



Confederation of Indian Industry

24TH NATIONAL AWARD FOR EXCELLENCE IN ENERGY MANAGEMENT 2023

NALCO – Smelter & Power Complex, Angul

TEAM MEMBERS

**Shri Pramath Kumar Mohanty
General manager Mechanical**

**Shri Sruti Ranjan Behera
Senior Manager Reduction**



NALCO

Aluminum Smelter & Power complex

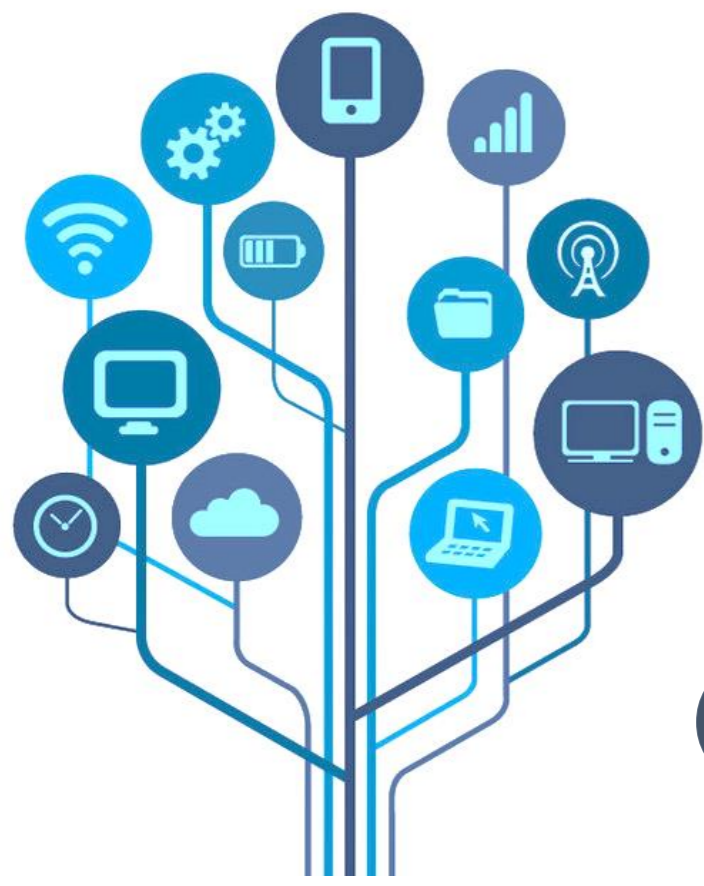
About us

A NAVRATNA CPSE under Ministry of Mines with Govt. of India holding 51.28 % equity

- **Established in 7th January, 1981**
- **4,60,000 TPA Capacity - state of art smelting Technology**
- **A group 'A' CPSE having integrated and diversified operations in mining, metal and power sectors**
- **NALCO's business footprints are present in more than 15 countries**

Foreign Exchange

- **NALCO is one of the leading foreign exchange earning CPSEs of the Country. The Company continues to retain its position of lowest cost producer in Bauxite and Alumina production in the World in 2022.**



Our Technology



AP 18 Technology

- **180 KA Prebake Cell Technology**
- **The captive thermal power plant having a generation capacity of 1200 MW (10X120MW) provides entire electric power requirement of smelter.**
- **Operating at a 94.50 % of current Efficiency of smelter**



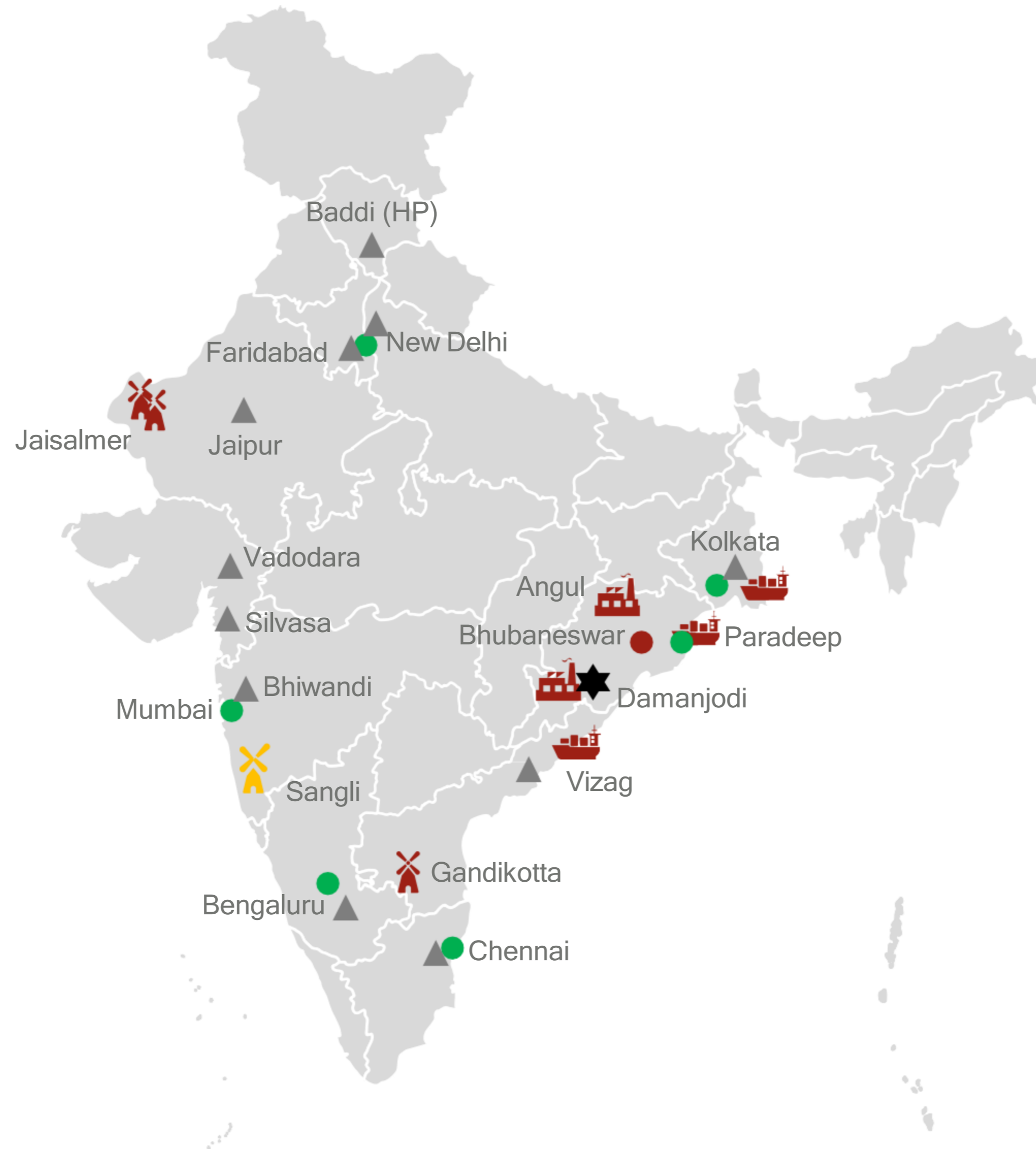


Our Products

- Standard Ingots
- Mechanized Sow ingots
- T-Ingots
- Wire Rods
- Billets
- Cast Strips
- Cold Rolled Coils & Sheets

