Greenhouse Gas Inventory Report 2022-23

GMR Warora Energy Limited,

Mohabala MIDC Warora Growth Centre,

Post-Warora, Tehsil-Warora,

Chandrapur- Dist.,Maharashtra-442907

Date of verification: Sept 25 and 26 (On site) followed by remote and offsite verification

Verifier: Anantha Prabhu Uppunda and Sanjay Patankar Type of Verification :Reasonable

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1. **Reporting Organisation:**
   GMR Warora Energy Limited (Formerly EMCO Energy Limited)

2. **Description of the organisation**

About GMR Warora Energy Ltd.(GWEL)

GMR Warora Energy Ltd (Formerly EMCO Energy Limited) is a subsidiary of GMR Energy Ltd. Operates 2 x 300 MW Coal Based power plant at Warora MIDC, Chandrapur district of Maharashtra, 90 km from Nagpur. Electricity Generated is transmitted through Power Grid Corporation of India Ltd., Bhadrawati, 35 Km from plant location. 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 Gujarat Urja Vikas Nigam Limited (GUVNL) and 150 MW with Tamil Nadu Generation and Distribution Corporation (TANGEDCO).

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 system 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 environmental 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.

Plant Process Flow:

- Coal is received through rail wagons, unloaded by wagon tippler, transported through belt conveyors and crushed at crusher house.
- Crushed coal stacked at coal yard through stacker.
- Coal is fed to bunkers through network of belt conveyors by reclaiming from coal yard by Reclaimer
- The coal is drawn from the bunkers by gravimetric feeders and fed into the coal pulveriser (mills).
- In the mills the coal is dried by hot air, pulverized and carried to the coal burners in the Boiler (steam generator)
- This steam generated in boiler is fed to turbine assembly which drives the Turbo generator.
- The Turbo generator at its full capacity can deliver 300MW power at 20000 volts.
- This power is stepped up to 400KV in a Transformer and fed to the grid through a network of breakers and buses and power lines.
- Steam entering the condenser is cooled back to water state by circulating cooling water through the condenser.

- The circulating water in turn is cooled in the cooling tower by evaporative cooling.
- The condensed steam in the condenser pumped back to the boiler by means of boiler feed pump.
- Flue gases from the boiler are cooled in air preheaters and then cleaned by electrostatic precipitators to remove ash.
- The cleaned flue gas is disposed of to atmosphere through the 275-meter height chimney

3. Purpose and objective of the GHG audit report:

The purpose of and objective of this report is to demonstrate continual commitment of GWEL towards sustainable development by reporting its GHG emissions and its directed actions towards reducing the same. This report has been prepared in accordance with the international standards organisation standard ISO 14064-1: 2018. This report will be the most significant to promote transparency on GHG related information & Climate Change initiatives to mitigate the GHG emission levels to the intended users (GWEL, customers and relevant stakeholders) to make reasonable decisions. The information provided in the report by following the requirements outlined in part 9.3.1 and (where applicable) 9.3.2 of the standards.

GHG performance that details in this report will be made available to the intended users through our annual reports, BRSR report, Corporate sustainability reports, investor's information, response to questionnaires and during interactions.

GWEL environment policy demonstrates that, we are committed to protect the environment by effective & responsible consumption, minimization of energy consumption, minimising waste generation, minimising GHG and other emissions & discharges to environment from our activities. To persist the environmental protection, GWEL had taken the strategies to reduce the carbon footprint of the organisation by considering FY2021-22 as a starting year. Reduction activities taken

and documented through internal procedures. The reduction strategies area monitoring and performance reporting on yearly basis.

We have a clearly defined path to reduce emissions in line with the Paris Agreement goals. We have also following TCFD approach to identify our climate related risks and opportunities. We are in the process of setting our emission targets in line with the Science Based Targets approach.

We have taken all reasonable care to ensure that the facts stated as a part of this report are Relevant, complete, consistent, accurate and transparent in all the aspects as on the date of preparation and based on the information and data provided by stakeholders of GWEL.

