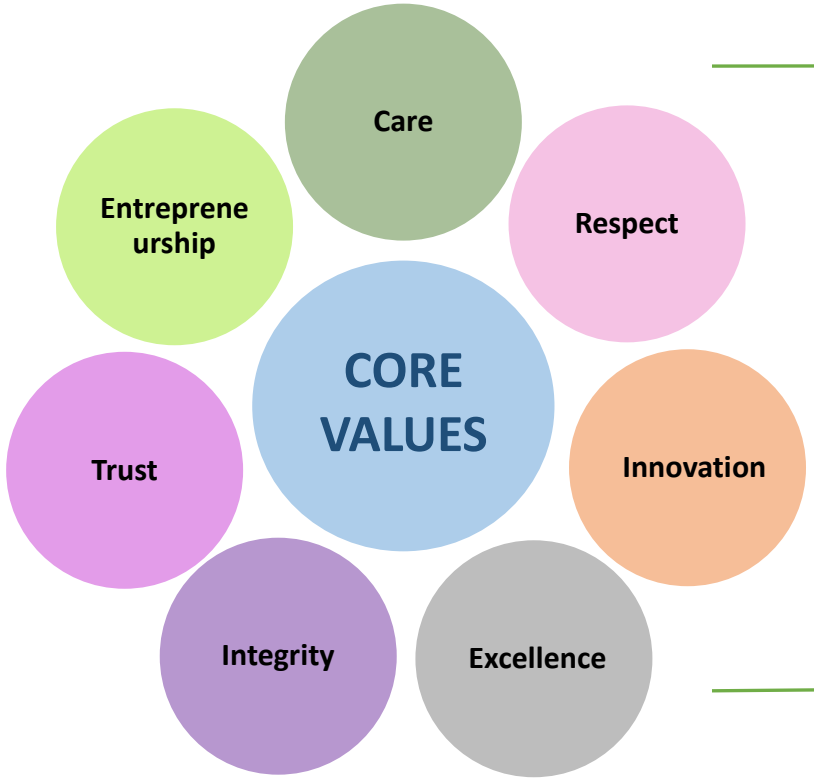


CII Award for Excellence in Energy Management – Metal Sector

Bharat Aluminium Company Limited

Date: 24 -Aug'22

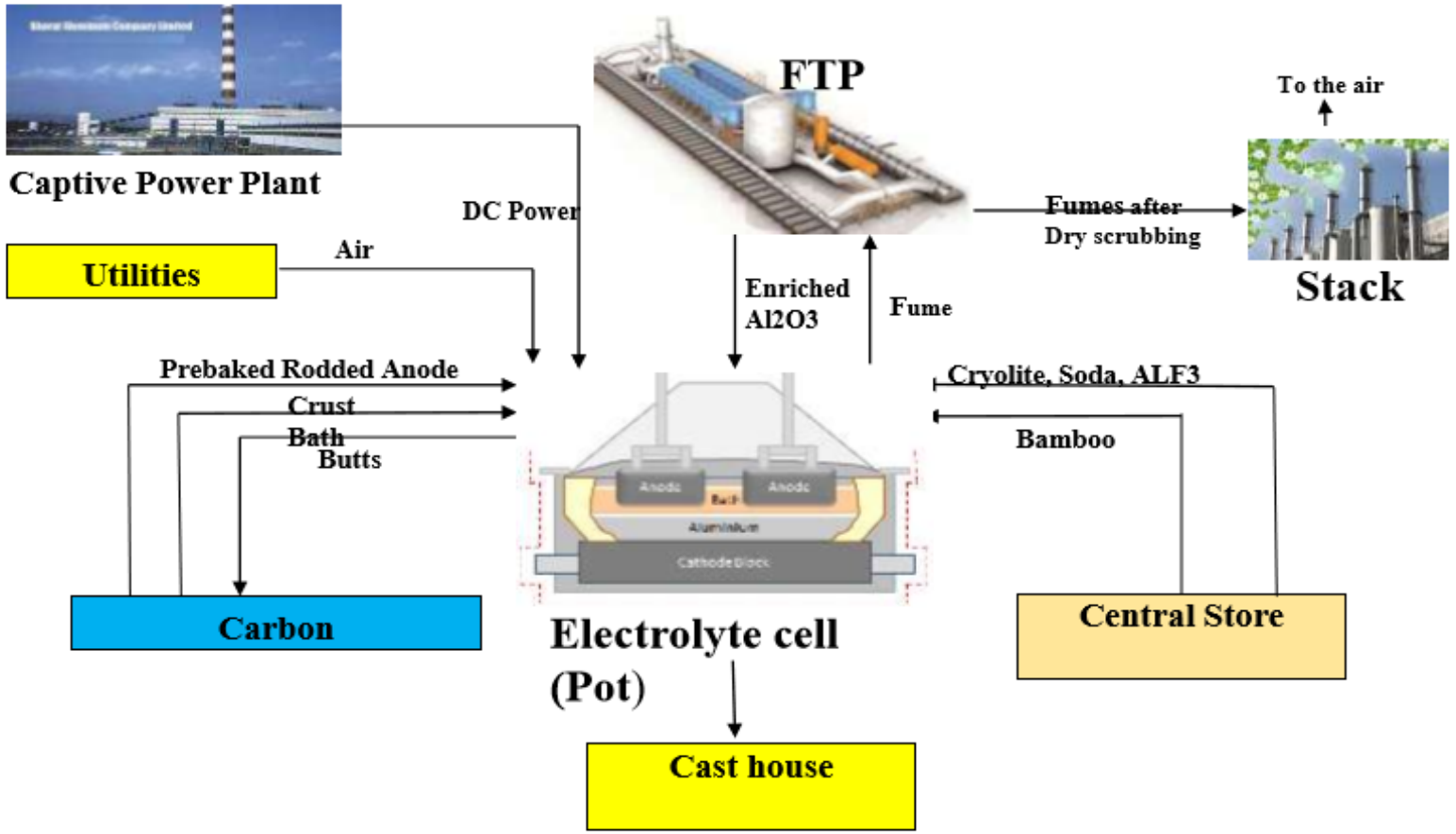
Prakant Sinha- Associate General Manager
Anish Rao- Deputy Manager

BALCO-A Snapshot

- **Bharat Aluminium Company** (BALCO) has made significant contributions as the **1st PSU** in India's Aluminium sector Incorporated in 1965, **BALCO** is India's first integrated Aluminium business.
- One of the first disinvestments of the Government of India. It now a part of Vedanta Limited, with 51% stake held by Vedanta Limited and 49% held by Government.
- Balco is based in Chhattisgarh State having Captive Bauxite mines in Mainpat and Kawardha, Captive coal mines in Chotia, 2010 MW power generation capacity and 5.7 LTPA Aluminium Smelting capacity at Korba Complex.
- Balco produces Wire Rods, Ingots, Alloy Rods, Alloy Ingots and Rolled Products. Balco is also selling Power to State Utilities & own sister concerns.
- Balco has been India's first to have - Captive Power Plant, to venture into +300 kA Prebake pots, to produce Alloy Rods for conductors used in power transmission industry, to roll material for Aerospace Industry, online riser replacement, busbar insulation in Pot Room, single beam implementation and holds patent for aluminium cell fuse technology.

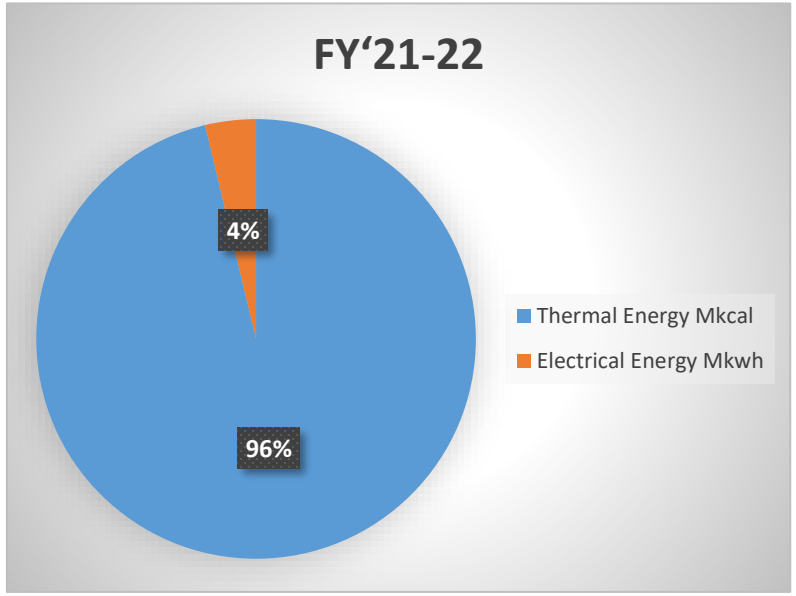
PANDIT NEHRU THEN PRIME MINISTER OF INDIA SIGNING AGREEMENT WITH USSR.FORMALLY STARTING KORBA ALUMINIUM PROJECT.(FORMER NAME BALCO)

Pot line Process Flow



Technology Provider –

Potline1 GAMI (320KA),
Potline2 GAMI (340KA)



Prebaked smelting processes (Hall Heroult) involve electrolytic reduction of the Alumina by Carbon to Hot metal and Carbon dioxide.

$$2\,Al_2O_3\,(dissolved) + 3C(s) \longrightarrow 4Al(l) + 3CO_2(g)$$

ENERGY OBJECTIVES (FY 22) :

- Reduce Net AC Power consumption for

  Potline-1 (13031 KWH/MT to 12958KWH/MT) - 73 kWh MT
  Potline-2 (13325 KWH/MT to 13094 KWH/MT) -231 kWh/MT

- Reduce Auxiliary Power Consumption of potline-1 from 400 to 379 KWH/MT- 21 kWh/MT

