23rd CII National Award for Excellence in Energy Management 2022
(Thermal Power Stations)

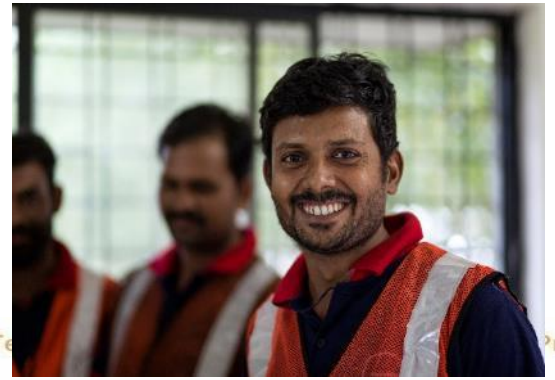




GMR WARORA ENERGY LTD

2x300 MW





23rd CII National Award for Excellence in Energy Management - 2022 (Thermal Power Stations)

Presentation Flow :

1. GWEL - At a Glance
2. Energy Consumption Over-view
3. Reduction in Sp. Energy Consumption
4. Benchmarking of Energy Consumption
5. Summary of Energy Saving projects implemented in FY 20, FY 21 & FY 22
6. Innovative Project implemented in FY 22
7. Utilization of Renewable Energy Sources
8. Environment Management – Ash Utilization
9. Environment Management - Emission
10. Environment Management - Water
11. Best Practices – Non Energy Efficiency
12. Team work, Employee Involvement & Monitoring
13. Implementation of ISO 50001 at GWEL
14. Learnings from CII/Other Award Program
15. Awards & Accolades

1. GWEL At a Glance - Group's Vision, Values & Mission

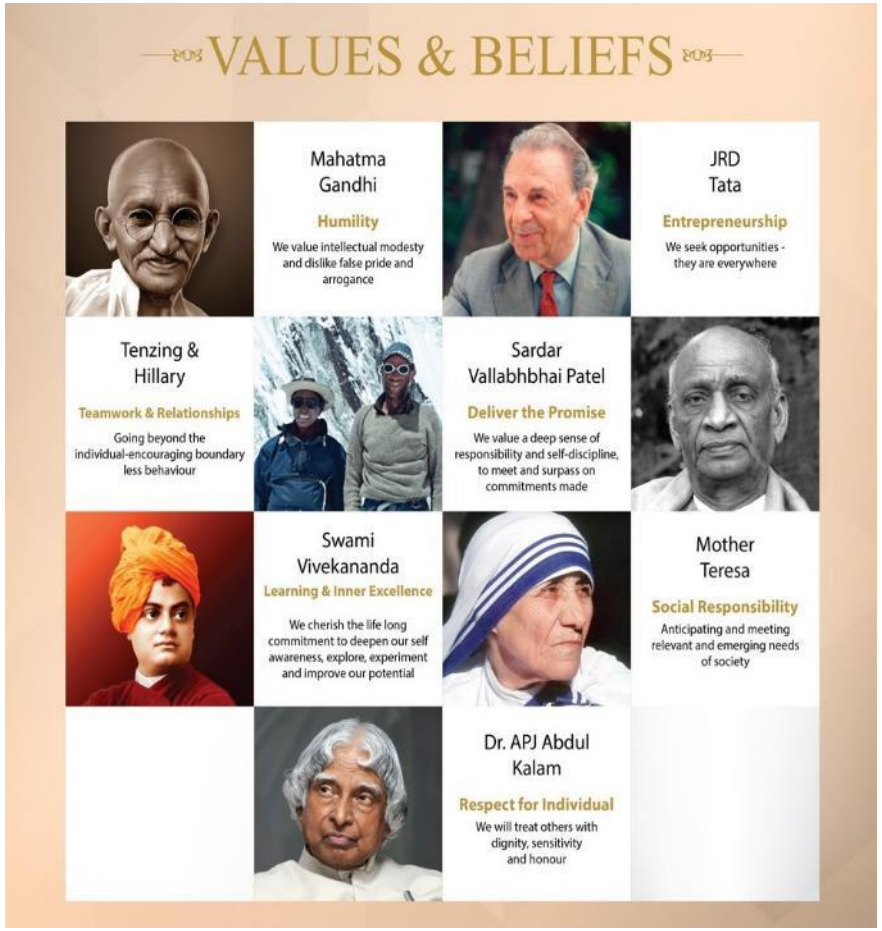
Vision

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

Mission

GMR Energy wants to be the most profitable and one of the leading Integrated Energy Companies in India and derive value by

- **Diversifying strategically across Energy value chain**
- **Being a preferred employer**
- **Being socially responsible"**



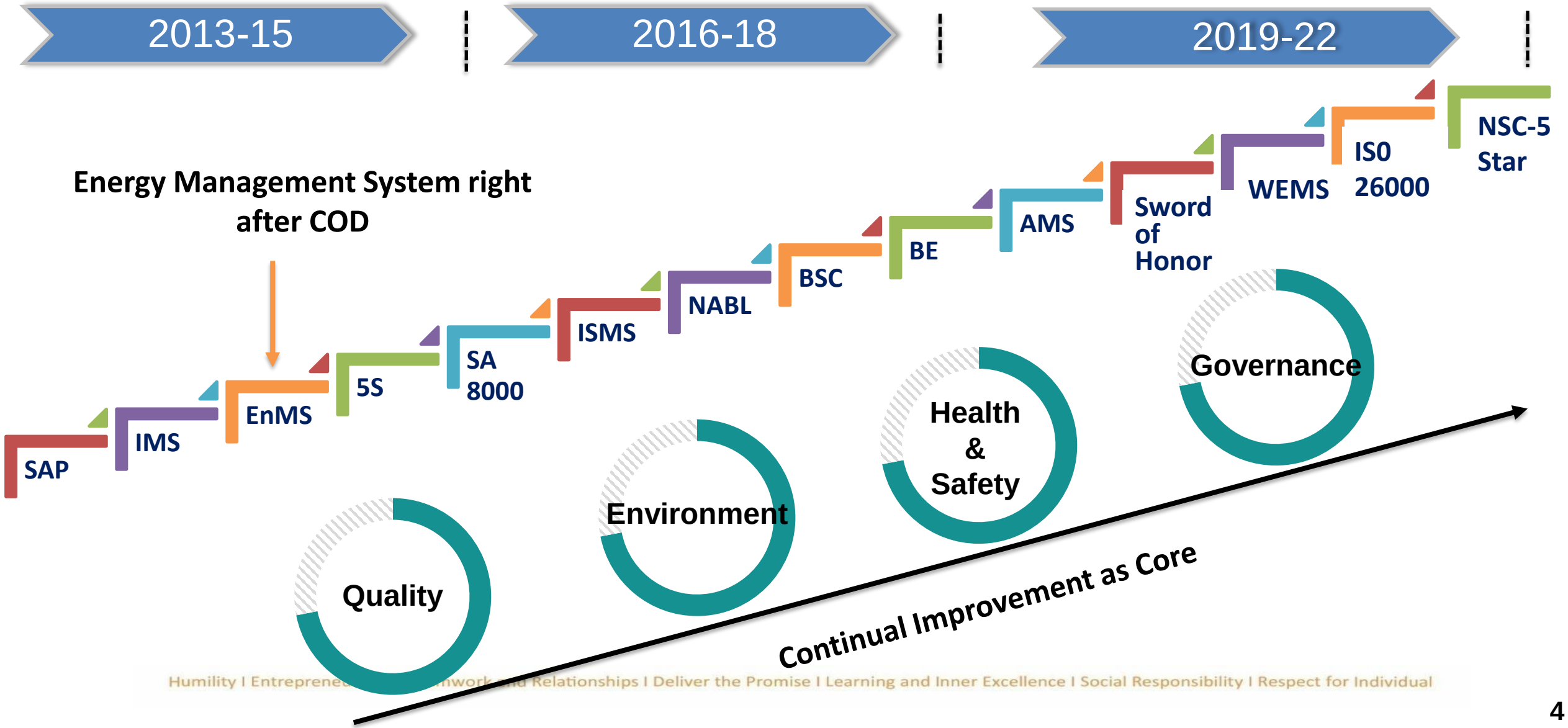
In line with Group's Vision & Mission,

GWEL strives to create a difference to society through creation of Value by Institution Building

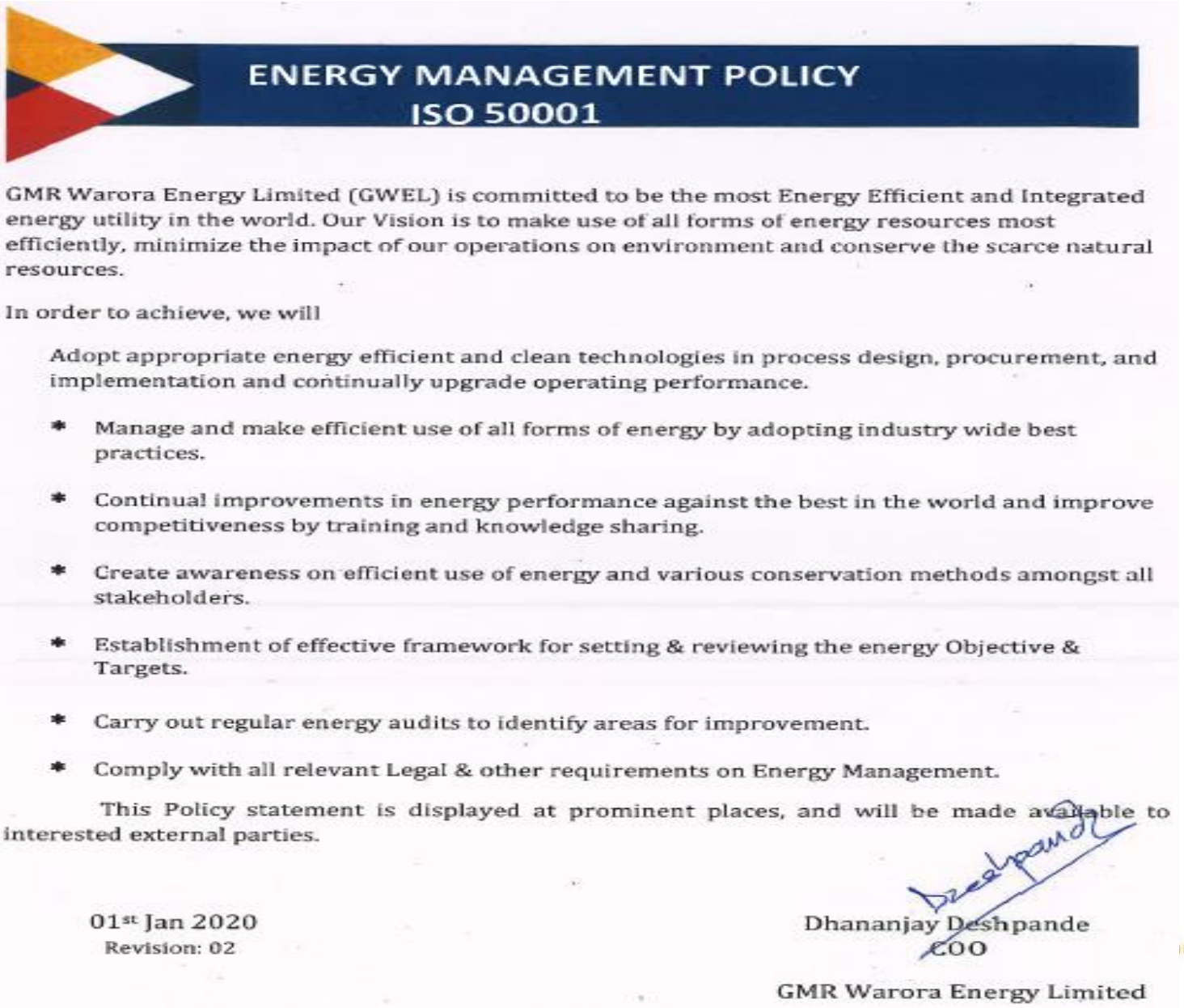
Humility I Entrepreneurship I Teamwork and Relationships I Deliver the Promise I Learning and Inner

1. Institution Building through System Approach- The GWEL Journey Towards Excellence

Various Management Systems implemented towards Quality, Environment, Health & Safety and Governance Management



1. 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 & Improvement Initiatives
- Compliance with all legal requirements

