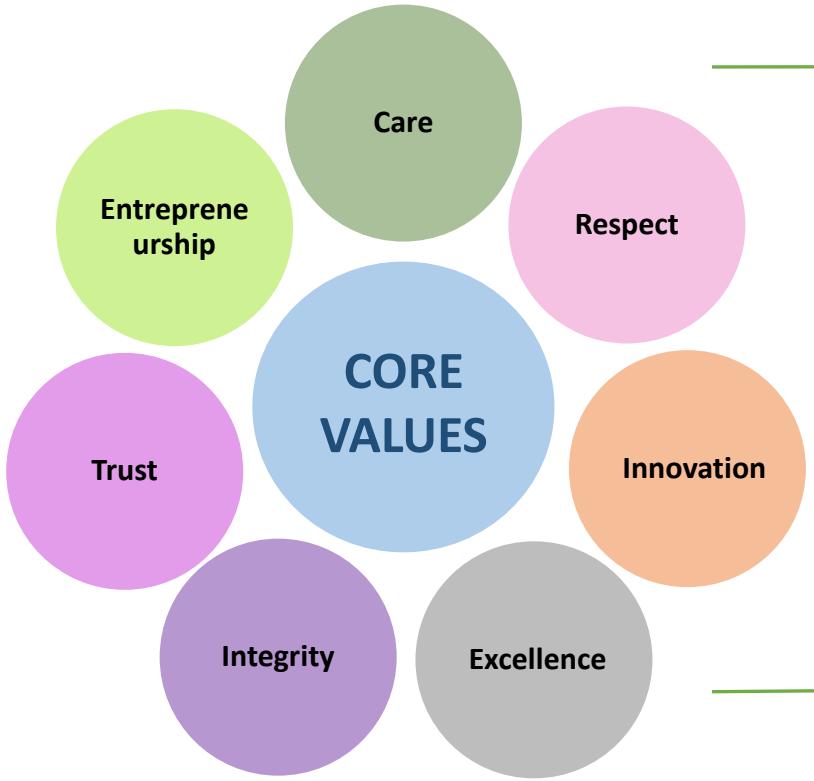


CII Award for Excellence in Energy Management – Metal Sector
Bharat Aluminium Company Limited

Sep'24

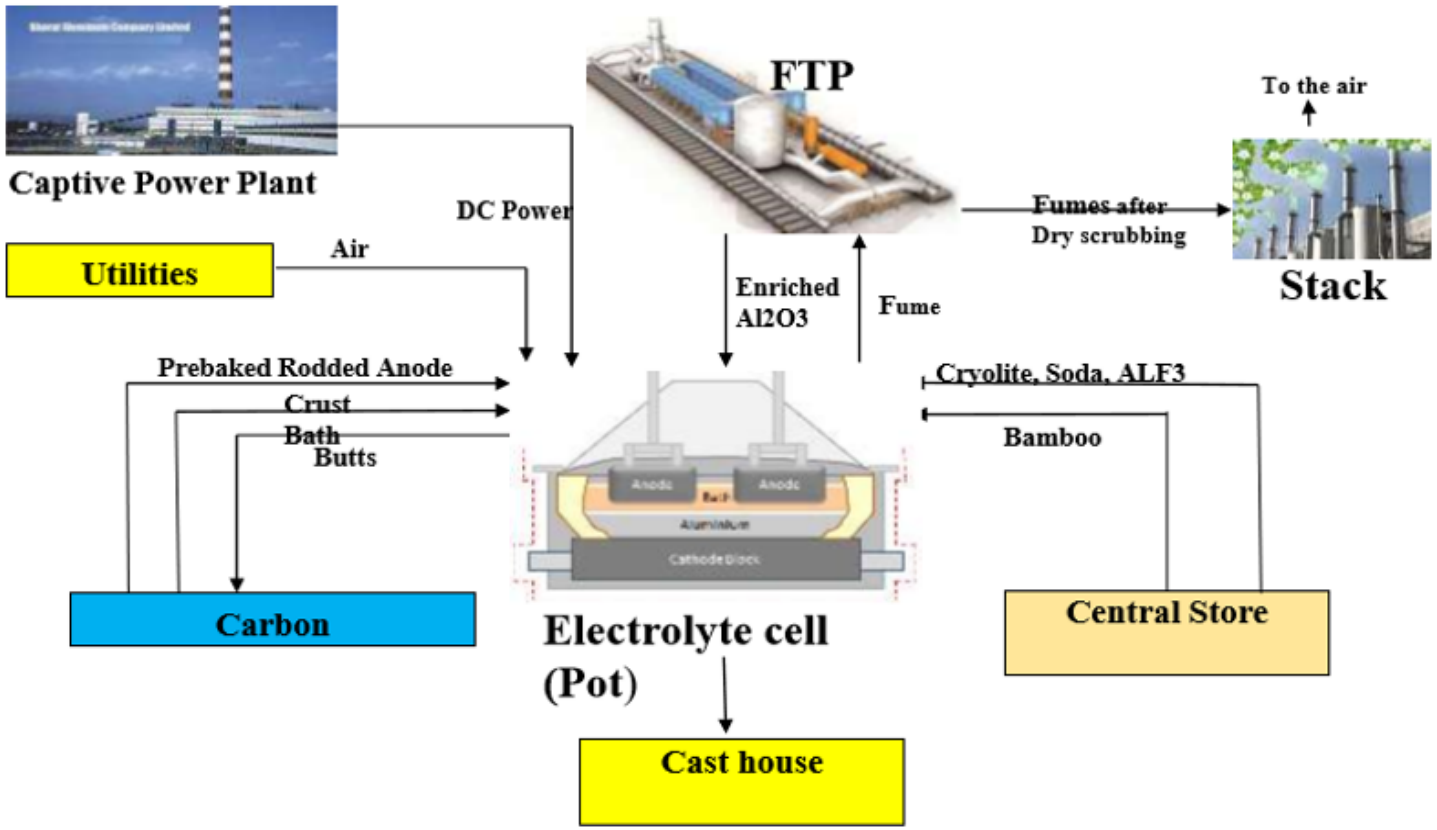
- Arvindh Ravindran– (Manager)
- Mukesh Kumar- (Dpty. Manager)
- Kariveda Sreekanth (Asst. Manager)

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.
- BALCO is currently in installation of a +500 KA smelter Potline first of its kind in INDIA expected to come in to operation from Feb-Mar'25

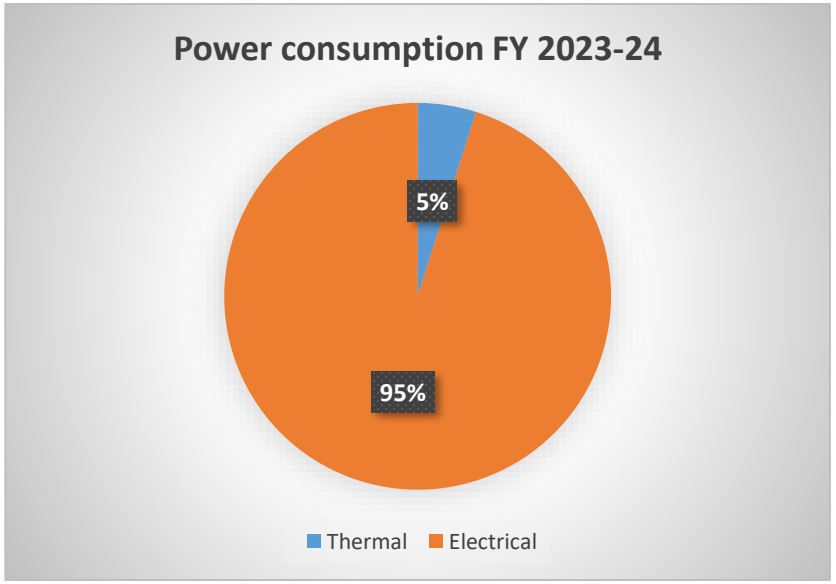
PANDIT NEHRU THEN PRIME MINISTER OF INDIA SIGNING AGREEMENT WITH USSR.FORMALLY STARTING KORBA ALUMINIUM PROJECT.(FORMER NAME BALCO)

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.

$$2\,Al_2O_3\,(dissolved) + 3C(s) \text{ ------> } 4Al(l) + 3CO_2(g)$$

Specific Energy Consumption – Product wise

ENERGY CONSUMPTION REDUCTION (FY 24) :

- Reduce Net AC Power consumption for
  Potline-1 (13587 KWH/MT to 13504 KWH/MT) - **83 kWh MT**
  Potline-2 (13817 KWH/MT to 13728 KWH/MT) - **89 kWh/MT**
  BALCO (13713 KWH/MT to 13627 KWH/MT) - **84 kWh/MT**

