# 24th CII National Award for Excellence in Energy Management-2023
## (Thermal Power Stations)




**GMR WARORA ENERGY LTD**

**2x300 MW**





## Presentation Flow :

1. GWEL - At a Glance; Journey Towards Excellence; Auditable System
2. Energy Consumption Over-view
3. Specific Energy Consumption
4. Benchmarking of Energy Consumption
5. Summary of Energy Saving projects implemented in FY 21, FY 22 & FY 23
6. Innovative Project implemented in FY 23
7. Use of Renewable Energy
8. Environment Management – Ash Utilization; Emission & Water
9. Best Practices in Plant
10. Team work, Employee Involvement & Monitoring
11. Implementation of EMS/ISO Certifications & AFR
12. Learnings from CII/Other Award Program
13. Awards & Accolades

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

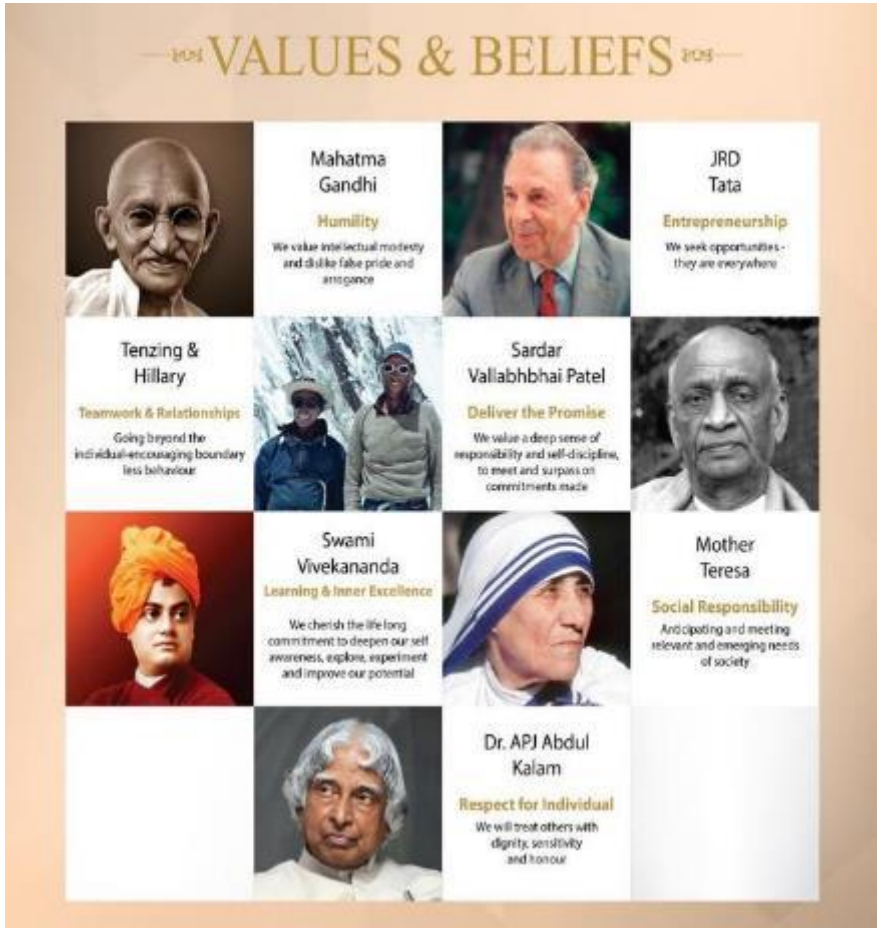
## Vision

***"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"**



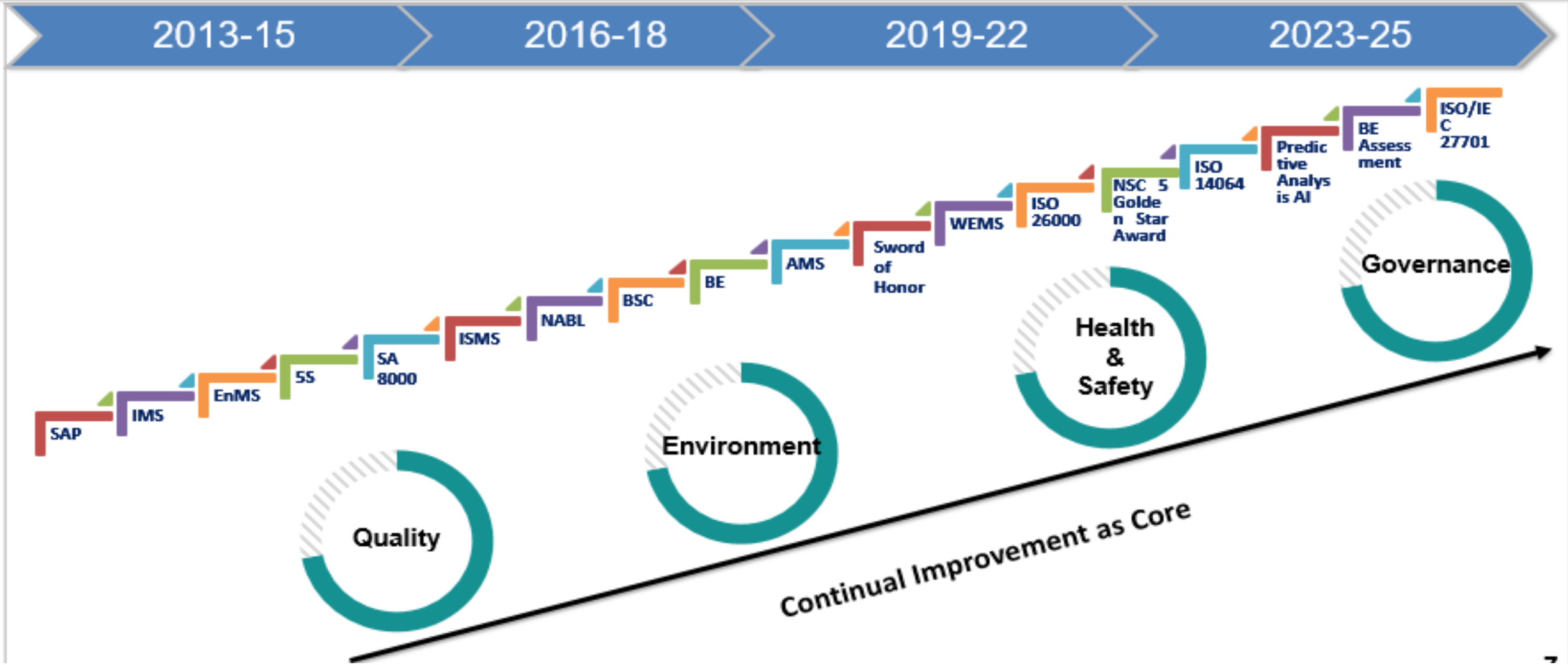

**In line with Group's Vision & Mission,**

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

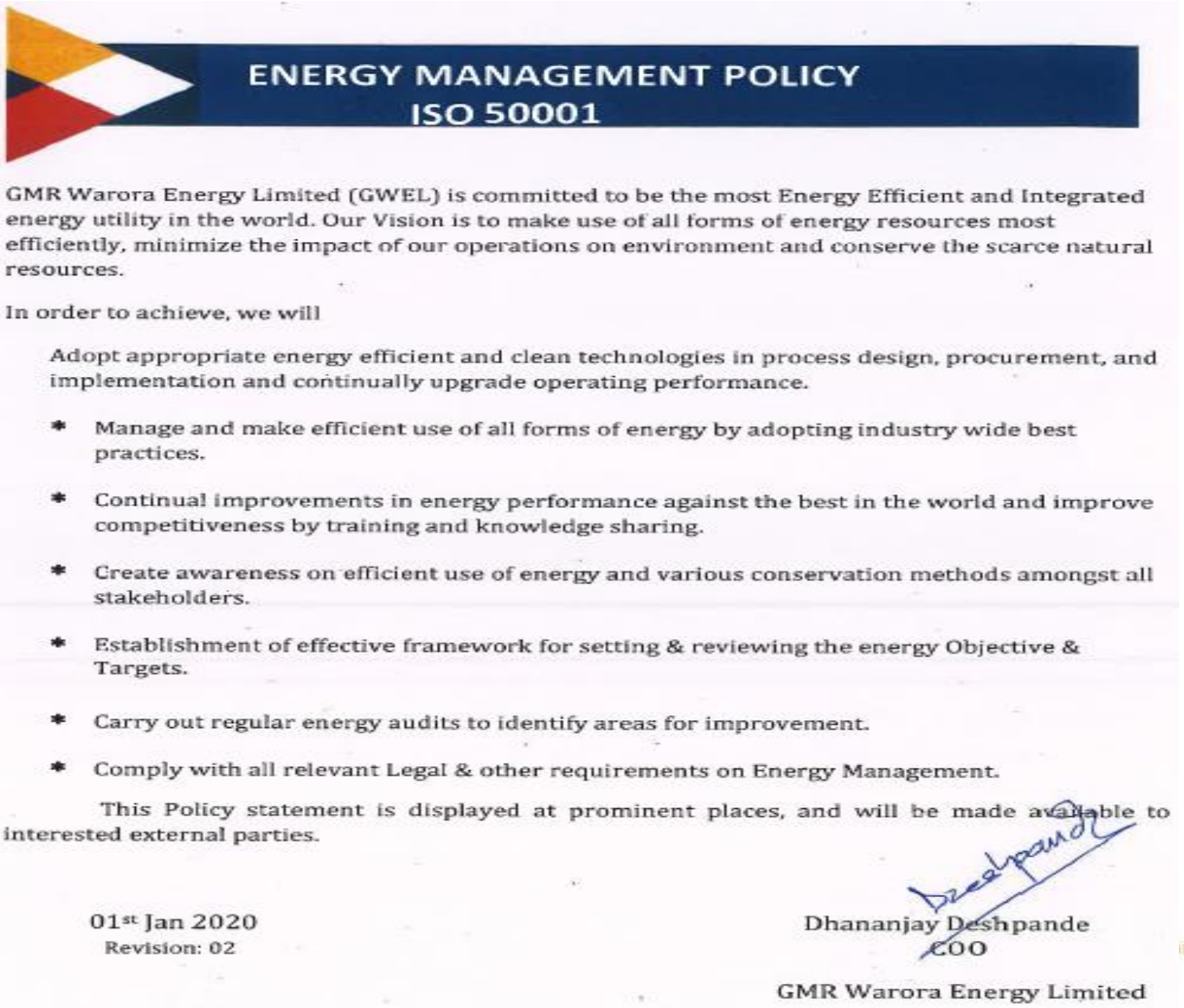
Humility I Entrepreneurship I Teamwork and Relationships I Deliver the Promise I Learning and Inner