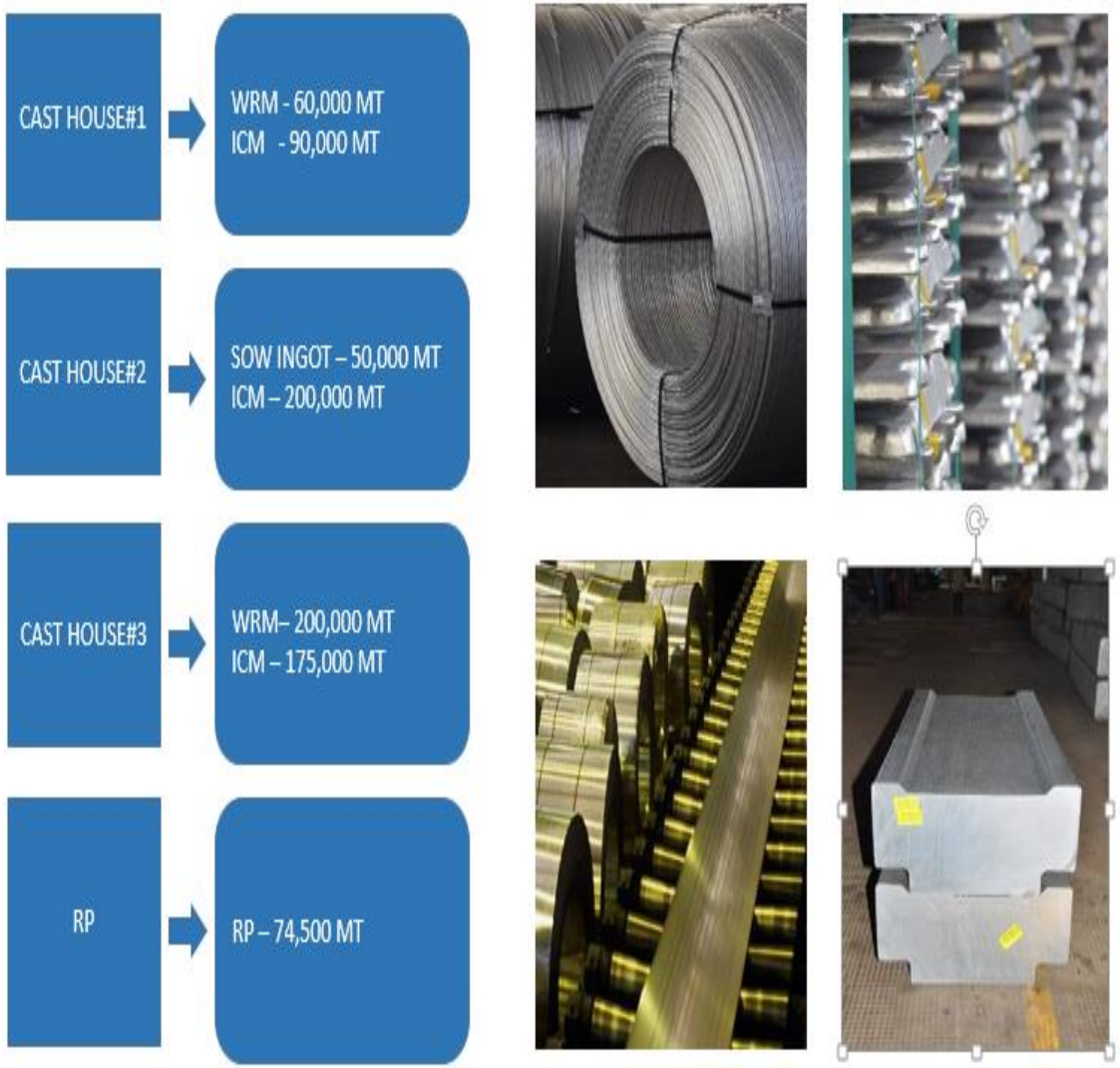
- Reduce Auxiliary Power Consumption of Potline-2 from 521 to 460 KWH/MT - 61 kWh/MT

ENERGY OBJECTIVES (Vision FY25)

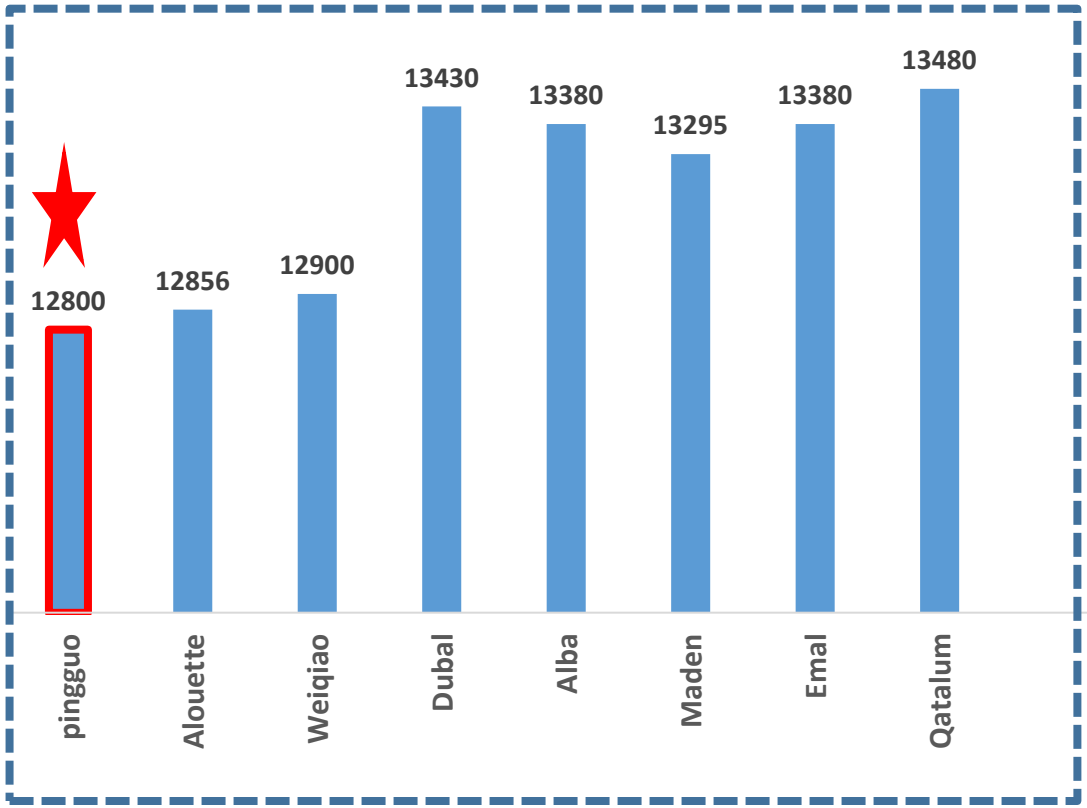
- Reduce Net Power consumption – 12865 kWh/MT of Al

- Reduce Auxiliary Power Consumption of potline-1 -82 kWh/MT

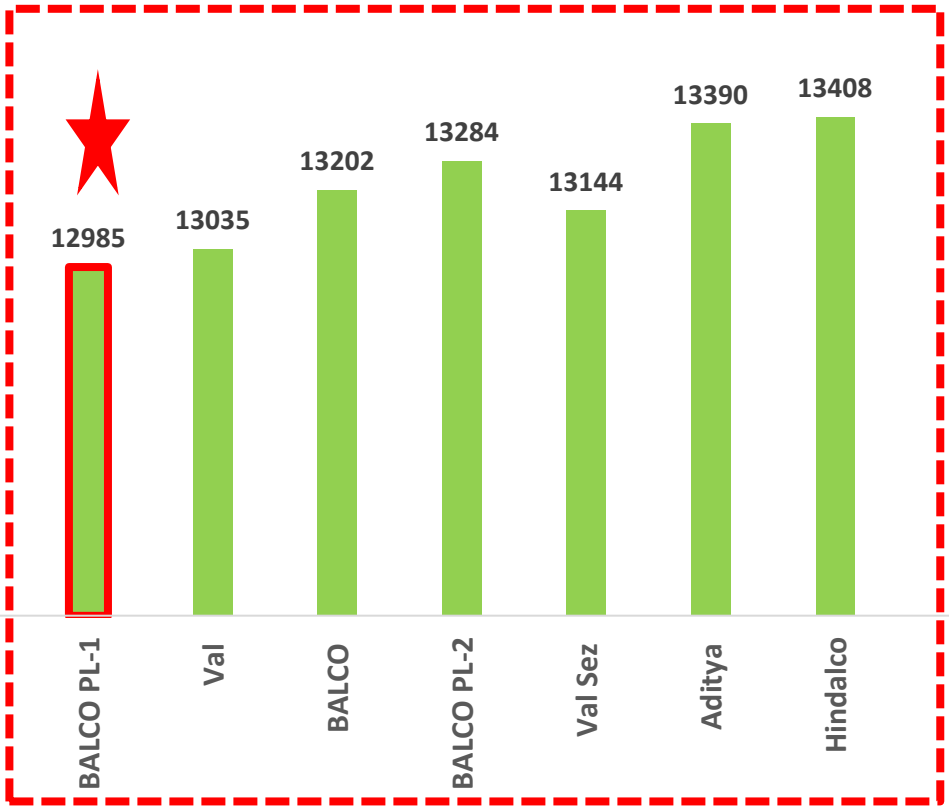
- Reduce Auxiliary Power Consumption of Potline-2 - 124 kWh/MT



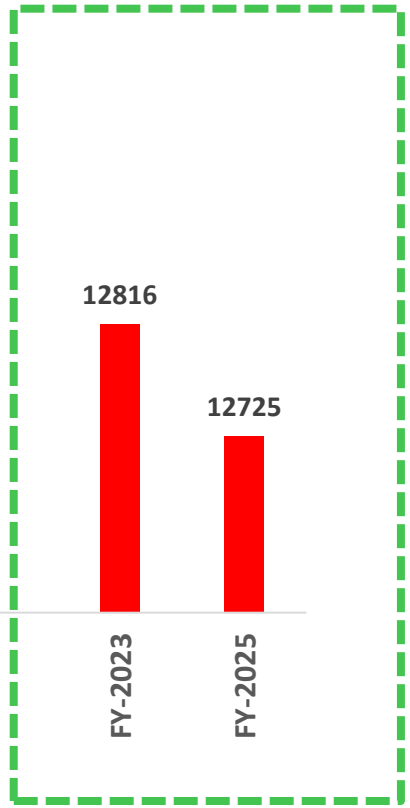
Pot-line DC Specific-Power kWh/MT & Benchmarking



International Benchmark



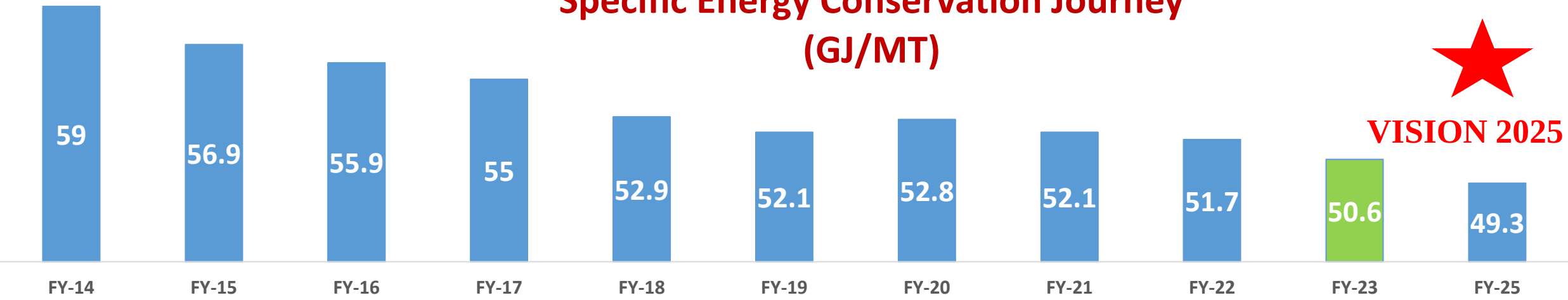
National Benchmark



BALCO Vision

** Balco is benchmark in Indian & Gulf smelters in DC Specific Power Consumption

Specific Energy Conservation Journey (GJ/MT)



S. No.	Major Projects / Action Plan for Vision FY25	Power Saving	Unit	Target Completion
1	Installation of 100% graphitized Cathodes	228	Kwh/MT	Mar-23
2	Up gradation of Pot-control system in Pot-line 2	417	Kwh/MT	Mar-23
3	Replacement of conventional motors with energy efficient motors	230	Kwh/MT	Mar-25
4	Reduction of Stub Carbon drop , High Slotted Anode	33 & 57	Kwh/MT	Mar-24
5	Reduction of Auxiliary energy Consumption PL-1 & PL-2	21&61	Kwh/MT	Mar-23

