ENERGY EFFICIENT INITIATIVES AT VEDANTA LANJIGARH

Driving Efficiency & Redefining Environmental footprints towards NET Zero

Team Members:-

Sanjaya Kumar Jena - GM, COO-3 MTPA

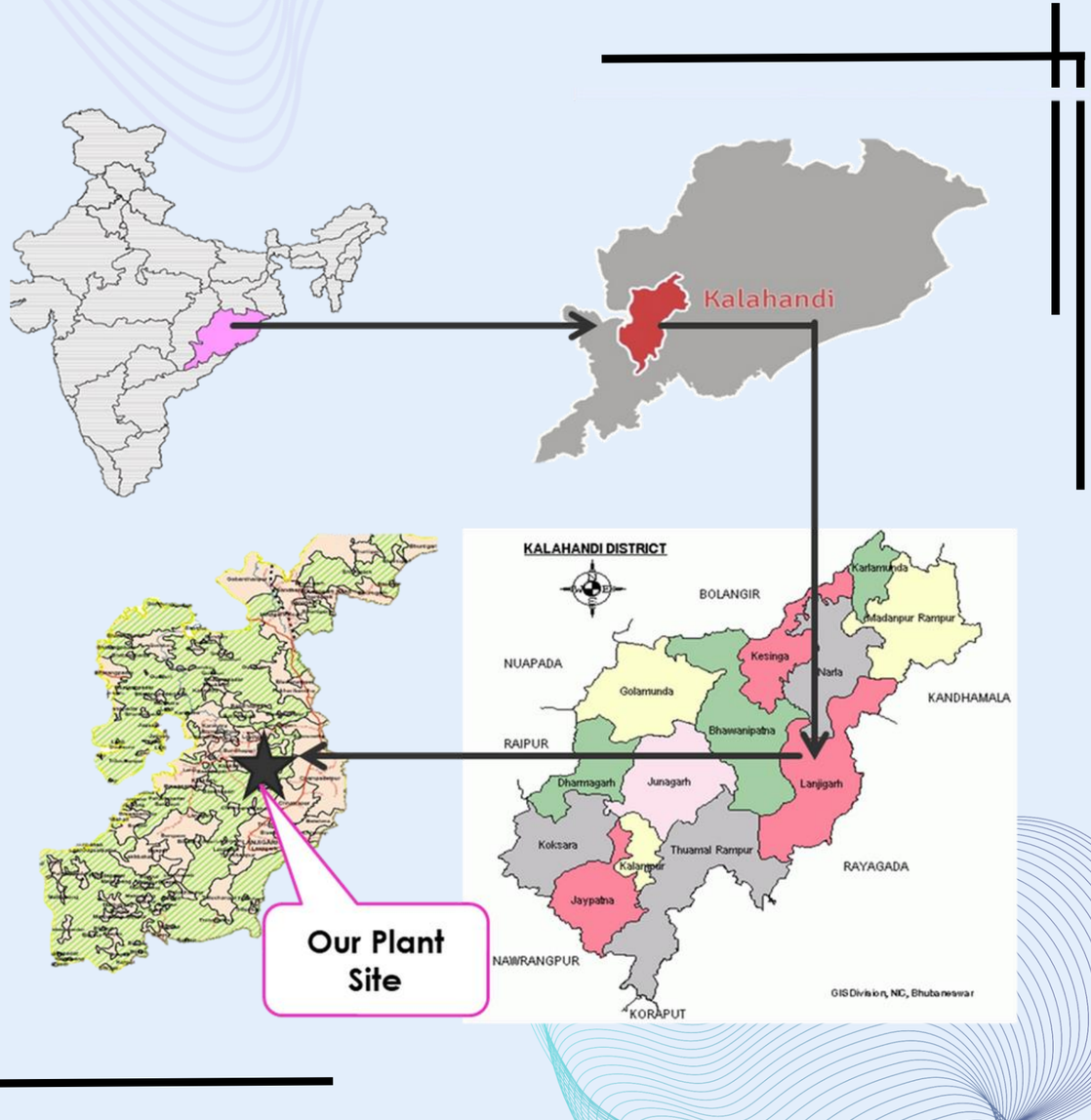
Soumava Das - Deputy Manager, EnMS-Lead

Pakruti R Sahoo - Assistant Manager, EnMS Co-ordinater

Prasidhi Rastogi - Assistant Manager, Environment Co-ordinater

Plant Profile

- Vedanta Limited, Lanjigarh (An ISO 9001, 14001, OSHAS 18001 certified Company) is a 2MTPA Alumina refinery plant which provide Smelter grade Alumina to its smelters in Jharsuguda and Balco
- 2 MMTPA Alumina production with 90 MW CGPP
- Expansion is in progress : 2 to 5 MMTPA
- 32 Km long railway line
- 65 Km water pipeline
- Dry red mud disposal using press filter
- The 1st Organization to be ISO 50001 certified



