining activities can also induce a series of problems, such as enrichment of toxic elements, soil acidification, and groundwater disturbances, which further restrict the vegetation growth at the mining sites. For example, tailings and waste land which are rich in heavy metals concentration are in general, deficient in essential nutrients for vegetation growth. Therefore, tailings and waste land is highly unsuitable for seed germination and plant growth. Notably, dynamic response of SOC varies with the vegetation restoration type, which might have a direct influence on the litter mass. Usually, the litter mass of herbaceous plants is higher than that of ligneous plants. According to some studies, the SOC reserve may increase, decrease, or remain



constant after afforestation, depending on the forest age, climate, soil type, and many other factors. Researchers [14] found that compared with ligneous plants, herbaceous plants exhibit a higher efficiency in accumulating the SOC and nutrients during vegetation restoration in mining areas, which may be explained by the higher biomass decomposition rate of herbaceous plants. Other researchers had shown that the type of vegetation was a primarily reason affecting the changes in the soil carbon and its dynamics, as it influences the physical and chemical protections offered by soil aggregates for organic matters. Studies on soil and vegetation development at the early stage of vegetation succession during ecological restoration in mining areas indicated that the soil carbon content decreases significantly under the restoration of ligneous vegetation. It is also clear that vegetation restoration in degraded mining areas takes considerable time. However, the nutrient cycling and ecosystem carbon sequestration mediated by plant-soil interactions may not overlap in spatial and temporal orders. For this reason, the timing of introducing different forest stands, number of years of vegetation restoration, and plant combination can have a dramatic impact on carbon sequestration potential in mining areas.

5.3 National and international standard

5.3.1 National guidelines

In line with India's Panchamrit & Nationally Determined Contribution (NDC) commitments, Ministry of Coal is promoting sustainable coal mining and reduction in carbon footprint by encouraging the following as presented below in verbatim.

1. Greening Initiatives—Bio-Reclamation/Plantation: The Coal/Lignite PSUs have been constantly making efforts to minimize the footprints of coal mining through sustained reclamation and afforestation of areas in and around their operating mines.
2. Energy Efficiency Measures: Coal/Lignite PSUs have been taking various energy conservation and efficiency measures over the years to reduce carbon intensity such as replacement of conventional lights with LED lights, installation of energy-efficient air conditioners, super fans, deployment of EVs and installation of efficient water heaters, energy-efficient motors for pumps, auto timers in street lights etc.
3. Green Credit Programme: Coal PSUs are also participating in extensive plantation under Green Credit Program launched by MoEF&CC.



4. First Mile Connectivity (FMC) projects: The Coal PSUs have taken steps to upgrade the mechanized coal transportation and loading system under 'First Mile Connectivity' projects. Commissioning of FMC projects in coal mining areas reduces consumption of diesel significantly and therefore reduces carbon emissions.
5. Deployment of Blast free technology in coal mining: Coal companies are deploying modern equipment having environment friendly features, like Surface Miner, Continuous Miner in coal mining, which eliminates the drilling, blasting and crushing operations in coal and hence, in turn, obviates pollution caused due to these operations. Rippers are also being deployed for blast-less removal of overburden in some mines.
6. Renewable Energy and clean coal initiatives: Coal PSUs have also started commissioning Renewable Energy power projects. Additionally, they are venturing into various clean coal technologies like Coal gasification, Coal Bed methane (CBM) etc.

Sustainable coal production is being promoted by ensuring compliance with applicable environmental laws like prior Environmental Clearance (EC), Forest Clearance (FC), Consent to Operate (CTO), Consent to Establish (CTE) etc. In addition, the steps adopted to reduce carbon emissions and environmental impact due to coal mining includes:

- Use of surface miners, continuous miners, highwall / longwall mining, etc.
- Increasing installation & usage of First Mile Connectivity (FMC) initiatives to reduce coal transport via roads.
- Improving energy efficiency across coal mining projects. Reclamation and eco-restoration of mined-out areas including development of eco-parks, mine tourism sites, etc.
- Conceptualizing re-purposing of de-coaled areas for sustainable uses like installation of renewable energy generation plants, development of agricultural avenues for surrounding communities, development of mine sumps, etc.
- At present, there is no specific directive / guideline stipulating the number of times mining companies are required to review their Environmental Impact Assessment (EIA), particularly with reference to carbon emissions.



5.3.2 International standard: ISO 14064-1:2018 (Greenhouse Gases Quantification and Reporting of GHG Emissions and Removals at the Organizational Level) [15]

ISO has specific standards on GHG Quantification, Reporting and Removals at the Organizational Level. The main principles and requirements for designing, developing, managing and reporting organization-level for GHG are summarized here. It includes requirements for determining GHG emission and removal boundaries, quantifying an organization's GHG emissions and removals, and identifying specific actions or activities aimed at improving GHG management. It also includes requirements and guidance on inventory quality management, reporting, internal auditing and the organization's responsibilities in verification activities.

[ISO 14064-2](#) details principles and requirements for determining baselines, and monitoring, quantifying and reporting of project emissions. It focuses on GHG projects or project-based activities specifically designed to reduce GHG emissions and/or enhance GHG removals. It provides the basis for GHG projects to be verified and validated.

[ISO 14064-3](#) details requirements for verifying GHG statements related to GHG inventories, GHG projects, and carbon footprints of products. It describes the process for verification or validation, including verification or validation planning, assessment procedures, and the evaluation of organizational, project and product GHG statements.

[ISO 14065](#) defines requirements for bodies that validate and verify GHG statements. Its requirements cover impartiality, competence, communication, validation and verification processes, appeals, complaints and the management system of validation and verification bodies. It can be used as a basis for accreditation and other forms of recognition in relation to the impartiality, competence and consistency of validation and verification bodies.

[ISO 14066](#) specifies competence requirements for validation teams and verification teams. It includes principles and specifies competence requirements based on the tasks that validation teams or verification teams have to be able to perform.

[ISO 14067](#) defines the principles, requirements and guidelines for the quantification of the carbon footprint of products. The aim of [ISO 14067](#) is to quantify GHG emissions associated with the life cycle stages of a product, beginning with resource extraction and raw material sourcing and extending through the production, use and end-of-life phases of the product.



[ISO/TR 14069](#) assists users in the application of this document, providing guidelines and examples for improving transparency in the quantification of emissions and their reporting. It does not provide additional guidance to this document. The relationship among the ISO 14060 family on GHG is presented below.

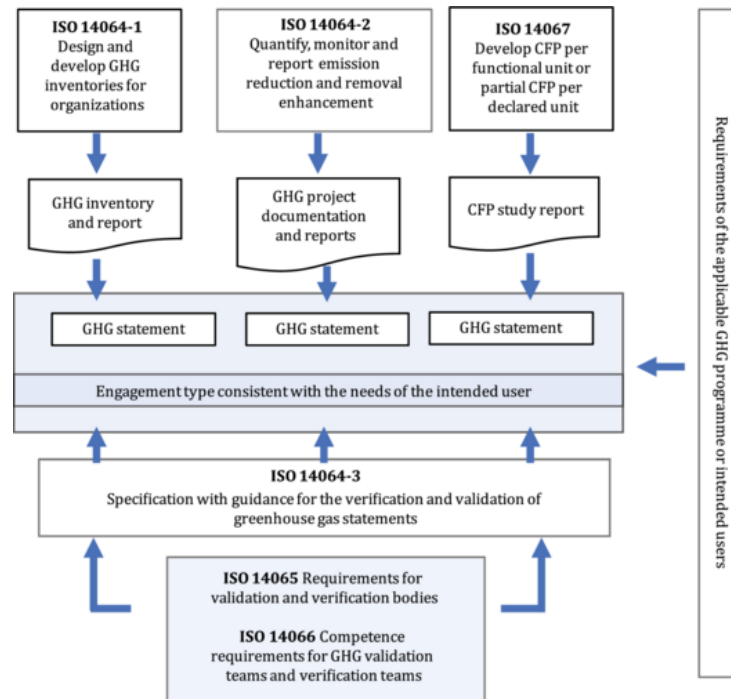


Figure 1: Diagrammatic illustrations of the relationship among the ISO 14060 family of GHG standards [3].

