GMR Group

Airports Energy Transportation Urban Infra Services Sports Foundation

www.gmrgroup.in

25th CII National Award for Excellence in Energy Management-2024

GMR Warora Energy Limited-2X300 MW (Thermal Power Station)

Group's Vision, Values & Mission

Vision

"GMR Group will be an institution in perpetuity that will build entrepreneurial organization making a difference to society through creation of value."

Mission

GMR Warora Energy Ltd wants to be the leading generation company in India, creating sustainable value for all stakeholders by pursuing excellence in all facets of business operation

"Build Entrepreneurial Organizations, making a difference to Society through creation of Value"

Mahatma Gandhi

Humility

We value intellectual modesty and dislike false pride and arrogance

JRD Tata

Entrepreneurship

We seek opportunities – they are everywhere

Tenzing & Hillary

Teamwork & Respect for Individual

Nurturing a relationship of trust, collaboration and mutual respect.

Sardar Vallabhbhai Patel

Deliver the Promise

We value a deep sense of responsibility and self-discipline, to meet and surpass on commitments made

Swami Vivekananda

Learning & Inner Excellence

We cherish the lifelong commitment to deepen our self awareness, explore, experiment and improve our potential

Mother Teresa

Social Responsibility

Anticipating and meeting relevant and emerging needs of society

Warren Buffet

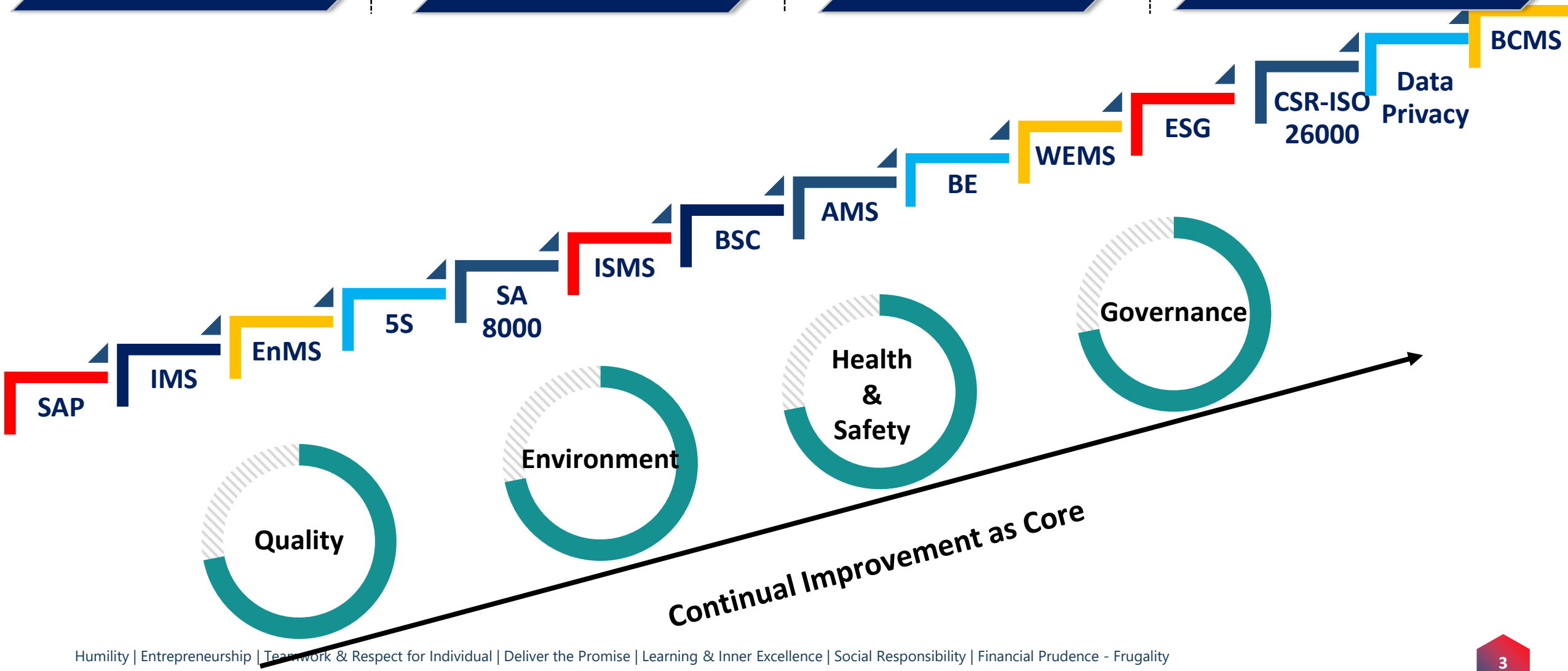
Financial Prudence – Frugality

We spend wisely and judiciously

Institution Building through System Approach- The GWEL Journey Towards Excellence

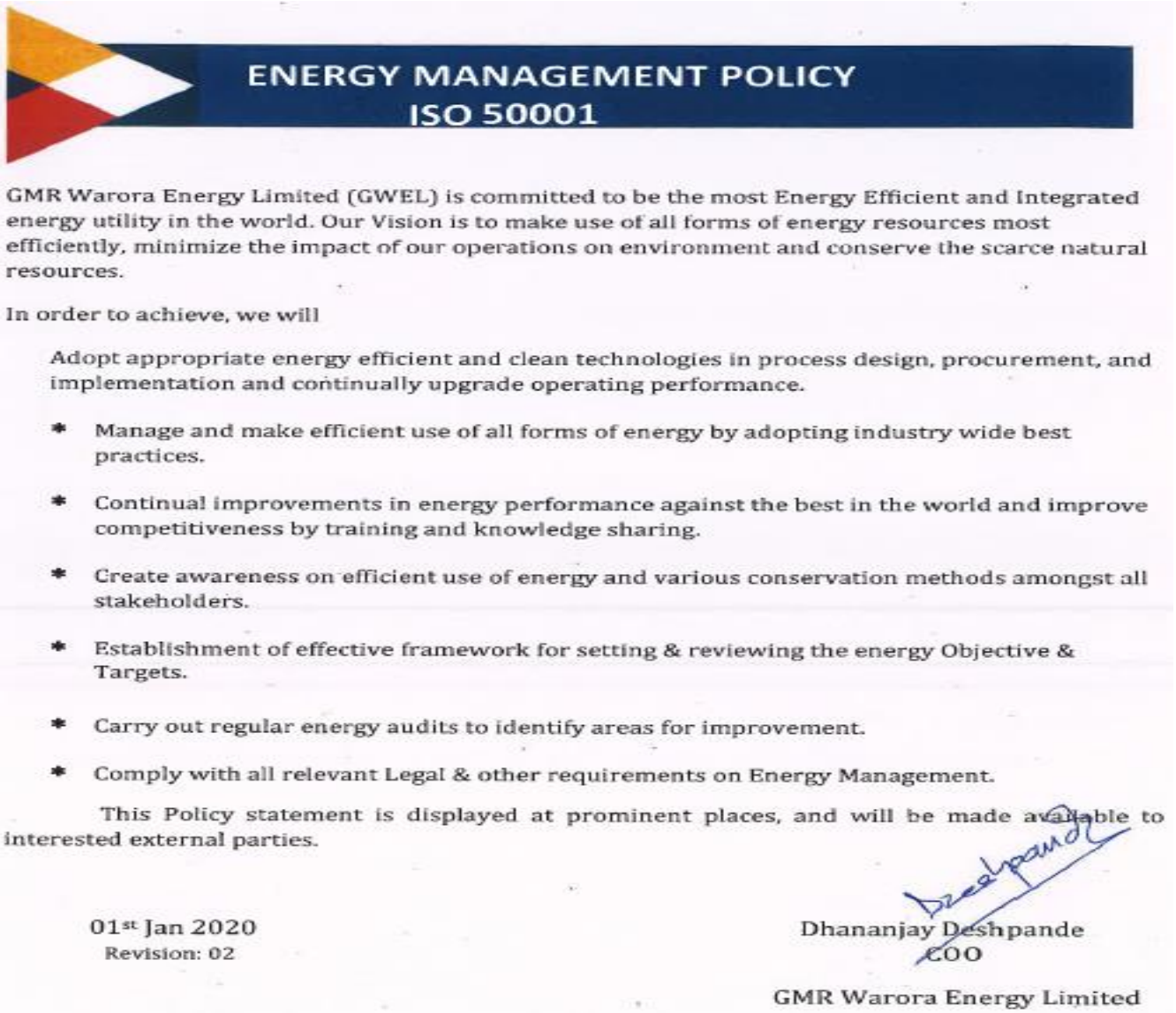
Various management systems implemented towards Quality Environment , Health &Safety and governance Management:

2013-15 | 2016-18 | 2019-22 | 2023-25



1. GWEL At a Glance

1.C Auditable System for Energy Management



ENERGY MANAGEMENT POLICY
ISO 50001

GMR Warora Energy Limited (GWEL) is committed to be the most Energy Efficient and Integrated energy utility in the world. Our Vision is to make use of all forms of energy resources most efficiently, minimize the impact of our operations on environment and conserve the scarce natural resources.

In order to achieve, we will

Adopt appropriate energy efficient and clean technologies in process design, procurement, and implementation and continually upgrade operating performance.

* Manage and make efficient use of all forms of energy by adopting industry wide best practices.
* Continual improvements in energy performance against the best in the world and improve competitiveness by training and knowledge sharing.
* Create awareness on efficient use of energy and various conservation methods amongst all stakeholders.
* Establishment of effective framework for setting & reviewing the energy Objective & Targets.
* Carry out regular energy audits to identify areas for improvement.
* Comply with all relevant Legal & other requirements on Energy Management.

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

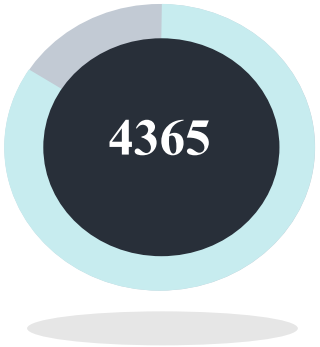
01st Jan 2020
Revision: 02

Dhananjay Deshpande
COO
GMR Warora Energy Limited

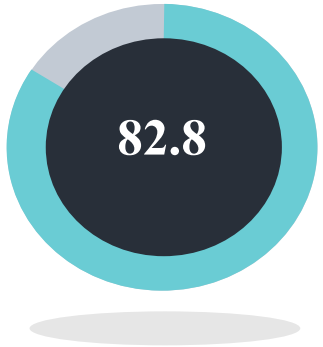
- Setting of Energy Objective & Targets
- Efficient Manage and usage of Energy
- Adoption of Best practices & continual upgradation
- Training & Knowledge sharing to raise awareness
- Internal & External Energy Audits & Initiatives
- Compliance with all legal requirements

2. Energy Consumption Overview FY: 2023-24

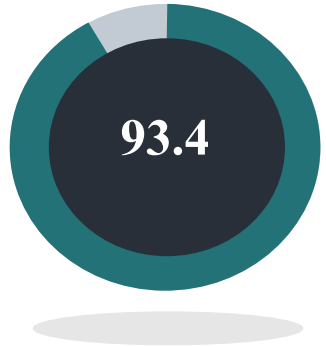
2.A Energy Consumption Overview for FY: 2023-24