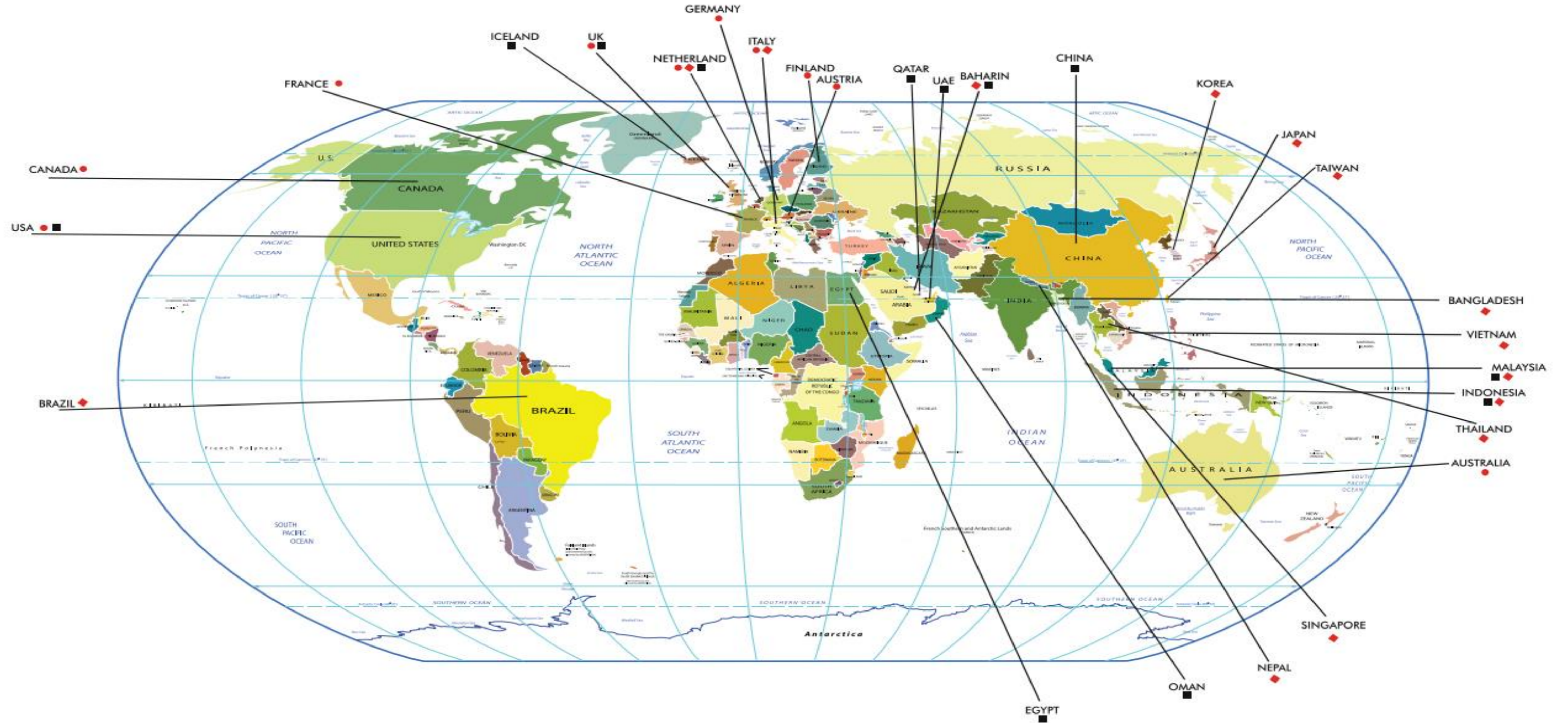


INDIAN PRESENCE

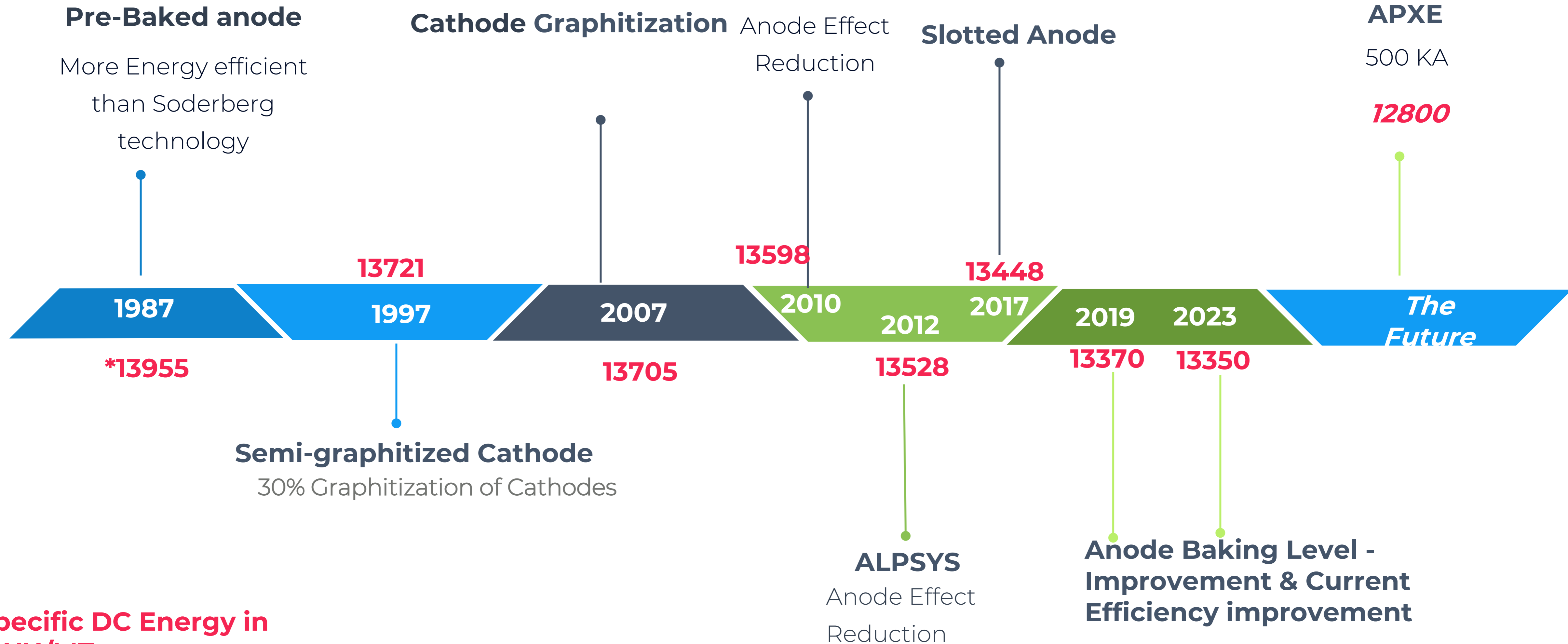


- Registered Office
- Regional Offices - 6
- 🏭 Production Centers - 2
- 🚢 Ports - 3
- ★ Bauxite Mines - 1
- ▲ Stockyards - 11
- 🌪 Wind Power-3
- 🌪 Wind Power under construction -1

GLOBAL REACH



Our Energy Efficiency Journey



***Specific DC Energy in KWH/MT**

Vision, Mission and Core Values

नालको  NALCO



To be a Premier and Integrated company in the Aluminium value chain with strategic presence in Mining both domestic & global, Metals and Energy sectors

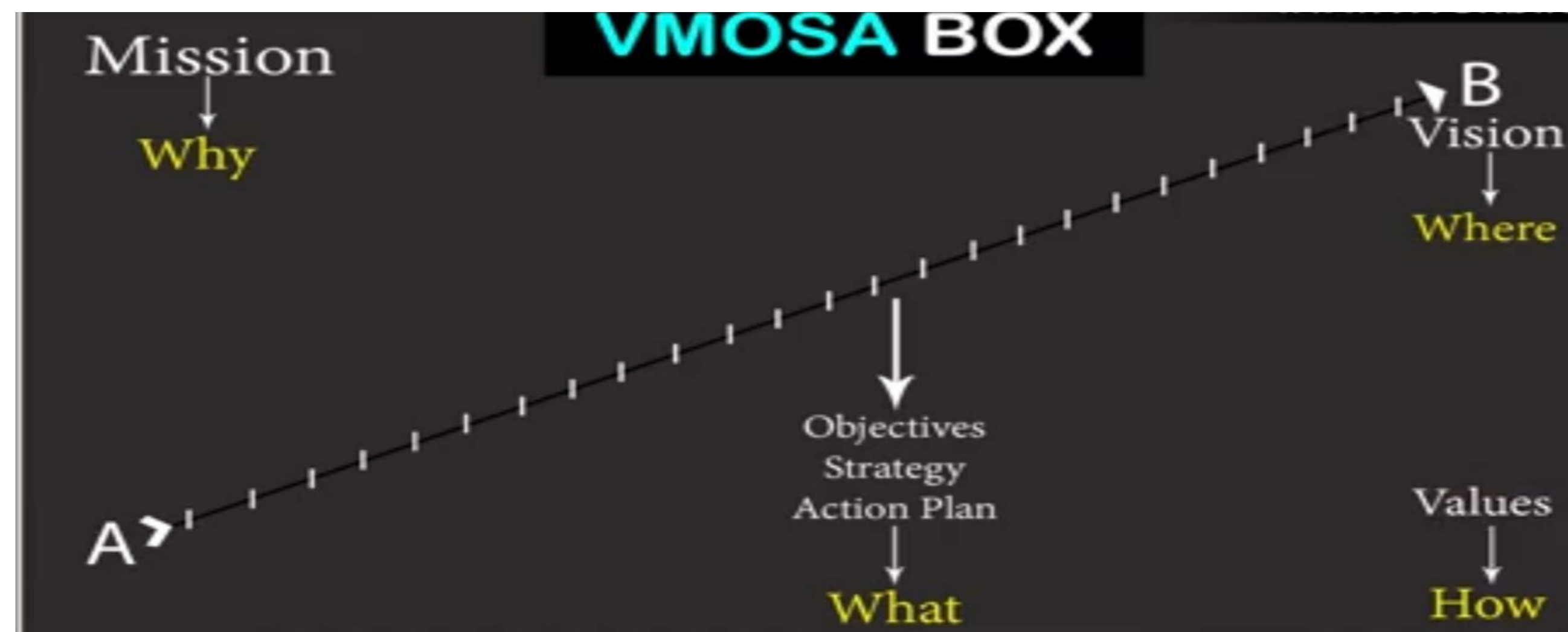


To sustainably grow multi-fold in Mining, Alumina and Aluminium business along with select diversification in Minerals, Metals and Energy sectors, while continuously improving on efficiency and business practices thus enhancing value for all stakeholders


Core Values

- B**enefitting Stakeholders
- E**xcellence and Quality
- S**ustainability
- T**rust & Integrity

V	Vision	
M	Mission	
O	Objective	
S	Strategy	
A	Action Plan	



Our Energy Vision

नालको  **NALCO**
National Aluminium Company Limited
CIN : L27203OR1981GOI000920

ENERGY POLICY

Enhancing Energy Performance, comprehensively optimizing Energy Use, Energy Consumption and Energy Efficiency, is a major imperative for an Energy Intensive industry like ours. In recognition of this, we focus on improvement of Energy Performance in all areas of operations with thrust on planning Energy Objectives based on the enshrined Guiding Principles.