2. Energy Consumption Overview FY 21-22

FY 21-22

Generation Mu's

Machine Availability %

Plant Availability %

PLF %

Key Performance Indicators

Gross Station Heat Rate – 2310 kCal/kWh

Turbine Heat Rate – 1981 kCal/kWh

Boiler Efficiency – 87.48 %

APC – 8.22%

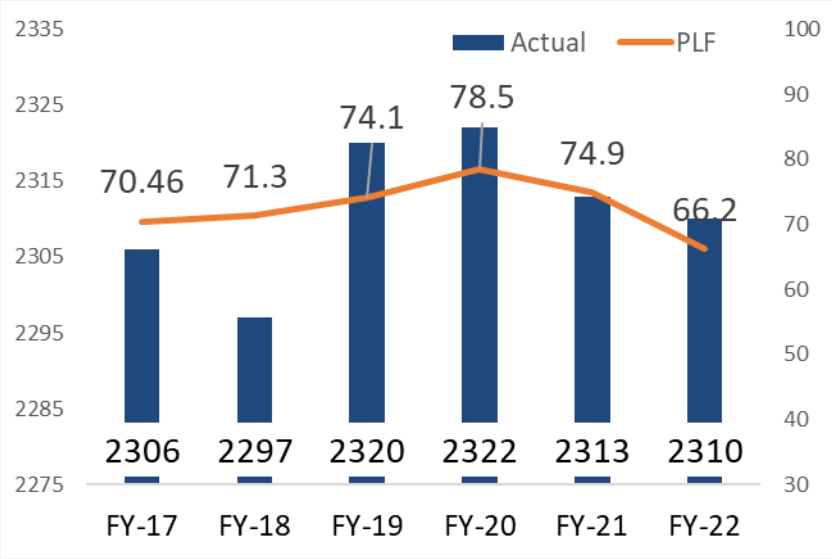
SOC – 0.17 ml/Kwh

DM Make Up – 0.15 %

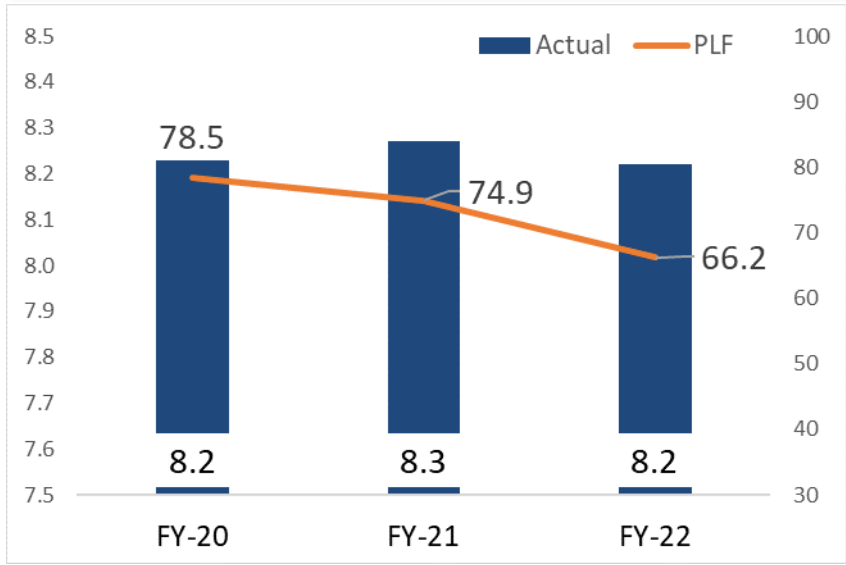
Raw Water – 2.32 m3/MWh

3. Reduction in Specific Energy Consumption

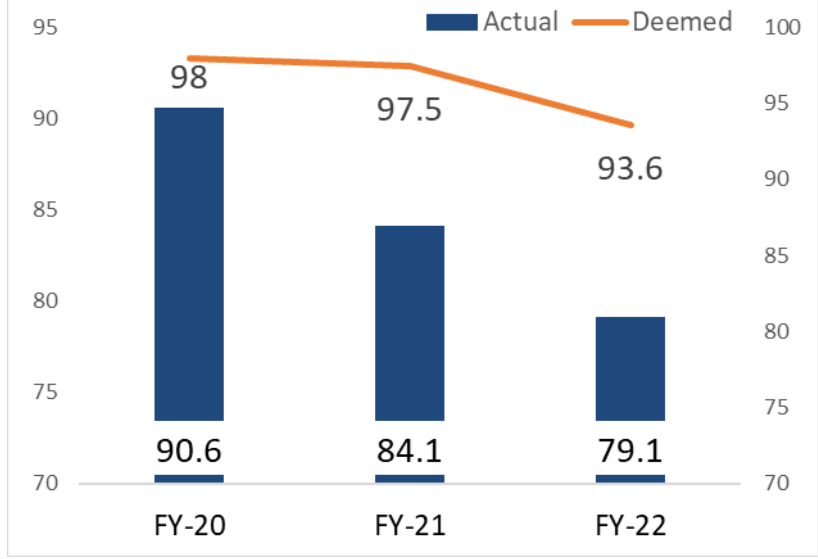
Gross Heat Rate Kcal/Kwh



Auxiliary Power Consumption %



Plant Availability %



KPI	Improvement
Heat Rate	(+) 0.12 %
APC	(+) 0.61 %
Plant Availability	(-) 5.96 %
Plant Load Factor	(-) 11.60 %

Reason for Deviation

Constraints

1. Low PLF & Availability on account of Customer curtailment, coal shortage, untied capacity.
2. Machine aging impact as U2 COH deferred from past 3 years, same under progress in Aug-2022
3. As received GCV Deterioration by 180 kCal impacting performance

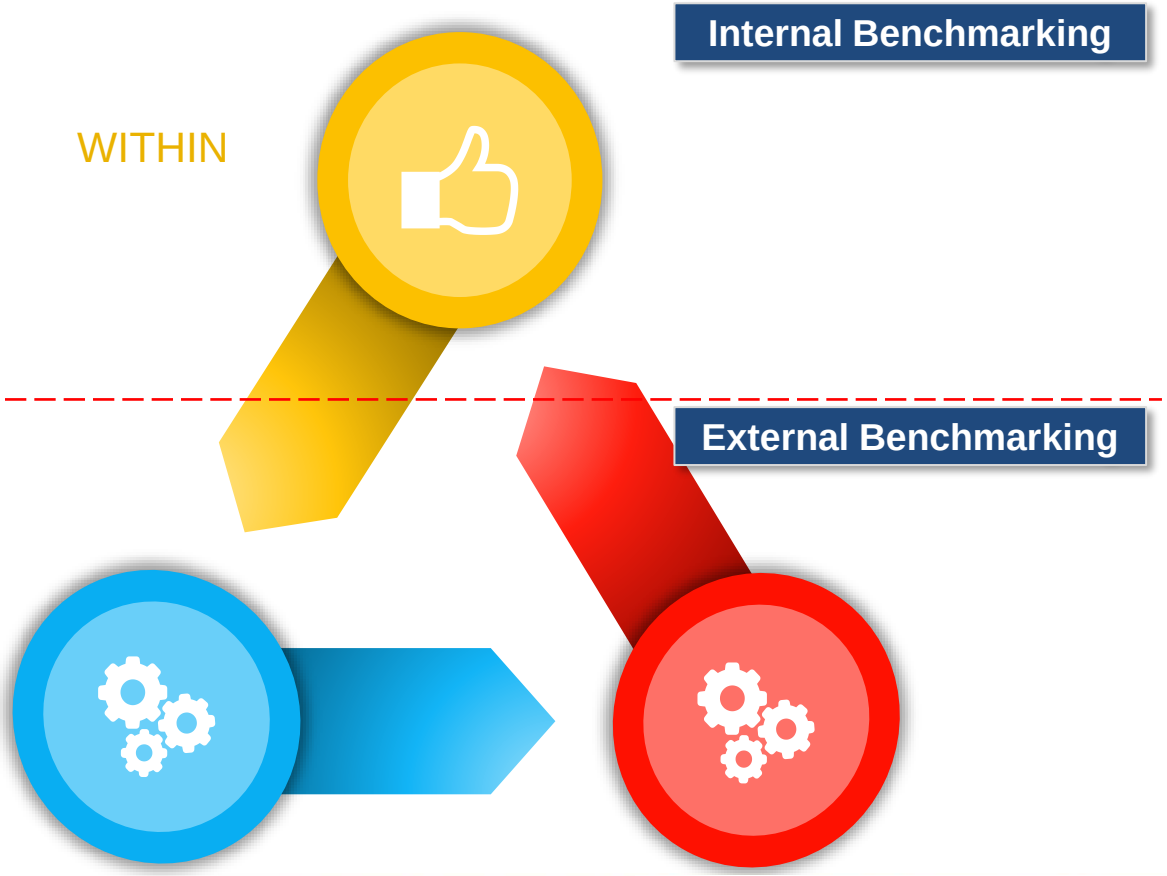
Crises to Opportunity

1. Despite of low PLF of 66% in FY-22 (due to PPA Expiry, Pandemic, Coal Shortage), achieved APC of 8.22% & Heatrate of 2310 kCal/kWh with various Energy Conservation Initiatives
2. Improvement & Innovative projects like Flexible load operation, Boiler Efficiency improvement, CT Fill replacement etc has improved APC & Heatrate
3. H2 Performance for FY-22 stands at APC of 7.81% & Heatrate of 2301 kCal/kWh
4. Our Current APC & Heat Rate Stands at 7.73% & 2300 kCal/kWh
5. U1 AOH conducted in Jul-22. Achieved Heat Rate improvement of 28 Kcal/Kwh & APC improvement of 0.5%
6. Despite of severe Cash Flow Constraint, implemented various Energy Conservation projects

4. Benchmarking of Energy Consumption

Benchmarking Strategies: Roadmap to achieve National / Global Benchmark : Approach

GWEL uses Benchmarking tool to discover best performance being achieved



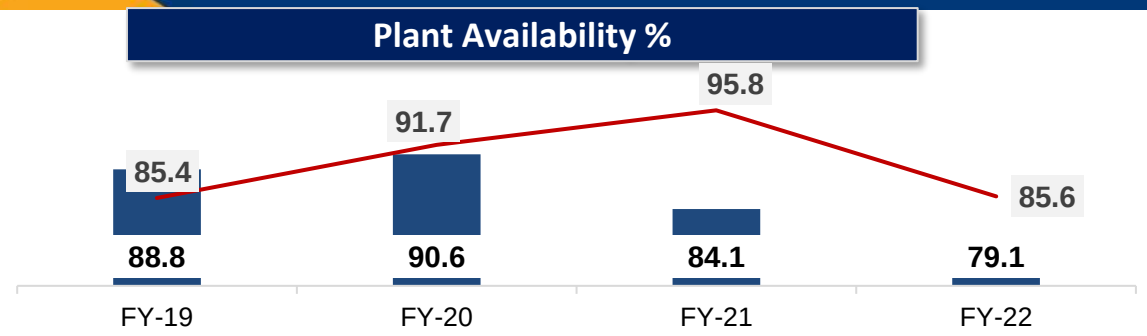
Internal Benchmarking

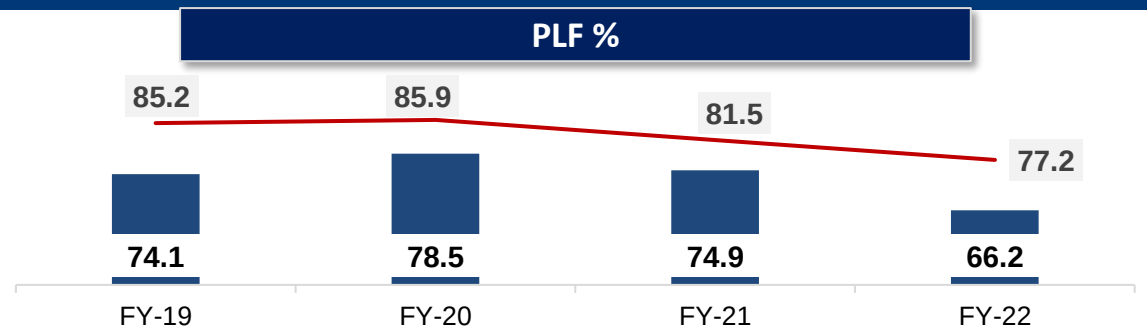
- **Design Performance-** Monthly performance against design
- **Performance Guarantee-** Quarterly PG test, Audit and deviation analysis
- **Interdepartmental Benchmarking –** Reliability and efficiency KPI's department wise benchmarking study
- **Performance after modification-** Change Management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

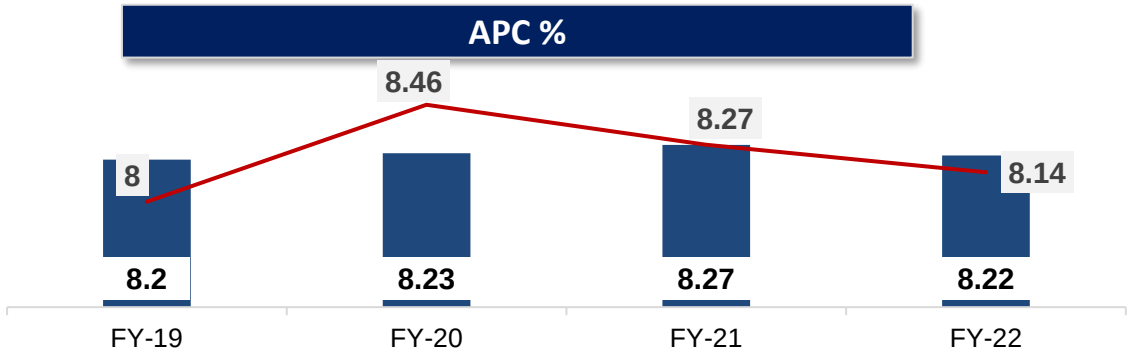
External Benchmarking

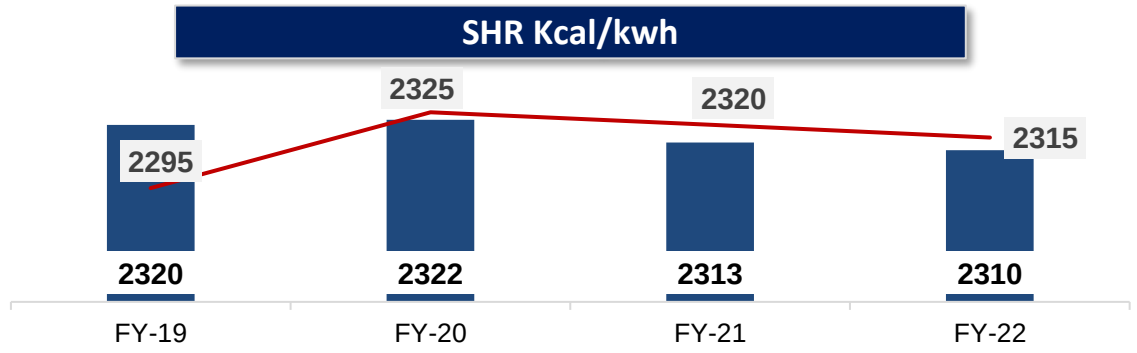
- **Same Sector Benchmarking** with Thermal Power Stations of Similar Capacity & Technology
- **International benchmarking** with strategic Investor – Tenaga
- **Site Visits** to Similar capacity plants like Dhariwal Power Station
- **Sharing of Best practices** & incorporating the learnings through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

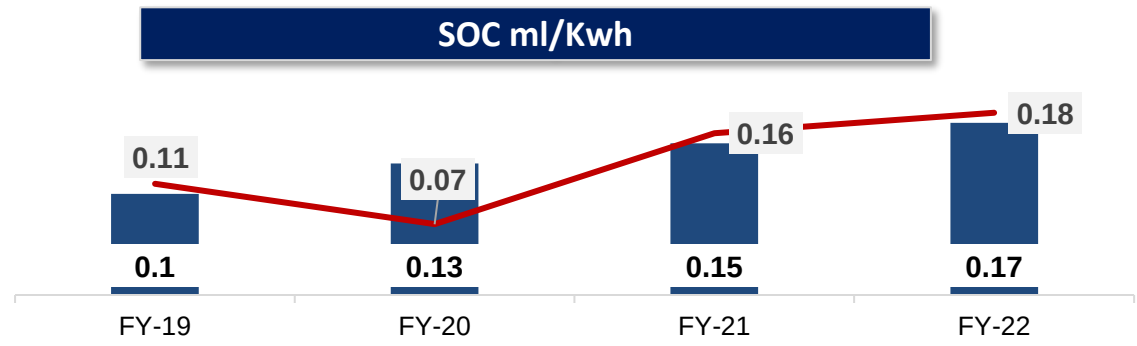
4. Internal Benchmarking of Energy Consumption