Major Energy Conservation Projects-2020

S.No	Title of Project	Annual Energy Saving Million KWH	Investment Million INR
1	Increase in Potline1 Current Efficiency from 94.28% to 94.65% to save 56KWH/MT	11.02	NIL
2	Cathode upgrade & Process optimization in Potline-1 40 pots in FY 20(55KWH/MT).	12.53	304
3	Increase in Pot line 2 Current Efficiency from 93.85% to 94.38% to save 79 KWH/MT	10.98	NIL
4	Cathode upgrade & Process optimization in Potline-2 102 pots in FY 20.(142KWH/MT).	15.55	561
5	Bake oven-Duct leakage arresting in FTP duct leading to a a reduction in ID fan speed by 2 %.	0.12	NIL
6	Ach Potline-2 Reduce the operating pressure of pumps in line 2 compressor pump house by VFD installation)	0.08	1.6
7	GAP- HTM heater oil change	0.08	NIL
8	Foundry -Optimizing Temperature set point of all holding furnace	0.01	0.03
	TOTAL (ROI- 18 Months)	**50.37**	**866**

Major Energy Conservation Projects-2021

S.No	Title of Project	Annual Energy Saving Million KWH	Investment Million INR
1	120 (PL 1 : 45 pots & PL 2 :75 pots,) 100% graphitized pots installation & Normalization	79.1	138
2	Reduction in Sp Aux consumptions by 19 kwh/mt (F20 : 479 to BP21 - 459)	3.58	2
3	Auto Cut off EMS whenever furnace tilts up in Cast house 1	0.03	NIL
4	Optimizing furnace temperature set point by operational excellence in cast House 3	0.44	NIL
5	Optimization of annealing furnace cycle time from 9 Hr. to 7 Hr.	0.02	NIL
6	Reduction of compressed air Usage in cast House 3	0.24	NIL
7	Closed loop system in pump house in cast House 3	0.51	35
8	Optimizing furnace temperature set point by operational excellence	0.44	NIL
	TOTAL (ROI- 18 Months)	**84.36**	**175**

Major Energy Conservation Projects-2022

S.No	Title of Project	Annual Energy Saving Million KWH	Investment Million INR
1	120 (PL 1 : 43 pots & PL 2 :77 pots,) 100% graphitized pots installation & Normalization	82.7	1440
2	Reduction in Sp Aux consumptions by 15 kwh/mt (Mar'21 : 454 to BP21 - 440)	1.13	NIL
3	Idle running hours reduction of roller conveyors(10 conveyors)	0.01	NIL
4	Cast House Reduction in compressed air consumption	0.22	NIL
5	GAP Throughput Increment	0.04	NIL
6	Led Replacement	0.66	2
	TOTAL (ROI- 15 Months)	**84.76**	**1442**

Major Energy Conservation Projects-2023

S.No	Title of Project	Annual Energy Saving Million KWH	Investment Million INR
1	110 (PL 1 : 14 pots & PL 2 :37 pots,) 100% graphitized pots installation & Normalization	1.2	510
2	Reduction in Sp Aux consumptions by 15 kwh/mt	16	65
3	Reduction in Stub to carbon drop by 33 kwh/mt -	7.9	NIL
4	Reduction in High Slotted Anodes by 57 kwh/mt	7.8	561
5	Reduction due to ALPSYS by 350 kwh/mt -	32	900
6	Process Optimization –(Voltage Gain, Enhancement of CE)	32.6	NIL
7	Gap process Optimization	0.78	NIL
8	SRS & Foundry process Optimization	2.0	NIL
9	Cast House Reduction in compressed air consumption	0.9	NIL
	TOTAL (ROI- 18 Months)	**53.27**	**2036**

Description

Aluminium manufacturing is done through Electrolytic process which involves huge power consumption of up 13500-14000KWhr/MT of AL. It is thereby necessary to explore all possibilities to control the consumption and reduce Carbon Footprint. Power consumption of potline is measured thus

DC Energy consumption= Gross Voltage(in V)/CE%*Kh of Al prod./hr*KA

Scope of project

Reduction of Voltage by even 0.005V/Cell will give a huge margin to reduce Power consumption by 15Units. Voltage is required in aluminum production to drive the current through the reduction cell. In practical application its seen that voltage required to run the reduction cell is more than the theoretical value. This is mainly to overcome various losses and resistance of mediums involved in the electrolytic cell. One such huge scope is in Anode voltage Drop.

Various drops in the total Anode Drops are Clamp drop, Stem to Clad, Clad to Stub, Stub to Carbon, carbon drop. This trial is based on the actions taken to reduce drop between Stub to Carbon.

Drops Measured and scope Identification

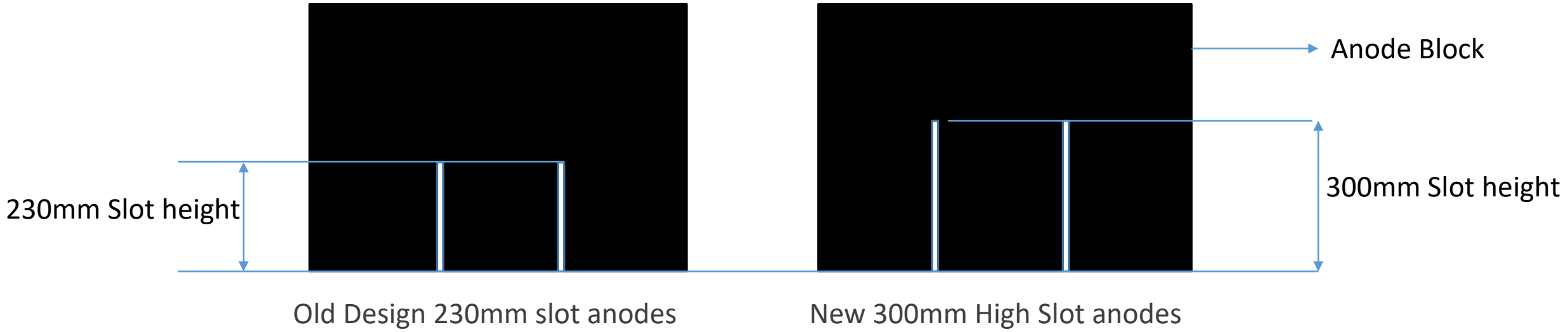
Drop specification	Drop Values	Contribution
Anode clamp drop reduction	20	5%
Stem to Clad drop reduction	50	14%
Clad to Stub reduction	30	8%
Stub to Carbon drop	85	23%
Carbon Drop	180	50%
Total Anode Drop	**365**	

While benchmarking, Stub to carbon drop was found to have a huge scope for improvement

Target	3.3 - 3.7 %	0.6 - 0.9 %	0.5% max.	0.2 % max	2.7 - 3.2 %	4.3 - 4.7	
	Carbon	Manganese	Phosphorus	Sulphur	Silicon	Carbon Equivalent	STC
Unit	%	%	%	%	%	%	mv.
BALCO	3.45	0.68	0.09	0.34	2.93	4.46	84
VAL,P-1	3.62	0.81	0.06	0.15	2.68	4.54	82
VAL,P-2	3.53	0.85	0.06	0.11	2.73	4.46	76
Benchmark (Alba Traget)	3 - 3.6 %	0.3 - 0.8 %	1.4 - 1.6 %	0.075% max	2.5 - 3.5 %	4.3 - 5.3%	
Alba Line-5 (Avg value)	3.27	0.56	1.45	0.04	2.59	4.61	56
Sohar							65

Modifications done

1. Increased Slot in Anode block from 230 to 300mm: Helps in reducing bubble drop and in AED reduction.



2. Modified Stub hole dimensions and No. of flutes

OLD STUB HOLE

MODIFIED STUB HOLE

	Normal Anodes	Modified Anodes
stub Outer Dia	190	205
Stub Inner Dia	180	190
Stub Depth	117	122

		Trial pots avg	Ref Pots	Ref section
SetV	Before Trial	4.121	4.117	4.126
	During Trial	4.113	4.129	4.139
Avg V	Before Trial	4.131	4.126	4.139
	During Trial	4.132	4.142	4.153
Noise	Before Trial	10.1	10.7	12.6
	During Trial	12.7	10.6	12.2
VF	Before Trial	0.1	0.4	0.3
	During Trial	1.6	1.4	1.3
AEF	Before Trial	0.24	0.04	0.11
	During Trial	0.18	0.14	0.14
AED	Before Trial	2.3	1.5	2.5
	During Trial	2.1	2.7	2.5
ALF3	Before Trial	48.7	60.5	45.1
	During Trial	48.0	60.0	49.6
BT	Before Trial	954.3	957.6	956.6
	During Trial	955.2	957.3	955.9
Mushroom	Before Trial	1.0	2.0	3
	During Trial	9.0	8.0	10
CE	Before Trial	94.9	95.3	95.1
	During Trial	96.5	93.1	94.8

	Trial Vs Ref	Trial VS sec	Trial Vs Ref %	Trial VS sec %	Remarks
SetV	-20	-21	-164%	-159%	SetV Reduced in trial Pots compared to Ref
mV					
Avg Volt	-14	-12	-92%	-90%	Avg Volt reduced by 13mv compared to Ref
mV					
Noise	2.7	3	-1%	-1%	Noise increase by 2~3mV but avg is within 13mV
mV					
VF	0.41	0.46	0.04%	0.05%	Swing/Day increased by 1.5mins/Day compared before trial
/pot/day					
AEF	-0.17	-0.09	-0.2%	-0.3%	AEF reduced compared to reference. Also brkr fdr issues
/pot/day					were there in 1601,1602 Trail pots
AED	-1.4	-0.18			AED lesser by>1min compared to Reference
/ae					
ALF3	-0.2	-5	0.0%	-0.1%	AlF3 reduced even upto 6Kg compared with Ref
kg/day					
BT	1.2	2	-0.4%	-0.2%	BT seems increased compared to Ref. Still in Range.
°C					
Mushroom	2.0	1	0.0%	0.0%	Mushroom increased compared to the sections trend.
					Probable Causes other than anode: PO, fdr lkg, brkr problems
CE	3.7	2			Increased current efficiency in trial pots compared to
					ref pots, ref section, same pots before trial period too.

2 Pots selected and the modified special Anodes were used. The results were compared with pots of the same age, and average of total section. Around 20mv impact in voltage reduction with significant reduction of 1min in AED too. Around 10mV of voltage reduction contribution from Stub hole modification, and the remaining 5-10mV through Increased Slot

	AVG STUB TO CARBON	Units
1601	64.4	mV
1602	79.5	mV
Average	72.0	mV
Difference from normal range	12	mV
Impact reduction in Pot V	6	mV
Energy Impact	18	kWhr/T of Al
Cost Benefit	106,117,460	Rs/Year

Innovation Project -2

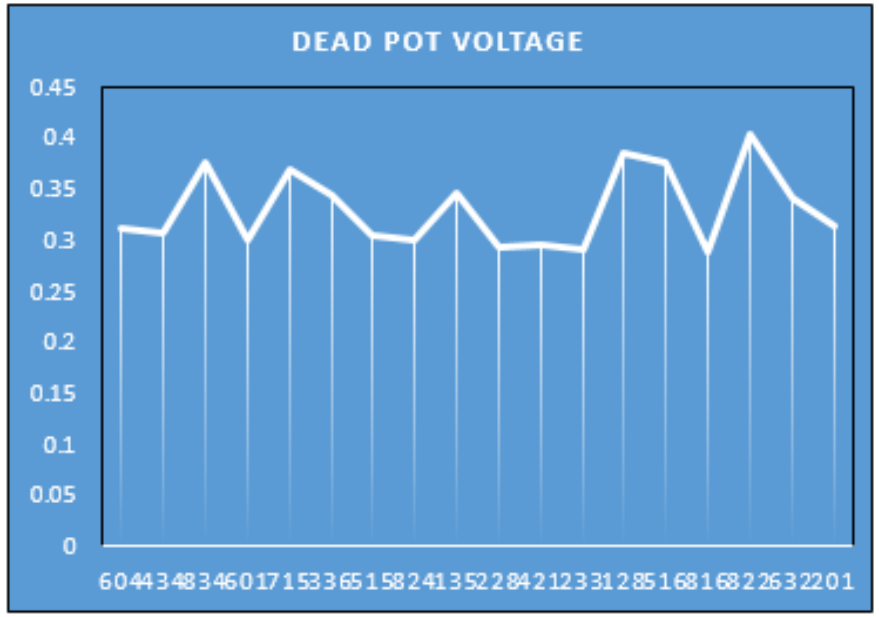
Description -Energy is the product of voltage, current and time and it is energy that has to be paid for, hence it is desirable to operate at high current efficiency and consume as little voltage as possible at the same time ,DC Energy consumption= gross Voltage(in V)/CE%*Kh of Al prod./hr*KA