Generation Mu's



PLF %



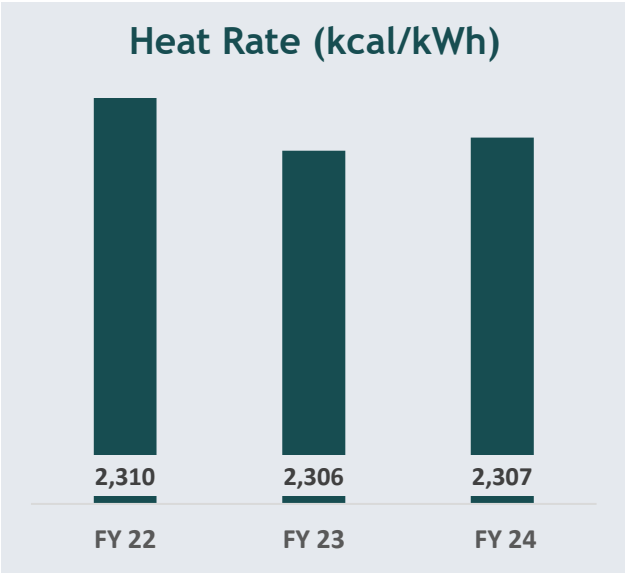
Plant Availability %

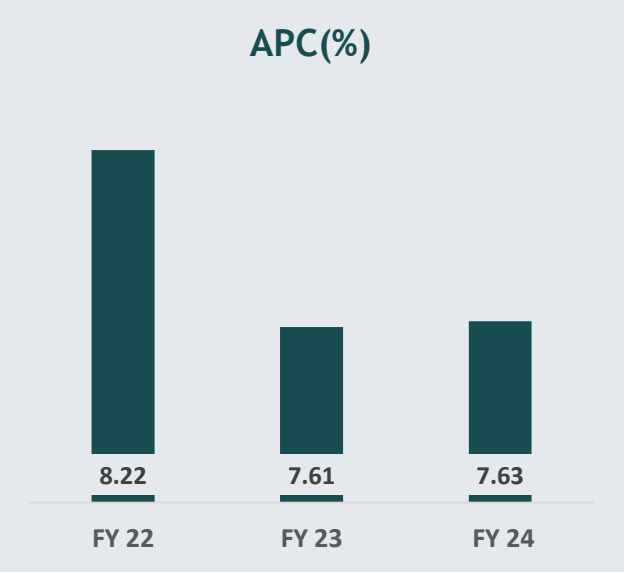
2.B Key Performance Indicators

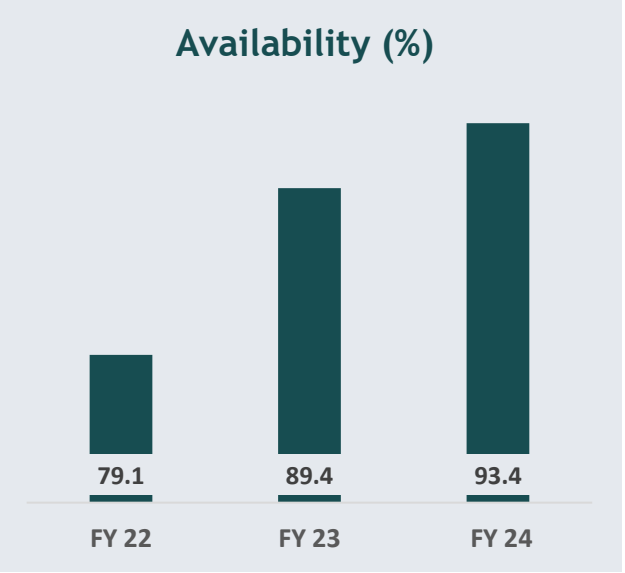
SHR (kcal/kWh)	Boiler (%)	THR (kcal/kWh)	APC (%)	SOC (ml/kWh)	DM (%)	SWC (m3/kWh)
2307.1	87.2	1971	7.6	0.10	0.14	2.30

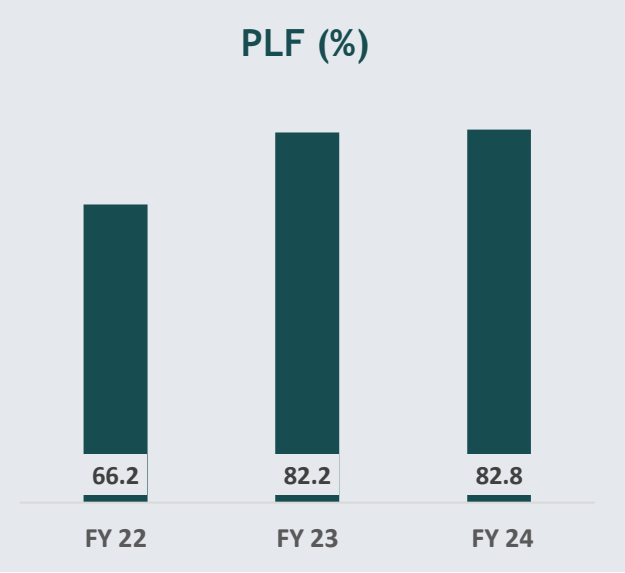
2. Specific Energy Consumption

2.C SEC in Last Three Years









KPI	% Improvement
Heat Rate	(-) 0.0 %
APC	(-) 0.0 %
Plant Availability	(+) 4.5 %
Plant Load Factor	(+) 0.7 %

Constraints

1. Further Heat rate could have been reduced by 7 kcal/kWh, however, could not be achieved due to increase in the moisture in coal.

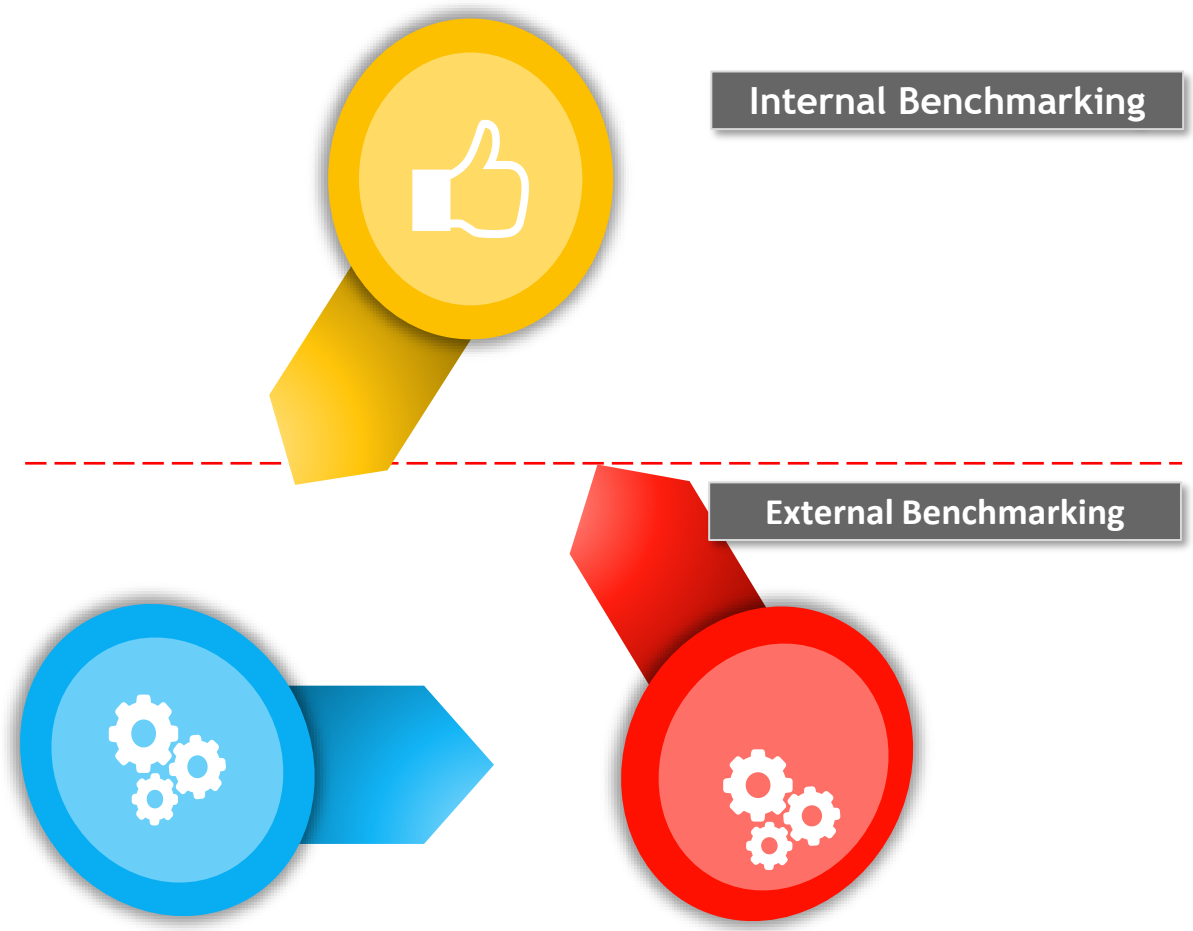
Comments

- GWEL has sustained Heat Rate and APC in comparison with the previous year despite considerable reduction in Loading Factor due to customer curtailment.
- Considering reduction in Loading Factor& increase in Coal moisture the expected Heat Rate for FY 24 would have been 2298 Kcal/kWh.
- GWEL has achieved best Plant Load Factor (PLF) of 82.83 % since commissioning. Unit 2 has achieved highest ever availability of 212 days since commissioning.
- Continuous efforts towards sustainability has restricted auxiliary power consumption at 7.6 %. Further improvement in APC& Heat Rate is expected in FY 25 through various EnCON projects planned in Capital and annual overhauling scheduled in 2024.
- Station achieved Heat rate of 2307 Kcal/kWh which is best among peer companies for FY 24.

3. Benchmarking of Energy Consumption

3.A Benchmarking Strategies: Roadmap to achieve National / Global Benchmark : Approach

GWEL uses Benchmarking tool to discover best performance being achieved



Internal Benchmarking

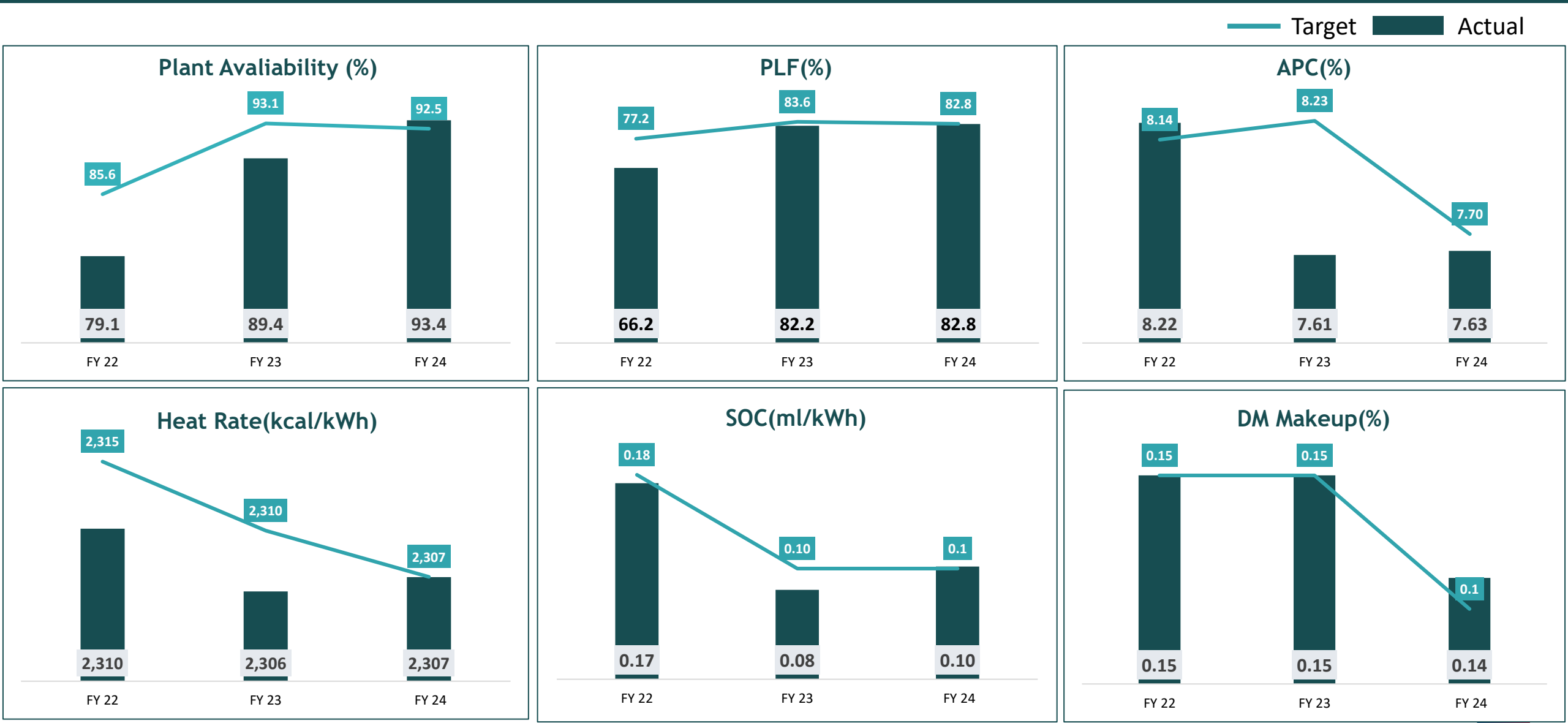
- **Design Performance-** Monthly performance against design
- **Performance Guarantee-** Quarterly PG test, Audit and deviation analysis
- **Interdepartmental Benchmarking -** Reliability and efficiency KPI's department wise benchmarking study
- **Performance after modification-** Change Management & Sustenance
- **Past Best Achieved -** Performance analysis against past best performance

External Benchmarking

- **Similar Sector Benchmarking** with Thermal Power Stations of Similar Capacity & Technology
- **International benchmarking** with strategic Investor – Tenaga
- **Site Visits** to Similar capacity plants like Dhariwal Power Station
- **Interacting& Sharing of Best practices** & incorporating the learnings through Participation in Paper presentations, Awards, Workshops etc.,
- **Cross-Sector benchmarking** like with our Airport Businesses - Best Maintenance Practices for HVAC, Compressors