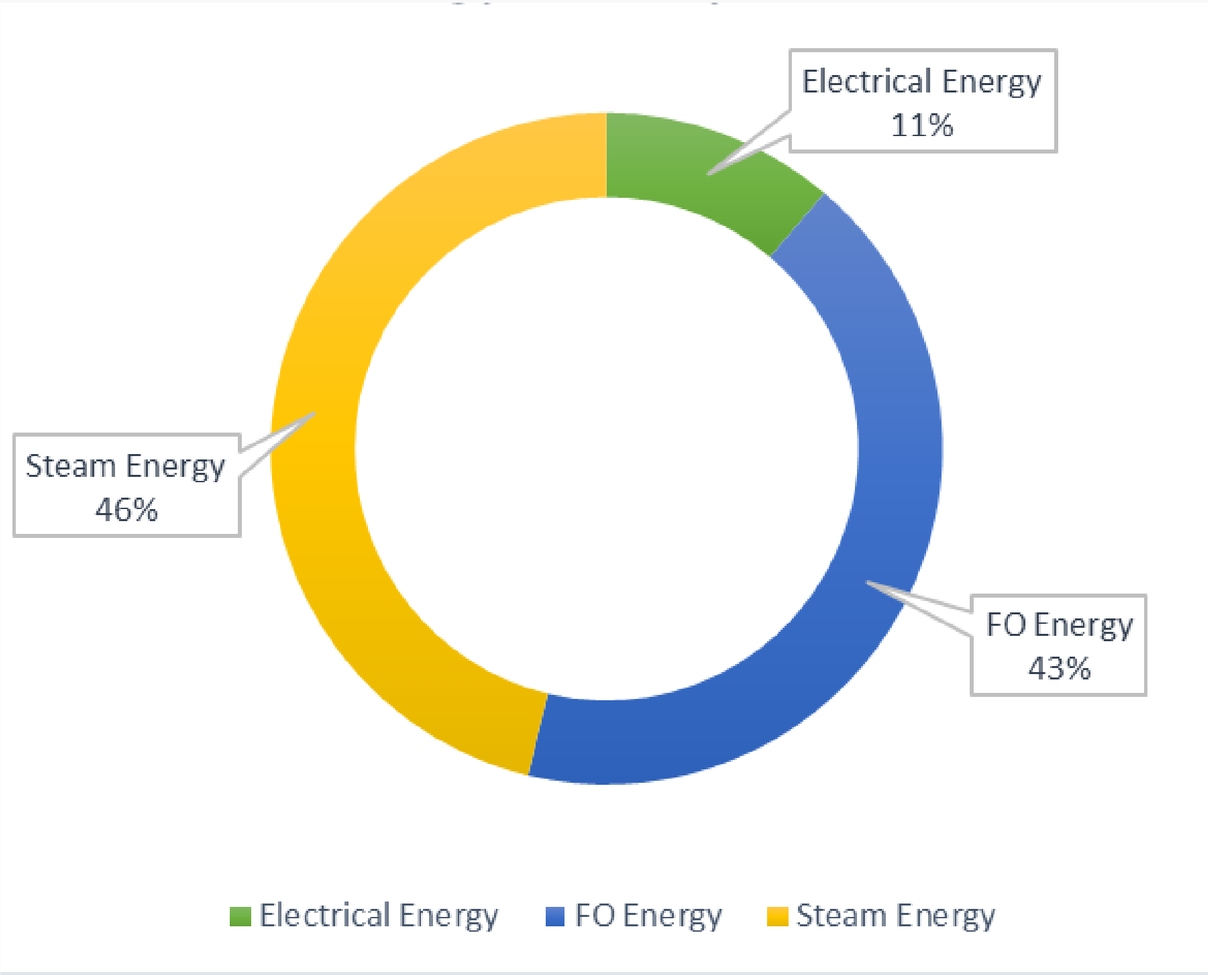
Agenda

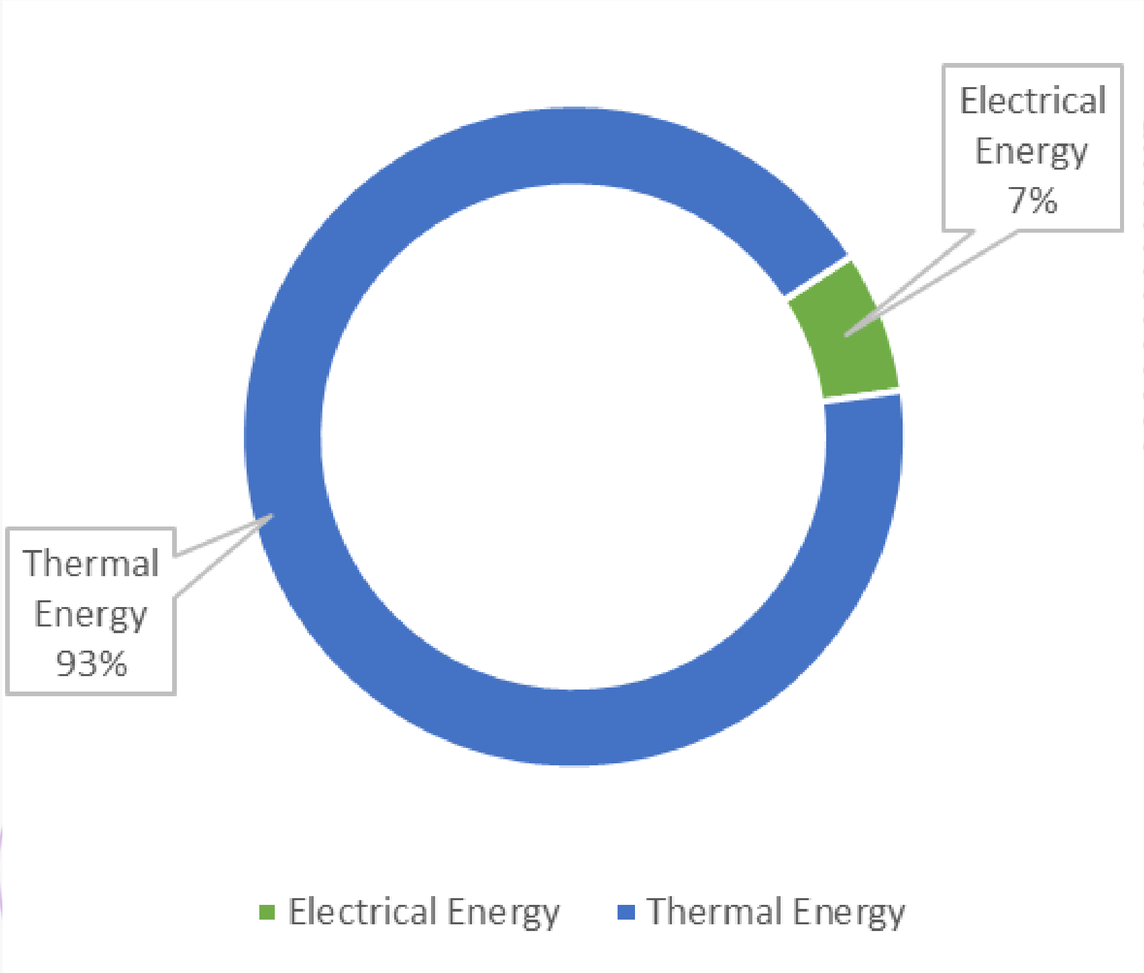
1. Alumina Manufacturing Process
2. Current Energy Trends and Major Projects taken
3. Benchmarking with Peer Groups
4. Top Projects
5. Emission Trends
6. Energy Management Systems
7. People Involvement in Energy Activities
8. Awards & Accolades

Energy Trends

Year	Hydrate (T)	Calcined (T)	Power (Kwh/T)	FO (Kg/T)	Steam (T/T)	Total Energy (GJ)
FY - 21	1847778	1840893	215.66	71.13	1.72	7.25
FY - 22	1969212	1967910	217.54	70.63	1.68	7.16
FY - 23	1854926	1792474	226.69	72.046	1.68	7.17