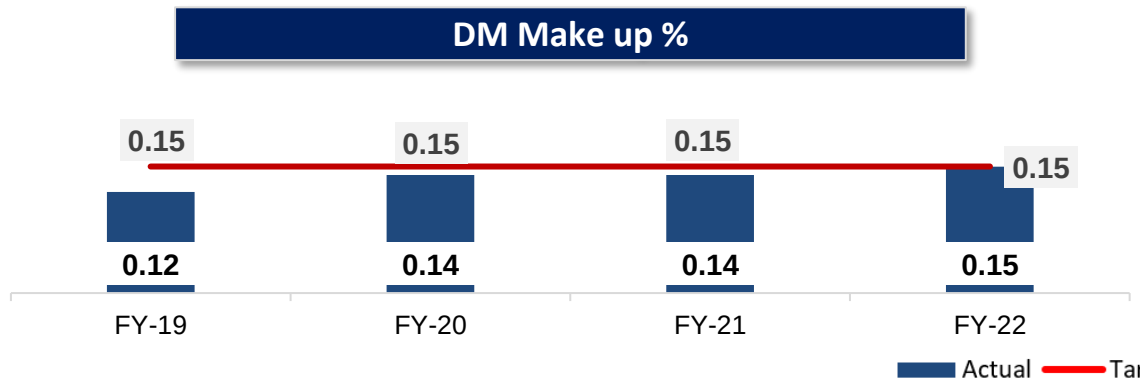






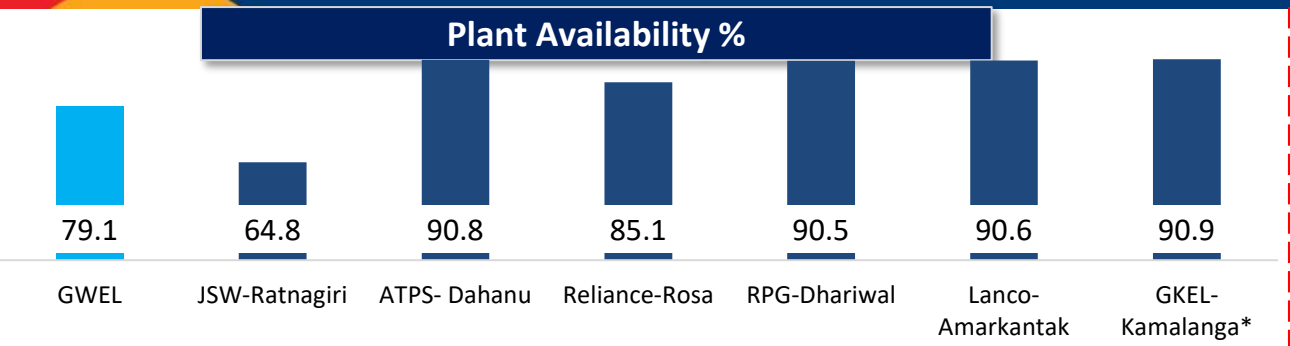


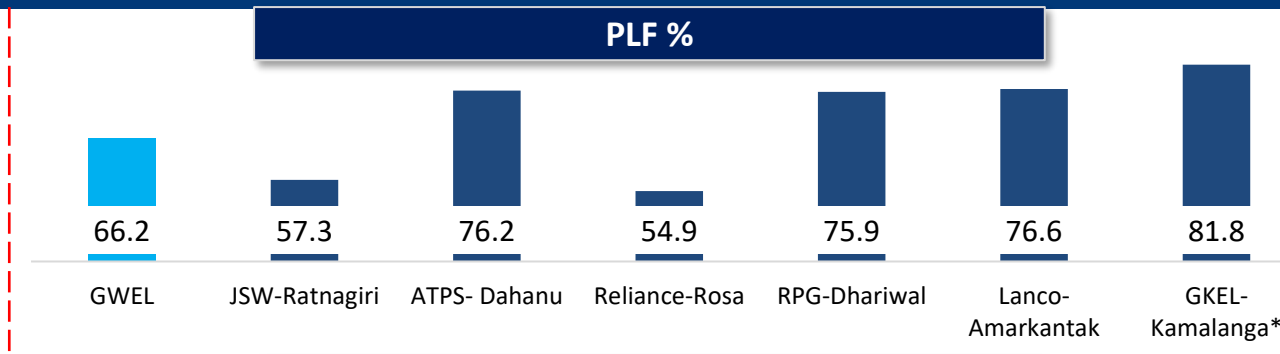


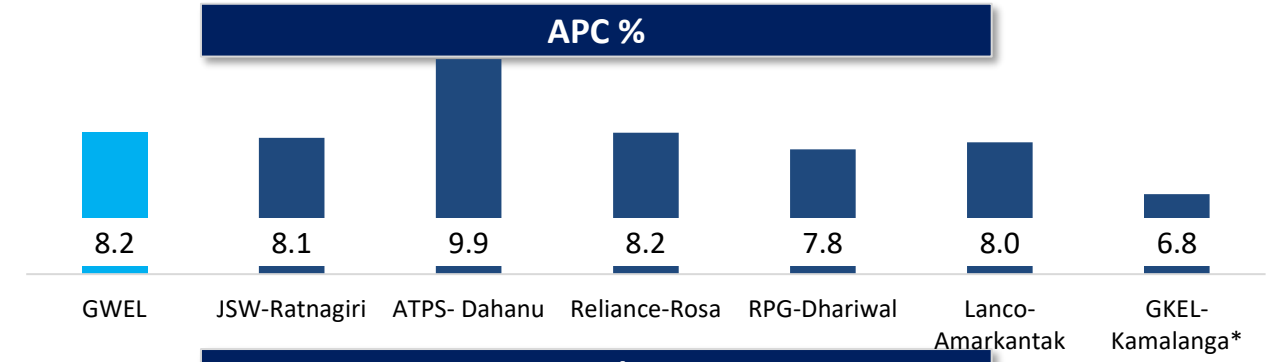


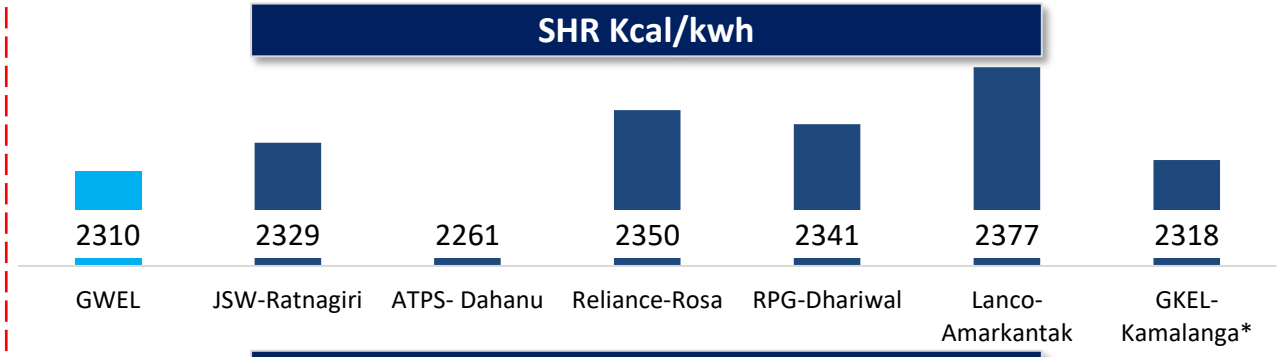
- Low Availability & PLF is on account of 2nd wave of COVID, Coal Shortage & untied capacity. However, GWEL has maintained Machine Availability of 93 %
- Improvement in APC and SHR, despite of reducing trend of PLF due to various energy conservation initiatives and sustenance measures.

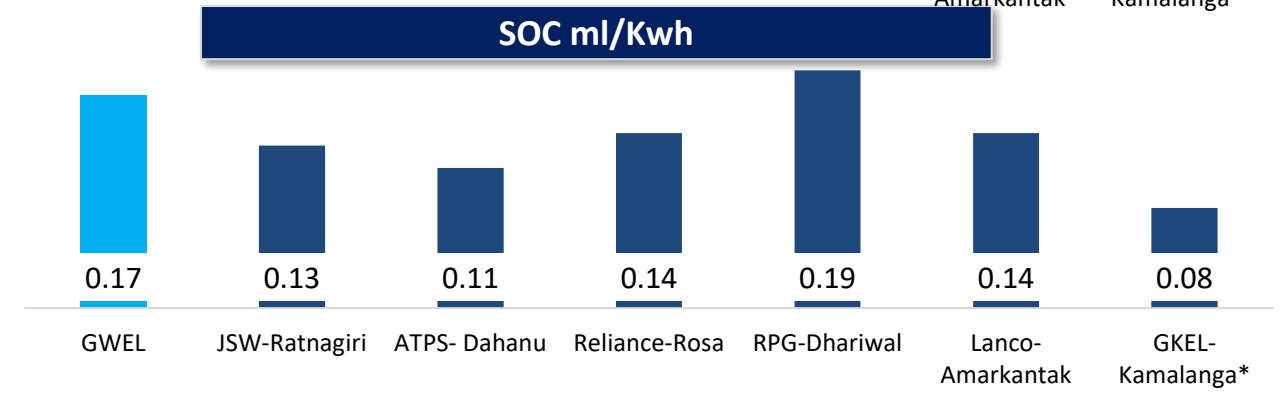
4. External Benchmarking of Energy Consumption

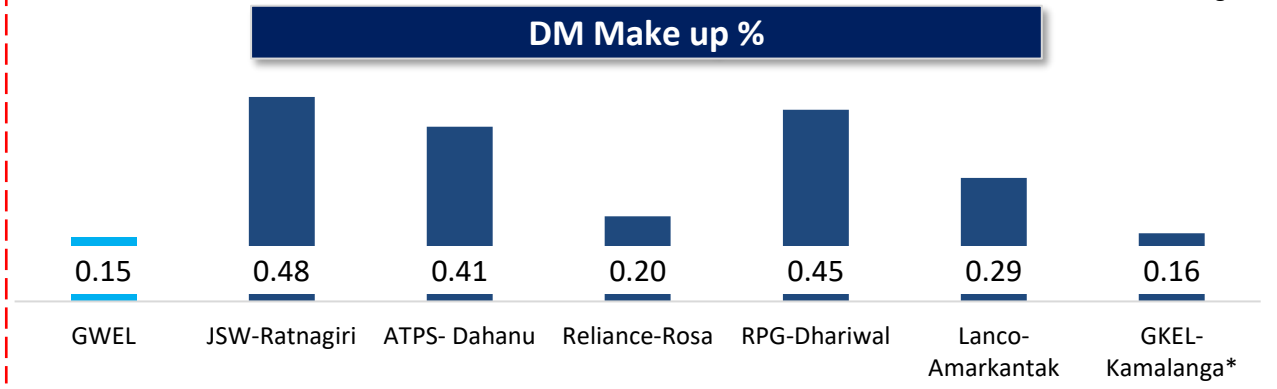










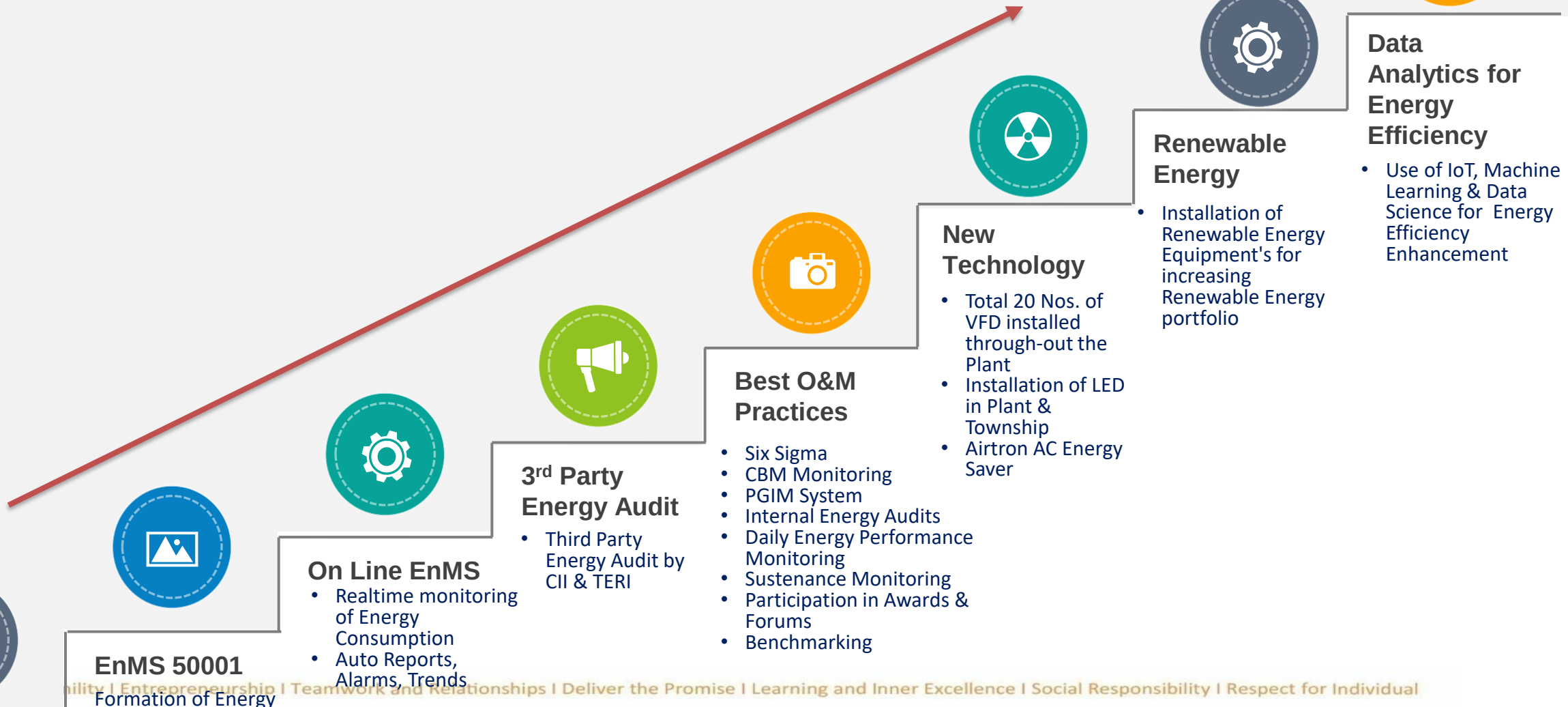


KPI	National Benchmark	International Benchmark
APC %	7.82 (RPG)	7
SHR kCal/kwh	2261(ADTPS)	2239

- **GWEL Best Achieved – Heat rate of 2275 Kcal/kwh & APC of 7.23% at 100% PLF**
- **GWEL achieved Best Heat rate & DM Make up %**