# 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

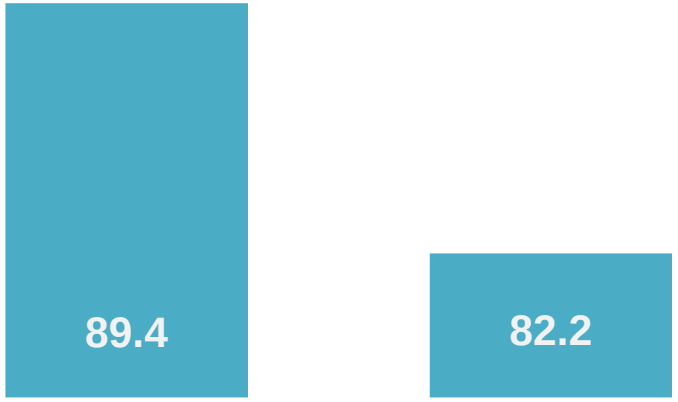
GMR Warora Energy Limited

- 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: 2022-23

## Energy Consumption Overview for FY: 2022-23


Generation Mu's




Plant Availability %

PLF %

## Key Performance Indicators

**Gross Station Heat Rate** - 2306 kCal/kWh

**Turbine Heat Rate** - 2011 kCal/kWh

**Boiler Efficiency** - 87.21 %

**APC** - 7.61%

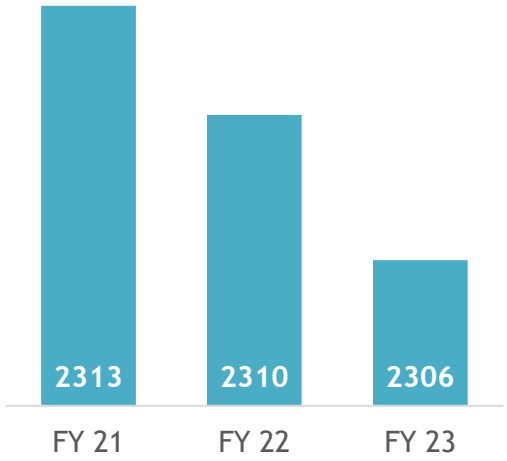
**SOC** - 0.11 ml/Kwh

**DM Make Up** - 0.16 %

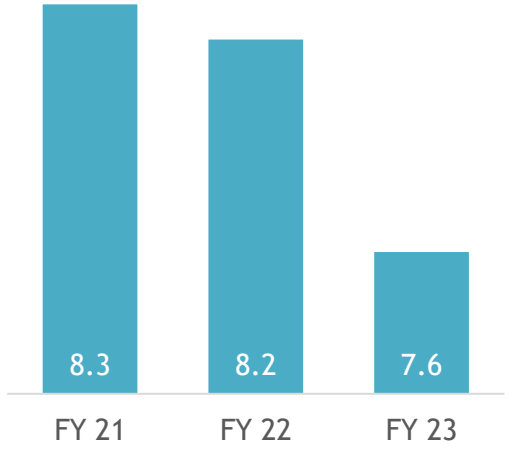
**Raw Water** - 2.39 m3/MWh

# 3. Specific Energy Consumption

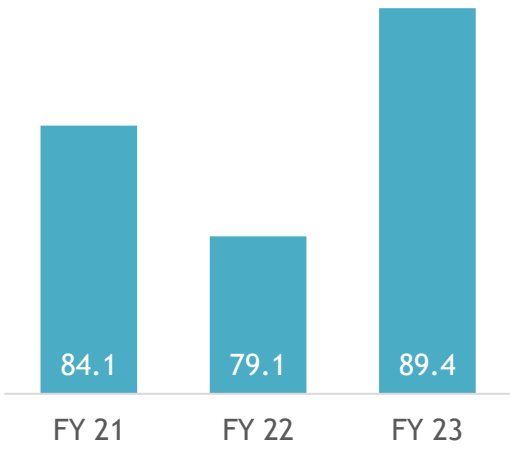
## Gross Heat Rate Kcal/Kwh



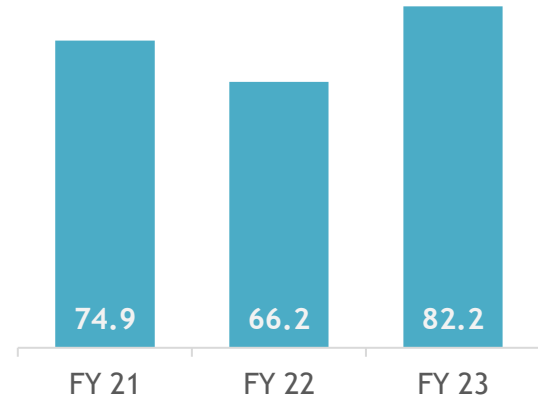

## Auxiliary Power Consumption %




## Plant Availability %




## Plant Loading Factor %




| KPI | % Improvement |
|---|---|
| Heat Rate | (+) 0.17 % |
| APC | (+) 7.32 % |
| Plant Availability | (+) 13.02 % |
| Plant Load Factor | (+) 24.12 % |

**Constraints**

1. Partial Loading on account of Customer curtailment, coal shortage, market constraints.
2. Further Heat rate could have been reduced by 7 kcal/kWh, however could not be achieved due to increase in the moisture in coal.

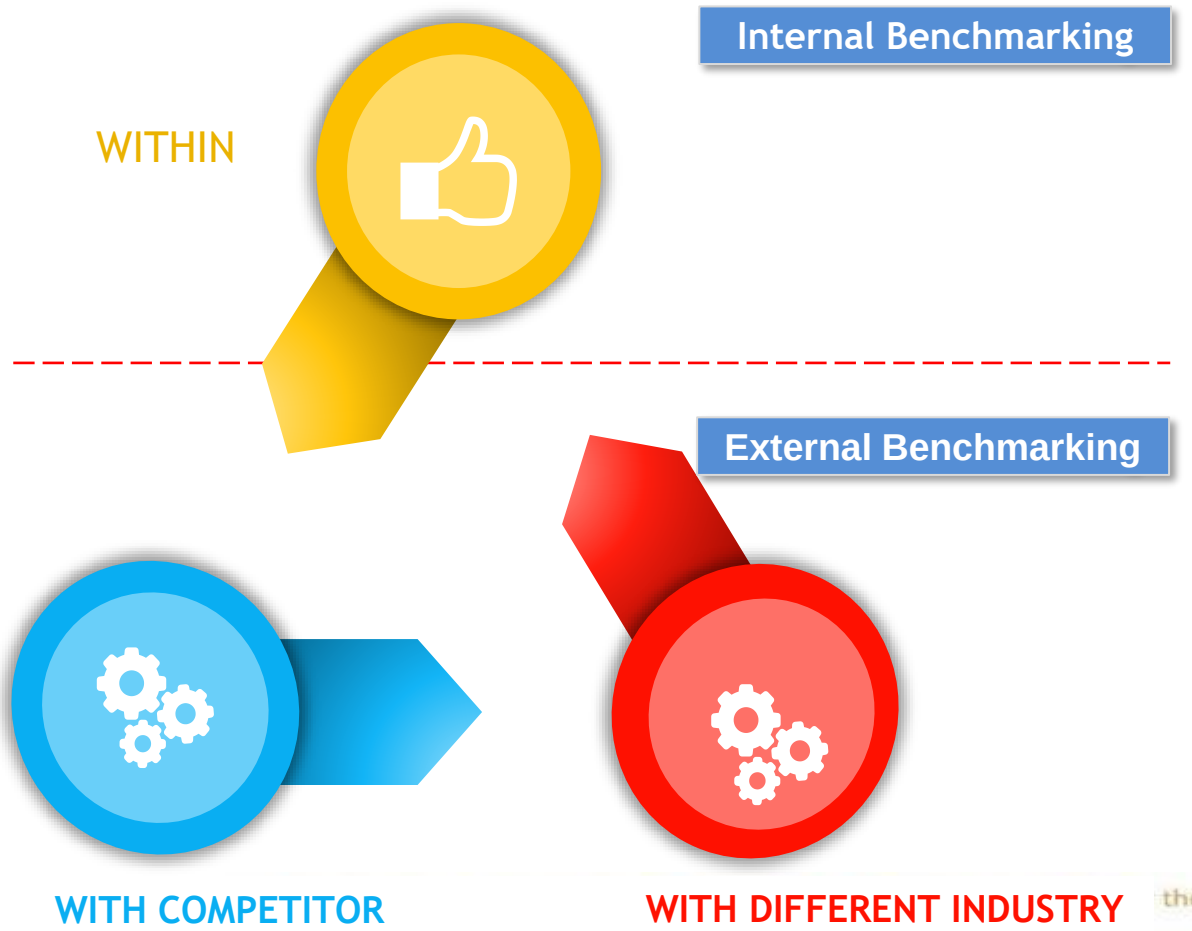
**Comments**

1. Station achieved Heat rate of 2306 Kcal/kWh which is best among peer companies for FY 22-23. Heat Rate improved from previous year by 4 KCal/kWh. Station Heat rate before overhauling (COH) is 2313 Kcal/kWh which reduced to 2300 Kcal/kWh. Improvement projects like CT fills replacement, turbine flow path correction etc. has improved station heat rate & APC.
2. Reduced auxiliary power consumption from 8.4% to 7.3 % by embracing best operational practices and implementing various ENCON projects in overhauling, despite severe cash flow constraints. APC improved from previous year by 0.6% out of which 0.2% impact observed due to increase in PLF.
3. Station has recorded availability of 89.4% for FY-22-23. U-1 and U-2 achieved consecutive run of units for 239 & 155 days respectively and also Station achieved 155 days of continuous running in FY.