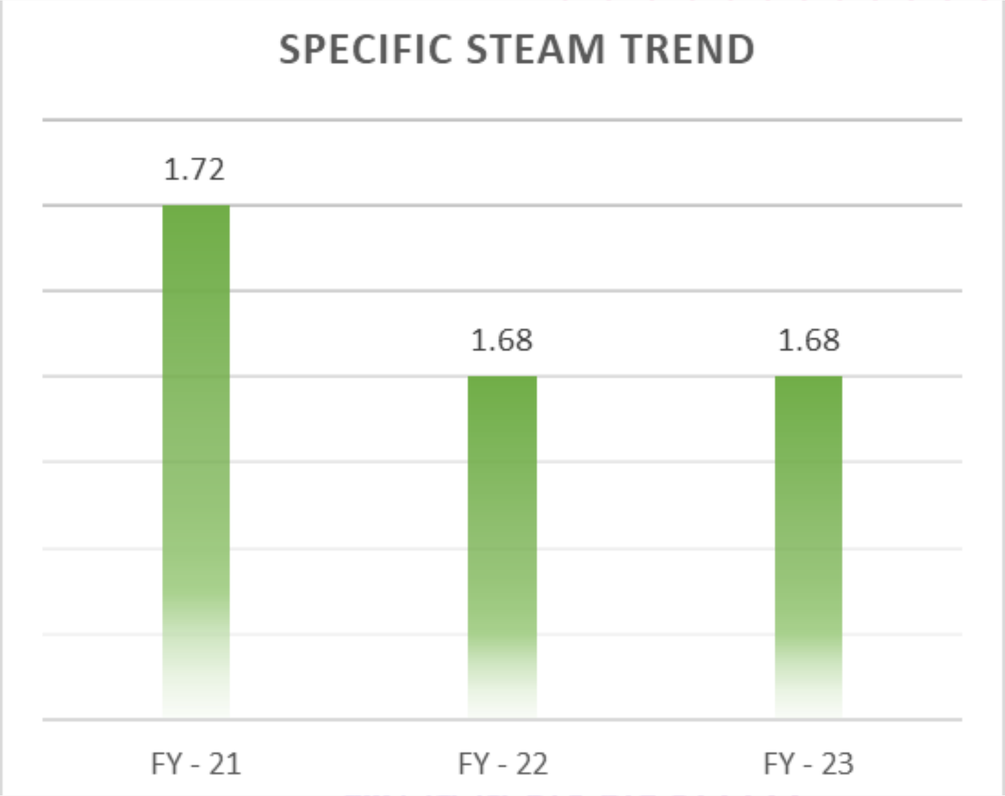
Energy Breakup chart





Specific Steam

All the units are in T/T

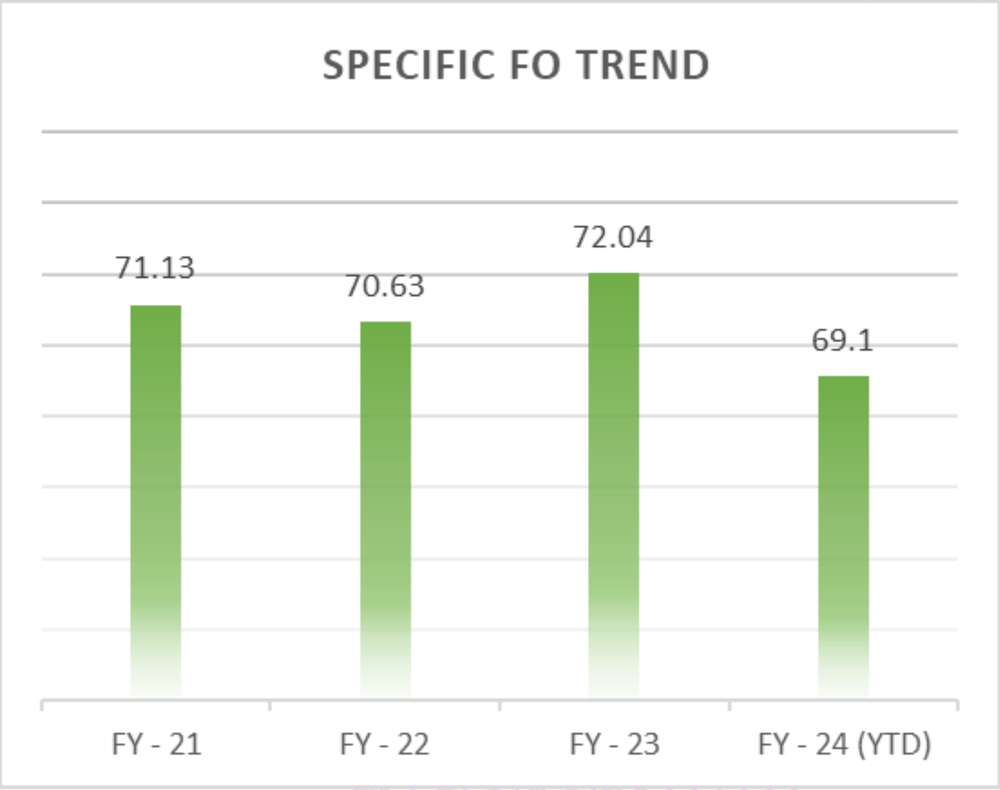


Projects

- Replacement of 2 nos. of Digestion heaters. Annual savings of 60 KT of steam.
- Calandria 1 replacement in Evaporation 1 & 2. Annual Savings of 40 KT of steam.
- Max HT dosing in Evaporation Units resulting in steam saving of 20 KT per annum.
- APC in Evaporation units Specific Steam improvement by 0.01 T/T.
- Replacement of Steam traps in Digestion and Evaporation units.
- Specific Steam improvement by cleaning and overhauling indirect pass heaters of Digestion unit

Specific FO

All the units are in Kg/T

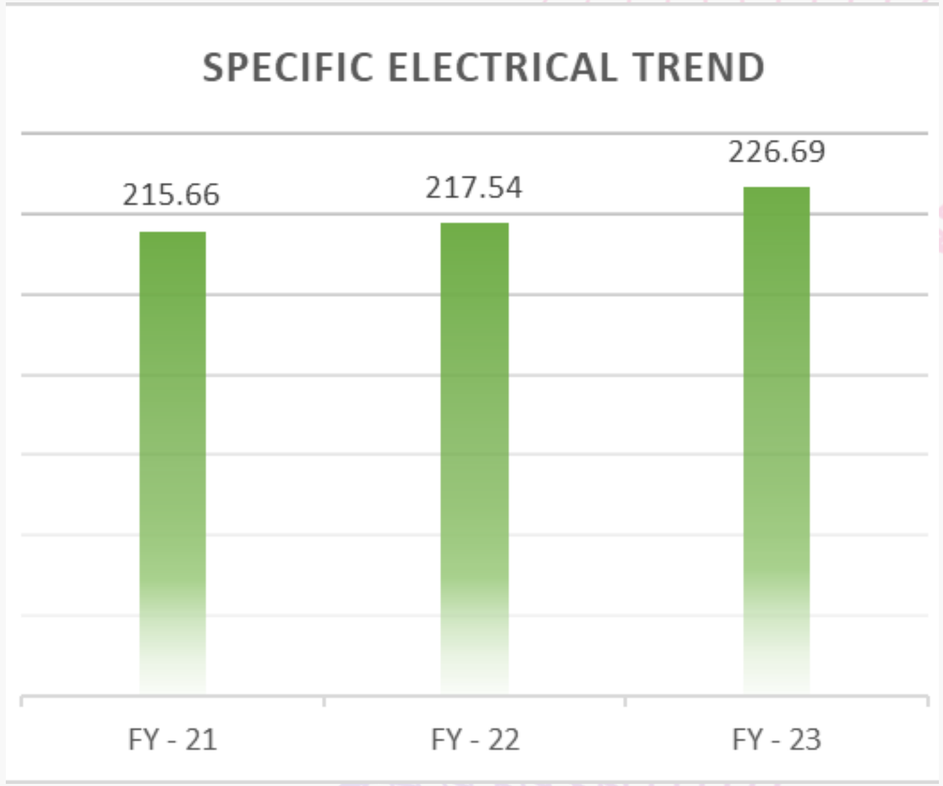


Projects

- Air ingression arrest in Calciner 1&2 venturi/ESP/other cyclones. Annual savings of 100 KT of HFO.
- Refractory replacement and overhauling of Calciner 1 and 2. Annual savings of 100 KT of HFO
- Advance Process Controllers in Calciner units to improve Specific FO by 0.1 Kg per Ton.
- Implementation of online blind system for anytime CCl of Pan filter-0 & trail of Filter-Max 482FM to reduce hydrate moisture with potential saving in Specific FO by 0.1 Kg/T

