An ISO 9001, 14001 & OHSAS 18001 Certified Company

ENERGY EFFICIENT INITIATIVES AT VEDANTA LANJIGARH

DRIVING EFFICIENCY THROUGH ENMS & ESG PLATFORMS

TEAM MEMBERS:-

Sanjaya Kumar Jena (GM & EM, Elec. Maint.)
Soumava Das (DM, EnMS Lead)
Pakruti Ranjan Sahoo (AM, EnMS Co-ordinator)

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Website: www.vedantalimited.com

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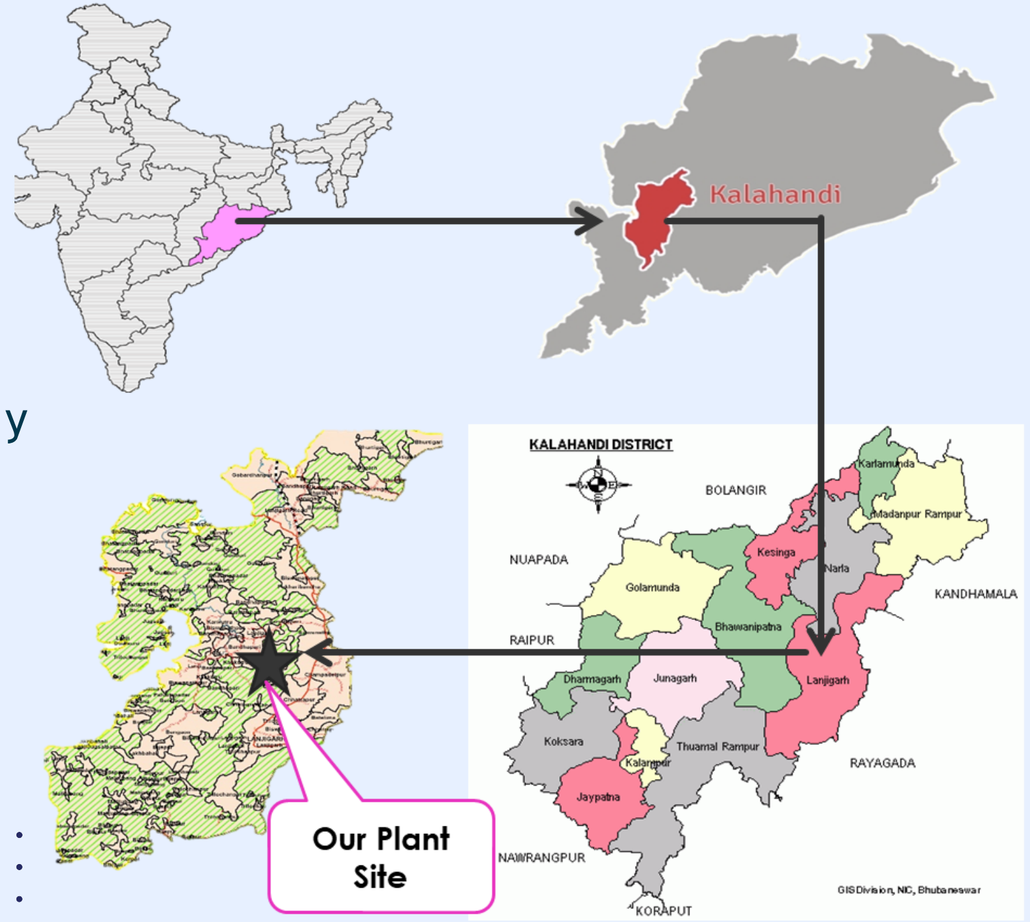


Location Map

ALUMINA MANUFACTURING PROCESS

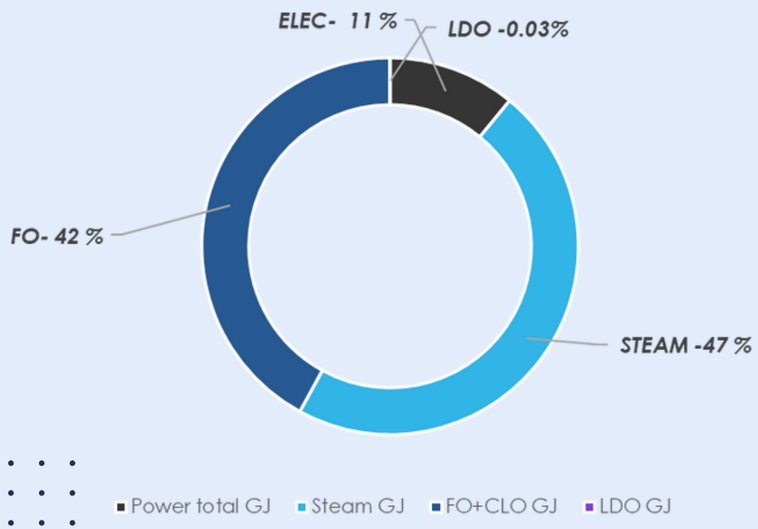
Plant Profile

- 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
- 1st organization to be certified as ISO 50001

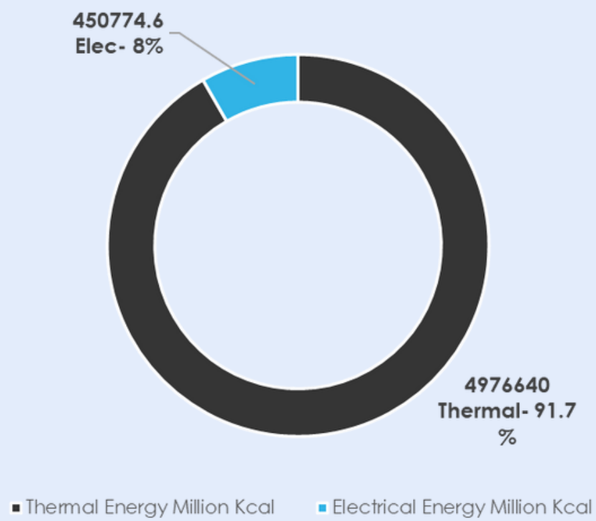
CURRENT ENERGY TRENDS

Hydrate Production	Hydrate Production	Alumina production	Power (KWH/T)	Steam (T/T)	FO (Kg/T)	Total Energy (GJ/T)	Total Energy (TOE/T)
FY 2019-20	1825325	1810702	216.75	1.73	70.59	7.27	0.2572
FY 2020-21	1847778	1840893	215.66	1.72	71.13	7.25	0.2556
FY 2021-22	1969212	1967910	217.54	1.68	70.63	7.16	0.2523