# 4. Benchmarking of Energy Consumption

## 4.1 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

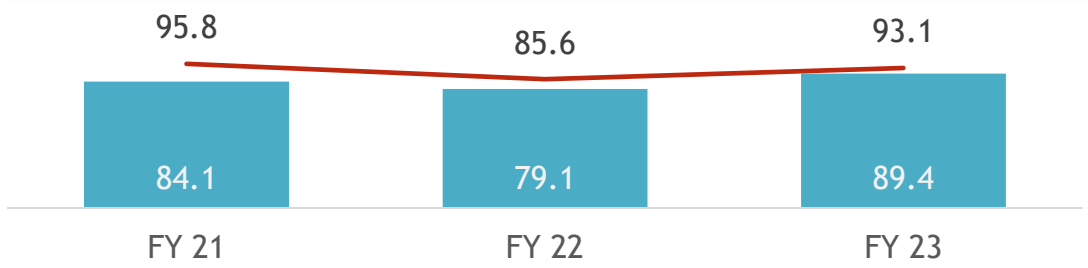
### External Benchmarking

- **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

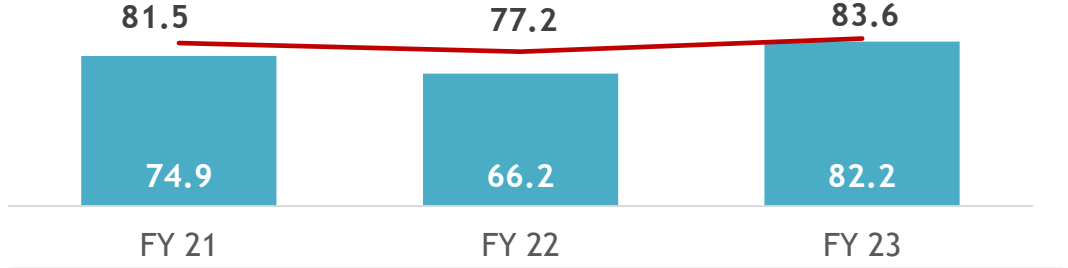
# 4. Benchmarking of Energy Consumption

## 4.2 Internal Benchmarking

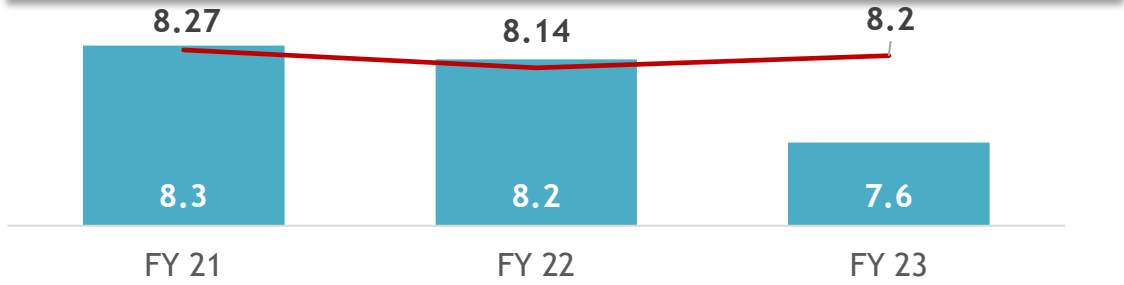
### Plant Availability %



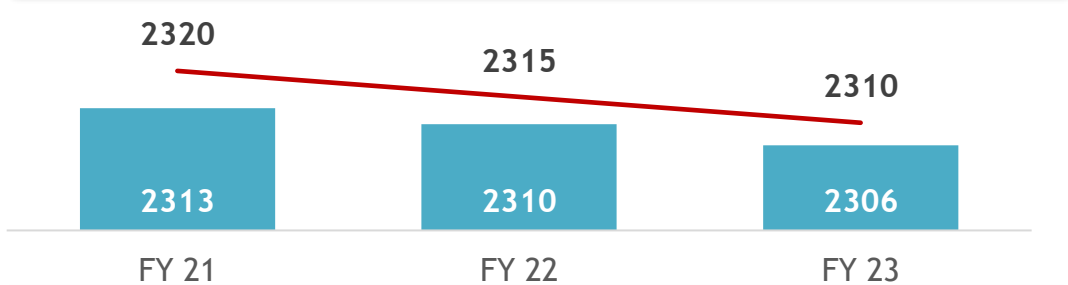

### PLF %



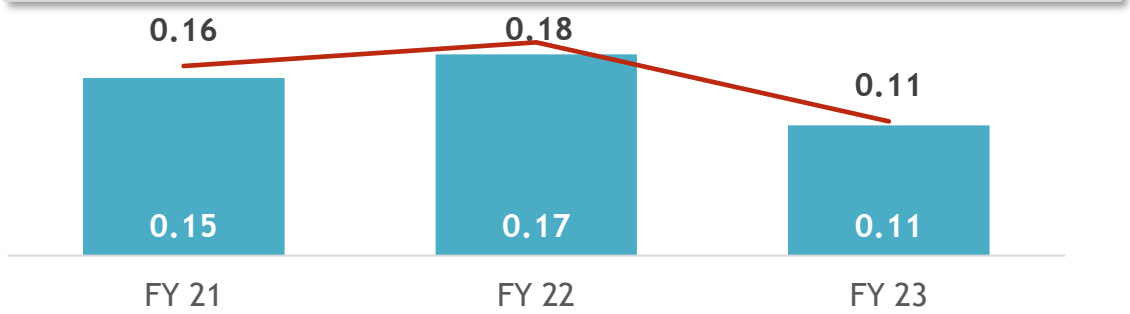

### APC %



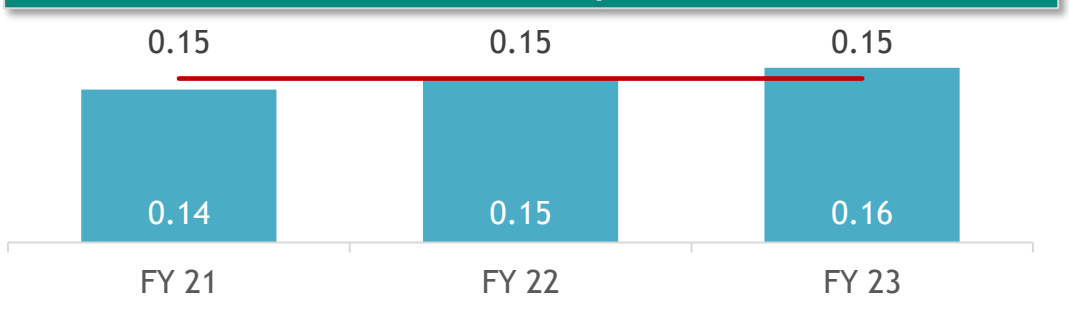

### SHR Kcal/kwh




### SOC ml/Kwh




### DM Make up %



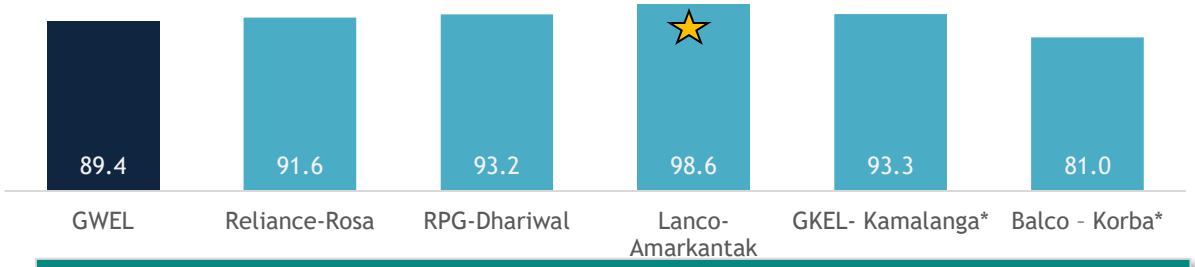

- GWEL has achieved Plant Load Factor (PLF) of 82.2 % and best (Lowest) ever APC of 7.61% in FY 22-23, since commissioning.
- GWEL has best ever station performance in FY: 2022-23.

Actuals — Target

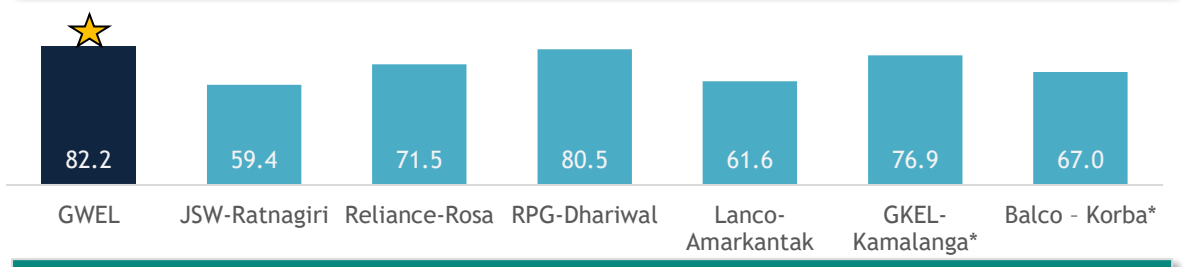
# 4. Benchmarking of Energy Consumption

## 4.3 External Benchmarking

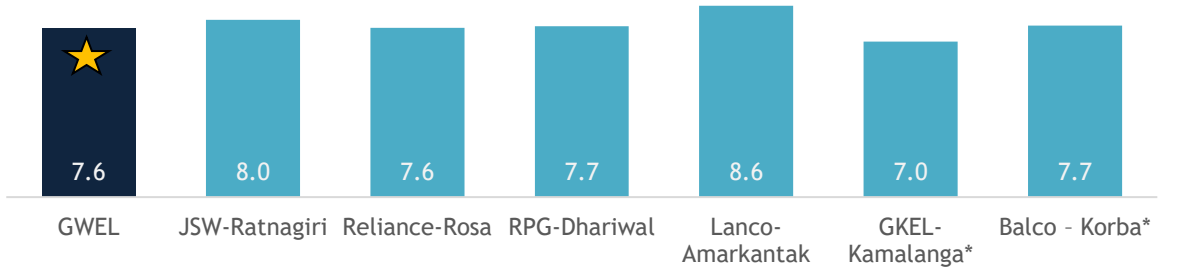
### Plant Availability %



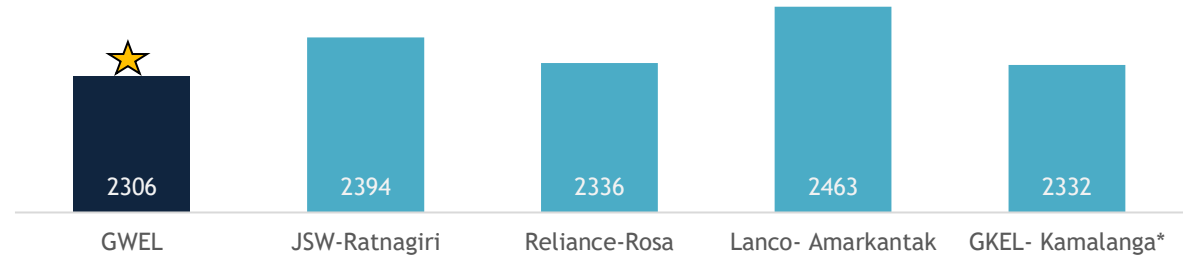

### PLF %



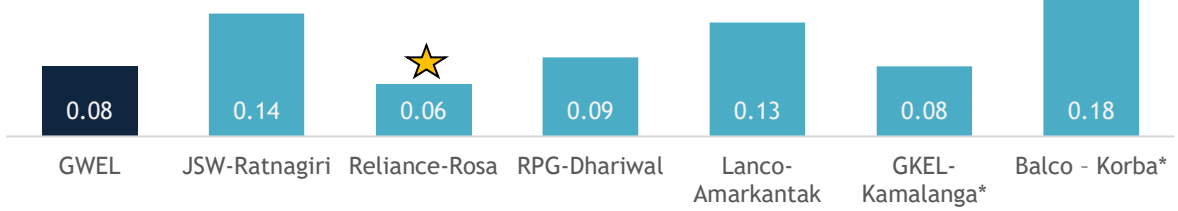

### APC %



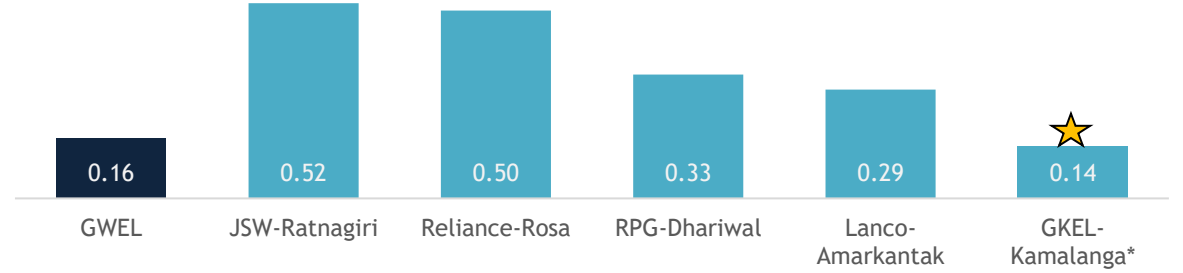

### SHR Kcal/kwh




### SOC ml/Kwh




### DM Make up %



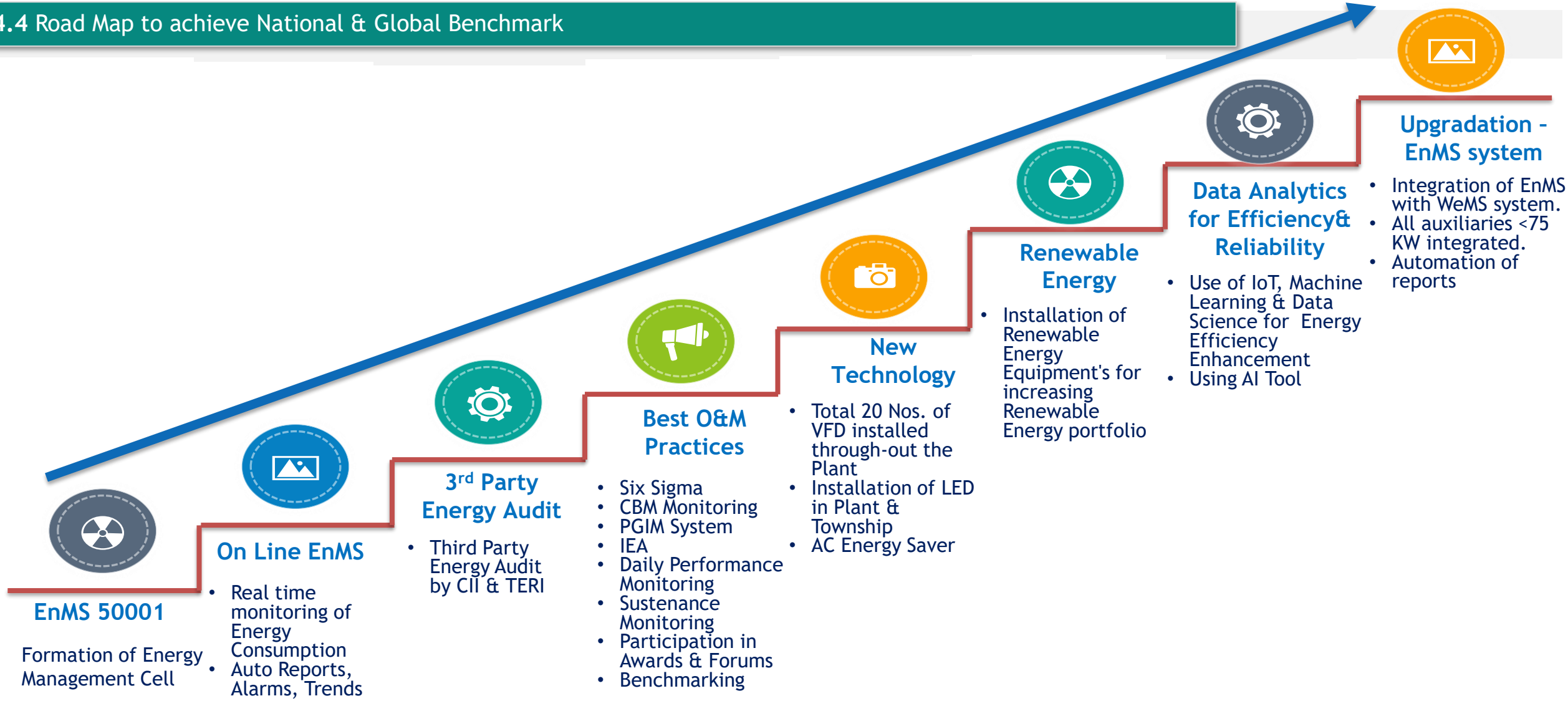

GWEL ★ Best Achieved Peers

| KPI | National Benchmark | International Benchmark |
|---|---|---|
| APC % | 7.73 | 7.71 |
| SHR kCal/kwh | 2248 | 2242 |

- GWEL Best Achieved - Heat rate of 2275 Kcal/kwh & APC of 7.23% at 100% PLF
- GWEL achieved Best Heat rate & APC among its' peer companies.