4. Benchmarking of Energy Consumption

Road Map to achieve National & Global Benchmark



EnMS 50001

Formation of Energy Management Cell

On Line EnMS

- Realtime monitoring of Energy Consumption
- Auto Reports, Alarms, Trends

3rd Party Energy Audit

- Third Party Energy Audit by CII & TERI

Best O&M Practices

- Six Sigma
- CBM Monitoring
- PGIM System
- Internal Energy Audits
- Daily Energy Performance Monitoring
- Sustenance Monitoring
- Participation in Awards & Forums
- Benchmarking

New Technology

- Total 20 Nos. of VFD installed through-out the Plant
- Installation of LED in Plant & Township
- Airtron AC Energy Saver

Renewable Energy

- Installation of Renewable Energy Equipment's for increasing Renewable Energy portfolio

Data Analytics for Energy Efficiency

- Use of IoT, Machine Learning & Data Science for Energy Efficiency Enhancement

4. Energy Benchmarking – Action Plan

Future Plans towards Energy Conservation - FY-22-23

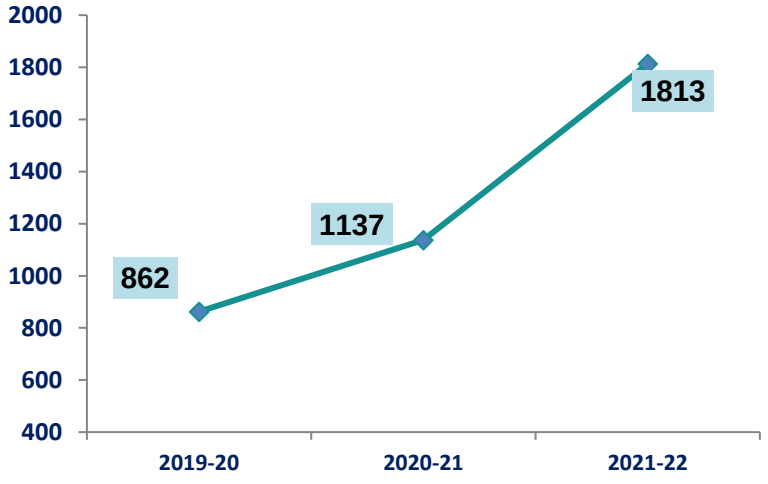
S.No	Project Description	Status	Target Date	Annual Expected Benefit
1	Installation of Vibro Feeder in Second Stream Conveyor-BCN-2A	Material Received. Installation Planned in Sep-22	September-2022	221.29 Million Kcal
2	AI & ML based Predictive Analytics for Plant Performance & Reliability Improvement	Project Execution Started	November-2022	1.26 Million kWh 15120.70 Million Kcal
3	Installation of Sonic Soot Blower in APH	Feasibility Study Under Progress	January-2023	102 Million Kcal
4	Installation of 5 MW Floating Solar Plant at Reservoir	Third Party feasibility study done	March-2023	6.00 Million kWh
5	Installation of 30 MW Solar Plant	Third Party feasibility study done	March-2023	36.00 Million kWh
6	Efficiency Improvement through Unit-1 AOH in Jul-2022	AOH Conducted in Jul-22	Completed	1.77 Million kWh 66585.60 Million Kcal
7	Efficiency Improvement through Unit-2 COH in Aug-2022	AOH Under Progress in Aug-22	Aucgust-2022	1.86 Million kWh 92044.80 Million Kcal
8	Six Sigma project taken for Reduction in Start-up Oil consumption by 20% by adopting various operational strategies & new technologies	Under Progress	November-2022	454.18 Million Kcal
9	Utilisation of fluidized air for hopper instead of hopper heater in ESP	Project Under Study	December-2022	3.24 Million kWh
10	Cooling Tower Performance Improvement Program (Existing Cooling Tower Drift Eliminator, Nozzle & Fill Replacement, CW line modification etc)	6 Nos. Cells Planned in AOH & COH in FY-23 18 No. of Cells Completed	December-2022	56688.70 Million Kcal
11	CFD Analysis of Flue Gas duct-Economiser Outlet to APH Inlet	Planned in COH in FY-22-23	August-2022	0.596 Million kWh
12	Application of Anti-erosion Coating in ID fan 1A and 1B Impeller	Completed in AOH in FY-22-23	Completed	0.815 Million kWh
13	Cooling Tower Fan Motor to Gearbox Metallic Shaft to be changed with Carbon Fiber Shaft	Vendor Exploring Under Progress	January-2023	1.051 Million kWh
	Total Expected Benefits :	**Electrical Energy : 52.59 Million kWh**	**Thermal Energy : 231217.28 Million KCal**	

5. Summary of Energy Saving Projects

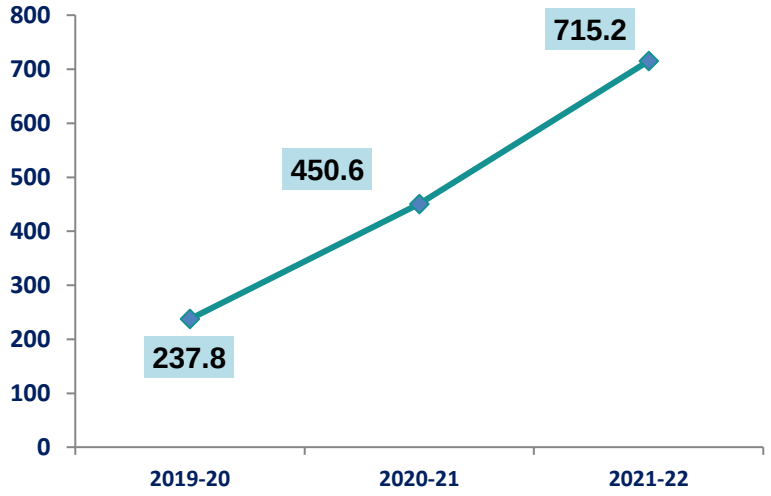
Summary of Energy Consumption Last 3 years

FY	No. of Energy Saving Projects Nos.	Investments INR Million	Electrical Savings (Million kWh)	Thermal Savings (Million Kcal)	Savings (INR Million)
FY 2019-20	22	86.23	23.78	196878	260.82
FY 2020-21	21	27.47	21.28	181377	230.92
FY 2021-22	25	67.63	26.46	164427	251.02
	68	**181.3**	**71.5**	**542682.1**	**742.8**

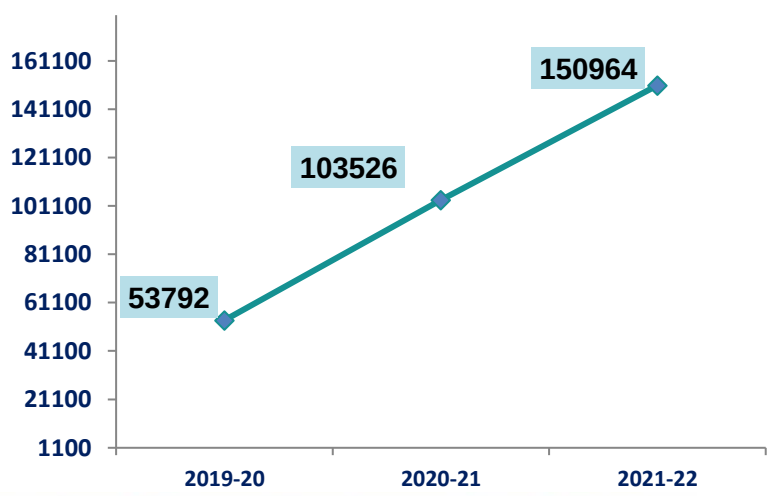
Investment made (Lakh Rs/year)



Energy Savings (Lakh kWh/year)



Coal Savings (MT/year)



5. Summary of Energy Saving Projects

Major EnCon Projects Implemented in FY 2021-22

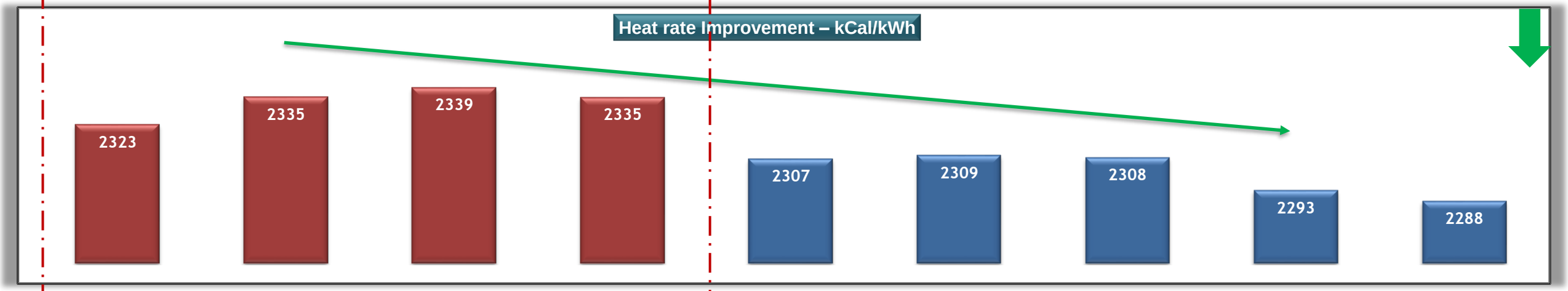
S.No	Title of Project	UoM	Annual Energy Saving
1	Compressed Air System Energy Conservation through installation of Intelligent Flow Controller	kWh	232505
2	ID Fan 2A & 2B Auxiliary Power Consumption reduction through Energy Efficient & Anti-erosion Impeller Coating	kWh	814816
3	AHP Auxiliary Power Consumption Reduction through Cycle Time Optimization	kWh	435583
4	APC reduction through ID Fan Power Consumption optimization by Ceramic Tiles Coating in Flue Gas duct for mitigating erosion & duct leakages	kWh	2444448
5	U2 BFP Power Consumption Optimization by Replacement of Existing Valve with Modified RC Valve	kWh	987779
6	'Energy Conservation through MRHS System Power Saver Mode Logic Enhancement through providing 2 more operating modes	kWh	59994
7	AHP All Compressor Water Inlet & Outlet Line Pneumatic Wall Installation With Auto Logic	kWh	60356
8	Heat Rate Improvement Through CT Cells (6 Nos.) Fills & Nozzles Replacement	MT	16365
9	Boiler Efficiency improvement by CAVT Test, Attending Duct Leakages, APH Seal Replacement & Jet Cleaning	MT	18657
10	Improvement in Yard GCV losses by 15 Kcal by adopting best operational strategies	MT	7752

Installation of Intelligent Flow Controller (IFC) & ICC Metacentre for Compressed Air System:-

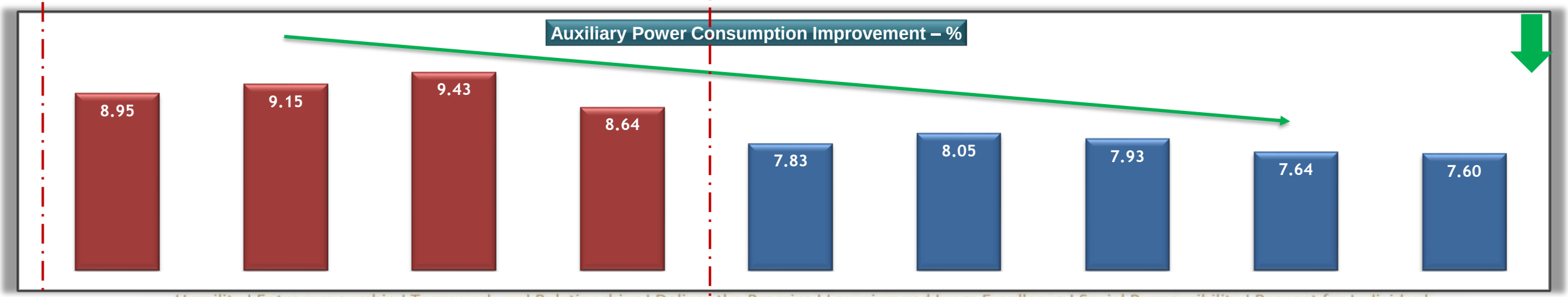
- IFC was installed for both Service & Instrument Air System for Demand Side Management of Compressed Air requirement
- Intelligent Compressor Controller (ICC) Metacentre was installed for Supply Side Management for all 4 compressors
- Reduction in Pressure achieved
  - Service Air IFC - 6.8 bar to 5.2 bar
  - Instrument Air IFC - 6.5 bar to 5.6 bar
- **Energy Saving achieved - 7%**

5. Summary of Energy Saving Projects - Benefits

Heat rate & APC Improvement - Pre & Post Initiatives Taken



Improvement in Performance through Energy Conservation Initiatives



6. Innovative Project implemented in FY 2021-22

6.1 : ESP Power Consumption Optimization through Enhanced Temperature Control Logic for Hopper Heaters

Replicability : YES

Project Trigger: Through Quarterly Internal Energy Audit

Analysis:

- Heat Mass Balance & Energy Profile Mapping of ESP
- Analysis of Temperature Gradient Availability in ESP through Temperature Profile Mapping of Each Hopper Heater for 4 months in different load & seasonal condition
- Regression analysis for checking of Ash Evacuation Proficiency at different temperature condition

Constraint:

- In-built Temperature Measurement only at last field hopper heater
- Single Electrical Module power supply to All Hopper Heaters of Single pass

Solution Implementation:

- **Temperature Measurement-** 16 Nos. of Additional Temperature measurement was provided at third field of hopper heater in each pass & integrated to DCS for real-time monitoring
- **Module Connection Modification-** On-Off of only First Three Fields Hopper heater (A1 to A3, B1 to B3 etc) separately with rest of the 4 fields
- **Logic Modification-** Auto Cut-in of Hopper Heaters if temperature drops below set threshold limit of 90 DegC for ensuring smooth ash evacuation
- **Innovation-Design Rethinking & Modification-Beyond OEM**

Sustenance:

- Smooth Ash Evacuation
- No Change in Environmental Parameters

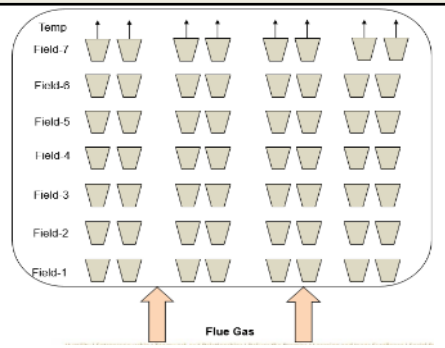
Impact : Annual Energy Saving - 635040 kWh