Scope of project Voltage is required in aluminum production to drive the current through the reduction cell. After pot cut out from the circuit, ideally voltage of the dead pot should be zero but it has residual voltage. This is associated with the voltage drop across welding joints in alternative current flowing bus bars (Compensating bus bars), and also, lower cross section area coupled with higher current density in alternate current path (Compensating bus bars). So, In order to reduce dead pot voltage, following

1. Provide an alternate shorter current flow path which is having higher cross section and lower current density.

Dead Pot voltage trend before the project

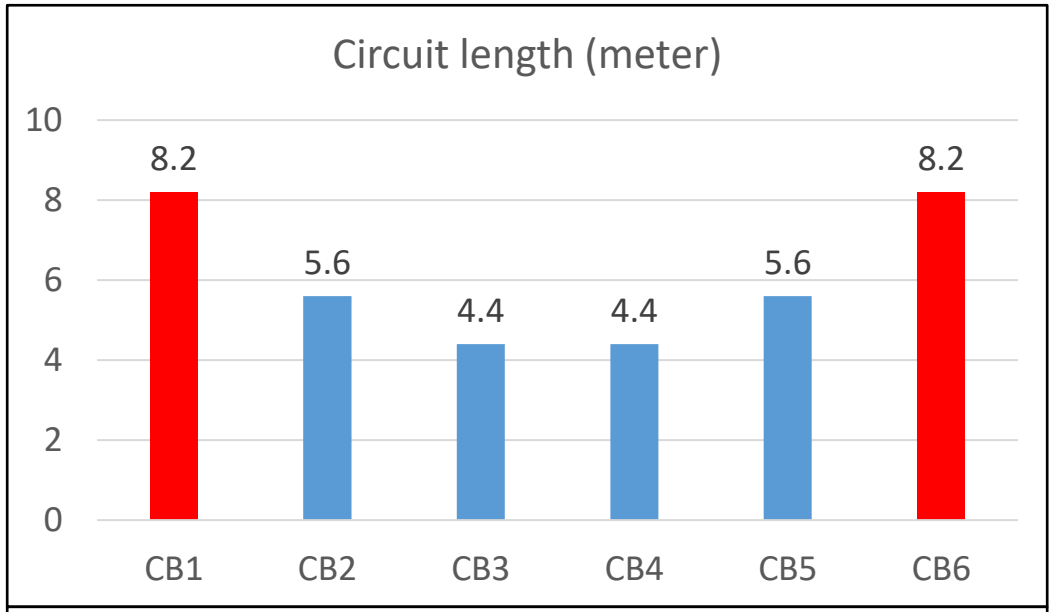
S.No.	CUT OUT DATE	Pot No	Cut Out Voltage
1	8-Jan-21	604	0.35
2	20-Jan-21	434	0.34
3	29-Jan-21	834	0.38
4	7-Feb-21	601	0.32
5	10-Feb-21	715	0.37
6	18-Feb-21	336	0.34
7	3-Mar-21	515	0.30
8	5-Mar-21	824	0.33
9	21-Mar-21	135	0.35
10	4-May-21	228	0.32
11	7-May-21	421	0.33
12	12-Jun-21	233	0.34
13	18-Jul-21	128	0.39
14	29-Jul-21	516	0.38
15	19-Aug-21	816	0.37
16	24-Sep-21	822	0.40
17	6-Oct-21	632	0.34
18	11-Dec-21	201	0.31
Average			0.35

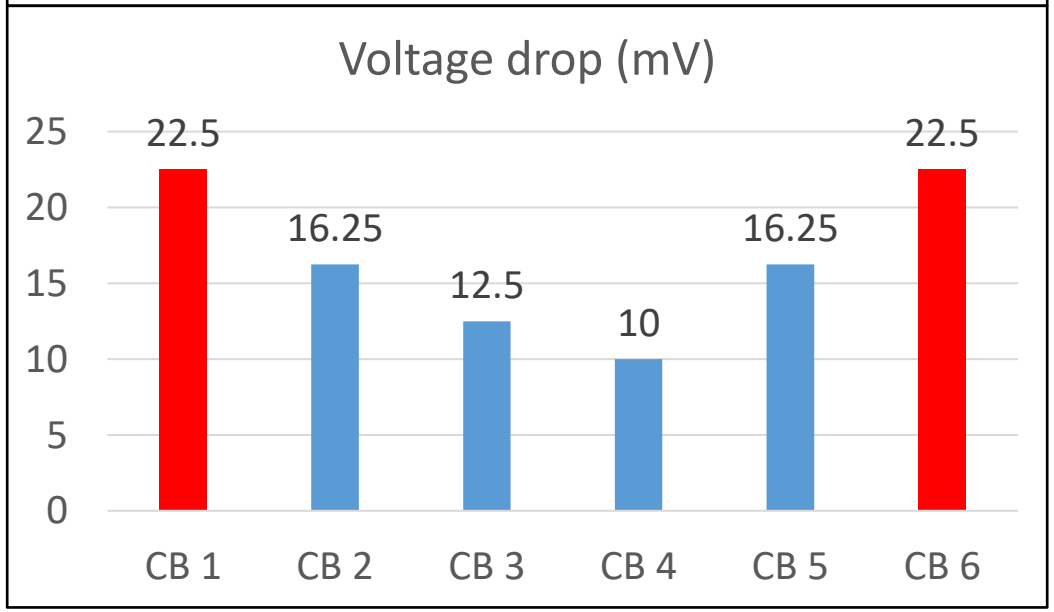


Contributing causes of higher dead pot voltage

Riser no.	CB	Circuit length (meter)	Number of joints
Riser 1	CB1	8.2	12
Riser 2	CB2	5.6	9
Riser 3	CB3	4.4	5
	CB4	4.4	5
Riser 4	CB5	5.6	9
Riser 5	CB6	8.2	12

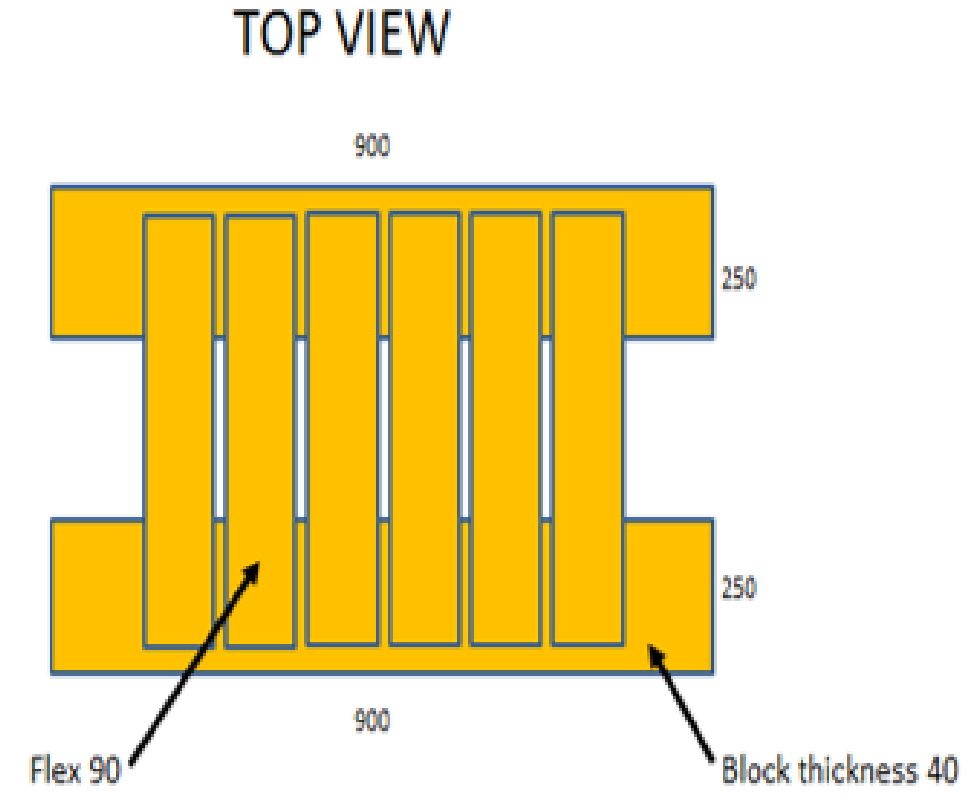
Riser no.	Compensating bus bars (CB)	Voltage drop (mV)
Riser 1	CB 1	9
Riser 2	CB 2	6.5
Riser 3	CB 3	5
	CB 4	4
Riser 4	CB 5	6.5
Riser 5	CB 6	9

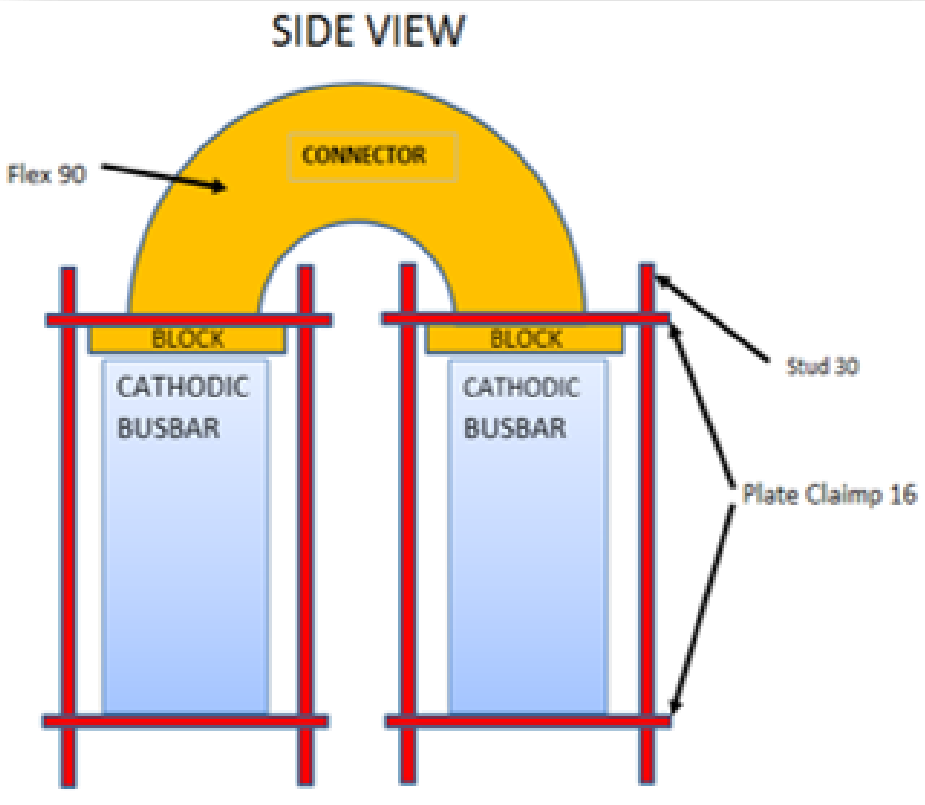




- Circuit length of CB 1 and CB 6 is highest, hence, current passing through this route will experience higher resistance.
- Welding joints are highest in CB 1 and CB 6, hence, current passing through this route will also experience higher resistance.
- Higher circuit length coupled with higher number of welding joints is accountable for higher voltage drop in CB 1 and CB 6 while the pot is cut out. Hence, it is decided to install a connector to divert the current from CB 1 and CB 6 to cathodic bus bars

