GMR WARORA ENERGY LIMITED

GHG INVENTORY REPORT FY 2023 – 24

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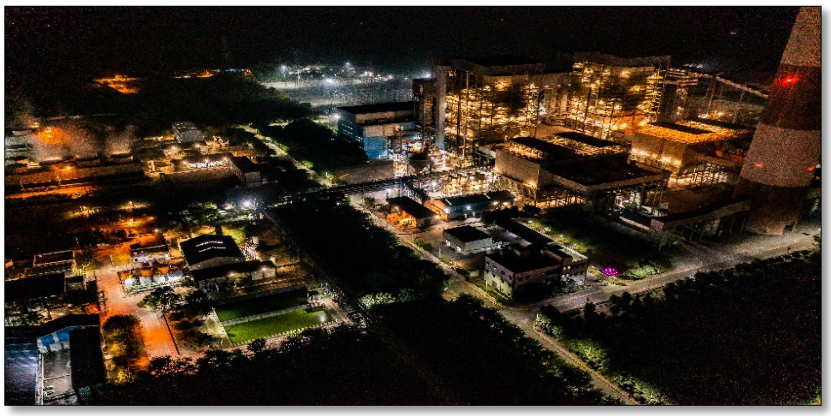

GMR Warora Energy Limited,
Mohabala MIDC Warora Growth Centre,
Post-Warora, Tehsil-Warora,
Chandrapur- Dist.,Maharashtra-442907

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LEVEL OF ASSURANCE: REASONABLE

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1. Objectives:

The objective of GHG accounting is to ***identify*** GHG Emissions ***caused*** by the operation, ***maintenance*** and management of GMR Warora Energy Limited (GWEL). The major operations/activities at GWEL include generation of electricity and other ancillary services e.g. STP, ETP, Balance of Plant (BOP) and transportation.

Furthermore, the purpose of GHG accounting is to improve environmental integrity while identifying and managing GHG-related risks, obligations, and opportunities to minimize GHG emissions through mitigation methods and optimizing greenhouse gas sources whenever practicable. It also seeks to ensure and enhance energy management in products, services, and activities within the operating boundaries.

2. Terms & Abbreviations

GWEL	GMR Warora Energy Limited
GHG	Green House Gas
IPCC	Intergovernmental Panel on Climate Change
NABL	National Accreditation Board for T
SAP	System, Applications and Products
GWP	Global warming Potential
ISO	International Organization for standardization
KM	Kilometer
KL	Kiloliters
LPG	Liquefied Petroleum Gas
STP	Sewage Treatment Plant
DEFRA	Department for Environment, Food and Rural Affairs
BOP	Balance of Plant
ETP	Effluent Treatment Plant
MSEDCL	Maharashtra State Electricity Distribution Company Limited
PPA	Power Purchase Agreement
UHBVNL	Uttar Haryana Bijli Vitaran Nigam Limited
TANGEDCO	Tamil Nadu Generation and Distribution Corporation
DDC	Digital Distribution Control
SCADA	Supervisory Control & Data Acquisition System
PLC	Programmable Logic Control
IT	Information Technology
HR	Human Resource
CFT	Cross Functional Team

3. Organization Overview.

3.1. Organization Description:

GMR Warora Energy Ltd (GWEL) is a subsidiary of GMR Power and Urben Infrastructre Ltd. operates 2 x 300 MW Coal Based power plant at Warora MIDC, Chandrapur district of Maharashtra, 90 km from Nagpur **(Figure – 1)**. Electricity Generated is transmitted through Power Grid Corporation of India Ltd., Bhadrawati, 35 Km from plant location. GWEL Supplies power under long term power purchase agreement. 91% Capacity tied up with Long term customer ensuring sustainability. Fuel supply agreement in place for the entire life of PPA. GWEL is fully tied up under long term PPA for 200 MW with Maharashtra State Electricity Distribution Company Limited (MSEDCL), 150 MW with Uttar Haryana Bijli Vitaran Nigam Limited (UHBVNL) and 150 MW with Tamil Nadu Generation and Distribution Corporation (TANGEDCO).

Figure – 1: Location Map of Organization

3.2. Reporting Organization:

GWEL's gross power generation capacity is 600 MW (2 x 300 MW), consisting of subcritical type coal fired boilers. The technology & major equipment used at the plants are boilers and auxiliaries, turbo-generators, transformers and auxiliaries, equipment for coal and ash handling, fuel oil system, de-mineralized water plant and other associated equipment. The equipment's are operated and controlled by state-of-art control and instrumentation sys-tem which includes Digital Distribution Control (DDC), Programmable Logic Control (PLC), and Supervisory Control & Data Acquisition System (SCADA).

The safety of the generation process is ensured through protection and interlock system such as DEH (Digital Electro Hydraulic Governing), FSSS (Furnace Safeguard Supervisory System), etc. IT infrastructure is extensively used within the company. Integrated ERP system (SAP) is used for carrying out all transactions, HR operations, etc. Distributed Control Systems (DCS) and various other modern plant automation systems at the plant ensure real time monitoring and control of plant operations and environ-mental performance parameters. Further, stack and ambient air parameters are monitored online as well as off-line.

GWEL is the foremost Integrated Energy Organization to implement all key SAP modules and other customized IT applications in record time. This has resulted in ensuring seamless access to Enterprise ERP for enhanced availability, accuracy, reliability, security, and confidentiality of Data and Information.

3.3. Awards & Accolades:

GWEL has received many National & International awards for Environmental Protection, Energy Conservation, Occupational Health & Safety Management and 5s Management at workplace. GWEL also certified with various management system as per ISO standards. The list of awards and certificate as mentioned in **Table – 1 & 2.**

3.4. Person Responsible /Cross – Functional GHG Management Team:

Head – EHS is GHG Coordinator and he is responsible for the accounting of GHG inventory, preparing GHG reports, and communicating reports to the concerned person. Cross Functional Team (CFT) members are responsible for accounting for GHG emissions and removals in their

respective areas. CFT Members have been identified and defined in **Table - 3** GHG Core Team Members.

Table 1: List of Awards

Sr. No.	Name of Award	Organization
1	Winner of 33rd National Energy Conservation Award – 2023	National Energy Conservation Award – 2023 by BEE, Ministry of Power (MoP), Government of India (GoI)
2	24th National award for Excellence in Energy Management – 2023	Confederation of Indian Industry (CII)
3	National Award for Excellence in Water Management – 2023	Confederation of Indian Industry (CII)
4	Safety Shield – 2022	National Safety Council (NSC)
5	Sarvashrestha Surksha Gold Award – 2022	National Safety Council (NSC)
6	Excellent Energy Efficient Unit Award - 2022	Confederation of Indian Industry (CII)
7	Best Environmental Management Award – 2023	Confederation of Indian Industry (CII)
8	Sword of Honor Health, Safety and Environment (HSE) Management System – 2021	British Safety Council

Table 2: List of Management System

Sr. No.	ISO Standard	Description
1	9001:2015	Quality Management System
2	14001:2015	Environmental Management System
3	45001:2018	Occupational Health & Safety Management System
4	50001:2018	Energy Management System
5	27001:2013	Information Security Management System
6	SA 8000:2014	Social Accountability in Workplace
7	55001:2014	Asset Management System
8	46001:2019	Water Efficiency Management System
9	17025:2017	NABL Accreditation for Coal, and Water Testing
10	17025:2017	NABL Accreditation for Calibration Lab for Mechanical &Thermal
11	26000:2010	Guidance on Social Responsibility
12	14064:2018	Quantifying and reporting Greenhouse gas emissions
13	27701:2019	Privacy Information Management System
14	22301:2019	Business Continuity Management System
15	14064:2018	Quantification and Reporting of GHG Emission and Removals

Table 3: Cross Functional GHG Management Team

Sr. No.	Name	Department	Responsibility
1	Praveen Shetty	EHS	GHG Co-coordinator, GHG inventory report preparation and audit
2	Bapiraju M	Operations Services	GHG inventory compilation Stationary combustion –Coal, LDO, Diesel
3	Vijendra Khandekar	EHS	GHG inventory compilation
4	Pallav Kulkarni	EHS	CO2 Fire Extinguisher
5	Kaushal Dewangan	Operation	Stationary combustion –Diesel, Fugitive emission- CO2
6	Sagar Bandurkar	Operations Services	Stationary combustion –Coal, LDO, Diesel
7	Ajendra Thakur	Stores	Upstream and downstream transportation miscellaneous
8	Deepak Das	Chemistry/WTP	Water treatment
9	Sandeep Bendre	Coal sourcing and Logistics	Upstream transportation Coal
10	Pamesh Aggarwal	Ash utilization	Downstream transportation Ash
11	Goutam K	TS/Legal	Downstream transportation Ash
12	Naveen Kumar	HR&FMS	Business travel, Employee commuting, food waste
13	Amit Rathod	F&A	Use of product by the organization

3.5. Purpose of the Report:

The purpose of this report is to demonstrate continual improvement of GWEL towards sustainable development by reporting its GHG emissions and it's intend towards reduction GHG emission. This report demonstrates

- ✓ Organization's performance progress tracking system for reduction of GHC emission and/or removal/mitigation programs.
- ✓ To identify risks and opportunities associated with carbon emission/removal.