- Reduce Auxiliary Power Consumption of
  Potline-1 from 427 to 408 KWH/MT- **19 kWh/MT**
  Potline-2 from 480 to 470 KWH/MT – **10 kWh/MT**
  BALCO from 456 to 442 KWH/MT – **14 kWh/MT**

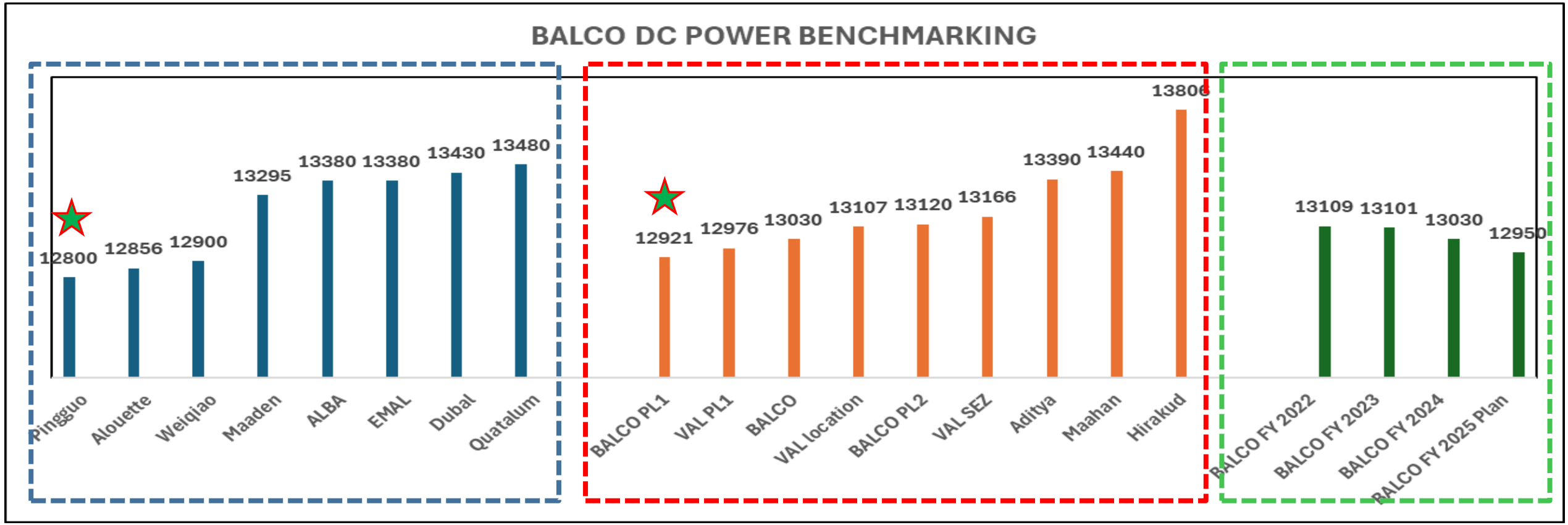
ENERGY OBJECTIVES (Vision FY25)

- Reduce Net Ac Power consumption – **13500 kWh/MT of Al**
- Reduce Auxiliary Power Consumption - **430 kWh/MT**

	FY 24 ACHIEVED	FY 26 SCALE UP PLAN
CH1	WRM – 60 KT ICM – 90 KT	WRM – 60 KT ICM – 90 KT
CH2	SOW INGOT - 0 KT ICM – 30 KT WRM – 50 KT	SOW INGOT - 200 KT ICM - 90 KT WRM – 50 KT
CH3	WRM - 262 KT ICM - 200 KT	WRM - 262 KT ICM - 203 KT
RP	RP - 70 KMT	RP - 180 KMT
CH4		Billet - 420 KT (FY 25 expansion)




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



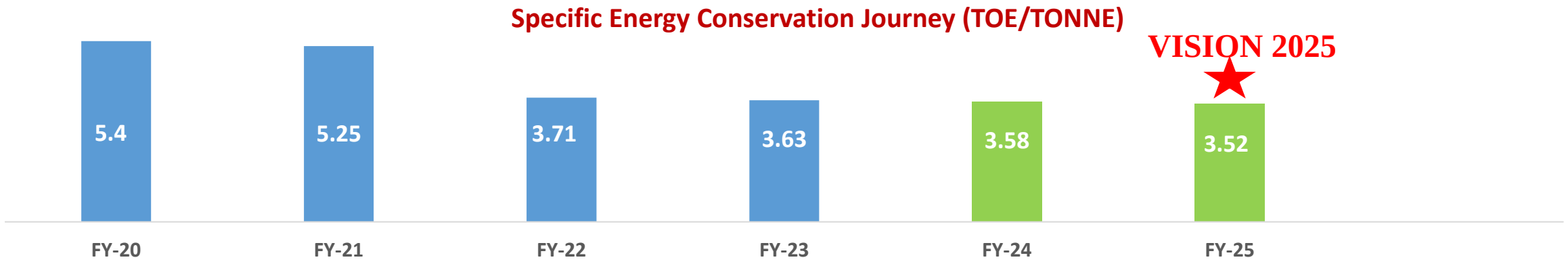
International Benchmark

National Benchmark

BALCO Roadmap and Vision

** Balco will be a benchmark in Indian & GULF smelters with regards to DC Specific Power Consumption

Energy Conservation Vision 2025



SN	Major Projects / Action Plan for Vision FY 25	Power Saving	Unit	Target Completion
1	Increase in Pot line Current Efficiency from 94.98% to 95.30 %.	0.004	TOE/TON	Mar-25
2	Anode drop reduction	0.002	TOE/TON	Mar-25
3	Increase low energy consumption Copper cathode pots from 1% to >5%	0.002	TOE/TON	Mar-25
4	Auxillary Power reduction by PL1 FTP alumina Airlift	0.001	TOE/TON	Mar-25
5	Pot Controller upgradation	0.001	TOE/TON	Mar-25
6	Anode Stub hole Former - New Design to implement.	0.0009	TOE/TON	Feb-24
7	Improvement in ER from 58.06 (FY 23) to 56.5%.	0.0009	TOE/TON	Mar-25
8	Anode Slot Height Improvement from 237 to 260 mm & Anode Stub hole Former - New Design	0.0009	TOE/TON	Mar-25
9	Reduction in Aux power Consumption	0.0006	TOE/TON	Mar-25

lajor Energy Conservation Projects-2022 & 2023

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

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	6.3	510
2	Reduction in Sp Aux consumptions by 15 kwh/mt	4.8	65
3	Gap process Optimization	0.05	NIL
4	Cast House-Reduction in compressed air consumption	0.79	NIL
5	Cast Replacement of hot-well pump with lower rating of pump	0.7	2
6	LED Replacement	0.36	2
	TOTAL (ROI- 18 Months)	13	579