Guiding Principles :

- To endeavor for reduction in Specific Consumption of Energy in all forms and in all areas of Operations.
- To ensure availability of information and necessary resources for achieving Objectives and Targets.
- To comply with all applicable legal, regulatory and other requirements related to energy use, consumption and efficiency.
- To espouse Energy Efficient Technology encompassing procurement of Energy Efficient products & services and design for Energy Performance improvement.
- To carry out Energy audits and Energy reviews, at planned intervals, to improve energy performance.

Commitment

We affirm our commitment to continually improve our Energy Performance and strive for achieving the objectives and targets.

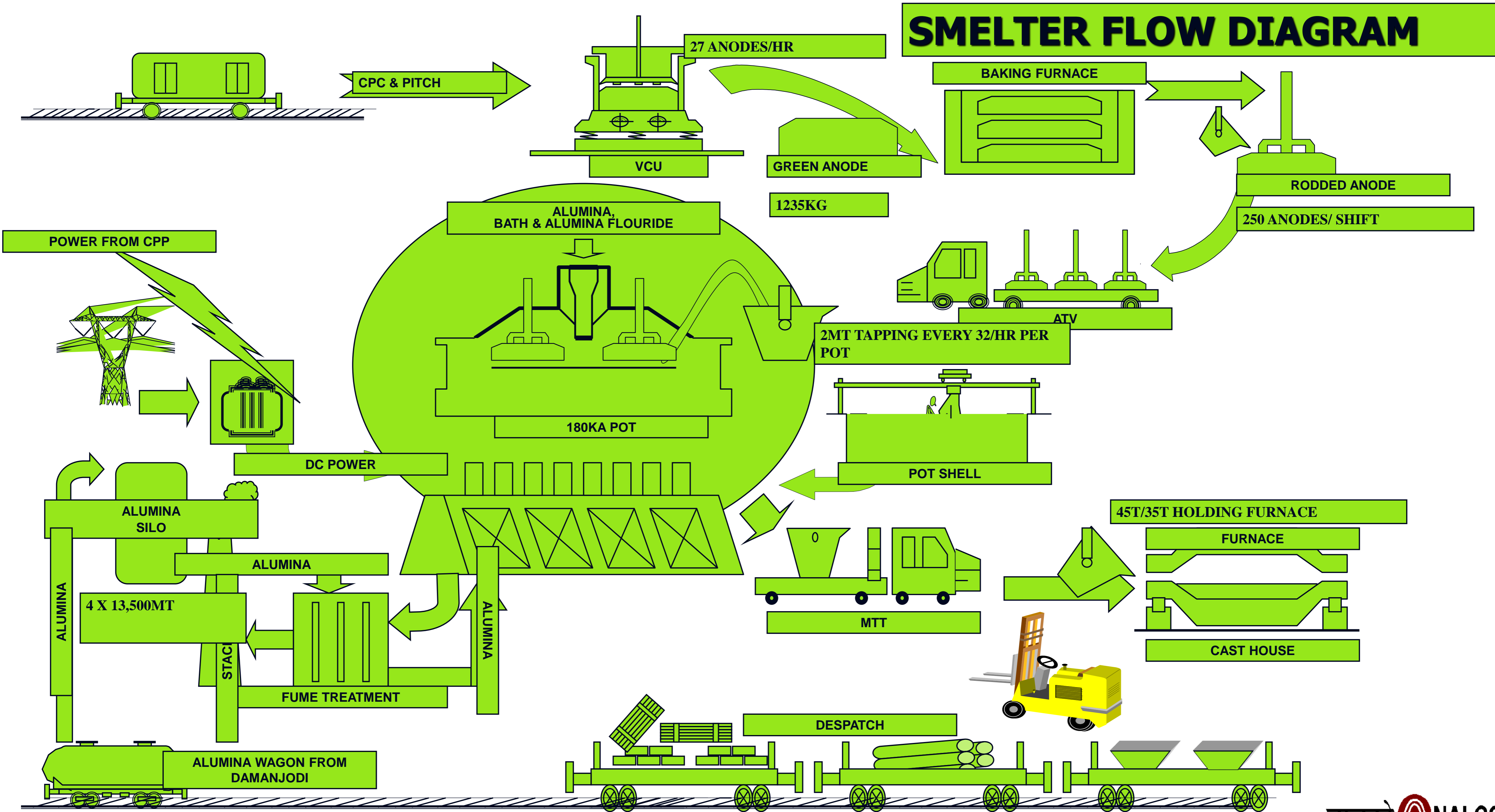
Bhubaneswar
Effective Date 30.09.2020


(Sridhar Patra)
Chairman-cum-Managing Director

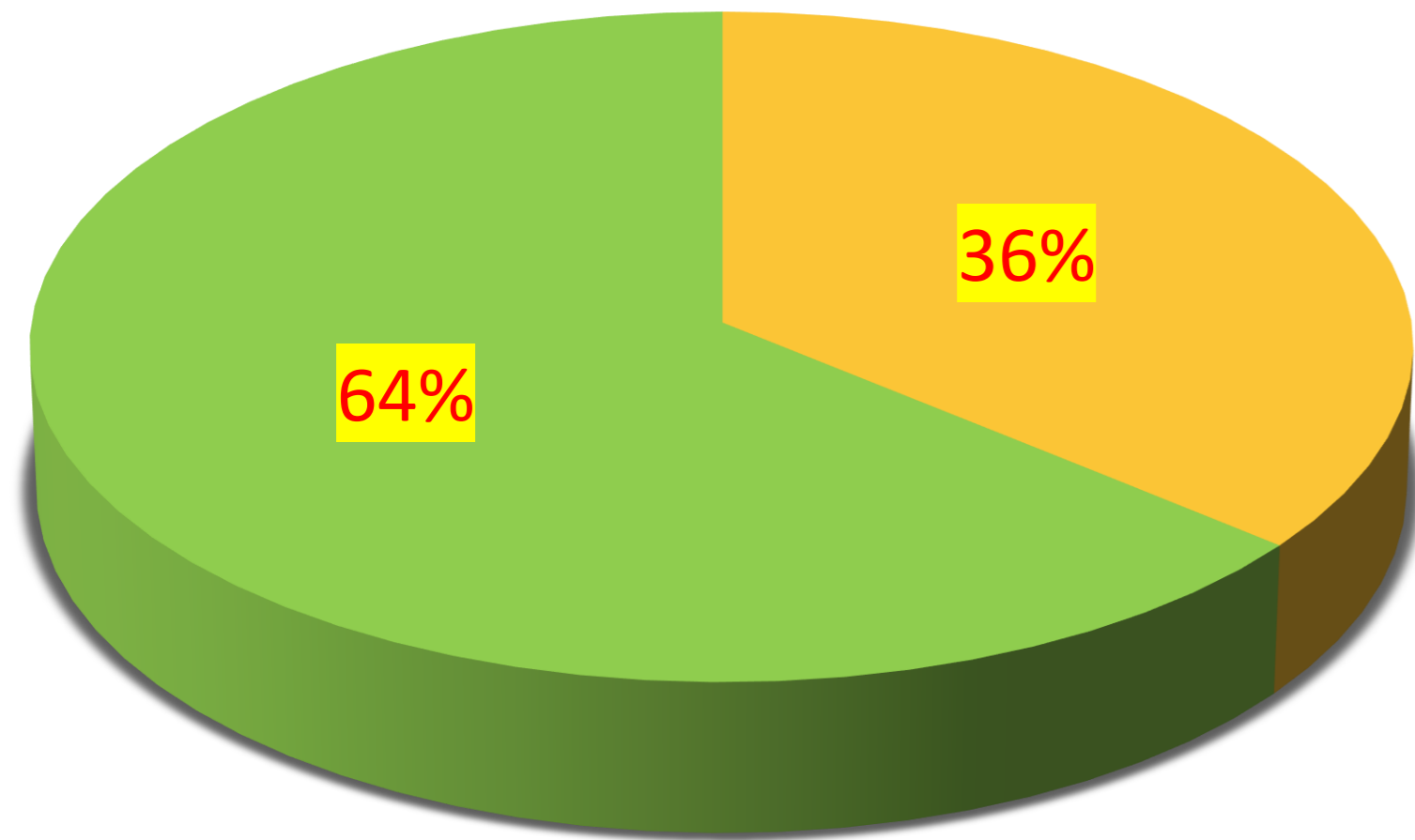
**Achievement
(2021-22)**

**DC Energy : 13446.8
kWH/MT of HM**

SMELTER FLOW DIAGRAM