3.6. Intended Users and Dissemination Policy

For reporting GHG accounting to the management of GMR Warora Energy Limited

- ✓ Business purpose to meet customer requirements, as required
- ✓ Internal users including top management, HODs, and other group companies, customers and Stakeholders.

This report is prepared for business purposes, to meet customer requirements, to ensure efficient operation, to mitigate emissions, etc. This report is used by the Management of GWEL and will be made available to the limited users /interested parties for information.

3.7. Reporting Period & Baseline Year

GHG inventory is prepared using methodologies consistent with the inventory guidelines. GHG Inventory Report is for financial year 2023-2024. The organization has chosen the financial year 2021-2022 verification year as the baseline year considering the availability of the required data mandatory for the GHG quantification for the reporting boundary. GHG report is published every financial year for the identified reporting boundary.

This base year will be reviewed every year and if required, the base year will be changed considering a significant change in organizational boundaries, change in calculation methodologies, and change in emission factors or there is a significant error observed in the calculated GHG inventories. There is no change in the baseline year (2021-2022) for the financial year 2023-2024.

3.8. Information Included in the Report & Organization Statement:

Climate change is a complex problem, which, although environmental in nature, has consequences on all spheres of existence in our planet. It impacts on or is impacted by global issues, including poverty, economic development, population growth, sustainable development, and resource management. It is not surprising that solutions to control climate changes come from all disciplines

including the field of research and development. However, at the beginning to the response to climate change, there is a need to reduce emissions.

While there has been some success in climate change mitigation, global emissions of greenhouse gases continue to rise. Increasingly frequent and progressively more severe impacts of climate change make the need for urgent action abundantly clear. This is underscored by a growing number of reports, which have also provided options and solutions for the world to act effectively to prevent much more serious climate change in the future.

This emissions inventory identifies and quantifies GWEL primary sources and sinks of greenhouse gases which are essential for addressing climate change. This inventory adheres to a comprehensive and detailed set of methodologies for the estimation of sources and sinks of anthropogenic greenhouse gases.

GWEL has been able to determine the emission of the following gases from its operations

- ✓ Carbon dioxide (CO_2),
- ✓ Methane (CH_4),
- ✓ Nitrous Oxide (N2O)
- ✓ Hydrofluorocarbons (HFCs)
- ✓ Sulphur Hexafluoride (SF6)

The GHG emission calculations are for all the identified sources within the organizational boundary of GWEL, Warora. The entire GHG Inventory Report is prepared following the principles and requirements of ISO 14064-1:2018. GHG Inventory report has been verified by a third-party verification body, Bureau Veritas Certification.

This report also includes Quantification Methodology, Uncertainty assessments, GHG Data management system, assumptions, GHG sink details, and directed actions by management.

The total emission expressed in terms to tons of carbon equivalent (tCO2e).

4. GHG Inventory Design and Development

4.1. Organizational Boundaries:

The company used the operational control-based approach to defining organizational boundaries. The reporting period is from **01.04.2023 to 31.03.2024.** Every process and sub process identified and fuel/GHG gases used in that processes identified. All 6 categories considered for inventory calculation. Some processes not included due to inaccuracy unavailability of data.

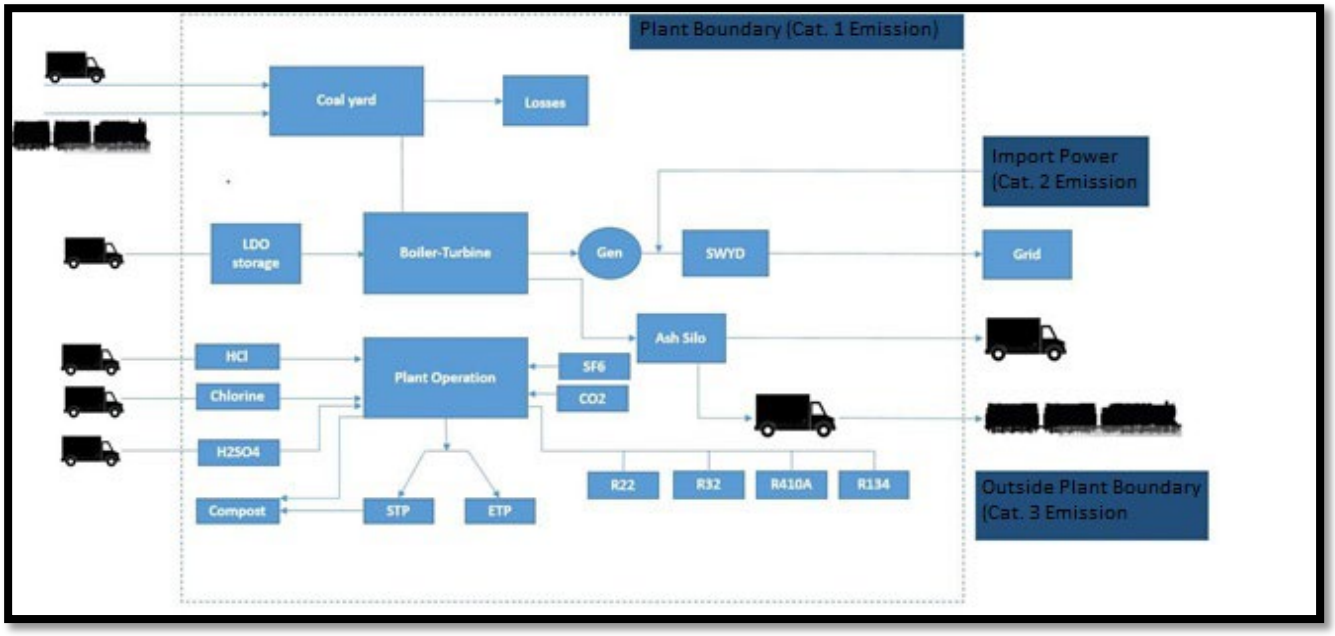

Figure 2: Organization Boundaries

4.2. Plant Process Flow

Coal is received through rail wagons, unloaded by wagon tippler, transported through belt conveyors. Coal stacked or direct feed to coalbunkers or stacked at coal yard through stacker and reclaimed. The coal is drawn from the bunkers by gravimetric feeders and fed into the coal pulverizer (mills). Pulverized and carried to the coal burners in the Boiler (steam generator). LDO is used as secondary fuel for startup activity.

This steam generated in boiler is fed to turbine assembly, which drives the Turbo generator. The Turbo generator at its full capacity can deliver 350 MW power at 20 KV. Generated power injected to grid through 400 KV switch yard (SWYD) and during initial startup power is imported from Grid Flue gases from the boiler are cooled in air pre heaters and then cleaned by electrostatic precipitators to remove ash. Removed Ash is collected in ash silo. Collected ash is disposed / utilized out of plant through rail and road mode.