Major Energy Conservation Projects-2024

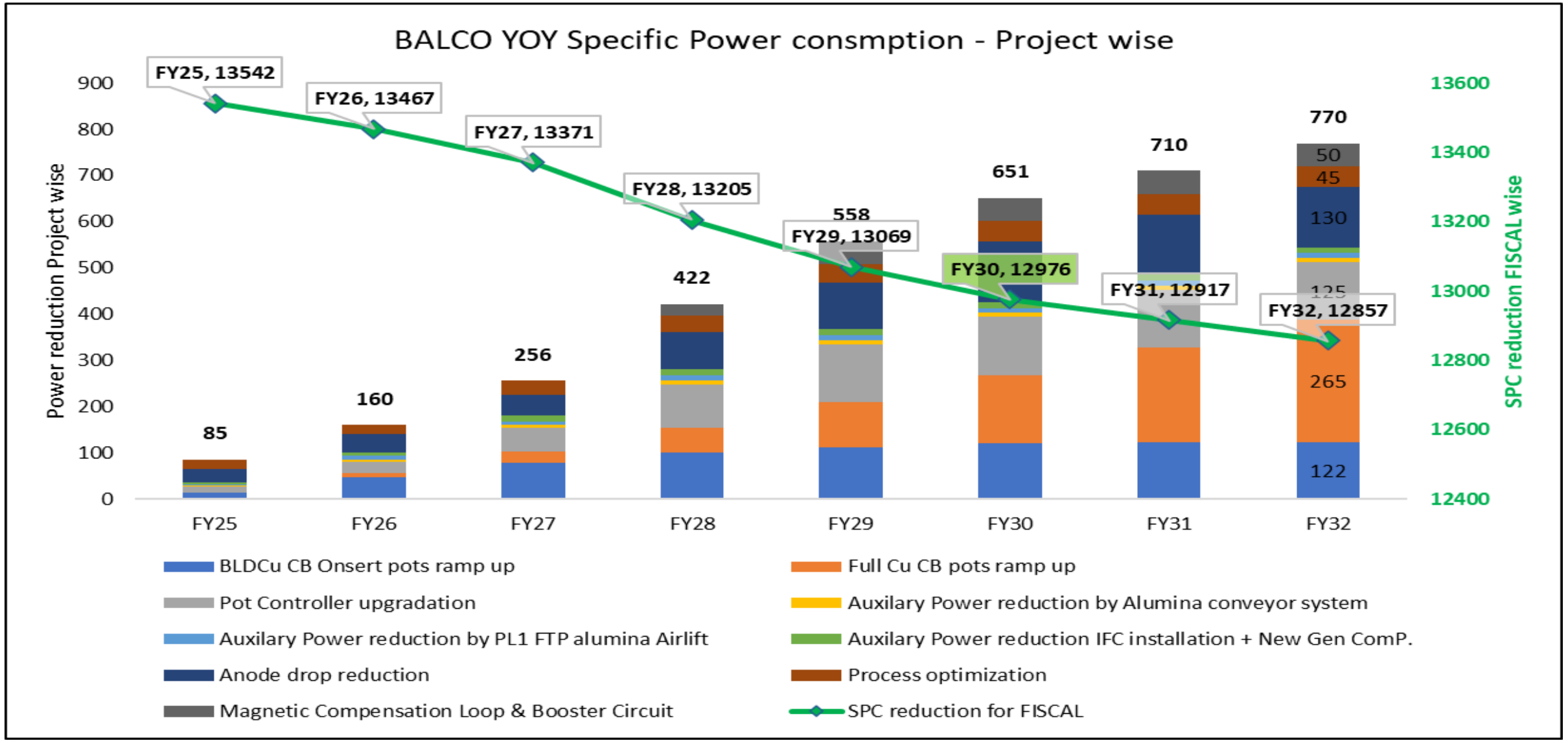
S.No	Title of Project	Annual Energy Saving Million KWH	Investment Million INR
1	Anode Stub hole Former - New Design to implement.	11	NIL
2	Process optimization in Potline (High CVD Pots Optimization & Reduction in high voltage pots).	12	NIL
3	Increase in Pot line Current Efficiency from 94.89% to 95.30 %.	56	NIL
4	Improvement in ER from 58.06 (FY 23) to 56.5%.	11	NIL
5	100% graphitization of Pots from the level of 98%.	5	49
6	Anode voltage drop reduction	11	6
7	Reduction in Aux power Consumption	11	70
8	Anode Slot Height Improvement from 237 to 260 mm & Anode Stub hole Former - New Design	0.3	NIL
9	New design Cathode development	5	70
10	cast House-Close loop system , Trimming CW Pump impeller & Colling Tower	0.2	1
	TOTAL (ROI- 18 Months)	**94.5**	**196**

Major Energy Conservation Projects-2025

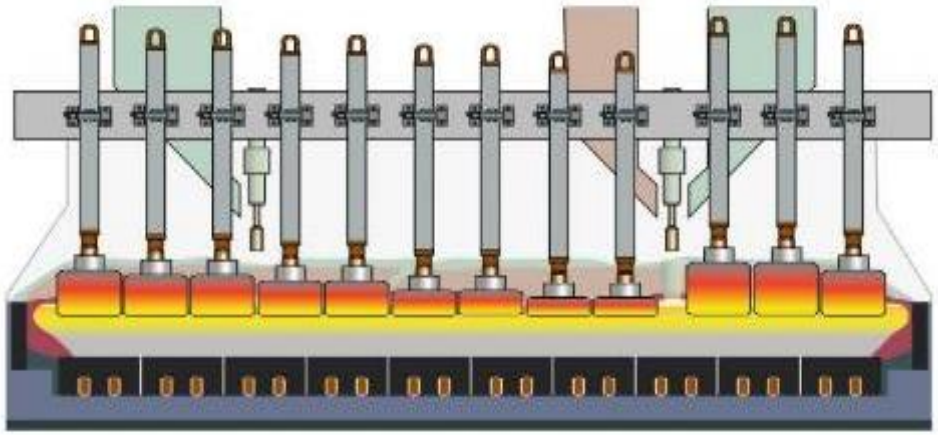
S.No	Projects under progress for FY25	Annual Energy Saving Million KWH	Investment Milln. INR
1	Increase in Pot line Current Efficiency from 94.98% to 95.30 %. (Process + PC Upgradation)	34	NIL
2	Anode drop reduction	18	330
3	Increase low energy consumption Copper cathode pots from 1% to >5%	12	117
4	Auxilary Power reduction by PL1 FTP alumina Airlift	7	63
5	Pot Controller upgradation direct power saving	7	32
6	Anode Stub hole Former - New Design to implement.	7	4.5
7	Improvement in ER from 58.06 (FY 23) to 56.5%.	7	NIL
8	Anode Slot Height Improvement from 237 to 260 mm & Anode Stub hole Former - New Design	7	6
9	Reduction in Aux power Consumption	7	70
10	Process optimization in Potline (High CVD Pots Optimization & Reduction in high voltage pots).	6.5	NIL
11	Auxilary Power reduction by Alumina conveyor system	5.2	72
12	Auxilary Power reduction IFC installation	3	147
	Expected ROI - 11 Months	**120.7**	**841.5**

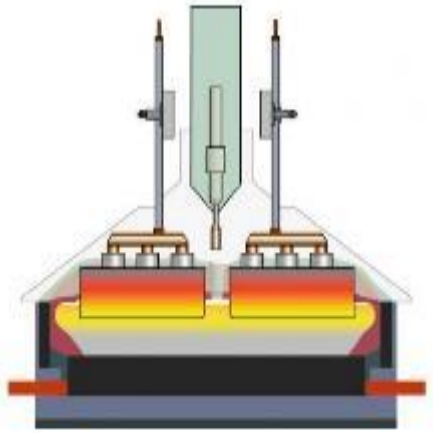
Roadmap for 13000 SPC (Potline)

Roadmap for SPC



Objective	Implementation of Copper collector bar Cathode pots ,Balco with following benefits ✓ Increase in Current efficiency. ✓ Reduction in specific DC energy consumption. ✓ Increase in Pot life.
Approach	✓ 2 Pots Trial pots installed in PL-1 & 3 Pots in PL-2 , which are highly successful. ✓ Lowest voltage and lowest power consumption achieved in those trial pots. ✓ Pots are more stable & having lesser Alf3 consumption.





Net Impact – 12 Million KWH

Innovation I Reduction of Anode voltage Drop

Objective	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
Approach	Reduction of Voltage by even 1mV/Cell will give a huge margin to reduce Power consumption by 3.3 Units. 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 drops at anode stem & joint between carbon and stub.

Benchmarking and scope Identification

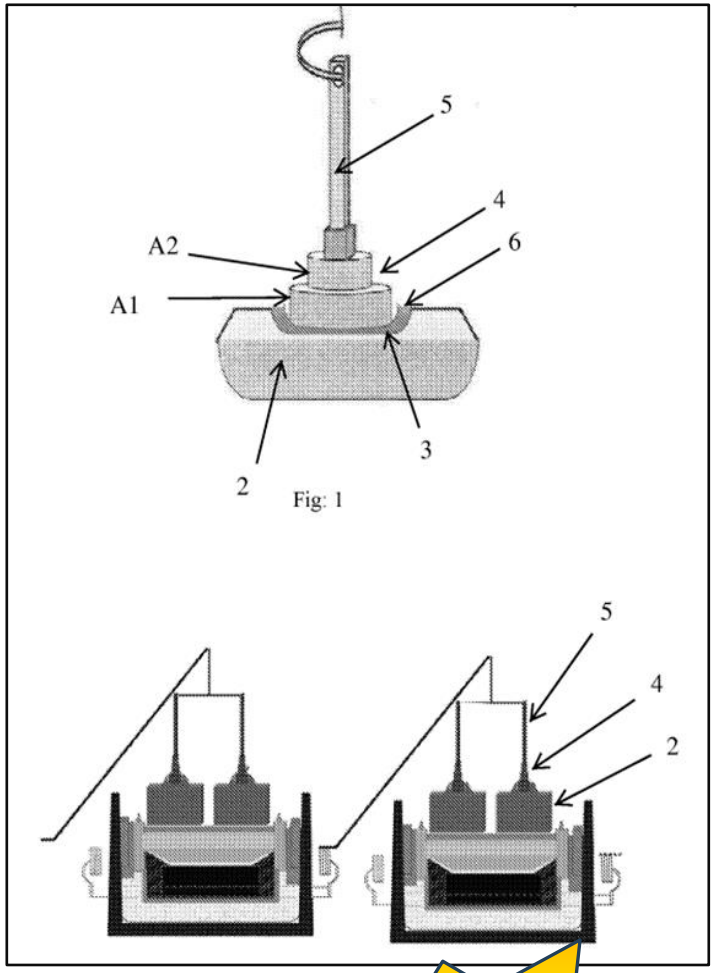
Anode drop bifurcation	Voltage Drop - BALCO	Benchmarking	Smelter	Scope of Improvement	Contribution
Anode clamp drop	18	14	VAL,J	-4	6%
Stem to Clad drop	28	8	Hirakund	-20	28%
Clad to Stub	20	10	Hirakund	-10	14%
Stub to Carbon drop	85	55	Alba	-30	42%
Carbon Drop	257	250	Hillside	-7	10%
Total Anode Drop	408			-71	