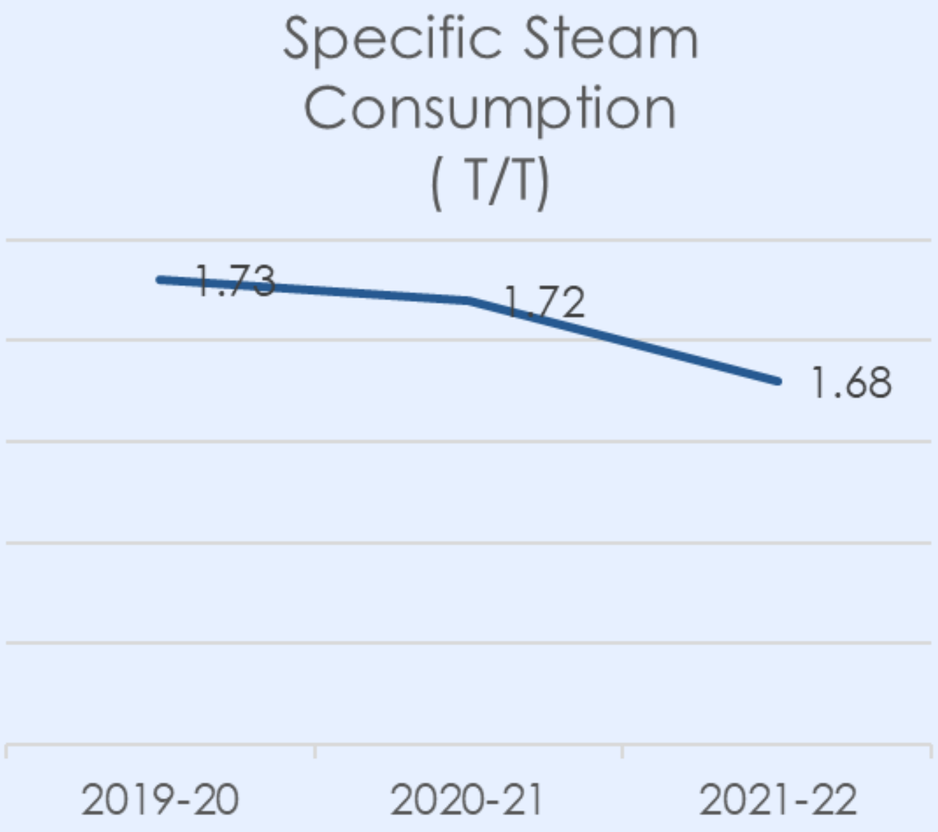
Energy Break Up- Alumina



Thermal Energy-Electrical Energy Break Up

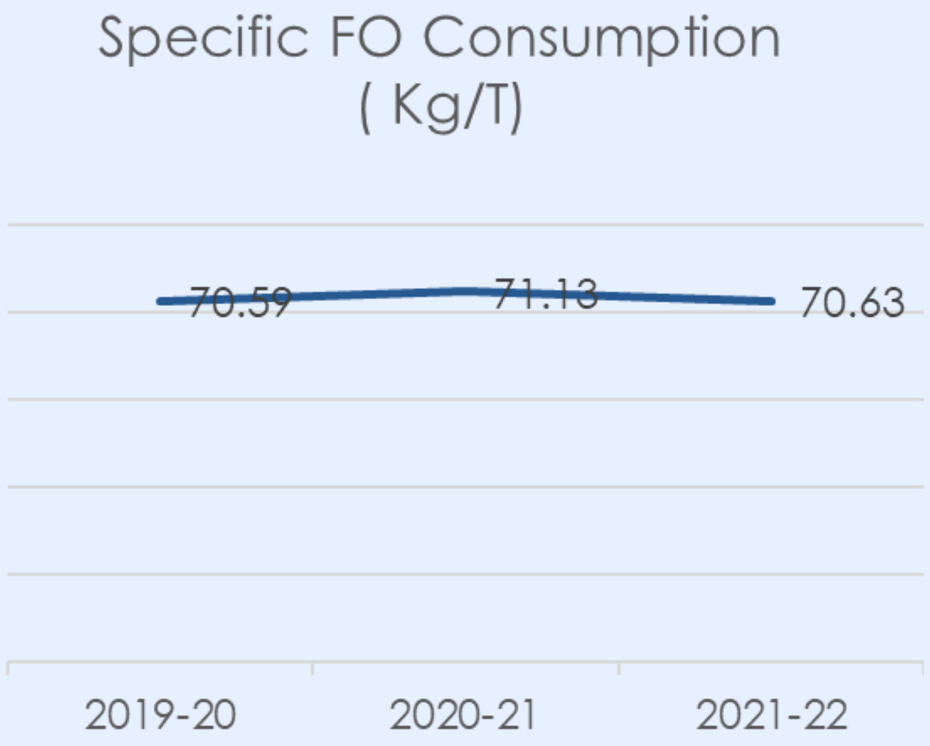


MAJOR PROJECTS & STEAM CONSUMPTION TRENDS



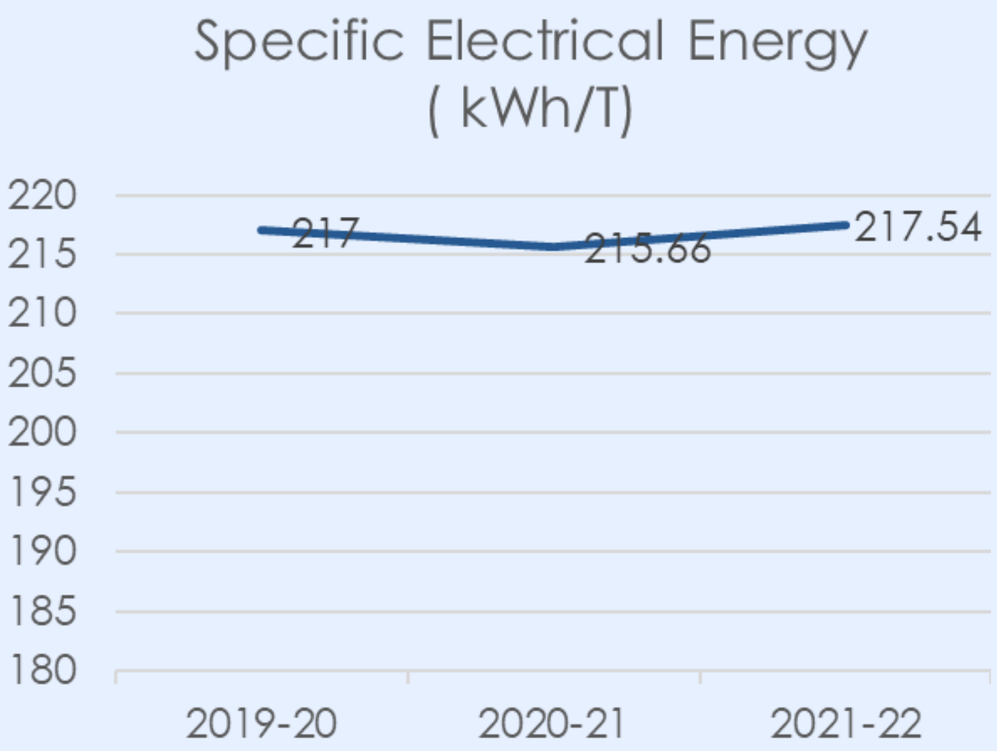
- Digestion 0 Heater HX 0005 replacement
- APC in all 3 evaporation units
- Evaporation 3 Acid wash system commissioning & Cal 1 & 2 acid wash system development
- Continuous dosing of Max HT Chemical in Evaporation units
- Improvement in steam economy from 3.35 to 3.8 T/T
- Replacement of cal-1,2 distribution plates

MAJOR PROJECTS & FO CONSUMPTION TRENDS



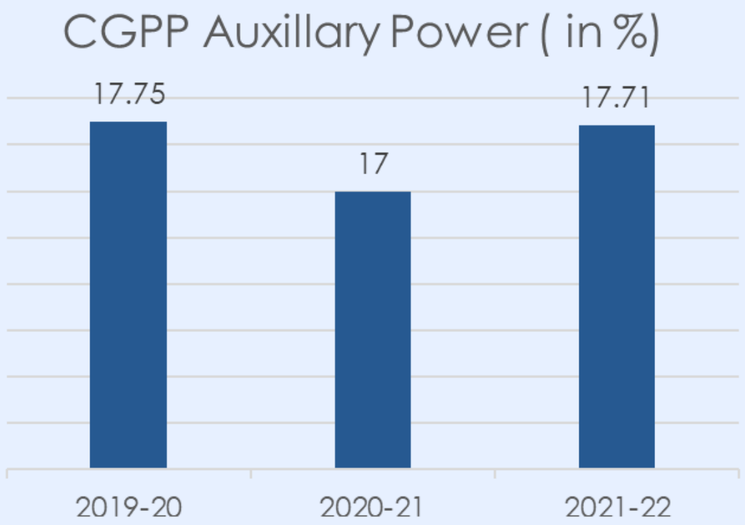
- Adjustment of P01 flap gate for both calciner for PO3 temp maintenance (50-60 C difference)