GWEL reports to the verification body about the facts discovered after the validation/ verification on accuracy of GHG emission and removals, during the verification/ through this report.

This report covers the GHG emission sources and sinks with in the organisational boundary of GWEL generation site and employee accommodation township for the reporting period FY 23(i.e. from 1st April 2022 to 31st March 2023). GWEL has continuously consolidated its position as a global benchmark for its commitment to transparency and its sustainable and environment friendly growth model. To give continuity to this commitment, we are presenting this GHG inventory report annually. FY 22 is taken as base year reference for future GHG inventories. As we said in the above paragraph, GWEL had taken GHG reduction targets for FY-2030(target year) considering FY22 as base year.

4. GHG Inventory design and development:

Organisation boundary:

Organisation boundary is defined as all the quantified GHG emissions and removals from our Warora power generation site and employee accommodation township.

Chosen Consolidation approach: Operational Control.

Reporting Boundary:

The operational boundaries include the identification of GHG emissions and removals associated with the organisation operations.

Scope 1: Direct GHG emissions and removals.

Scope 2: Indirect GHG emissions from imported energy.

Scope 3: Indirect emissions from transportation.

GHG emissions arising from all activities coming under our operational control for all part of the reporting year. These facilities include:

- Power plant
- Employee accommodation –Township

5. Quantification of GHG emissions and removals:

a) Identified GHG sources and Sinks

1	**Scope 1: Direct GHG emissions**	**Type of GHG**
1.1	Direct emissions from stationary combustion source	
1.1.1	Emission Boiler operation(Coal)	CO2, CH4, N2O
1.1.2	Emission from Boiler operation(LDO)	CO2, CH4, N2O
1.1.3	Emission from DG sets & Diesel Engine driven Pumps (HSD consumption)	CO2, CH4, N2O
1.1.4	Emission from Oxy fuel cutting(LPG)	CO2
1.1.5	Emissions from cooking (LPG)	CO2
1.2	Direct emissions from Mobile combustion source	
1.2.1	Emission from vehicles owned & controlled by GWEL(HSD)	CO2, CH4, N2O
1.2.2	Emissions from Dozers, LOCO & other machineries for coal & ash handling.(HSD)	CO2, CH4, N2O
1.2.3	Emission from Motorcycles (Petrol)	CO2, CH4, N2O
1.3	Direct Fugitive Emission	
1.3.1	CO2 Consumption for generator purging	CO2
1.3.2	CO2 Fire Extinguisher used for fire fighting	CO2
1.3.3	SF6 Breaker	SF6
1.3.4	Refrigerant cooling gases (HFCs)	R-22, R-407C, R-410A, R134A
1.3.5	Treatment of food waste	CH4
1.3.6	Treatment of waste water	CH4
2	**Scope 2: Indirect GHG emission from Imported Energy**	**Type of GHG**

2.1	Imported Electricity	CO2e
3	**Scope 3: Indirect GHG emission from Transportation**	**Type of GHG**
3.1	Emission from upstream transportation	
3.1.1	CO2/ H2 cylinder Transportation	CO2e
3.1.2	Electrical Parts for Transportation (for Maintenance)	CO2e
3.1.3	Chlorine Tonner transportation	CO2e
3.1.4	H2SO4 Transportation	CO2e
3.1.5	HCL Transportation	CO2e
3.1.6	LDO Transportation	CO2e
3.1.7	Coal Transportation – Rail	CO2e
3.1.8	Coal Transportation – Road	CO2e
3.1.8	Coal Transportation- Cargo ship	CO2e
3.2	Emission from downstream transportation	
3.2.1	Ash Transportation- Rail	CO2e
3.2.2	Ash Transportation- Road	CO2e
3.3	Business Travels	
3.3.1	Business Travel – Flight	CO2e
3.3.2	Business Travel – Rail	CO2e
3.3.3	Visitors Transport	CO2e
	Removals (Offsetting)	
1	Direct Removals from Carbon Sequestration	CO2e

b) GHG quantification methodology:

- The ISO 14064-1:2018 and GHG Protocol, CO2 baseline database for Indian power sector user guide -version 18.0 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 18.0 by CEA (Ministry of Power-GOI), IPCC, GHG Protocol, Emission Factors for Greenhouse Gas Inventories by EPA, etc.