Net Impact – 18 Million KWH

While benchmarking, Anode Stem-Clad, Anode Stub-carbon drop were found to have a huge scope for improvement

Trial -1: Stepped Stub Stem anodes

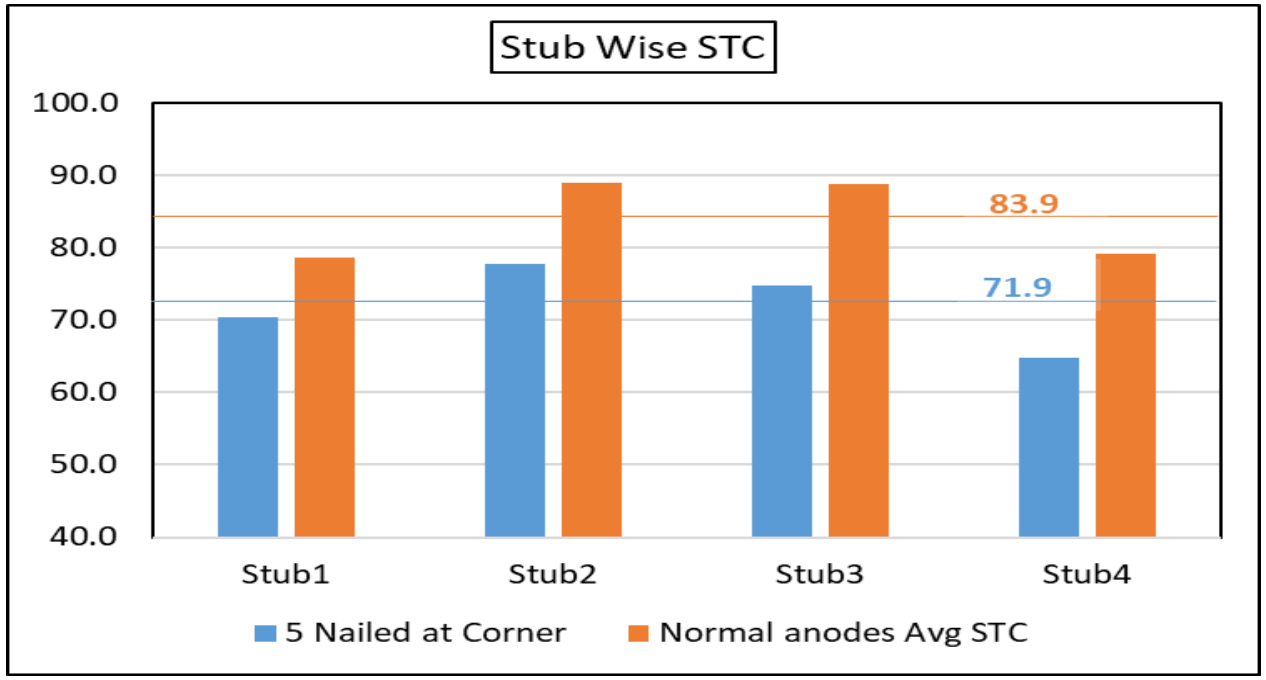
Anode prepared	Anode placed	STC date	Number of anodes	TRIAL #	Trial Phases	STUB 1	STUB 2	STUB 3	STUB 4	STEM TO CARBON		Avg Stub To Carbon (mV)	Effective STC Rdtn. (mV)	Effectiveness
					PL2 Avg STC of last 6 months	93	90	89	79	137		88		
12-Jan-24	17-Jan-24	22-Jan-24	10	TRIAL 1	150 mm dia stub avg in trial anodes	81	82	72	63	122		75	75	Success
			3		150 mm dia stub in all 4 stubs	98	79	70	56	122		75	75	Success
	21-Feb-24	26-Feb-24	10	TRIAL 1B	150 mm dia stub avg in trial anodes	74	66	71	61			68	68	Success
			3		150 mm dia stub in all 4 stubs	72	67	66	60	117		66	66	Success
	24-Mar-24	28-Mar-24	8	TRIAL 1C	150 mm dia stub avg in trial anodes	86	78	86	66			79	79	Success
1st Jun-12 Jun 2024	14 Jun to till date in one section		180	Scale - Up	Implementation Phase of stepped stub anodes	76	80	77	63	124		74	-14	Gain

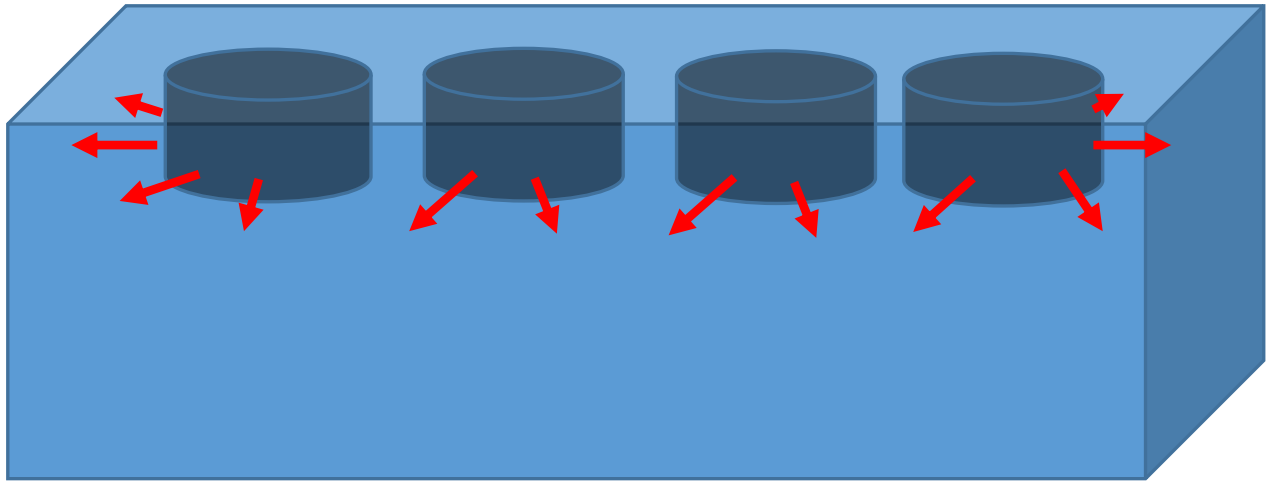


By increasing the cross-sectional area of Anode stub Net conductive surface area increases, there by reducing the resistance of the Anode drop. More precaution were taken to ensure that there is no failure of Anode due to excess stress released by increased stub diameter.

Net Impact – 18 Million KWH

Trial -2: Inference and Trend (Drop reduction by air resistance reduction between stub and carbon)





Results :

Nails reduces the voltage drop impact due to Air resistance between stub to Cast iron and Cast Iron to Anode block.

10-12mV reduction of Anode Drop will impact 30-33 Unit in Power reduction of Potline (Cost Saving 7.6 INR Cr/year)

No major abnormality w.r.t. Anode stem structure or transition joints were seen.

All trial Butts were found in good shape and compared to their reference. This year phase 2 of the trial was incorporated in trial at several other locations of anode and in automation of anode nailing under progress to improve the efficiency of nailing anodes.