# 4. Benchmarking of Energy Consumption

## 4.4 Road Map to achieve National & Global Benchmark



# 4. Benchmarking of Energy Consumption

## 4.5 Future Plans towards Energy Conservation - FY:2023-24

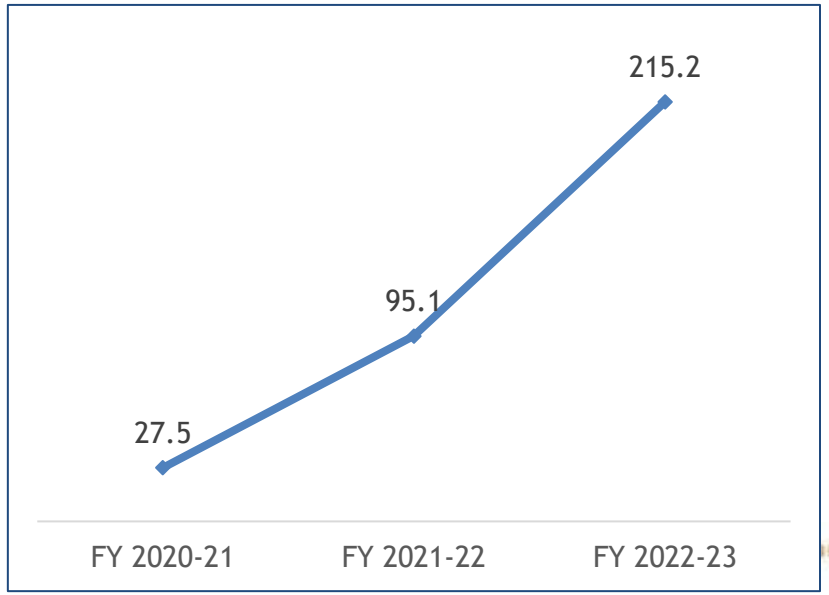
| S. No. | Title of Project | Annual Electrical Saving (Million kWh) | Annual Thermal Saving (Million Kcal) | Investment Planned in 2023-24 (INR in Million) |
|---|---|---|---|---|
| 1 | Upgradation of Energy Management system under Digitalization and Monitoring the Energy Management | 3.40 | | 5.00 |
| 2 | Boiler Feed pump Performance Improvement through cartridge replacement & rectification of RC valve | 0.36 | | 5.26 |
| 3 | Condenser Performance Improvement through jet cleaning, helium Leak test & hydro test | | 13437.15 | 0.62 |
| 4 | Installation of vibrating feeder in second stream conveyor - BCN 2B | | 179.25 | 2.50 |
| 5 | Cooling Tower Performance Improvement Program (Existing Cooling Tower Drift Eliminator, Nozzle & Fill Replacement, CW line modification etc.) | | 13437.15 | 3.00 |
| 6 | Cooling tower fan motor to gearbox metallic shaft replacement with carbon fiber shaft | 0.53 | | 4.80 |
| 7 | Installation of 30 MW Solar Plant | 36.00 | | 1350.00 |
| 8 | Three coal mill operation instead of four coal mill operation during partial load operation. | 1.96 | | - |
| 9 | Boiler Efficiency Improvement through replacement/ refurbishment of Coal mill rollers along with bull ring segments. | | 9288.00 | 1.46 |
| 10 | Installation of Sonic Soot Blower in APH | | 5.94 | 2.10 |
| 11 | APH Sector- plate servicing & replacement. | 0.53 | 7.70 | 1.17 |
| 12 | Implementation of CAVT recommendation in second pass for unit-1 | 0.40 | | 0.30 |
| 13 | Unit 1 HPHs partition plate inspection & replacement. | | 1652.40 | 0.30 |
| 14 | Boiler Refractory Inspection and replacement | 0.67 | 1261.97 | 1.00 |
| 15 | Flue gas duct & primary air duct ceramic tiles inspection & replacement, duct leakage arrestation | 0.53 | | 1.68 |
| 16 | Coal Mill Aero foil Replacement | 0.27 | | 1.68 |
| 17 | Phase II project on optimal operation of LED along with reduction in LED wattage. | 2.40 | | 1.17 |
| 18 | AHU retrofit- High efficient EC Fan | 0.34 | | 4.50 |
| 19 | Governing Valve Overhauling and replacement | | 5832.00 | 1.00 |
| **Total** | | **43.98** | **45101.55** | **1382.54** |

# 5. Summary of Energy Saving Projects

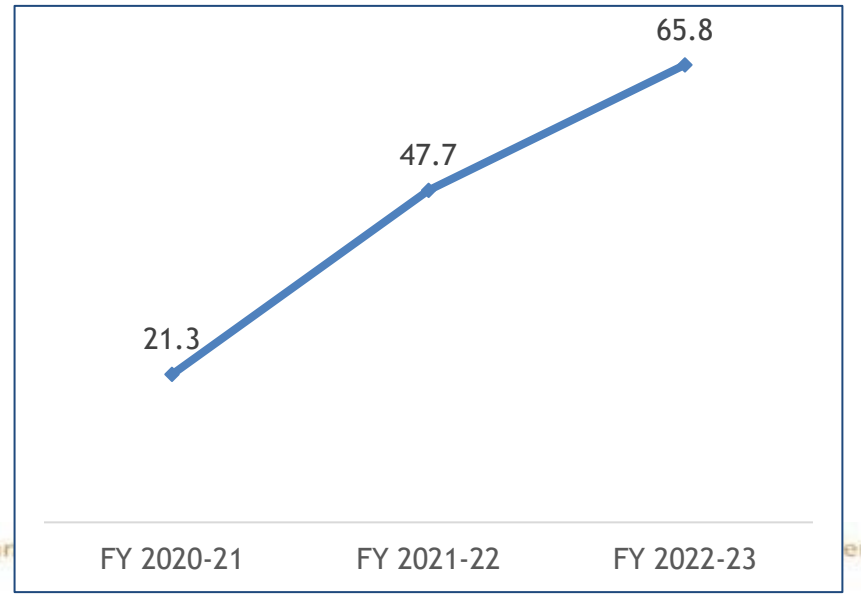
## Summary of Energy Saving Projects in Last 3 years

| FY | No. of Energy Saving Projects Nos. | Investments INR Million | Electrical Savings (Million kWh) | Thermal Savings (Million Kcal) | Savings (INR Million) |
|---|---|---|---|---|---|
| FY 2020-21 | 21 | 27.5 | 21.3 | 181377 | 230.9 |
| FY 2021-22 | 25 | 67.6 | 26.5 | 164427 | 251.0 |
| FY 2022-23 | 17 | 120.1 | 18.0 | 259451 | 329.4 |
| | **63** | **215.2** | **65.8** | **605255** | **811.4** |

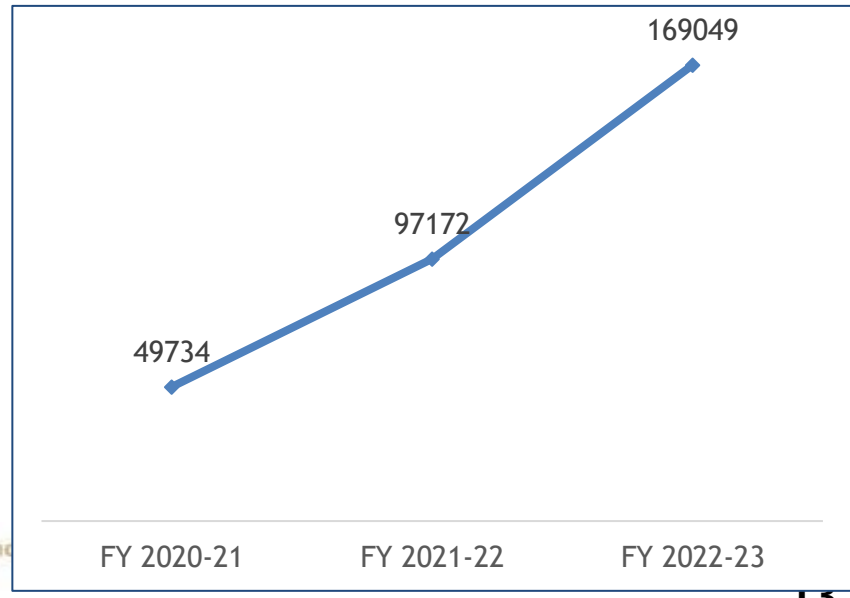
### Investment made (Lakh INR/year)




### Energy Savings (Lakh kWh/year)




### Coal Savings (MT/year)



# 6. Innovative Project implemented in FY 2022-23

## 6.1: Reliability& Efficiency Improvement through Predictive Analysis using artificial intelligence& Machine learning.

**Replicability : YES**

**Project Trigger:**

- A Typical TPP consumes Considerable amount of Energy which generates as APC.
- Difficulty in identifying **cause/ Solutions** on real time for High Specific Energy consumption by auxiliaries.
- DCS/EMS, Uses threshold based alarms to detect the operational issues after causing energy losses.
- DCS/EMS- Failure in detection of performance degradation & Equipment reliability issues beforehand.
- Unable to identify problems at early stages leading to disruptions leading to efficiency loss, Equipment failures leads to high Cost of generation & also poses a safety risk to workers.

**Problem Description:**

- GWEL adopts industry best O&M practices such as EMS (ISO:50001)/AMS(ISO:55001) etc., but which are not always effective in identifying & addressing potential issues of High Sp. Energy consumption on real time basis.
- Due to aging of experienced personnel, leading non-availability of repository of knowledge base is impacting operational performance & also Non-Availability of guidance to operator on historical/ design performance.
- To optimize APC of Plant & also to achieve Operational/ Energy efficiencies it is imperative to embrace Digital solution which can enhance Asset Efficiency through Predictive Performance solution models.

**Solution:**

- "AI Expert" utilizes, AI/ ML technology to optimize operational Parameters while analyzing **System Failure Modes** along with Providing **Recommendations** to Operator to maximize **the Asset Efficiency and Reliability**.
- AI Expert's Artificial intelligence engine uses unsupervised deep learning on historical data to learn **correlations** between operating parameters. Given high order of system models, correlations are more precise compared to traditional statistics& multi-variate regression models.
- AI Expert capable of Early detection of issues requires detecting subtle changes in the operating parameters, As a result "AI Expert" is more accurate in giving early warning of the impending issues in the equipment and systems.
- Further, "AI Expert" model continuously updates itself to learn new behavior of equipment with very little manual effort. AI Expert Artificial intelligence models can detect the following kinds of issues without requiring the creation of four separate models.

1. Performance anomalies
2. Process anomalies
3. Equipment reliability anomalies

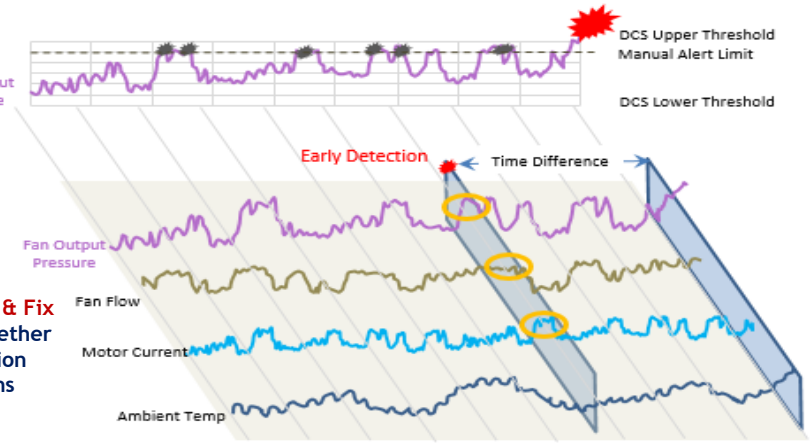
**Functions:**

| Multi-equipment System Models | Instrumentation Health& Data Quality | Anomaly Detection | Failure Diagnosis | Advance Analysis Module | Alert Management | Performance Dashboards |
|---|---|---|---|---|---|---|
| Generates a single alert for a system level issue& able to diagnose Equip./ Process/ Perf. | Root Cause analysis, accuracy in MSA & Minimizing false alert | Equipment reliability, process & performance anomalies | "Fingerprints" translate anomalies& interpret them as specific set of failure modes& Recommended actions. | Process Heat map, Deviation in start& stops, correlating several parameters & computing signal statistics | Grouping of similar alerts, duplicate alert suppression, auto-escalation of repeated alerts | Plant level & system level dashboards to get relevant information in a single page. |