Specific Electrical

All the units are in Kwh/T

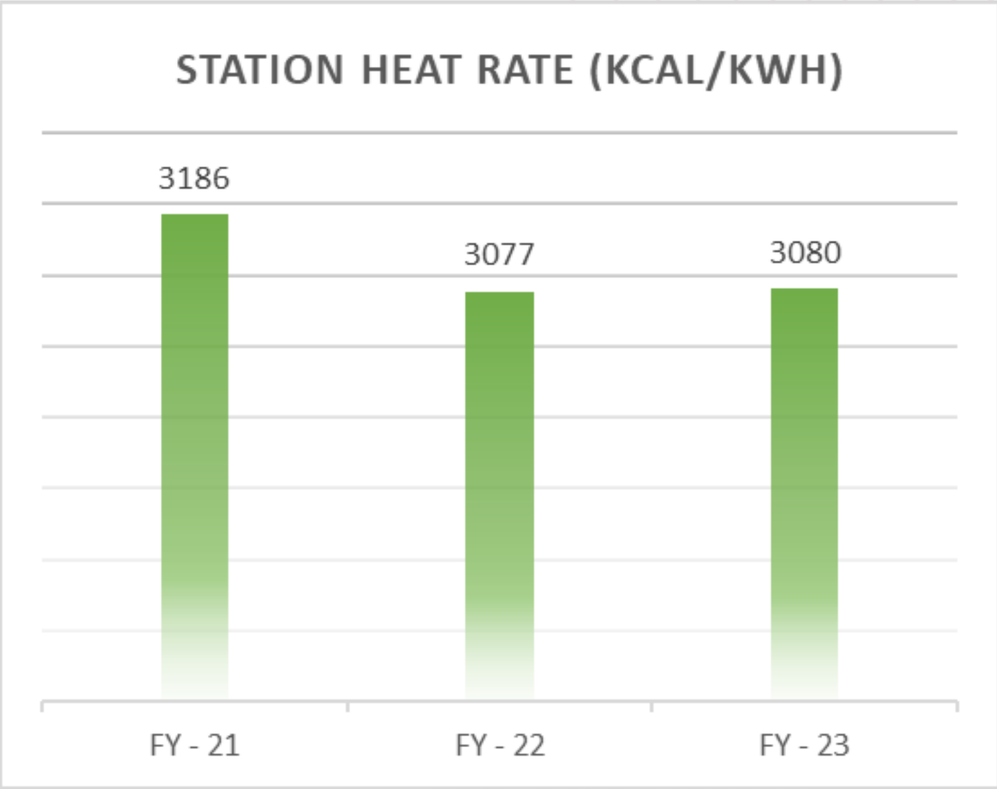


Projects

- Conversion of Condensate pumps in Digestion & GQC pumps in Evap unit from DOL to VFD. Annual Savings of 6.9 lakh units of electrical energy.
- Conversion of one HST overflow motor from DOL to VFD. Annual Savings of 4.32 lakh units of electrical energy.
- Energy Saving initiatives in main air compressor house. Annual Savings of 22.74 lakh units of Electrical Energy.
- Pulley replacement of ISC pumps in White 1. Annual savings of 12.09 lakh units of Electrical energy.
- Net liquor productivity improvement froom 82 gpl to 85 gpl to yield savings of 2 Kwh/T per GPL improvement.
- Power factor improvement from 0.81 to 0.94 across all substations
- Installation of ASVG in SWR 4.1 to mitigate harmonics as per IEEE norms.
- Replacement of 172 nos. of IE 1 motor to IE 3 motors . Annual savings of 1800 Mwh per year.

Station Heat Rate

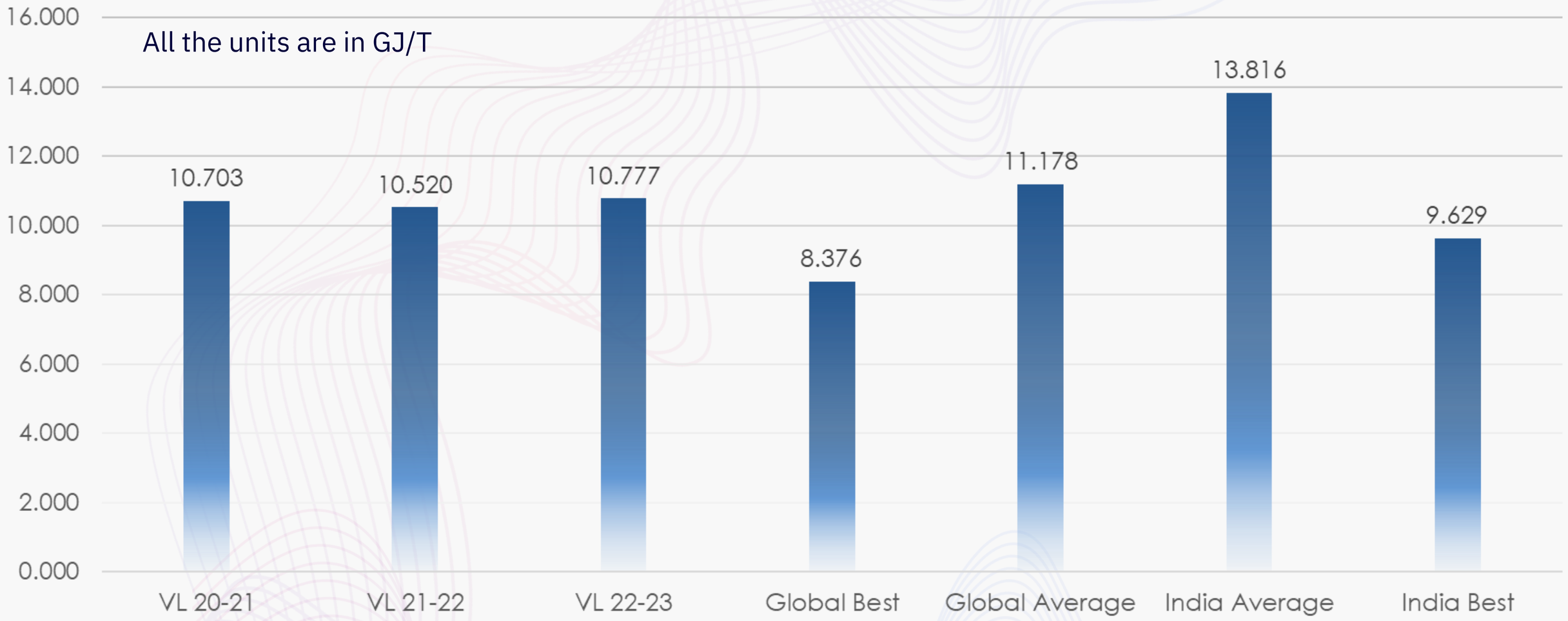
All the units are in Kcal/Kwh



Projects

- Steam economy Improvement in Turbine 3 (TG 3 overhauling, Condenser 3 cleaning, GV servicing and cement insulation in turbine). Savings of 26,308 Tons of coal per annum
- Replacement of CT fills in CGPP. Annual savings of 8.75 lakh units of electrical energy.
- Air pre-Heater replacement in Boiler 2. Savings of 11,700 tons of coal per annum.
- Replacement of Boiler bowl mill ring/roller in Boiler 1, 2 and 3. Annual savings of 3.36 lakh units of electrical energy.

Performance Benchmarking



Roadmap towards Benchmarking

- Improvement in Precipitation productivity by 5% up to 88 gpl
- Further Improving evaporation rate and calciner energy Introductionof FD (Fluidized bed) fan based calciner in FY 2022-2023
- Alternative energy source like use of Natural Gas instead of FO and coal
- Reducing total energy consumption MEA 2021-22 suggestions
- Achieve substantial energy efficiency gains by introducing APC and digitization
- Optimizing the efficiency of the overall process and capacity utilization
- Proposal of installation of 10MW solar power plant.
- Installing new technologies like IE3 motors, Harmonic filters, VFD in compressors

Implemented Projects

Key projects impacting Specific Coal consumption and Station Heat rate.

TG 3 steam economy improvement: - Overhauling of the turbine rotor with repair of damaged blades. Steam Economy of Turbine Main Steam Improved by 0.2 T/MW. Energy Saving of 3.69 Lakh GJ and GHG savings of 31735 tons of Co2.

Boiler 2 APH replacement: - Air preheater replacement in boiler to improve specific coal and Thermal efficiency with coal savings of 11.7 KT. Energy Saving of 1.46 Lakh GJ and GHG savings of 14113 tons of Co2.

Key projects impacting Specific Steam consumption.

Max HT Chemical Dosing: - MHT chemical acts as a scale growth inhibitor. It helps as an anti-scalant in evaporation tubes. Energy Saving of 0.4 Lakh GJ and GHG savings of 3563.9 tons of Co2.

Evaporation 1 & 2 Calandria 1 tubes replacement: - Scaling inside calandria tubes affect Specific steam consumption. Energy Saving of 0.8 Lakh GJ and GHG savings of 8134 tons of Co2.

Implemented Projects

<u>Key projects impacting Specific Electrical & FO consumption.</u>

Calciner 2 Refractory and air venturi replacement: - To minimize heat loss in calciner. To arrest air ingress in furnace and to improve Specific FO. Energy Saving of 0.86 Lakh GJ and GHG savings of 5900 tons of Co2.

HST O/F motor from DOL to VFD: - To prevent Valve throttling operation. Energy Saving of 1228 Mwh and GHG savings of 1014 tons of Co2.