Field Number	Hoppers Comes under field							
	PASS A		PASS B		PASS C		PASS D	
	Module 1	Module 2	Module 3	Module 4	Module 5	Module 6	Module 7	Module 8
Field 1	A1	A8	B1	B8	C1	C8	D1	D8
Field 2	A2	A9	B2	B9	C2	C9	D2	D9
Field 3	A3	A10	B3	B10	C3	C10	D3	D10
Field 4	A4	A11	B4	B11	C4	C11	D4	D11
Field 5	A5	A12	B5	B12	C5	C12	D5	D12
Field 6	A6	A13	B6	B13	C6	C13	D6	D13
Field 7	A7	A14	B7	B14	C7	C14	D7	D14

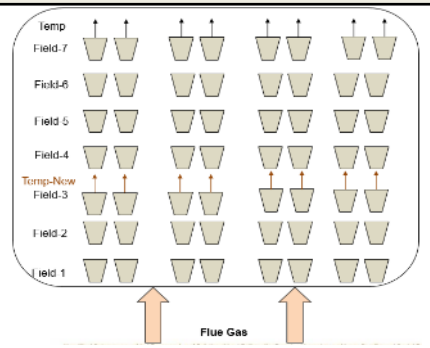
Past Hopper Heater Connection

Field Number	Hoppers Comes under field							
	PASS A		PASS B		PASS C		PASS D	
	Module 1	Module 2	Module 3	Module 4	Module 5	Module 6	Module 7	Module 8
Field 1	A1, A8		B1, B8		C1, C8		D1, D8	
Field 2	A2, A9		B2, B9		C2, C9		D2, D9	
Field 3	A3, A10		B3, B10		C3, C10		D3, D10	
Field 4		A4, A11		B4, B11		C4, C11		D4, D11
Field 5		A5, A12		B5, B12		C5, C12		D5, D12
Field 6		A6, A13		B6, B13		C6, C13		D6, D13
Field 7		A7, A14		B7, B14		C7, C14		D7, D14

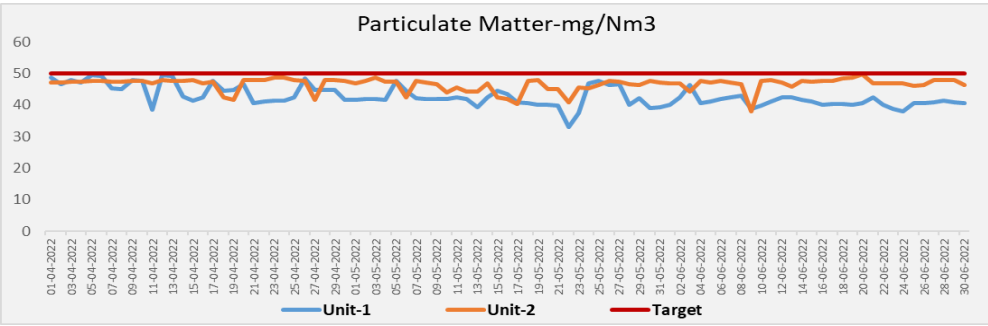
Present Hopper Heater Connection



Past Hopper Temperature Measurement



Past Hopper Temperature Measurement



6. Innovative Project implemented in FY 2021-22

6.2 : Auxiliary Power Consumption reduction during Flexible Operation

Replicability : YES

Problem Description:

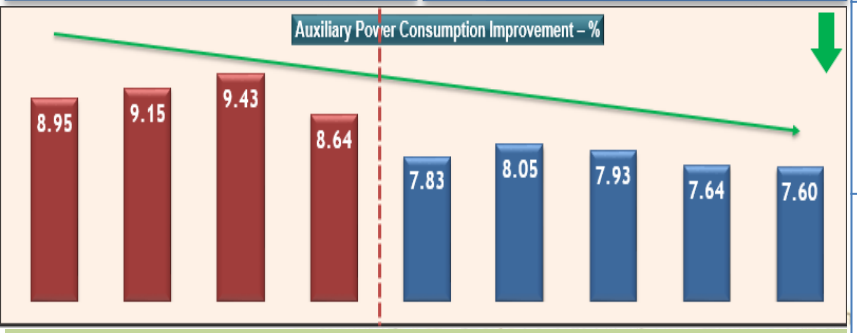
- 200MW PPA (37% of Export Capacity) Expired – Currently selling in IEX.
- Huge Load variation – Significant variation in operating parameters.
- Aggravated due to customer curtailment. In Few blocks units were operated at technical minimum load.
- Impacting Auxiliary Power Consumption.

Implementation:

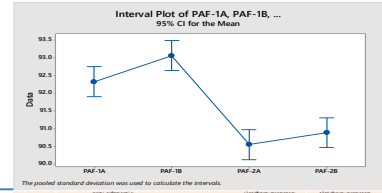
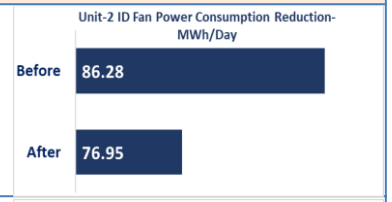
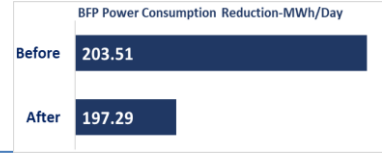
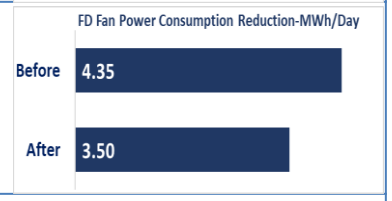
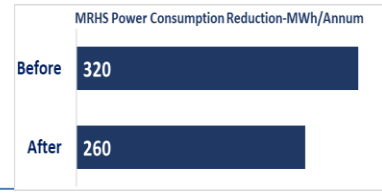
- Adopted **Six Sigma Methodology blended with Statistical tools (ANOVA, Regression)** for analysis of deviation & improvement opportunities

Duct Ceramic Tiles Lining

ID Fan Impeller Coating



Impact : Annual Electricity Saving - 4307037 kWh

Identification	Analysis	Action	Benefits
Analysis			
ANOVA Testing	• Analysis of Significant Auxiliaries performance at different PLF & operating conditions to identify the variation	• Best & Worst Performing Equipment's at various operating conditions were identified • Regression analysis done to identify performance impacting variables	
Correlation Analysis	• Co-relation analysis on Significant equipment's for identification of "Critical parameters" impacting performance.	• Parameter whose "R-Square" value is more than 70% is being considered as "Critical Parameter" impacting APC	
Implementation			
ID Fan Power Consumption Optimization	• ANOVA & Correlation output reflected U2 ID Fans performance was on lower side as compare to U1	• Application of Ceramic Tiles Coating in flue gas duct for mitigating leakages & reducing erosion • Application of Energy Efficient & Anti-erosion Impeller Coating	
BFP Power Consumption Optimization	• Correlation analysis result reflected deviation in performance due to Recirculation valve passing	• BFP-2A & 2C existing Recirculation valves replaced with upgraded modified recirculation valves	
FD Fan Power Consumption Optimization	• Regression analysis showed that, at low load, Total Air Flow was maintaining slightly higher than design even at minimum blade pitch position	• Modification was done for servo-mechanism pull fork assembly for further reducing blade pitch position	
MRHS System Power consumption optimization	• At Full Load & Poor Coal Quality, MRHS need to be run in manual mode with continuous operation due to high reject qty	• Before- MRHS system operates in auto with cycle of 30 minutes Stop and 1 Hour Run • After- Three Modes of logic Implemented based on Coal Qty & Quality	

6. Innovative Project implemented in FY 2021-22

6.3 : Improvement in Boiler Efficiency by 1% through Multiple Linear Regression Analysis

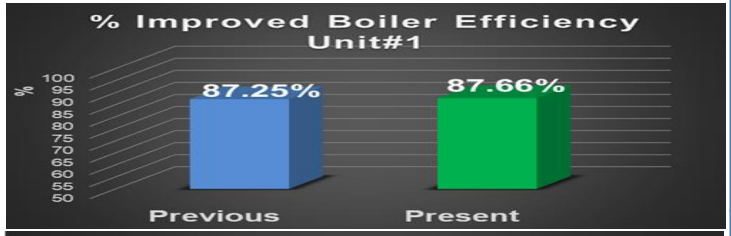
Replicability : YES

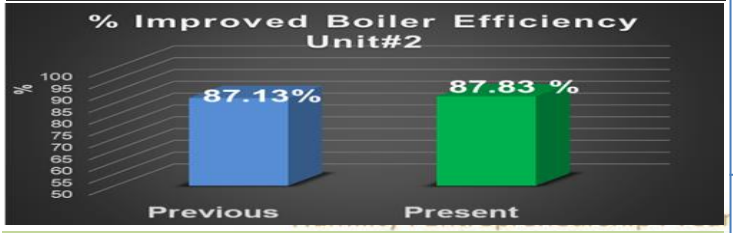
Problem Description:

- Huge Load variation due to untied capacity – Significant variation in operating parameters.
- Aggravated due to customer curtailment. In Few blocks units were operated at technical minimum load.
- Impacting Boiler Efficiency & Heatrate.

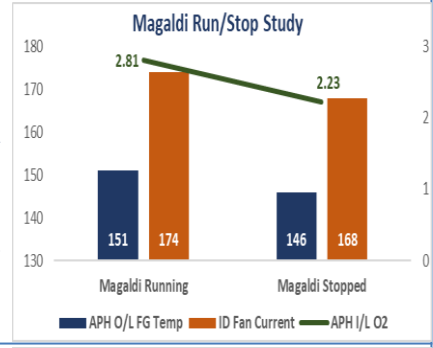
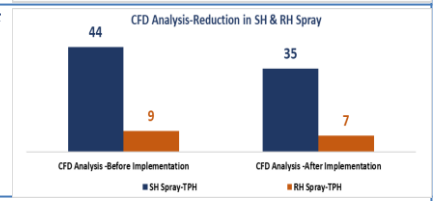
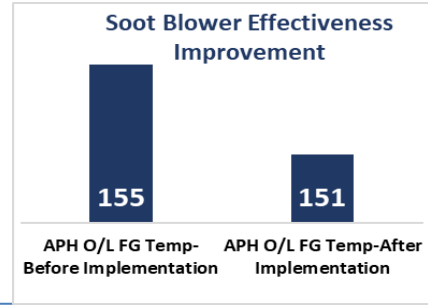
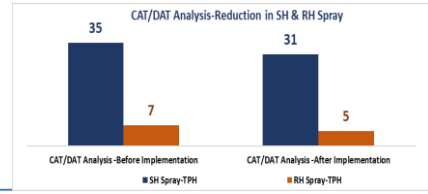
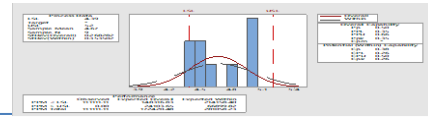
Solution Implementation:

- **Multiple Linear Regression Analysis Tool (MLRA)**-Identification of impacting variables (76 Nos.) on Boiler Efficiency & predicted performance with variation in this factors over different operating conditions.
- **Failure Mode & Effect Analysis (FMEA)**-On 34 Nos. of impacting parameters
- Implementation of Improvement initiatives





Impact : Annual Coal Saving - 22388 MT

Identification	Analysis	Action	Benefits
Total Air Optimization through addressing Magaldi Air Ingress	• MLRA reflected equal proportion of Primary & Secondary Air • Ambient Air ingress from Magaldi dry bottom ash system contributing as combustion air & giving cooling effect • Higher amount of air from bottom lifts the fuel from combustion zone and increases SH & RH zone temp. & increasing the spray	• Strategy revised for Magaldi Door operation for limiting air ingress • Optimization of SADC Dampers- Bottom AA dampers & Stopped mills dampers closed for balancing required combustion air • Post Cooler Belt replacement done as a pro-active measure	
CFD Analysis & installation of Baffle Plates	• MLRA, Control Chart Analysis & Energy Profile Mapping reflected uneven flue gas flow distribution inside furnace	• CFD Analysis done for detailed analysis of Flue gas profile & corrective measures • Based on CFD recommendation, Baffle plates installation done for uniform distribution of flue gas flow	
Soot Blower Operation Optimization	• After Soot Blowing, temp regaining in short duration during poor coal & low load leading to higher spray	• Soot Blowing effectiveness optimized through real-time mathematical model • Pressure Setting Optimization • Puppet valve replacement with upgraded valves • Color coding of SB based on last operation • Effectiveness optimization through Drain temperature logic modification	
SH & RH Spray reduction	• Deviation in Temp gain in various zones identified through Energy Mapping • Testing resulted in high Primary Air Velocity leading to more heat gain in second pass & increase in temps & spray	• Clean Air Test-Orifice overhauling & adjustment carried out • Dirty Air Test-Primary air flow correction & Classifier rpm adjustment done	
Other Actions	• Impact of varying coal on Boiler Performance	• Boiler Water Washing through Jet Cleaning • Attending of Duct Leakages • APH Seal Settings & Basket Cleaning	

7. Use of Renewable Energy

7.1 : Use of Renewable Energy for GHG Emission Reduction

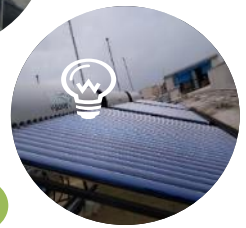
Renewable Energy Utilization

Wind operated Cooling Fans

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

Solar Water Heater for Associates

Solar water heater of capacity 1000 LPD installed at Associate employee township.

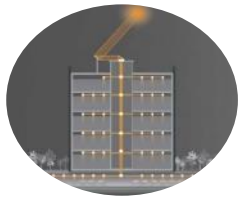


Solar Water Heater for Township

Solar Water Heater in Permanent Township installed for 150 Families

Translucent sheet cladding

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



Pipe-lighting

Pipe light in Stores & Warehouse.

Roof Top Rainwater Harvesting

Roof Top Rain Water Harvesting from all buildings.