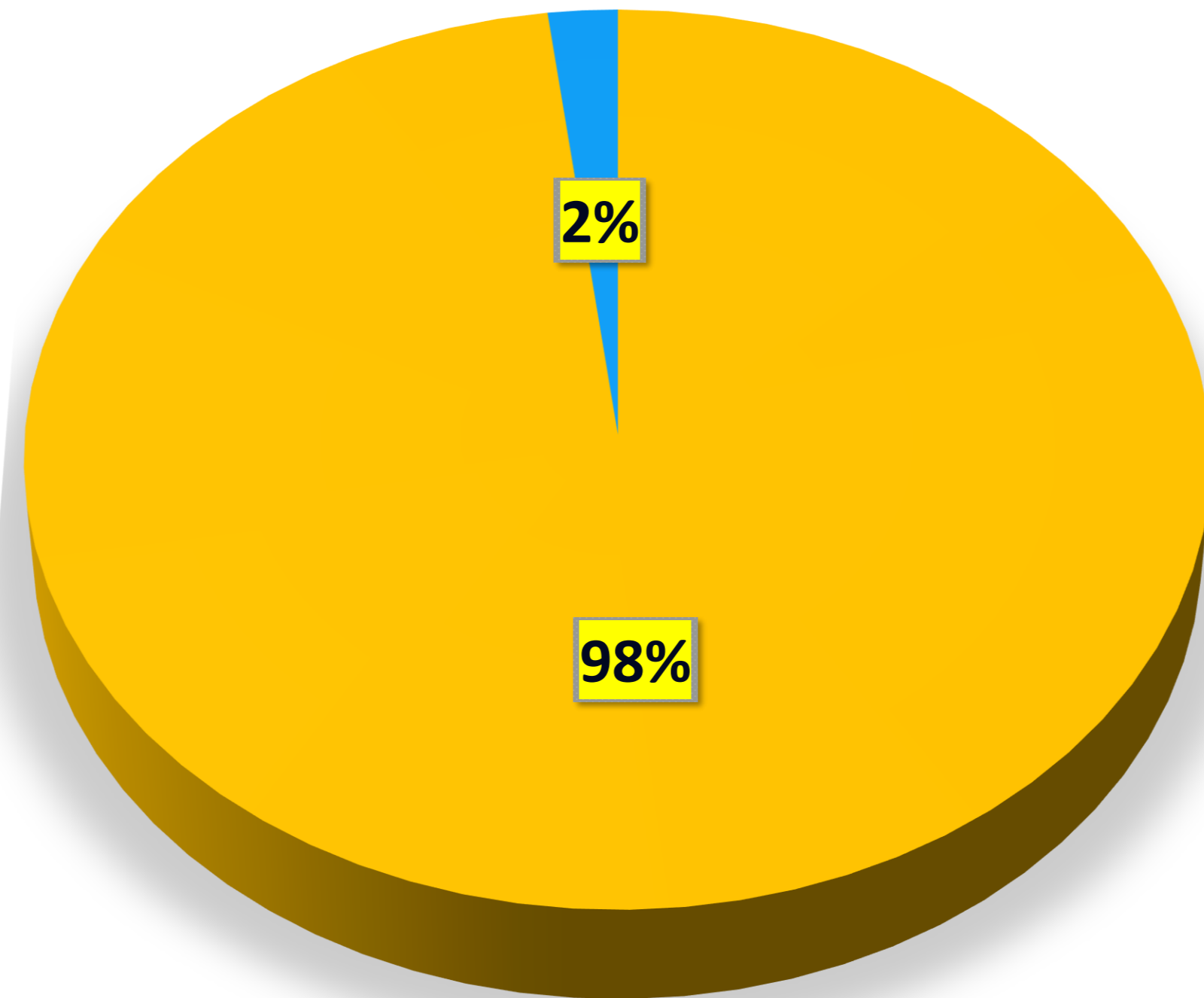


COST BREAK UP



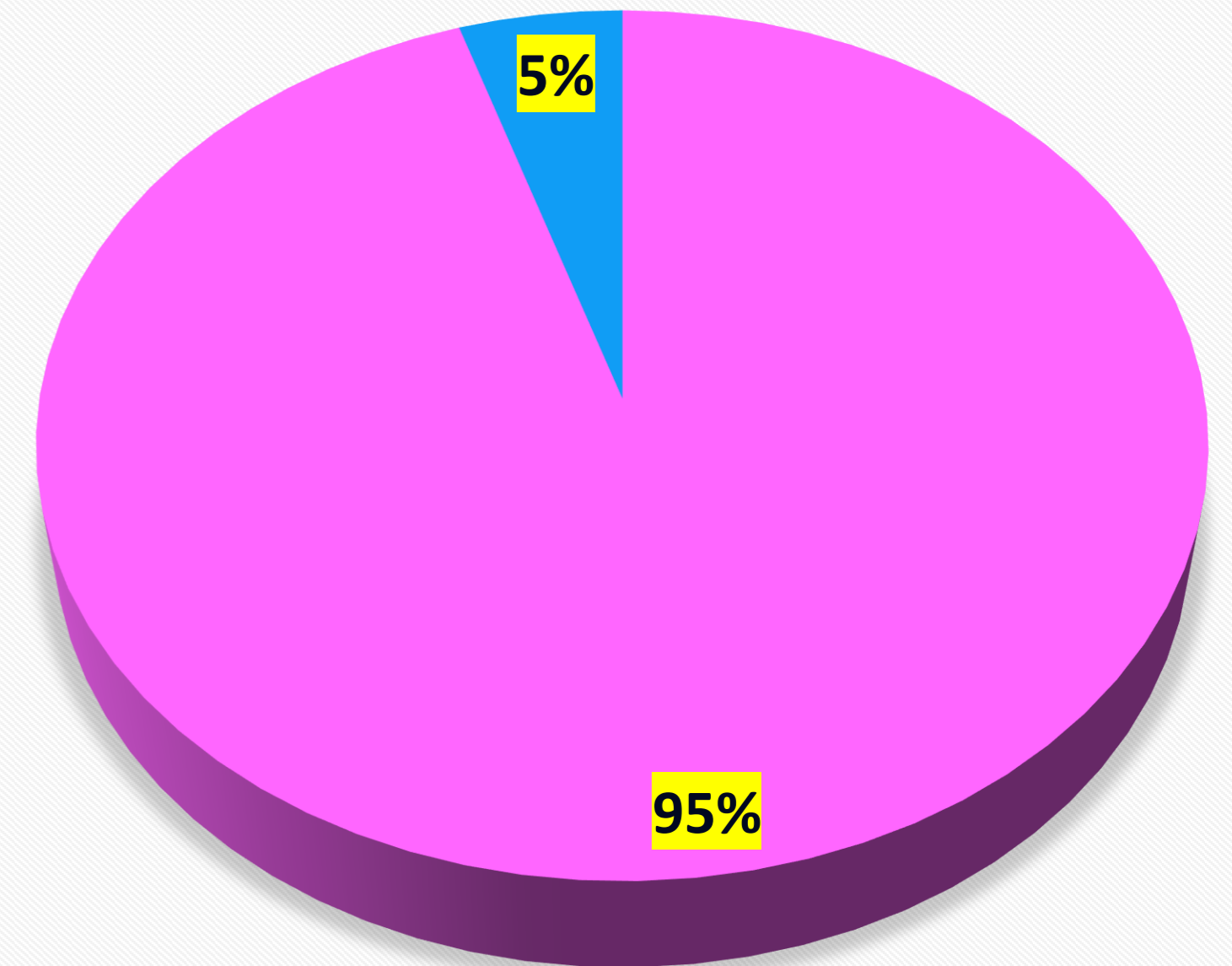
■ ENERGY COST ■ OTHER COST

% ENERGY CONSUMPTION



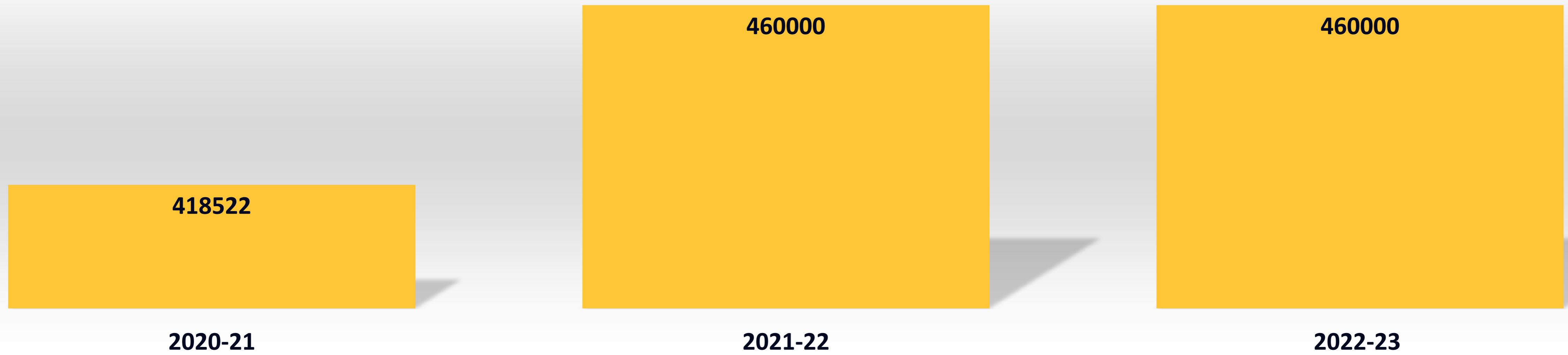
■ ELECTRICAL ENERGY ■ THERMAL ENERGY

% DC AND AC ENERGY CONSUMPTION

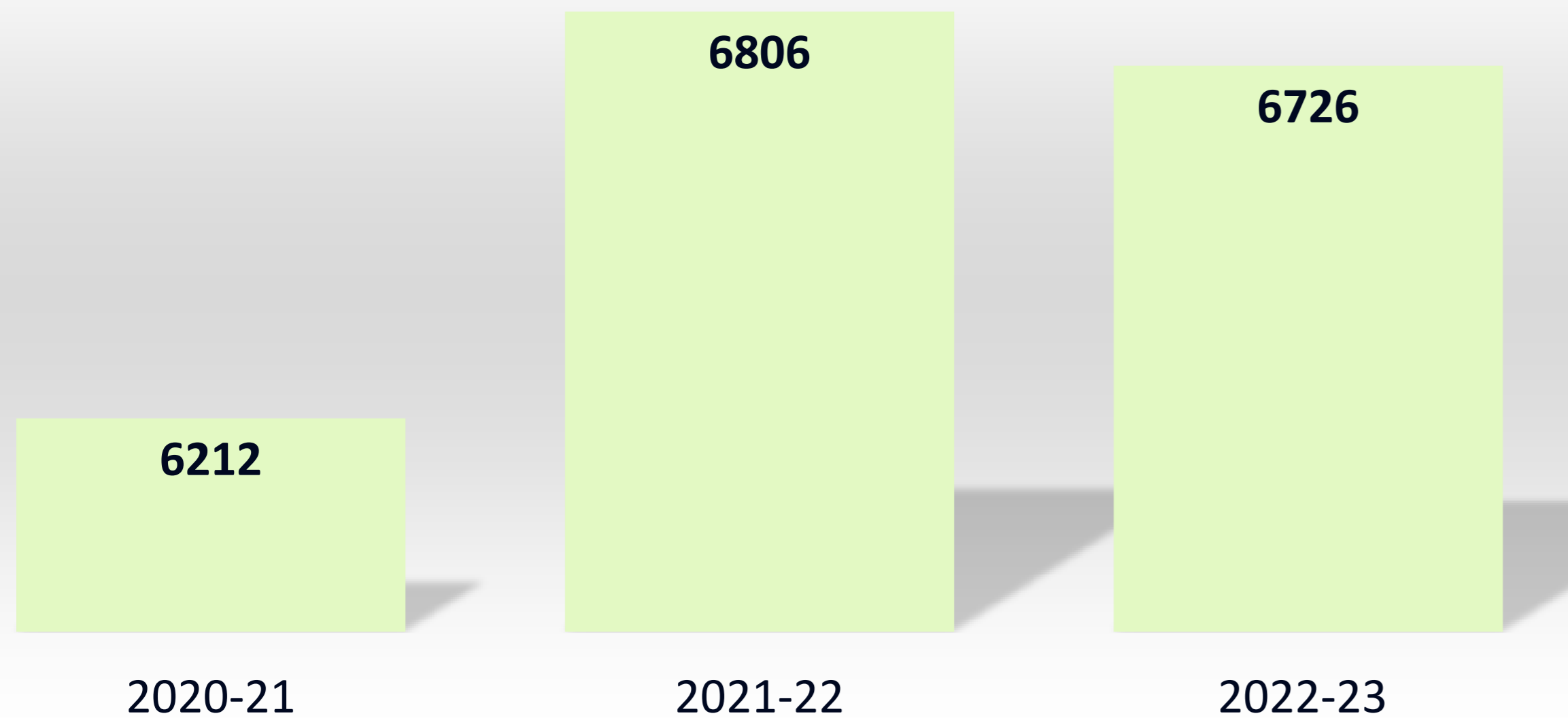


■ DC ENERGY ■ AUXILIARY

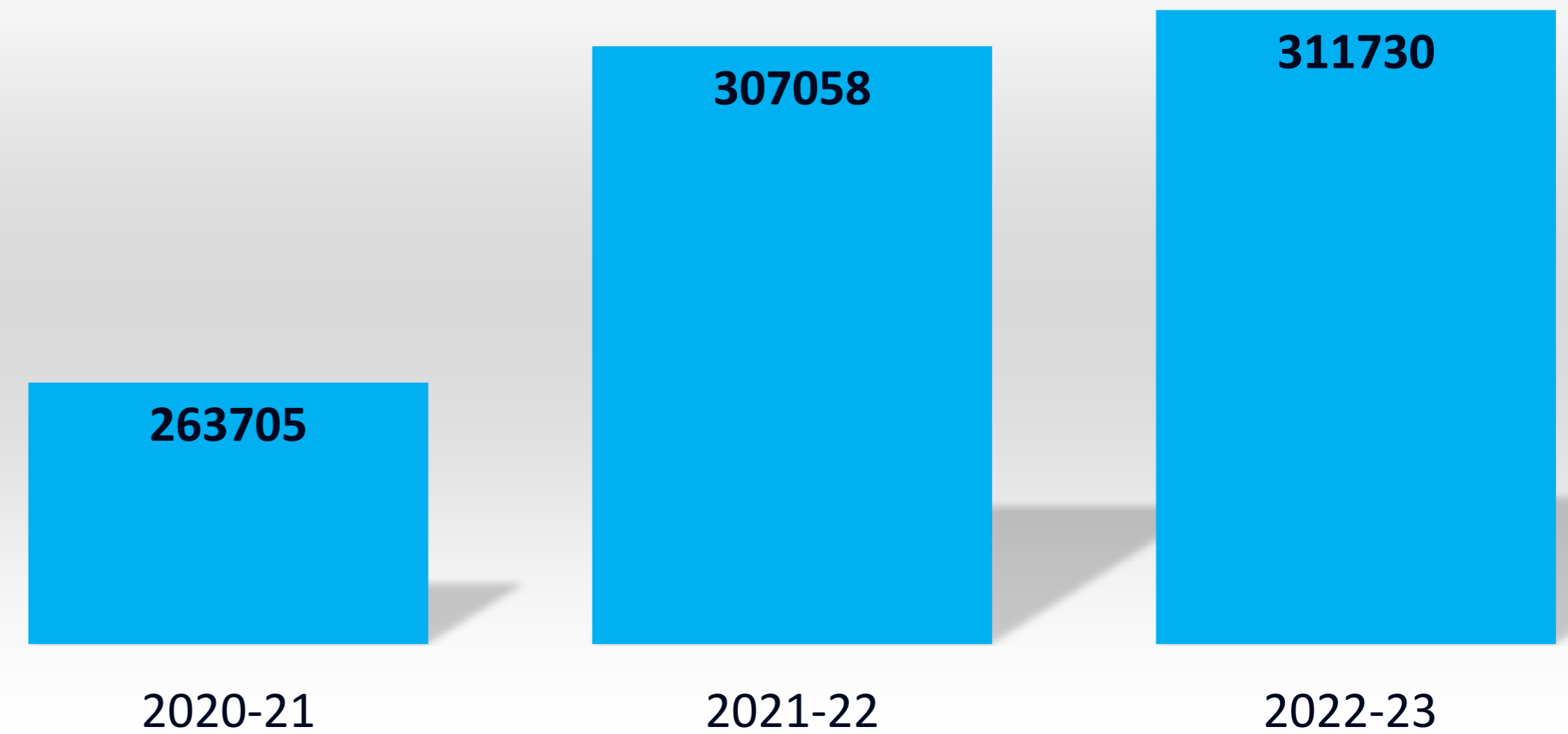
Cast Metal in MT



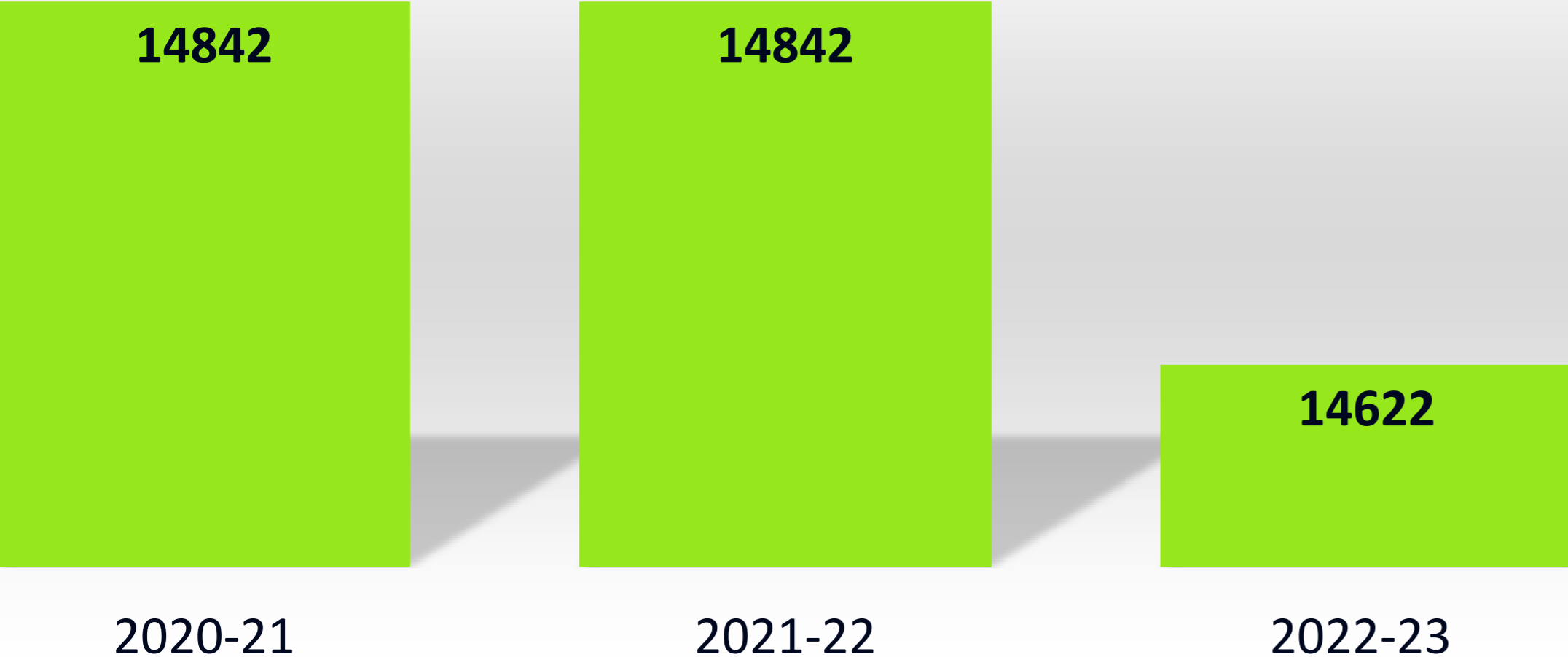
Annual Electrical Energy consumption in million kWh