- >95% operation in APC optimization for better optimization of calciner parameters
- Increase of both calciner atomizing air in burner nozzles(increase up to 6.5m3/hr in each nozzle) for proper atomization in burner.
- De bottlenecking of both Calciner to enhance capacity from 2500TPD to 3000TPD

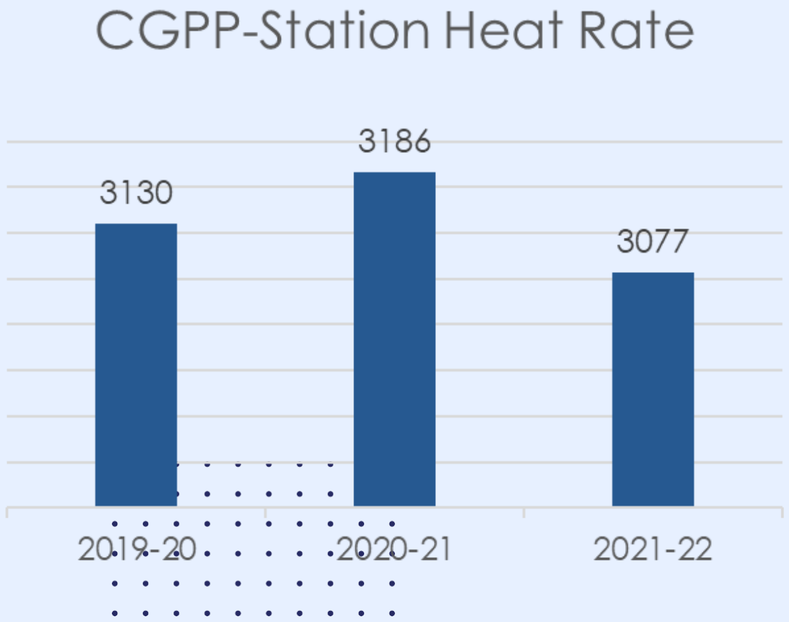
MAJOR PROJECTS & ELECTRICAL CONSUMPTION TRENDS



- Evaporation 3 CW pump & motor resizing from 980 to 600 Kw
- Reduction in pulley size of 3 evaporation test liquor pumps 28 PU 0001N/2N & 36 EPU101-C
- Replacement of 12 Nos HT motors to CACA to TEFC
- Conversion of 2 Nos . Digestion condensate pumps from DOL to VFD
- Replacement of 2000 LED lights
- Retrofitting of 650 KVAR capacitor banks
- Pulley modification of 6 No. ISC pumps