Advance Process Controller in Precipitation unit

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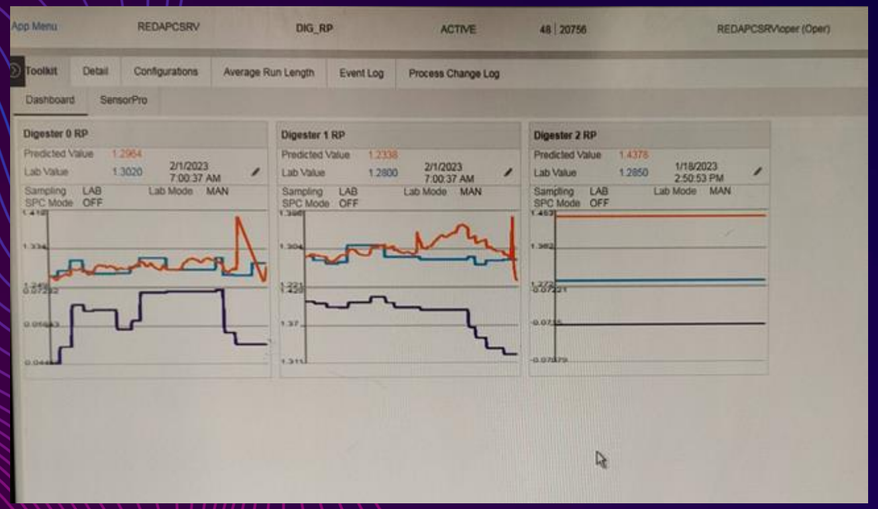
Problem Statement :-

The precipitation circuit is the is the first part of the white area where the saturated pregnant liquor is cooled down to recover the hydrate particles. The precipitation has two divisions i.e. agglomeration and growth circuit.
The controls are done manually to optimize the input flow, Tshampher ratio and last tank temperature where multilevel optimization is not possible.

" After Stabilization in Precipitation Circuit, it will be the 1st Refinery in India for 100 % E2E APC "



Before

- The process were manually controlled for optimizing flow and temperature.
- The manual control has operator knowledge dependency.
- Average productivity : 83.7 gpl

After

- The two APC controllers (Agglomeration & Growth) are taken in operation which optimizes the pregnant liquor flow, fines and temperature by controlling 46 parameters.
- Productivity improvement : 0.5 gpl and production gain of 0.84 KT.

Replacement of IE 1 motors with higher energy efficient IE 3 motors

Problem Statement :-

This project was taken to phase out less efficient IE 1 motors to enhanced Energy efficient IE 3 motors under National Motor Replacement plan. Motor readings pre and post data were taken from PHD software.IE 3 motors were procured through ESCO route where payment to be cleared phase wise under profit sharing basis.

Area	No of motors < 45% loading	No of motors 45-75 % loading	No of motors >75 % loading
Bauxite Handling	10	11	2
Bauxite Grinding	1	18	46
Red 1	0	8	129
Red 2	27	38	50
White 1	8	44	87
White 2	6	42	37
Utility	1	10	18
Total	53	171	369
Total Motors Included in study	593		
No of Motors in < 45 & 45-75 Range	224		
VFD can be considered for these motors with further study			

Projects Outcomes

§ 2702 Mwh Electrical energy saved

§ 1918 Tonnes of Co2 saved

§ 1.62 Crores monetary savings

§ Return of Investment in 20 months

Specific FO improvement by air ingression arrest in Calciner and refractory replacement job

Problem Statement :-

Heat Loss due to deterioration of Refractory materials.
Increase in fuel consumption in furnaces due to achieve the temperature gain due to shortcircuiting because of Air Ingress in Calciner 1 and calciner 2.

DAILY PRODUCTION REPORT

Date :10/Mar/2023 Print T

Steam	T/T	1.59	1.63	1.54
Energy (Hydrate)	kWh/T	172.00	176.97	171.47
Energy (Calcined)	kWh/T	30.00	30.00	33.82
Energy(Total)	kWh/T	202.00	206.00	210.27
Fuel Oil	kg/T	69.50	69.30	70.91
Fuel Oil (Cal-3)	kg/T			69.45

DAILY PRODUCTION REPORT

Date :30/Mar/2023 Print Ti

Steam	T/T	1.59	1.63	1.79
Energy (Hydrate)	kWh/T	172.00	176.97	202.76
Energy (Calcined)	kWh/T	30.00	30.00	31.69
Energy(Total)	kWh/T	202.00	206.00	238.74
Fuel Oil	kg/T	69.50	69.30	67.19
Fuel Oil (Cal-3)	kg/T			68.01

Before

§ Heat Loss due to deterioration of Refractory materials.

§ Air Ingress in furnace of Calciner 1 and calciner 2.

After

§ 2000 Tonnes of Heavy Furnace Oil saved annually

§ 6577 Tonnes of Co2 saved

§ 8.84 Crores monetary savings

§ Return of Investment in 7 months

3 years Project Synopsys & Projects planned for FY 24

95000 Tons of CO2 saved in FY 2023 from ENCON projects

Year	No. of Energy Saving Projects	Investment	Electrical Savings (million Kwh)	Thermal Savings (GJ)	Savings (In Crores)
FY 2019-2020	4	1.55	1.2	75805.4	6.38
FY 2020-2021	7	1.12	34.2	13.4	11.97
FY 2021-2022	15	7.63	5.5	339759.3	15.92
FY 2022-2023	**32**	**44.72**	**20.12**	**914709**	**61.5**

Project Status report	Total no. of Projects	Total Savings in GJ	Total Investment (in Crore rupees)	Annual financial Savings (in Crore rupees)	Impact on Specific GHG (T Co2/T)	Impact on SEC (including CGPP) (Gj/T)	$/T impact
Projects planned for FY 2023-24	32.00	786092.94	46.63	50.86	0.03	0.27	2.20

Key Projects towards path of Decarbonization

- Usage of Natural Gas in Calciners instead of Furnace Oil
- 10 MW Hybrid Power Plant
- Setting up of Biomass plant to aid sustanability goals and decarbonization by Biomass firing in Boilers @ 2000 T per month.
- VFD installation in two nos. of HST pump
- Steam Economy Improvement in Evaporation units
- Improvement of Heat Transfer Coefficient in Digestion heaters
- Reduction in Specific Coal Consumption and improvement of SHR by Boiler 1 APH tube replacement
- Improvement of Liquor Productivity to 88 gpl

Renewable Energy Sources

FY	Installation Capacity	Generation (in Million Kwh)	Import (IEX/PXIL) (in Million Kwh)	Percentage share
FY-21	180 KWp	0.071	0	0.015
FY-22	180 KWp	0.084	0.671	0.145
FY-23	180 KWp	0.138	6.667	1.32

Key Highlights

- 6667 MU of Renewable energy imported through IEX and PXIL platforms
- Installation of 10 MWp(Onsite) in under bidding process from Sterlite power
- 322 T of Biomass fired in our Co-gen Boilers

Energy Monitoring & Digitalization

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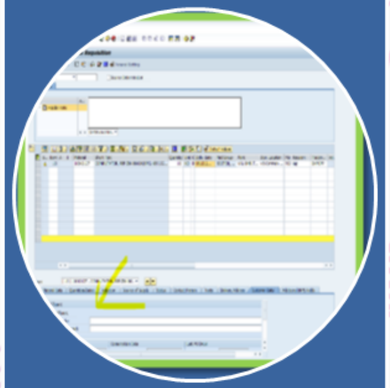
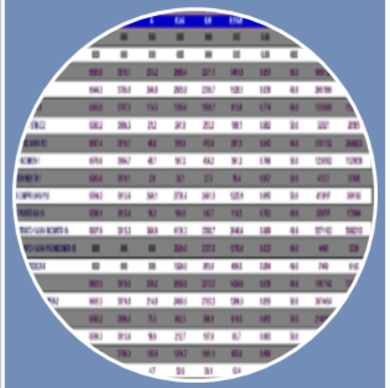
BAUXITE CONTROL TOWER