5.4 Compliance

Compliance with ISO 14064-1:2018 means that carbon accounting methodology quantifies and reports organizational greenhouse gas (GHG) emissions and removals according to international standards, covering design, management, reporting, and verification, ensuring credibility, transparency, and alignment with global climate goals by categorizing emissions and facilitating reduction strategies, often alongside the GHG Protocol.

Key Aspects of ISO 14064-1:2018 Compliance:

- **Organizational Boundary:** Defines the scope of emissions and removals to include (e.g., operational control, equity share).



- **Quantification:** Calculates GHG emissions and removals for specific categories (e.g., direct, imported energy, transport, product use).
- **Reporting:** Ensures transparent reporting of methodologies, data, and results, enhancing credibility.
- **Verification:** Provides requirements for internal and external auditing to confirm inventory accuracy.
- **Management:** Supports developing strategies for emissions reduction and tracking performance.

Benefits of Alignment:

- **Credibility:** Increases trust in environmental data through consistent, transparent methodologies.
- **Regulatory Readiness:** Helps meet evolving national and international climate regulations.
- **Strategic Improvement:** Identifies opportunities for effective GHG management and mitigation.
- **Global Recognition:** Aligns practices with frameworks like the UN SDGs and supports carbon neutrality goals.

By adhering to ISO 14064-1:2018, organizations establish a robust, verifiable framework for their carbon footprint, moving beyond basic measurement to effective management and reporting.

6.0 Present study

Bharat Coking Coal Limited (BCCL) is a major Indian public sector coal mining company, formed in 1972. Govindpur is a major coal hub in India's coal belt, managed by BCCL for significant coal output, integrating modern mining practices with extensive regional management. The extraction and operation method impacts environment that includes flora, fauna along with ecosystem as a whole. It impacts air, water quality that further affect human health.

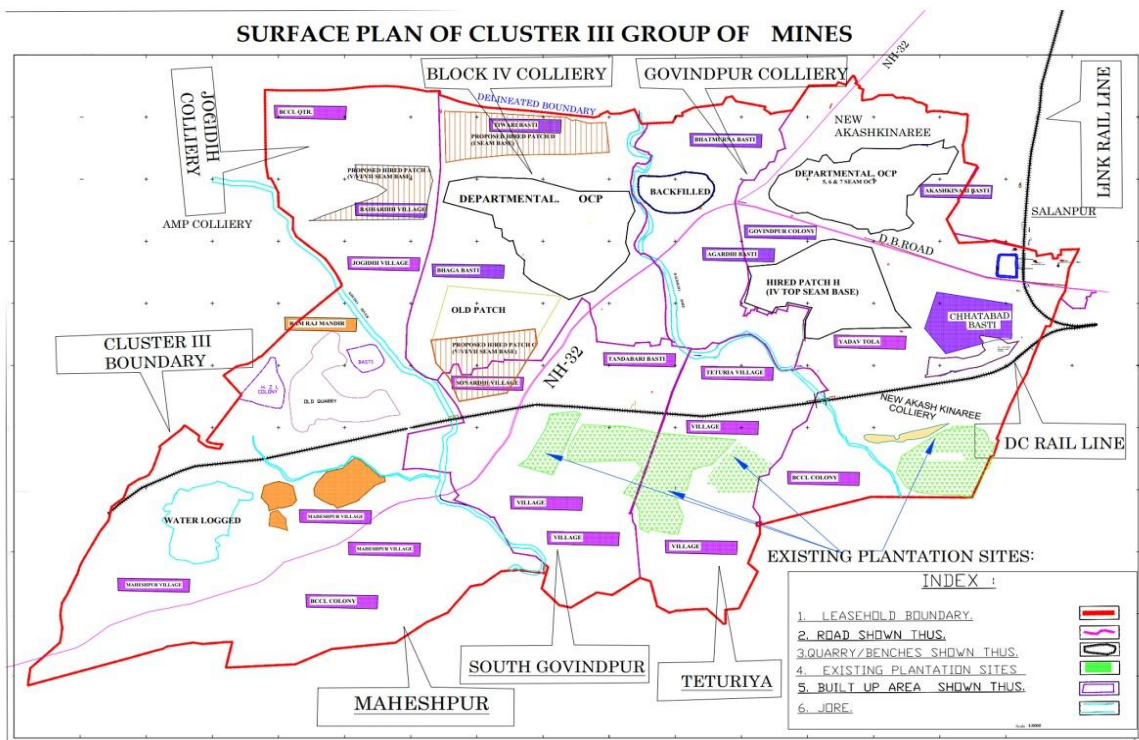
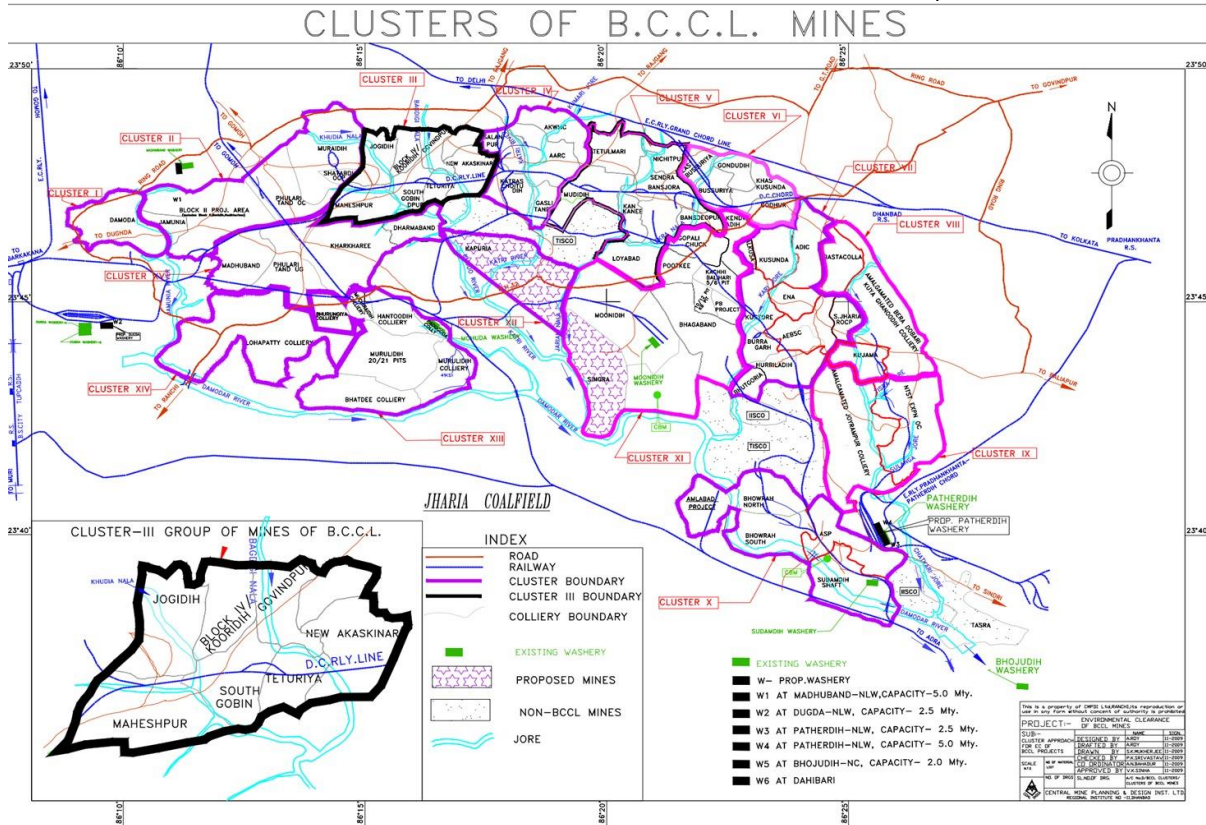
The Cluster III coal mines (Figure 1) of Govindpur area, face typical coal mining environmental issues as mentioned, the mine has implemented mitigation measures such as