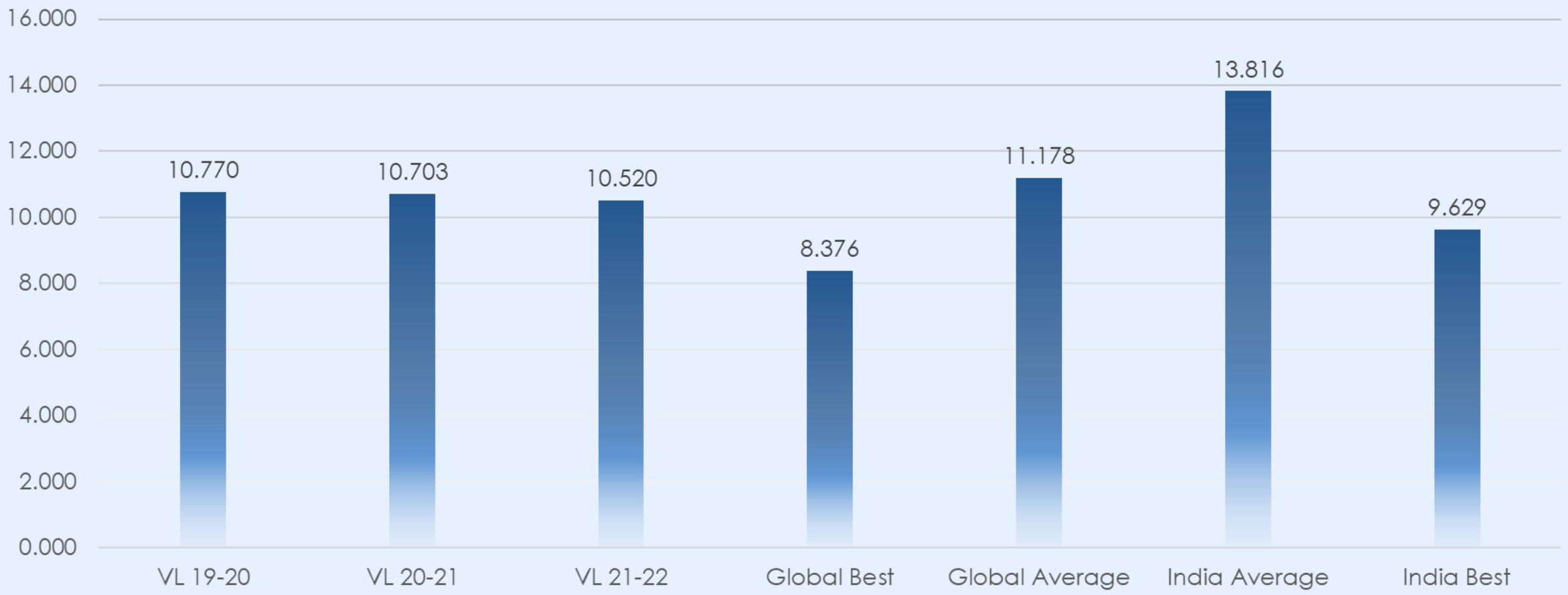
MAJOR PROJECTS & CGPP SHR , AUX POWER TRENDS





- Cooling Tower 3 Cells fill refurbishment
- Turbine 2 Gear Box Replacement & Capacity Utilization
- Boiler-1 and 2 Ring Roller replacement in all 4 bowl mills
- Anti corrosive coating in Cooling Water pumps
- Replacement of faulty Steam Traps
- 617 MW of Renewable Energy Import during Turbin shutdown
- Better Belt utilization in CHP
- Improvement of Turbine Condenser vacuum to -0.87 K pa

BENCHMARKING WITH PEER GROUPS



PROCESS PARAMETERS BENCHMARKING

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BENCHMARKING WITH UTKAL ALUMINA REFINERY-FY'22				
Particulars	UOM	Lanjigarh	Utkal	Remarks
		YTD FY22		
Production:				
Hydrate Production	KT	1969	2048	Utkal is having high recovery and high net liq productivity
Calcined Alumina	KT	1968	2022	Calcined circuit capacity is higher in Utkal compared to Lanjigarh
Specific Consumption:				
Bauxite	T/T	2.93	2.95	Lanjigarh is lower in bxt specs due to higher THA because of import bxt mix
Caustic	kg/T	72	47	Utkal's non chemical soda loss is low @6 kg/T compared to 10.6 kg/T of Lanjigarh,Utkal's washer circuit is designed to higher solids of ~1150 gpl compared to ~750 gpl in Lanjigarh
Lime	kg/T	31	19	Due to high TOC with EGA bxt mix,Lanj lime cons is higher because of high liq impurity level
Steam	T/T	1.68	1.74	Lanj best achieved specific steam consumption is lower at 1.56 t/t
Energy	kWh/T	216	153	Utkal design has better power consumption.
Fuel Oil	kg/T	70.6	69.8	-
Efficiency:				
Alumina Recovery	%	93.65%	95.4%	Utkal has higher recovery by due to single source OMC bxt and MHA<0.5% compared to Lanj with import mix of higher G/H, MHA~1.5%% and higher BOR~1.300
Net liquor Productivity	gpl	83	90	Utkal precip circuit designed at higher yield, lanjigarh best achieved in Q4 FY22 is at 88 gpl.
Bauxite Quality:				
Gibbsitic Alumina	%	39.99%	38.80%	
Reactive Silica	%	2.46%	1.73%	

ROAD MAP TOWARDS BENCHMARKING

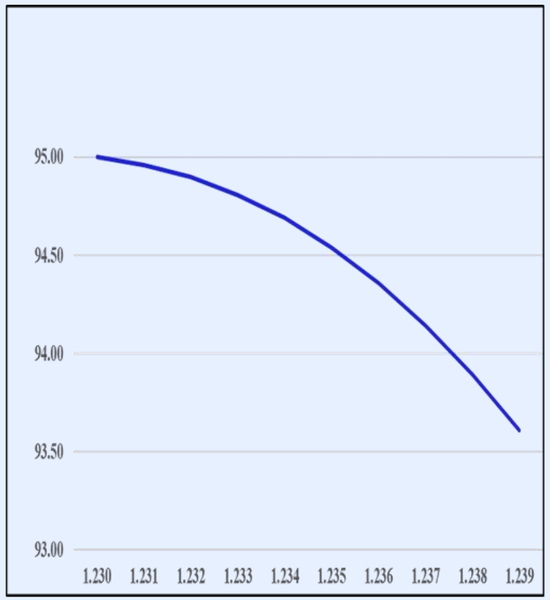
- Improvement in precipitation productivity to minimize specific energy consumption by10%
- Further Improving evaporation rate and calciner energy
- Introduction of FD (Fluidized bed) fan based calciner in FY 2022-2023
- Alternative energy source like use of Natural Gas instead of FO and coal.
- Reducing total energy consumption through improved methods of
- Calcination, cogeneration and process improvements
- Achieve substantial energy efficiency gains by introducing APC and digitization
- Optimizing the efficiency of the overall process and capacity utilization
- Proposal of installation of 15MW solar power plant.
- Implementation of zero waste projects to minimize global GHG emissions