### Difference in Traditional Monitoring& AI Expert

**Traditional Monitoring**

- Monitors All Signals Separately
- Manually adjust thresholds




**AI Expert-Early Detection & Fix**

- Monitors All Signals Together
- Gives advance notification
- Understands Correlations
- No Manual rules

### Anomaly Detection with Failure Mode Analysis

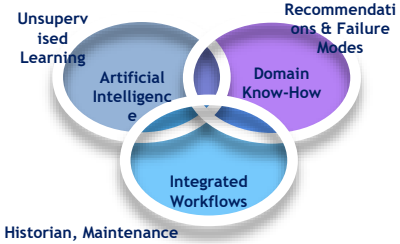
# 6. Innovative Project implemented in FY 2022-23

## 6.1: Reliability& Efficiency Improvement through Predictive Analysis using artificial intelligence& Machine learning.

**Replicability : YES**

**Advantages with "AI Expert":**

- Digitize "knowledge and work processes" to achieve plant consistency.
- Understand system& Equipment interrelations to identify root cause of an issue.
- Guides O& M teams by providing meaningful diagnosis& actionable recommendations using built-in cause-effect analysis
- Identify Data quality& sensor re calibration requirement.
- Seamlessly integrates with current operational Technology(OT) stack including maintenance systems like SAP-PM to asses issues holistically& identify root causes and Integrated Maintenance information for better context during analysis
- Plant wide coverage including all critical systems
- SAP& PI connectors for work history details and live data streaming




Defined with 3000+ DCS Tags of Critical Parameters of Critical Asset/ System Models

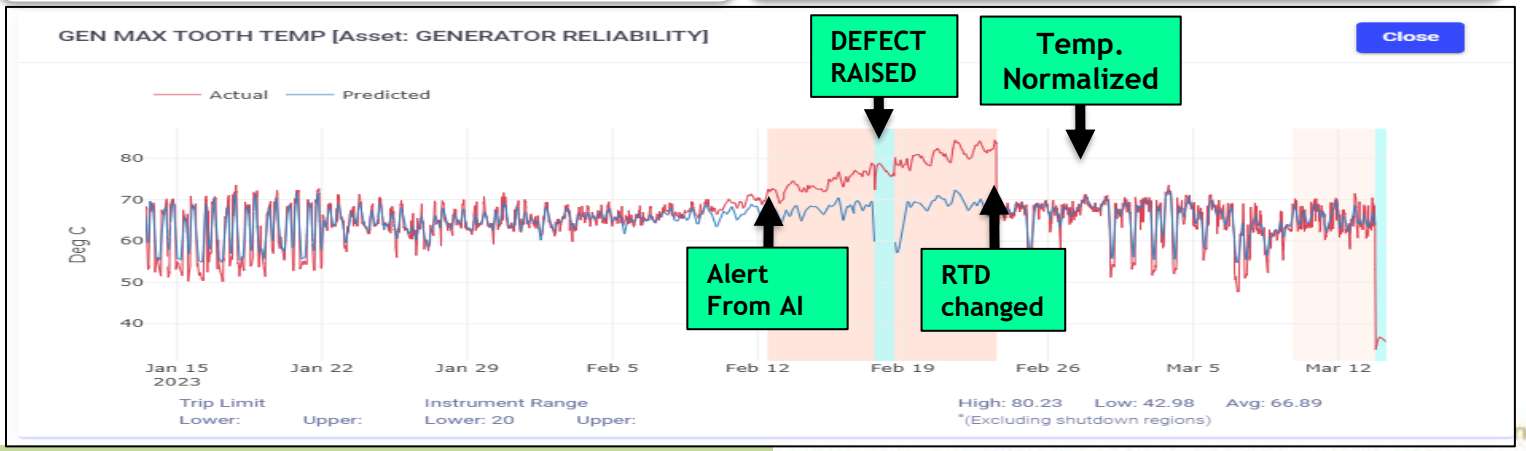
Configured with 1000+ failure modes and recommendations with predefined signature of deviations

90+ Assets are being covered under Phase-1 Implementation& 800+ Critical Alerts generated for corrections to operators

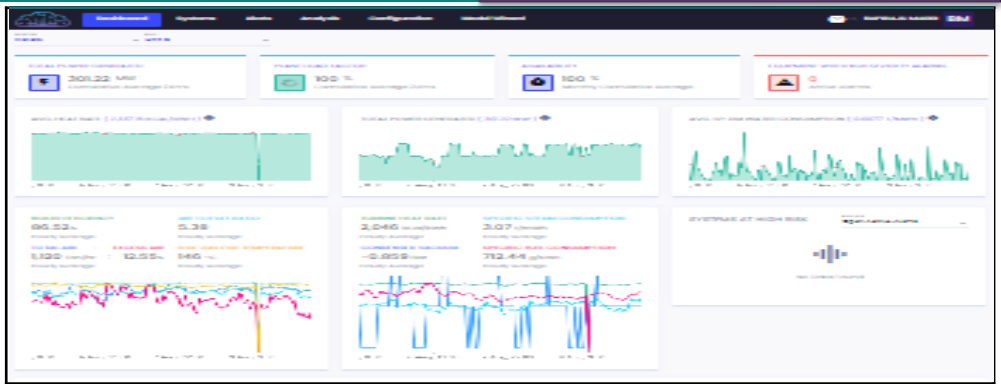
Anomaly score of latest alert region& identify contributing tags that opens up when clicked on the anomaly score.

Each Alert when generated will also show possible failure modes and recommended actions to rectify the failure

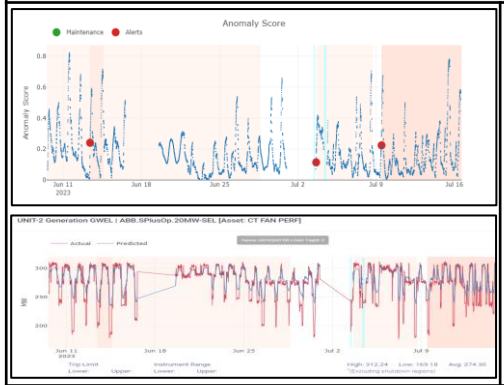
By default top 5 contributing tags will launch upon a click on anomaly score. The other tags in the model can also be opened if user wants to find any between the deviations.



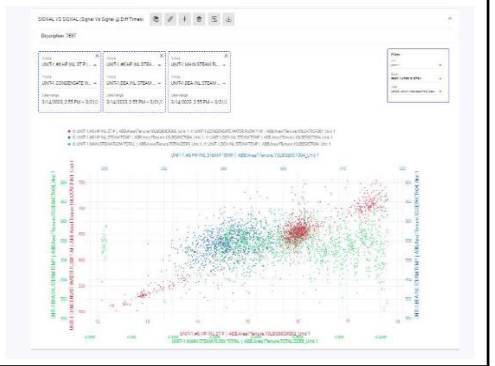

**Impact : Annual Energy Saving - 12,60,000 kWh**



Plant & system dashboards




Anomaly Detection/ Failure Diagnosis



Multi variable regression, ANOVA & Correlation of Critical Parameters

Failure Mode Effect Analysis

# 7. Use of Renewable Energy

## 7.1 : Savings achieved through Onsite Renewable Energy Projects

| | 2020-21 | 2021-22 | 2022-23 |
|---|---|---|---|
| No. of Project Implemented | 3 | 2 | 2 |
| Total Capacity - MW | 1 | | |
| Total Power Savings Lakh KWh | 87.18 | | |
| % Share | 0.25 | | |
| Cumulative Savings (Rs Lakh) | 267.38 | 268.01 | 270.08 |
| RPO Obligation | Not Applicable | | |

| Particulars | 2020-21 | 2021-22 | 2022-23 |
|---|---|---|---|
| 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 2020-21 | Wind | Electrical | 0.97 | 8.46 | 0.22 |
| FY 2021-22 | Wind | Electrical | 0.97 | 8.46 | 0.24 |
| FY 2022-23 | Wind | Electrical | 0.97 | 8.46 | 0.20 |

| Onsite Generation | Technology (Thermal) | Installed Capacity (MW) | Usage (million kWh) | % of overall electrical energy consumption |
|---|---|---|---|---|
| FY 2020-21 | Solar | Thermal | 0.52 | 0.013 |
| FY 2021-22 | Solar | Thermal | 0.52 | 0.014 |
| FY 2022-23 | Solar | Thermal | 0.52 | 0.012 |

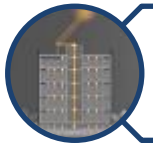
## 7.2 : Renewable Energy Projects Implemented

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.

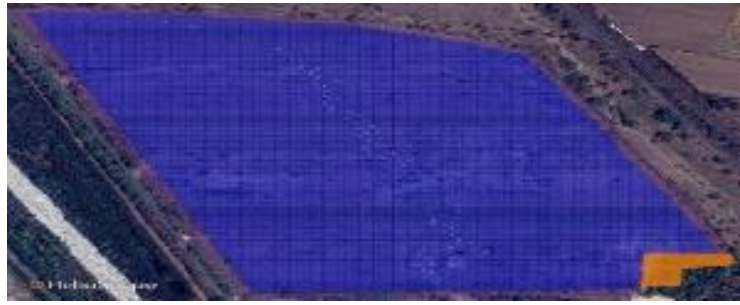
Translucaent Cladding Sheet Translucent sheet cladding in CHP belt conveyors, Compressor House, RO-DM to reduce lighting load

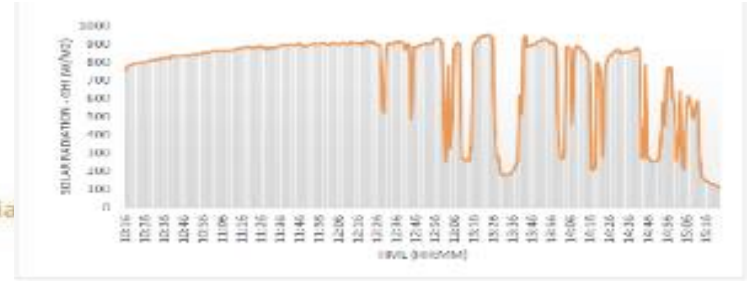
Roof Top Rainwater Harvesting Roof Top Rain Water Harvesting from all buildings.

## 7.3 : Renewable Energy Projects under Implementation

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

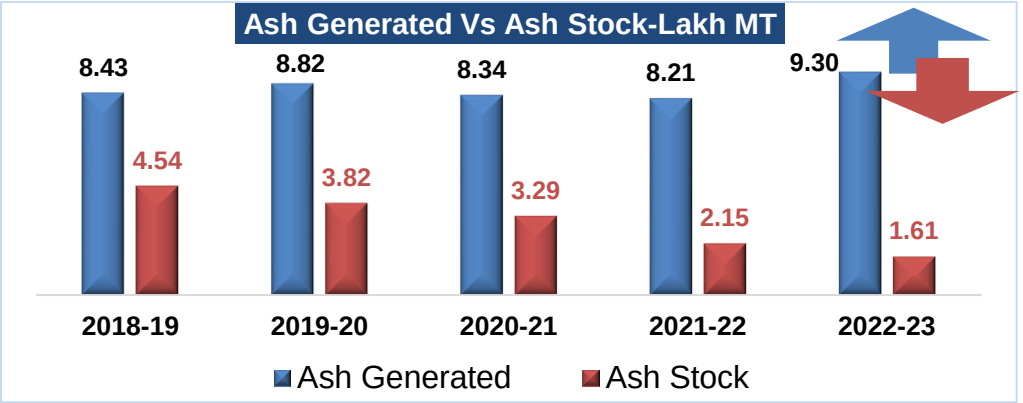
- ✓ Third Party feasibility study done for setting up Solar PV at available land area, reservoir space & roof top for plant & township building by M/s TERI
- ✓ Study included Solar PV potential at locations of plant, analysis of the energy yield from system and proposed recommendations by performing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