Design development of bypass connector





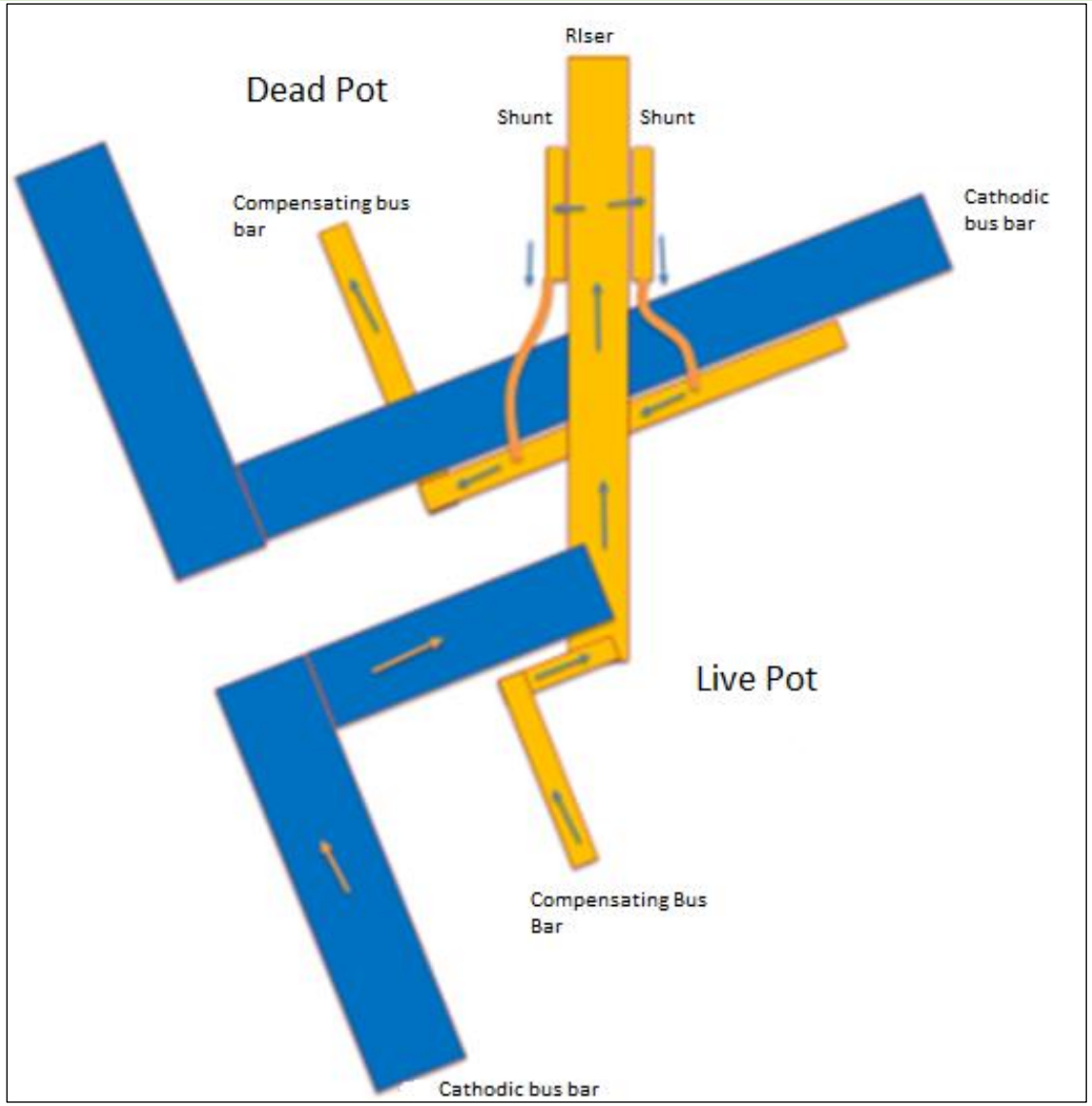
Aluminum Block Size 900*250*40 - 2 Nos.
Aluminum Flexibles size 90*10*285 to 785 - 90 Nos.

New Design connector Cross section 90*10*20*6 = 111000

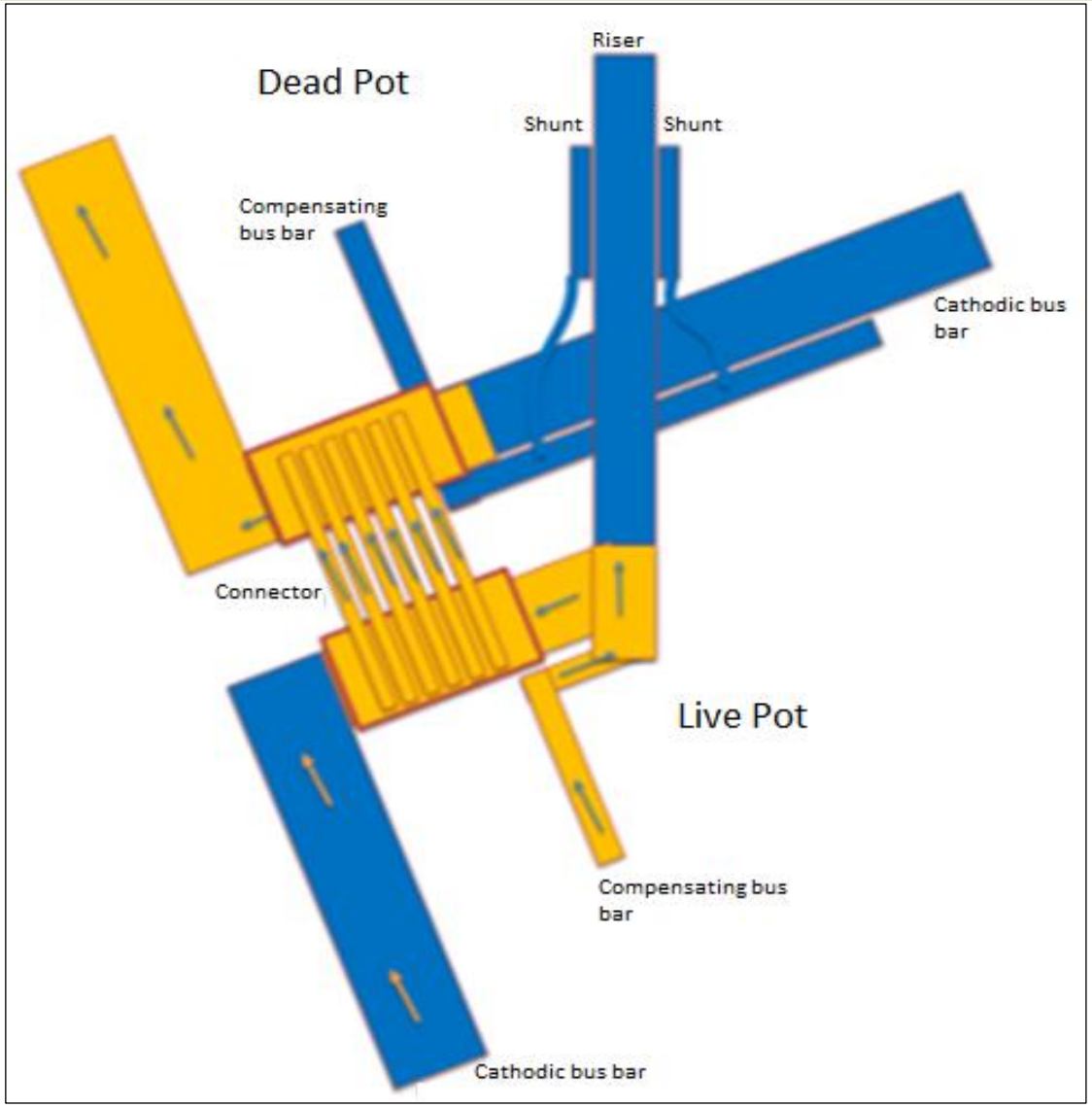
Compensating Bus-bar Cross section 300*250