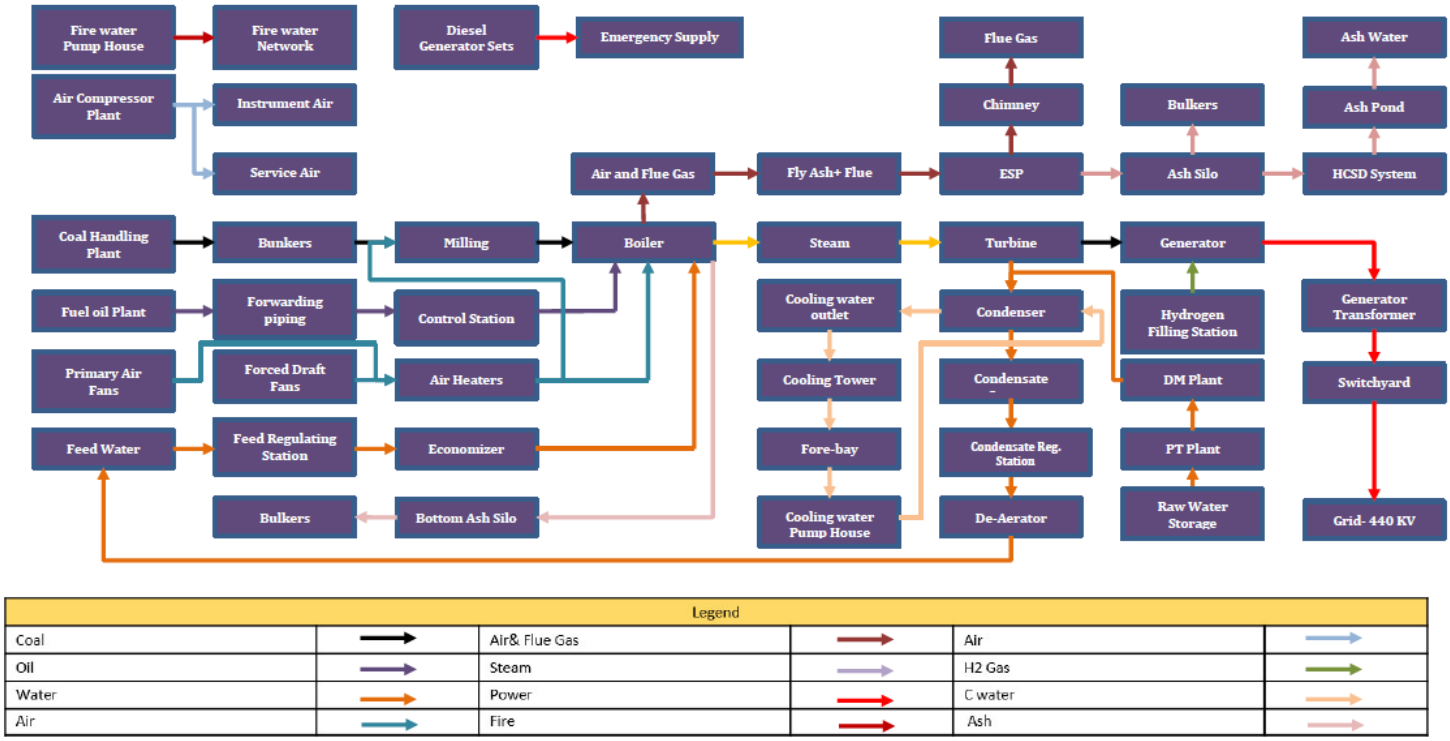

Figure 3: Plant Process Diagram

4.3. Reporting Boundary:

The operational boundaries include the identification of GHG emissions and removals associated with the organization operations. GHG emissions arising from all activities coming under our operational control for all part of the reporting year FY 2023 – 24.

These facilities include:

- ✓ Power plant.
- ✓ Employee accommodation –Township

Criteria for arriving at Significant emission:

- ✓ GWEL's gross power generation capacity is 600 MW (2 x 300 MW), consisting of subcritical type coal fired boilers. Coal is the used as primary fuel in boilers. Significant emission from our operations is from combustion of coal in boiler.

4.4. Geographical Boundary

GMR Warora Energy Limited,
Plot No. B – 1, Mohabala MIDC Warora Growth Centre,
Post-Warora,Tehsil-Warora,Chandrapur,
Maharashtra-442907, India

5. Quantification & Methodology of GHG Emission

5.1 Identification of GHG Sources & Sink:

Emissions sources were identified with reference to the methodology described in the ISO14064-1:2018.

These emissions have then been classified into 6 categories:
Category 1: Direct greenhouse gas emission
Category 2: Indirect greenhouse gas emission from purchased energy
Category 3: Indirect greenhouse gas emission from transport
Category 4: Indirect greenhouse gas emission from the use of product by the organization
Category 5: Indirect GHG emissions associated with the use of products from the organization
Category 6: Indirect GHG emissions from other sources.

Table 4: GHG Emission Sources

Category 1: Direct Green House Gas (GHG) Emission		
1. Direct Emissions from Stationary Combustion Source		**Type of GHG**
1.1	Emission from Boiler operation (Coal)	CO2, CH4, N2O
1.2	Emission from Boiler operation (LDO)	CO2, CH4, N2O
1.3	Emission from DG sets & Fire Diesel Pump (Diesel)	CO2, CH4, N2O
1.4	Emission from 'Dozers, LOCO & other machineries for coal & ash handling (Diesel)	CO2, CH4, N2O
1.5	Emission from Cooking Plant Canteens (LPG)	CO2, CH4, N2O
1.6	Emission from Cooking Township Guest House (LPG)	CO2, CH4, N2O
1.7	Emission from Cooking Township Residents (LPG)	CO2, CH4, N2O
1.8	Emission from Balance of Plant Maintenance (LPG)	CO2, CH4, N2O
1.9	Emission from AHP Maintenance (LPG)	CO2, CH4, N2O
1.10	Emission from CHP Maintenance (LPG)	CO2, CH4, N2O
1.11	Emission from CO2 from Consumption Fire Fighting	CO2
1.12	Emission from CO2 from Turbine Generator	CO2
1.13	Emission from Refrigerant Cooling Gases	R- 22, R-407C, R-410A, R134A
1.14	Emission from Food Waste Treatment - Plant	CH4
1.15	Emission from Food Waste treatment – Township	CH4
1.16	Emission from Wastewater Treatment - Plant	CH4
1.17	Emission from Wastewater Treatment - Township	CH4
Category 2: Indirect Green House Gas (GHG) Emission		
2. In Direct GHG Emission from Purchased Electricity		
2.1	Emission from Purchased Electricity – Grid	CO2e

Category 3: Indirect Green House Gas (GHG) Emission from Transportation		
3.1 Emission from Upstream Transportation		**Type of GHG**
3.1.1	CO2 cylinder Transportation	CO2e
3.1.2	Electrical Parts for Transportation (for Maintenance)	CO2e
3.1.3	Chlorine Tonner transportation	CO2e
3.1.4	HCL Transportation	CO2e
3.1.5	LDO Transportation	CO2e
3.1.6	Coal Transportation – Rail	CO2e
3.1.7	Coal Transportation – Road	CO2e
3.2 Emission from Downstream Transportation		
3.2.1	Ash Transportation- Rail	CO2e
3.2.2	Ash Transportation- Road	CO2e
3.3 Emission from Business Travel		
3.3.1	Business Travel – Flight	CO2e
3.3.2	Business Travel – Rail	CO2e
3.3.3	Visitors Transport	CO2e
3.3.4	Hired Vehicle for Employee Travel	CO2e
Category 4: Indirect Green House Gas (GHG) Emission from use of product by the organization		
4.1	Emission from Supply Chain	
4.1.1	Machinery & Equipment's	CO2e
4.1.2	Computer, electronics & optical products	CO2e
4.1.3	Office/Electrical equipment's	CO2e
4.1.4	Buildings & construction work	CO2e
4.1.5	Cement purchase	CO2e
4.1.6	Steel purchase	CO2e
4.1.7	Extraction of Coal from Mine	CO2e
Category 5: Indirect GHG Emissions Associated with the Use of Products from Organization		**Not Accounted**
Category 6: Indirect GHG Emissions from Other Sources		**Not Accounted**
Removal/Sink		
1	Direct Removals from Biomass Utilization	CO2e
2	Direct Removals from Carbon Sequestration	CO2e

5.2 GHG Quantification Methodology:

The ISO 14064-1:2018, CO2 baseline database for Indian power sector user guide -version 19.0 by CEA (Ministry of Power-GOI), provides the methodological framework for calculating the GHG emission. We have adopted these guidelines for quantifying and reporting GHG inventories. GHG

is calculated and converted into CO2 equivalent (CO2e) with the help of the specified equivalence emission factors.

All the calculations of GHG emissions sources are based on emission factor method calculation. All the conversion factors and data used are based on standard accepted protocols [CO2 baseline database for Indian power sector user guide-version 19.0 by CEA (Ministry of Power-GOI), IPCC, DEFRA, Emission Factors for Greenhouse Gas Inventories by EPA, etc.

Methodologies are selected and used in such a way that they reasonably minimize the uncertainty or bias and yield accurate, consistent and reproducible results, in other words, to ensure consistent results.

GHG Emissions=Activity data (AD) X Emission Factor (EF) or Global Warming Potential (GWP)

$$AbsCO_2(station)_y = \sum_{i=1}^{2} FuelCon_{i,y} \times GCV_{i,y} \times EF_i \times Oxid_i \quad (1)$$

Where:

$AbsCO_{2,y}$	Absolute CO_2 emission of the station in the given fiscal year 'y'
$FuelCon_{i,y}$	Amount of fuel of type i consumed in the fiscal year 'y'
$GCV_{i,y}$	Gross calorific value of the fuel i in the fiscal year 'y'
EF_i	CO_2 emission factor of the fuel i based on GCV
$Oxid_i$	Oxidation factor of the fuel i

5.3 Collection of Activity Data & Calculation Methodology:

Activity data is collected consistent with the GHG quantification methodology to quantify the GHG emission and removals. GHG activity data considered for our GHG inventory includes Fuel invoices, ERP logs (SAP), for measuring instruments, calibration is carried out by annual basis.

5.3.1 Heat from Coal Consumption:

Inputs are

- Coal consumption month wise from SAP
- Weighted average Fired GCV month wise
- Carbon % of coal from ultimate analysis
- Weighted average Fired GCV month wise
- Emission factor of CEA CO2 calculation guidelines

Calculation methodology

- Month wise coal consumption to be recorded from SAP and weighted average GCV from form 15 data / chemical lab report.
- GCV to be calculated based on H2% and moisture % reported to CEA.
- Heat value of coal fired calculated TJ
- Calculation based on CEA Emission factor taken from Appendix- B of CEA User Guide__Version_19.0.
- Carbon %, moisture %, unburn carbon content % in fly ash taken from CEA Format for data of Coal/Lignite based Thermal Power Stations (FY 2023-24).

5.3.2 Furnace Oil (LDO):

- LDO consumption data to be collected from SAP, DGR and log book to be used as objective evidence.
- GHG emission will be calculated based on IPCC default emission factor for stationary combustion in the energy industries (kg of greenhouse gas per TJ on a Net Calorific Basis) refinement in 2019.