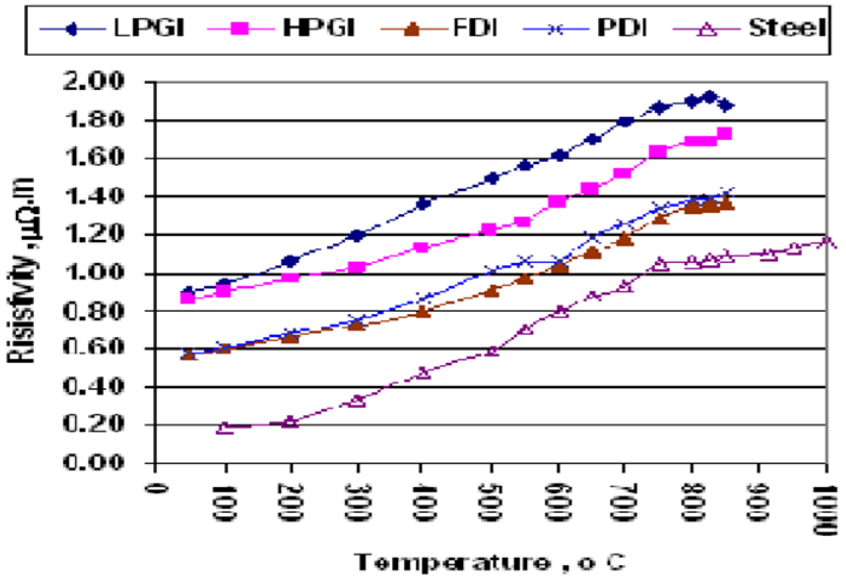
Net Impact – 18 Million KWH

Trial -3: Cast iron composition change

Rodding Grey-CI to PI composition benchmarking

Table 1. Chemical composition of Cast Alloys

	C	Si	Mn	P	S	Cu
Low-P gray iron (LPGI)	3.50	2.52	0.66	0.03	0.02	-
High-P gray iron (HPGI)	3.50	2.60	0.62	0.71	0.09	-
Ferrite ductile iron (FDI)	3.58	2.59	0.11	0.04	0.01	-
Pearlitic ductile iron (PDI)	3.63	2.16	0.36	0.02	0.01	0.71



BALCO COMPOSITIONS	C	Mn	P	S	Si	C.E
Pig iron avg Composition	3.77	0.28	0.11	0.05	1.38	4.27
Last 12 months avg CI comp	3.54	0.68	0.06	0.33	2.80	4.49

- **Our average PI sample composition is very well matching with FDI which has the lowest ever resistivity next to steel.**
- **It has an added advantage of marginally higher C% and P% which helps increase flowability and improved dimensional clarity of CI**

	STUB 1	STUB 2	STUB 3	STUB 4	STEM TO CARBON Drop	Stub To Carbon drop avg (mV)
Pig Iron Anodes (trial)- Dec'22	81	86	83	66	135	79
Pig Iron Anodes (trial)- May'23	81	84	79	63	135	77
Pig Iron Anodes (trial)- Feb'24	82	82	73	61	133	74
PL2 Avg STC of last 12 months	91	87	84	89	144	88

Net Impact – 18 Million KWH

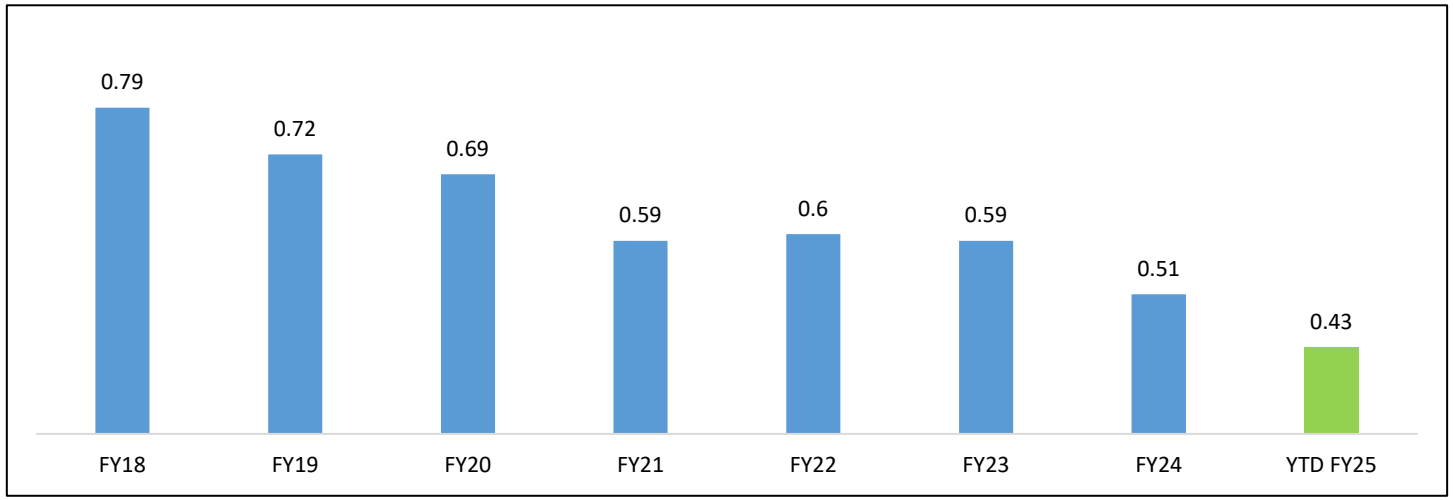
There are 3-4 times these PIG IRON casting are segregated and their AVG STC are measured at different time periods. Every time, Avg. STC drop of PIG IRON casting was found lesser by 10~14mV.

Best Practices to reduce CFP - BALCO

We have undertaken various initiatives to reduce our carbon footprint-

- ✓ Implementation of **Graphitised cathodes in smelter** – Saving of 880 tCO_{2eq}.
- ✓ Introduction of indigenously developed **Copper insert cathode in smelter** – Saving of 0.42 tCO_2/MT Al.
- ✓ The trial development of **Pot Controller Upgradation** in smelter- Expected Savings of 150 KWh/MT.
- ✓ The adoption of **Biomass** cofiring in TPP's– Saving of 19766 tCO_{2eq}
- ✓ Conversion of **EV Forklifts** reduced a total of **246 tCO_{2eq}** emissions during FY 2024.
- ✓ Substitution of HFO with **LSHS** -in the metal processing areas.
- ✓ **RE Power** procurement - 179.91 MU -127735 $tCO_{2e.}$

Specific Water Consumption (KL/MT)

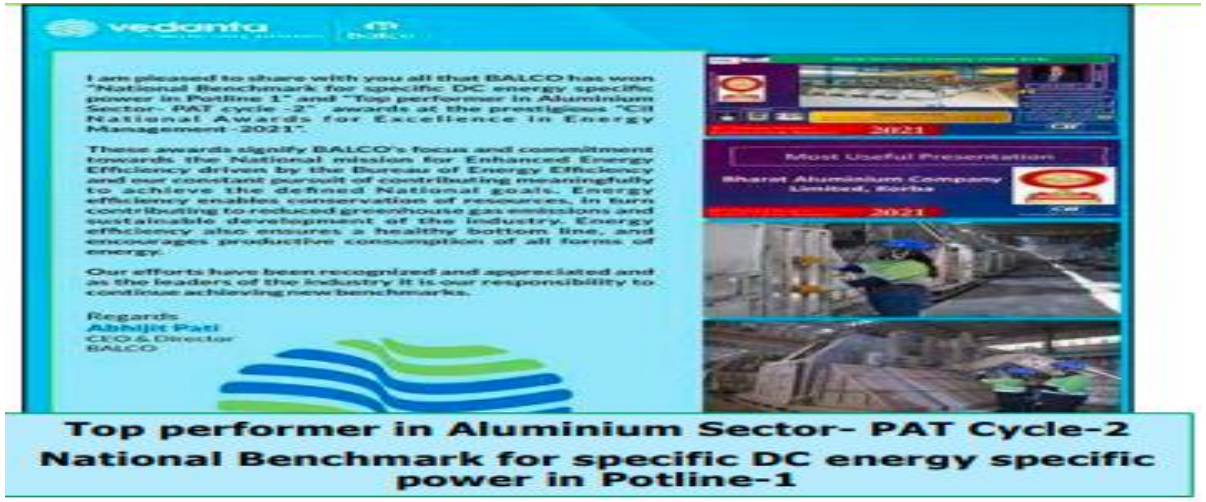


Plantation Drive

Year	Planted	Survived	Survival %
2016-17	30000	25000	85
2017-18	5000	4500	82
2018-19	5000	4500	80
2019-20	15000	12000	86
2020-21	10000	8000	84
2021-22	15000	14500	87
2022-23	123562	113677	86
2023-24	85111	74047	87

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

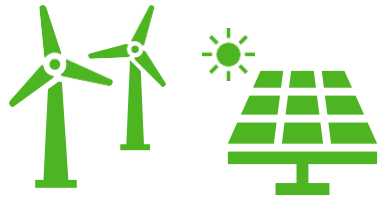


Particulars	UOM	PAT Cycle -2
Notified baseline SEC (Period 14-15)	TOE/MT	5.3967
Notified target SEC	TOE/MT	5.0275
SEC Target for Reduction	TOE/MT	0.3692
Energy Certificates achieved	Nos.	424421