Rainwater Harvesting

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

7. Use of Renewable Energy

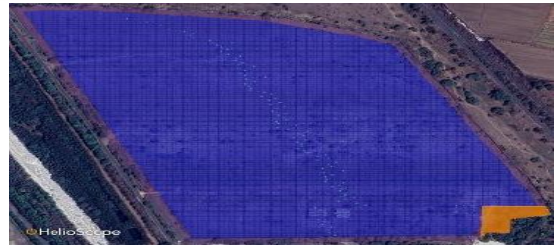
7.2 : Savings achieved through Onsite Renewable Energy Projects

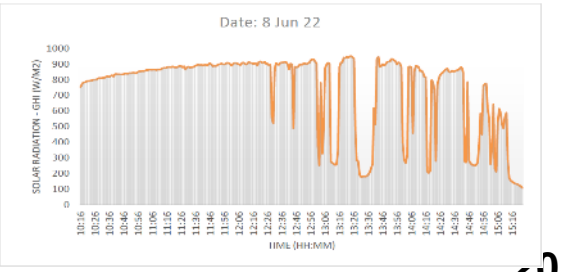
	2015-16	2016-17	2017-18	2018-19	2019-20	2020-21	2021-22
No. of Project Implemented	2	1	1	3	3	3	2
Total Capacity - MW				1			
Total Power Savings Lakh KWh				87.18			
% Share				0.25			
Cumulative Savings (Rs Lakh)	16.93	25.63	38.76	68.20	242.09	267.38	268.01
RPO Obligation				Not Applicable			

7.3 : Renewable Energy Projects under Implementation at GWEL

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

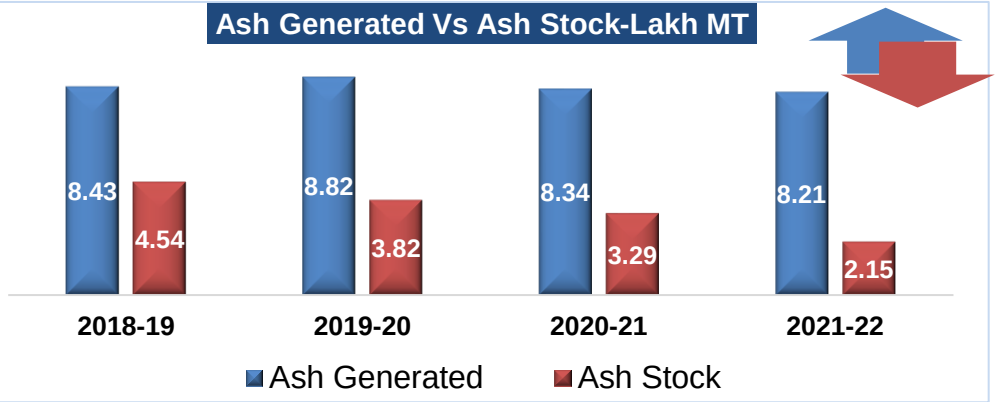
- ✓ Third Party feasibility study done for setting up Solar PV at available land area, reservoir space & roof top for plant & township building by M/s TERI
- ✓ Study included Solar PV potential at locations of plant, analysis of the energy yield from system and proposed recommendations by performing feasibility capacity through Desktop Research, Site Visit, Solar PV Simulations
- ✓ Feasibility Study Output:-
  - ✓ 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

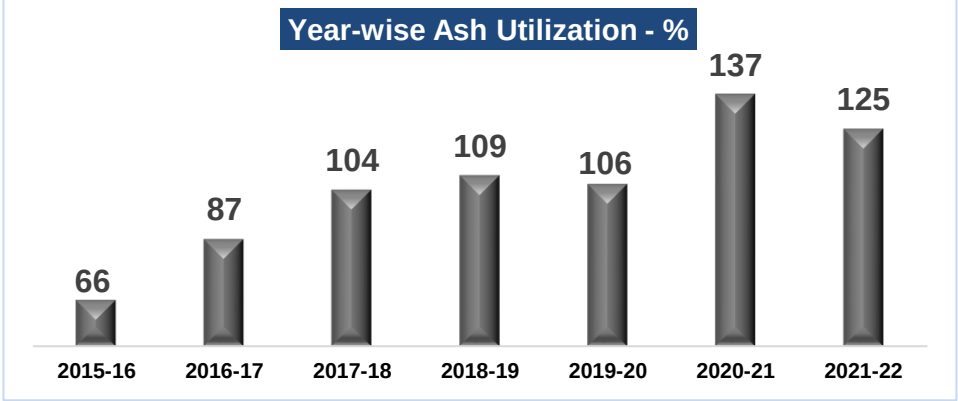


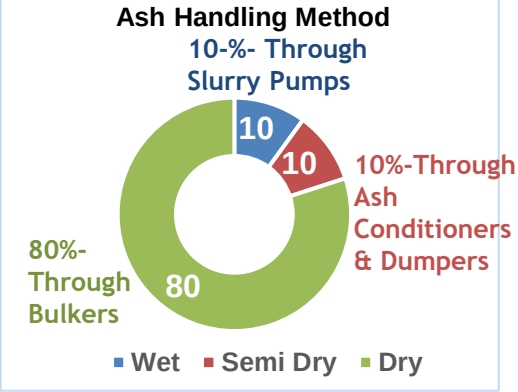


8. Environment Management-Ash Utilization

8.1 : Utilization of Ash Generated







Distribution of Areas of Ash Utilization						
Sr No.	Particulars	UoM	2018-19	2019-20	2020-21	2021-22
1	Ash Utilized in manufacturing of cement/ concrete others similar products	%	68%	53%	28%	20%
2	Ash Utilized in Fly Ash Bricks	%	0%	14%	25%	22%
3	Ash Utilized in Mine Filling	%	9%	2%	20%	0%
4	Ash Utilized for Road Pavements	%	4%	26%	24%	49%
5	Ash Utilized in Brick Manufacturing (From Bottom Ash)	%	13%	4%	2%	9%
6	Ash Utilized in Bottom Ash Mine Filling	%	4%	0%	0%	0%
7	Ash Utilized Bottom Ash for Road Pavements	%	2%	0%	0%	0%
8	Expenditure on Ash Utilization (Annual)	INR (Lakhs)	0	828	1181	1180

- Continuous reduction in Legacy Ash YoY
- 100% Ash Utilization despite of COVID

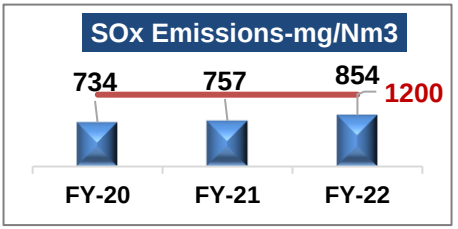
Ash Utilization at GWEL is 100% for Consecutive 5 Years

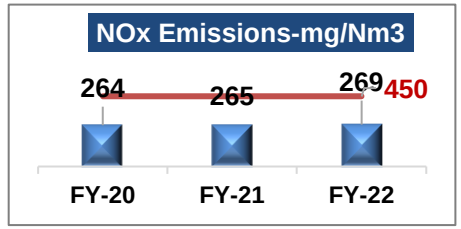
9. Environment Management-Emission

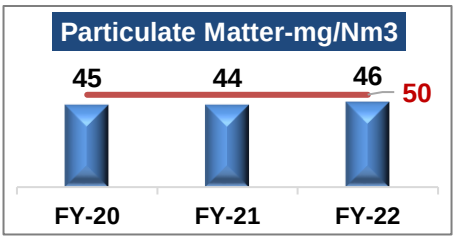
9.1 GHG Inventorisation

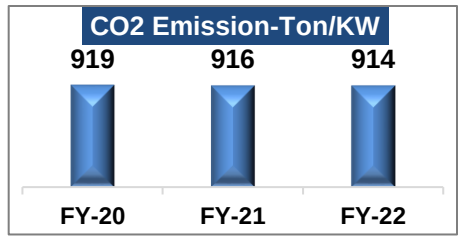
GMR Sustainability Report

- Every year GMR group publishes its sustainability report for public. It is available on the following link: Scope-1 Emission https://www.gmrgroup.in/energy/









Best Practices for Maintaining Emission Level within Norm

Current Control:

- GWEL is having **Low Nox Burner installed** since design stage with Nox value within norms limit
- GWEL is having **100% Ash Utilization**
- **Coal Blending through Automated Software** to minimize emission & maximize efficiency. PM within norms limit
- **Real time Ash monitoring system** installed
- Transportation of ash through jumbo bags by train mode
- Biomass Co-firing for reducing emissions

Future Control:

- **FGD Implementation by 2024**- Contract finalization In progress, Project Execution will start from Jan-2023
- **5 MW Floating Solar Installation**- Contract finalization under progress, Project Execution by- Mar-2023
- **30 MW Floating Solar Installation-** Contract finalization under progress, Project Execution by- Mar-2023
- **Implementation of ISO 14064**- Green House Gas Reduction
- AAC (Aerated Autoclave Concrete) block manufacturing unit installation

9.2 PAT Cycle-II Compliance

PAT Cycle-II - Energy Consumption Target & Actual - Registration No.-TPP0149MH

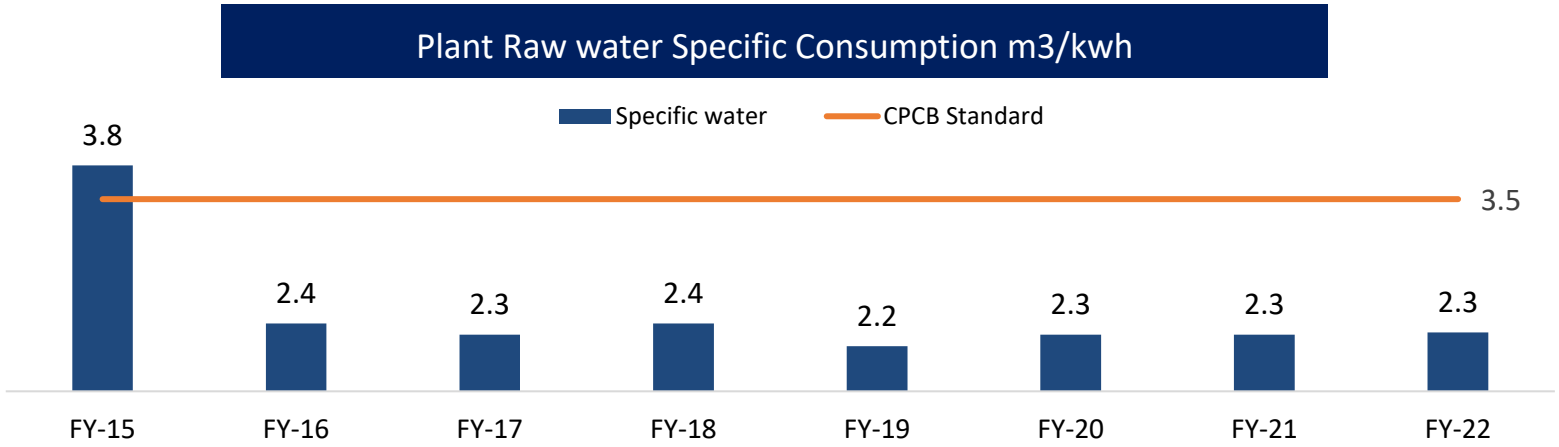
Target Net Heat Rate for Assessment Year 2018-19	Actual Net Heat Rate Achieved for Assessment Year 2018-19	Net Heat Rate Target Overachieved for PAT Cycle-II by
2554.62	2524.24	30.38

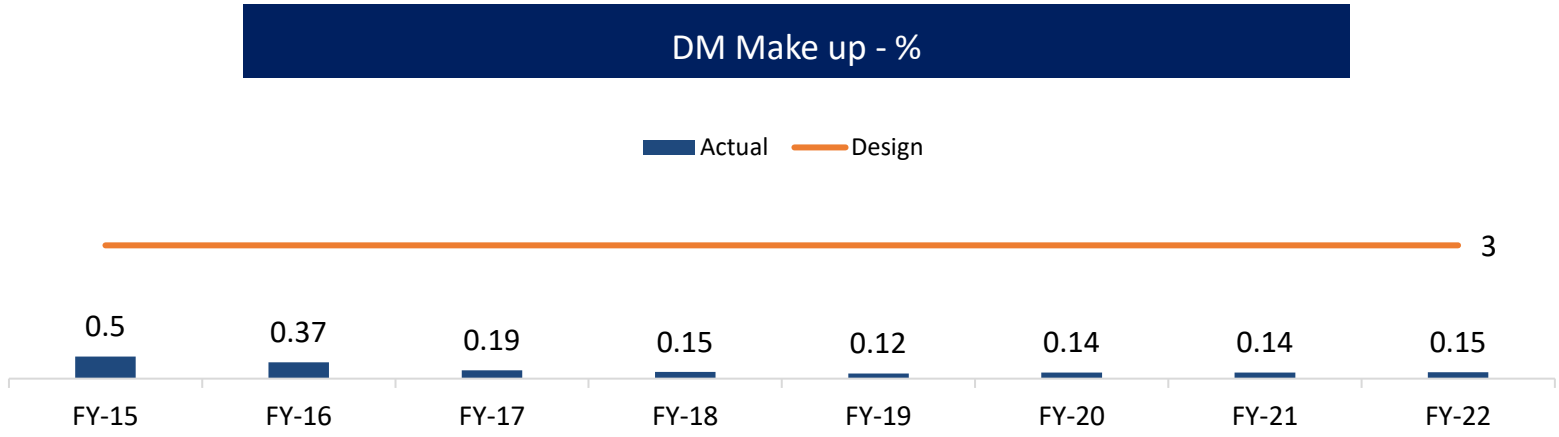
Operating Station NHR achieved with Normalization in FY 2018-19 : 2524.24 kCal/kWh

Number of Escerts to Sell : 9957 **Total Price of Escerts to sell : Rs. 1 Crores**

10. Environment Management - Water

- ✓ 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**





SCADA for water accounting -3.17 Lac m3 savings

Rain Water Harvesting -54000 m3/annum recharge

GWEL is a Zero Liquid Discharge Plant

10. Environment Management - Water

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)**

- ✓ 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

Water SCADA

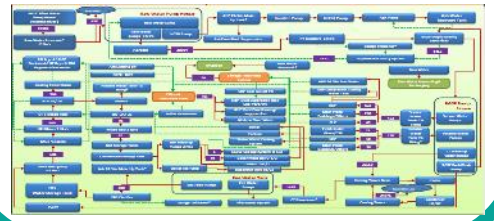
Implementation

- 36 Flow Meters Installed
- 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-317314 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 9.22 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-13141 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**

11. Best Practices - Non Energy Efficiency

Bes Practices Non Energy Efficiency

Digitalization

- Project SARATHI – Digital Platform for Becoming Paperless

31 Process Digitized with **PDCA approach**

- Digital Logbook
- Near Miss, Incidents
- IMS Internal Audits
- Waste Management
- Vehicle Gate Pass
- Agency Gate Pass
- HIRA

Asset Management

Implementation of ISO 55001

AMS implementation by

- Asset System Manual
- AMS Procedures
- Work Instructions and Manuals
- Identification of Significant Assets by Asset Risk register

Flexible Operation

- Sale of 10 MW of Power saved through APC in Market

Bio Diversity

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

Afforestation

- **42% of the total Plant area** is covered under Green Belt against norm of 33%
- Total 205550 No. of Plants has been planted in plant area.
- Plantation has been done in nearby villages under CSR activity.