ENERGY EFFICIENT PROCUREMENT

E-CER (CAPEX PROJECT) ENERGY IMPACT ASSESSMENT

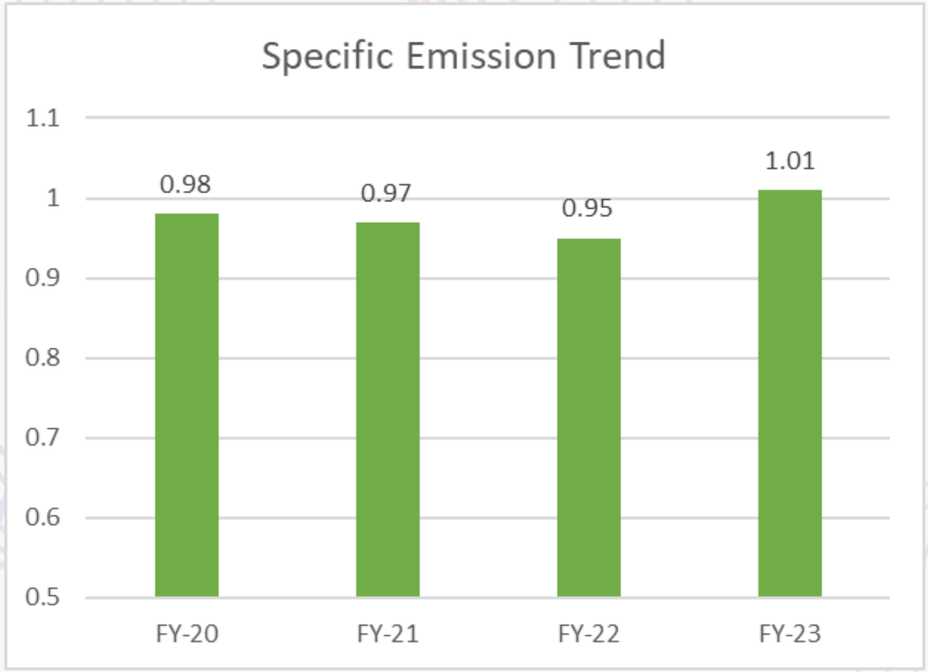
MES ONLINE FLASH REPORT



ONLINE ENERGY MANAGEMENT

LIEP Portal

Emission Trend & Initiatives



Dust suppression system

- Fly ash Disposal through HCSD (High Con. Slurry Disposal) to Ash Pond
- Covered conveyers for Bauxite & Coal & pipe conveyer for Alumina
- Dry fog system at transfer points of Bauxite Handling Area and Coal Handling Plant
- Water Sprinkling by using rain gun, mist canon, water tanker at Bauxite yard, Red Mud pond, Fly ash

Emission Control system

- Online ESP with bag filters at CPP to achieve PM level < 50mg/Nm3
- Online ESP at Calciner stacks
- Online Wet Scrubbers at Lime handling Plant
- Online Bag Filters on Alumina storage silo and Bauxite crusher house.

Effluent Management

- Site is Zero Liquid Discharge & Reuse of all process wastewater in system
- Reuse of Treated Sewage Water for Horticulture in Refinery & Township
- All process ponds like BRDA (RMP), PWL, Caustic pond, Storm water pond & Ash pond are used for rainwater collection & reuse.

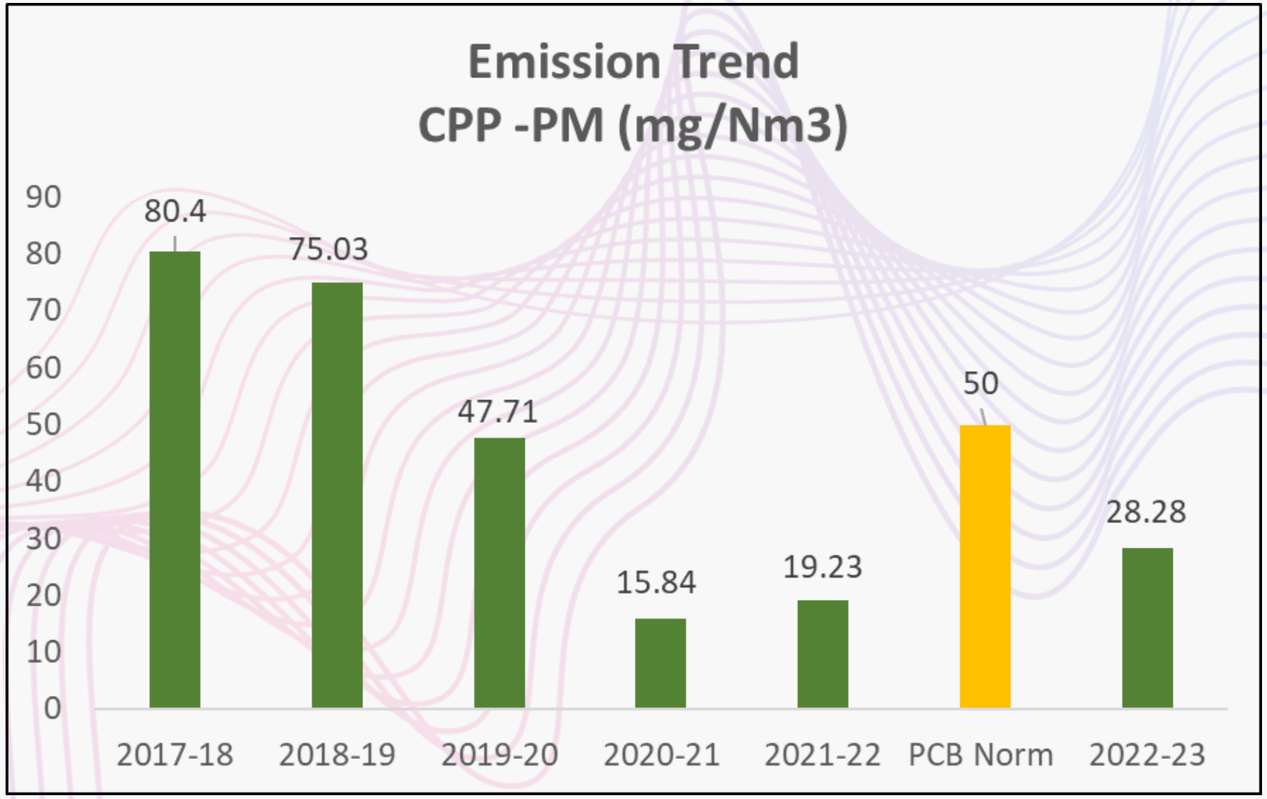
Air Quality Management

Continuous Ambient Air Quality Monitoring Station (CAAQMS)