3. Benchmarking of Energy Consumption

3.B Internal Benchmarking



3. Benchmarking of Energy Consumption

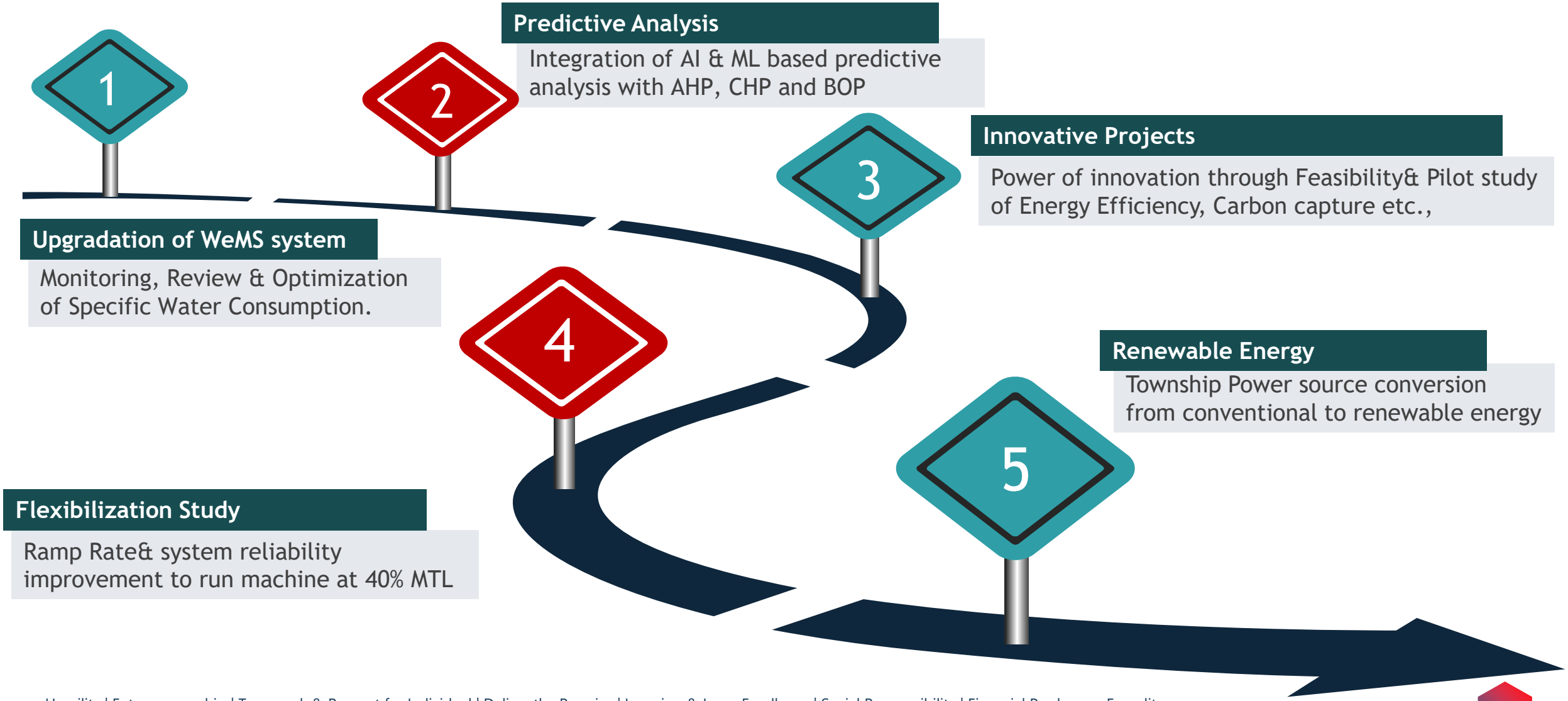
3.C External Benchmarking

Description	UoM	GWEL - Warora	RPG-Haldia	Reliance-Rosa	RPG-Dhariwal	Lanco-Amarkantak	Balco - Korba
Availability	%	93	96	94	92	89	90
Plant Loading Factor	%	83	87	72	84	73	74
Loading factor	%	88.7	90.4	78.1	91.84	82.44	81.8
Auxiliary Power Consumption	%	7.6	7.4	7.6	7.6	8.4	7.8
Specific Oil Consumption	mL/Kwh	0.1	0.09	0.06	0.09	0.1	0.21
DM Water Makeup	%	0.14	0.14	0.34	0.29	0.28	-
Heat rate	Kcal/Kwh	2307	-	2333	-	2395	2487
Specific Water Consumption	M3/Mw	2.3	-	2.07	2.24	2.71	-

- Considering reduction in Loading Factor GWEL APC would have been 7.4% & SHR would have been 2298 Kcal/kWh.

3. Benchmarking of Energy Consumption

3.D Road Map to Achieve Global Industry Benchmark



Upgradation of WeMS system

Monitoring, Review & Optimization of Specific Water Consumption.

Predictive Analysis

Integration of AI & ML based predictive analysis with AHP, CHP and BOP

Innovative Projects

Power of innovation through Feasibility& Pilot study of Energy Efficiency, Carbon capture etc.,

Flexibilization Study

Ramp Rate& system reliability improvement to run machine at 40% MTL

Renewable Energy

Township Power source conversion from conventional to renewable energy

3. Benchmarking of Energy Consumption

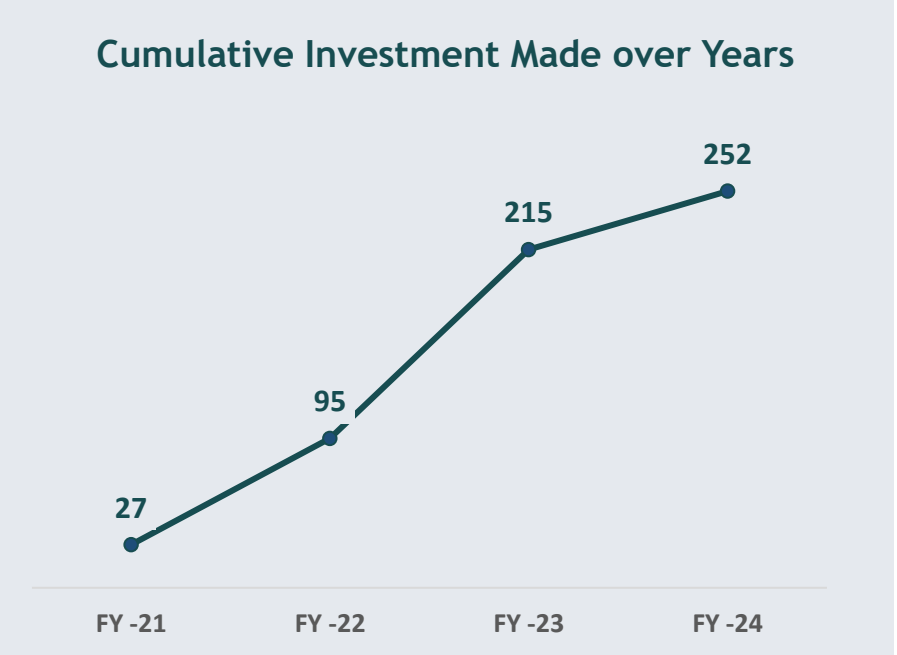
3.E Future Energy Conservation Plans

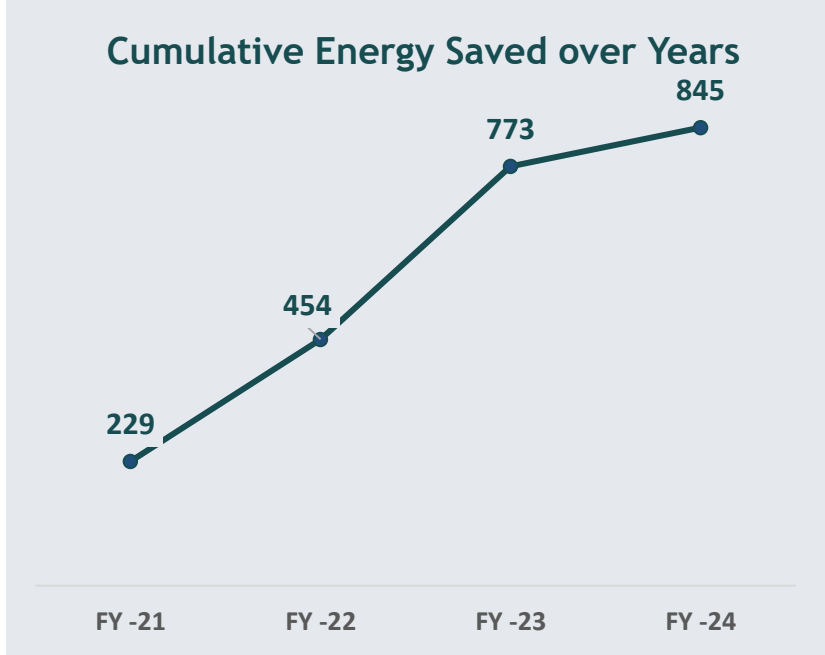
Title of Project	Annual Electrical Saving (Million kWh)	Annual Thermal Saving (Million kCal/annum)	Investment (Rs in Million)
APC Reduction through replacement of conventional HVAC cooling tower with Fan & Fill Less Cooling Tower	0		0.75
AHU retrofit- High efficient EC Fan	0		4.50
Improvement in efficiency of unit at part load operation through flexibilization study and implementation of recommendations	5	10800	28.80
500 kWp Solar Project Conversion of Township power consumption from conventional source to Solar energy source	1		32.57
Boiler Feed Pump Specific energy consumption optimization through cartridge replacement	2		2.47
Boiler Draft Power consumption reduction and Boiler efficiency Improvement through APH Basket & Seal Replacement	2	27049	60.00
Induced Draft Fan Specific Energy Consumption optimization and reliability improvement through ID Fan Impeller Coating	1		0.15
Circulating Water Specific Energy Consumption reduction and Condenser Vacuum improvement in peak summer through flow enhancement	0	5137	6.50
Condenser Vacuum Improvement through CW water quality Improvement		4478	0.15
Mill Specific energy Optimization and PA fan current optimization through aero foil Replacement	0		0.02
Optimization of Boiler Radiation loss through Refractory & Cladding Sheet replacement in Boiler		10611	4.45
Improvement of Boiler Combustion Efficiency through Combustion tuning		53057	7.00
DM water make up reduction and Turbine cycle heat rate improvement through rectification of critical valves passing and leakages.		3031	0.00
Hetar Rate & APC improvement through Mandatory Energy Audit and Implementation of Recommendations.	5	11876	9.30
Boiler efficiency Improvement through burner replacement		18136	1.00
Vacuum Pump Specific energy consumption reduction through rotor replacement	0		0.00
Installation of Sonic Soot Blower in APH		1782	2.10
Boiler Efficiency Improvement through replacement/ refurbishment of Coal mill rollers along with bull ring segments.		9288	1.46
Cooling tower fan motor to gearbox metallic shaft replacement with carbon fiber shaft	1		4.80
Total	**18.3**	**155243.4**	**166.0**

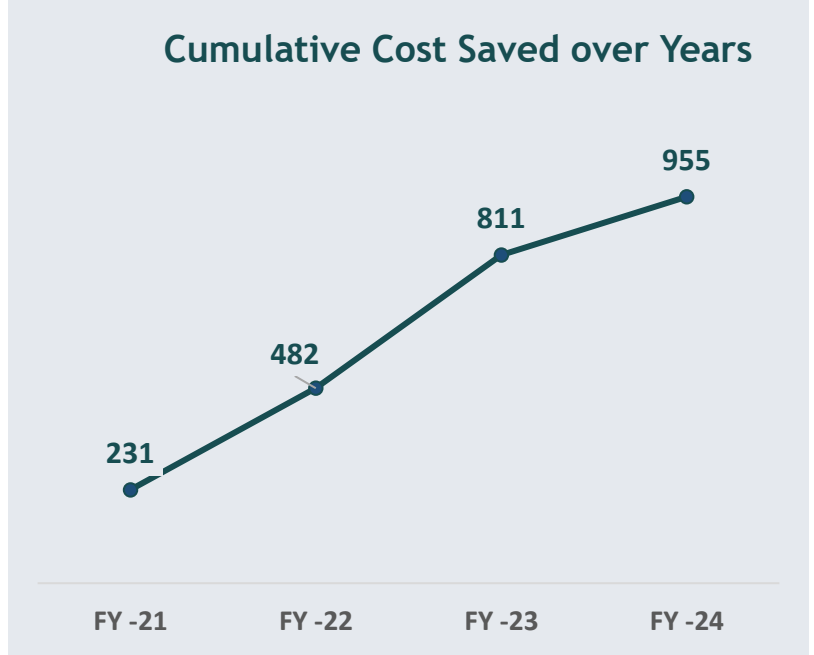
4. Summary of Energy Saving Projects

4.A Summary of Energy Savings Projects in Last Four Years

FY	No. of Projects No's	Electrical Savings (Million kWh)	Thermal Savings (Million Kcal)	Cost Savings (INR Million)	Investment INR Million
FY -21	21	21	179042	230.9	27.5
FY -22	25	26	170778	251.0	67.6
FY -23	17	18	258761	329.4	120.1
FY -24	19	19	45393	143.6	37.1
Total	**82**	**85**	**653974**	**955**	**252**