11. Best Practices - Non Energy Efficiency

Bes Practices Non Energy Efficiency

Wellness

Employees Wellbeing is of Paramount Importance

Various Wellbeing Initiatives being taken

- Fun Run
- Kausalika
- Tournaments
- Celebrations
- Open Air Movie
- Outbound Trainings
- Yoga & Mindfulness
- Heath Awareness

New Technology

Intelligent Flow Controller (IFC)

- IFC & Metacentre Installation for Service & Instrument Compressed Air System
- Resulted in Pressure reduction by 1 bar
- **Energy Saving – 7%**

p I Teamwork and Relationships I Deliver the Promise I Learning and Inner Exce

Maintenance & Reliability

Best in class Maintenance Methodologies adopted for 100% reliability

- Vibration Analysis
- Lube Oil Analysis - Wear Debris, NAS, TAN
- Infrared Thermography
- Dissolved Gas Analysis
- Motor Current Signature Analysis
- At GWEL we follow Six Sigma based approach for Chronic issues.

Research

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

Social Responsibility

- **Implementation of ISO 26000**
- Infrastructure support to Govt. Schools
- Kid Smart Centres
- Transportation Facility for students
- Health Clinics & Camps
- Construction of Individual Sanitary Lavatory
- Vocational Training Centre & Community Libraries
- Tailoring centres for women
- Farmers Training

12. Team work, Employee Involvement & Monitoring

12.1 Monitoring of Energy Consumption

UNIT-1 CONSUMPTION 25.37 MW

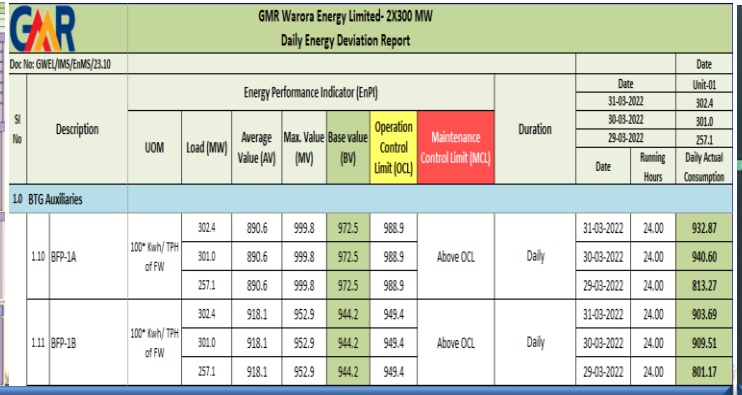
UNIT-1 DASHBOARD

FEEDER NAME	BOILER			FEEDER NAME	TURBINE			FEEDER NAME	BOP		
ESP-1A	0.68	MW	2.67 %	BFP-1A	4.57	MW	18.01 %	CWP-1A	1.48	MW	5.84 %
ESP-1B	0.75	MW	2.95 %	BFP-1B	4.35	MW	17.16 %	CWP-1B	1.25	MW	4.94 %
COAL MILL-1A	-0.00	MW	? %	BFP-1C	-0.00	MW	? %	CCCW-1A	-0.00	MW	? %
COAL MILL-1B	0.41	MW	1.63 %	CEP-1A	0.00	MW	0.00 %	CCCW-1B	0.33	MW	1.31 %
COAL MILL-1C	0.42	MW	1.65 %	CEP-1B	0.68	MW	2.70 %	CTT-1A	0.37	MW	1.48 %
COAL MILL-1D	0.44	MW	1.74 %					CTT-1B	0.27	MW	1.06 %
COAL MILL-1E	0.38	MW	1.50 %					SWYD-1A	0.01	MW	0.02 %
COAL MILL-1F	0.00	MW	0.00 %					AIR COMP-1A	0.00	MW	0.00 %
TOTAL MILL	1.66	MW	6.61 %					AIR COMP-1B	0.27	MW	1.06 %
PA FAN-1A	0.81	MW	3.19 %					WTP/ETP-1A	0.39	MW	1.54 %
PA FAN-1B	0.78	MW	3.07 %					TECH. BLDNG-1A	0.17	MW	0.66 %
FD FAN-1A	0.18	MW	0.73 %					COAL HNDLNG-1A	0.84	MW	3.31 %
FD FAN-1B	0.16	MW	0.61 %					RIVER WTR-1A	0.01	MW	0.03 %
ID FAN-1A	1.33	MW	5.23 %					SST-1B	0.33	MW	1.30 %
ID FAN-1B	1.35	MW	5.31 %					FOPH-1B	0.02	MW	0.06 %
TOTAL FAN	4.60	MW	18.13 %					ASH HNDLNG-1B	0.46	MW	1.80 %
								HVAC-1B	0.20	MW	0.77 %
TOTAL BOILER	7.68	MW	30.27 %	TOTAL TURBINE	9.61	MW	37.86 %	TOTAL BOP	6.38	MW	25.16 %

Centralized Energy Management System

- ✓ **Real Time Comparison of HT & LT Equipment's Auxiliary Power consumption** in EMS system for **BTG, BOP, AHP & CHP**
- ✓ **Auto Reports Generation for Energy Consumption** on Daily/ Monthly and 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 wrt interlinked variables
- ✓ **Upgradation of Online Plant Performance Monitoring System – 18 Modules – Turbine, Boiler, Heaters, APH, Mills, Pumps, Fans, Compressors etc**

12.2 Daily MIS Reports for Monitoring of Energy Consumption & Real time Monitoring System



GMR Warora Energy Limited- 2X300 MW

Daily Energy Deviation Report

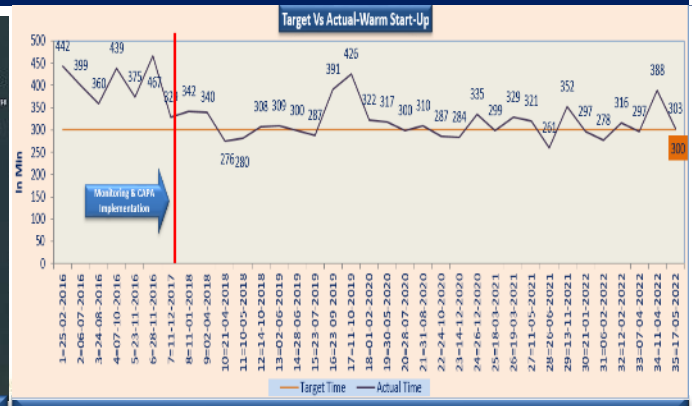
Doc No: GWEL/IMS/EnMS/23.10

Sl No	Description	UOM	Load (MW)	Energy Performance Indicator (EnPI) Average Value (AV)	Max. Value (MV)	Base value (BV)	Operation Control Limit (OCL)	Maintenance Control Limit (MCL)	Duration	Date	Running Hours	Daily Actual Consumption
1.0	BTG Auxiliaries											
1.10	BFP-1A	100* Kwh/ TPH of FW	302.4	890.6	999.8	972.5	988.9	Above OCL	Daily	31-03-2022	24.00	932.87
			301.0	890.6	999.8	972.5	988.9			30-03-2022	24.00	940.60
			257.1	890.6	999.8	972.5	988.9			29-03-2022	24.00	813.27
1.11	BFP-1B	100* Kwh/ TPH of FW	302.4	918.1	952.9	944.2	949.4	Above OCL	Daily	31-03-2022	24.00	903.69
			301.0	918.1	952.9	944.2	949.4			30-03-2022	24.00	909.51
			257.1	918.1	952.9	944.2	949.4			29-03-2022	24.00	801.17

Daily APC & Energy Deviation Report

DESCRIPTION	DES	MILL A	MILL B	MILL C	MILL D	MILL E	MILL F
INPUT POWER (KW)	650.00	310.95	322.18	371.82	351.55	2.68	-0.26
SEC(KW/TPH)	30.03	0.00	9.49	10.77	11.71	0.00	0.00
MILL AF TO CF RATIO	1.01	2.71	2.18	2.39	2.71	0.00	0.00
MILL MAX COAL FLOW LOADING(%)	70.50	50.98	55.63	48.99	42.58	0.00	0.00
WT OF MOISTURE REMOVED(KG/HR)	9504.57	6844.19	9936.93	4554.17	4263.79	30.75	34.60
% OF MOISTURE REMOVED	18.90	19.04	22.59	12.61	14.20	0.00	0.00
MILL MOTOR EFFICIENCY(%)	92.00	92.80	92.80	92.00	92.00	92.80	92.80

Real time Monitoring – Mill Performance Monitoring

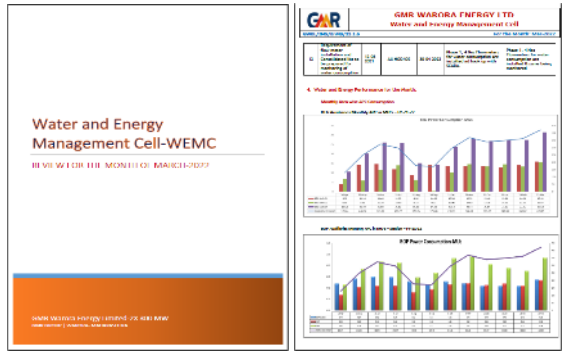


Sustenance Monitoring Reporting

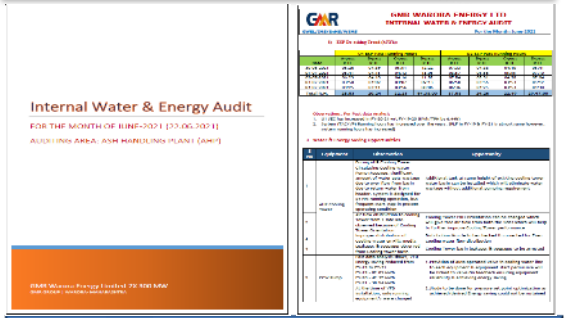
12. Team work, Employee Involvement & Monitoring

12.3 Involvement of Employees in Energy Conservation

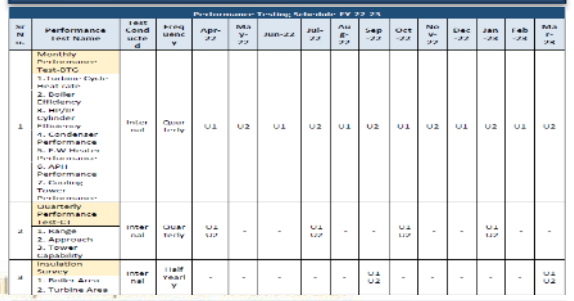
- **Formation of Water & Energy Management Cell under ISO-50001 & ISO-46001**
- **Objectives of EMC :**
  - Monitoring of Specific Energy & Water Consumption
  - Water & Energy Audit (Internal & External) & Recommendation implementation status review
  - Discussion on Water & Energy Conservation Projects
  - Identification of New Water & Energy Conservation Initiatives
- **Members of EMC :** Plant Head (Chairperson), O&M 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 23 Water & Energy leaders appointed.**



WEMC MOM



Internal Water & Energy Audit under Water & Energy Management Cell

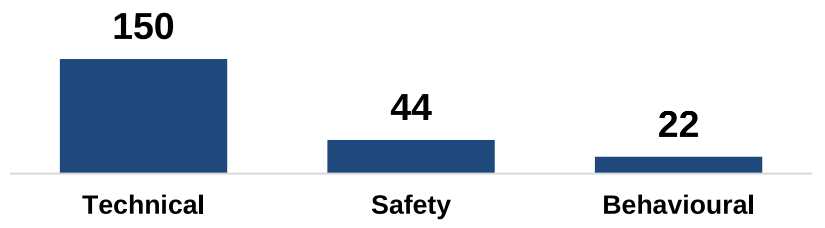


Performance Test Schedule

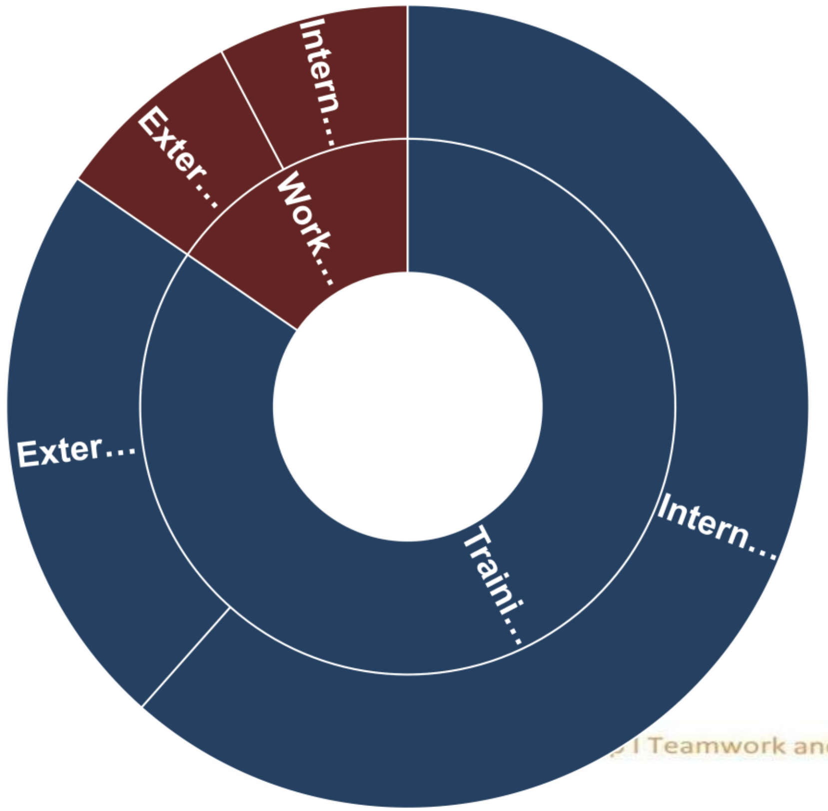
12. Team work, Employee Involvement & Monitoring

12.4 Energy Efficiency Capability Building

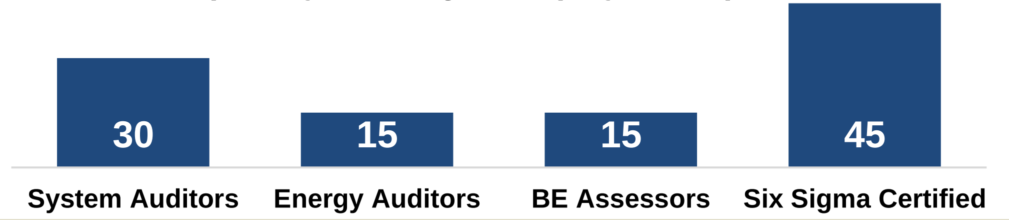
Number of Trainings-All



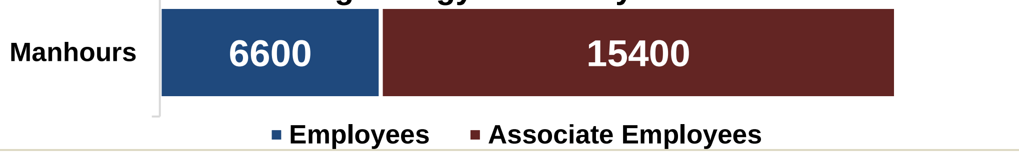
Capability Building-Energy Efficiency



Capability Building-% Employees Expertise

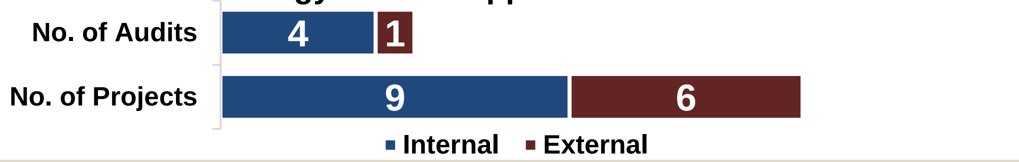


Training-Energy Efficiency-Man-hour



Nos. of Energy Conservation Ideas Identified Through Trainings – 16 Nos.