5.3.3 Diesel Used in Plant Premise:

- Store issue data for diesel used for contract vehicle. GHG emission will be calculated based Diesel consumption data to be collected from SAP, DGR and log book to be used as objective evidence.

- GHG emission will be calculated based on IPCC default emission factor for stationary combustion in the energy industries (kg of greenhouse gas per TJ on a Net Calorific Basis) refinement in 2019.
- Losses to be included as consumption

5.3.4 LPG Used in Plant Premise:

- LPG is used in canteen, Township, oxy fuel cutting operation. Store data to be used for LPG receipt month wise. Sum of total LPG consumption will be multiplied with emission factor.
- GHG emission calculated based on IPCC default emission factor for stationary combustion in the energy industries (kg of greenhouse gas per TJ on a Net Calorific Basis) refinement in 2019.

5.3.5 CO2 Consumption:

- Co2 gas consumption to be collected from operation used for CO2 gas purging in generator.
- Co2 gas consumption to be collected from Fire department for CO2 fire extinguisher used
- Emission factor Ref- Table – 5

5.3.6 Refrigerant gases. (HFC (R)- 22, HFC (R)-407 C, R-410A, HFC, (R-134A):

- Refrigerant use to be collected from contractor job sheet signed copy month wise. Day wise use to be calculated based on cylinder weight drop.
- Emission factor Ref: Calculation based on UK Government GHG Conversion Factors for Company Reporting (DEFRA).
- Link:https://www.gov.uk/government/publications/greenhouse-gas-reporting-conversion-factors-2024.

5.3.7 STP /Water Treatment:

- STP data to be calculated from meter reading at output of STP (Final reading – Initial reading) for the month

- Emission factor Ref: Calculation based on UK Government GHG Conversion Factors for Company Reporting (DEFRA).
- Link: https://www.gov.uk/government/publications/greenhouse-gas-reporting-conversion-factors-2024.

5.3.8 Electrical Energy Import:

- Import data to be collected from OS MIS report
- CTU data (Switchyard meter import data) to used as objective evidence
- CTU data (WRLDC data) also can be considered as objective evidence
- Emission factor Ref- https://cea.nic.in/wp-content/uploads/baseline/2024/04/User_Guide Version_19.0.pdf

5.3.9 Emission in Coal Trucks:

- No of trucks against each source of mines
- Distance of mines
- Mileage of truck
- SAP Weighbridge data to be used as objective evidence.
- Emission factor Ref- Table – 5
- Uncertainty- Mileage is considered min mileage provided by OEM of trucks used for transport with an approach of conservativeness.

5.3.10 Emission in Coal Transport in Rail Mode:

- No of rakes against each destination of coal suppliers
- Distance of mines
- Calculation to be done for tone /km
- Emission factor to be used co2 in (kg / ton-km)
- SAP Store receipt data to be considered. (RR quantity)
- Emission factor Ref- Table – 5

5.3.11 Emission from transportation for Supply of H2SO4, HCl, Chlorine, H2:

- No of trucks against each destination of chemical suppliers
- Distance of supplier (Multiplied by 2 for to and fro)
- Emission factor Ref- Table – 5

5.3.12 Emission from Business travel:

- For GHG accounting of Business, travel done by GWEL employees in the FY using the online tool for carbon emission calculation - www.icao.int/environmental-protection/Carbonoffset for Passenger,
- In the tool by putting the Origin, Destination, No. of passenger (one) and trip as one way,
- The carrier is by default taken by the tool as 320/32A/32N/32Q,
- The output of the inputs and consideration by the tool is the CO2 Emissions per passenger,
- The CO2 emission is coming in kgCO2 that is to be converted in tCO2.

5.3.13 Emission in Ash logistic diesel- External:

- No of trucks against each destination of ash transportation inside the plant
- Distance of supplier (Multiplied by 2 for to and fro)
- Emission factor Ref- Table – 5

5.3.14 Emission from purchase of capital goods (Machinery & equipment's, Computer, electronics & optical products, Electrical equipment's, Buildings & Buildings construction work:

- Capital goods emission calculation based on spent basis.
- Refer Carbon Saver tool 2024.
- The 2024 factors are based on the latest UK Footprint data published by DEFRA in 2024.
- Emission factor Ref- Table – 5

5.3.15 Emission in purchase of Cement Purchase:

- Total quantity of cement purchases to be taken from SAP/Store receipt data.
- Average CO2e emission per MT of cement production to be taken from 03 cement manufacturing unit.
- Emission factor Ref- Table – 5

5.3.16 Emission from purchase of Steel:

- Total quantity of cement purchases to be taken from SAP/Store receipt data.
- Average CO2e emission per MT of steel production to be taken from 03 steel manufacturing unit.
- Emission factor Ref- Table – 5

5.3.17 Emission from Coal purchase:

- Total quantity of coal purchases to be taken from SAP/Store receipt data.
- CO2e emission per MT of Coal production to be taken from Coal India BRSR report.
- Emission factor Ref- Table – 5

5.4 Reference Details for Emission & Removal Factor:

The references for emission and removal factors are mentioned in **Table – 5**.

Table 5: References Details for Emission Factor

Sl.no.	Description	Value	Source
1	Emission Factor based on GCV for Coal (KG/TJ)	92500	CO2 Baseline Database for the Indian Power Sector User Guide Version 19.0 December 2023
2	LDO CO2 emission factor (kg/TJ)	77400	IPCC 2019 Guideline Vol. 2 Chapter 2 Stationary Combustion Table 2.2
3	LDO CH4 emission factor (kg/TJ)	3	IPCC 2019 Guideline Vol. 2 Chapter 2 Stationary Combustion Table 2.2
4	LDO N2O emission factor (kg/TJ)	0.6	IPCC 2019 Guideline Vol. 2 Chapter 2 Stationary Combustion Table 2.2
5	Diesel CO2 emission factor (kg/TJ)	74100	IPCC 2019 Guideline Vol. 2 Chapter 2 Stationary Combustion Table 2.2

6	Diesel CH4 emission factor (kg/TJ)	3	IPCC 2019 Guideline Vol. 2 Chapter 2 Stationary Combustion Table 2.2
7	Diesel NO2 emission factor (kg/TJ)	0.6	IPCC 2019 Guideline Vol. 2 Chapter 1 Introduction Table 2.2
8	LPG CO2 Emission factor (kg/TJ)	63100	IPCC 2019 Guideline Vol. 2 Chapter 2 Stationary Combustion Table 2.2
9	LPG CH4 Emission factor (kg/TJ)	1	IPCC 2019 Guideline Vol. 2 Chapter 2 Stationary Combustion Table 2.2
10	LPG NO2 Emission factor (kg/TJ)	0.1	IPCC 2019 Guideline Vol. 2 Chapter 2 Stationary Combustion Table 2.2
8	Calorific Value of Coal Domestic (Kcal/kg)	3579	LAB Report GMR Warora Energy Limited NABL Accredited Chemistry Lab
9	Calorific Value of Coal Imported (Kcal/kg)	4908	LAB Report GMR Warora Energy Limited NABL Accredited Chemistry Lab
10	Calorific Value of LDO (Kcal/kg)	10622	LAB Report GMR Warora Energy Limited NABL Accredited Chemistry Lab
11	Calorific Value of Diesel (Kcal/kg)	10764	LAB Report GMR Warora Energy Limited NABL Accredited Chemistry Lab
12	Calorific Value of LPG (Kcal/kg)	11300	HPCL Website
13	Density of LPG (KG/L)	0.58	HPCL Website
14	Density of LDO (KG/L)	0.88	LAB Report GMR Warora Energy Limited NABL Accredited Chemistry Lab
15	Density of Diesel (KG/L)	0.82	LAB Report GMR Warora Energy Limited NABL Accridiated Chemistry Lab
16	GWP of CO2	1	Department for Environment, Food and Rural Affairs (DEFRA 2024)/ Refrigerant &others
17	GWP of HFC (R)- 22	1760	
18	GWP of HFC (R)-407 C	1624	
19	GWP of R-410A	1924	
20	GWP of HFC (R)134A	1300	
21	GWP of HFC SF – 6	23500	
22	GWP of Food Waste (CH4)	8.88386	Department for Environment, Food and Rural Affairs (DEFRA 2024)/ Waste Disposal
23	GWP of Treatment of Wastewater (CH4)	0.18574	Department for Environment, Food and Rural Affairs (DEFRA 2024)/ Water Treatment
24	Grid Electricity	0.716	CO2 Baseline Database for the Indian Power Sector User Guide Version 19.0 December 2023
25	CO2 Emission factor by Fuel (CO2e/Unit)	2.91	1. GHG protocol 2024 CO2 Emission Factors by Fuel 2. Link: Emission_Factors_for_Cross_Sector_Tools_V2.0_0.xlsx