4. Summary of Energy Saving Projects

4.B Major Energy Conservation Projects Implemented in Last Three Years

Year	Name of Projects	Investment (INR Million)	Electrical Savings (million kWh)	Thermal Savings (million Kcal)	Total Savings (INR Million)
FY 22	Improvement in Boiler Efficiency by 1% through Multiple Linear Regression Analysis	15	-	22388	741
FY 22	Auxiliary Power Consumption Optimization during Flexible Operation	5	4	-	149
FY 22	ESP Power Consumption Optimization through Enhanced Temperature Control Logic for Hopper Heaters	4	1	-	22
FY 22	Compressed Air System Energy Conservation through installation of Intelligent Flow Controller	2	-	-	1
FY 22	Optimization of ESP Power through Power Saver Mode	-	9	-	31
FY 22	Optimization of CW/ACW Pump & CT Fan running hours	-	5	-	19
FY 22	Replacement of Existing conventional lightings with LEDs throughout the plant	5	4	-	13
FY 22	APC reduction through ID Fan Power Consumption optimization by Ceramic Tiles Coating in Flue Gas duct for mitigating erosion & duct leakages	2	2	-	9
FY 23	AI & ML based Predictive Analytics for Plant Performance & Reliability Improvement	4	1	-	4
FY 23	Installation of Vibro Feeder in Second Stream Conveyor-BCN-2A	3	0.01	181	2
FY 23	Efficiency Improvement through Unit 2 COH in Aug-2022	30	7	83981	107
FY 23	Efficiency Improvement through Unit-1 AOH in Jul-2022	4	6	42224	62
FY 23	Implementation of CFD & CAVT Test recommendation at flue gas duct in boiler second pass	0.3	1	-	2
FY 23	Application of Anti-erosion Coating in ID fan-1A and 1B Impeller	0.4	1	-	2
FY 24	Strengthening Energy Management system through Digitalization and Integration with AI based predictive analytics	5	3	-	15
FY 24	Ash Handling Plant Transport Air energy Consumption reduction using Ultrasound analyzer for air leakage detection	2	1	-	2
FY 24	Diesel Consumption Optimization through reduction of Truck Idle time running hours	0.5	-	538	5
FY 24	HVAC power consumption Optimization through Chiller Efficiency Improvement	0.4	0.08		3
FY 24	Reduction of throttle Loss through Governing Valve Overhauling and replacement	0.1	-	1616	2

5. Innovative Project Implemented in FY 2023-24

Replicability - Yes

5.A Innovative Project-I Strengthening Energy Management system through Digitalization and Integration with AI based predictive analytics.

Project Trigger:

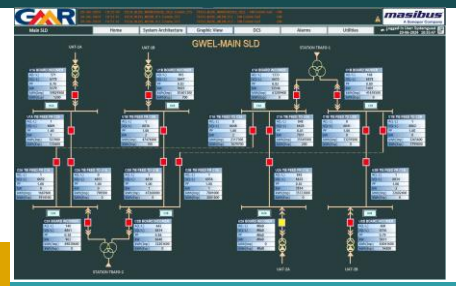
- Non-Availability of real time **"Energy deviation patterns" of SEUs.**
- **Specific Energy Consumption** not being available on real time basis.
- **Lack of Integration** with other Plant Operating systems.
- Absence of **Predictive tools like AI&ML** systems.
- Limited number of **Alert and Anomalies detection**.
- Non-Availability of **Energy Consumption baseline** and Best performing equipment amongst similar type.
- Non availability of **Process Variable** impacting EnPIs.

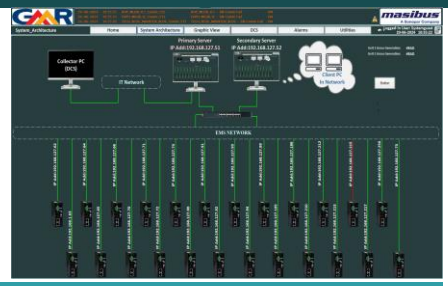
Conventional Energy Management

- SLD of Actual Electrical System
- Visualize Energy Consumption
- Energy Monitoring and reporting
- Set Alarms& Trends
- Dashboards

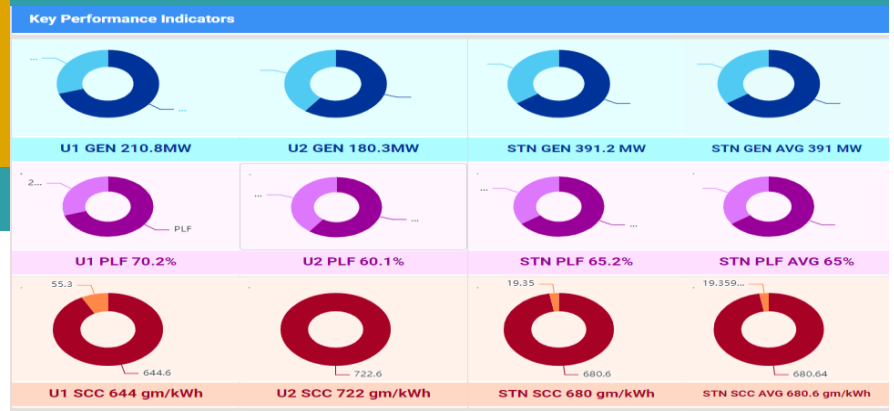
AI Energy Expert with AI/ML Features

- Visualization of Energy performance
- Identify anomalies and inefficiencies
- Benchmark Energy consumption
- Insights of Energy usage patterns
- Enhance Energy reporting& disclosure.





Realtime Plant SLD & System Architecture



Energy Dash Boards

Key Features:

Reduce performance loss with Explanations

Unique **deep learning models** can analyze even complex systems with thousands of sensors to explain the reason behind loss of performance. Improve **station heat rate** and **optimize auxiliary power consumption.**

Improve people productivity

Increase workforce productivity with intelligent system that can analyze upstream/downstream impacts **and explains failure modes.** Empower people with AI-driven solution that **automates mundane and repetitive tasks.**

Increase Reliability with Full Plant Coverage

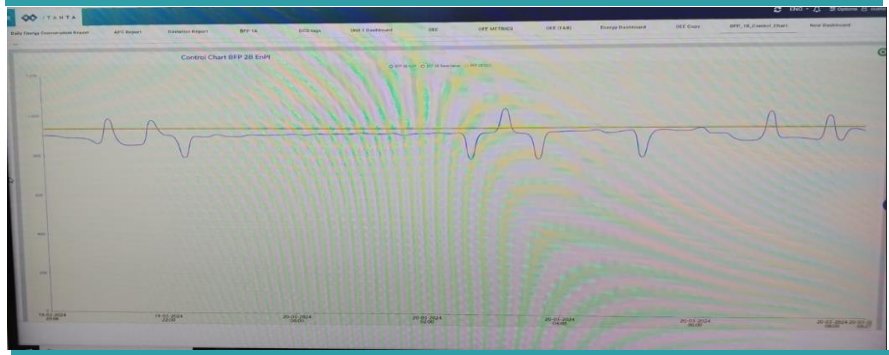
With unique system-level models, **AI Energy Expert** offers a practical and cost-effective way to monitor every single sensor and equipment - the full balance of plant. **Avoid false alarms** and get precise alerts with deep learning models.

Dash Boards& Reports

- **Unit/System wise ENPI comparisons**
- **Auto Generation of Reports** along with **Energy Deviations**
- Major KPIs in single page dashboard.
- **Energy deviations during Startup & Shutdown** of unit

Alert Management

- Detect Equipment **Energy Deviations/ Process Degradation,**
- **Prescriptive Recommendations,**
- **Customized Alarms** Communication Errors, Data Freezing, Bad quality of signals, energy deviations etc. & **Auto escalation of Alert**



Real Time Energy Deviation Using EnPI/ EnB

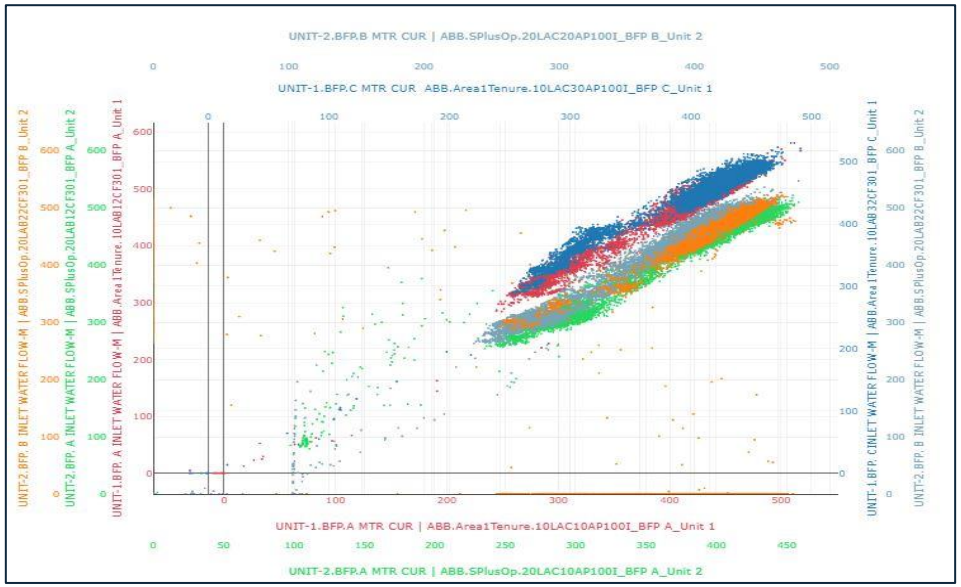
5. Innovative Project Implemented in FY 2023-24

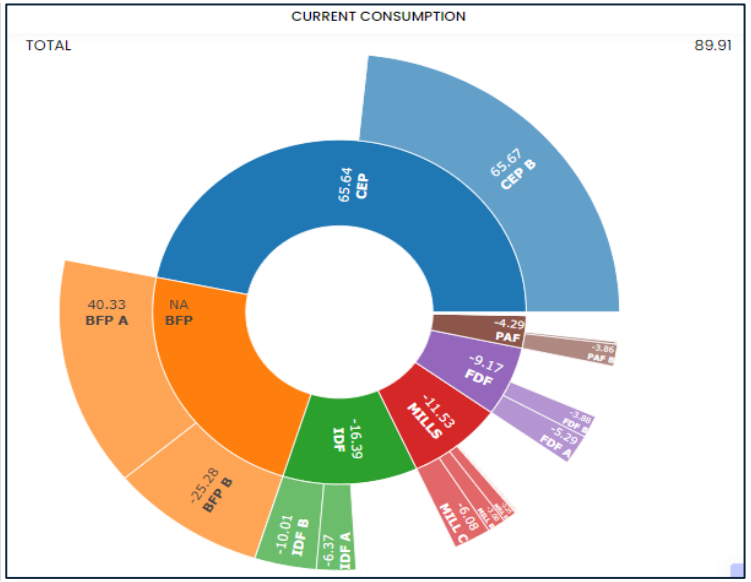
Replicability - Yes

5.A Innovative Project-I Strengthening Energy Management system through Digitalization and Integration with AI based predictive analytics.

Key Highlights:

- 300+ SEU's are being covered under Phase-1 Implementation& 3000+ Critical Alerts generated for corrections to operators
- Total Tags: 7000+ includes BTG/BOP/CHP/AHP/WTP Configured with 2500+ failure modes and recommendations with predefined signature of deviations
- Integration of SEU Energy Meters 330+ are Integrated from BTG/ BOP/AHP/CHP/ WTP
- Energy Meters Parameters Configured: Current, Voltages, Power Factor, Run Hours Fault Signals etc.,
- Integration with DCS/ WTP/CHP/AHP: Process Operational variables/ Static Factors Configured for Evaluation of EnPi.
- APC Break Up& Deviation Report Auto generation and Auto triggering of reports, Dash Boards to be configured
- EnPI Based Alerts are Configured for Possible Failure modes and Recommended actions to rectify the failure.
- Each Alert when generated will also show possible failure modes and recommended actions to rectify the failure
- Anomaly score of latest alert region& identify contributing tags that opens when clicked on the anomaly score.
- Top Contributing tags will launch upon a click on anomaly score. The other tags in the model can also be opened if user wants to find any between the deviations.
- Focus on what matters most - understand reasons behind symptoms& make operational decisions rather than sorting alarms.