= 75000

Current flow direction in from live pot to dead pot



Before connector placement

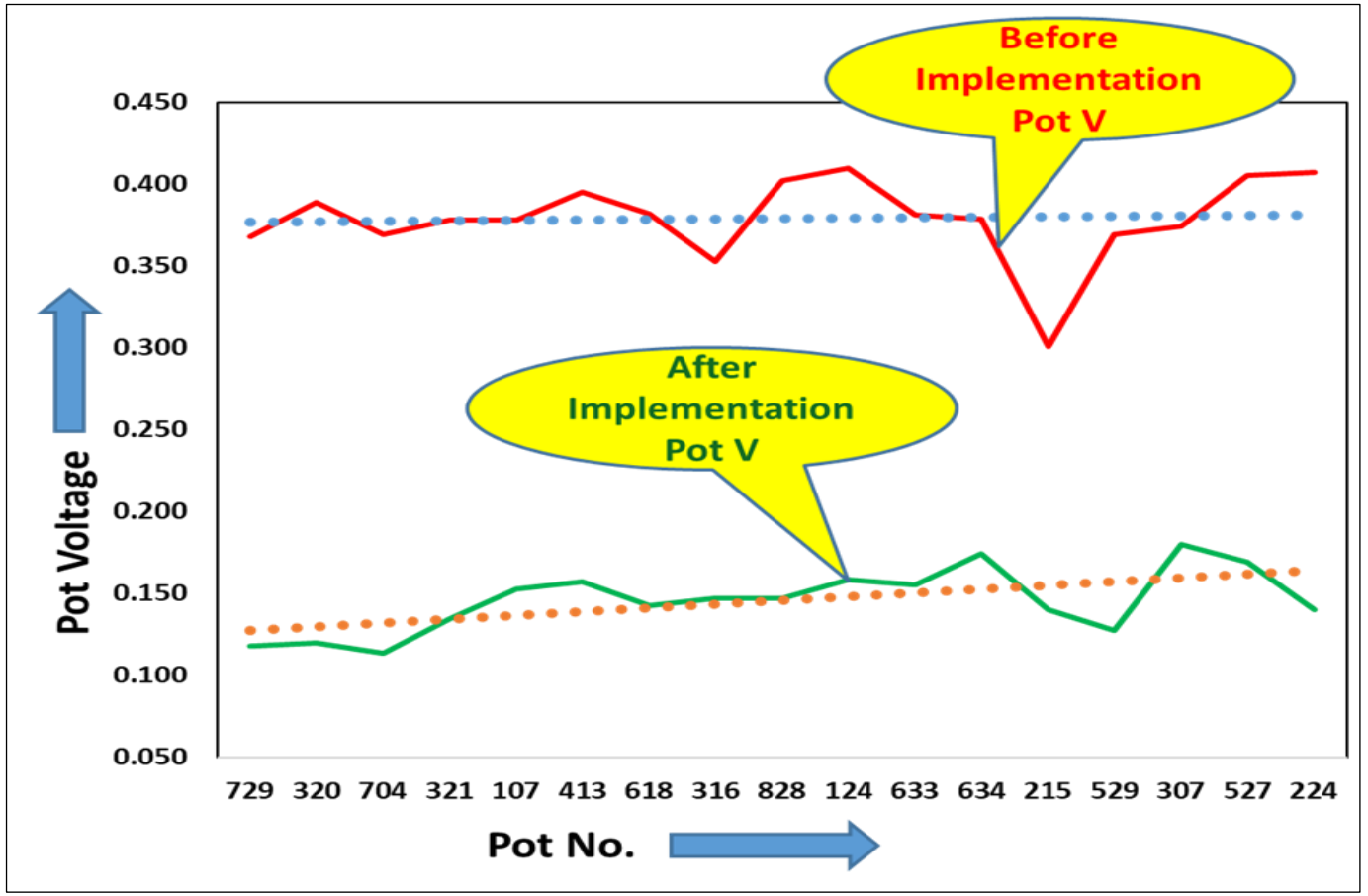


After connector placement

Reduction in dead Pot voltage after implementation & savings

Pot No.	Cut Out date	Before Implementation Pot Voltage	After Implementation Pot Voltage
729	30-Jan-22	0.368	0.118
320	05-Mar-22	0.389	0.120
704	12-Mar-22	0.369	0.114
321	24-Mar-22	0.378	0.135
107	14-Apr-22	0.378	0.153
413	30-Apr-22	0.395	0.157
618	10-May-22	0.382	0.143
316	21-May-22	0.353	0.147
828	26-May-22	0.402	0.147
124	30-May-22	0.410	0.159
633	12-Jun-22	0.381	0.155
634	17-Jun-22	0.379	0.174
215	26-Jun-22	0.301	0.140
529	29-Jun-22	0.369	0.128
307	06-Jul-22	0.374	0.180
527	14-Jul-22	0.405	0.169
224	26-Jul-22	0.407	0.140
Average		0.379	0.146

Savings/pot(mv)	0.234
Average shut down pot	9.2
saving(Mv)	2.2
Saving kwh/mt	7.1
Total Saving($/mt)	0.4



Fitch Fuel Catalyst use in HFO

Innovation Project title –Fitch fuel catalyst use in Bake oven and cast house .

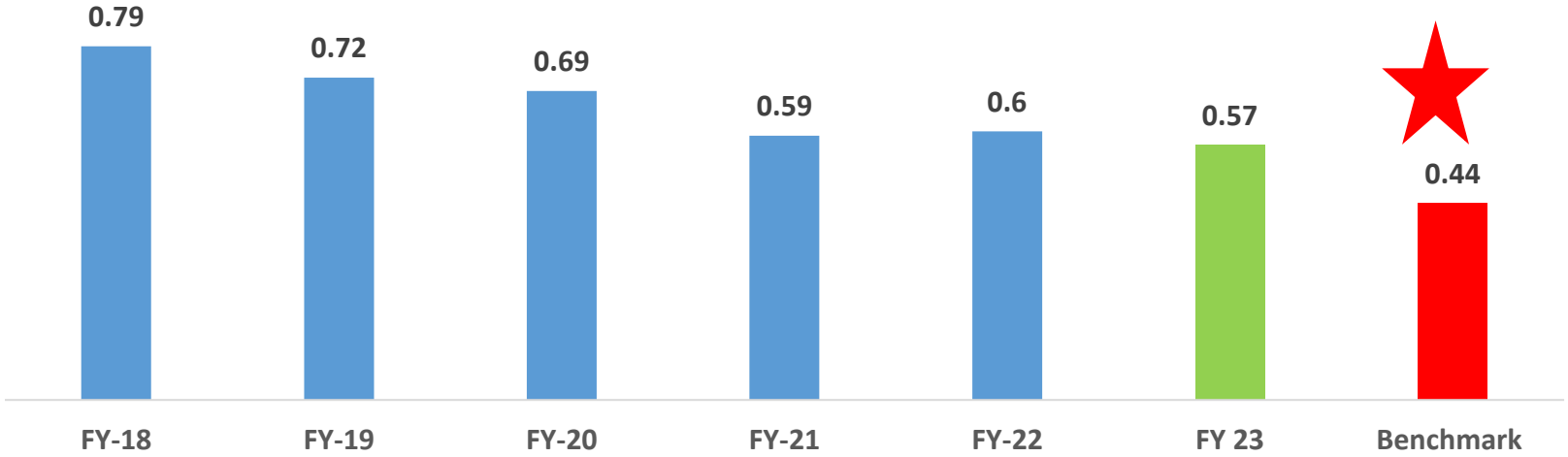
Date of Commencement –05-11-2021

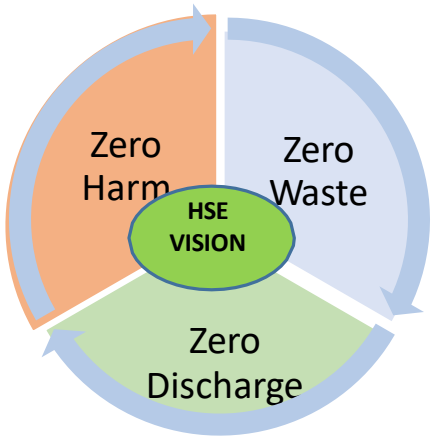
Date of Completion – 16-06.2022

1. **Trigger for the project** - In order to save HFO consumption and to reduce emissions in Bake Oven and cast house.
2. **Outcome expected by project implementation** –Improved combustion efficiency leading to 2-5% less HFO consumption and lesser emissions.
3. **Why the project is Innovative** – Currently no Aluminium company is using this kind of technology for fuel saving and lowering the emissions.
4. **The process deployed and innovation implemented -Benefits derived-** Around 5 to 10 % of fuel saving is expected by this with lower emissions then current situation.

Environment Management Initiatives

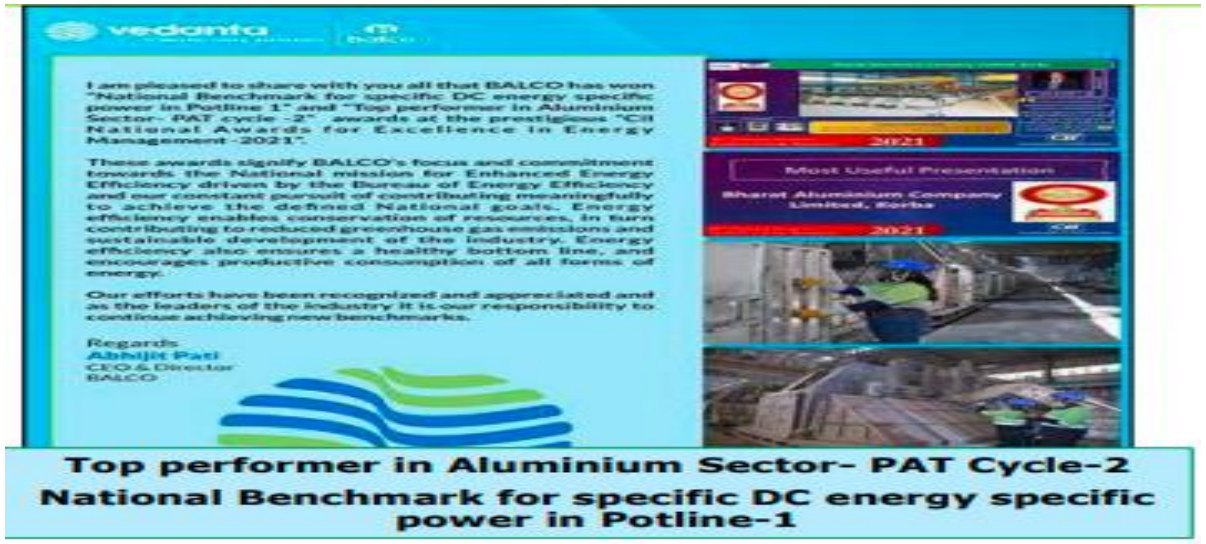
Specific Water Consumption (KL/MT)





Designated Consumer under PAT scheme for Aluminum Sector. PAT cycle -1 target over achieved by **0.088 TOE** (awarded 22203 EScerts).

Balco has topped in PAT Cycle-2 in Aluminium Sector across India. Highest no of Energy certified - 4.24 Lakhs


I am pleased to share with you all that BALCO has won "National Benchmark for specific DC energy specific power in Potline 1" and "Top performer in Aluminium Sector- PAT cycle -2" awards at the prestigious "CII National Awards for Excellence in Energy Management -2021".

These awards signify BALCO's focus and commitment towards the National mission for Enhanced Energy Efficiency driven by the Bureau of Energy Efficiency and our constant pursuit of contributing meaningfully to achieve the defined National goals. Energy efficiency enables conservation of resources, in turn contributing to reduced greenhouse gas emissions and sustainable development of the industry. Energy efficiency also ensures a healthy bottom line, and encourages productive consumption of all forms of energy.

Our efforts have been recognized and appreciated and as the leaders of the industry it is our responsibility to continue achieving new benchmarks.

Regards
Abhijit Pati
CEO & Director
BALCO

Most Useful Presentation
Bharat Aluminium Company Limited, Korba
2021

Top performer in Aluminium Sector- PAT Cycle-2
National Benchmark for specific DC energy specific power in Potline-1

Particulars	UOM	PAT Cycle -2
Notified baseline SEC (Period 14-15)	TOE/MT	5.3967
Notified target SEC	TOE/MT	5.0275
SEC Target for Reduction	TOE/MT	0.3692
Achieved SEC	TOE/MT	3.42
Energy Certificates achieved	Nos.	424421

GHG Inventorisation

Year	Scope 1 Emission Kg CO2 /Ton Final Product	Scope 1 Emission Kg CO2 /Ton Final Product	Kg CO2 /Ton Final Product
2014 - 15	21	2.3	23.30
2015 - 16	18.30	0.2	18.50
2016 - 17	18.87	0.03	18.90
2017- 18	17.32	0.27	17.59
2018-19	17.38	0.05	17.43
2019-20	17.79		17.79
2020-21	17.29		17.29
2021-22	16.75	0.26	17.03

Plantation Drive		
Year	Planted	Survived
2015-16	30000	25434
2016-17	30000	25000
2017-18	5000	4500
2018-19	5000	4500
2019-20	15000	12000
2020-21	10000	8000
2021-22	15000	14500

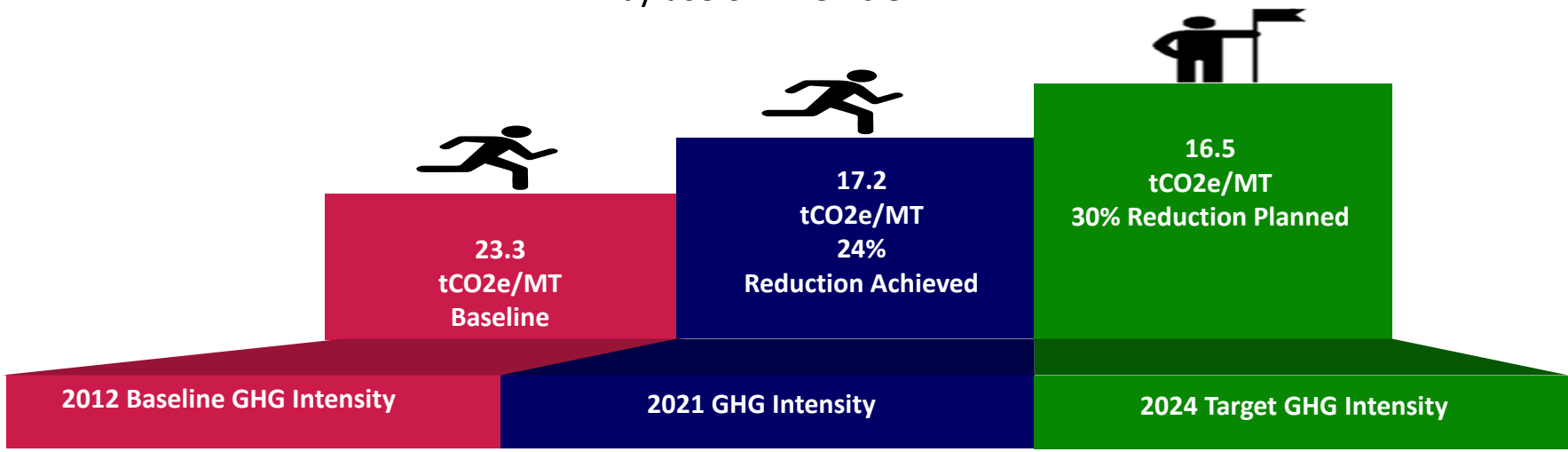
Scope -3 calculation

FY21 - 3Kg CO2 /Ton Final Product

Plan for E-Vehicle model to be adopted both in OPEX model. having plan to Change Battery Operated vehicle for shorter distance movement.