- Methodologies are selected and used in such a way that they reasonably minimise 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) X Global Warming potential(GWP)

- Electrical generation equipment is heavily regulated by CEA (Ministry of power, GOI) and is required to report Fuel consumption, Gross calorific value, Heat rate, Auxiliary Power Consumption (APC) on a periodic basis. CO2 emission for coal and other fuel used in stationary combustion is calculated based on fuel, GCV and heat rate data.
- Fugitive emissions from materials and fuels are considered as part of total consumption.

c) Collection of Activity Data:

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.

d) Selection of GHG emission or removal factors:

The selected GHG emission and removal factors are derived from CO2 baseline database for Indian power sector user guide -version 18.0 by CEA (Ministry of Power-GOI), IPCC and DEFRA, India Specific Rail Transport Emission Factors for Passenger Travel and Material Transport, etc. These factors are appropriate and current at the time of quantification and consistent with the intended use of GHG inventory.Through application of documented emission factor and GWPs, GHG emissions from all sources are calculated. If any changes/ upgradations in the sources/ references for the emission factors and GWPs are considered.

e) GHG Emission Factors:

SN	Emission Source	GHG	Emission factor	Units	Reference
1.1	Direct emissions from stationary combustion source				
1.1.1	Emission from Boiler operation (Coal)	CO2	92500	Kg/TJ	CO2 baseline database for Indian power sector user guide -version 18.0 by CEA (Ministry of Power-GOI)
		CH4,	1	Kg/TJ	

		N2O	1.5	Kg/TJ	2006 IPCC Guidelines for National Greenhouse Gas Inventories: IPCC V2_2_Ch2_Stationary_Combustion. TABLE 2.2 DEFAULT EMISSION FACTORS FOR STATIONARY COMBUSTION IN THE ENERGY INDUSTRIES
1.2.2	Emission from Boiler operation (Bio mass)	CO2,	100000	Kg/TJ	2006 IPCC Guidelines for National Greenhouse Gas Inventories IPCC V2_2_Ch2_Stationary_Combustion. TABLE 2.2 DEFAULT EMISSION FACTORS FOR STATIONARY COMBUSTION IN THE ENERGY INDUSTRIES
		CH4,	30	Kg/TJ	
		N2O	4	Kg/TJ	
1.1.2	Emission from Boiler operation (LDO)	CO2,	77 400	Kg/TJ	2006 IPCC Guidelines for National Greenhouse Gas Inventories IPCC V2_2_Ch2_Stationary_Combustion. TABLE 2.2 DEFAULT EMISSION FACTORS FOR STATIONARY COMBUSTION IN THE ENERGY INDUSTRIES
		CH4,	3	Kg/TJ	
		N2O	0.6	Kg/TJ	
1.1.3	Emission from DG sets & Diesel Engine driven Pumps (HSD consumption)	CO2,	74 100	Kg/TJ	2006 IPCC Guidelines for National Greenhouse Gas Inventories IPCC V2_2_Ch2_Stationary_Combustion. TABLE 2.2 DEFAULT EMISSION FACTORS FOR STATIONARY COMBUSTION IN THE ENERGY INDUSTRIES
		CH4,	3	Kg/TJ	
		N2O	0.6	Kg/TJ	
1.1.4	Emission from Oxy fuel cutting (LPG)	CO2	1.55709	KgCO2e/Litre	Defra, 2022 volume 2.0