Decarbonization – Approach – BALCO

Power Plant

Decarbonisation power generation and the deployment of **carbon capture utilisation and storage (CCUS), RE Power procurement Biomass co-firing , etc., offer** the most significant opportunity to reduce emissions to near zero by 2050

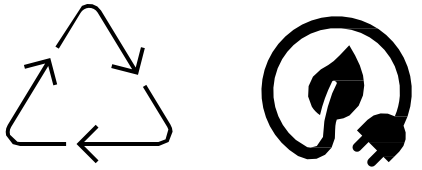


Smelting

Energy Efficiency to reduce smelting energy consumption and technologies to reduce the process emissions from smelting operation such as **Cupper inserted cathodes, Pot controller upgradation., etc.**

Anode/Casting

Emissions from fuel combustion can be reduced by **electrification, fuel switching to Natural gas and CCUS** offer the most credible options to reduce GHG emissions



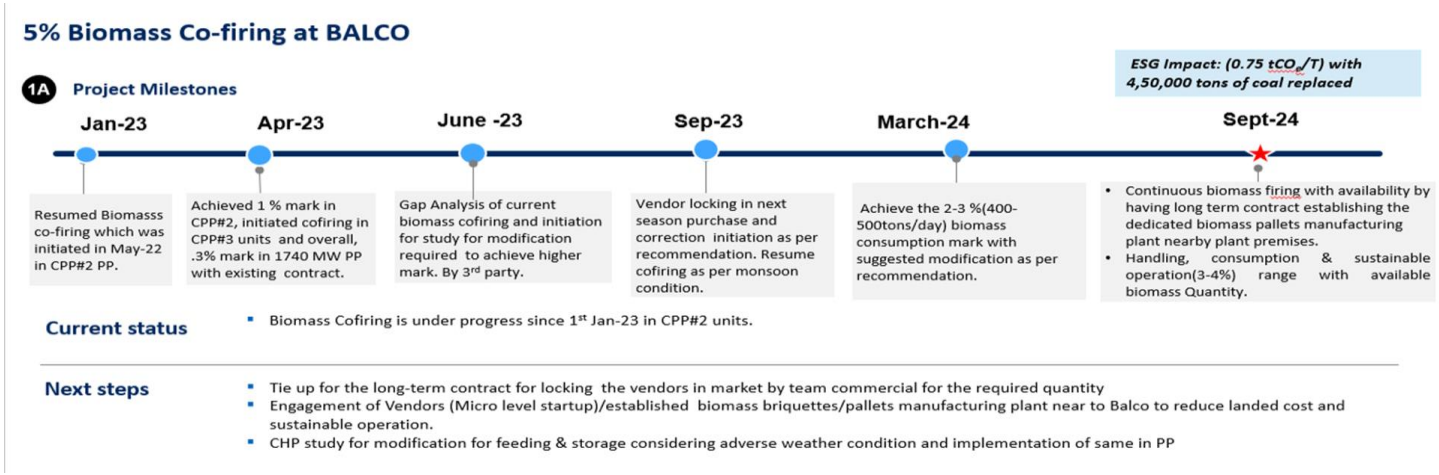
Another important decarbonization lever for Aluminum Sector is – Recycling

Renewable Energy

- Achieved highest ever RPO obligation in FY 23 : 100% In FY 23, we have purchased RE power (i.e 546 MU) when there was coal scarcity in PAN India level
- In FY 24, we have purchased 45% of RE power (i.e 179.91 MU).
- Balco a unique entity in the country which can simultaneously export and import of power. This has given freedom to Balco to purchase RE power as per the requirement without restricting its export of power, this has laid to tremendous scope of sourcing RE power which would result in reduction of carbon footprint, thereby laying a strong foundation for our journey towards Net zero carbon and production of green aluminium.
- 505 MW RE mix tie up for BALCO Smelter operation to be completed by FY-26.

Renewable Energy – BIOMASS COFIRING

- Biomass Pilot Trial taken successfully at BALCO. Co-firing **4.755 KT biomass has been fired in FY-23**
- **Adoption of biomass co firing in our coal-based power plant; highest ever Biomass consumption : ~ 13 KT in FY- 24. Corresponds to Energy saving 16.7 MU, Saving of 19.766 K.Tons of CO_{2eq}**



GHG Inventorisation

Year	Scope-1 Emission KG CO2/Ton	Scope-2 Emission KG CO2/Ton	Total Kg CO2/Ton
FY-15	21	2.3	23.3
FY-16	18.3	0.2	18.5
FY-17	18.87	0.03	18.9
FY-18	17.32	0.27	17.59
FY-19	17.38	0.05	17.43
FY-20	17.79		17.79
FY-21	17.29		17.29
FY-22	16.75	0.26	17.03
FY-23	15.44	0.81	16.26
FY-24	**15.22**	**0.8**	**16.02**

Table 4: Scope 3- Inventory Group (Category Wise)
Total Scope 3 Emissions (tCO2e)
Category 1- Purchased Goods and Services
Category 2- Capital Goods
Category 3- Fuel and Energy Related
Category 4- Upstream Transport
Category 5- Waste in operations
Category 6- Business Travel
Category 7- Employee Commute
Category 9- Downstream Transport

Year	Scope-3 Emission KG CO2/Ton
FY-21	**3**
FY-22	**3.15**
FY-23	**3.51**
FY-24	**3.07**

Plan for E-Vehicle

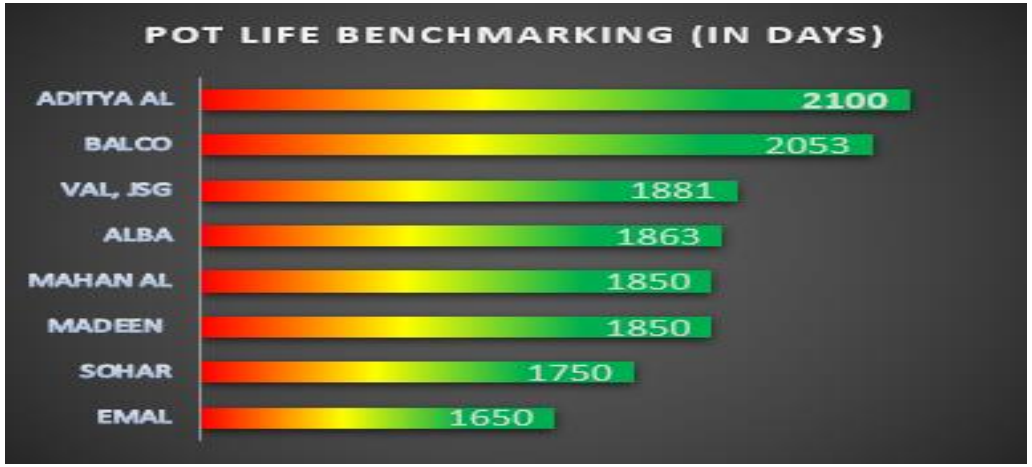
1. OPEX model-having plan to Change Battery Operated vehicle for shorter distance movement., Transportation cost reduction in longer term as right sizing led to 40% Annual CO2 release amount is 3470000 Kg Co2 approximately per year which can replaced by use of E-vehicle
2. E-vehicle Policy for all employees 50% discount on 2-Wheeler & 30% on 4-Wheeler to promote.

Waste to Wealth

SOURCE	FY23 (In Crs.)	FY24 (In Crs.)	FY25 YTD (In Crs.)
MS SCRAP	18.0	53.6	16.9
DROSS	7.6	2.9	0.0
OTHERS	6.4	61.0	20.0
COKE DUST	6.0	3.4	2.3
NET WEALTH from WASTE	38.0	120.9	39.2

- Used Oil sellout – 68.63 MT in FY24

- 3224 MT/year Co-processing at M/s Green-mech Technology SPL ,SPL Utilization- (FY-23 21721 MT) (FY-24 36640 MT)



Short Term

Medium Term

Long Term

SPL

Annual Generation

4520 MT

- Increase of Pot Life by improving operational efficiency
- Set up of SPL Detoxification plants(Under CPCB Approval)
- Explore for Blast furnace injection as fuel, As Flux for Steel making or as reducing agent for slag cleaning

Al Dross

Annual Generation

6963 MT

- Maximising Al recovery by increasing utilisation of DPM to 95%
- Achieved Melt loss 0.45 %
  Further reduction target- 0.35%
- Install and Operate DPS which can recover metal of approx. 30-35% from hot Dross Processing

Green Supply Chain & Ongoing Plans with Various Vendors

SN	Initiatives	Savings IN Rs
1	Smart logistics for vehicles	60 Lakh/Year
2	EV vehicle in operation	
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 FY23 –4403
- Idea accepted FY23 –2201
- Idea implemented FY23– 1668
- Idea under implementation FY23 –566