26	CO2 Emission factor Coal Transport by Rail (CO2e/Unit)	0.00996	Emission factors from India Specific Rail Transport Emission Factor for Passanger Travel and Material Transport: India GHG Program: 2015 Version 1.0
27	CO2 Emission factor Passenger Travel by Rail (CO2e/Unit)	0.007837	Emission factors from India Specific Rail Transport Emission Factor for Passanger Travel and Material Transport: India GHG Program: 2015 Version 1.0
28	CO2 Emission factor Passenger Travel by Air (CO2e/Unit)	0.16098	DEFRA 2024/Business Travel Air
29	CO2 Emission factor Passenger Travel by Air (CO2e/Unit)	2.66155	DEFRA 2024/Fuel
30	Supply Chain CO2 emission factor for Machinery & Equipment (kgCO2e/INR)	0.44527	Carbon Saver: DEFRA 2024 Supply Chain CO2e
31	Supply Chain CO2 emission factor for Computer, electronics & optical products (kgCO2e/INR)	0.40382	Carbon Saver: DEFRA 2024 Supply Chain CO2e
32	Supply Chain CO2 emission factor for Office/Electrical equipment's(kgCO2e/INR)	0.43781	Carbon Saver: DEFRA 2024 Supply Chain CO2e
33	Supply Chain CO2 emission factor for Buildings & construction work(kgCO2e/INR)	0.32368	Carbon Saver: DEFRA 2024 Supply Chain CO2e
34	Cement Purchase (TCO2/Cement)	0.54	BRSR Report FY 2022-23 of Shree Cement Ltd. (tCO2/per Ton of Cement Production)
35	Steel Purchase (TCO2/tcs)	2.49	Sustainability Report FY 2022-23 of SAIL (tCO2/per Ton of Steel production)
36	Coal Extraction from (tCO2e)	0.085	BRSR Report FY 2021-22 Coal India Limited
Removal			
37	Biomass CO2 emission factor (kg/TJ)	100000	IPCC 2019 Guideline Vol. 2 Chapter 2 Stationary Combustion Table 2.2
38	Biomass CH4 emission factor (kg/TJ)	30	IPCC 2019 Guideline Vol. 2 Chapter 2 Stationary Combustion Table 2.2
39	Biomass N2O emission factor (kg/TJ)	4	IPCC 2019 Guideline Vol. 2 Chapter 2 Stationary Combustion Table 2.2
40	Direct Removals from Tree Plantation (kgCO2e/Tree)	25	https://ecotree.green/en/how-much-co2-does-a-tree-absorb

5.5 Spend Based Method:

The spend-based method is a carbon accounting method that estimates greenhouse gas (GHG) emissions by multiplying the financial value of a purchased good or service by an emission factor. One of the main advantages of spend based method analysis is that they require less detailed data than other methods, making them less time-consuming and less expensive to implement. Additionally, spend-based method can be useful for organizations with complex supply chains, where it may be difficult to obtain accurate data on all emissions associated with each activity.

5.6 Supply-Specific Method:

Calculating emissions using the Supplier-Specific method involves gathering suppliers' activity data, identifying the right emissions factor(s), and converting the activities to CO2e. This method requires the re-porting company to collect operational data from its suppliers.

Supplier-Specific Category 3 Emissions= Supplier Activity * Secondary Emission Factor

The GHG Protocol recommends the Supplier-Specific calculation method be used for Category 3 categories 1(purchased goods and services), 2 (Capital goods), 3 (Fuel- and energy-related activities), and 5 (Waste generated in operations).

5.7 Uncertainty & Accuracy:

Uncertainty analysis is one aspect of accounting for GHG emissions. We have attempted to capture basic uncertainty assessment for GHG inventory data. GHG activity data considered for our GHG inventory includes Fuel invoices, ERP logs (SAP), NABL accredited Coal lab reports for coal GCV. The values of emission factors and other input assumptions are based on relevant, credible, and publicly available sources and hence are most appropriate and lead to correct calculation of GHG emissions. Uncertainty analysis done as per GHG Protocol guidance on uncertainty assessment in GHG inventories and calculating statistical parameter uncertainty. Cumulated uncertainty for direct emission is +/-2.8% which having "HIGH" Aggregated certainty ranking (Annexure – A) followed by +/-6.5% for Indirect GHG emission which reflect "GOOD" Aggregated certainty ranking (Annexure – B).

5.8 Exclusion:

The below mentioned are excluded for calculating GHG inventory

- Indirect GHG emissions from Transportation-Visitors' travelling to the site with their own vehicles. This was not done this year as the visits and the usage could not be accurately captured and recorded in our records. This element of GHG Source would be included in the next year report.
- Indirect emissions from Contractor employee travel, when happens through their own vehicles (two wheeler/ four wheeler) is not considered this year as their quantification is currently not technically feasible.
- Use of Welding Electrode
- Use of Employee Own Vehicle for commuting to work
- Emission from supply of spare and consumable
- Emission from Cement Transportation
- Emission from Steel Transportation

6. GHG Inventory

6.1 Direct Emission:

Category—1 Emission which consists of Stationery Combustion Sources, Mobile Combustion Sources, Direct Fugitive Emission and Emission from Waste Treatment. An emission calculation is mentioned in Table – 6a & 6b.

Table – 6a: GHG Inventory Stationary Combustion Sources

Emission Source	Fuel	Fuel Consumption (MT or KL/ Annum)	Average As Fired Fuel GCV (Kcal/ Kg)	Total Heat value (T Joule)	Emission			
					tCO2	tCO2 from CH4	tCO2 from N2O	Total GHG (tCO2e
Boiler Operation	Coal - Domestic	2814158.62	3579	42138.01	3879366.44	3476	17256	3900098.34
Boiler Operation	Coal - Imported	130.73	4908	3	228.13	0.22	1	229.45
Boiler Operation	LDO	423.544	10,622.00	10.55	816.27	2.61	1.73	820.61
'DG sets & Fire Diesel Pump	Diesel	2.68	10,764.00	0.07	5.01	0.02	0.01	5.04
'Dozers, LOCO & other machineries for coal & ash handling	Diesel	317.736	10,764.00	8.02	594.08	1.98	1.31	597.38
'Cooking at canteen and guest house, Oxy fuel cutting at plant O&M	LPG	14.993	11,300.00	0.40	25.06	0.03	0.003	25.10
Total GHG Emission (tCO2e)								**3901775.91**

Table – 6b: GHG Inventory from Refrigerant's & Treatment of Waste & Wastewater

Basis (Spend/actual measurement	Emission Source	Fuel Type	Fuel/GHG consumption	Quantity (MT & KL)	GWP in CO2e/Unit	Total GHG (tCO2e)
Actual measurement	CO2 consumption (Fire extinguisher and Generator purging)	Gas	CO2	1.41	1	1.41
Actual measurement	Air Conditioner	Gas	HFC (R)- 22	0.121	1760	212.96
Actual measurement	Air Conditioner	Gas	HFC (R)-407 C	0.01	1624	19.49
Actual measurement	Air Conditioner	Gas	R-410A	0.051	1924	98.12
Actual measurement	Air Conditioner	Gas	HFC (R)134A	0.0836	1300	108.68
Actual measurement	Electrical Breaker	Gas	SF6	00	23500	0
Actual measurement	Treatment of Food Waste	Gas	CH4	13.93	8.88	123.78
Actual measurement	Treatment of waste water	Gas	CH4	15909.00	0.186	2.95
Total GHG Emission (tCO2)						**567.39**

6.2 In Direct Emission:

Category—2 Emission consists of purchasing electricity from the grid. GWEL caters auxiliary power demand with its own power generation, although electricity is being purchased when both units are shut down to meet the APC requirements. In FY 2023—24 GWEL purchased an electricity from grid and emission occurred from the same is as follows in Table – 7.

Table – 7: GHG Inventory from Indirect Greenhouse Gas (GHG) Emission

Basis (Spend/actual measurement	Emission Source	Fuel Type	Quantity	CO2e/Unit	Total tCO2e
Actual measurement	Purchased Electricity Consumption	From Grid	171.35	0.716	**122.68**

6.3 Indirect Emission (Transportation):

Category—3 Emissions come from upstream and downstream activities such as transportation of raw material, fuel, material purchased, waste generation from operation & its disposal and business travel. Emissions are mentioned in Table – 8.

Table 8: GHG Inventory from Transportation

Basis (Spend/actual measurement	Emission Source	Fuel/GHG consumption	Quantity	UoM	Emission Factor CO2e/Unit	Total GHG (tCO2e)
Actual measurement	Transportation of Coal by Road	Diesel	3297001.00	KM	2.91	9,594.27
Actual measurement	Coal transportation by Rail	Diesel/Electrical	4943814517	Ton-KM	0.00996	49,240.39
Actual measurement	Transport of Ash Outside Plant Premises - Road	Diesel	3791536.00	KM	2.91	11,033.37
Actaul measurement	Transport of ash by Rail	Diesel/Electricity	68427314.00	Ton-KM	0.00996	681.54
Actual measurement	Transportation H2SO4 by Road Tankers	Diesel	55800.00	KM	2.91	162.38
Actual measurement	Transportation HCl by Road Tankers	Diesel	880.00	KM	2.91	2.56
Actual measurement	Transportation of Chlorine by Road	Diesel	4320.00	KM	2.91	12.57
Actual measurement	Transportation of CO2 by Road	Diesel	320.00	KM	2.91	0.93
Actual measurement	Transportation of LDO by Road Tankers	Diesel	32400.00	KM	2.91	94.28
Actual measurement	Transportation of Electrical Parts	Diesel	6133.00	KM	2.91	17.85
Actual measurement	Business Travel - Air	Aviation Fuel	219237.50	P-KM	0.16098	35.29
Actual measurement	Business Travel - Rail	Diesel/Electricity	17145.00	P. – KM	0.00784	0.13
Actual measurement	Visitor Transport	Mixed	14134.00	KM	0.16984	2.40
Actual measurement	Hired vehicle (under company for employee travel)	Diesel	28158.00	Litre	2.7	74.94
					Total GHG Emission (tCO2e)	**70952.96**

6.4 In Direct Emission (Product Used By Organization):

Category—4 Emissions are come from supply chain which defined as use of product by organization. The emission inventory is mentioned in Table – 9.