Tangible Benefits:

- Energy savings of 34 million kWh annually which is 2% of plant auxiliary power consumption.
- Eliminated the need for continuous manual oversights.

Case Study

Primary Air High Specific Energy Consumption

Anomaly detection module detects High EnPI of PA Fan and generates Alarm and shows possible failure modes and recommends actions to rectify the issue

Shares contributing factors with anomaly score
1. Abnormality in Mill Air Damper
2. Aero foil Damage
3. Deviation in PA Flow corresponding to PA Header Pressure

Online Activities -
PA Flow and PA pressure transmitter flushing, Mill Hot & Cold Air damper rectification
Offline Activities
Mill Aero foil Replacement

5. Innovative Project Implemented in FY 2023-24

Replicability - Yes

5.B Innovative Project-II Reduction of Diesel Consumption through optimization of TAT by automation and digitalization of truck movement

Project Trigger:

- Since FY-2022-23, Per day on average 120 no's coal trucks transporting coal from nearby mines to plant& The turnaround time (TAT) of 70% of coal trucks is less than 35 minutes and 30 % coal trucks is greater than 50 minutes,
- The high TAT of 30% coal trucks leads to high diesel consumption.
- These activities apparently will lead to GHG Emissions as per the auxiliary performance & availability which are impacted due to Aging of Equipment, Poor Operations& Maintenance practices.

Action Implementation

- Human interference removed by automation ANPR camera/UHF reader automation
- SAP entry automation
- WCL requirement for loading of next trip entry and exit verification shifted to main gate.

Benefits:

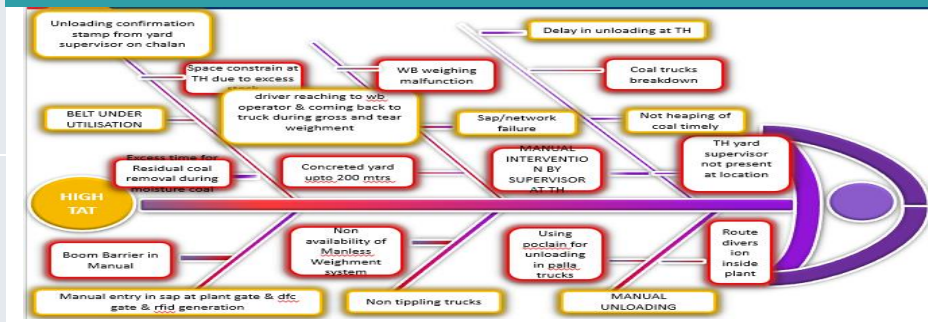
- Automating truck entry and exit process reduced diesel savings due to idle running of trucks by 172 liter per day which translated to approximately 54 lakh of cost savings.

Particulars	UoM	Values
Reduction in TAT	Min/truck	20
Truck average mileage in idle cond.	Litre/min	0.07
Diesel Savings	Litre	1.4
Diesel Cost	INR/litre	88
Cost Savings/truck	INR	123.2
No. of Trucks per Day	No's	120
No. of Trucks in Year	No's	43800
Annual Cost Savings (Million)	INR	5.4

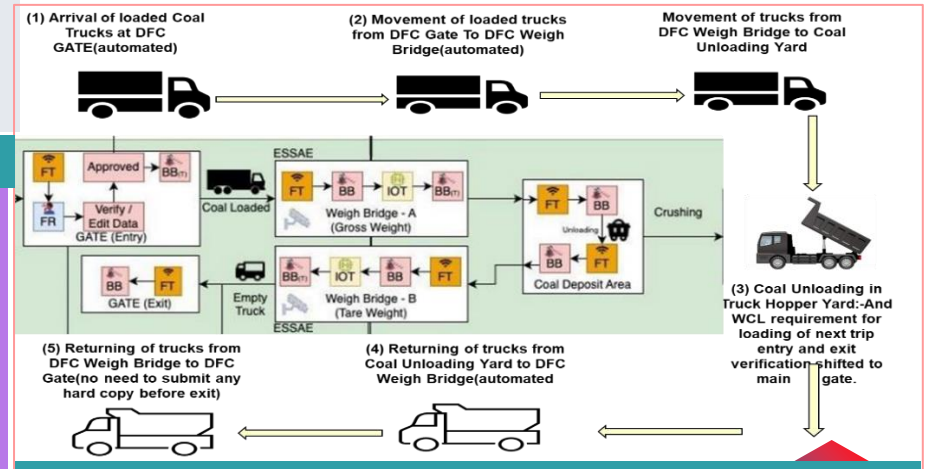
Key Highlights:

- High Resolution Lense ANPR Camera uses optical character Recognition system
- UHF RFID reader for seamless vehicle entry/exit without human intervention
- Automated entry in SAP to reduced idle time and human error in data entry
- Automatic Truck Weighment & minimal Human intervention

Automation of Data Entry using Scanner & Fast Tag



Fish Bone Analysis of High TAT of Truck Movement in Plant



SAP gate entry Automation- Digitization of process

5. Innovative Project Implemented in FY 2023-24

Replicability - Yes

5.C Innovative Project-III Adopting Six Sigma methodology for HVAC power consumption optimization through Chiller Efficiency Improvement.

Project Trigger:

- As per the design, Chillers, AHUs and Pumps are proposed for 2 Working + 1 Stand-by. For the past 2 to 3 years, there are frequent cooling issues in the Main Control Room during the peak summers even after operating all the Chillers, Pumps, Cooling Towers and 3 no. AHUs at Main Control Room

Action Implementation:

- Diverting and using Aire washer water as circulating water has led to improvement in condenser inlet water by 2 to 4 deg. C.
- Circulating water chemistry improved through regular monitoring and chemical dosing.

Benefits:

- **Temperature Drop actualized - 2 to 4 Deg.C**
- **Electrical energy Savings: -** 8,01,12 kWh.
- **Total Annual Cost Savings:-** INR 7 million




Various Testing & analysis by CFT team


Diverting Air Wash Water for Circulating Water

Before Implementation					
Parameter	Unit	CT 1	CT 2	CT 3	CT 4
Water Inlet Temperature	Deg. C	28.6	27.2	27	25.7
Water Outlet Temperature	Deg. C	26	24.5	23.4	22.3
Entry Air Dry Bulb Temperature	Deg. C	24	25	25	25
Entry Air Wet Bulb Temperature	Deg. C	17	18	18	18
Range	Deg. C	2.6	2.7	3.6	3.4
Approach	Deg. C	9	6.5	5.4	4.3
Effectiveness	%	22.4	29.3	40.0	44.2

After Implementation					
Parameter	Unit	CT 1	CT 2	CT 3	CT 4
Water Inlet Temperature	Deg. C	29	28	27	26
Water Outlet Temperature	Deg. C	22	22.5	22	21.5
Entry Air Dry Bulb Temperature	Deg. C	25	25	26	27
Entry Air Wet Bulb Temperature	Deg. C	16.5	17	17	17
Range	Deg. C	7	5.5	5	4.5
Approach	Deg. C	5.5	5.5	5	4.5
Effectiveness	%	56.0	50.0	50.0	50.0

Cooling Tower Performance Comparison

6. Utilization of Renewable Energy Sources

6.A Savings achieved through Onsite Renewable Energy Projects

	2021-22	2022-23	2023-24
No. of Project Implemented	2	2	3
Total Capacity - MW	0.97		1.04
Total Power Savings Lakh KWh			9728
% Share			0.2%
Cumulative Savings (Rs Lakh)	268.01	270.08	272.08
RPO Obligation	No		

Particulars	2021-22	2022-23	2023-24
Performance Ratio (%)	100	100	100
Capacity Utilization Factor (CUF)	100	100	100
Energy Injected into the grid	Nil	Nil	Nil
O&M Cost (Rs./MWp)	0.0067	0.0067	0.0067

Onsite Generation	Technology	Type of Energy	Installed Capacity (MW)	Usage (million kWh)	% of overall electrical energy consumption
FY 2021-22	Wind	Electrical	0.97	8.46	0.24
FY 2022-23	Wind	Electrical	0.97	8.46	0.20
FY 2023-24	Wind	Electrical	0.97	8.48	0.19

Onsite Generation	Technology (Thermal)	Installed Capacity (MW)	Usage (million kWh)	% of overall electrical energy consumption
FY 2021-22	Solar	Thermal	0.52	0.014
FY 2022-23	Solar	Thermal	0.52	0.012
FY 2023-24	Solar	Thermal	0.53	0.013

6.B Renewable Energy Projects Implemented

70 KW Roof Top PV Solar Module to reduce building HVAC & lighting Load.

Solar Water Heater for Township : Solar Water Heater in Permanent Township installed for 150 Families

Solar Water Heater for Associates : Solar water heater of capacity 1000 LPD installed at Associate employee township.

Wind operated Cooling Fans (150 nos.) on TG Building, Ware-House, CW Pump House, AHP Compressor House by replacing motor operated fans.

Rainwater Harvesting : Deep Aquifer & reservoir Recharge by Rainwater Harvesting in Plant & Colony

Pipe-Lighting Pipe light in Stores & Warehouse.

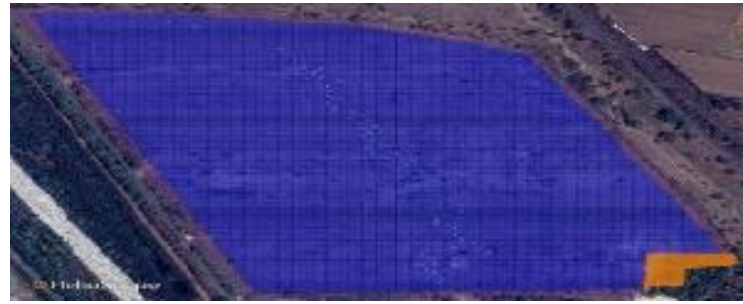
Translucent Cladding Sheet Translucent sheet cladding in CHP belt conveyors, Compressor House, RO-DM to reduce lighting load

Roof Top Rainwater Harvesting Roof Top Rain-Water Harvesting from all buildings.

6.C Renewable Energy Projects under Implementation

Installation of 30 MW Ground Mount Solar & 5 MW Floating Solar Plant

- ✓ Feasibility Study Conducted:-
  - ✓ Ground Mount Solar – 3 Potential Sites identified - Near Main Gate, Near Switchyard Area, Near Ash Pond
  - ✓ Floating Solar – 2 Nos. Reservoir
  - ✓ Roof Top Solar - 7 Potential Sites identified

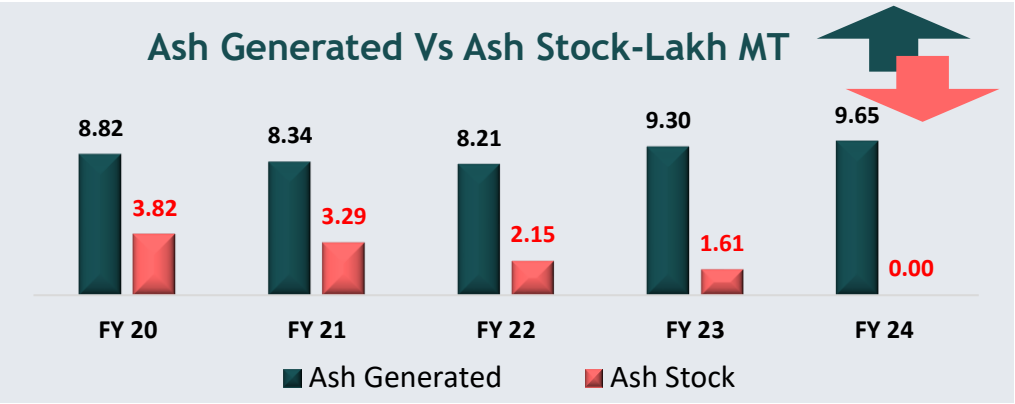


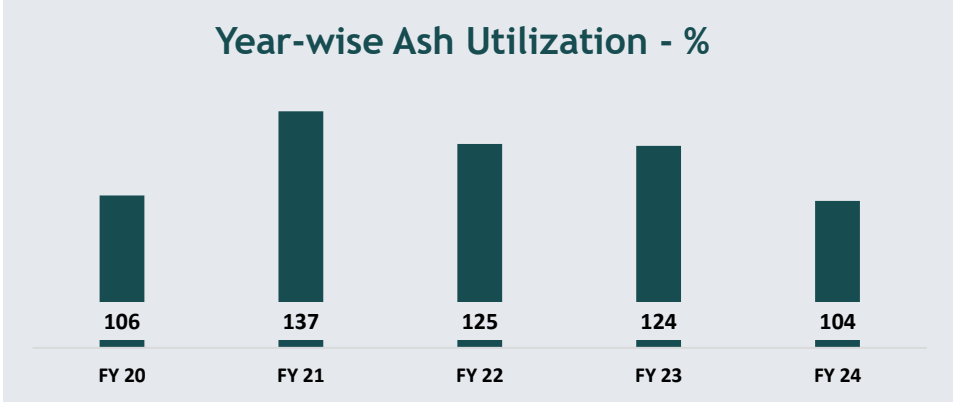
Installation of 0.5 MW Ground Mount Solar for GWEL Township