water treatment plants, extensive reclamation, and habitat restoration plans, with ongoing monitoring for heavy metals and dust, aiming to balance mining with environmental protection in the Jharia coalfield region. These should be continued with proper monitoring and scientific analyses for strengthening their endeavour.

7.0 Purpose of the present study

According to global emission regulations, greenhouse gas (GHG) emissions have become one of the most critical environmental challenges faced by every nation. The world has been increasingly witnessing natural disasters such as floods, storms, wildfires, heatwaves, droughts, poor air quality, bushfires, and cyclones that are expected to intensify in both frequency and severity in the near future as per the various regulatory and environmental agencies.



B

Figure 1: Location and Surface Maps of (A) BCCL Clusters and (B) Cluster III Mine of Govindpur area



Among all greenhouse gases, carbon dioxide (CO₂) is the most significant contributor, accounting for the largest share of total emissions. According to the Intergovernmental Panel on Climate Change (IPCC), the concentration of CO₂ in the atmosphere has increased by approximately 40% since the pre-industrial era. Coal Mines under operation contribute significantly in CO₂ generation in form of fleet movement, power consumption etc. Govindpur coal mines produces good amount of coking and non-coking coal from open pit and underground mines. Mining activities lead to generation of GHG, CO₂. Authority has desired to achieve “Net Zero CO₂ emission”. In this regard, BCCL authority has approached to IIT Kharagpur study team to take up a study for assessing present status of CO₂ emission and possible suggestions for sequestration measures. IIT study team visited the site along mine officials to comprehend overall gamut of the study.

8.0 Methodology followed in the present study

8.1 Data source

As provided and or collected during field visit. The same is represented as follows;

- Energy consumption, Vehicular Movement and Plantation Data are attached in Exhibit

8.2 CO₂ emission estimate

Diesel Consumption

Mining machinery will discharge carbon dioxide into the environment. The emission of same carbon dioxide increases the carbon footprint. Further, it is considered that a diesel vehicle contributes to CO₂ emissions, though generally less than a gasoline vehicle per kilometer driven due to its better fuel efficiency; it still produces a significant amount of CO₂ that contributes to climate change.

There is large variation in data on diesel consumption. Diesel consumption for the entire year for HEMM has been considered as 3.2 million liter (32 lac liter). However, on account of vehicle trips for coal despatch from the mine to the destination during the period of 01.01.2025 to 30.06.2025, it is noted that total distance travelled is 141929.55 km. On this basis, the diesel consumption due to this vehicular movement is 37847.88 litre (considering, per-liter fuel efficiency for a mining dumper in India is highly variable, but figures like 3.0 to 5.0 kilometers per liter (kmpl) are common for unloaded and loaded conditions, respectively, while a heavier dumper may average around 3.75 to 4 kmpl). Hence, accounting both the consumptions



together, diesel used per year has been calculated as 3654175 liter.

From the literature (<https://www.autolexicon.net/en/articles/vypocet-emisi-co2/>), CO₂ produced due to burning of one-liter diesel fuel is approximately 2.64 kilograms. Hence, CO₂ produced per year due to diesel fuel consumption is 9647 ton per year.

8.3 Use of electricity in mining activities

Electricity used during mining operations is a secondary source of CO₂ emission for the mine. The data records from the mine suggest that the total electricity consumed by the mine due to various operations is 85698736 kwh over the period of one year (considering progressive energy consumption instead of base level). It is also found that solar panels installed in the mine produced 88 kWp at present (1 kWp generates ~1400-1600 kWh/year) (https://www.eai.in/ref/ae/sol/rooftop/power_output). Assuming, an average value of 1500 kWh/year, the equivalent electric energy that is produced from the solar roof top is 132,000 kWh/year. Hence, adjusted amount of CO₂ due to electricity consumption is 38077 ton of CO₂ per year. It may be noted that the global average for CO₂ produced per kWh of electricity is 445 grams (g CO₂/kWh) in 2024 (<https://www.iea.org/reports/electricity-2025/emissions>).

Mining-induced deforestation

It is reported that mining induced deforestation is significant. Literature suggest between 2001 and 2020, mining and related activities removed 1.4 million hectares of trees, emitting 36 million tonnes of CO₂ equivalent annually. The same has not considered in the present study.

- **Carbon Sequestration Measure**

8.4 Carbon sequestration due to afforestation/plantation

It is reported that a significant increase in carbon footprint would be observed due to felling of trees. On the contrary, substantial amount of CO₂ sequestration occurs during plantation/afforestation by photosynthetic activities.

Hence, it is required to calculate and analyse the amount of carbon dioxide that will be sequestered due to plantation drive.

There is, as such, no standard methodology to calculate carbon sequestration due to afforestation. The most cited method with some assumptions has been used for the present study [Source: <https://www.ecomatcher.com/how-to-calculate-co2-sequestration/>].

The formula used for the present work is as follows;

- Yearly rate of CO₂ sequestration/ CO₂ due to afforestation (TCx3.67)/ Age of tree.
- TC= TDW x 0.5; TDW= 0.725 x TB, TB= AGB + 0.2 BGB;
- AGB= 0.25 x D²x H; [TC: TOTAL CARBON; TDW: TOTAL DRY WEIGHT, AGB: ABOVE GROUND LEVEL, D: MEAN OF GIRTH DIAMETER, TB: TOTAL BIOMASS, H: HEIGHT OF TREE ASSUMED TO BE 50 x D]

8.4.1: Carbon sequestration through Algal Biomass:

Research indicates that the use of microalgae for CO₂ sequestration helps in mitigating global warming.