Table 9: GHG Inventory from Product Used by Organization

Basis (Spend/actual measurement	Emission Source	Quantity	UoM	CO2e/Unit	Total GHG (tCO2e)
Spend-based method	Machinery & equipment's	72173846.15	INR	0.00425	306.44
Spend-based method	Computer, electronics & optical products	15013008.32	INR	0.40382	6,062.59
Spend-based method	Office/Electrical equipment's	3444440.95	INR	0.43781	1,508.01
Spend-based method	Buildings & construction work	13057216.82	INR	0.3237	4,226.34
Supplier-specific method	Cement purchase	59.55	MT	0.54	32.16
Supplier-specific method	Steel purchase	57.92	MT	2.49	144.22
Supplier-specific method	Coal purchase (from CIL)	2814158.62	Ton	0.085	239,203.48
				Total GHG Emission (tCO2e)	**251483.2428**

7. GHG Mitigation & Reduction Targets.

7.1 GHG Mitigation:

Few Key improvements made on GHG emission reduction during the reporting period are:

- Maximizing sourcing of coal from nearest coal mines which has dedicated road constructed by GWEL which reduced Category 3 emission from upstream transportation.
- Maintaining the Greenbelt with over 1.57lac trees developed over last 10 years of plant operation
- Biomass Pellet utilization in Boiler Operation.
- Various efficiency improvement and Energy conservation projects: The objective of these projects is to reduce Auxiliary power consumption and Heat rate improvement. These reduction results in an direct reduction of Greenhouse Gas emissions. The following table contains the details of the energy efficiency projects.

Mitigation Efforts & key improvements are mentioned in Table – 10a, 10b & 10c.

Table – 10a: Carbon Offset Through Biomass Utilization

Emission Source	Fuel	Fuel Consumption (MT or KL/ Annum)	Average As Fired Fuel GCV (Kcal/ Kg)	Total Heat value (T Joule)	Emission			
					tCO2	tCO2 from CH4	tCO2 from N2O	Total GHG (tCO2e
Boiler Operation	Biomass	79.1	3447	1.142	114.156	0.034	0.0046	**114.20**

Table – 10b: Carbon Offset Through Biomass Utilization

No. of Tree Planted as on 31.03.2024	Survival Rate (%)	Net Tree Available	Carbon Sequential Rate (in kg CO2 per plant-year)	Avg. Age of Tree (Yrs.)	GHG Removal (tCO2e)
157430	90	141687	25	6	**3542.18**

Table – 10c: Energy Conservation Projects (FY 2023-24)

SN	Description of energy efficiency improvement measure	Fuel	Units	Annual Verified Energy Savings	Total GHG (tCO2e)
1	Improvement in first stage pressure through reduction of throttle Loss by Governing Valve Overhauling and replacement.	Coal	MT	267	1.967
2	Optimization of Illumination and reduction in power consumption through optimal operation of LED along with reduction in LED wattage.	Electricity	KWH	143,856	103
3	Mill and PA fan current optimization by 4 amps through Mill aero foil Replacement.	Electricity	KWH	212,783	152
4	Draft power Consumption Optimization by 22 Amps through Flue gas duct & primary air duct ceramic tiles inspection & replacement.	Electricity	KWH	1,170,307	838
5	Boiler Radiation loss by 0.02% & Draft Power Consumption optimization by 4 Amps through Refractory & Insulation Repair and Replacement.	Coal	MT	484	3.567
		Electricity	KWH	212,783	152
6	Turbine Cycle Heat rate improvement through Improvement in TTD by 0.5 Deg.C & DCA by 1.2 Deg.C through HPHs partition plate repair & replacement.	Coal	MT	13	0.096
7	Reduction in Fan power consumption by 10 Amps through Implementation of CAVT recommendation in second pass of unit-1.	Electricity	KWH	569,548	408
8	ID fan power consumption optimization by reducing Air Leakage through APH Sector- plate & seal servicing and replacement.	Coal	MT	2873	21.171
		Electricity	KWH	284,774	204
9	APC optimization through Three coal mill operation instead of four coal mill operation during partial load operation. (Mill Current - 48 Amps)	Electricity	KWH	3,191,748	2285
10	Installation of 70 kWp roof top Solar Plant to cater building power consumption from conventional energy sources.	Electricity	KWH	9,728	7
11	Condenser vacuum improvement by 0. 36 kPa(abs) through Cooling Tower Performance Improvement Program (Existing Cooling Tower	Coal	MT	2158	15.902

	Drift Eliminator, Nozzle & Fill Replacement, CW line modification etc.)				
12	Optimization of Diesel Consumption by 20.6 KL through Installation of vibrating feeder in second stream conveyor - BCN 2B	HSD	L	20681	38.651
13	Condenser Performance Improvement by 0.21 kPa (abs) in unit 2 through condenser tube jet cleaning, helium Leak test & hydro test.	Coal	MT	279	2.056
14	Boiler Feed pump Current Consumption optimization by 5 Amps through cartridge replacement & rectification of RC valve	Electricity	KWH	284,774	204
15	Strengthening Energy Management system through Digitalization and Integration with AI based predictive analytics. (Viz. Early identification of BFP RC valve passing issue etc.)	Electricity	KWH	1,751,293	1254
16	Ash Handling Plant Transport Air Energy Consumption reduction by compressor current reduction by 9 Amps using Ultrasound analyzer for air leakage detection	Electricity	KWH	509,543	365
17	Mill Seal air Fan Power Current Optimization by 3 Amps through IGV auto operation.	Electricity	KWH	139,639	100
18	Diesel Consumption Optimization by 61.3 KL through reduction of Truck Idle time running hours.	HSD	L	61320	44
19	HVAC power consumption optimization through Chiller Efficiency Improvement by reducing Chiller water inlet temperature by 2 Deg.C	Electricity	KWH	26859	19
Total Emission Reduction (tCO2e)					**6218.78**

7.2 GHG Reduction Targets:

GHG emission targets for FY 2023 – 24 is as follows:

- 29% Reduction of GHG emission by 2032.
- Switching Energy Source from thermal to solar for Admistartion Building by FY 2024.
- Switching Energy Source from thermal to solar for Greenwood Township by FY 2026.
- Enhance Biomass Utilization up to 5% by FY 2026.
- Set up 45 MW Solar Plant by 2026.

8. Conclusion

8.1 GHG Performance:

GHG report is prepared in accordance with ISO 14064-1:2018. Overall GWEL's GHG emission is **4224902** tonnes of CO2e. This represents direct emissions from fuel combustion and energy generation (Category 1), Indirect emissions from purchased electricity (Category 2), and indirect emissions from upstream and downstream transportation (Category 3), Indirect emissions from the use of product by the organization (Category 4).The reported GHG emissions & CO2 offset for the reporting period as per the GWEL submitted information on GHG Inventory for the year ended March 31, 2024 are mentioned in Table – 11.