MAX HT CHEMICAL DOSING IN EVAPORATION UNITS

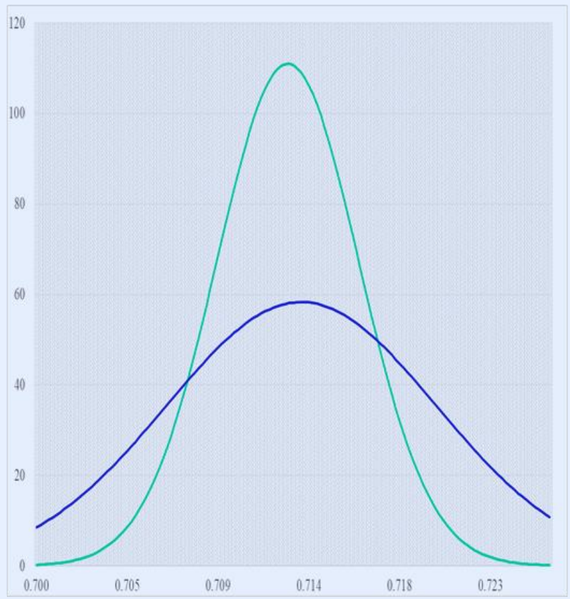
- Shut down frequency for acid cleaning of tubes got reduced
- Inhibits the growth of scaling in Calandria tubes
- Increase heat transfer
- Steam benefiets of 0.01 T/T is achieved

MAJOR PROJECTS TAKEN FOR ENERGY IMPROVEMENT

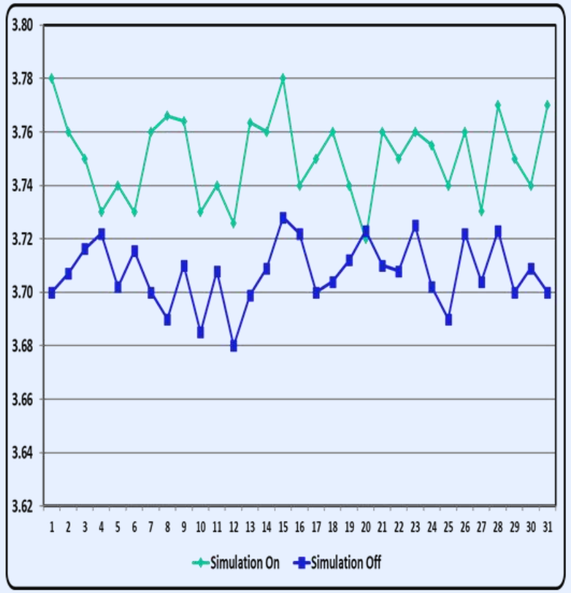
APC IN EVAPORATION UNITS



Digestion Efficiency vs Alumina to Caustic ratio



Standard Deviation Of Alumina to Caustic Ratio



Steam Economy variation Results

Remarks

- ***Optimum Digestion Efficiency*** **has been worked out under variable** ***Alumina to Caustic Ratio***
- ***Model*** **has made the simulator to work closer to its** ***constraints***
- ***Simulation software*** **has helped to achieve steadier plant operations & process control parameters**

TANGIBLE BENEFITS

- **Reduction in Steam Consumption by 0.012 t/t**
- **Reduction in COP by 36 Rs./t Alumina**

INTANGIBLE BENEFITS

- **Stable operation**
- **Improved Equipment health**
- **Less operator stress with minimal manual intervention**

MAJOR PROJECTS TAKEN FOR ENERGY IMPROVEMENT

EVAP-3 COOLING TOWER PUMP AND MOTOR REPLACEMENT FOR ENERGY SAVING

- Optimization is required for Evaporation 3 unit as it is drawing more power than other two units of evaporation
- 50% of energy got wasted in recirculation valve
- So an in-House project has been implemented to reduce power consumption by replacing both pump and motor of lower capacity

MAJOR PROJECTS TAKEN FOR ENERGY IMPROVEMENT

DIGESTION 2 HEATER REPLACEMENT

- Specific Steam consumption was brought down from 1.71 T/T to 1.68 T/T .
- Annual Reduction in Steam consumption: 60,000 T/Year
- Annual savings: Rs 7.08 Crores
- Investment: Rs 35 Lakhs
- GHG Reduction per annum: 38480 T/Co2

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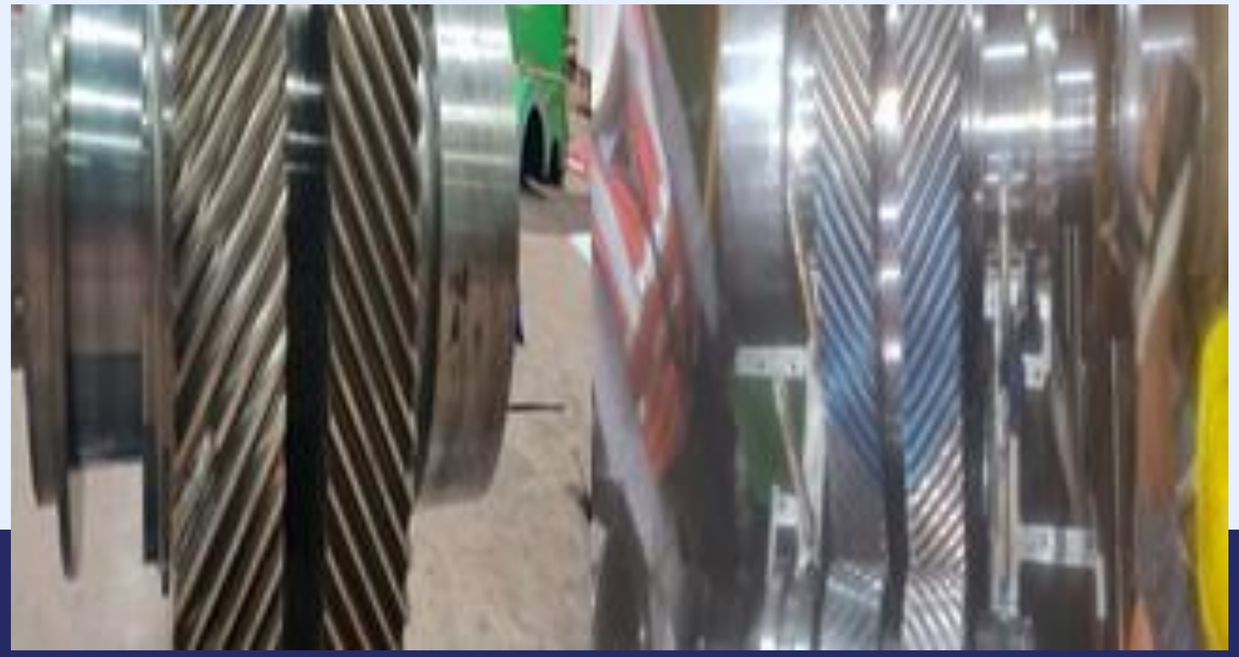
INSTALLATION OF 600 KVAR CAPACITOR BANKS