1.1.5	Emissions from cooking (LPG)	CO2	1.55709	KgCO2e/Litre	Defra, 2022 volume 2.0
1.2	Direct emissions from Mobile combustion source				
1.2.1	Emission from vehicles owned & controlled by GWEL(HSD)	CO2,	74 100	Kg/TJ	2006 IPCC Guidelines for National Greenhouse Gas Inventories Chapter 3: Mobile Combustion
		CH4,	3.9	Kg/TJ	
		N2O	3.9	Kg/TJ	
1.2.2	Emissions from Dozers, LOCO & other machineries for coal & ash handling. (HSD)	CO2,	74 100	Kg/TJ	2006 IPCC Guidelines for National Greenhouse Gas Inventories Chapter 3: Mobile Combustion
		CH4,	3.9	Kg/TJ	
		N2O	3.9	Kg/TJ	
1.2.3	Emission from Motorcycles (Petrol)	CO2,	69 300	Kg/TJ	2006 IPCC Guidelines for National Greenhouse Gas Inventories Chapter 3: Mobile Combustion
		CH4,	3.8	Kg/TJ	
		N2O	5.7	Kg/TJ	
1.3	Direct Fugitive Emission	Gas	Global Warming potential		Reference
1.3.1	CO2 Consumption for generator purging	CO2	1		IPCC, 2014
1.3.2	CO2 Fire Extinguisher used for fire fighting	CO2	1		IPCC, 2014
1.3.3	SF6 Breaker	SF6	23500		IPCC, 2014
1.3.4	Refrigerant cooling gases (HFCs)	R-22	1760		IPCC, 2014
		R-407C	1624.2		IPCC, 2014
		R-410A	1923.5		IPCC, 2014
		R134A	1120		IPCC, 2014
1.3.5	Treatment of food waste	CH4	28		IPCC, 2014
1.3.6	Treatment of waste water	CH4	28		IPCC, 2014

2	Category 2- Scope 2: Indirect GHG emission from Imported Energy	GHG	Emission factor	Units	Reference
2.1	Imported Electricity (Average Grid Emissions Factor)	CO2e	0.9	KgCO2e/KWh	CEA Version 17.0
3	Category 3- Scope 3: Indirect GHG emission from Transportation	GHG	Emission factor	Units	Reference
3.1	Emission from upstream transportation				
3.1.1	HGV(100%Ladan) CO2/ H2 cylinder Transportation)	CO2e	0.95522	KgCO2e/km	Defra, 2022 version 2.0
3.1.2	HGV(100%Ladan) Chlorine Tonner transportation	CO2e	0.95522	KgCO2e/km	Defra, 2022 version 2.0
3.1.3	HGV(100%Ladan) H2SO4 Transportation	CO2e	0.95522	KgCO2e/km	Defra, 2022 version 2.0
3.1.4	HGV(100%Ladan) HCL Transportation	CO2e	0.95522	KgCO2e/km	Defra, 2022 version 2.0
3.1.5	HGV(100%Ladan)	CO2e	0.95522	KgCO2e/km	Defra, 2022 version 2.0

	LDO Transportation				
3.1.6	Coal Transportation – Rail	CO2e	0.00996	kg CO_2 / Ton – km)	India Specific Rail Transport Emission Factors for Passenger Travel and Material Transport https://indiaghgp.org/sites/default/files/ Rail%20Transport%20Emission.pdf
3.1.7	HGV(100%Ladan) Coal Transportation – Road	CO2e	0.95522	KgCO2e/km	Defra, 2022 version 2.0
3.2	Emission from downstream transportation				
3.2.1	Ash Transportation - Rail	CO2e	0.00996	Kg CO_2 / Ton – km	India Specific Rail Transport Emission Factors for Passenger Travel and Material Transport https://indiaghgp.org/sites/default/files/ Rail%20Transport%20Emission.pdf
3.2.2	HGV(100%Ladan) Ash Transportation - Road	CO2e	0.95522	KgCO2e/km	Defra, 2022 version 2.0
3.2.3	HGV(100%Ladan) Electrical Parts for Transportation (for Maintenance)	CO2e	0.95522	KgCO2e/km	Defra, 2022 version 2.0
3.2.4	Cargo ship (imported coal transportation)	CO2e	0.01323	Kg CO_2 / Ton – km	Defra, 2022 version 2.0