Green-co certification with CII ,Learning From CII & Others

Confederation of Indian Industry

GreenCo Scoreband - Bharat Aluminium Company Ltd, Korba

PARAMETERS	POINTS AWARDED														
	0-10	11-20	21-30	31-40	41-50	51-60	61-70	71-80	81-90	91-100	101-110	111-120	121-130	131-140	141-150
Energy Efficiency													X		

Legends: Points scored by BALCO | X: Maximum points scored by another GreenCo company

Green-co Silver certification

Confederation of Indian Industry

CII - Sohrabji Godrej Green Business Centre

hereby certifies that

Bharat Aluminium Company Limited

Korba

has successfully achieved the standards as required for the following level of certification under the GreenCo - Green Company Rating System which is valid for a period of 3 years

GreenCo Silver

Issue Date: 24-12-2022 Expiry Date: 23-12-2025

Jamshyd N Godrej	Pradeep Bhargava	L S Ganapati	K S Venkatagiri
Chairman	Chairman	Chairman	Executive Director
CII-Godrej GBC	GreenCo Rating System	GreenCo Assessor Panel	CII-Godrej GBC

Learning From CII & Other Energy efficiency Program

- **Benchmarking Data.**
- **Energy management system.**
- **Global Energy efficient technology.**
- **Waste to wealth creation idea.**
- **Cooling tower modification – Efficiency improvement**
- **Closed loop Implementation in Pump Houses.**
- **Compressor House Air line Interconnection HP & LP line**
- **ESCO model for financing.**

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

Review Mechanism

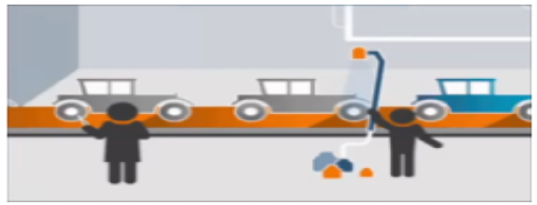
- Corporate Sustainability Review
- Monthly Management Review by CEO
- Monthly Operational Review by Plant Head
- Weekly Energy Cell review by Energy Manager
- SBU Level review – Daily War Room

Measuring & recoding Energy consp	Correlating energy Consp with production	Comparing with Benchmark	Setting targets to control energy consp	Comparing energy consp w.r.t target on regular basis	Reporting Variance against Target	Implementing measures to correct variance
Recording	Analysing	Comparing	Target setting	Monitoring	Reporting	Controlling

BALCO 1.0

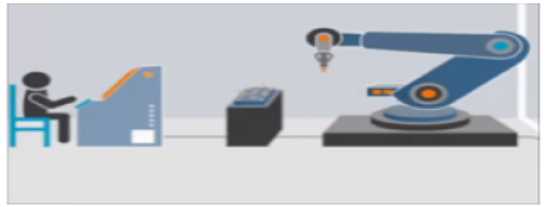
- Smelter **of 1 LTPA** with **Soder berg** technology in 1973
- BALCO was taken over in 2001 by **Vedanta**

BALCO 2.0



- **270 MW** Captive power plant
- **320 KA Smelter** with **GAMI - China**
- Expanding further by the installation of **3.25 LTPA** aluminium and

BALCO 3.0



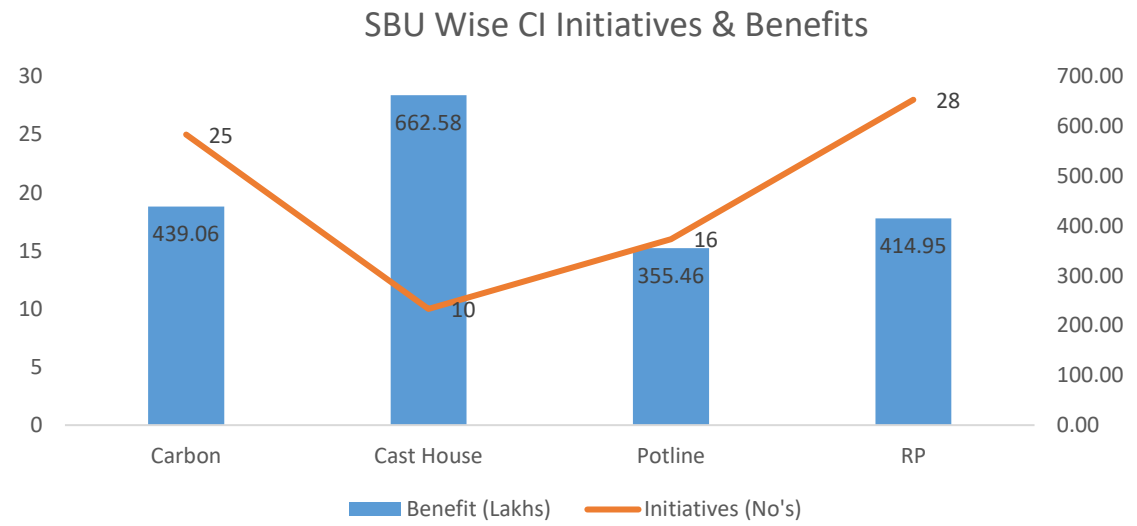
- **540 MW** Captive power plant
- Expansion of the smelter by installing **5.10 LTPA** by employing 500 KA
- **1200 MW** thermal power plant.

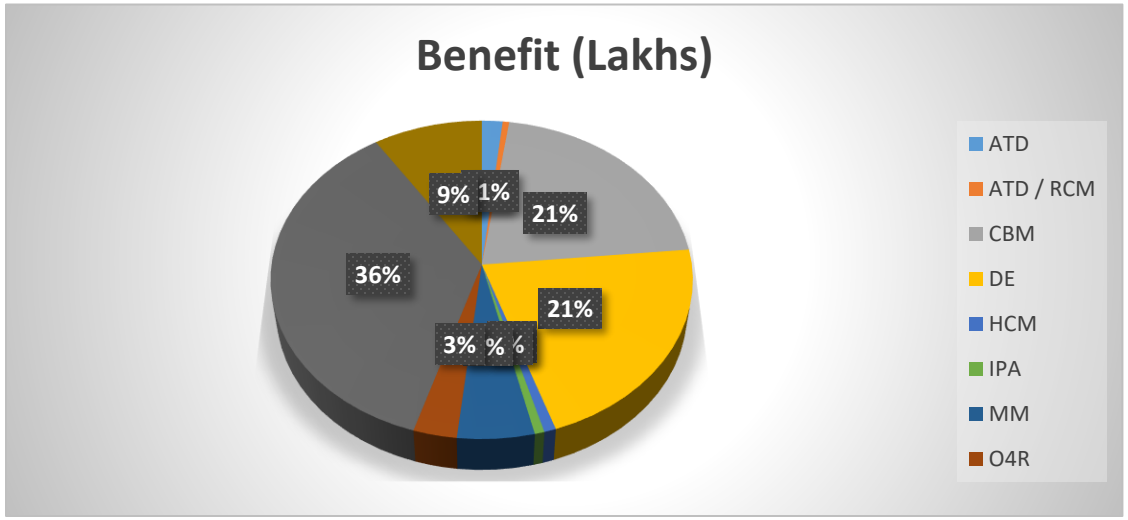
BALCO 4.0

1 MnT Aluminium Club

- ✓ ESG Leader
- ✓ Digital Driven
- ✓ AI Based Operation

Energy savings from Employee & Stakeholder Involvement





Details	Unit	2016-17	2017-18	2018-19	2019-20	2020-21	2021-22	2022-23	2023-24
Energy Savings	Kwh	26892304	59584971	25367013	31381627	8,48,70,225	8,42,25,659	13207980	39290000
Benefits due to energy savings	Rs. lacs	806	1788	887	1098	2907	2378	726	1768

Status of EnMS (ISO 50001) Audit Observation

Year	No. of NC	No. of Observation	Open NC	Open Observation
17-18	0	6	0	0
18-19	0	5	0	0
19-20	0	3	0	0
20-21	0	2	0	0
21-22	0	2	0	0
22-23	0	2	0	0
23-24	0	0	0	0

%Investment for Major Energy conservation projects on Turnover

FY	Project Description	Investment (Rs. Crs)	Turnover (Rs. Crs)	% Investment on Turnover	ROI(Months)
FY-20	100% Graphitized Cathodes	138	10500	1.3	18
FY-21	100% Graphitized Cathodes	101	9688	1.04	18
FY-22	100% Graphitized Cathodes	147	13607	1.08	15
FY-23	100% Graphitized Cathodes	57.9	12680	0.45	18
FY-24	Cathode development, Anode Modification & Aux power	13.1	13607	0.09	15
FY-25	Pot-controller Upgradation ,New Relining design	25.2	13067	0.20	18