This will also optimize the transportation cost in longer term as right sizing led to 40% reduction in cost

Annual CO2 release amount is 3470000 Kg Co2 approximately per year which can replaced by use of E-vehicle



Waste to Wealth

MS Scrap	19.5 Cr FY22 YTD
Coke Dust	3.13 Cr FY21 YTD
Dross	8.7 Cr FY21 YTD
Others	6.4 Cr FY21 YTD

- 3224 MT/year Co-processing at M/s Green-mech Technology
- 1906 MT kept at SLF
- Drosses and waste from treatment of salt sludge - 7421 MT
- Used Oil sellout – 49.56 MT
- Empty barrels /containers/liners contaminated with Haz Chem Waste – 2532 Nos

	SPL Annual Generation 4320 MT	Al Dross Annual Generation 7421 MT
Short Term	Increase of Pot Life by improving operational efficiency	Maximising Al recovery by increasing utilisation of DPM to 95%
Medium Term	Set up of SPL Detoxification plants(Under CPCB Approval)	Achieved Melt loss 0.45 % Further reduction target- 0.35%
Long Term	Explore for Blast furnace injection as fuel, As Flux for Steel making or as reducing agent for slag cleaning	Install and Operate DPS which can recover metal of approx. 30-35% from hot Dross Processing

Utilization of Renewable Energy

- Grid connectivity for simultaneous import/ export to meet RP Obligation & ESG Commitments.
- 10 MWp Solar plant installation in 270 MW BCPP.
- Installed 33 KW Grid connected Solar power plant.

Short term : On opportunity basis, 310.36 MU of RE Mix purchased from grid.

Long term :

- 200 MW renewable mix tie up for BALCO smelter operation with Partner (Sterlite Power) by FY 25.
- 600 MW renewable mix tie up for BALCO Smelter operation to be completed by FY-30.
- Continuous purchase of Renewable energy Certificates from Exchange as per opportunity.

RPO Obligation Details

Year	Captive Consumption (MWh)	% of Obligation		Obligation in Units (MWh)	
		Solar	Non Solar	Solar	Non Solar
2020-21	7996674	1.00%	6.25%	79,967	4,99,792
2020-21 (Import)	4990	6.50%	8.50%	324	424

Renewable Energy

- Biomass Pilot Trial taken successfully at BALCO CPP#2(4X135 MW) in month of June-20, total 125 tons of biomass was blended from 3% to 10 %to check technical feasibility as per MNRE guideline line.
- Biomass Co-firing initiated in May-22. Total 555 tons of biomass co-fired with coal till July'22.
- Co-firing to be resumed after Monsoon period. Total 0.692 MU generated till now via biomass co-firing.
- 5% biomass co firing to be done existing facility(1740 MW).

1A **Project Milestones**

May-22
Biomasss co-firing initiated against plan in sept-22

June-22
- Biomass co-firing initiation in 1200 MW PP.
- Floating of National level EOI for required Quantity.

Oct-22
Initiation & tie up for the long term contract for locking the vendors.

June-23
- R.M.Mapping through CSR initiatives.
- Achieve the 2-3 %(500-600tons/day) biomass availability by having long term contract.

Jan-24
Achieve the 3-4%(800-900 tons/day) biomass with CSR initiatives by establishing the biomass pallets manufacturing plant nearby plant premises.

Sept-24
- Biomass Firing implementation with 5% volume in 135 & 300 MW units in Balco.
- Handling, consumption & sustainable operation with available biomass Quantity.

Next steps

- **Tie up for the long term contract for locking the vendors and to be first mover in market.**
- **Mapping of raw material availability in nearby area through CSR initiatives and engagement to capture the RM quantity**
- **Engagement of Vendors established biomass briquettes/pallets manufacturing plant near to Balco to reduce landed cost and sustainable operation.**
- **Connect the new start up for biomass supply under Vedanta green Spark initiative.**

Green Supply Chain & Ongoing Plans with Various Vendors

SN	Initiatives	Savings IN Rs
1	Smart logistics for vehicles	1.1 Cr /Year
2	Saving Disel & consumable : Muffler & Gasket	8 Lakhs
3	Availability of LCM machine	8 Lakhs
4	Reduction in Ladle Dispatch cost	5 Lakhs

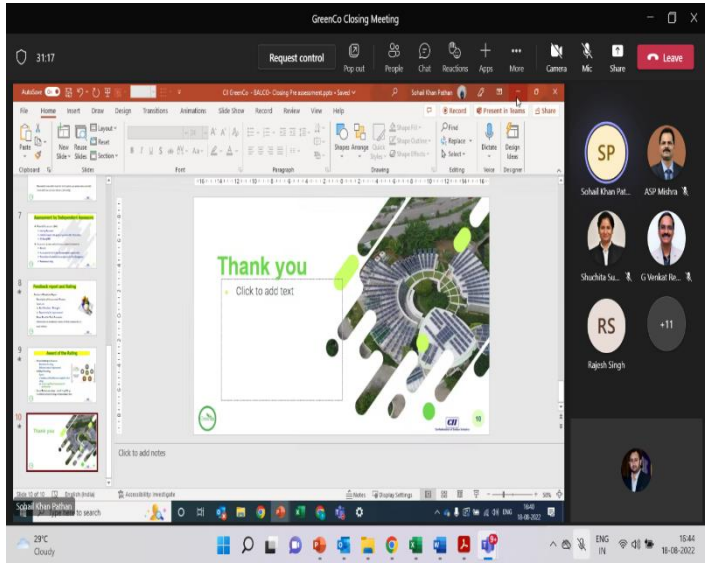
Sl. No.	Name of the Vendor	Description of the Collaboration / energy reduction initiative
1	SGL	For energy efficient cathodes
2	GAMI & AP	Pot controller upgradation
3	SKF	For energy efficient bearing & V-belts
4	EESL	Energy Efficient Motor replacement
5	Atlas Copco	Compressed Air Audit
6	Energy Audit	Mott Macdonald

Implementation of Best Practices

Idea Portal & !DEA@BALCO APP for generation of ideas for All Balco & Contract employees.

- Idea generated FY22 – 8576
- Idea accepted FY22 – 5116
- Idea implemented FY22– 5064
- Idea under implementation FY22 –3512

Green-co certification is on process with CII



CII assessor for Greenco pre-assessment done In BALCO plant –Date: 17th Aug-22 to 23rd Aug 22

Learning From CII

- **Closed loop Implementation in Pump Houses**
- **Compressor House Air line Interconnection HP & LP line**

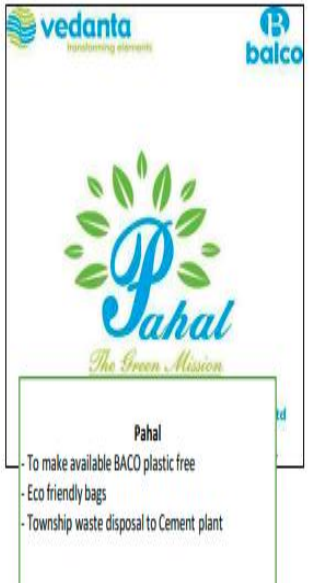
Rain water Harvesting

- Currently 5 rain water harvesting system installed in the plant & township.
- Combine water recharge is approximately 2000 m3/year.
- For Current year, Rain water harvesting cum Artificial wet land project has been taken up for Water harvesting and conservation of the biodiversity plan.

Green School Project
- Implemented in 11 school of BALCO
- 1st round assessment completed
- Next assessment delayed due to COVID 19

Green School Concept

- "Green School" is a vision statement involving efforts :
  - To reduce school's ecological footprints;
  - To make school environmentally sound;
  - To drive the whole community to think about solutions for the environmental problems we face;
  - To use the Precautionary Principle: "Prevention is better than Cure"
- Approximately 14 Schools are expected to participate with combine strength of 6000+ Students. The project would significantly increase Green Cover, low carbon footprint among schools, environmental awareness and Environment friendly sustainable alternatives in every aspect of schooling.



Energy Policy & Certifications

#	Description	Certification
1	Quality management system	ISO 9001:2015
2	Environment Management System	ISO 14001:2015
3	Occupational Health & Safety Management System	ISO 45001:2018
4	Energy Management System	ISO 50001:2011
5	Asset Management System	ISO 55001:2014
6	Quality Management System for the automotive industry.	IATF 16949
7	Information Security Management System(ISMS)	ISO/IEC 27000:2013
8	NABL accredited Lab	ISO 17025:2005
9	Social Accountability	SA8000

POLICY NO.: BALCO/POLICY/01 **ISSUE NO. :07** **ISSUE DATE: 03.02.2022**

At BALCO, we are committed to the effective management of health, safety, and the environment as an integral part of our business. The health and safety of our employees and any other person who may be impacted by BALCO's operations are of paramount importance and our aim is zero harm to people and minimal impact to the environment.