3.3	Business Travels				
3.3.1	Business Travel – Flight	CO2e	0.13003	KgCO2e/Passenger-km	Defra, 2022 version 2.0
3.3.2	Business Travel – Rail	CO2e	0.007837	(kg CO2 / Passenger – km	India Specific Rail Transport Emission Factors for Passenger Travel and Material Transport https://indiaghgp.org/sites/default/files/ Rail%20Transport%20Emission.pdf
3.4	Employee Vehicles used for self for up-down in office	CO2e	0.170824	KgCO2e/Km	Defra, 2022 version 2.0
3.5	Visitors Transport	CO2e	0.170824	KgCO2e/Km	Defra, 2022 version 2.0
	Removals				
1	Direct Removals from Carbon Sequestration	CO2e	25	KgCO2e/tree	https://ecotree.green/en/how-much-co2-does-a-tree-absorb

f) Global Warming Potential(GWP) of Gases:

Global Warming Potential of Gases				
SN	Gas	Chemical Formula	Global Warming potential	Reference
1	Carbon dioxide	CO2	1	IPCC, 2014
2	Methane	CH4	28	IPCC, 2014
3	Nitrous Oxide	N20	265	IPCC, 2014
4	Sulphur Hexafluoride	SF6	23500	IPCC, 2014
5	R-22	CHClF2	1760	IPCC, 2014
6	R-407C	--	1624.2	IPCC, 2014
7	R-410A	--	1923.5	IPCC, 2014
8	R134A	--	1300	IPCC, 2014

g) Calculation of GHG emissions and removals:

GHG emissions and removals are calculated in accordance with the quantification methodology.

h) Baseline year:

GWEL would be considering FY 2021-22 as its base year for GHG accounting and assertion from this year onwards.

i) Greenhouse gas emissions reported:

GWEL Greenhouse Gas inventory includes all the GHG gases relevant to Coal based Power plant and wherever it is possible to estimate them as identified by IPCC.
We have been able to ascertain the emission of following gases from our operations:

- Carbon dioxide (CO2)
- Methane (CH4)
- Nitrous oxide (N2O)
- Hydro fluorocarbons (HFCs)
- Sulphur Hexafluoride(SF6)

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

j) Exclusions:

The Below mentioned are excluded for calculating GHG inventory

- Scope 3: 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

k) Report Responsibility:

The Cross Function team headed by Shri. Bharat Pinjarkar (Head Operations) is a dedicated team constituted for the compilation of Greenhouse Gas emission data. The CFT collects data, calculates emissions, and is responsible for verifying it externally and reporting it through sustainability reports.

CFT for 2022-23:

Sr. No.	Name of the Department	Responsible person Name	Responsible for
1	EHS	Praveen Shetty	GHG inventory report preparation and audit

2	Operations Services	Bapiraju M	GHG inventory compilation Stationary combustion –Coal, LDO, Diesel
3	EHS	Avnish Sharma	GHG inventory compilation
4	EHS	Pallav Kulkarni	CO2 Fire Extinguisher
5	Operation	Kaushal Dewangan	Stationary combustion –Diesel, Fugitive emission- Co2
6	Operations Services	Vipin Dubey	Stationary combustion –Coal, LDO, Diesel
7	Stores	Ajendra Thakur	Upstream and downstream transportation miscellaneous
8	Chemistry/WTP	Deepak Das	Water treatment
9	Coal sourcing and Logistics	Sandeep Bendre	Upstream transportation Coal
10	Coal sourcing and Logistics	Aniptabh Saxena	Upstream transportation Coal
11	Ash utilization	Pamesh Aggarwal	Downstream transportation Ash
12	TS/Legal	Goutam K	Downstream transportation Ash
13	HR&FMS	Naveen Kumar	Business travel, Employee commuting, food waste
14	CHP	Harishankar	Mobile combustion
15	AHP	Vishal Pahune	Mobile combustion
16	Mechanical Maintenance	Venkatesh M	Fugitive emissions
17	Electrical	Mukund	Fugitive emissions
18	COO office/Legal	Murali Ravi Shankar B	Upstream & Downstream transportation , Business travel
19	Finance	Mahesh Choudhari	GHG inventory audit
20	C&I	Avadhesh Tiwari	Calibration