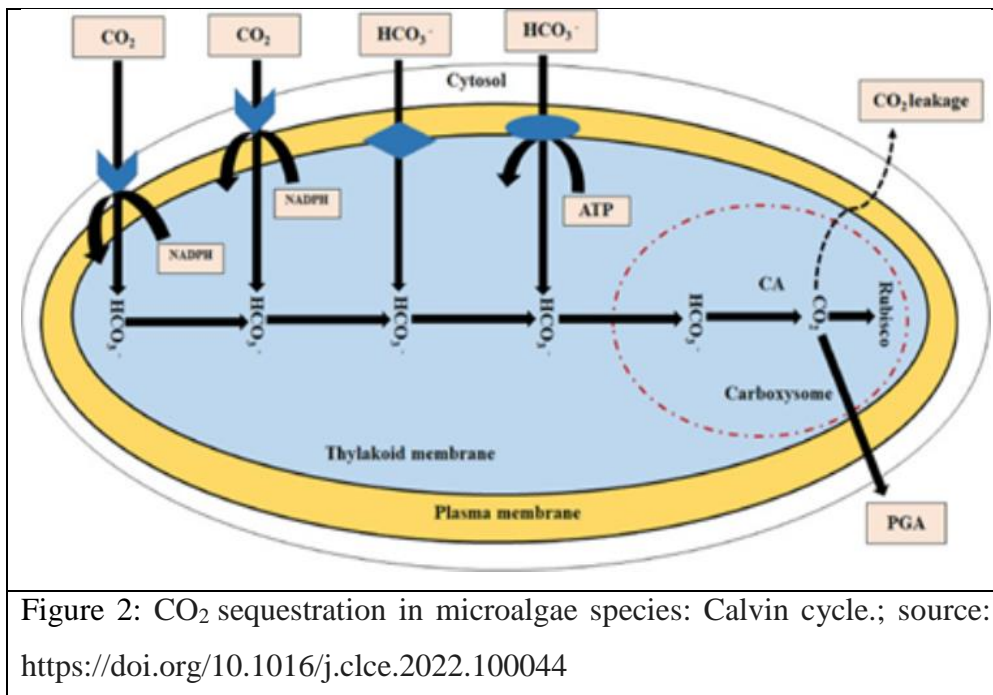


Figure 2: CO₂ sequestration in microalgae species: Calvin cycle.; source: <https://doi.org/10.1016/j.clce.2022.100044>

Carbon uptake by microalgae varies from species to species. CO₂ uptake rates is of 160–175 mg of biomass per liter per day approximately. Carbon sequestration efficiency of some variety of microalgae is around 4.8 kg of CO₂ per kg of biomass. However, the commercial viability of microalgae has been challenged by high production costs, technical complexities, and regulatory gaps. But, it is expected to be considered one of the viable option in near future, eg creation of small water body, cultivation of microalgae of proper variety.

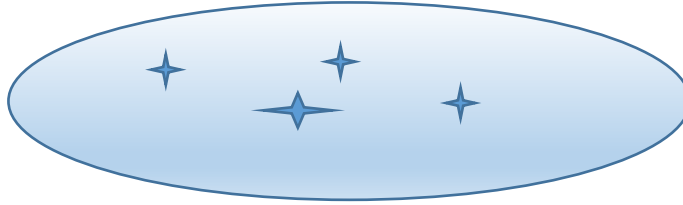


Figure 3: Water body and microalgae cultivation

However, contribution of this factor is unknown due to lack of data.

8.5: Geological carbon sequestration

The geological sequestration of CO₂ in coal seams holds significant implications for coalbed methane development and greenhouse gas mitigation. Methods includes transportation and injecting it via wells.

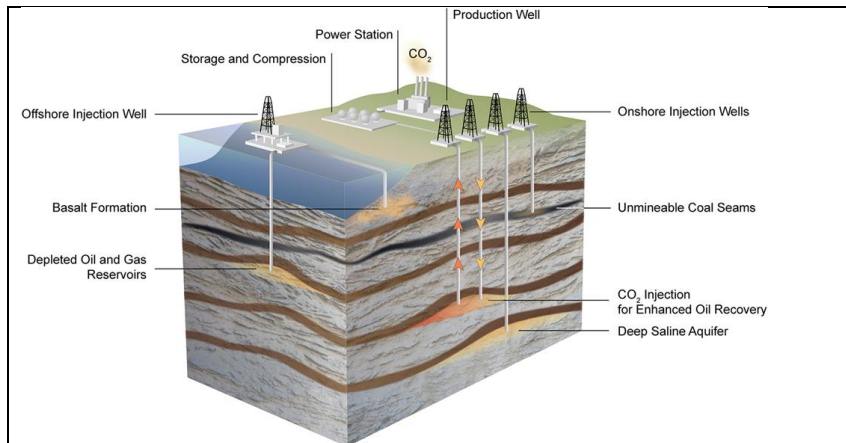


Figure 4: Geological carbon sequestration;
source: <https://doi.org/10.1016/j.earscirev.2021.103895>

However, contribution of this factor is unknown due to lack of data.

Soil Carbon Sequestration

Soil store carbon as Soil organic matter. Soil Carbon Sequestration is calculated using the formula, SOC content x BD x Soil Depth. [SOC=Soil Organic Carbon, BD=Bulk Density].

9.0 Results and Discussions

This section summarises the outcomes of the study including calculations of emissions based on the available data following the IPCC and other standards. The outputs are presented in the following sub-sections:



1. Quantification of Carbon Emissions (in the form of CO₂)

Table 1: Quantification of Carbon Emissions (in the form of CO₂)

Key Emission Sources	Factors	Amount (ton / year)	Remarks
Energy Consumption (Indirect Emissions)			
	Electricity: Factor for purchased electricity (kg CO _{2e} /kWh).	38077	
	Fuel Combustion (Vehicles, Machinery): EFs for diesel, petrol (kg CO ₂ /litre) based on IPCC guidelines, considering fuel type and usage.	9647	
Methane (CH₄) Emissions (Direct), NO_x and SO_x			
	Fugitive Methane: Varies greatly; use IPCC Tier 1 (global average, e.g., 10-25 m ³ /tonne coal) or Tier 2 (country-specific, measured) factors.	Unknown	Continuous monitoring data for SO _x and NO _x data are available. However, CO ₂ equivalent of the above emissions are considered in diesel and explosive related emission.
	Spontaneous Combustion: Factors for CH ₄ release from burning coal/gangue.	75.02 to 286.03 g / s / m ²	Stockyard area is unknown.
Explosives			
	EFs for emissions from explosives used in blasting.	337 ton of CO _{2e} /yr (@0.19 kg CO _{2e} / ton of explosives and 1773 tonne explosive/yr)	Details of site-specific factors (e.g., explosive composition, rock type, blast design, and weather conditions) are unknown.
Other Sources			
	Ventilation/Drainage: Factors for compressed air and drainage (e.g., 1.01 x 10 ⁻² t CO ₂ /m ³ for ventilation).	Not applicable.	Not applicable.

2. Current Carbon Sequestration Estimation

Table 2: Current Carbon Sequestration Estimation

Key Emission Sources	Factors	Amount (ton / year)	Remarks
For Plants/Trees			
	Measure Biomass: Measure tree height, diameter (DBH), and circumference to estimate above-ground biomass	1293	Details are in EXHIBIT.