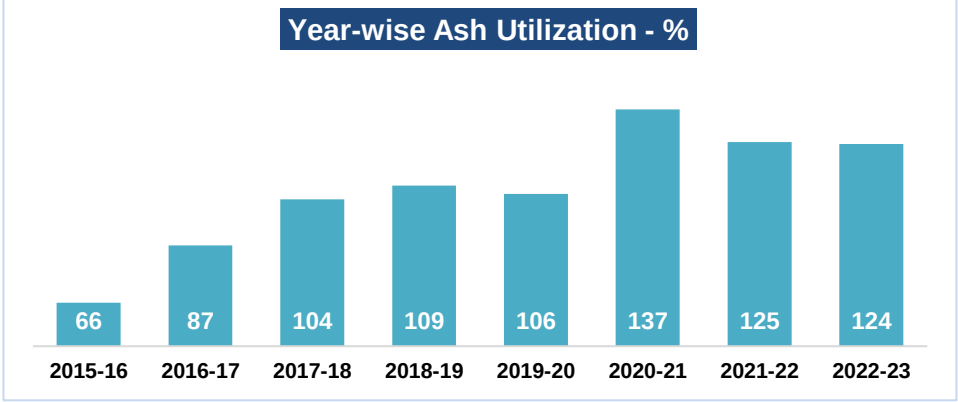


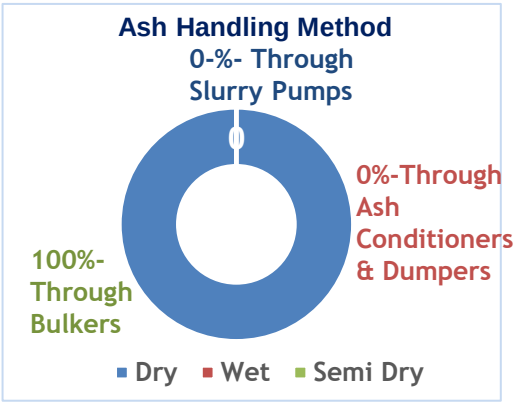


# 8. Environment Management-Ash Utilization

## 8.1 : Utilization of Ash Generated




**Distribution of Areas of Ash Utilization**

| Sr No. | Particulars | UoM | 2020-21 | 2021-22 | 2022-23 |
|---|---|---|---|---|---|
| 1 | Ash Utilized in manufacturing of cement/ concrete others similar products | % | 28% | 20% | 26% |
| 2 | Ash Utilized in Fly Ash Bricks | % | 25% | 22% | 25% |
| 3 | Ash Utilized in Mine Filling | % | 20% | 0% | 13% |
| 4 | Ash Utilized for Road Pavements | % | 24% | 49% | 23% |
| 5 | Ash Utilized in Brick Manufacturing (From Bottom Ash) | % | 2% | 9% | 7% |
| 6 | Ash Utilized in Bottom Ash Mine Filling | % | 0% | 0% | 3% |
| 7 | Ash Utilized Bottom Ash for Road Pavements | % | 0% | 0% | 3% |
| 8 | Expenditure on Ash Utilization (Annual) | INR (Lakhs) | 1181 | 1180 | 2094.744 |


Utilization of Ash at GWEL

- Continuous reduction in Legacy Ash YoY
- In FY: 2022-23, 82357 MT of ash was disposed of through 22 no's of rakes by rail.

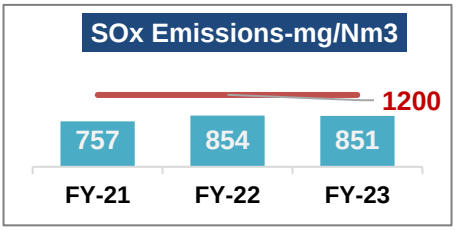
**Ash Utilization at GWEL is 100% for Consecutive 6 Years**

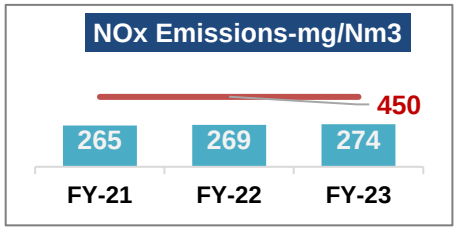
# 8. Environment Management-Emission

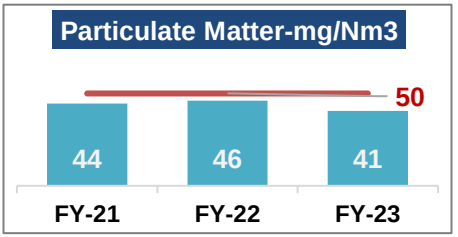
## 8.2 GHG Inventorisation

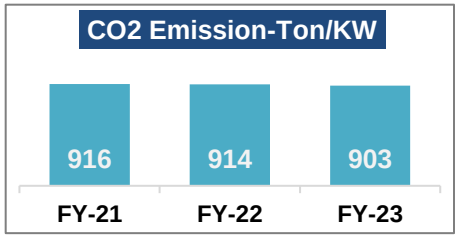
GMR Sustainability Report

- 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/




◊ Mercury Emission - Nil

### 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 & 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 will start from 2024
- **70 KW Solar Installation**- Contract finalization under progress, Project Execution start by- Oct-2023.
- **30 MW Floating Solar Installation-** Contract finalization under progress, Project Execution by- Mar-2024
- AAC (Aerated Autoclave Concrete ) block manufacturing unit installation

## 8.3 PAT Cycle-II Compliance

PAT Cycle-II - Energy Consumption Target & Actual - Registration 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 |

## 8.4 PAT Cycle-VII Compliance

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

| Target NHR for Assessment Year 2024-25 | Actual NHR Achieved for 2022-23 | Difference | Remarks |
|---|---|---|---|
| 2520 | 2496 | 24 | Mandatory Energy Audit Completed in Dec-21 |

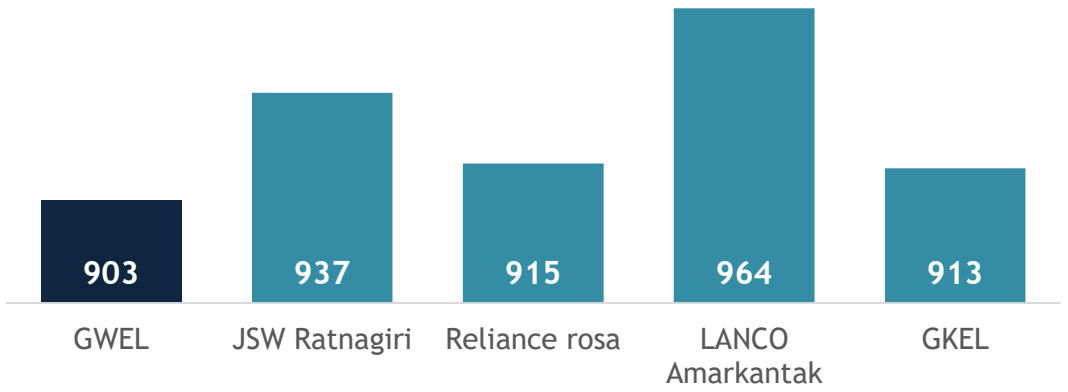
Operating Station NHR achieved with Normalization in FY 2018-19 : 2524.24 kCal/kWh

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

# 8. Environment Management - Emission

## 8.5 : ISO 14064:2019 Quantification, Monitoring & Reporting of GHG Emission and reduction

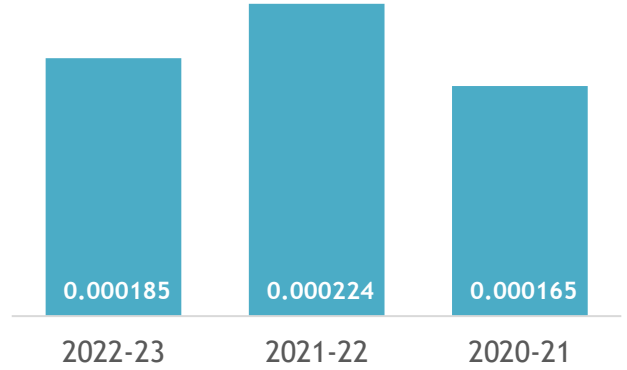
### External Benchmarking GHG Emission Intensities in Kgco2/MWhr



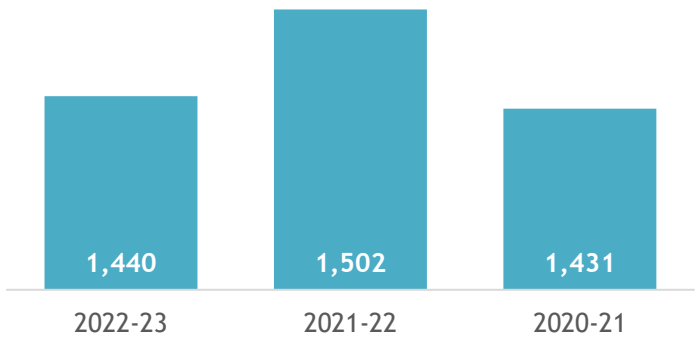

- GWEL successfully completed the GHG emissions verification audit as per guidelines laid with ISO-14064:2019. (Carbon Emission disclosure)
- Fuel sources& Activities includes Energy consumed, Travel, Transportation, Direct& Indirect emissions and many more.
- In Scope- 3 following categories are being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

### Total Emission in million tCO2 e

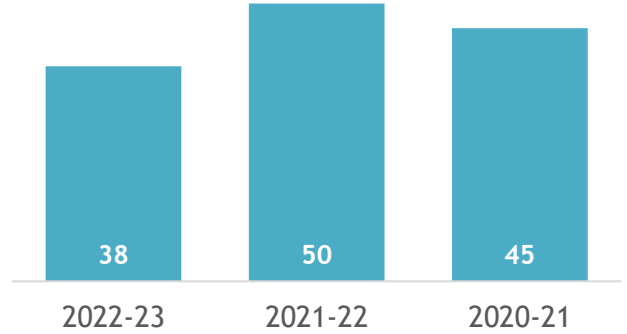

### Scope-2 Emission in million tCO2 e




### Scope-1 Emission in million tCO2 e




### Scope-3 Emission in million tCO2 e



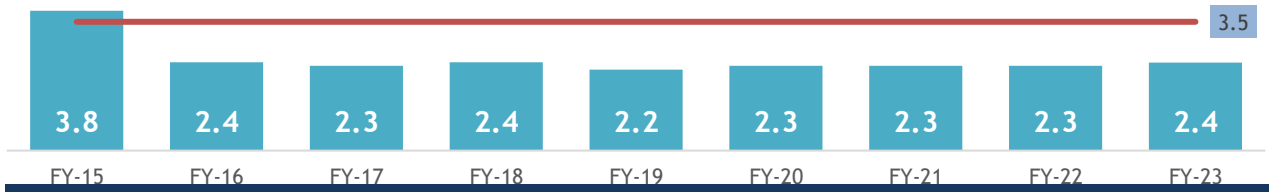
# 8. Environment Management - Water

## 8.6 Our Value of Social Responsibility by Conservation of Natural Resource

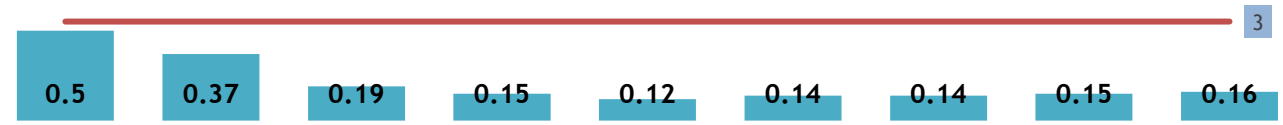
To achieve above objective , we have adopted **Auditable System Driven Approach by implementing comprehensive "Water Efficiency Management System" (WEMS, ISO 46001:2019)**

- ✓ 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**

### Plant Raw water Specific Consumption m3/kwh




### DM Make up - %




## 1st IPP to Implement WEMS, ISO 46001:2019

### Water SCADA

Implementation

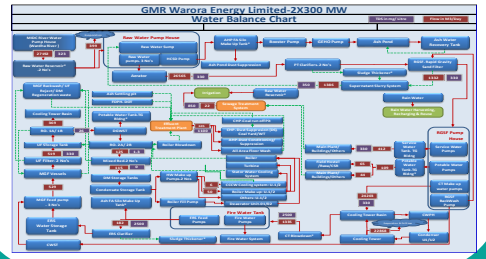
- 36 Flow Meters Installed.
- Additional 8 Flowmeters in Phase II.
- Area wise consumption accounting.
- Identification of Water Wastage
- Automated Reports
- Real Time Dashboard & Trend
- Alarm for increase in Water Consumption above base value
- **Water Saving-53.41 Lakh m3**