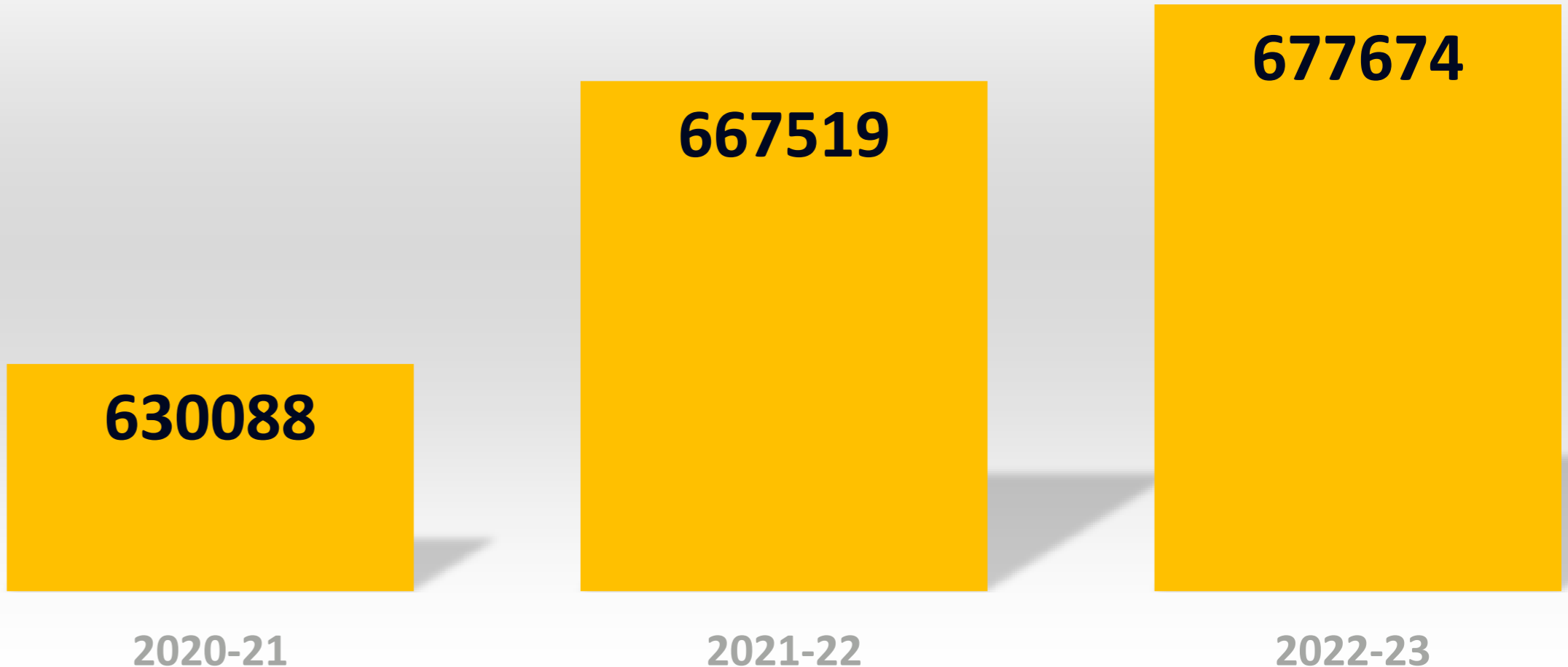
Annual Thermal Energy Consumption in million kcal



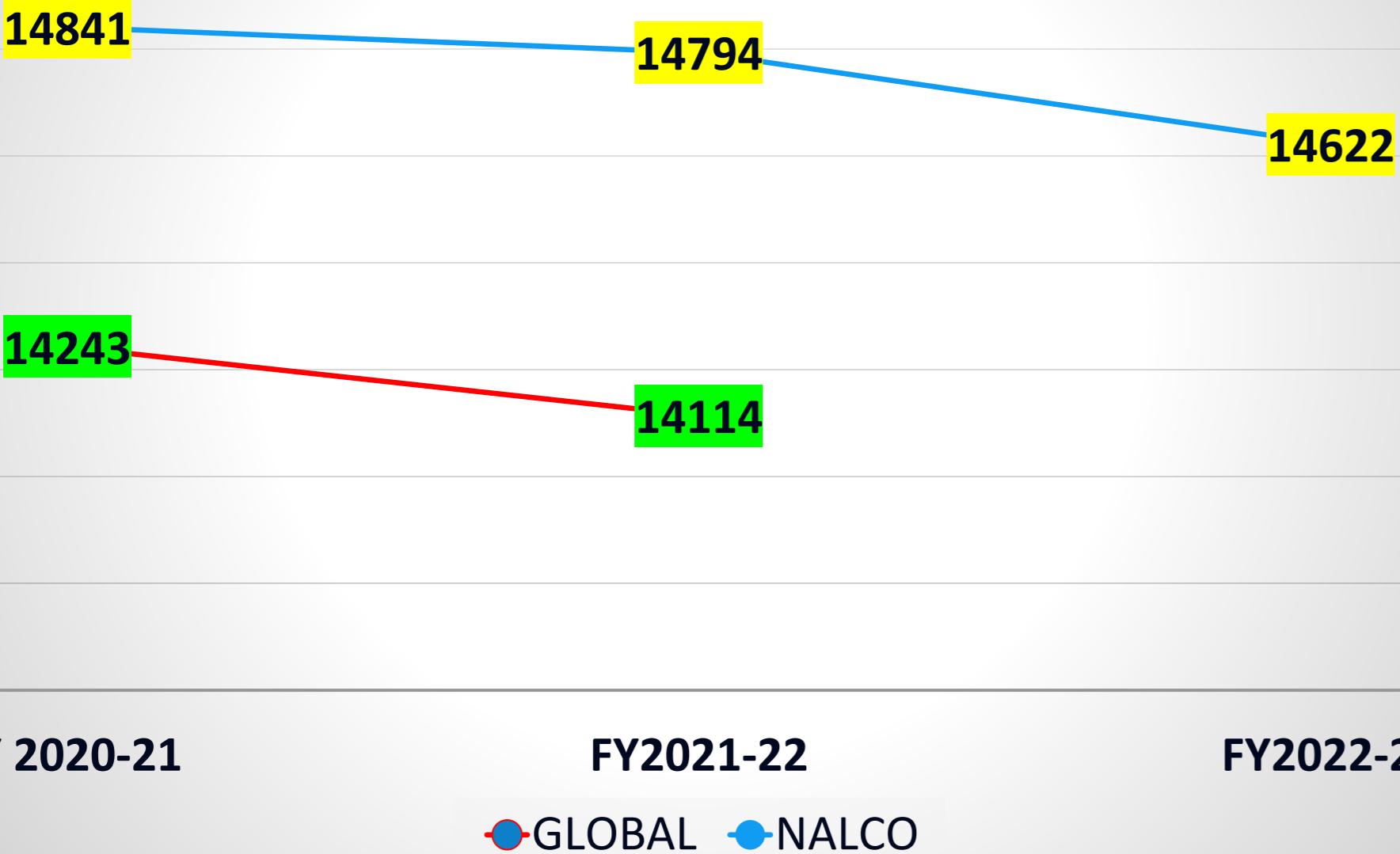
specific Electrical Energy in kWh/MT of Production