	<p>(AGB) using established formulas. Estimate below-ground biomass (BGB) using root-to-shoot ratios, often tied to AGB. Total Biomass (TB) = AGB + BGB</p>		
	<p>Calculate Carbon Content: Carbon (C) = Total Biomass (dry weight) × 0.50 (50%). Convert to CO₂ Equivalent (CO₂e): CO₂e = Carbon (C) × 3.67 (ratio of CO₂ molecular weight to Carbon's). For annual sequestration, divide the total CO₂e by the tree's age or use growth rates.</p>		
For Soil			
	<p>Sample: Collect soil samples from different locations within your area. Analyze: Dry samples, measure their mass, and determine the percentage of organic carbon content (%). Calculate Stock Change: Compare measurements over time, accounting for soil bulk density and depth, to find the change in stored carbon.</p>	<p>Soil samples data are available for core zone as well as nearby villages (Pl. see exhibit)</p>	<p>Parameters of organic carbon, types of soil, soil density may be useful to estimate SOC. Based on the data, equivalent CO₂e is 7.5 ton/Ha. On this basis, amount sequestered to be 750 ton.</p>



3. Carbon Sequestration Potential Enhancement

Table 3: Suggestive Measures for Carbon Sequestration Potential Enhancement

Key Sources	Factors	Action Plan	Remarks
Ecological Restoration and Land Management			
	<p>Revegetation with Optimal Species: Planting appropriate vegetation is the primary way to sequester atmospheric CO₂ into plant biomass and soil organic carbon (SOC). Forestland is a major carbon sink Species Selection Multi-tier Vegetation</p>	<p>270 Ha plantation considering existing plantation drive along with capacity of 2.4 MT per year. However, it will be 423 Ha for 3.6 MT per year capacity.</p> <p>Around 4.8 kg of CO₂ per kg of biomass</p>	<p>The same will reduced to 23.3 Ha and 38.6 Ha for 2.4 MT/year and 3.6 MT/year production capacity respectively using Miyawaki plantation with plant density 25000 per Ha.</p> <p>Exploration of biomass cultivation in water bodies is suggested.</p>
	<p>Soil Reconstruction and Improvement: Mining activities often leave behind poor quality soil (mine spoil) that lacks organic matter. Topsoil Management</p> <p>Organic Amendments Soil Aggregation</p>	<p>Soil organic carbon contain in the core zone and surrounding villages are measured to be 0.5%</p>	<p>-----</p>
	<p>Sustainable Land Use Planning: Long-term carbon sequestration requires a shift to sustainable land use.</p>	<p>-----</p>	<p>-----</p>



	Reclaimed land can be repurposed for: Agriculture Ecotourism or Protected Areas		
Technological and Engineering Solutions			
	<p>Renewable Energy Integration: Utilizing abandoned mine land for renewable energy infrastructure can indirectly enhance carbon sequestration efforts by displacing fossil fuel use.</p> <p>Solar Farms Pumped Storage Hydropower</p>	To generate 1 kWh (1unit) of electricity daily, you generally need about 80 to 100 square feet (approx. 8–10 square meters) from solar Panel	May adopt Solar Panel Installation

4. Compliance with International and National Standards

This needs to be complied with the national policy issues.

5. Policy and Strategic Recommendations

1. Bio-Reclamation/Plantation: The mine is continuously doing plantation to minimize the footprints of coal mining through sustained reclamation and afforestation. This should be continued and possibly further enhanced.
2. Non-efficient / old machinery to be replaced by energy-efficient new ones.
3. It is suggested to take various energy conservation and efficiency measures over the years like replacement of conventional lights with LED lights, installation of energy-efficient air conditioners, super fans, deployment of EVs and installation of efficient water heaters, energy-efficient motors for pumps, auto timers in street lights etc.
4. Use and deployment of Blast free technology in coal mining to be encouraged.
5. Modern equipment having environment friendly features, for Surface Miner, Continuous Miner etc., which eliminates the drilling, blasting and crushing operations in coal, to be increased in operations.
6. The mine is using solar panels which should be further propagated.



Table-1

Year	Land, Ha	Plant density	Total Plant	Total Plants	Survival (0.95)	Height (m)	Diameter (m)	AGB	BGB	Total	TDW	TC	Yearly rate (TC/yr)	Age of Tree (yr)	Total CO ₂ (kg)	Per year CO ₂ (tonne)
2017-18	17.5	2500	43750	43750	41563	10.5	3.5	9.18	1.83	11	7.99	3.99	14.66738	7	609613	87.09
2018-19	5	2500	12500	12500	11875	9	3	6.75	1.35	8.1	5.87	2.94	10.77604	6	127965.45	21.33
2020-21	9.5	2500	23750	23750	22563	6	2	3	0.6	3.6	2.61	1.31	4.78935	4	108059.71	27.01
2021-22	23	2500	57500	57500	54625	4.5	1.5	1.69	0.34	2.03	1.47	0.73	2.694009	3	147160.26	49.05
2010	10	2500	25000	25000	23750	15	6	22.5	4.5	27	19.58	9.79	35.92013	15	853102.97	56.87
2000	43	2500	107500	107500	102125	25	9	56.2	11.25	67.5	48.94	24.5	89.80031	25	9170856.91	366.83

Where:

TC: Total Carbon

TDW: Total Dry Weight

AGB: Above Ground Level, kg

D: Mean of Girth Diameter, m

TB: Total Biomass, kg

H: Height of Tree Assumed to be 50 x D (m)



10.0 Recommendations

It is observed from above tables that there is huge gap of carbon dioxide generation due to mining activities and carbon dioxide fixation due to plantation. The calculated gap with present capacity of 2.4 MT per year is 46768 ton per year. In order to reduce the gap, there is a requirement of huge plantation drive i.e 708606 number. Considering present plant density (2500 per Ha), plantation area that is required is 270 Ha.

Further, the same may be increased to 1092295 number of plants with plantation area 423 Ha. for increased capacity of 3.6 MT production per year.

Hence, it is observed that traditional approach i.e through plantation drive is not practically feasible to achieve “Net Zero” production, even with carbon dioxide solely.

Alternative approach may be the mixed method along with existing plantation mode and/ or type such as;

(A) May consider Miyawaki plant with average plant density 25000 per Ha, if agro climatic condition permit the same. [<https://doi.org/10.1016/j.tfp.2025.100925>]. Further, literature

support that the said plant can grow in India [<https://www.pib.gov.in/PressReleaseIframePage.aspx?PRID=1983156>].

Calculation reflects that the plantation drive with Miyawaki plant with presumption of carbon capture capacity of normal mature plant, the plantation area requirement may be reduced drastically.

The additional plantation requirement for net zero with the above stated plantation, Miyawaki drive for 2.4 MT per year capacity may be 23.3 Ha and for 3.6 MT per year may be 38.6 Ha approximately.

(B) Partial microalgae cultivation in water body. The same will generate alternative business avenue in the form of biomass that is having fuel and/or food value.

(C) Using fleet management, the diesel consumption may further be curbed. Further, there is a need of proper monitoring of diesel consumption. Published literature indicate implementation of AI for management of HEMM, dumper etc. Further research paper such as (J. Phys.: Conf. Ser. 2683 012010) suggested different alternative approaches to reduce carbon.

(D) Auditing of energy/electricity consumption in base level and installation of solar roof top with higher kWp may be adopted. To generate 1 kWh (1 unit) of electricity daily, you generally need



about 80 to 100 square feet (approx. 8–10 square meters. May think about 1000 sq mt solar installation to generate 100kWp.

Hypothetical Model

Assuming a hypothetical model mine along with activities to achieve “NET ZERO” with targeted capacity of 3.6 MT/year.