CEMS at Power Plant

CEMS at Calciner

Water sprinklers at bauxite handling



Biodiversity Management & Green Belt Development

BIRD CONSERVATION DRIVE

MASS PLATATION DRIVES

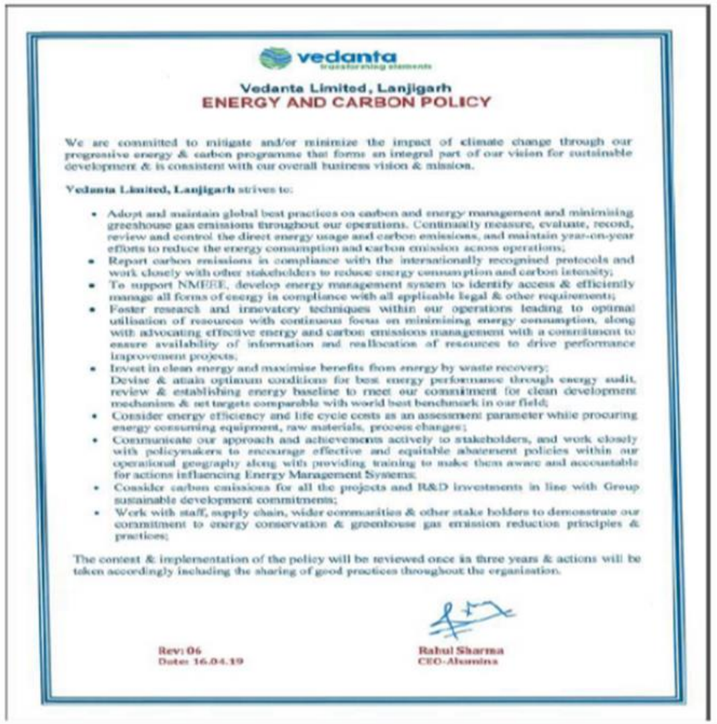
AWARENESS CAMPAIGNS

TOWNSHIP

PLANT SITE

RED MUD POND AREA

EnMS ISO 50001:2018 & ESG



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Vedanta Limited, Lanjigarh

ENERGY AND CARBON POLICY

We are committed to mitigate and/or minimize the impact of climate change through our progressive energy & carbon programme that forms an integral part of our vision for sustainable development & is consistent with our overall business vision & mission.

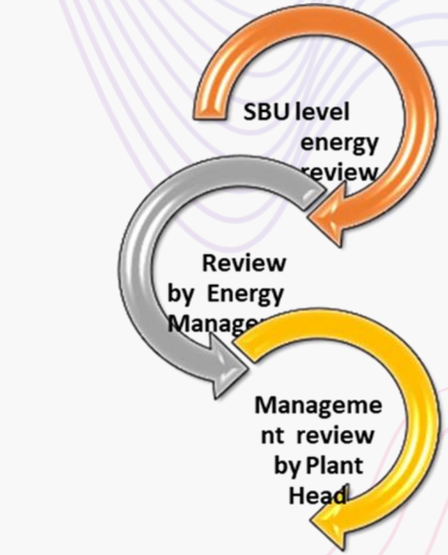
Vedanta Limited, Lanjigarh strives to:

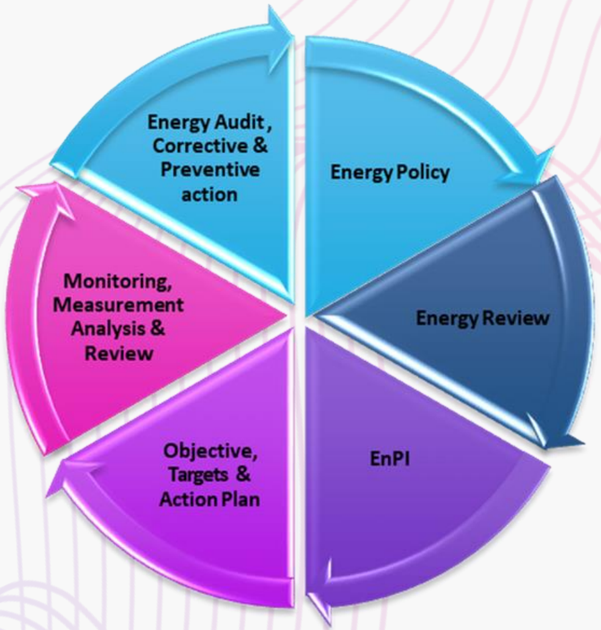
- Adopt and maintain global best practices on carbon and energy management and minimising greenhouse gas emissions throughout our operations. Continually measure, evaluate, record, review and control the direct energy usage and carbon emissions, and maintain year-on-year efforts to reduce the energy consumption and carbon emission across operations;
- Report carbon emissions in compliance with the internationally recognised protocols and work closely with other stakeholders to reduce energy consumption and carbon intensity;
- To support NMEEE, develop energy management system to identify access & efficiently manage all forms of energy in compliance with all applicable legal & other requirements;
- Foster research and innovatory techniques within our operations leading to optimal utilisation of resources with continuous focus on minimising energy consumption, along with advocating effective energy and carbon emissions management with a commitment to ensure availability of information and reallocation of resources to drive performance improvement projects;
- Invest in clean energy and maximise benefits from energy by waste recovery;
  Devise & attain optimum conditions for best energy performance through energy audit, review & establishing energy baseline to meet our commitment for clean development mechanism & set targets comparable with world best benchmark in our field;
- Consider energy efficiency and life cycle costs as an assessment parameter while procuring energy consuming equipment, raw materials, process changes;
- Communicate our approach and achievements actively to stakeholders, and work closely with policymakers to encourage effective and equitable abatement policies within our operational geography along with providing training to make them aware and accountable for actions influencing Energy Management Systems;
- Consider carbon emissions for all the projects and R&D investments in line with Group sustainable development commitments;
- Work with staff, supply chain, wider communities & other stake holders to demonstrate our commitment to energy conservation & greenhouse gas emission reduction principles & practices;

The content & implementation of the policy will be reviewed once in three years & actions will be taken accordingly including the sharing of good practices throughout the organization.

Rev: 06
Date: 16.04.19

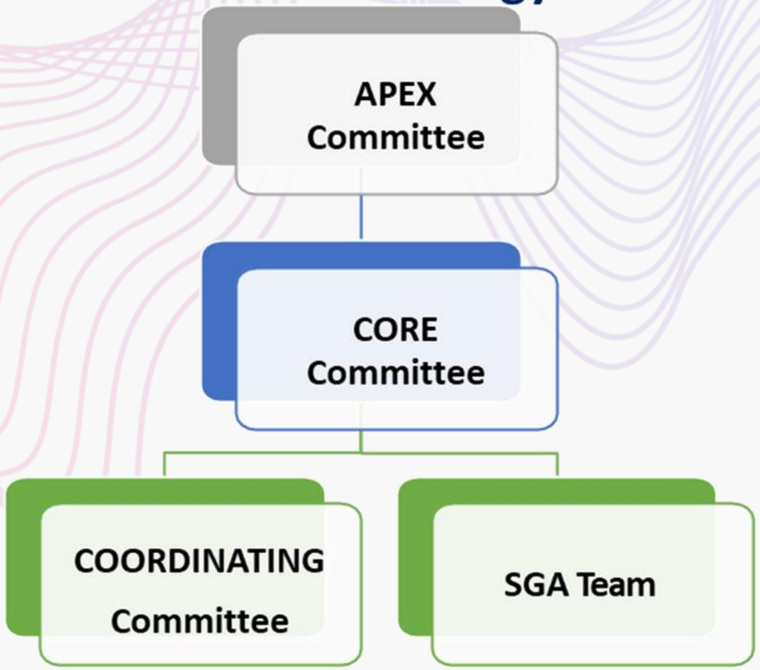
Rahul Sharma
CEO-Alumina



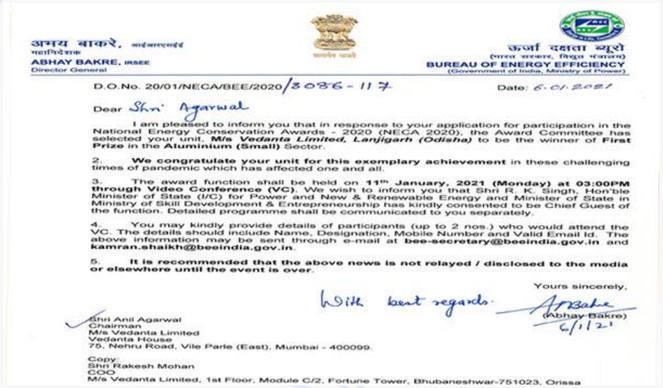


EMS (ISO-50001:2018)

Formation of Energy Cell



PAT & Escerts



अभय बाकरे, भाविअसे
महानिदेशक
ABHAY BAKRE, IRSEE
Director General

ऊर्जा दक्षता ब्यूरो
(ऊर्जा मंत्रालय, विद्युत मंत्रालय)
BUREAU OF ENERGY EFFICIENCY
(Government of India, Ministry of Power)

D.O.No. 20/01/NECA/BEE/2020/8086-117 Date: 6.01.2021

Dear Shri Agarwal

I am pleased to inform you that in response to your application for participation in the National Energy Conservation Awards – 2020 (NECA 2020), the Award Committee has selected your unit, **M/s Vedanta Limited, Lanjigarh (Odisha)** to be the winner of **First Prize** in the **Aluminium (Small)** Sector.