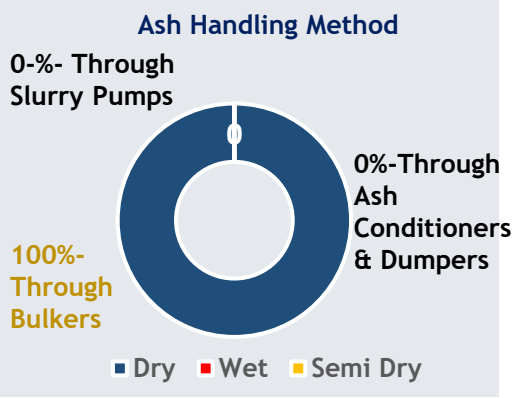
- ✓ Ground Mount Solar –Mono PERC half Cut Fixed Tilt
- ✓ Connectivity – 11 KV Internal Substation
- ✓ Performance Ratio – 78%
- ✓ Capacity Utilization – 17% (Minimum)

7. Environment Management-Ash Utilization

7.A : Utilization of Ash Generated







Particulars	UOM	FY 22	FY 23	FY 24
Total Ash generated	Tons	820810	930062	965561
Ash Stock in Plant (yard + pond)	Tons	214869	161152	0
Ash Utilization	%	125%	124%	104%
Ash Utilized in manufacturing of cement/concrete - other similar products	%	20%	26%	43%
Ash Utilized in Fly Ash Bricks	%	22%	25%	25%
Ash Utilized in Mine filling	%	0%	13%	8%
Ash Utilized for Roads pavements	%	49%	23%	4%
Ash Utilized in Brick Manufacturing (from Bottom Ash)	%	9%	7%	13%
Ash Utilized in Bottom Ash Mine Filling	%	0%	3%	6%
Ash Utilized Bottom Ash for Road Pavements	%	0%	3%	2%

Utilization of Ash at GWEL

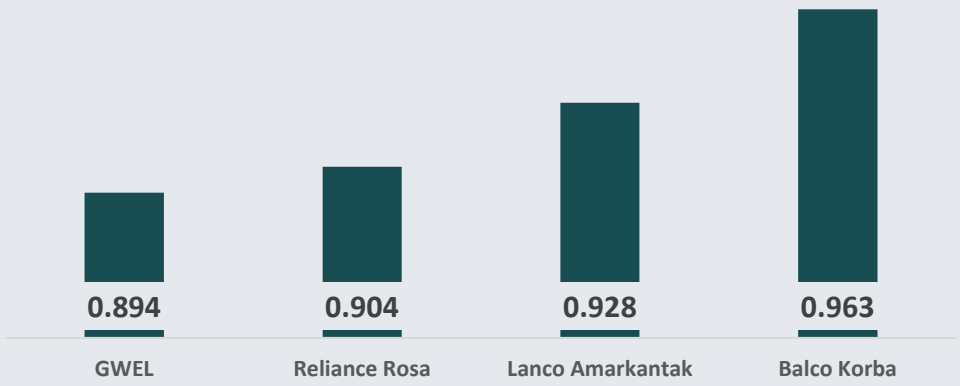
- Utilisation of Legacy Ash YoY basis is completed well before the Target of FY 27.

Ash Utilization at GWEL is 100% for Consecutive 6 Years

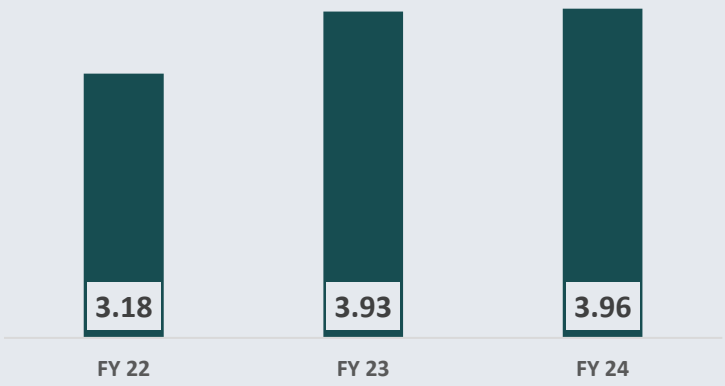
7. Environment Management - Emission

7.B ISO 14064:2019 Quantification, Monitoring & Reporting of GHG Emission and reduction

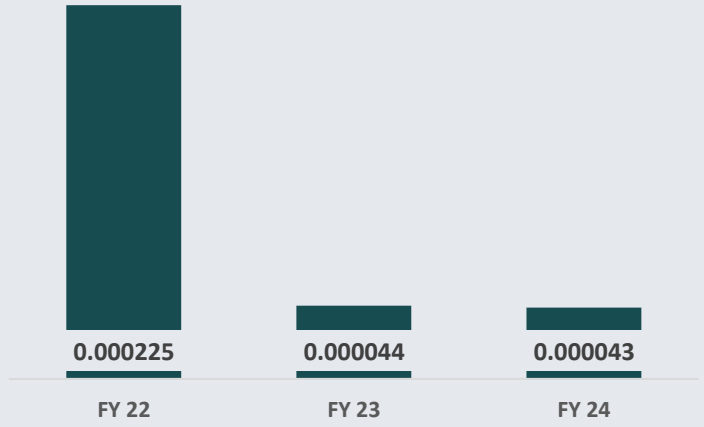
External Benchmarking GHG Emission Intensities in Kgco2/kWhr



Total Emission Including all Scopes (million tCO2e)

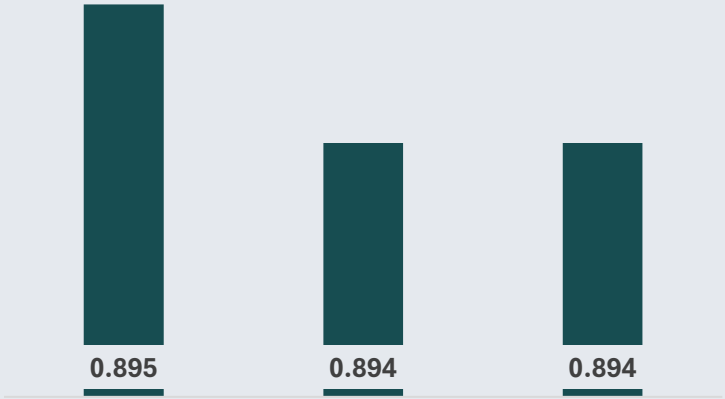


Scope-2 Emission KgCO2/kwh

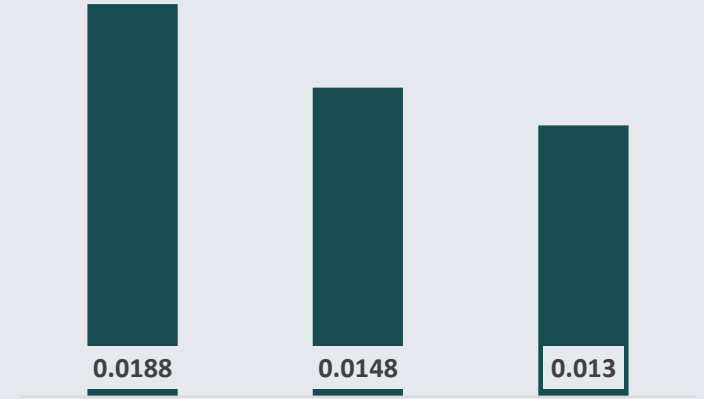


- GWEL successfully completed GHG emissions verification audit as per guidelines laid with ISO-14064:2019. (Carbon Emission disclosure)
- Fuel sources& Activities includes Energy consumed, Travel, Transportation, Direct& Indirect emissions and many more.
- In Scope- 3 following categories are being considered -
  - Coal Transportation- Rail/ Road
  - Ash Transportation
  - Business Travel- Flight/ Road
  - CO2 Transportation
  - Chlorine Transportation
  - H2SO4/ HCL Transportation
  - LDO Transportation
  - Contractual Vehicle
  - Food Waste - Plant/ Township

Scope-1 Emission (Kg CO2/kwh)



Scope-3 Emission Kg CO2/kwh

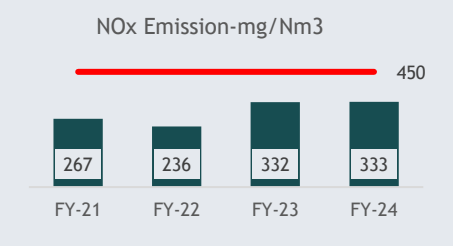


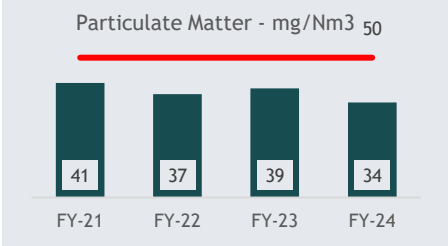
7. Environment Management-Emission

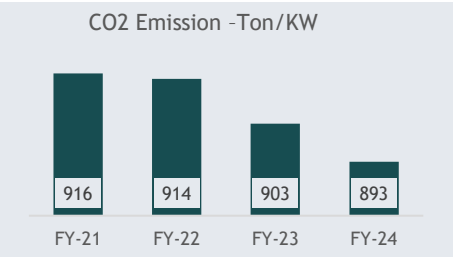
7.C GHG Inventorisation

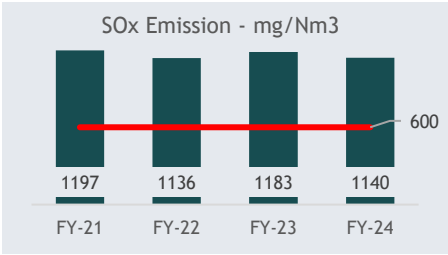
GMR Sustainability Report

- Every year GMR group publishes its sustainability report for public. It is available on the following link: Scope-1 Emission
  https://investor.gmrpui.com/sustainability-reports









Best Practices for Maintaining Emission Level within Norm

- GWEL is committed to reduce Greenhouse Gas Emissions and also to offset any remaining emissions.
- GWEL is committed for the "Net Zero" by the year 2070

Current Control:

- GWEL is having **Low NOx Burner installed** since design stage with Nox value within norms limit
- **Coal Blending through Automated Software** to minimize emission& maximize efficiency.
- PM within norms limit & complete utilisation legacy ash before target year.
- **Real time Ash & GCV Monitoring system** installed
- Transportation of ash through jumbo bags by train mode
- Biomass Co-firing for reducing emissions
- ISO 14064- Green-house Gas reduction

Future Control:

- **FGD Implementation by Dec-2026**- Contract finalization In progress, Project Execution start by Jan-2025
- **30 MW Floating Solar Installation-** Contract finalization under progress, Project Execution by- Mar-2026
- AAC (Aerated Autoclave Concrete) block manufacturing unit installation

7.D PAT Cycle-II Compliance

PAT Cycle-IIRegistration No.-TPP0149MH		
Target NHR for Assessment Year: 2018-19	Actual NHR Achieved for Assessment Year: 2018-19	NHR Target Overachieved for PAT Cycle-II by
2555	2524	30.4

7.E PAT Cycle-VII Compliance

PAT Cycle-VII - Registration No.-TPP0149MH			
Target NHR for Assessment Year 2024-25	Actual NHR Achieved for FY: 2023-24	Difference	Remarks
2520	2499	21	MEA Planned in Dec'24

Operating Station NHR achieved with Normalization in FY 2018-19 : 2524.24 kCal/kWh