- a) Microalgae cultivation in water body. Consider 30 Ha. water body for cultivation. Biomass/microalgae that can be cultivated in waterbody with yield around 25 ton/Ha/year. Total cultivation =750 ton/year. One ton of microalgae biomass can sequester roughly 1.83 tons of CO₂. Hence, the carbon sequestration through microalgae = 1372 ton per year.
- b) Diesel consumption may be reduced to 25,00,000 liter/year, resulting in 7150 ton/year of CO₂ produced. The same can be accomplished with alternative use of material transport that include EV.
- c) Net use of Energy/Electricity may be reduced using solar roof top installation with higher capacity, and any other renewable energy sources so that resulting CO₂ produced would be 2025 ton/year. It is reported that A 1 kWp (kilowatt-peak) solar power system typically reduces CO₂ emissions by approximately 0.7 to 0.9 tonnes (700-900 kg) per year.
- d) To generate 1 kWh (1 unit) of electricity daily, you generally need about 80 to 100 square feet (approx. 8–10 square meters); through solar panel CO₂ emission can be reduced. 100 kWp solar installation reduces CO₂ emission by approximately 150 ton per year.
- e) Soil Organic Carbon sequestration should be also considered

Taking (a), (b), and (c) along with present plantation, it is observed that the gap is reduced to 6510 ton of carbon dioxide per year. The same can be met up using plantation area of 39.45 Ha using present plantation density. However, the same will be reduced to 3.945 Ha with Miyawaki plantation as suggested. Further the same will be reduced, if (d) and (e) are considered.

11.0 References

1. IPCC (2000). IPCC special report on Land Use, Land Use Change, and Forestry, Summary for Policy makers. Cambridge, UK: Cambridge University Press.
2. IPCC (2006). Agriculture, forestry and other land use. In: Eggleston, HS et al., (Eds.), IPCC Guidelines for National Greenhouse Gas Inventories, Prepared by the National Greenhouse Gas Inventories Programme. IGES, Japan.
3. Pachauri and Meyer, 2014, IPCC, Core Writing Team, R.K. Pachauri, L.A. Meyer (Eds.), Climate change 2014: Synthesis report. Contribution of working groups I, II and III to the




- fifth assessment report of the Intergovernmental Panel on Climate Change, IPCC (2014), p. 151
4. C.Ö. Karacan, F.A. Ruiz, M. Cotè, S. Phipps (2011), Coal mine methane: A review of capture and utilization practices with benefits to mining safety and to greenhouse gas reduction, *International Journal of Coal Geology*, 86 (2–3) (2011), pp. 121-156
 5. T. Igogo, K. Awuah-Offei, A. Newman, T. Lowder, J. Engel-Cox, (2021) Integrating renewable energy into mining operations: Opportunities, challenges, and enabling approaches, *Applied Energy*, 300 (2021), Article 117375
 6. P.C. Frumhoff, R. Heede, N. Oreskes, 2015, The climate responsibilities of industrial carbon producers, *Climatic Change*, 132 (2) (2015), pp. 157-171
 7. Y. Wang, W. Wang, G. Mao, H. Cai, J. Zuo, L. Wang, P. Zhao, 2013, Industrial CO₂ emissions in China based on the hypothetical extraction method: Linkage analysis, *Energy Policy*, 62 (2013), pp. 1238-1244
 8. Greenhouse Gas Protocol, An accounting and reporting standard for estimating the greenhouse gas effects of policies and actions, prepared by World Resource Institute and Advisory Committee, (2014).
 9. Bray, J.R., Gorham, E. (1964). Litter production in forest of the world. In: Gragg, J.B. (Ed.), *Advances in Ecological Research*, vol. II. Academic Press, New York.
 10. Brown, S. (1997). Estimating biomass and biomass change of tropical forests: a primer (Vol. 134). Food & Agriculture Org.
 11. Brown, S., Gillespie, A. J., and Lugo, A. E. (1989). Biomass estimation methods for tropical forests with applications to forest inventory data. *Forest science*, 35(4), 881-902.
 12. Cairns, M. A., Brown, S., Helmer, E. H., Baumgardner, G. A. (1997). Root biomass allocation in the world's upland forests. *Oecologia*, 111: 1-11.
 13. Recommendations for Reducing Greenhouse Gas Emissions, visit: <https://www.iema.net/resources>
 14. S. Luckeneder, S. Giljum, A. Schaffartzik, V. Maus, M. Tost, 2021, Surge in global metal mining threatens vulnerable ecosystems. *Global Environmental Change-Human and Policy*
 15. ISO 14064-1:2018 (Greenhouse Gases Quantification and Reporting of GHG Emissions and Removals at the Organizational Level) at <https://www.iso.org/standard/66453.html>.

*Study on Carbon Sequestration Status Including Carbon Emissions from Coal Mining in Cluster-III,
Govindpur Area, BCCL*





EXHIBIT

<p>भारत कोकिंग कोल लिमिटेड (एक मिनीरल कम्पनी) कोल इण्डिया लिमिटेड का एक अंग कम्पनी) महाप्रबंधक का कार्यालय, पास्ट-सानारडीह, जिला-धनबाद पिन-828125 (आरखण्ड)</p>		<p>BHARAT COKING COAL LIMITED (A Mini-ral Company) A Subsidiary of Coal India Limited (A Maharatna Co Office of the General Manager Govindpur Area PO-Sonardih, Dist. Dhanbad Pin-828125(Jharkhand)</p>
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L/AREA-III/E&M/2025-26/08

Date: 08.04.2025

5

Sl. No.	Area	Industry	
1	Area Water Treatment Plant	Industrial	
2	Govindpur Colliery		
3	Block-IV Colliery		
4	Maheshpur Colliery		
5	South Govindpur Colliery		6877830
6	Kharkharee Colliery		4460348
7	Jogidih Colliery		
8	New Akashkinaree Colliery		
9			
10	CHP		
11	SILO, Maheshpur		
12	Central Excavation Workshon		
	TOTAL		

Study on Carbon Sequestration Status Including Carbon Emissions from Coal Mining in Cluster-III,
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EXHIBIT

Date: 2025-07-29 11:39:51	User: GOVINDPUR						
BCCL VTS TRIP REPORT							
From: 2025-01-01 00:00 Hrs To: 2025-07-01 23:59 Hrs							
Area: GOVINDPUR							
SNo	Vehicle Number	Area	Source	End Date	Destination	Total Time	Total Distance
		Transporter		& Time			
1	JH10BS6157	GOVINDPUR	1/2 Seamed C_Dump	30-06-2025 14:03	NEW MCW End	0d 0h 48m	15.94 Km
		Mundane				49s	
2	JH10BS6157	GOVINDPUR	1/2 Seamed C_Dump	30-06-2025 01:21	NEW MCW End	0d 0h 35m	15.82 Km
		Mundane				27s	
Total Trips of JH10BS6157 on 2025-06-30:							
	2						
1	JH10BS6157	GOVINDPUR	1/2 Seamed C_Dump	29-06-2025 19:22	NEW MCW End	0d 0h 45m 1s	16.08 Km
		Mundane					
2	JH10BS6157	GOVINDPUR	1/2 Seamed C_Dump	29-06-2025 15:45	NEW MCW End	0d 0h 52m	15.78 Km
		Mundane				26s	
3	JH10BS6157	GOVINDPUR	1/2 Seamed C_Dump	29-06-2025 06:16	NEW MCW End	0d 0h 41m	16.19 Km
		Mundane				35s	
Total Trips of JH10BS6157 on 2025-06-29:							
	3						
1	JH10BS6157	GOVINDPUR	1/2 Seamed C_Dump	28-06-2025 21:54	NEW MCW End	0d 0h 57m	16.46 Km
		Mundane				28s	
2	JH10BS6157	GOVINDPUR	1/2 Seamed C_Dump	28-06-2025 14:43	NEW MCW End	0d 0h 45m	15.94 Km
		Mundane				50s	
3	JH10BS6157	GOVINDPUR	1/2 Seamed C_Dump	28-06-2025 06:12	NEW MCW End	0d 0h 35m	16.08 Km
		Mundane				57s	
Total Trips of JH10BS6157 on 2025-06-28:							
	3						
1	JH10BS6157	GOVINDPUR		27-06-2025 22:21	NEW MCW End		16.43 Km