### 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 9.26 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**

# 9. Best Practices in the Plant

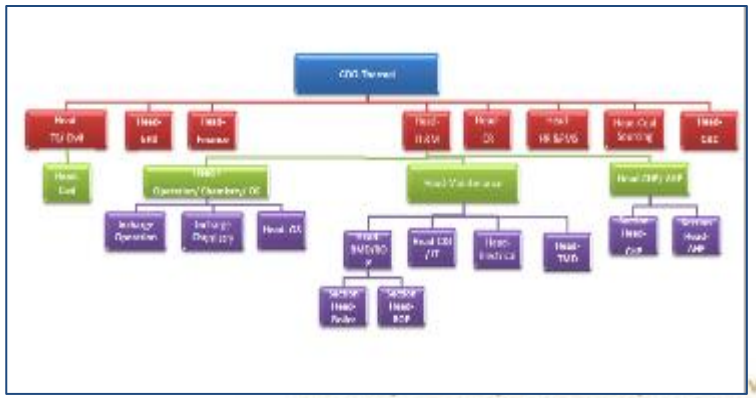
## 9.1 Best Practices – Non Energy Efficiency

| | |
|---|---|
| Flexibilization | •Sale of 10 MW of Power saved through APC in Market.<br>• |
| Maintenance & reliability | •Vibration Analysis, LOA, WDA, NAS, TAN, Infrared, Thermography, Dissolved Gas Analysis, Motor Signature Analysis<br>•Six Sigma based approach for addressing chronic issues.<br>•Adopted 5S methodology for boosting productivity, workplace management and safe & efficient |
| Digitization | •Project SARATHI –Digital Log book, Near Miss, Incidents, HIRA, IMS Internal Audits, Waste Management, Vehicle/Agency Gate Pass<br>• Knowledge Management Portal, RFID based coal supply chain management. |
| Asset Management | •Implementation of ISO 55001, AMS implementation by Asset System Manual & procedures Work Instructions and Manuals.<br>•Identification of Significant Assets by Asset Risk register. |
| Biodiversity | •Friendly Habitat for Floras & Faunas<br>•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 against norm of 33%<br>•Total 205550 No. of Plants has been planted in plant area.<br>•Plantation has been done in nearby villages under CSR activity. |
| 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, Social Accountability, Infrastructure support to Govt. Schools, Kid Smart Centres & Transportation Facility Health Clinics & Camps/ Individual Sanitary Lavatory, Vocational Training Centre & Libraries.<br>•Implementation of Business Continuity Management System, Information Security Management System. |

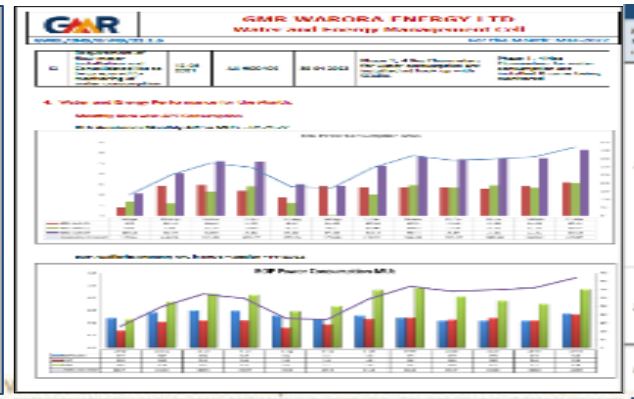
# 10. Team work, Employee Involvement & Monitoring

## 10.1 Involvement of Employees in Energy Conservation

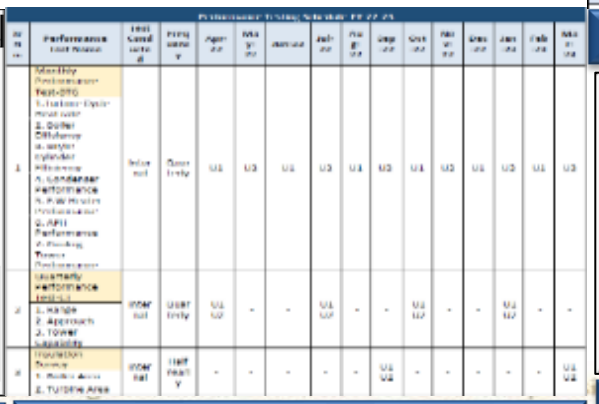
- **Formation of Water & Energy Management Cell under ISO-50001 & ISO-46001**
- **Objectives of EMC :**
  - Monitoring of Specific Energy & Water Consumption
  - Water & Energy Audit (Internal & External) & Recommendation implementation status review
  - Discussion on Water & Energy Conservation Projects
  - Identification of New Water & Energy Conservation Initiatives
  - Daily/weekly/Monthly/Yearly EnCON projects review by EMC.
- **Members of EMC :**
  - COO- Thermal(Chairperson), 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 and all are BEE Certified EA/EM.



WEMC Organogram



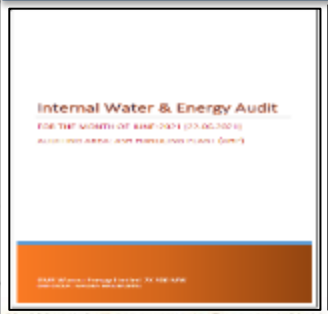
WEMC MOM



Performance Test Schedule

| 1.0 | Summary | | | |
|---|---|---|---|---|
| S.No | Test Description | Test Conditions | UoM | Test Results |
| 2.0 | Boiler Performance Tests | | | |
| 2.1 | Boiler Efficiency | 3VWO with 0% Make up | % | Un Corrected: 86.234<br>Corrected: 87.575 |
| 2.2 | Air Pre-Heater X Ratio | 3VWO with 0% Make up | | APH-A: 0.65<br>APH-B: 0.66 |
| 2.3 | Air Pre-Heater Gas Efficiency | 3VWO with 0% Make up | % | APH-A: 56.79<br>APH-B: 57.43 |
| 2.4 | Mill Fineness Result | 3VWO with 0% Make up | % | Mill-B –74.82; Mill-C – 67.57<br>Mill-D –75.34; Mill-E- 80.22 |
| 3.0 | Turbine Performance Tests | | | |
| 3.1 | Turbine Heat rate | 3VWO with 0% Make up | Kcal/Kwh | Un Corrected: 1911.5<br>Corrected: 1958.6 |
| 3.2 | Turbine Efficiency | 3VWO with 0% Make up | % | HPT: 85.15 ; IPT: 90.55 ; LPT: 90.71 |
| 3.3 | HP Heater Performance | | | |
| 3.3.1 | HPH-8 Heater: TTD | 3VWO with 0% Make up | Deg C | 2.5 |
| 3.3.2 | HPH-8 Heater: DCA | 3VWO with 0% Make up | deg C | 9.7 |
| 3.3.3 | HPH-7 Heater: TTD | 3VWO with 0% Make up | deg C | 6.5 |
| 3.3.4 | HPH-7 Heater: DCA | 3VWO with 0% Make up | deg C | 5.4 |
| 3.3.5 | HPH-6 Heater: TTD | 3VWO with 0% Make up | deg C | 4.0 |
| 3.3.6 | HPH-6 Heater: DCA | 3VWO with 0% Make up | deg C | 13.6 |
| 3.4 | Condenser Performance | | | |
| 3.4.1 | TTD | 3VWO with 0% Make up | deg C | 4.33 |
| 3.4.2 | Temperature Raise | 3VWO with 0% Make up | deg C | 13.54 |
| 3.4.3 | Air Suction Temp Depression | 3VWO with 0% Make up | deg C | 4.77 |
| 3.5 | Cooling Tower Performance | | | |
| 3.5.1 | Approach | 3VWO with 0% Make up | deg C | 9.33 |
| 3.5.2 | Range | 3VWO with 0% Make up | deg C | 13.11 |
| 3.5.3 | Effectiveness | 3VWO with 0% Make up | | 0.58 |
| 3.6 | Unit Heat rate | 3VWO with 0% Make up | Kcal/Kwh | Un Corrected: 2218.7<br>Corrected: 2241.59 |
| 3.7 | Auxiliary Power consumption | 3VWO with 0% Make up % | % | 7.36 |

Performance Test Reports

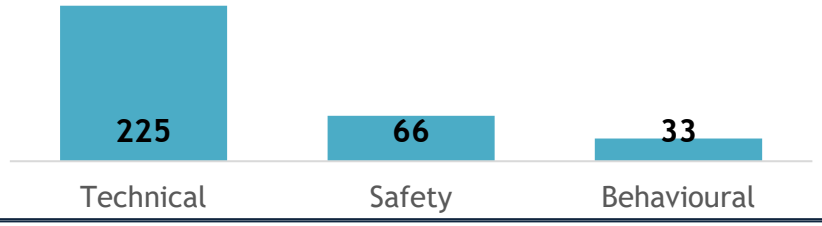



Internal Water & Energy Audit under Water & Energy Management Cell

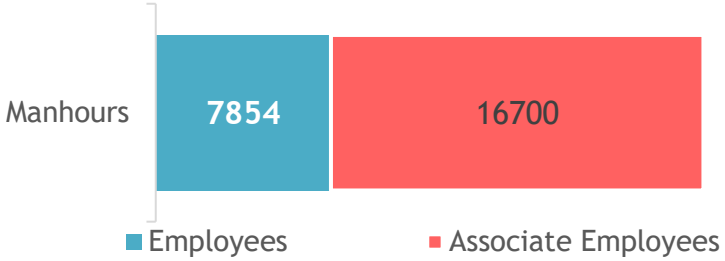
# 10. Team work, Employee Involvement & Monitoring

## 10.2 Energy Efficiency Capability Building

### Number of Trainings-All



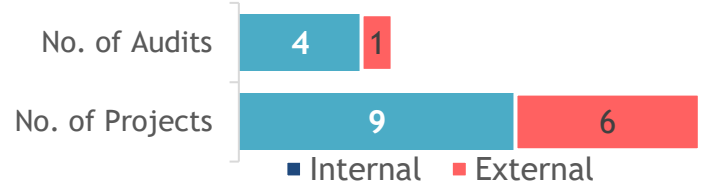

### Training-Energy Efficiency-Man-hour




### Capability Building-% Employees Expertise


**Nos. of Energy Conservation Ideas Identified Through Trainings - 18 Nos.**

### Energy Audit & Opportunities Identified




| 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 |

**GWEL rated ESCO Grade-4 by Bureau of Energy Efficiency**

# 10. Team work, Employee Involvement & Monitoring

## 10.3 Projects implemented through Kaizen ( Workers and Supervisor level)

| At Supervisor Level |
|---|
| ❑ Standby seal air fan auto pick up logic modified. |
| ❑ Pressure Transmitter installed in economizer ash evacuation line. |
| ❑ Stopping of Ferric Chloride dosing pump by providing Ferric Chloride Tank By-pass discharge line for gravity dosing. |
| ❑ Replacement of Conventional exhaust fans with energy efficient exhaust fans at washrooms. |
| **At Workmen level** |
| ❑ Energy Conservation through Installation of Wind Driven Exhaust fan in RO-DM building Roof Top |
| ❑ Installation of Touchless Water Taps |
| ❑ Auto Operation of Lamps in CW pump house by Day-Night Sensor |
| ❑ Reduction in Auxiliary Power Consumption in Compressor House by identifying and attending air leakages |

## 10.5 GWEL - Celebration of Energy Conservation Week

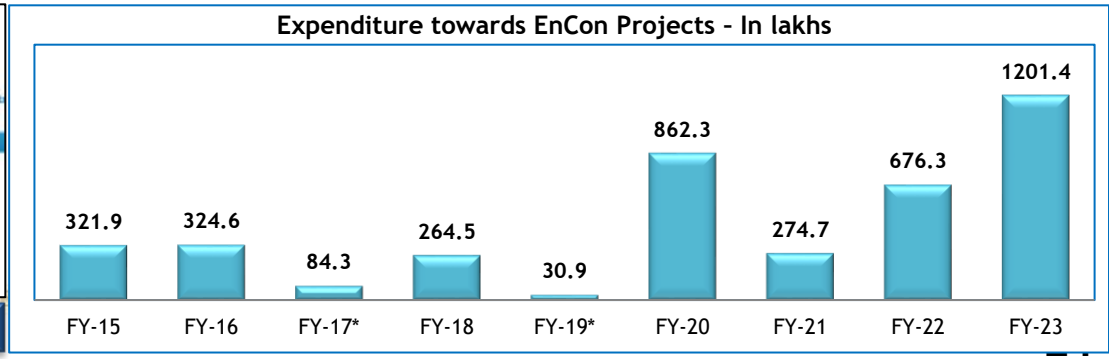
- Display of Energy Conservation Posters.
- EC Training for GWEL Employees and Associate employees.
- EC Program for Children of nearby village schools.
- Competitions for EC for Employees, Associates, Family Members.
- EC Program for family members.
- Felicitation of Winners.