- 100 Kvar*4 and 200Kvar*1 Capacitor banks are installed in SWR 3.2 and SWR 2.1 respectively.
- Power factor improved from 0.81 to 0.85
- Total current saving in HT side : 45A
- Total power saving per annum:105 MWH
- Monetary saving per annum: 4.8Lakhs
- Reduction of GHG/ annum- 87 Tons

MAJOR PROJECTS TAKEN FOR ENERGY IMPROVEMENT

OVERHAULING OF TG-2 AND REPLACEMENT OF DAMAGED GEAR BOX



- TG-2 Specific steam was running at 8.8 T/MW against the target of 8.5T/MW. Turbine overhauling with damaged Gear box replacement brought down specific steam consumption.
- Annual Reduction in Coal consumption: 13154 T/Year
- Annual savings: Rs 4.02 Crores
- Investment: Rs 1.91 Crores
- GHG Reduction per annum: 15549 T/Co2

ENERGY SAVING INITIATIVES

VFD IN DIGESTION CONDENSATE PUMPS

- Monetary saving per annum: 19.5Lakhs
- Reduction of GHG/ annum- 356 Tons of CO2
- VFD conversion was done as Digestion condensate pumps were operating with 30% value throttling & for speed control
- Total Power saving per day: 1200 KWH
- Total power saving per annum:432 MWH

BLDC FANS INSTALLATION IN OFFICE BUILDINGS

- Old Fan set is replaced with BLDC fans
- Remote controlled & per Fan set savings of 40 W
- Total Energy saving per day : 20 kWH
- Total Energy saving per annum: 6 MWH
- Monetary saving per annum: 0.3 Lakhs
- Reduction of GHG/ annum- 17 Tons
- Stage 2 replacement of 1700 fans in plant & colony planned

CACA MOTORS REPLACED INTO TEFC MOTORS

- Replacement of existing CACA HT motors with improved design of TEFC motors
- Total Power saving per day: 2653 KWH
- Total power saving per annum:955 MWH
- Monetary saving per annum: 42.98 Lakhs
- Reduction of GHG/ annum- 788 Tons

ENERGY SAVING INITIATIVES

LED LIGHTS INSTALLATION IN ALL AREAS OF REFINERY

- Traditional lights replaced with LED lights in Red & White Area
- Total Energy saving per day : 1375 kWH
- Total Energy saving per annum: 502 MWH
- Monetary saving per annum: 25 Lakhs
- Reduction of GHG/ annum- 414 Tons

CONVERSION OF IE 1 MOTORS TO IE 3 MOTORS INSIDE REFINERY BY NATIONAL MOTORS REPLACEMENT PLAN

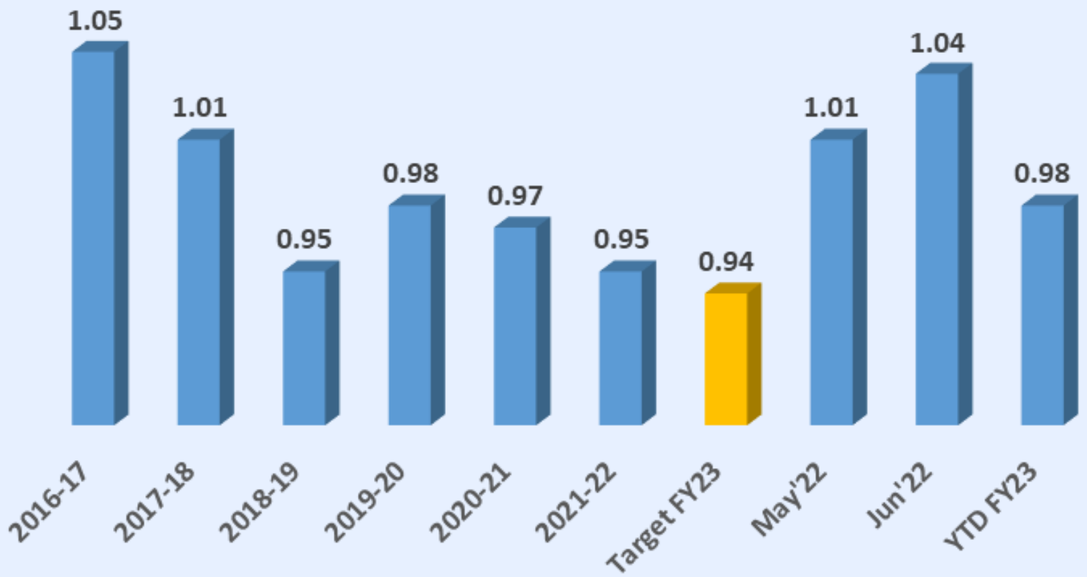
- Replacement of existing IE 1 motors with improved efficiency design of IE 3 motors
- Total Power saving per day: 4.95 Mwh
- Total power saving per annum: 1780 Mwh
- Monetary saving per annum: 80 lakhs
- Reduction of GHG/ annum-1479 tonnes

REPLACEMENT OF PULLEYS IN EVP UNITS

- Pulley dia. reduced from 645mm to 485mm and had reduction in rpm from 1176 to 891 rpm in both pumps
- Total Power saving per day: 6.6 MWh
- Total power saving per annum:1650 MWH
- Monetary saving per annum: 74 Lakhs
- Reduction of GHG/ annum- 1360 Tonns

EMISSION TRENDS & INTIATIVES

Specific GHG Emission (tCO2e/MT of Hydrate)



Continuous Ambient Air Quality Monitoring Station (CAAQMS)

Water sprinklers at bauxite handling

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.