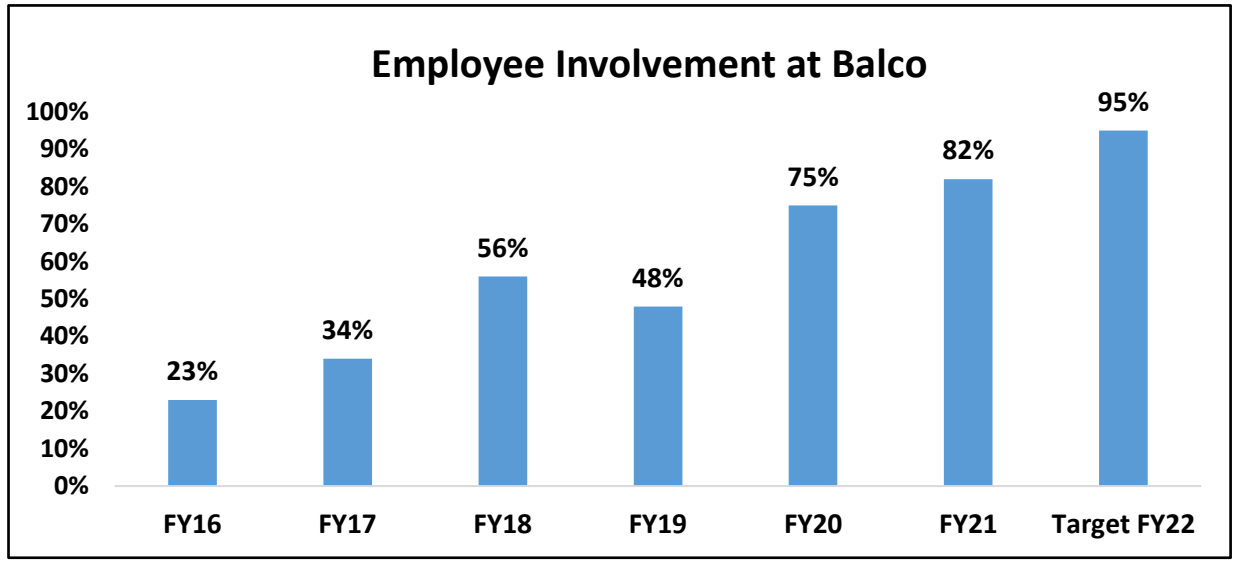
BALCO strives to:

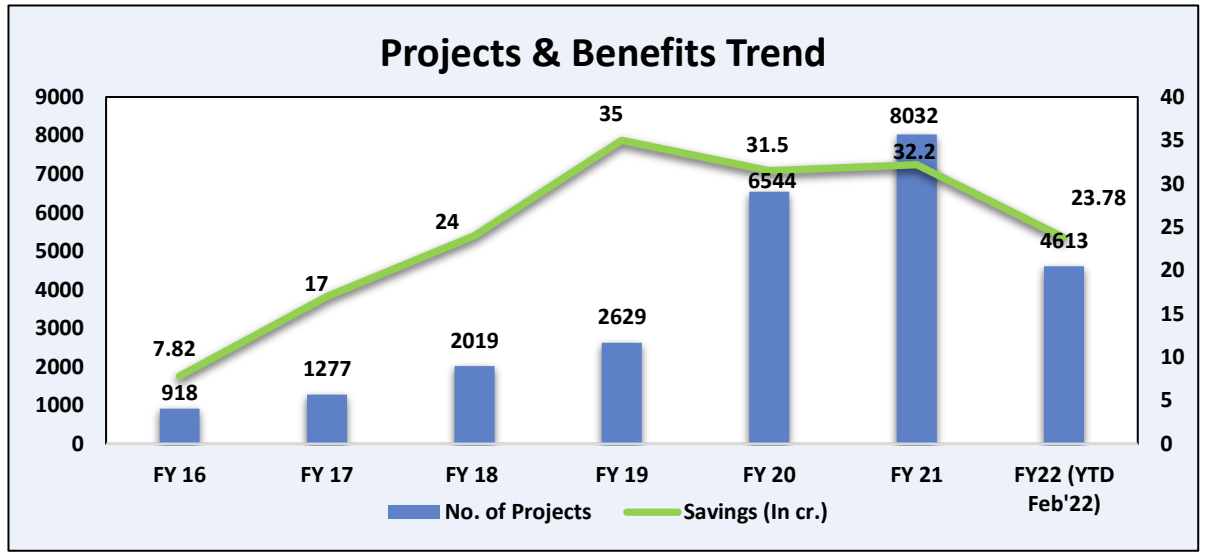
- comply with applicable national, regional, and local Health, Safety, and Environment (HSE) regulations and statutory obligations. In the absence (or lack) of appropriate legislation, industry best practices and standards will be used;
- prevent injury and ill-health to employees and business partners by providing a safe and healthy work environment and minimising the risks associated with occupational hazards;
- implement regular health surveillance and risk-based exposure monitoring of employees;
- avoid, reduce or mitigate impacts to the environment and neighbouring communities and where feasible improve and enhance environmental conditions;
- conserve natural resources by adopting environmentally-friendly and energy-efficient technologies and through process improvements;
- eliminate existence of hazardous substances from the workplace through effective administrative and engineering controls
- commit to taking responsibility when conducting our business by integrating environmental, social and governance (ESG) factors into our operational processes;
- manage waste from our operations and adopt the principles of waste avoidance, reuse, recycling and beneficial utilisation to minimise discharge and disposal to the environment;
- consistently assess our climate-related risk, manage our emissions, take appropriate mitigation and adaptation measures and communicate our climate strategy to our stakeholders;
- ensure that all tailings' storage facilities are designed, constructed, operated and closed in compliance with all applicable laws and regulations and alignment with accepted international practice;
- develop, implement, and maintain HSE&S management systems aligned with our commitments and beliefs and consistent with world-class standards;
- drive continuous HSE&S improvement through setting and reviewing targets using appropriate best available practices and providing all employees with appropriate training;
- promote a positive HSE&S culture through effective communication, participation and consultation with employees and business partners;
- influence our business partners and suppliers to adopt principles and practices in alignment with our policies;
- communicate with all our stakeholders on the progress and performance of HSE&S management.

Business leaders will be held accountable for HSE&S performance and line managers are responsible for the full implementation of the related HSE&S standards. We will measure and report performance on a periodic basis to ensure ongoing management of health, safety, environment, sustainability and quality including the sharing of good practices throughout the organization. The content and implementation of this policy will be reviewed periodically.

Creating Awareness Among Stakeholders

Energy savings from Employee & Stakeholder Involvement





Details	Unit	2015-16	2016-17	2017-18	2018-19	2019-20	2020-21	2021-22
QCs & Kaizen Projects Implemented	No.	918	1277	2019	2629	6544	8032	4613
Energy Savings	Kwh	4375000	26892304	59584971	25367013	31381627	8,48,70,225	8,42,25,659
Benefits due to energy savings	Rs. lacs	131	806	1788	887	1098	2907	2378

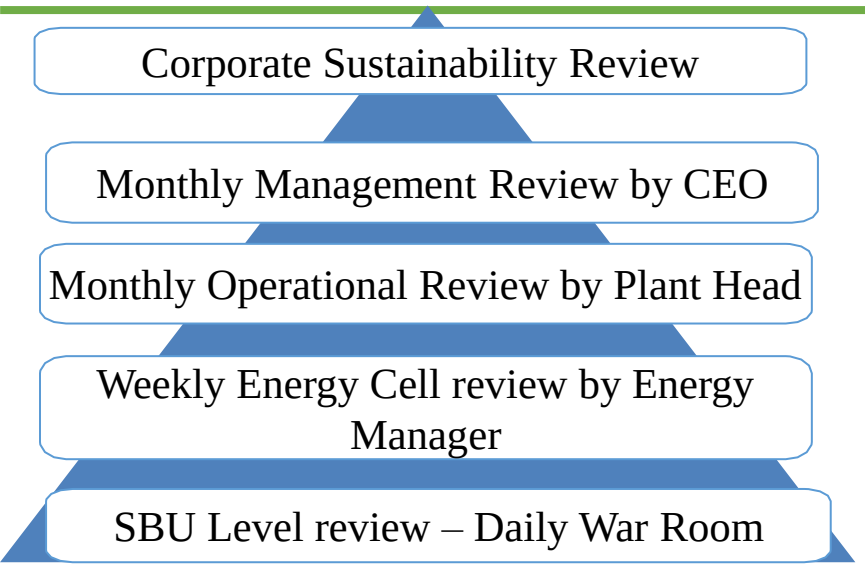
Status of EnMS (ISO 50001) Audit Observation

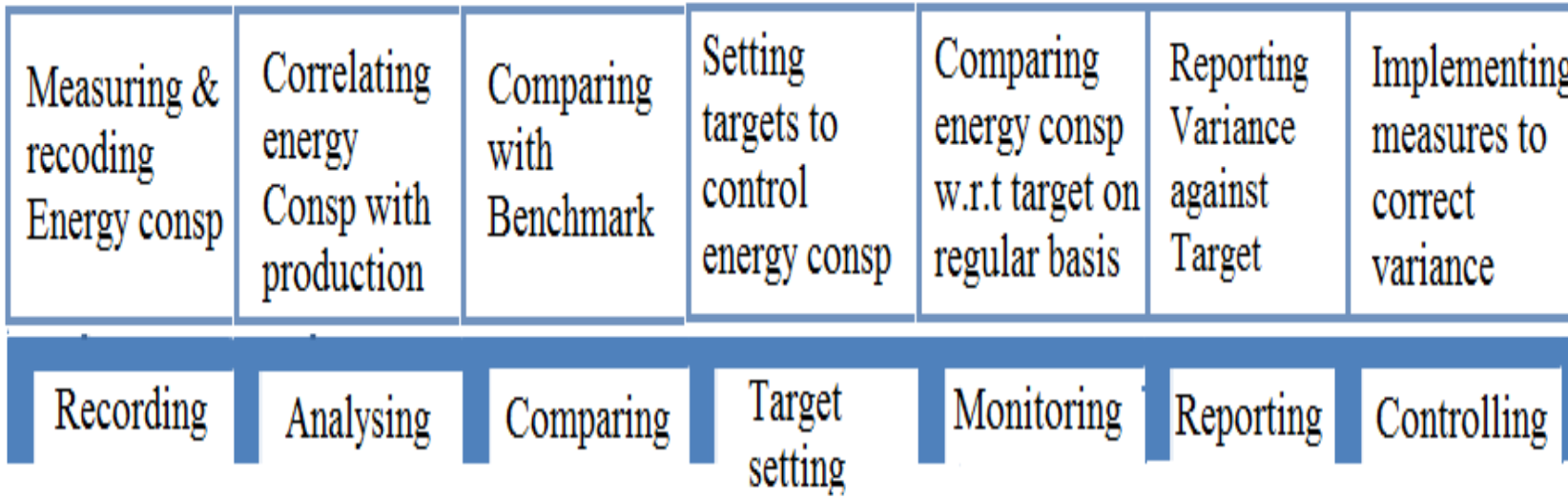
	Year	No. of NC	No. of Observation	Open NC	Open Observation
Balco	15-16	3	17	0	0
Balco	16-17	0	10	0	0
Balco	17-18	0	6	0	0
Balco	18-19	0	5	0	0
Balco	19-20	0	3	0	0
Balco	20-21	0	2	0	0
Balco	21-22	0	1	0	0

%Investment for Major Energy conservation projects on Turnover

FY	Project Description	Investment (Rs. Crs)	Turnover (Rs. Crs)	% Investment on Turnover	ROI (Months)
2018-19	Pot controller up gradation Pl-1 & Energy efficient cathode	183	9063	2.0%	20
2019-20	100% Graphitized Cathodes	138	10500	1.3%	18
2020-21	100% Graphitized Cathodes	101	9688	1.04	18
2021-22	100% Graphitized Cathodes	147	13607	1.08%	15
2022-23	Pot controller up gradation PL-2 ,Graphitized Cathodes & slotted anode	203	10000	2.03	18

Review Mechanism





Awards

Month	Award	Category	Agency	Category
Aug'21	Excellent Energy Efficient unit	BALCO	CII National Awards for Excellence in Energy Management	Balco wins Excellent Energy Efficient unit by CII National Awards for Excellence in Energy Management -2021
Aug'21	Most Useful presentation	BALCO	CII National Awards for Excellence in Energy Management	Balco wins Most Useful presentation by CII National Awards for Excellence in Energy Management -2021
Aug'21	2nd Price in CII Kaizen competition	BALCO	CII Kaizen competition	BALCO Bake oven team won 2nd Price in CII Kaizen competition 2021
Aug'21	International Green Apple Award	BALCO	The Green Organisation	Balco wins International Green Apple Award in Environment Category 2021
Sep'21	Leading director award	CEO	Green Tech	CEO and WTD of BALCO wins Greentech leading director award 2021
Nov'21	CII Encon Award	PP-1200MW	CII	Vedanta Limited – BALCO 1200 MW unit wins – Energy Excellence award for Chhattisgarh State