NET ZERO PLAN & GHG intensity Reduction

Area	Key Initiative	Business Partner	Saving (TCO2/T)		Timeline	Investment (Mn$)	Cost Benefit (Mn$/Yr)
			FY26	FY30			
Renewable Energy	• Hybrid Phase-I (380 MW) at BAL	Serentica	0.7	0.7	Sep'24	59	13
	• Hybrid Phase-II (155 MW) at BAL	Serentica	0.2	0.3	Jun'25	24	5
Technology	• Pot controller	Alpsys	0.06	0.11	Mar' 27	21	5
	• Graphitization/ Upgraded Relining	COBEX	0.05	0.19	Mar' 30	48	12
Alternate Fuel	• Bio mass Co-firing in Power plant (5 -10 %)	-	0.14	0.57	Sep'26	-	-
	Total		**1.65**	**5.37**		**455**	**102**

Sl No	Particulars	UoM	FY21	FY23	FY24	FY26	FY30	FY40	FY50
1	**Production**	**MnT**	**0.6**	**0.57**	**0.58**	**0.78**	**1.02**	**1.02**	**1.02**
	% Increase from FY21	%		*-6%*	*-3%*	*30%*	**71%**	*71%*	**71%**
2	**Absolute Emission**	**MnT**	**10.3**	**9.2**	**8.9**	**15.6**	**11**	**6.8**	**2**
3	**Intensity**	**TCO2/T**	**17.21**	**16.26**	**15.34**	**15.26**	**11**	**6.7**	**2.2**
	% Reduction from FY21	%		*6%*	*11%*	*11%*	*37%*	*61%*	*87%*
4	**Renewable Energy (RTC)**	**MW**	**0**	**62**	**65**	**500**	**700**	**1000**	**1800**
	Mix	%	0%	7%	7%	30%	45%	63%	95%
5	**Green Aluminium**	**KT**	**0**	**0**	**42**	**100**	**300**	**600**	**1000**

Our decarbonization roadmap

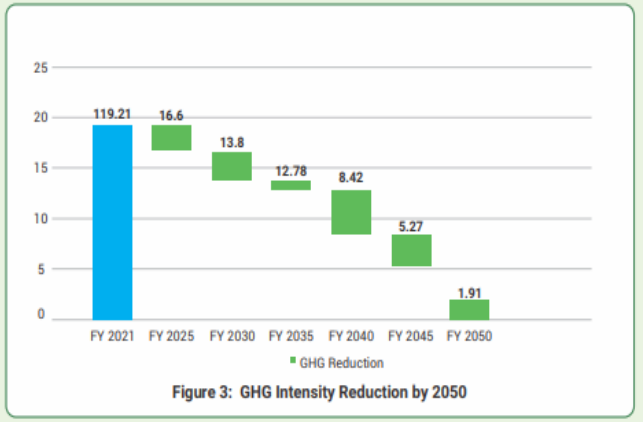


Figure 3: GHG Intensity Reduction by 2050

Table 3: Phase wise action plan for GHG intensity reduction

FY 2025	FY 2030	FY 2035	FY 2040	FY 2050
Increasing potline energy efficiency through pot graphitization, smart pot controllers, ready to use cathodes, voltage reduction and auxiliary power reduction. Power plant efficiency improvement through annual overhauling and capital overhauling, variable frequency drives (VFD) on auxiliary pumps and fans. Shift calciner operations from oil to natural gas at our alumina refinery. Enter into PDA and use of 200 MW and 180 MW renewable power for our aluminium smelters at BALCO and Jharsuguda plants respectively.	Biomass co-firing up to 5% in 135 MW power plants at BALCO and Jharsuguda respectively Total 1500 MW of renewable power purchase for our smelter at JSG & BALCO. Natural gas at our BALCO and Jharsuguda plants at Cast house & back oven plant. MoU & pilot trial of inert anodes and wetted cathode usage at our smelters	Commencement of inert anodes and wetted cathode usage at our smelters Commence Battery backup for storing the RE power at operations. Additional renewable power capacity for our smelter.	Continue shift to inert anodes and Wettable cathodes Explore hydrogen fuel for calciner at alumina refinery	100% of anodes to be inert anodes and cathodes to be weighted cathode 100 % power from RE power at smelters

BALCO | Awards & Accolades

Awards April 23

National Awards for Manufacturing Competitiveness

Awards April 23

CII National HR Excellence Awards

Awards July 23

Most Active Industry In Certificates Market

Awards September 23

CII National Energy Leader Award in Metal Sector and Energy Efficient

Awards May 23

IMC RBNQA Performance Excellence

Awards June 23

Great place to work

Awards September 23

Digital Transformation (Platinum Winner) by CII

Awards September 23

Chapter Conventions on Quality Concepts (CCQC)

BALCO | Awards & Accolades

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Awards Mar 24

CII National HR Excellence Award 2023-24

Awards Feb 24

"Digital Transformation in Manufacturing Process" by FICCI

Awards Nov 23

Grow Care India OHS Award

Awards September 23

Integrated Manufacturing Excellence Initiative Award 2023

Awards May 23

People First HR Excellence Awards 2023

Awards Oct 23

CSR BOX award

Awards Dec 23

Happiness & Wellbeing Award 2023

Awards Jan 24

ICC Environmental Excellence Award 2023 (Gold Certificate)

Awards Q1 FY25

ASSOCHAM's 3rd Menstrual Hygiene Management Awards & Conference 2024

TITAN International Business Awards 2024

GEEF Global Road Safety Awards 2024

ICC Social Impact Awards 2024

Month	Award	Category	Agency
Apr'24	BALCO's Project Arogya conferred at ICC Social Impact Awards 2024	CSR	ICC
May'24	BALCO's Project Nayi Kiran conferred at ASSOCHAM's 3rd Menstrual Hygiene Management Awards & Conference 2024	CSR	ASSOCHAM
`May'24	Balco Wins "GEEF Global Road Safety Awards 2024"	safety	Global Energy and Environment Foundation
May'24	BALCO bags the Best Total Quality Management (TQM) Organization Award	Employee Engagement	QCFI
June'24	BALCO conferred with GOLD Winner - TITAN International Business Awards 2024	HR	TITAN
June'24	BALCO's Project Nayi Kiran conferred at ASSOCHAM's 3rd Menstrual Hygiene Management Awards & Conference 2024	CSR	ASSOCHAM

Thank You!

Bharat Aluminium Company Limited
Korba, Chhattisgarh

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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	6.3	510
2	Reduction in Sp Aux consumptions by 15 kwh/mt	4.8	65
3	Gap process Optimization	0.05	NIL
4	Cast House-Reduction in compressed air consumption	0.79	NIL
5	Cast Replacement of hot-well pump with lower rating of pump	0.7	2
6	LED Replacement	0.36	2
	TOTAL (ROI- 18 Months)	**13**	**579**

Renewable Energy

- Biomass Pilot Trial taken successfully at BALCO. Co-firing **4.755 KT biomass has been fired in FY-23**
- **Adoption of biomass co firing in our coal-based power plant; highest ever Biomass consumption : ~ 13 KT in FY- 24. Corresponds to Energy saving 16.7 MU, Saving of 19.766 K.Tons of CO_{2eq}**

5% Biomass Co-firing at BALCO

ESG Impact: (0.75 tCO_e/T) with 4,50,000 tons of coal replaced

1A Project Milestones

Jan-23	Apr-23	June -23	Sep-23	March-24	Sept-24
Resumed Biomasss co-firing which was initiated in May-22 in CPP#2 PP.	Achieved 1 % mark in CPP#2, initiated cofiring in CPP#3 units and overall, .3% mark in 1740 MW PP with existing contract.	Gap Analysis of current biomass cofiring and initiation for study for modification required to achieve higher mark. By 3rd party.	Vendor locking in next season purchase and correction initiation as per recommendation. Resume cofiring as per monsoon condition.	Achieve the 2-3 %(400-500tons/day) biomass consumption mark with suggested modification as per recommendation.	• Continuous biomass firing with availability by having long term contract establishing the dedicated biomass pallets manufacturing plant nearby plant premises. • Handling, consumption & sustainable operation(3-4%) range with available biomass Quantity.

Current status

- Biomass Cofiring is under progress since 1st Jan-23 in CPP#2 units.

Next steps

- Tie up for the long-term contract for locking the vendors in market by team commercial for the required quantity
- Engagement of Vendors (Micro level startup)/established biomass briquettes/pallets manufacturing plant near to Balco to reduce landed cost and sustainable operation.
- CHP study for modification for feeding & storage considering adverse weather condition and implementation of same in PP