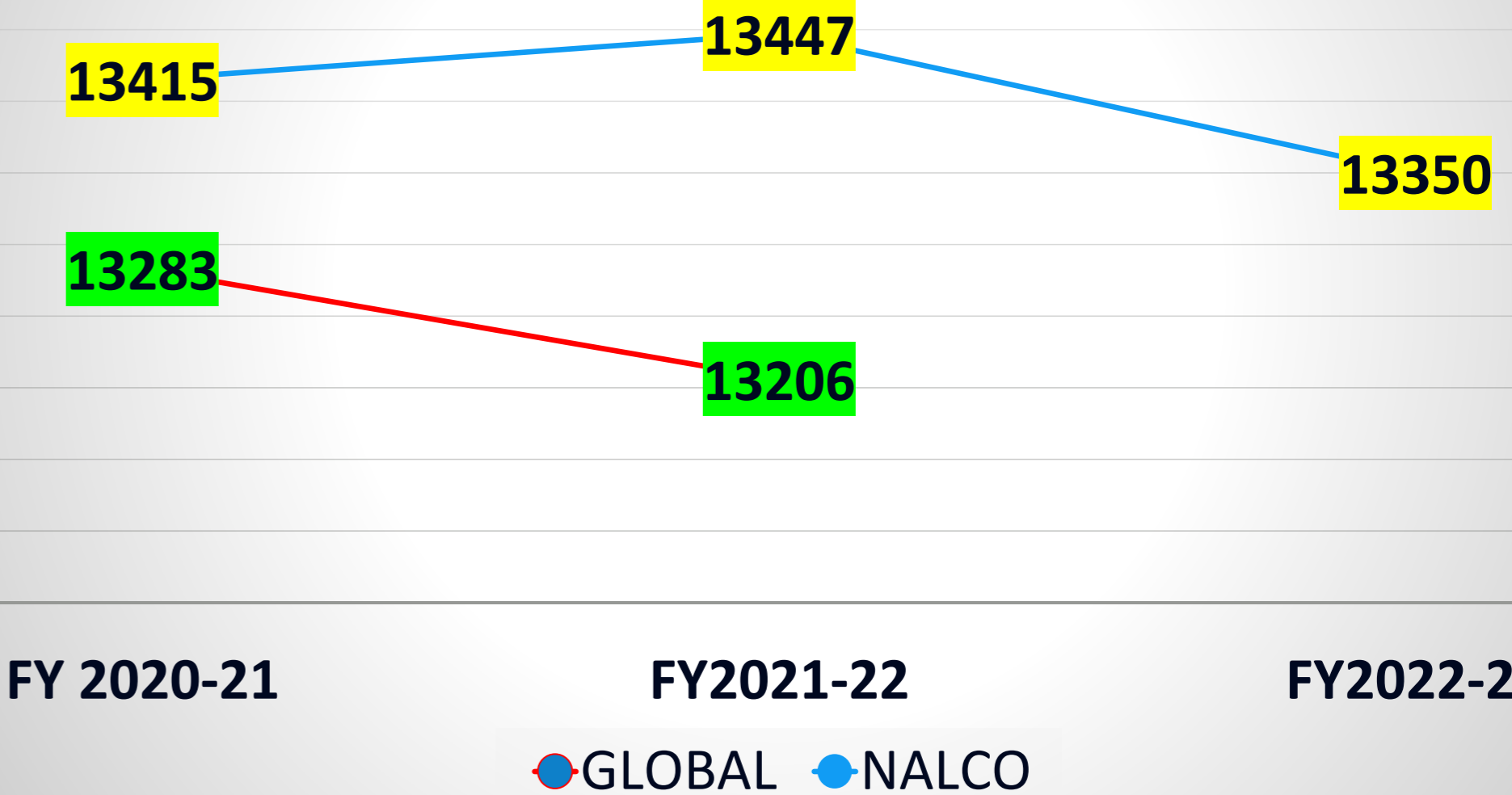
specific Thermal Energy in kCal/MT of Production



NALCO VS GLOBAL BECNHMARKING SP AC ENERGY IN KWH/MT



NALCO VS GLOBAL BECNHMARKING SP DC ENERGY IN KWH/MT



Energy Saving projects implemented in last three years

Year	Name of the Energy savings Projects	Investment (INR millions)	Electrical Savings (million kWh)	Thermal savings (million kcal)	Total Savings (INR million)	Payback period (in months)
2020-21	Replacement of oversized centrifugal pumps by energy efficient pumps along with IE4 motors	1.54	992340	0	3.08	6
2021-22	Replacement of electrically heated desiccant dryers by refrigerated air dryer	2.38	3057240	0	9.5	3.01
2022-23	Graphitization of electrolytic cells	5	1369115	0	6.24	9.62

Innovative Projects implemented

SI No	Name of the Project	Brief Description of Project	Why Project is important	COST BENEFITS
1	Replacement of oversized centrifugal pumps by energy efficient pumps.	Replacement of Electrically heated desiccant driers with Refrigerant type driers, the age old problem of high Energy consuming drying could be resolved by consuming hardly 7% of the electrical energy consumed. It means there is an opportunity of almost 93% saving. Hence it is an Innovative solution.	93 % of Energy saved.	In the new system=227760 KWH Annual Saving=3057240 KWH Estimated Saving in %= 93%
2	AP2XNO POTS	INNOVATIVE MODIFICATION IN BOOTOM INSULATION DESIGN LEADS TO HEAT RETENTION IN THE POT SO THAT LESS EXTERNAL ENERGY IS REQUIRED FOR HEATING EFFECT	Approx 150 kWh/MT Energy saving Potential	Reduction of 150 kwh/MT of metal produced

BRIEF DESCRIPTION ABOUT THE PROJECT

Sl No	Name of the Project	Brief Description of Project	Why Project is important	COST BENEFITS
1	Reduction of Sp.D.C.Eenergy consumption in FY 2022-23 by Process improvement	Nalco smelter was following low voltage pot operation till FY2021-22. Sp.D.C.Energy consumption achieved in 2021-22 was 13447.0 KWH/MT. But from the year 2022 onwards, smelter has adopted the methodology to increase %Current Efficiency by keeping required voltage in the pots for reducing Sp.D.C.Energy consumption. By following this methodology, smelter has achieved lowest Sp.D.C.Energy consumption with increased metal production. Reduction of Sp.D.C.Eenergy consumption was also possible by optimizing pot parameters like KA etc	All potlines adopted the principle of raising %Current Efficiency for reducing Sp.D.C.Energy consumption. Roadmap for INDUSTRY 4.0	Sp.D.C.Energy consumption in FY: 2022-23 i.e.13351 KWH/MT of Hot Metal, which is the lowest consumption since inception of Nalco smelter plant
2	Graphitisation of Potline Cathodes	All Potline Cathodes are Graphitised	By using Graphitized electrode it was observed we are saving 55 KWH/MT of Hot metal.	Energy Reduction to the the tune of 55kwh/MT of Hot Metal.