Study on Carbon Sequestration Status Including Carbon Emissions from Coal Mining in Cluster-III,
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		Mundane	1/2 Seamed C_Dump			0d 1h 22m 32s	
2	JH10BS6157	GOVINDPUR Mundane	1/2 Seamed C_Dump	27-06-2025 14:51	NEW MCW End	0d 0h 46m 21s	15.99 Km
Total Trips of JH10BS6157 on 2025-06-27:		2					
1	JH10BS6157	GOVINDPUR Mundane	1/2 Seamed C_Dump	26-06-2025 23:37	NEW MCW End	0d 1h 28m 50s	16.44 Km
2	JH10BS6157	GOVINDPUR Mundane	1/2 Seamed C_Dump	26-06-2025 17:48	NEW MCW End	0d 0h 44m 46s	15.91 Km
Total Trips of JH10BS6157 on 2025-06-26:		2					
1	JH10BS6157	GOVINDPUR Mundane	1/2 Seamed C_Dump	25-06-2025 17:30	NEW MCW End	0d 0h 39m 3s	16.27 Km
Total Trips of JH10BS6157 on 2025-06-25:		1					
1	JH10BS6157	GOVINDPUR Mundane	1/2 Seamed C_Dump	24-06-2025 12:58	NEW MCW End	0d 0h 41m 38s	15.90 Km
2	JH10BS6157	GOVINDPUR Mundane	1/2 Seamed C_Dump	24-06-2025 06:50	NEW MCW End	0d 0h 34m 34s	16.21 Km
Total Trips of JH10BS6157 on 2025-06-24:		2					
1	JH10BS6157	GOVINDPUR Mundane	1/2 Seamed C_Dump	24-06-2025 00:18	NEW MCW End	0d 0h 36m 46s	15.93 Km
2	JH10BS6157	GOVINDPUR Mundane	1/2 Seamed C_Dump	23-06-2025 17:23	NEW MCW End	0d 0h 42m 3s	16.09 Km
3	JH10BS6157	GOVINDPUR Mundane	1/2 Seamed C_Dump	23-06-2025 12:14	NEW MCW End	0d 0h 39m 58s	15.82 Km
Total Trips of JH10BS6157 on 2025-06-23:		3					
1	JH10BS6157	GOVINDPUR Mundane	1/2 Seamed C_Dump	22-06-2025 02:36	NEW MCW End	0d 0h 34m 33s	15.74 Km

Study on Carbon Sequestration Status Including Carbon Emissions from Coal Mining in Cluster-III,
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Total Trips of JH10BS6157 on 2025-06-22:	1						
1	JH10BS6157	GOVINDPUR Mundane	1/2 Seamed C_Dump	21-06-2025 20:44	NEW MCW End	0d 0h 38m 45s	16.10 Km
2	JH10BS6157	GOVINDPUR Mundane	1/2 Seamed C_Dump	21-06-2025 16:08	NEW MCW End	0d 0h 35m 13s	16.33 Km
3	JH10BS6157	GOVINDPUR Mundane	1/2 Seamed C_Dump	21-06-2025 06:46	NEW MCW End	0d 0h 41m 24s	16.18 Km
Total Trips of JH10BS6157 on 2025-06-21:	3						
1	JH10BS6157	GOVINDPUR Mundane	1/2 Seamed C_Dump	21-06-2025 00:42	NEW MCW End	0d 0h 43m 3s	16.23 Km
2	JH10BS6157	GOVINDPUR Mundane	1/2 Seamed C_Dump	20-06-2025 19:24	NEW MCW End	0d 0h 46m 58s	15.91 Km
3	JH10BS6157	GOVINDPUR Mundane	Maheshpur Dump	20-06-2025 13:19	NEW MCW End	0d 1h 2m 37s	14.37 Km
4	JH10BS6157	GOVINDPUR Mundane	Maheshpur Dump	20-06-2025 10:52	NEW MCW End	0d 1h 1m 46s	14.60 Km
Total Trips of JH10BS6157 on 2025-06-20:	4						
1	JH10BS6157	GOVINDPUR Mundane	Maheshpur Dump	19-06-2025 16:38	NEW MCW End	0d 1h 23m 27s	14.91 Km
Total Trips of JH10BS6157 on 2025-06-19:	1						
1	JH10BS6157	GOVINDPUR Mundane	1/2 Seamed C_Dump	18-06-2025 20:32	NEW MCW End	0d 0h 48m 19s	16.15 Km
2	JH10BS6157	GOVINDPUR Mundane	1/2 Seamed C_Dump	18-06-2025 06:01	NEW MCW End	0d 0h 38m 18s	16.14 Km
Total Trips of JH10BS6157 on 2025-06-18:	2						
1	JH10BS6157	GOVINDPUR Mundane	1/2 Seamed C_Dump	17-06-2025 22:24	NEW MCW End	0d 1h 45m 14s	16.28 Km

Study on Carbon Sequestration Status Including Carbon Emissions from Coal Mining in Cluster-III,
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2	JH10BS6157	GOVINDPUR	1/2 Seamed	17-06-2025 14:59	NEW MCW End	0d 1h 36m 18s	16.37 Km
		Mundane	C_Dump				
3	JH10BS6157	GOVINDPUR	1/2 Seamed	17-06-2025 01:28	NEW MCW End	0d 0h 33m 59s	16.02 Km
		Mundane	C_Dump				

EXHIBIT

AMBIENT AIR QUALITY DATA

		CENTRAL MINE PLANNING AND DESIGN INSTITUTE LIMITED Environment Laboratory, Regional Institute-II Ambient Air Quality Test Report				CMPDIL, RI-II KOYLA BHAWAN COMPLEX DHANBAD, -826005 Phone:0326-223-850 email: rdri2cmpdi@coalindia.in		
Test Report for Ambient Air Samples								
Month & Year	10/2025	Cluster	Cluster III			ULR NO.	TC143212500002188F	
Customer	Environment Department, Bharat Coking Coal Limited (BCCL), Koyla Bhawan, Dhanbad (E-mail: gmenv.bccl@coalindia.in)				Date of Issue	05.12.2025		
Project	Block-IV		Sample Ref. No.	REM/BCCL/2025/10	Sampling Method	CMPDI/RI-II/LPM 13, (IS 5182)		
Date of Sampling	10.10.25		29.10.25	Period of Analysis	10.10.2025	25.11.2025	Zone of Station: Core Zone	
Sl. No.	Parameter	Method of Analysis	Observed Values (in µg/m ³)		Range Of Testing	LDL	MoEF Standards Notification dated 25th September, 2000 (GSR 742 E)	NAAQS, 2009
			A4676	A4760				
1	PM ₁₀	IS-5182(Part 23):2006, R-2017	75	70	10 µg/m ³ - 1000 µg/m ³	10 µg/m ³	300	100
2	PM _{2.5}	IS-5182(Part 24):2019	37	35	10 µg/m ³ - 400 µg/m ³	10 µg/m ³	Not Specified	60
3	SO ₂	IS-5182(Part-2): 2001, R-2017	10	<10	10 µg/m ³ - 1050 µg/m ³	10 µg/m ³	120	80
4	NO ₂	IS-5182 (Part-6): 2006, R-2017	33	29	06 µg/m ³ - 420 µg/m ³	06 µg/m ³	120	80
* LDL Indicates Lower Detection Limit, **All units are in µg/m ³ , 24 hourly Average,								
 ANALYSED BY (Gaurav Kant)		 REVIEWED BY (Gaurav Kant)		 Authorised Signatory (Kumar Vaibhav)				
Note: The results above relate to the samples tested as received. This report can not be reproduced in part or full without the written permission of the HOD(Env) , CMPDI, RI-II.								
---- End of Report ---- Page -1 of 1								