## 10.4 GWEL - Web based Portals for Creating Awareness


Knowledge Management Portal in Intranet

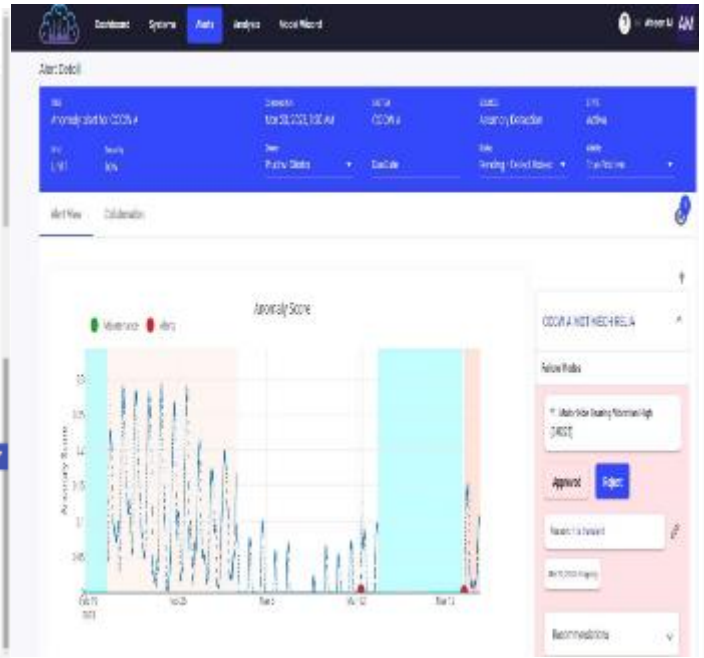

EnMS (ISO 50001) Web Portal in GMR intranet

## 10.6 Expenditure towards EnCon Projects



# 10. Team work, Employee Involvement & Monitoring

## 10.7 Monitoring of Energy Consumption

### Centralized Energy Management System

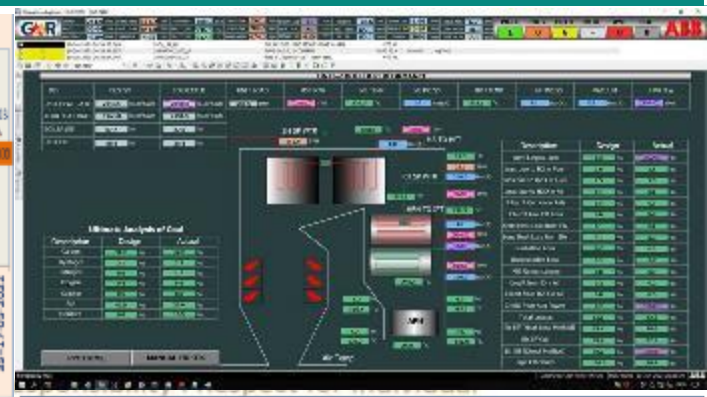
- ✓ **Real Time Comparison of HT & LT Equipment's Auxiliary Power consumption** in EMS system for **BTG, BOP, AHP & CHP**
- ✓ **Equipment SEC performance monitoring through Artificial intelligence.**
- ✓ **Auto Reports Generation for Energy Consumption** on Daily/ Monthly and FY basis.
- ✓ **Trending 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 w.r.t interlinked variables
- ✓ **Upgradation of Online Plant Performance Monitoring System - 18 Modules - Turbine, Boiler, Heaters, APH, Mills, Pumps, Fans, Compressors etc.,**

## 10.8 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

# 10. Team work, Employee Involvement & Monitoring

## 10.9 Major Area of Concern in Energy Efficiency & Reliability

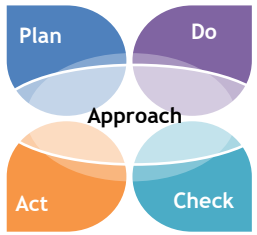
| | |
|---|---|
| Flexible Operation | **Impact due to Low load and high Ramp Rate** - Escalated O&M costs, deteriorated Heat Rate & APC, high startup & shutdown cost, High Emission, Machine reliability compromised and PPA availability loss |
| Coal Shortage | Plant PLF is getting affected due to **Coal Quality & Quantity Constraint** & same is affecting station Performance |
| 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** |
| 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** |

# 11. Implementation of EMS

## 11.1 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

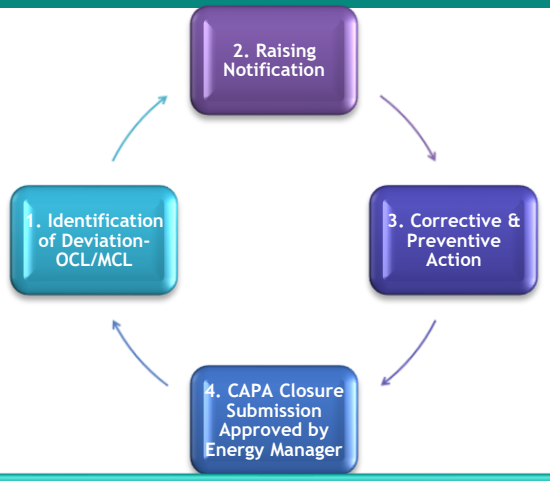
- ✓ Adoption of New Technologies
- ✓ Renewable Energy Projects
- ✓ EC Plans Implementation
- ✓ Green Supply Chain Management



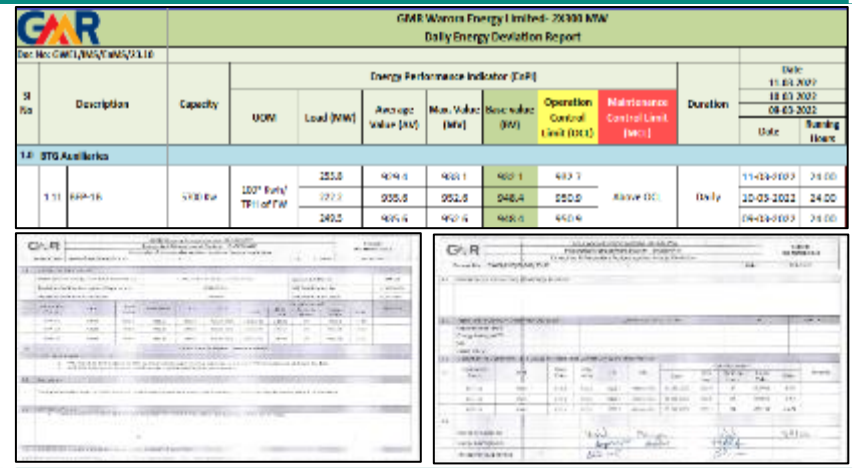

- ✓ Best O&M Practices
- ✓ Energy Conservation projects for Stakeholders & CSR
- ✓ Sustenance Monitoring

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

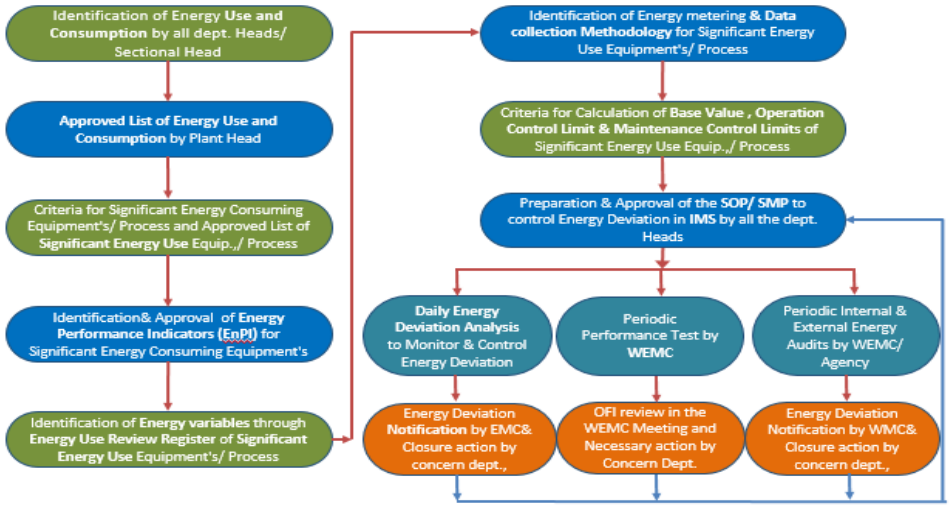
**PDCA Approach- ISO 50001 Implementation**




**Process of Continual Improvement**




**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 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

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

**Total 223 Energy Conservation SIP's implemented in last 8 FY's**

**% Investment on Turnover in FY 2022-23 : 0.51%**

# 11. Implementation of ISO 55001/ Other ISO Certifications & AFR

## 11.2 Implementation of ISO 55001 and other ISO Certifications

**AMS Policy**
- AMS Policy was prepared & Communicated to all Stakeholder

**Level-1,2 &3**
- Level-1:Asset System Manual for AMS
- Level-2:AMS Procedures
- Level-3:Work Instructions and Manuals

**AMS Objective & Target**
- Department wise dedicated OBT made for AMS

**Asset Management System Manual**
- AMSM for different processes was made by Process Owner & then reviewed by MA and approved by Plant head

**AMS Procedures, Work Instructions and Records**
- AMS Procedures, Work Instructions & Records was made & maintained

**Compilation of all Assets**
- SH's submits all identified assets. MA then compiles assets identified by SH

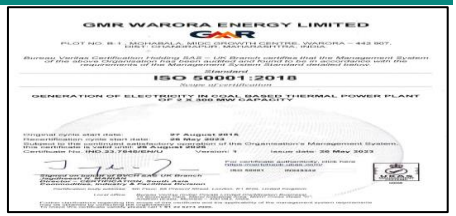
**Asset Criticality Rating (ACR)**
Effect on Function restoration (F) x Severity (S)
- Critical (ACR>8) & Non Critical (ACR<8)
- Critical- Asset relating to compliance to consent to operate or any other legal requirements

**Risk Score (RS)**
Likelihood(L)x Severity(S)
- RS>45 is considered as most severe risk and RPN rating calculated for same
- For Assets, RS<45, Existing control in sufficient

**Risk Priority Number (RPN)**
ACR x Occurrence x Redundancy Factor
- Significant Assets=RPN>120
- Asset register must for performance monitoring

**Asset Register**
For RPN>120
- Operation Controls for individual Significant Equipment
- Maintenance Controls for individual Significant Equipment


SA- ISO 26000:2010


ENMS- ISO 50001:2018


ISMS- ISO 27001:2013


ISO 9001;14001;45001


AMS- ISO 55001:2014

## 11.3 Alternate Fuel Utilization

**20 MT of Biomass is blended with 1300 MT of Coal at different blending ratios (1.3 - 1.8%)**

**Practices followed to maximize the AF utilization**

1. Identification of designated location for storage of Biomass pellets.
2. Installation of fire fighting equipment around storage yard to prevent fire.
3. Deployment of specific team for biomass storage yard management.
4. Formulation of bunkering & blending methodology of pellets.
5. Interlock & Protection system incorporation for coal mill according to suitability of biomass fuel firing in both units.
6. Ensured the healthiness of Mill inerting steam system availability and trials for the same in regular intervals.

**Challenges Faced**

1. Increase in Exit flue gas temperature.
2. Fluctuation in Flame Intensity.
3. Shortage in Availability of Bio-mass at plant location.
4. Non robust, M/s Shanghai Electric Company make Chinese machine not suitable for bio-mass co-firing.
5. Fire & Explosion hazard for people working in mill & bunker area.


# 12. Learnings from CII/Other Award Program

## 12.1 Learning from CII/Other Award Program

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

CII event gives opportunity for Inter & Intra Sector Benchmarking for improvement.
Such as:
Intelligent Flow Controller - Exhibition
Airtron AC Energy Saver - Airport Sector
Mill Dynamic Classifier - Cement Sector

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

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

An Opportunity to interact & network with individuals and companies of repute for further strengthening Energy Efficiency System & to learn the best practices from best performing companies

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

# 13. Awards & Accolades


BEE-National Energy Conservation Award 2020-Consecutive 2 Times



CII Excellent Energy Efficient Unit Award (Consecutive Five Times) & National Energy Leader Award (Consecutive Thrice) & Most Useful Presentation -2022


NSC-Sarvashreshtha Suraksha Puraskar-3 Times


Sword of Honor 2019


BSC 5 Star 2019



CII Innovative Environmental Project & Water Management Excellence 2021

IMC Ramakrishna Bajaj National Quality Award 2017


National Safety Council - Safety Shield'

Maharashtra CSR Award _WASH

Global Performance Excellence Award 2018-World Class

*There is a Name for those Who Conserve Energy….*

# … SMART

**Thank You**