6. GHG Inventory Components:

6.1. Direct Emissions:

Scope 1 Direct- 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			
					CO2(Kg)	CH4(Kg)	N2O(Kg)	Total GHG (tCO2e)
Boiler operation	Coal	2759711	3608.89984	41698.52079	3857113173	41698.52	62547.78118	3857217.419
Boiler operation	Biomass	19.9	3787	0.315522691	31552.26908	9.465681	1.262090763	31.56299686
Boiler operation	LDO	682.25	10620	26.06595982	2340832.824	78.19788	15.63957589	2340.926661
DG sets & Fire Diesel Pump operation	Diesel	2.205	10707	0.080784761	7358.513526	0.242354	0.048470856	7.358804351
Total								**38,59,597.27**

Scope 1 Direct- Stationary combustion sources					
Emission Source	Fuel	Fuel Consumption Kg/ Annum)	Total LPG consumption (litres)	Emission factor (Kg Co2e/Ltr	Total GHG (tCO2e)
Oxyfuel cutting	LPG	14.985	8.0919	1.55709	0.012599817
Cooking at canteen and guest house	LPG	25704.6	13880.484	1.55709	21.61316283
Total					**21.63**

Category1-Scope 1 Direct – Mobile combustion sources								
Emission Source	Fuel	Fuel Consumption (MT or KL/ Annum)	Average As Fired Fuel GCV (Kcal/ Kg)	Total Heat value (T Joule)	Emission			
					CO2(Kg)	CH4(Kg)	N2O(Kg)	Total GHG (tCO2e)
Company owned Motorcycles	Petrol	0.04	11472	0.00144	133.053	0.00547	0.00821	0.133066
Dozers, LOCO & other machinaries for coal & ash handling.	Diesel	391.241	10707	14.897821	1298739	58.1015	58.1015	1298.856
Company owned / Hired vehicle (under company for employee travel)	Diesel	30.09923	10707	1.1461298	99915.5	4.46991	4.46991	99.92449
Total								**1398.91**

Scope 1 Direct- Fugitive Emission						
Emission Source	**Gas**	**GHG gas name**	**Qty.**	**Unit**	**(GWP) CO2 Conversion Factor (Kg/Unit)**	**Total GHG Emission (tCO2e)**
Air Conditioner	Gas	R-22	100	kg	1760	176
Air Conditioner	Gas	R-407C	20	kg	1624.2	32.484
Air Conditioner	Gas	R-410A	20	kg	1924.5	38.49
Air Conditioner	Gas	R134A	162	kg	1120	181.44
CO2 Gas used in Generator purging	Gas	CO2	2310	kg	1	2.31
CO2 Gas used in Fire fighting	Gas	CO2	13.5	kg	1	0.0135
Total						**430.74**

Scope 1 Direct- Emission from Waste treatment						
Emission Source	**Gas**	**GHG gas name**	**Qty.**	**Unit**	**CO2 Conversion Factor (Kg/Unit)**	**Total GHG Emission (tCO2e)**
Food Waste - Plant	Gas	CH4	736.19	Kg	8.95	6.5889005
Food Waste-Township	Gas	CH4	12124	Kg	8.95	108.5098
Treatment of waste water	Gas	CH4	14013.98	KL	0.272	3.81180256
Total						**118.91**