OUR 10 COMMITMENTS – ON NET ZERO WE COMMIT TO:

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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

RENEWABLE ENERGY SOURCES

- Besides, 180 KwP of Roof Top Solar in Plant all plant Import Power in Renewable energy from IEX platform
- Installation of 15 MWp(Onsite) in under bidding process from interested parties
- Biomass Firing pilot Trail run of 30 T successfully completed in Boilers
- Up to 8 % Generation from Renewable sources in 2025.

Year	Technology (Electrical)	Type Of Energy	Onsite/Offsite	Installed Capacity	Generation (million Kwh)	% (Overall Electrical Energy)
FY 2019-2020	solar PV	Solar	Onsite	180 KwP	1.71	0.35
FY 2020-2021	solar PV	Solar	Onsite	181 KwP	1.39	0.28
FY 2021-2022	solar PV+IEX Import	Solar	Onsite+Offsite	182 KwP	7.01	1.34

WASTE TO VALUE

Bio-gas supplied to Jawan Barrack for cooking

Year	Type of waste	Quantity (MT)	GCV (Kcal/kg)
FY 19-20	Food waste	4.129	3927.5
FY 20-21	Food waste	6.93	3927.5
FY21-22	Food waste	14.612	3927.5

Waste to Energy

MUNICIPAL SOLID WASTE MANAGEMENT

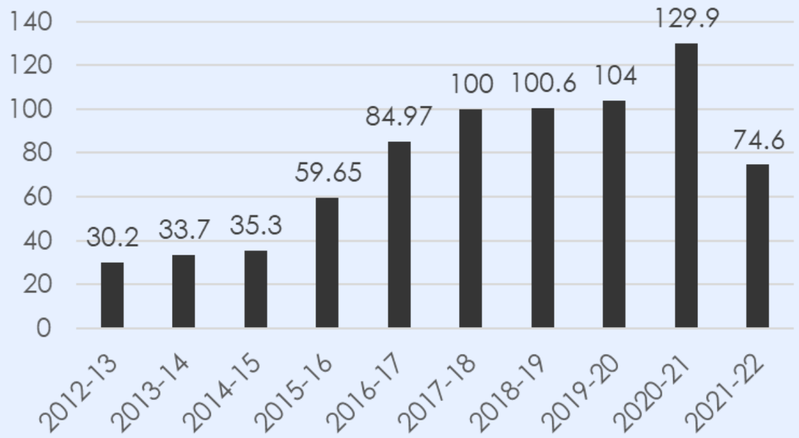
- All the MSW wastes from Plant & Township are disposed to Cement plant for coprocessing through Municipality
- Waste segregation at source for dry waste & Wet Waste

SCRAP WASTE MANAGEMENT

Collection and segregation of scrap in Reg Tag area → Regular scrap transfer to Scrap yard → Auction and sell of scrap to recyclers

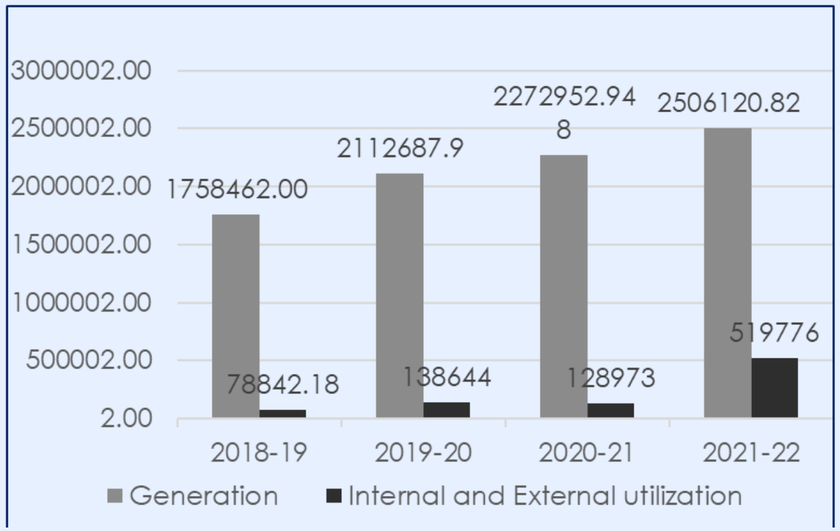
WASTE TO VALUE

ASH UTILIZATION TREND



- Identified local brick manufacturing vendors
- Technology transferred and demonstrated to Fly Ash bricks industries through the provision of fly ash at free of cost.
- Handholding to the manufactures for making bricks
- Ash utilized in road construction
- Ash utilized in dyke height of ash pond
- PWL dyke height raising by utilization of ash
- Continuous efforts to explore new avenues for ash utilization
- 9 new projects identified under ESG drive for ash utilization

RED MUD UTILIZATION TREND

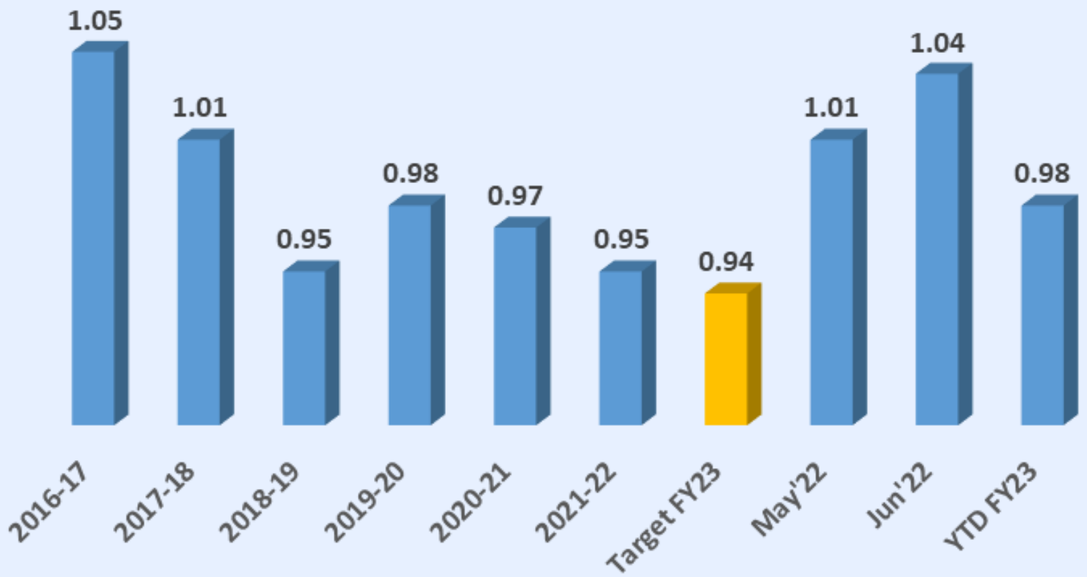


- Signed MOUs with cement industries for utilization of red mud.
- R&D projects for exploring new avenues of red mud utilization
- Red mud utilized in internal road construction
- 11 new projects identified under ESG drive for red mud utilization