EXHIBIT

Sl no	Site	Area (Ha)	Plantation type	Plantation Year	Agency
1.	Block-IV Colliery	4.5	OB dump	FY 2020-21	Forest Department, Dhanbad
2.	New Akashkinaree Colliery	17.5	Backfilled	FY 2014-15 to 2017-18	Departmental Manpower
		5	OB dump	FY 2020-21	Forest Department, Dhanbad
3.		23	OB dump	FY 2021-22	Forest Department, Dhanbad
4.	Maheshpur Colliery	5	OB dump	FY 2018-19	Departmental Manpower
		43		FY 2010	
		10		FY 2000	



Period: 15th March 2024 to 15th June 2024

Location:- Block-IV (Core Zone)

Sl. No.	Parameters	Observed Value		
		SS1		
		(0-30cm)	(30-60cm)	(60-90cm)
1	Soil Texture	Sandy loam	Sandy Loam	Sandy Loam
2	Grain Size, %			
	a) Sand	64.3	66.3	65.2
	b) Silt content	24.6	23.5	24.8
	c) Clay content	11.1	10.2	10.0
3	Porosity, %	25.4	24.6	24.1
4	Maximum water holding capacity(WHC max, %)	24.5	26.2	23.3
5	Field moisture (%)	15.6	16.2	17.1
6	Wilting Coefficient (%)	0.78	0.66	0.45
7	Bulk density (g/cc)	1.39	1.42	1.46
8	pH (1:2.5;w/v)	7.45	7.35	7.32
9	Electrical conductivity (micro S/cm; 1.2.5;w/v)	188.6	186.5	185.8
10	Soil Organic Carbon (%)	0.65	0.48	0.36
11	Available N (kg/ha)	100.2	82.35	79.64
12	Phosphorous as P ₂ O ₅ kg/ha	11.8	9.7	8.3
13	Potash as K ₂ O, kg/ha	107.5	98.3	85.8
14	Sodium Adsorption Ratio	0.59	0.52	0.48
15	Cation Exchange Capacity, Meq/100gm	21.2	20.5	17.6

Soil Fertility Quality Standard w.r.t C: N: P: K

Sl. No.	PARAMETERS	QUALITY STATUS		
		Poor	Medium	Fertile
1	Organic Carbon %	<0.5	0.5 to 0.75	>0.75
2	Nitrogen as N, kg/ha	<280	280 to 560	>560
3	Phosphorus as P ₂ O ₅ , kg/ha	<23	23 to 57	>57
4	Potash as K ₂ O, kg/ha	<133	133 to 337	>337



Period: 15th March 2024 to 15th June 2024

Location: -Bamandiha (Forest)

Sl. No.	Parameters	Observed Value		
		SS2		
		(0-30cm)	(30-60cm)	(60-90cm)
1	Soil Texture	Sandy Loam	Sandy Loam	Sandy Loam
2	Grain Size,%			
	a) Sand	54.0	58.5	59.2
	b) Silt content	33.8	31.8	29.1
	c) Clay content	12.2	9.7	11.7
3	Porosity, %	33.5	32.2	30.2
4	Maximum water holding capacity(WHC max,%)	36.2	37.7	38.5
5	Field moisture (%)	20.5	21.2	22.7
6	Wilting Coefficient (%)	0.87	0.85	0.84
7	Bulk density (g/cc)	1.51	1.54	1.56
8	pH (1:2.5;w/v)	7.12	7.21	6.98
9	Electrical conductivity (micro S/cm;1.2.5;w/v)	180.5	175.3	171.6
10	Soil Organic Carbon (%)	0.44	0.39	0.36
11	Available N (kg/ha)	145.2	139.5	134.5
12	Phosphorous as P ₂ O ₅ kg/ha	10.1	9.5	9.3
13	Potash as K ₂ O, kg/ha	133.5	132.5	138.2
14	Sodium Adsorption Ratio	1.03	1.01	1.05
15	Cation Exchange Capacity,Meq/100gm	18.5	19.2	22.2

Soil Fertility Quality Standard w.r.t C: N: P: K

Sl. No.	PARAMETERS	QUALITY STATUS		
		Poor	Medium	Fertile
1	Organic Carbon %	<0.5	0.5 to 0.75	>0.75
2	Nitrogen as N, kg/ha	<280	280 to 560	>560
3	Phosphorus as P ₂ O ₅ kg/ha	<23	23 to 57	>57
4	Potash as K ₂ O, kg/ha	<133	133 to 337	>337



Soil Characteristics of Core zone and nearby villages

Period: 15th March 2024 to 15th June 2024

Location: Muraidih Village (Agriculture)

Sl. No.	Parameters	Observed Value		
		SS3		
		(0-30cm)	(30-60cm)	(60-90cm)
1	Soil Texture	Sandy Clay Loam	Sandy Clay Loam	Sandy Clay Loam
2	Grain Size, %			
	a) Sand	52.4	50.0	50.5
	b) Silt content	19.6	23.2	25.4
	c) Clay content	28.0	26.8	24.1
3	Porosity, %	30.1	29.4	28.1
4	Maximum water holding capacity(WHC max,%)	30.4	33.2	35.5
5	Field moisture (%)	19.8	19.4	18.7
6	Wilting Coefficient (%)	0.81	0.85	0.85
7	Bulk density (g/cc)	1.44	1.51	1.53
8	pH (1:2.5;w/v)	7.35	7.12	6.96
9	Electrical conductivity (micro S/cm; 1.2.5;w/v)	199.6	187.5	181.2
10	Soil Organic Carbon (%)	0.55	0.40	0.39
11	Available N (kg/ha)	134.6	127.1	125.3
12	Phosphorous as P ₂ O ₅ kg/ha	14.6	13.5	13.2
13	Potash as K ₂ O, kg/ha	114.6	104.2	96.8
14	Sodium Adsorption Ratio	0.44	0.35	0.26
15	Cation Exchange Capacity, Meq/100gm	25.3	24.1	25.3

Soil Fertility Quality Standard w.r.t C:N:P:K

Sl. No.	PARAMETERS	QUALITY STATUS		
		Poor	Medium	Fertile
1	Organic Carbon %	<0.5	0.5 to 0.75	>0.75
2	Nitrogen as N, kg/ha	<280	280 to 560	>560
3	Phosphorus as P ₂ O ₅ , kg/ha	<23	23 to 57	>57
4	Potash as K ₂ O, kg/ha	<133	133 to 337	>337



EXHIBIT



Study on Carbon Sequestration Status Including Carbon Emissions from Coal Mining in Cluster-III,
Govindpur Area, BCCL





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