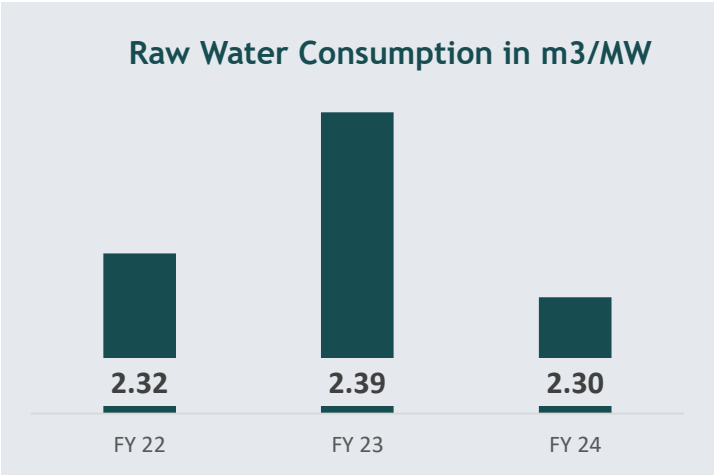
Number of EScerts to Sell : 9957 Total Price of EScerts to sell : Rs. 1.83 Crores

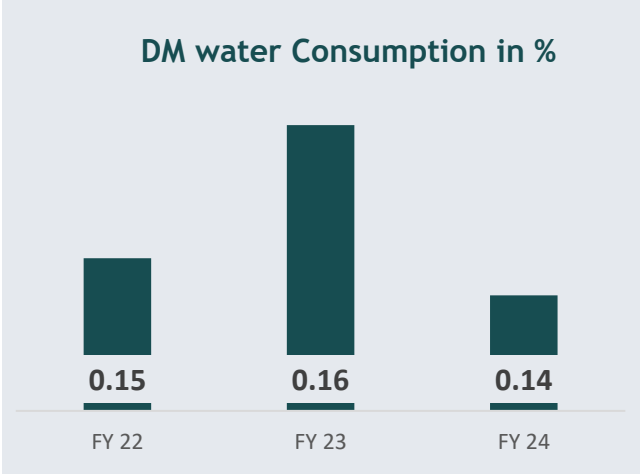
7. Environment Management-Water

7.F Our Value of Social Responsibility by Conservation of Natural Resource

To achieve above objective , we have adopted **Auditable System Driven Approach by implementing comprehensive "Water Efficiency Management System" (WEMS, ISO 46001:2019)**

- ✓ Implementation of **Water Efficiency Management System (ISO 46001)** for conservation of natural resource
- ✓ Implementation of **Water SCADA**- Dedicated water consumption monitoring and accounting
- ✓ **Zero Liquid Discharge Plant**
- ✓ Water Management Policy & Objectives
- ✓ **Identify Business activity indicators**
- ✓ **Evaluate the Water Use Review Report**
- ✓ **Significant Water Use Equipment's/Process**
- ✓ **Baseline Water Efficiency Indicators targets & action plan**
- ✓ **Benchmarking with Industry Leaders & capturing Best Practices**





1st IPP to Implement WEMS, ISO 46001:2019 & Blue Rating System by M/s CII - Triveni Water Institute

Water SCADA

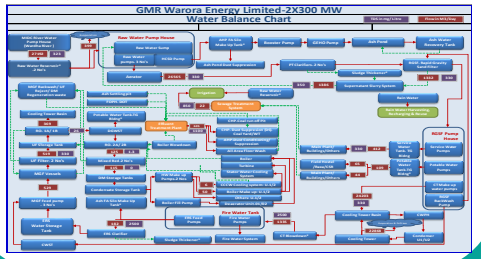
Implementation

- 36 Flow Meters Installed.
- Additional 8& 7 Flowmeters in Phase II/ III. Repect.
- Area wise consumption accounting.
- Identification of Water Wastage
- Automated Reports
- Real Time Dashboard & Trend
- Alarm for increase in Water Consumption above base value
- **Water Saving-59.36 Lakh m3**

Water Audit

Implementation

- External Water Audit by CII Triveni Water Institute.
- Implemented recommendations from Audit
- Internal Audit:- Through CIPs - Continual Improvement Plan
- **Water Saving of 8.26 Lac m3 has been achieved through CIPs**



Rain Water Harvesting

Deep Aquifer Recharge:

- Plant-wide storm water drains connected to Rain water harvesting pond.
- Annual Rain Water Harvesting of 8.6 Lac m3.

Rooftop Rain Water Harvesting:

- Rain water harvesting from building roof tops & used as cooling tower makeup .
- Fresh Water Saving-10580 m3/Annum

Reservoir Recharge:

- Fresh Water Saving-54000 m3/Annum

Water- Beyond the Fence

- Awareness on Scientific Watershed Management for improving water condition in draught areas
- **RO Water ATM** installed in **17 Villages** for providing **Safe drinking water in fluoride zone**
- **Check Dams** construction
- Pond deepening at nearby villages
- **2 Nos. KT Weir** restored
- More than **285 acre land** brought under **irrigation**

8. Best Practices in the Plant

Flexibilization

Sale of 10 MW of Power saved through APC in Market.
Flexibilization trial for 40% minimum technical load is carried out as per regulation & observation shared with OEM.

Maintenance & Reliability

Vibration Analysis, LOA, WDA, NAS, TAN, Infrared, Thermography, DGA, MCSA
Six Sigma based approach for chronic issues.
5S workplace management

Digitization

Digital Logbook, EHS Management, Internal Audits, Waste Management, Gate Pass
Knowledge Management Portal, Coal SCM, CCTV Analytics

Asset Management

Implementation of ISO 55001, AMS implementation by Asset System Manual & procedures Work Instructions and Manuals.
Identification of Significant Assets by Asset Risk register.

Biodiversity

Friendly Habitat for Floras & Faunas
Various varieties of fruit bearing & forest species plants like Danima, Eucalyptus, Golichowli, Conocorophous, Jamun, Amla etc.,

Afforestation

42% of the total Plant area is covered under Green Belt
Total 205550 No. of Plants has been planted

Research

Data Analysis Tool to generate innovative solutions to Cope with dynamic & regulated scenario for correct decision making for profitability improvement

New Initiatives

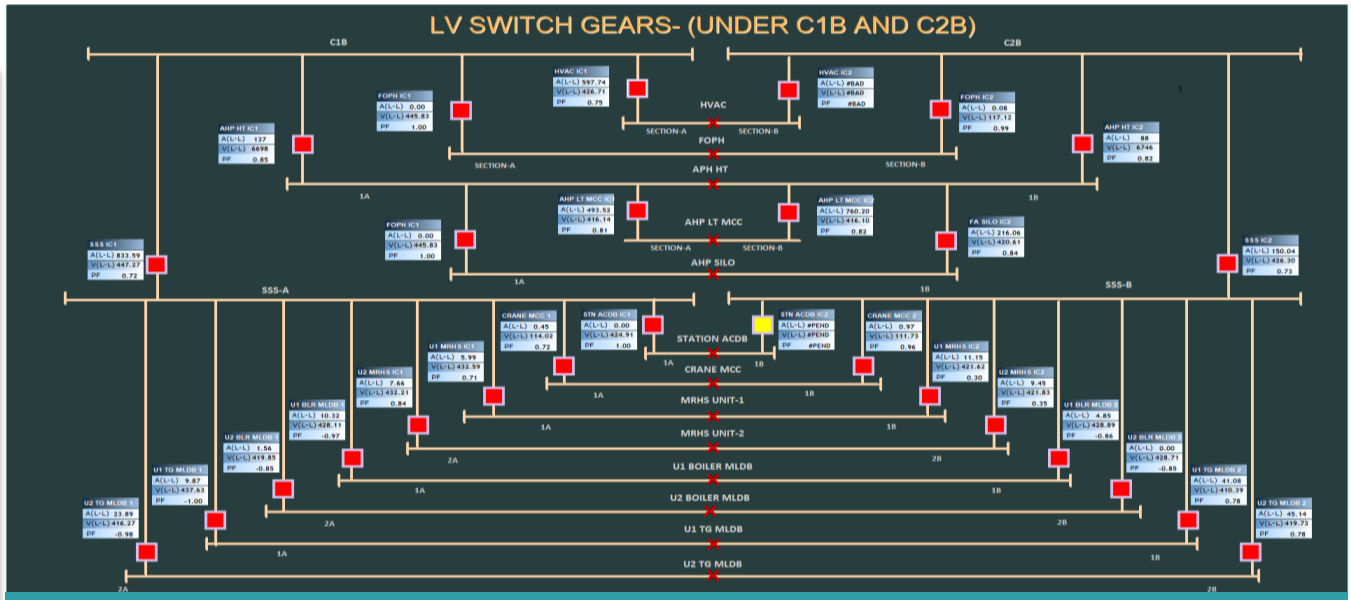
Implementation of ISO 26001, SA8000, BCMS, ISMS
Infrastructure support to Govt. Schools, Kid Smart Centres & Transportation Facility Health Clinics & Camps/ Individual Sanitary Lavatory, Vocational Training Centre & Libraries.

9. EMS System and Other Requirements

9.A Monitoring of Energy Consumption

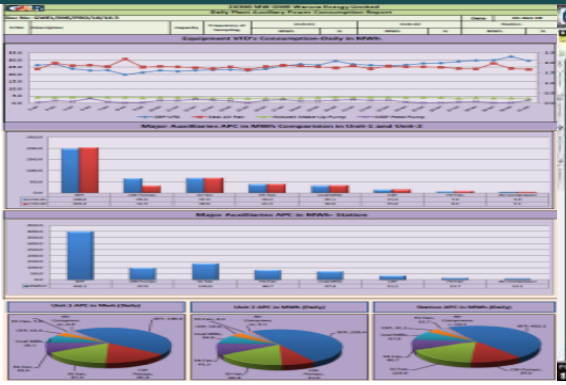
Centralized Energy Management System

- Real Time Comparison of HT & LT Equipment's Auxiliary Power consumption in EMS system for BTG, BOP, AHP & CHP
- Equipment wise Board wise Energy performance monitoring.
- Auto Reports Generation for Energy Consumption on Daily, Monthly& FY basis.
- Trending for better Analysis of Energy Consumption
- Availability of Plant-wide Equipment's with Rating >75KW
- Availability of Alarm, Auto SMS & Auto Mail Facility
- System Upgraded for Integration with DCS for Monitoring of Energy variation w.r.t interlinked variables
- Upgradation of Online Plant Performance Monitoring System – 18 Modules – Turbine, Boiler, Heaters, APH, Mills, Pumps, Fans, Compressors etc.,



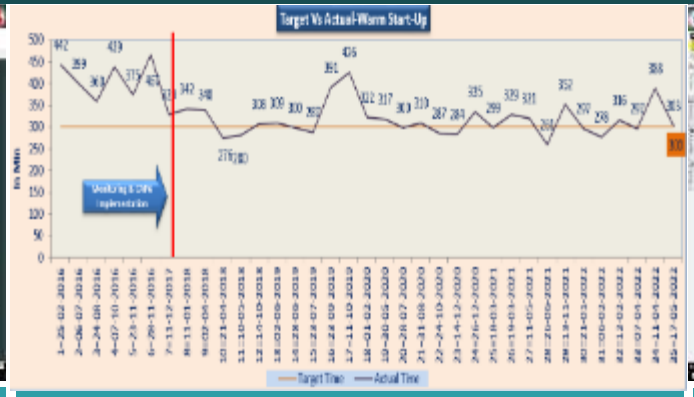
SLD for Switchgear of Energy management system

9.B Daily MIS Reports for Monitoring of Energy Consumption & Real time Monitoring System

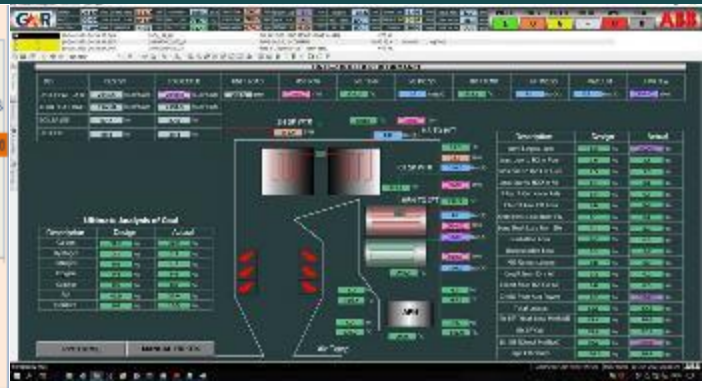


Daily APC & Energy Deviation Report

Turbine Performance Monitoring



Sustenance Monitoring Reporting



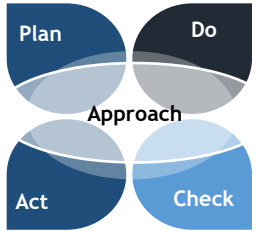
Boiler Performance Monitoring

9. EMS System and Other Requirements

9.C Implementation of ISO 50001- Upgraded to ISO 50001:2018

- ✓ Energy Objectives & Targets
- ✓ Separate budget for Energy Conservation
- ✓ Participation in Various Forums & Awards
- ✓ Training & Knowledge Sharing