Rainwater Recharging Structure in Township to recharge more than 1 lakh m3 of water

EMISSION TRENDS & INTIATIVES

Specific GHG Emission (tCO2e/MT of Hydrate)



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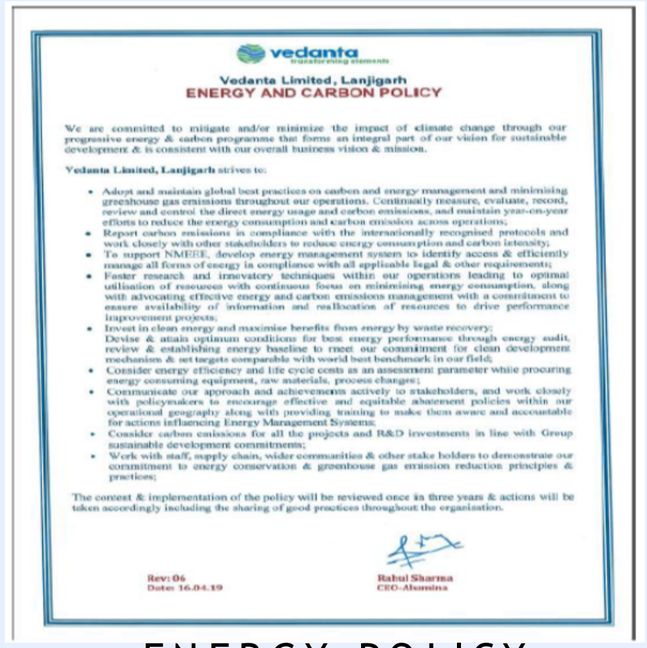
ENMS ISO 50001:2018 & ESG



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:

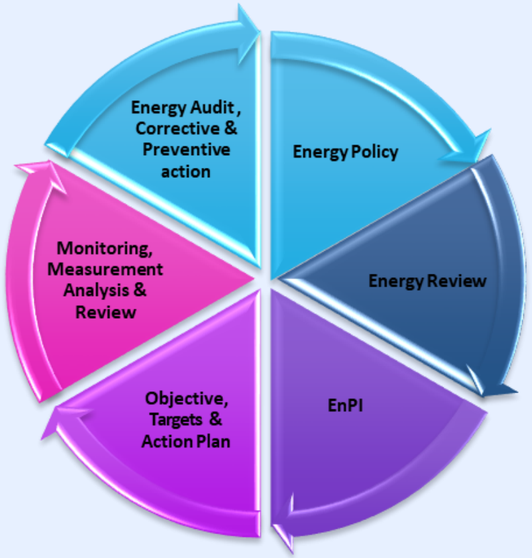
- Adopt and maintain global best practices on carbon and energy management and minimising greenhouse gas emissions throughout our operations. Continually measure, evaluate, record, review and control the direct energy usage and carbon emissions, and maintain year-on-year efforts to reduce the energy 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

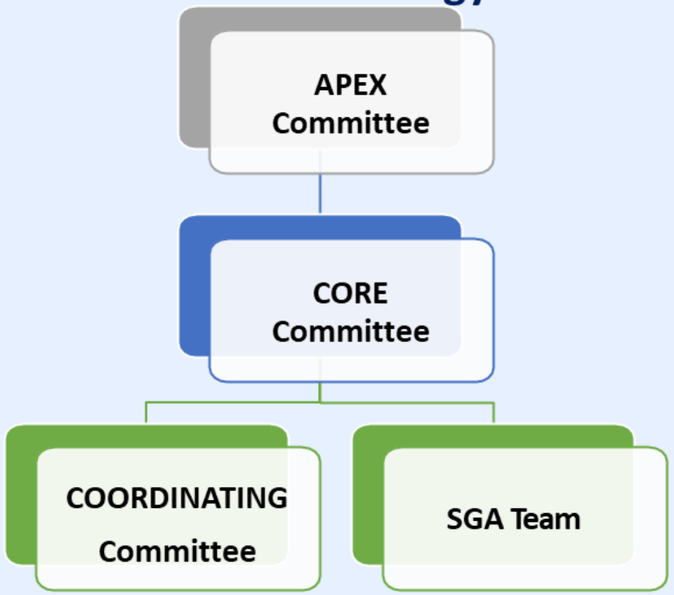
Rahul Sharma
CEO-Alumina

ENERGY POLICY



EMS (ISO-50001:2018)

Formation of Energy Cell



Annual Turnover of the Company (in Million INR)	54310
Budget allocated for Encon Energy Saving Projects (in Million INR)	76.74

AWARDS & RECOGNITION


CII-TRIVENI WATER INSTITUTE

CII
Confederation of Indian Industry
125 Years - Since 1895

CII National Award for Excellence in Water Management 2020

This is to certify that

Vedanta Limited
Lanjigarh, Kalahandi, Odisha

has been identified as a "Noteworthy Water Efficient Unit" in "Within the Fence" Category. This has been based on evaluation by the Jury at the National Competition for Excellence in Water Management 2020.

Dhruv M Sawhney
Chairman CII-Triveni Water Institute
& Past President, CII

Anil Kakodkar
Chairman of the Jury
CII National Award for Excellence in Water Management

Noteworthy Water Efficient Unit- 14th National Award for Excellence in Water Management 2020 organized by CII.

Quality Conclave(NCQC) Awards

Quality Conclave(CCQC) Awards

IMEA Award-Gold category

Kalinga Safety Award FY21

PEOPLE INVOLVEMENT IN ENERGY ACTIVITIES

- Occupancy sensors in all the office buildings
- SCADA system modification for display and monitoring of conveyor idle time .
- In house timer arrangement for lighting systems
- Numbering system of LED lights at multi purpose halls , conference rooms to segregate the c i rcuit number wise
- Sunroof (Utilization of Day light) at workshop.
- Conventional fans switched to BLDC

Idea generation Session

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