6.2. Indirect Emissions:

Category 2- Scope 2 Indirect – Purchased electricity(From Grid)				
Emission Source	Amount of Electricity Usage	Unit	Emission factor KgCO2e/KWh	Total GHG Emission (tCO2e)
Electricity Consumption from Grid	211345	Kwh	0.9	**190.21**

6.3. Indirect emissions from upstream transportation:

Category 3 -Scope 3–Indirect Emissions from upstream Transportation					
Emission Source	Qty	Unit	Emission Factor -CO2e (Kg/Unit)	CO2(Kg)	Total GHG Emission (tCO2e)
Co2 transportation	640	Km	0.95522	611.3408	0.6113408
Chlorine Transportation	864	Km	0.95522	825.31008	0.82531008
H2SO4 Transportation	84600	Km	0.95522	80811.612	80.811612
HCL Transportation	720	Km	0.95522	687.7584	0.6877584
LDO Transportation	6720	Km	0.95522	6419.0784	6.4190784
Electrical parts transportation	1625.2	Km	0.95522	1552.423544	1.552423544
Coal Transportation - Road	779634	Km	0.95522	744721.9895	744.7219895
Coal transported through Rly Rake	5640950445	TON-KM	0.00996	56183866.44	56183.86644
Coal Transportation-By cargo ship	206745000	TON-KM	0.01323	2735236.35	2735.23635
Total					**59754.73**

6.4. Scope 3 –Indirect emissions from Downstream transportation:

Category 3 -Scope 3–Indirect Emissions from downstream Transportation					
Emission Source	Qty	Unit	Emission Factor -CO2e (Kg/Unit)	CO2(Kg)	Total GHG Emission (tCO2e)
Ash transportation through trucks outside plant premises	3305760.9	Km	0.95522	3157728.927	3157.728927
Ash transported through Rly Rake	76906816.8	TON-KM	0.00996	765991.8953	765.9918953
Total					**3923.72**

6.5. Scope 3 –Indirect emissions from Business Travel:

Category 3 -Scope 3–Indirect Emissions from Business Travel					
Emission Source	Qty	Unit	Emission Factor -CO2e (Kg/Unit)	CO2(Kg)	Total GHG Emission (tCO2e)
Business Travel - Flight	254822.28	Passenger – KM	0.13003	33134.54107	33.13454107
Business Travel - Rail	1110	Passenger – KM	0.007837	8.69907	0.00869907
Visitors Transport- Road	8400	Km	0.170824	1434.9216	1.4349216
Total					**34.58**

6.6. Carbon Offset:

Carbon offset				
Nos.of trees planted As on 31.03.2023	Survival Rate (in %)	Net avialble trees	Carbon Sequential Rate (in kg CO2 per plant-year)	Offset tCO2
139050	90	125145	25	3128.63

7. GHG Mitigation and directed activities:

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

- Maximising sourcing of coal from nearest coal mines which has dedicated road constructed by GWEL which reduced Scope 3 emission from upstream transportation.
- Maintaining the Greenbelt with over 1.25lac trees developed over last 10 years of plant operation
- Maximising Transportation of Fly ash through Railway Rakes.
- 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 indirect reduction of Greenhouse Gas emissions. The following table contains the details of the energy efficiency projects.