Energy Audit & Opportunities Identified



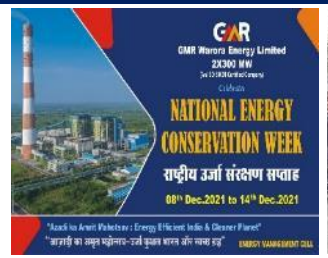
Program Name & details

Program Name & details
Internal
Heaters Performance Improvement through Level Optimization
Boiler Performance Monitoring & Improvement
Best Practices for Energy Consumption Reduction in AHP
Training on Energy Management System (ISO 50001) & Energy Conservation awareness for all stakeholders
External
Workshop on Opportunities for APC Reduction in Thermal Power Plant by M/s Steag
Compressed Air System Energy Consumption reduction Best Practices by M/s Godrej
Six Sigma Training for Structured Methodology of Energy Efficiency Optimization by M/s KPMG-Batch-3

12. Team work, Employee Involvement & Monitoring

12.5 GWEL – Celebration of Energy Conservation Week

- Display of Energy Conservation Posters
- EC Training for GWEL Employees and Associate employees
- EC Programme for Children of nearby village schools
- Competitions based on EC for Employees, Associates, Family Members etc
- EC Programme for family members
- Felicitation of Winners



12.6 Projects implemented through Kaizen (Workers and Supervisor level)

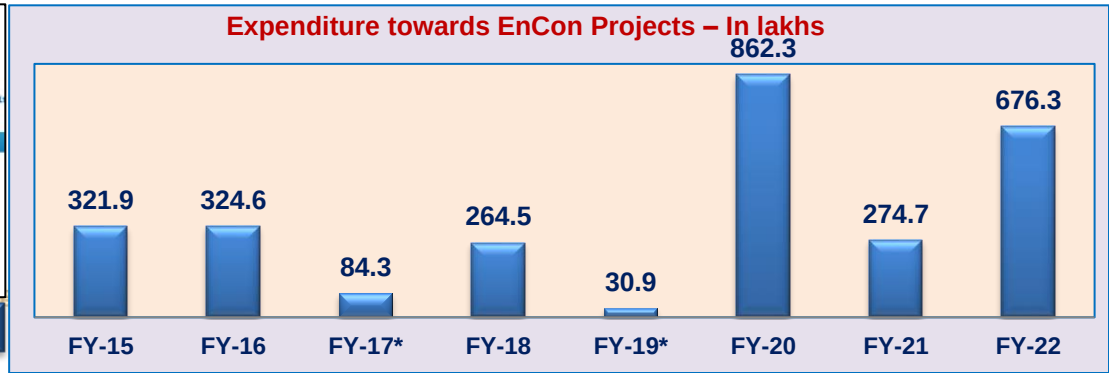
At Supervisor Level	At Workmen Level
❑ AHP All Compressor Water Inlet & Outlet Line Pneumatic Wall Installation With Auto Logic	❑ Energy Conservation through Installation of Wind Driven Exhaust fan in RO-DM building Roof Top
❑ Installation of Sensor lights in Conference Room & Low Occupancy Areas	❑ Installation of Touchless Water Taps
❑ Stopping of Ferric Chloride dosing pump by providing Ferric Chloride Tank By-pass discharge line for gravity dosing	❑ Auto Operation of Lamps in CW pump house by Day-Night Sensor
❑ Replacement of Conventional exhaust fans with energy efficient exhaust fans at washrooms.	❑ Reduction in Auxiliary Power Consumption in Compressor House by identifying and attending air leakages

12.7 GWEL – Web based Portals for Creating Awareness

Knowledge Management Portal in Intranet

EnMS (ISO 50001) Web Portal in GMR intranet

12.8 Expenditure towards EnCon Projects



12.9 Major Area of Concern in Energy Efficiency & Reliability

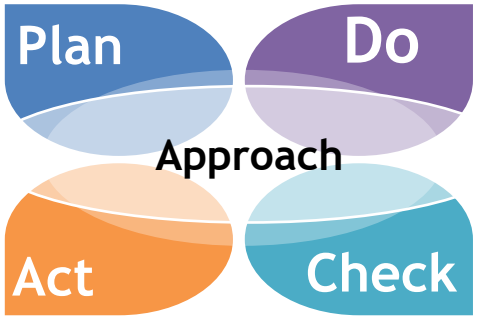
Untied Capacity	**Untied Capacity** due to PPA Expiry significantly affects plant performance in absence of new market opportunity & dynamic scenario of exchange market
Coal Shortage	Plant PLF is getting affected due to **Coal Quality & Quantity Constraint** & same is affecting station Performance
Flexible Operation	Impact due to Low load and high Ramp Rate - Escalated O&M costs, deteriorated Heat Rate & APC, high startup & shutdown cost, High Emission, Machine reliability compromised and PPA availability loss
Machine Aging	Impact of **Machine aging** on Plant Performance
Increase in APC due to FGD	**FGD** installation will result in **increase in plant Auxiliary Power Consumption**
Fund Availability	**Fund availability** major constraint for Technological Upgradation
Increase in Renewable Energy Portfolio	Increase in worldwide **Renewable Energy portfolio** is necessity for tackling Climate change issues but same **may affect Plant PLF which will effect performance**

13. Implementation of ISO 50001 at GWEL

13.1 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

13.2 GWEL – Management of Energy Conservation Program- SIP Digitalization-Complete Cycle in SAP

1. Identification

•Identification through Internal/ External Audits, RCA for Energy deviations. Approval of Plant Head

2. Implementation

•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 after 1 month of project completion & certified by Energy Manager

Total 206 Energy Conservation SIP's implemented in last 8 FY's

% Investment on Turnover in FY 2021-22 : 0.51%

13. Implementation of ISO 50001 at GWEL

13.3 GWEL - Energy Management System

Identification of Energy **Use and Consumption** by all dept. Heads/ Sectional Head

Approved List of Energy Use and Consumption by Plant Head

Criteria for Significant Energy Consuming Equipment's/ Process and Approved List of **Significant Energy Use** Equip.,/ Process

Identification& Approval of **Energy Performance Indicators (EnPI)** for Significant Energy Consuming Equipment's

Identification of **Energy variables** through **Energy Use Review Register** of **Significant Energy Use** Equipment's/ Process

Identification of Energy metering **& Data collection Methodology** for Significant Energy Use Equipment's/ Process

Criteria for Calculation of **Base Value , Operation Control Limit & Maintenance Control Limits** of Significant Energy Use Equip.,/ Process

Preparation & Approval of the **SOP/ SMP** to control Energy Deviation in **IMS** by all the dept. Heads

Daily Energy Deviation Analysis to Monitor & Control Energy Deviation

Periodic Performance Test by **WEMC**

Periodic Internal & External Energy Audits by WEMC/ Agency

Energy Deviation **Notification** by EMC& Closure action by concern dept.,

OFI review in the WEMC Meeting and Necessary action by Concern Dept.

Energy Deviation Notification by WMC& Closure action by concern dept.,

2. Raising Notification

1. Identification of Deviation-OCL/MCL

Closed Loop

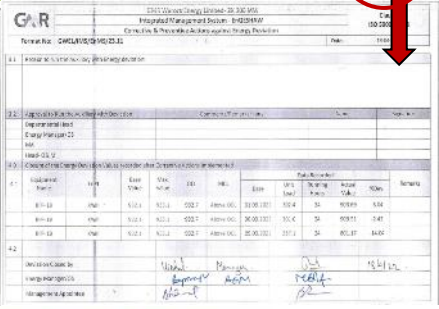
3. Corrective & Preventive Action

4. CAPA Closure Submission Approved by Energy Manager

GMR Warora Energy Limited- 2X300 MW
Daily Energy Deviation Report

Doc No: GWEL/IMS/EnMS/23.10

Sl No	Description	Capacity	Energy Performance Indicator (EnPI) UOM	Load (MW)	Average Value (AV)	Max. Value (MV)	Base value (BV)	Operation Control Limit (OCL)	Maintenance Control Limit (MCL)	Duration	Date	Running Hours	Daily Actual Consumption
											Date		Unit-01
											11-03-2022		255.8
											10-03-2022		222.2
											09-03-2022		249.5
1.0	BTG Auxiliaries												
1.11	BFP-1B	5700 Kw	100* Kwh/ TPH of FW	255.8	929.4	933.1	932.1	932.7	Above OCL	Daily	11-03-2022	24.00	945.10
				222.2	935.6	952.6	948.4	950.9			10-03-2022	24.00	982.26
				249.5	935.6	952.6	948.4	950.9			09-03-2022	24.00	96[illegible]



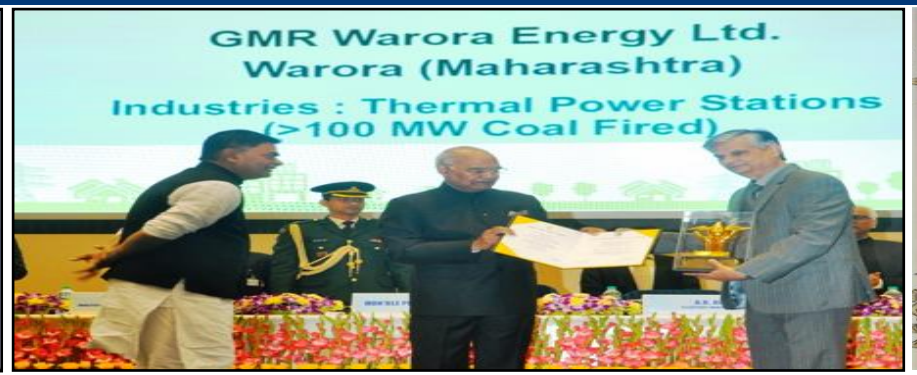
Monitoring through Daily Energy Deviation Report & Deviation Closure by CAPA Closure Mechanism

14. Learning from CII/Other Award Program

- To learn about the best practices adopted from best performing companies.
- CII event gives opportunity for Inter & Intra Sector Benchmarking for improvement
- Facilitate adoption of similar projects at our unit, leading to enormous saving viz.
  - Intelligent Flow Controller - Exhibition
  - Airtron AC Energy Saver - Airport Sector
  - Mill Dynamic Classifier - Cement Sector
- An Opportunity to interact & network with individuals and companies of repute for further strengthening Energy Efficiency System
- CII Best Practices Manual brings Potential Projects with high replicability of Energy Saving
- Information about Latest market trends & innovative products for Energy Efficiency .
- To identify strengths and opportunities to excel, based on a comprehensive and rigorous assessment by experts.

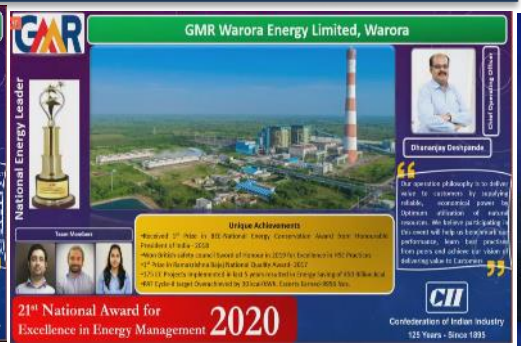
15. Awards & Accolades

BEE-National Energy Conservation Award 2020-Consecutive 2 Times



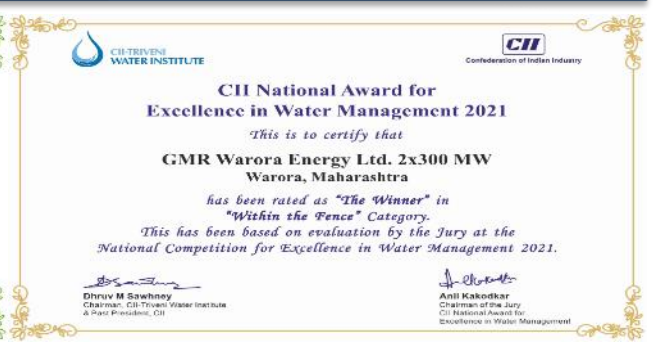
BEE-National Energy Conservation Award 2017

NSC-Sarvashreshtha Suraksha Puraskar-3 Times



CII National Energy Leader Award for Excellence in Energy Management-2021

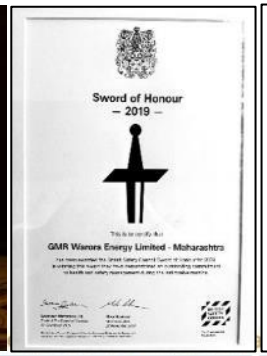
CII Innovative Environmental Project 2021



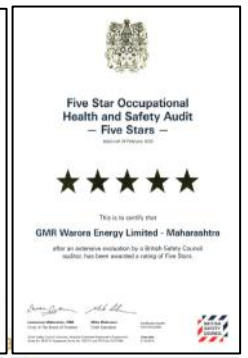
CII Excellence Water Management Award 2021

IMC Ramakrishna Bajaj National Quality Award 2017

Global Performance Excellence Award 2018-World Class



Sword of Honor 2019



BSC 5 Star 2019

There is a Name for those Who Conserve Energy….

… SMART

Thank You

Team Member Details:

1. Bharat Pinjarkar	- Head Operations	- 8390903659	- Bharat.Pinjarkar@gmrgroup.in
2. Murali Ravishankar B	- Manager-COO Office	- 8390903648	- Murali.Bodda@gmrgroup.in
3. Pratiksha K Sharma	- Manager-OS&E	- 8380098446	- Pratiksha.Sharma@gmrgroup.in