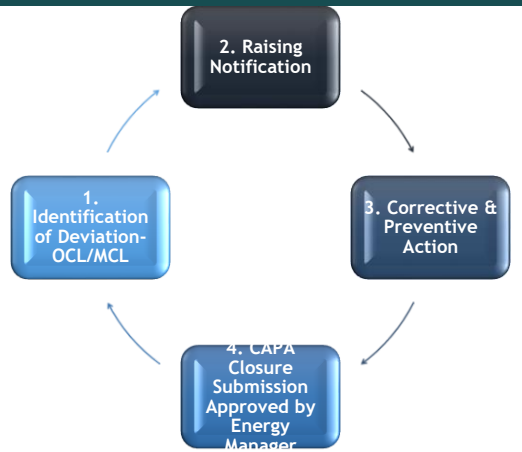
- ✓ Adoption of New Technologies
- ✓ Renewable Energy Projects
- ✓ EC Plans Implementation
- ✓ Green Supply Chain Management



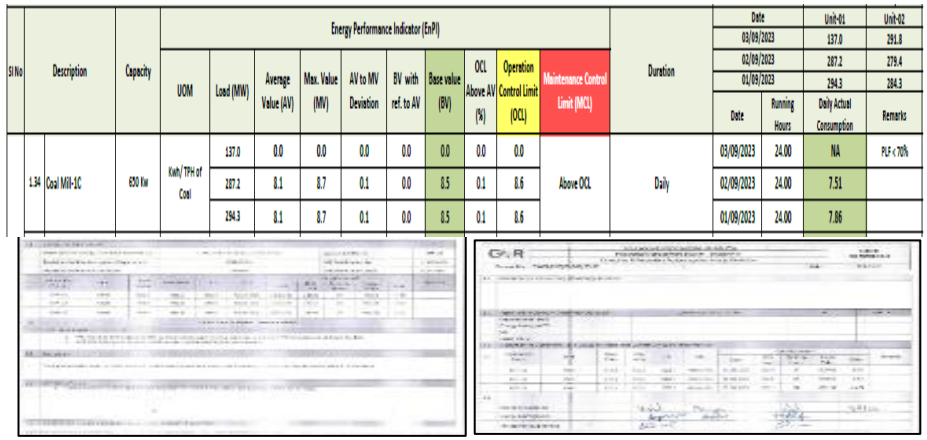
- ✓ Best O&M Practices
- ✓ Energy Conservation projects for Stakeholders & CSR
- ✓ Sustenance Monitoring

- ✓ Evaluation of Energy Performance
- ✓ Internal & External Energy Audits
- ✓ Evaluation of Vendors / Suppliers
- ✓ Benchmarking of Performances

PDCA Approach- ISO 50001 Implementation

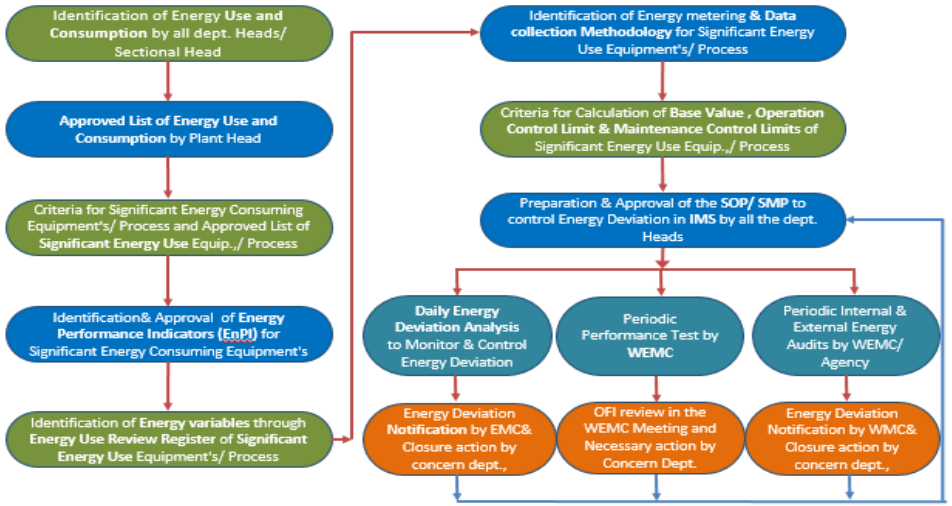


Process of Continual Improvement



Sl No	Description	Capacity	Energy Performance Indicator (EnPI)										Duration	Date	Unit-01	Unit-02
			UOM	Load (MW)	Average Value (AV)	Max. Value (MV)	AV to MV Deviation	BV with ref. to AV	Base value (BV)	OCL Above AV (%)	Operation Control Limit (OCL)	Maintenance Control Limit (MCL)		03/09/2023	137.0	291.8
														02/09/2023	287.2	279.4
														01/09/2023	294.3	284.3
1.34	Coal Mill-1C	650 Kw	Kwh/ TPH of Coal	137.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	Above OCL	Daily	Date	Running Hours	Daily Actual Consumption	Remarks
				287.2	8.1	8.7	0.1	0.0	0.5	0.1	8.6			03/09/2023	24.00	NA	PLF <70%
				294.3	8.1	8.7	0.1	0.0	0.5	0.1	8.6			02/09/2023	24.00	7.51	
														01/09/2023	24.00	7.86	

Monitoring through Daily Energy Deviation Report & Deviation Closure by CAPA Closure Mechanism



ISO 50001 Implementation Plan

1. Identification

- Identification through Internal/ External Audits, RCA for Energy deviations.
- Approval of COO-Thermal

2. Implementation

- Identified in-efficiencies are categorized on basis of Impact& Cost of improvement which is data-driven approach
- EC Plan Implementation Plan is Approved by Steering committee headed by Plant Head

3. Completion

- Post Completion of EC Plan, Completion along with Benefits will be certified by Steering committee

4. Effectiveness & Sustenance

- Actual savings achieved to be furnished against expected Post One month of project completion & certified by Energy Manager

GWEL - Management of Energy Conservation Program- SIP Digitalization-Complete Cycle in Saarthi Portal

Total 240 Energy Conservation SIP's implemented in last 9 FY's

% Investment on Turnover in FY 2023-24 : 0.67%

9. EMS System and Other Requirements

9.D Remaining Life Assessment of Boiler

Remaining Life Assessment Study

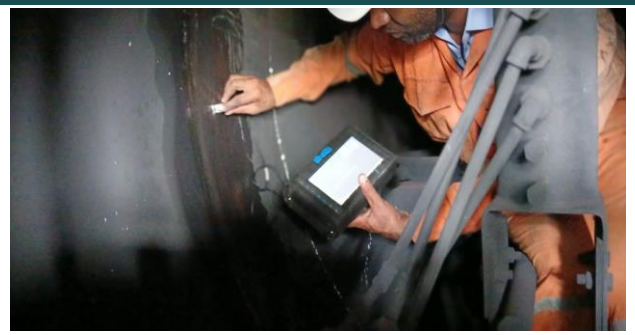
- Boiler Pressure part components of the Boiler were Assessed.
- Several Non-destructive testing methods were Utilized& Experts from a number of fields were involved.

Remaining Life Assessment Study

- Carried out In Situ Metallography (Replica) on Steam Drum& All Headers Total qty. 85 No's and Tube & Coil Sampling 30 No's.
- Following Samples were collected from the following Boiler Components and RLA/NDT Tests were carried out.,

RLA/NDT TEST REFFERED IN RULE 391A(B) (I) UNDER IBR
• Visual Test
• Ultra Sonic Testing
• Magnetic Particle Inspection
• Liquid / Dye Penetrate Insp.
• Replication
• Sampling
• Deposit Analysis
• Outside Dia. Meter& Thickness
• Fiber Optic Inspection
• Hardness Test etc.

IBR Boiler Component Considered for RLA/ NDT
• Furnace water Wall
• Drum (Steam)
• Bottom Headers
• Low temperature headers
• Attemparation Headers
• Economizer Tubes
• Main Steam Piping
• Cold Reheat Piping
• Hot Reheat Piping



RLA Observation& Conclusion

- No recordable indication has been observed during RLA Study & all types of NDT Test.
- No significant foreign materials or deposition observed inside the drum.
- No significant surface defects are observed during Dye Penetrant Test.
- No significant surface or sub-surface defects are observed during the Magnetic particle Inspection of steam drum, headers and other major components of Steaming.
- Ultrasonic test of the weld joints of different components revealed, no significant service induced internal discontinuities or deterioration observed.
- Hardness data of the various components found within normal range and confirmation of metallurgical test results.

9. Teamwork, Employee Involvement & Capacity Building

9.D Involvement of Employees in Energy Conservation

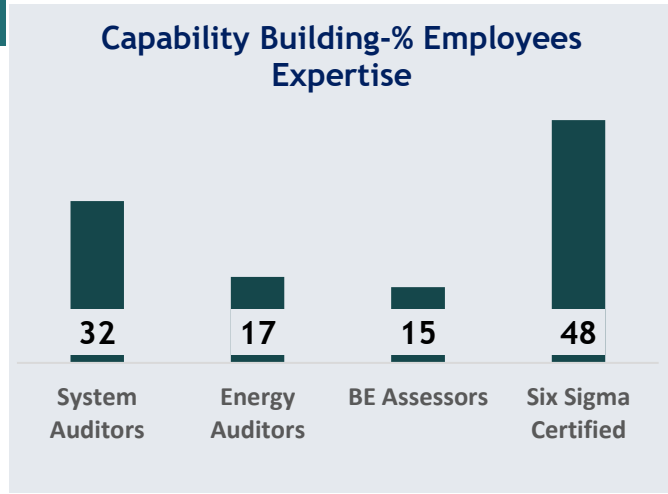
❑ Formation of Water & Energy Management Cell under ISO-50001 & ISO-46001

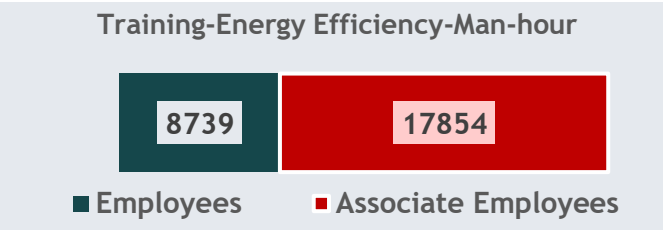
❑ **Objectives of EMC :**
- Monitoring of Specific Energy & Water Consumption
- Water & Energy Audit (Internal & External) & Recommendation implementation status review
- Discussion on Water & Energy Conservation Projects
- Identification of New Water & Energy Conservation Initiatives
- Daily/weekly/Monthly/Yearly EnCON projects review by EMC.

❑ **Members of EMC :**
- COO-Thermal(Chairperson), Deputy Plant Head, Head of WEMC, WEMC members (Energy Managers& Auditors)

❑ **Total Energy Managers- 21 Energy Auditors- 18**

❑ **Appointment of Water & Energy Leaders**
- Appointed throughout the plant & township
- Monitoring of Water & Energy consumption in their area
- Reporting of Energy (Electrical, Thermal, Air, Water wastage)
- Identification of Water& Energy saving opportunities.
- Monthly Localized Water& Energy Audits through Checklist
- Quarterly Area-wise Detailed Water& Energy Audit by Team of Energy Auditors & Managers
- Total 15 Water & Energy leaders appointed, and all are BEE Certified EA/EM.





GWEL rated ESCO Grade-4 by Bureau of Energy Efficiency

9. EMS System and Other Requirements

9.E Learnings & Implementation from CII and other programs

01 Implementation of learnings by adopting similar projects at our unit, leading to enormous savings

02 Ultrasonic System Analyzer for Valve Passing, Bearing health monitoring and Air Leakages identification

03 To identify strengths and opportunities to excel, based on a comprehensive and rigorous assessment by experts.

04 Information about Latest market trends & innovative products for Energy Efficiency.

05 Opportunity to interact & network with individuals and companies of repute.

06 CII Best Practices Manual brings Potential Projects with high replicability in Energy saving.

Awards& Accolades

BEE-National Energy Conservation Award 2023-Consecutive 3 Times

CII Excellent Energy Efficient Unit Award (Consecutive Six Times) & National Energy Leader Award (Consecutive Fourth) & Most Useful Presentation -2023 (Consecutive Third time)

NSC-Sarvashreshtha Suraksha Puraskar-3 Times

Sword of Honor 2019

BSC 5 Star 2019

CII Innovative Environmental Project & Water Management Excellence 2023

IMC Ramakrishna Bajaj National Quality Award 2017

National Safety Council - Safety Shield'

Maharashtra CSR Award

Global Performance Excellence Award 2018-World Class

Thank you