List of Energy Conservation Projects Implemented in 2022-23				
SN	Title of Project	Annual Electrical Saving (kWh)	Annual Thermal Saving(Fuel)	
			Quantity	UOM
1	**Efficiency Improvement through Unit-2 COH in Aug-2022** Condenser parting plate leakage arresting. Condenser jet cleaning, hydro test & tube plugging as per requirement. HPH partition plate leakage arresting. Turbine blades sand blasting, flow path correction. CAVT screen installation. Refractory application at boiler first & second pass as per requirement. Reheater spray valve passing issue resolved. Boiler air tightness test and rectification work. APH Overhauling.	66,29,040	23,328.00	MT
2	**Efficiency Improvement through Unit-1 AOH in Jul-2022** Condenser jet cleaning, hydro test & tube plugging as per requirement HPH partition plate leakage arresting GV inspection & rectification IDF anti erosion coating Coal Pipe Orifice rectification Flue gas & air duct inspection, rectification & Ceramic lining done. ESP GD screen replacement.	55,59,840	11,728.80	MT
3	AI & ML based Predictive Analytics for Plant Performance & Reliability Improvement	12,60,000.00		
4	Cooling Tower Performance Improvement Programme (Existing Cooling Tower Drift Eliminator, Nozzle & Fill Replacement, CW line modification etc.)		35,832.39	MT
5	Utilisation of fluidized air for hopper instead of hopper heater in ESP	2,95,680.00		
6	Installation of Vibro Feeder in Second Stream Conveyor-BCN-2A	14,490.60	16,961.54	L
7	Unit 2 HP Heater-6,7 & 8 partition plates replacement		988.63	MT

8	Optimal Operation of LED along with conversion of Conventional Lights with LED along with reduction in LED wattage.	24,01,800.00		
9	Reduction in Start-up Oil consumption by 10% by adopting various operational strategies using six sigma methodology.		58.87	KL
10	Implementation of CFD & CAVT Test recommendation at flue gas duct in boiler second pass	5,96,000.00		
11	Application of Anti-erosion Coating in ID fan-1A and 1B Impeller	5,59,671.55		
12	Optimization of CW/ACW Pump & CT Fan running hours	3,91,564.32		
13	Intelligent flow controller (IFC) installation in Compressed Air System.	2,32,505.00		
14	Water Treatment Plant Power Consumption Optimization by using the CW return line water instead of Effluent Recirculation feed pump.	30,800.00		
15	MRHS System Power saver mode logic modification for energy conservation.	23,760.00		
16	Optimization of Economiser and ESP deashing period by reducing the number of operation cycles.	24,000.00		
17	CCCW Pump-2A & 2B Overhauling & PHE Jet cleaning	1,56,625.73		

8. 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.

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. Concerned employees are provided with required training.

References/ Standards/ Protocols followed.

- ISO 14064-1:2018
- CEA (Ministry of Power-GOI)
- IPCC
- GHG Protocol

- EPA
- DEFRA

9. Results

GWEL's GHG emission is **39,22,342.07** tonnes of CO2e. This represents direct emissions from fuel combustion and energy generation (Scope 1), Indirect emissions from purchased electricity (Scope 2), and indirect emissions from upstream and downstream transportation (Scope 3).
This GHG inventory assertion GWEL for the reporting year is done using the ISO 14064-1:2018 standard; i.e. - specification with guidance at the organization level for quantification and reporting of greenhouse gas emissions and removals.

SN	GHG Emission	FY 23
1	Total Scope 1 Direct Emissions tCO2e	38,61,567.45
2	Total Scope 2 Indirect Emissions tCO2e	190.21
3	Total Scope 3 Indirect Emissions from Transportation tCO2e	63,713.03
4	Total mission(Direct & Indirect) tCO2e	**39,25,470.70**
5	Offset tCO2 through Plantation	3,128.63
6	Total Emission(Direct & Indirect) after offsetting	**39,22,342.07**
7	Net Station Generation (Mwh)	43,18,716.00
8	Sp.GHG Emission (Direct)	0.8941
9	Sp.GHG Emission (Direct & Indirect)	**0.9089**
10	Sp.GHG Emission after carbon offset	0.9082
11	Sp.GHG Emission (Scope 3)	0.0148

GHG Emission	FY 23	FY 22	Change
Specific GHG Emission tCo2/Mwh (Direct)	0.8941	0.8947	-0.1%
Specific GHG Emission tCO2/Mwh (Direct & Indirect)	**0.9089**	**0.9137**	-0.5%