Table 11: GWEL GHG Performance FY 2023 – 24

Category	Source	Emission (Tones of CO2e)
Category 1	Direct GHG emissions	3902343.30
Category 2	Indirect GHG emissions from imported energy	122.68
Category 3	Indirect GHG emissions from transportation	70952.92
Category 4	Indirect GHG emissions from products used by organization	251483.24
Category 5	Indirect GHG emissions associated with the use of products from the organization	Not Inventoried
Category 6	Indirect GHG emissions from other sources	Not Inventoried
GHG Removal	Biomass Utilization for Boiler Operation	114.20
	Green Belt Development	3542.18
	Emission Reduction Through Energy Conservation Projects	6218.78
Total GHG Emission for the Year 2023-24 (Tonnes of CO2e)		**4224902**
Net Power Generation (MWh) for FY 2023-24		**4365630**
Specific Emission (Direct) in tCO_2e **(tCO2e/MWh) -Net generation basis**		**0.8939**
Specific Emission (Total) in tCO_2e **(tCO2e/MWh) -Net generation basis**		**0.9678**

8.2 GWEL GHG Performance Tracking:

GWEL specific GHG emission is graphically represent in figure – 3 is as follows:

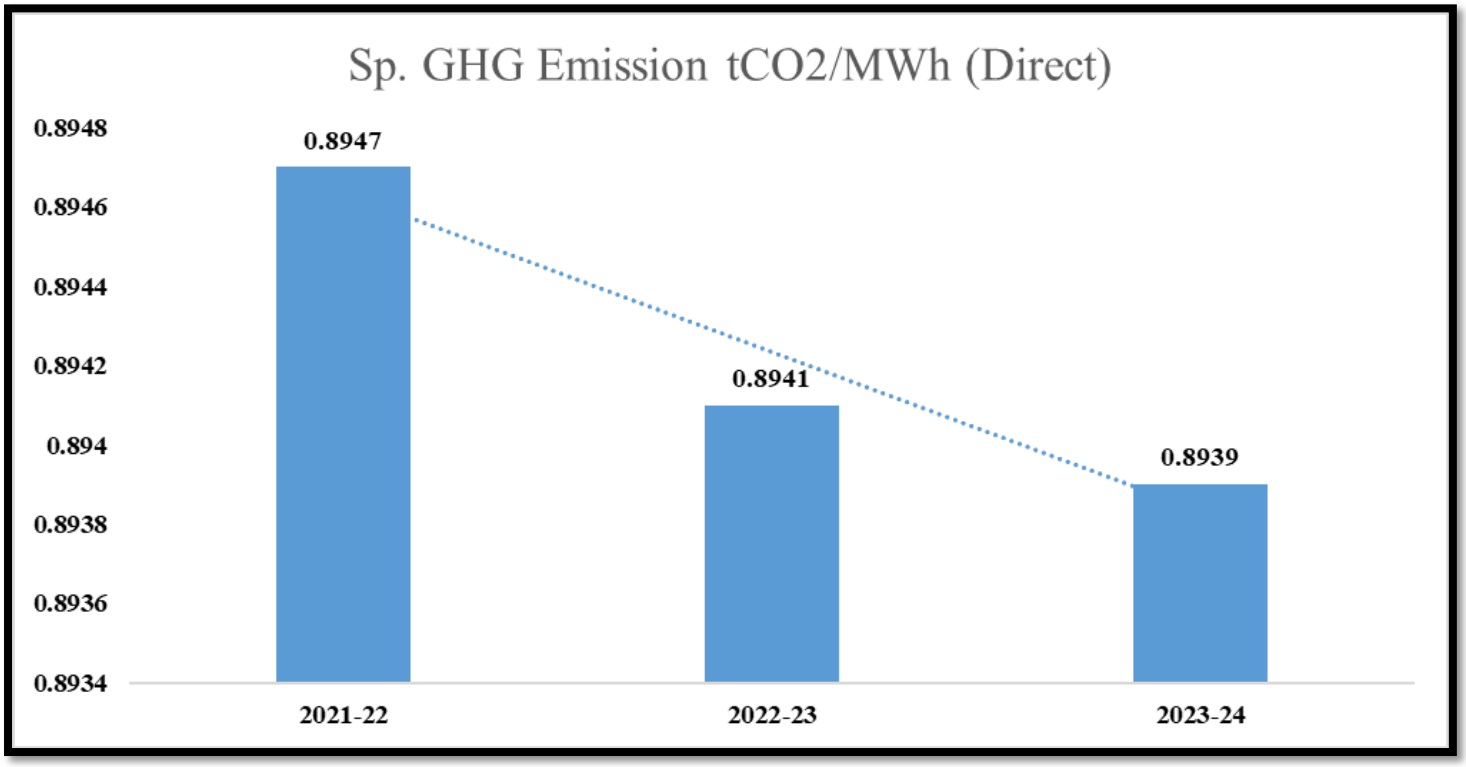

Figure 4: GWEL GHG Performance Tracking

Note: For the FY2023-24 Total (Direct & Indirect) emission consists of category 4 emissions from product used by organization.

9. GHG Inventory Quality Management:

Complying with ISO14064-1:2018, System is in place to assess our GHG emissions and all the GHG sources are consistently monitored to ascertain consistency in GHG inventory. Records are maintained as per procedure for record control as follows.

- Records required as per ISO 14064-1 (2018): Greenhouse Gases, Part 1 (Specification with Guidance at the Organization Level for Quantification and Reporting of Green House Gas Emission and Removals) i.e. GHG Reports, calculations, Procedures etc. shall be collected and maintained.
- The records of GHG shall be maintained as hard copy and or on electronic Media. The concerned department shall maintain records in legible & easily retrievable condition during the retention period (5 Years).
- Soft Copy records, worksheets shall be stored in computer with restricted access.
- The registers and reports for the records shall be kept safely in such a way as to prevent damage, deterioration or loss.
- After the records are no more required (after the retention period), they shall be destroyed/deleted.
- The record shall be maintained and made available for evaluation to the interested party or his representative, if necessary, data required for GHG accounting are updated in SAP as well as in records of respective sections and are reviewed regularly. Accessibility of these data is limited and controlled.

GWEL GREENBELT PHOTOGRAPHS

Annexure – A

measured emissions

For Non-CO2 GHG's the conversion factor has to be integrated in the emission factor!

User entry: Source description
User entry: emission factor/activity data values
User entry: Physical units
User entry: estimtated uncertainties (95% confidence interval)
Auto calculated value:
Automated uncertainty ranking

	Step 1+2						Step 3					
	A	B	C	D	E	F	G	H	I	J	K	L
	Activity Data (e.g. Quantity of fuel used)	Unit used to measure Activity Data	Uncertainty of activity data (a) (Confidence interval expressed in ± percent)	GHG emission factor	Unit of GHG emission factor (for kg CO2!)	Uncertainty of emission factor (Confidence interval expressed in ± percent)	CO2 emissions in kg	CO_2 emissions in metric tonnes	Uncertainty of calculated emissions $I=\sqrt{C^2+F^2}$	Certainty Ranking	Auxiliary Variable 1	Auxiliary Variable 2
							A * D	G/1000			(H*I)	K^2
Example: Source 1	1000.00	GJ	+/- 5.0%	56.10	kg CO2 / GJ	+/- 10.0%	56,100.00	56.10	+/- 11.2%	Good	6.27	39.34
Source description												
Heat from coal consumption Domestic	42138010.00	GJ	+/- 2.0%	92.50	kg CO2 / GJ	+/- 2.0%	3,897,765,925.00	3,897,765.93	+/- 2.8%	High	110,245.47	12,154,063,364.87
Heat from coal consumption Imported	2680.00	GJ	+/- 2.0%	92.50	kg CO2 / GJ	+/- 2.0%	247,900.00	247.90	+/- 2.8%	High	7.01	49.16
LDO	17.03	TJ	+/- 2.0%	77,400.00	kg CO2 / TJ	+/- 2.0%	1,318,122.00	1,318.12	+/- 2.8%	High	37.28	1,389.96
DG sets & Fire Diesel Pump	0.11	TJ	+/- 2.0%	74,100.00	kg CO2/TJ	+/- 2.0%	7,982.77	7.98	+/- 2.8%	High	0.23	0.05
Diesel Dozers, LOCO & other machinaries for coal & ash handling	12.77	TJ	+/- 2.0%	74,100.00	kg CO2/TJ	+/- 2.0%	946,257.00	946.26	+/- 2.8%	High		
LPG	0.60	TJ	+/- 2.0%	63100	kg CO2/TJ	+/- 2.0%	38,029.11	38.03	+/- 2.8%	High	1.08	1.16
CO2 CONSUMPTION (Fire extinguisher and TG)	1406.00	Kgs	+/- 2.0%	1.00	kg CO2/Kgs	+/- 2.0%	1,406.00	1.41	+/- 2.8%	High	0.04	0.00
STP Treated Water	15909.00	KL	+/- 2.0%	0.19	kg CO2/m3	+/- 2.0%	2,954.94	2.95	+/- 2.8%	High	0.08	0.01
Food waste	13933.00	Kgs	+/- 2.0%	8.88	kg CO2/TON	+/- 2.0%	123,778.82	123.78	+/- 2.8%	High	3.50	12.26
HFC (R)- 22	121.00	Kgs	+/- 2.0%	1,760.00	Kg CO2/ kg	+/- 2.0%	212,960.00	212.96	+/- 2.8%	High	6.02	36.28
R-410A	51.00	Kgs	+/- 2.0%	1,924.00	kg CO2/ Kgs	+/- 2.0%	98,124.00	98.12	+/- 2.8%	High	2.78	7.70
HFC (R)134A	83.60	Kgs	+/- 2.0%	1,300.00	kg CO2/Kgs	+/- 2.0%	108,680.00	108.68	+/- 2.8%	High	3.07	9.45
HFC 407C	12.00	Kgs	+/- 2.0%	1,624.00	kg CO2/Kgs	+/- 2.0%	19,488.00	19.49	+/- 2.8%	High	0.55	0.30

Note: For individual uncertainties greater than 60%, the results of the tool are not valid

Sum CO_2 emissions (M):	3,900,891,607.63	3,900,891.61

Step 4: Cumulated Uncertainty: $\pm u = \pm \frac{\sqrt{\sum_{i=1}^{n}(H_i * I_i)^2}}{M}$

+/- 2.8%	High

Aggregated Certainty Ranking

Annexure – B

Measured emissions

For Non-CO2 GHG's the conversion factor has to be integrated in the emission factor!