2. **We congratulate your unit for this exemplary achievement** in these challenging times of pandemic which has affected one and all.

3. The award function shall be held on **11th January, 2021 (Monday) at 03:00PM through Video Conference (VC)**. We wish to inform you that Shri R. K. Singh, Hon'ble Minister of State (I/C) for Power and New & Renewable Energy and Minister of State in Ministry of Skill Development & Entrepreneurship has kindly consented to be Chief Guest of the function. Detailed programme shall be communicated to you separately.

4. You may kindly provide details of participants (up to 2 nos.) who would attend the VC. The details should include Name, Designation, Mobile Number and Valid Email Id. The above information may be sent through e-mail at **bee-secretary@beeindia.gov.in** and **kamran.shaikh@beeindia.gov.in**.

5. **It is recommended that the above news is not relayed / disclosed to the media or elsewhere until the event is over.**

Yours sincerely,

With best regards.

(Abhay Bakre)
6/1/21

Shri Anil Agarwal
Chairman
M/s Vedanta Limited
Vedanta House
75, Nehru Road, Vile Parle (East), Mumbai - 400099.

Copy:
Shri Rakesh Mohan
COO
M/s Vedanta Limited, 1st Floor, Module C/2, Fortune Tower, Bhubaneshwar-751023, Orissa

VL-Lanjigarh Received 15044 EsCERTs in PAT-II cycle compared to 762 certificates received in PAT-I cycle.

Organization received first ever National energy conservation award (first prize) for the year 2020 by BEE and MIP.

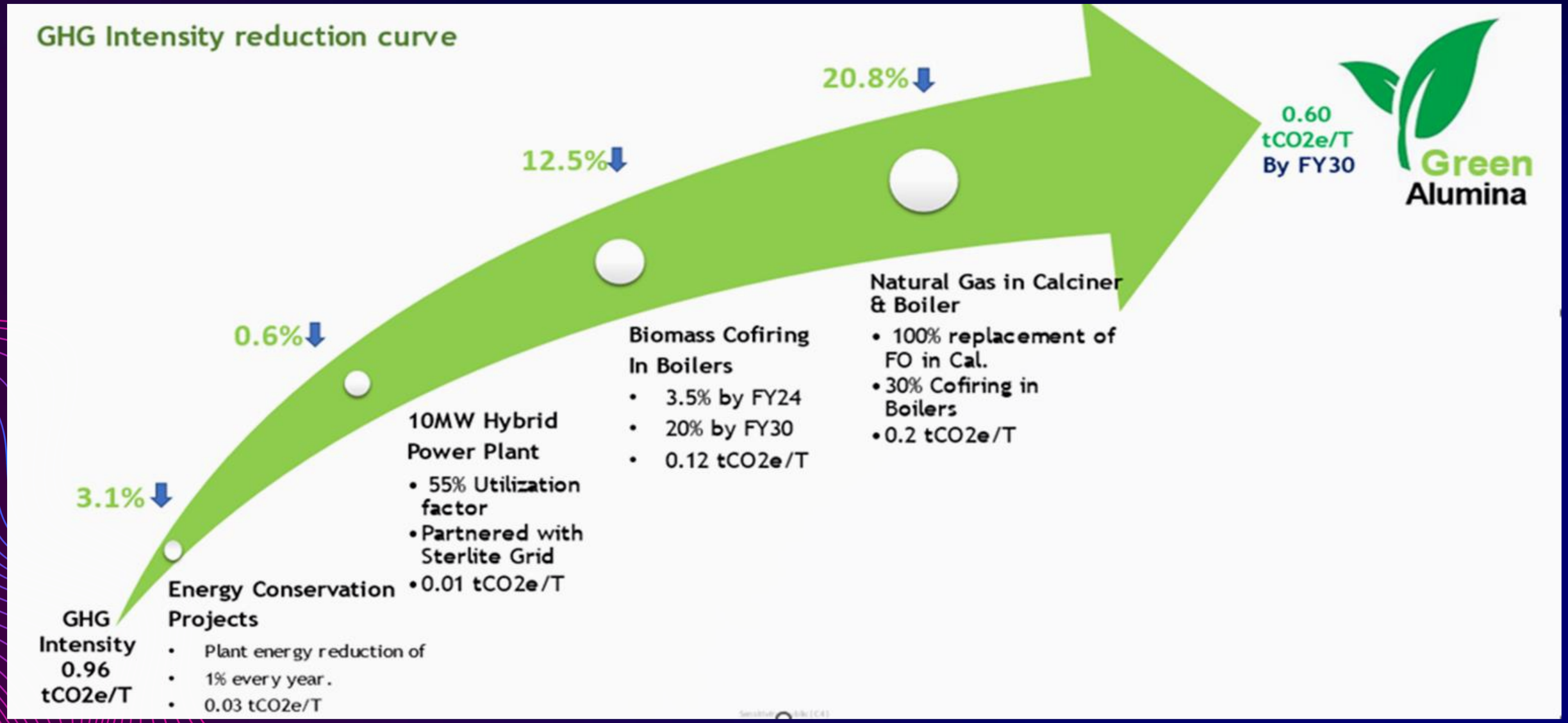
Till date 9731 nos. of EsCerts were sold generating a revenue of 1.2 Crore INR.

This year we recieved two awards
1). Best Energy Efficient Unit
2). Best Energy Efficient PAT DC
from CII Energy circle Chandigarh Chapter for our outstanding energy performance

Vedanta Commitment towards NET Zero

1. Net Zero Carbon by 2050 or sooner
2. Use 2.5 GW of Round-The-Clock RE and reduce absolute emissions by 25% by 2030 from 2021 baseline
3. Pledge US$ 5b over the next 10 years to accelerate transition to Net-Zero
4. No additional coal-based thermal power *and* ***coal-based power only till end of power plants life***
5. Decarbonize 100% of our Light Motor Vehicle (LMV) fleet by 2030 and 75% of our mining fleet by 2035
6. Commit to accelerate adoption of hydrogen as fuel and seek to diversify into H_2 fuel or related businesses
7. Ensure all our businesses account for their Scope 3 emissions by 2025
8. Work with our long-term, tier 1 suppliers to submit their GHG reduction strategies by 2025 and align with our commitments by 2030
9. Disclose our performance in alignment with TCFD requirements
10. Help communities adapt to the impacts of climate change through our social impact/CSR programs

Net Zero by 2050 or sooner



People Involvement

Energy walk with higher management conducted during Energy week celebration on December 14, 2022

Various Energy awareness activities such as Ideation session, Quiz session were conducted across all the areas inside refinery.

Energy Conservation is not something which should remain restricted to Industry. This time we took one step further and spread Energy awareness across two schools during Energy week in collaboration with CSR dept.

Awards & Recognition

CCQC Award -2022 (17 Gold medals) Rourkela Chapter

Kalinga Environment Excellence Award 2021

CII Excellent Energy Efficient unit FY 22

Digital CIO excellence award 2022

Golden Peacock Ard in Innovation Management FY 2022

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Mr. Sanjeev Kumar (Head O&M, 5 MTPA)

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Mr. Sanjay Kumar Jena (COO, 3 MTPA & E.M)

Sanjaya.Jena@Vedanta.co.in

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Thank you !

Aiming to create a more beautiful, sustainable, clean planet . . .