User entry: Source description
User entry: emission factor/activity data values
User entry: Physical units
User entry: estimtated uncertainties (95% confidence interval)
Auto calculated value:
Automated uncertainty ranking

	Step 1+2						Step 3				
	A	B	C	D	E	F	G	H	I	J	K
	Activity Data (e.g. Quantity of fuel used)	Unit used to measure Activity Data	Uncertainty of activity data (a) (Confidence Interval expressed in ± percent)	GHG emission factor	Unit of GHG emission factor (for kg CO2!)	Uncertainty of emission factor (Confidence Interval expressed in ± percent)	CO2 emissions in kg	CO_2 emissions in metric tonnes	Uncertainty of calculated emissions $I=\sqrt{C^2+F^2}$	Certainty Ranking	Auxiliary Variable 1
							A * D	G/1000			(H*I)
Example: Source 1	1000.00	GJ	+/- 5.0%	56.10	kg CO2 / GJ	+/- 10.0%	56,100.00	56.10	+/- 11.2%	Good	6.27
Source description											
Purchased electricity	171.35	MWh	+/- 2.0%	0.72		+/- 2.0%	122.68	0.12	+/- 2.8%	High	0.00
Road Transport of coal	3297001.00	KM	+/- 3.0%	2.91	kg CO2/KM	+/- 7.0%	9,594,272.91	9,594.27	+/- 7.6%	Good	730.68
Rail Transport of coal	4943814516.74	Ton KM	+/- 3.0%	0.01	kgCO2/ Ton KM	+/- 5.0%	49,240,392.59	49,240.39	+/- 5.8%	Good	2,871.18
Road Transport of Ash	3791536.00	KM	+/- 5.0%	2.91	kg CO2/KM	+/- 7.0%	11,033,369.76	11,033.37	+/- 8.6%	Good	949.13
Rail Transport of Ash	68427314.00	Ton KM	+/- 3.0%	0.01	kgCO2/ Ton KM	+/- 7.0%	681,536.05	681.54	+/- 7.6%	Good	51.90
Supply of H2SO4	55800.00	KM	+/- 5.0%	2.91	kgCO2/KM	+/- 5.0%	162,378.00	162.38	+/- 7.1%	Good	11.48
Supply of HCl	880.00	KM	+/- 5.0%	2.91	kgCO2/KM	+/- 7.0%	2,560.80	2.56	+/- 8.6%	Good	0.22
Supply of Chlorine	4320.00	KM	+/- 5.0%	2.91	kgCO2/KM	+/- 7.0%	12,571.20	12.57	+/- 8.6%	Good	1.08
Supply of LDO	320.00	KM	+/- 5.0%	2.91	kgCO2/KM	+/- 7.0%	931.20	0.93	+/- 8.6%	Good	0.08
CO2 Logistic	32400.00	KM	+/- 5.0%	2.91	kgCO2/KM	+/- 7.0%	94,284.00	94.28	+/- 8.6%	Good	8.11
Tranportation of Electrical Parts	6133.00	KM	+/- 5.0%	2.91	kgCO2/KM	+/- 7.0%	17,847.03	17.85	+/- 8.6%	Good	1.54
Business Travel (By Air)	219237.50	Passenger – KM	+/- 5.0%	0.16	kgCO2/Passenger – KM	+/- 7.0%	35,292.85	35.29	+/- 8.6%	Good	3.04
Business Travel (By Rail)	17145.00	Passenger – KM	+/- 5.0%	0.01	kgCO2/Passenger – KM	+/- 7.0%	134.37	0.13	+/- 8.6%	Good	0.01
Visitor Transport	14134.00	KM	+/- 5.0%	0.17	kgCO2/KM	+/- 7.0%	2,400.52	2.40	+/- 8.6%	Good	0.21
Company Hired Vehicle	28158.00	Litre	+/- 5.0%	2.66	kgCO2/LTR	+/- 7.0%	74,943.92	74.94	+/- 8.6%	Good	6.45
Machinery & equipments	72173846.15	INR	+/- 5.0%	0.00425	kgCO2/INR	+/- 7.0%	306,440.25	306.44	+/- 8.6%	Good	26.36
Computer, electronics & optical products	15013008.32	INR	+/- 5.0%	0.40382	kgCO2/INR	+/- 7.0%	6,062,591.63	6,062.59	+/- 8.6%	Good	521.52
Electrical equipments	3444440.95	INR	+/- 5.0%	0.43781	kgCO2/INR	+/- 7.0%	1,508,005.78	1,508.01	+/- 8.6%	Good	129.72
Buildings & Buildings construction work	13057216.82	INR	+/- 5.0%	0.32368	kgCO2/INR	+/- 7.0%	4,226,344.98	4,226.34	+/- 8.6%	Good	363.56
Cement purchase	59550.00	Kgs	+/- 5.0%	0.54	kgCO2/MT	+/- 7.0%	32,157.00	32.16	+/- 8.6%	Good	2.77
Steel purchase	57920.00	Kgs	+/- 5.0%	2.49	kgCO2/MT	+/- 7.0%	144,220.80	144.22	+/- 8.6%	Good	12.41
Coal production (CIL)	2814158620.00	Kgs	+/- 5.0%	0.085	kgCO2/Ton	+/- 7.0%	239,203,482.70	239,203.48	+/- 8.6%	Good	20,577.06

Note: For individual uncertainties greater than 60%, the results of the tool are not valid

Sum CO_2 emissions (M):	322,436,281.02	322,436.28

Step 4: Cumulated Uncertainty: $\pm u = \pm \frac{\sqrt{\sum_{i=1}^{n}(H_i * I_i)^2}}{M}$	+/- 6.5%	Good

Aggregated Certainty Ranking

GMR Warora Energy Limited

INTEGRATED MANAGEMENT SYSTEM POLICY (ISO9001, ISO14001, ISO45001)

GMR Warora Energy Limited (GWEL) is committed to establish and follow an Integrated Management System in line with the GMR Corporate EHSQ Policy supporting sustainable and competitive business activities including activities performed by associates, concurrently mitigating possibility of ny adverse impact on Environment and also ensuring Health and Safety of all under its organizational control.

While implementing the IMS, the Plant is committed to:

- Deliver Reliable, Quality energy supply & Services to All Customers and creating superior value to all Stakeholders by continually improving on all performance parameters.
- Comply with applicable legal and other requirements of Environment, Health & Safety and ensure continual improvement in EHS performance through management reviews & consultation & participation of employees at all levels.
- Protect the environments through continuous monitoring and review of our processes.
- Prevent Pollution, injury, ill health, eliminate hazard & reduce OH&S risk and ensure continual improvement in EHSQ performance by appropriate supervision, operational practices and deploying suitable Technologies.
- Involvement of employees at all levels to inculcate EHSQ culture by identifying the risks & opportunities in processes.
- Provide Training & Learning to employees to ensure competence and awareness in order to effectively carry out the requirements of Integrated Management System.

This policy statement is displayed at prominent places, and will be made available to interested external parties.

27th May 2021
Revision: 05

Dhananjay Deshpande
COO-GMR Warora Energy Limited

BUREAU VERITAS

Bureau Veritas Certification

GMR WARORA ENERGY LIMITED

PLOT NO. B-1, MOHABALA, MIDC GROWTH CENTRE, P&T. WARORA – 442 907,
DIST: CHANDRAPUR, MAHARASHTRA, INDIA.

Bureau Veritas Certification Holding SAS – UK Branch certifies that the Management System of the above Organisation has been audited and found to be in accordance with the requirements of the Management System Standards detailed below.

Standards

ISO 9001:2015, ISO 14001:2015 & ISO 45001:2018

Scope of certification

GENERATION OF ELECTRICITY IN COAL BASED THERMAL POWER PLANT OF 2 X 300 MW CAPACITY

Original cycle start date: **30 March 2023**
Expiry date of previous cycle: **Not Applicable**
Certification Audit date: **11 March 2023**
Certification cycle start date: **30 March 2023**

Subject to the continued satisfactory operation of the Organisation's Management System, this certificate is valid until: **29 March 2026**

Certificate No. **IND.23.4071/IM/U** Version: **1** Issue date: **30 March 2023**

Signed on behalf of BVCH SAS UK Branch
Jagdheesh N. MANIAN
Director – CERTIFICATION, South Asia
Commodities, Industry & Facilities Division

For certificate authenticity, click here
https://certcheck.ukas.com/

ISO 9001	IN043254
ISO 14001	IN043252
ISO 45001	IN043253

UKAS MANAGEMENT SYSTEMS
0008

Certification body address: 5th Floor, 66 Prescot Street, London, E1 8HG, United Kingdom.

Local office: Bureau Veritas (India) Private Limited (Certification Business) 72 Business Park, Marol Industrial Area, MIDC Cross Road "C", Andheri (East), Mumbai – 400 093, India.

Further clarifications regarding the scope of this certificate and the applicability of the management system requirements may be obtained by consulting the organisation.
To check this certificate validity please call **+ 91 22 6274 2000.**