POTLINE ANALYTIC

12-01-2021



JAN CE

93.45

JAN CE ex solid metal

92.71

JAN METAL PURITY

99.75

JAN SP DC ENERGY

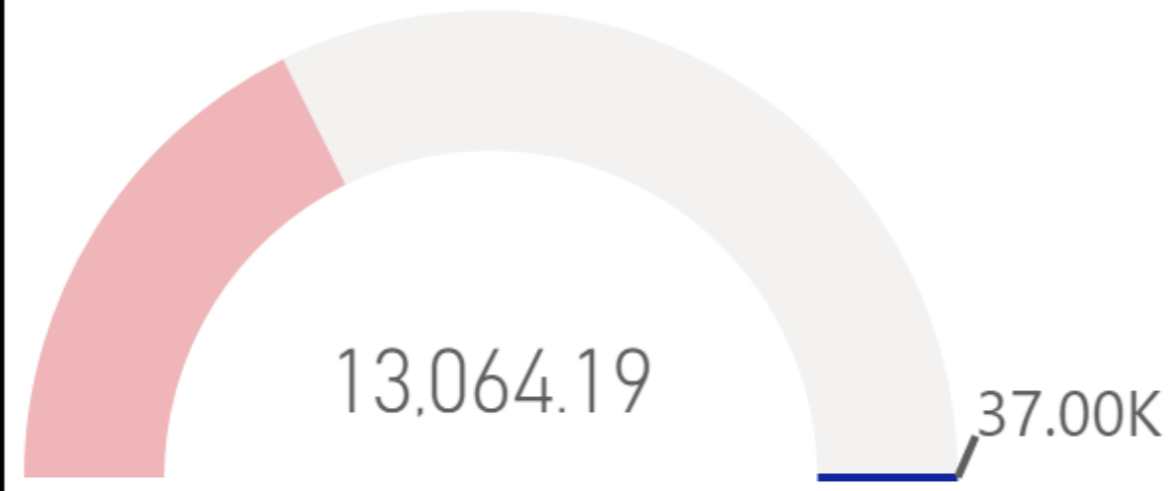
LINE sP dc eXCLUDING

PL1	13,242
PL2	13,845
PL3	13,396
PL4	13,373

RUNNING POTS



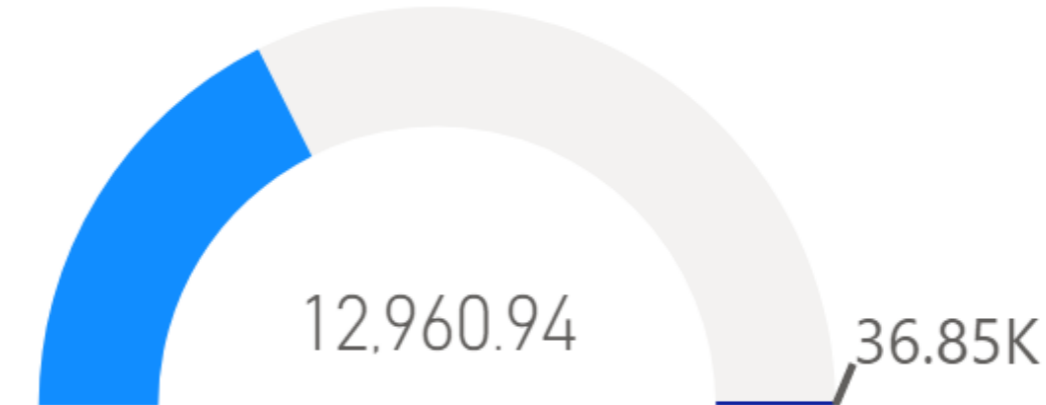
JAN PRODUCTION



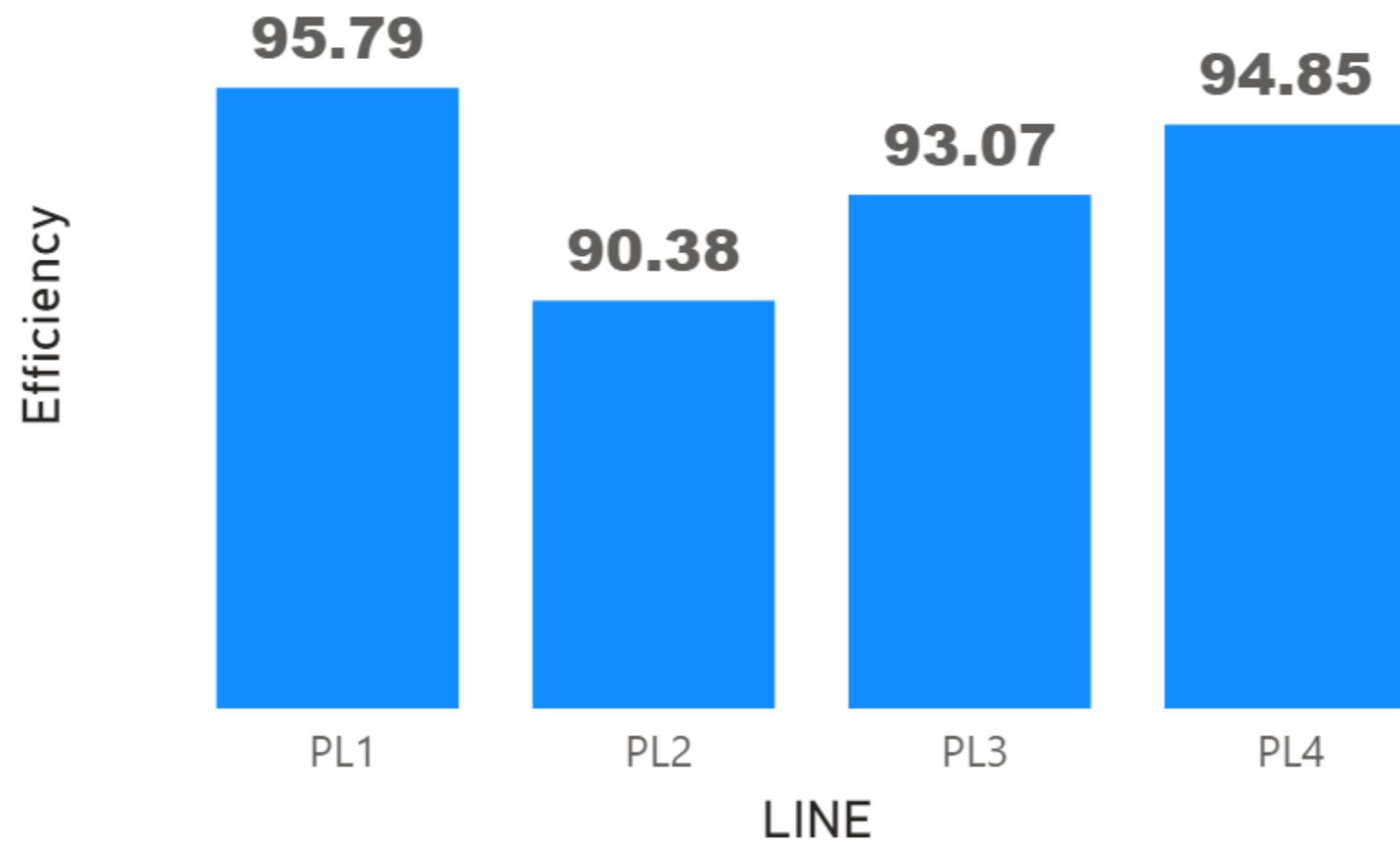
SOLID METAL

102

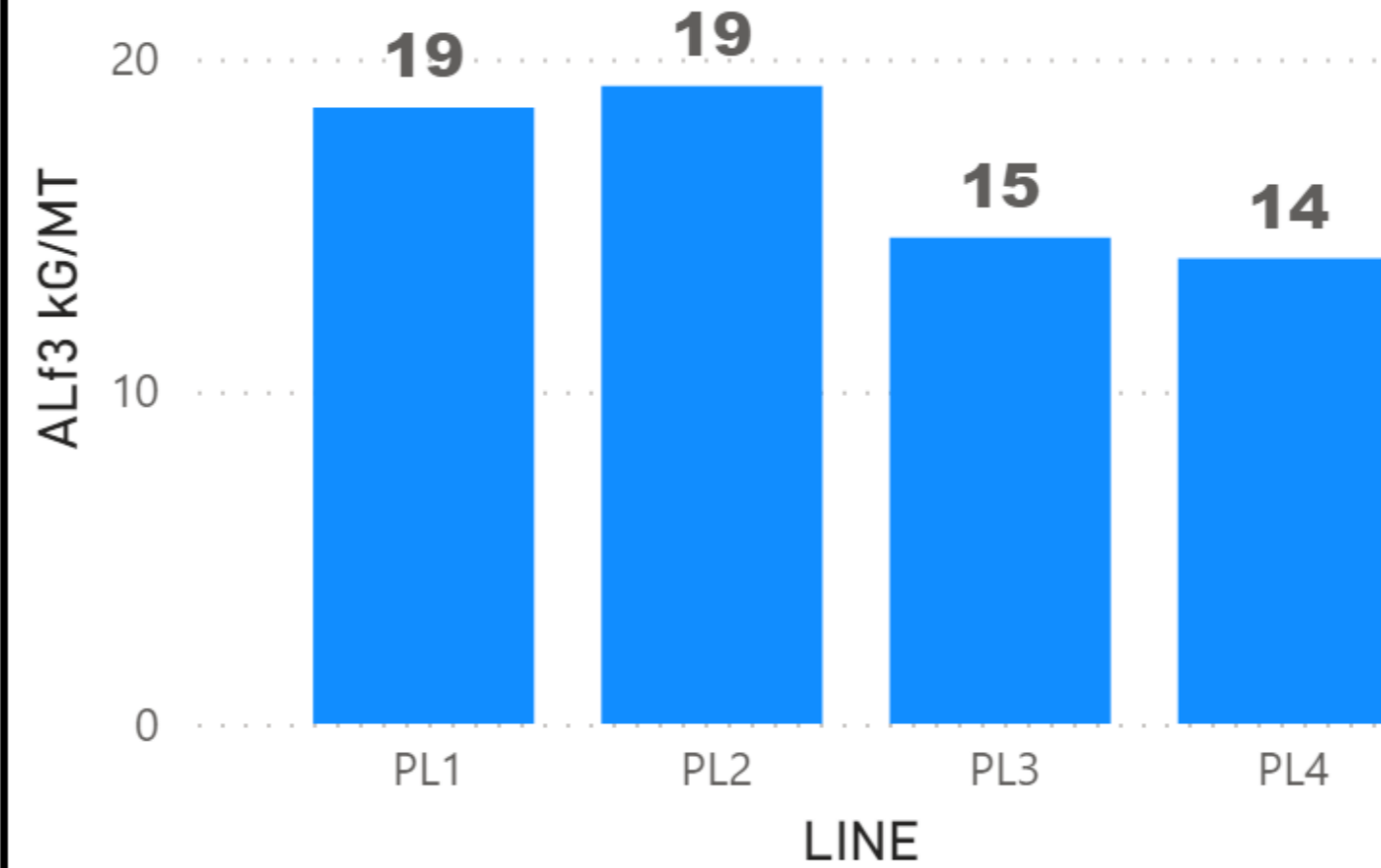
JAN PRODUCTION EX SOLID METAL



Current Efficiency by LINE



ALf3 kG/MT by LINE



JAN METAL PURITY

LINE	PURITY
PL1	99.76
PL2	99.74
PL3	99.76
PL4	99.75

PL 1 NO OF POTS

184

PL 2 NO OF POTS

222

PL 3 NO OF POTS

230

PL 4 NO OF POTS

239

JAN ALF3 CONSUMPTION (MT)

214.45

JAN ALF3 KG/MT

16.42

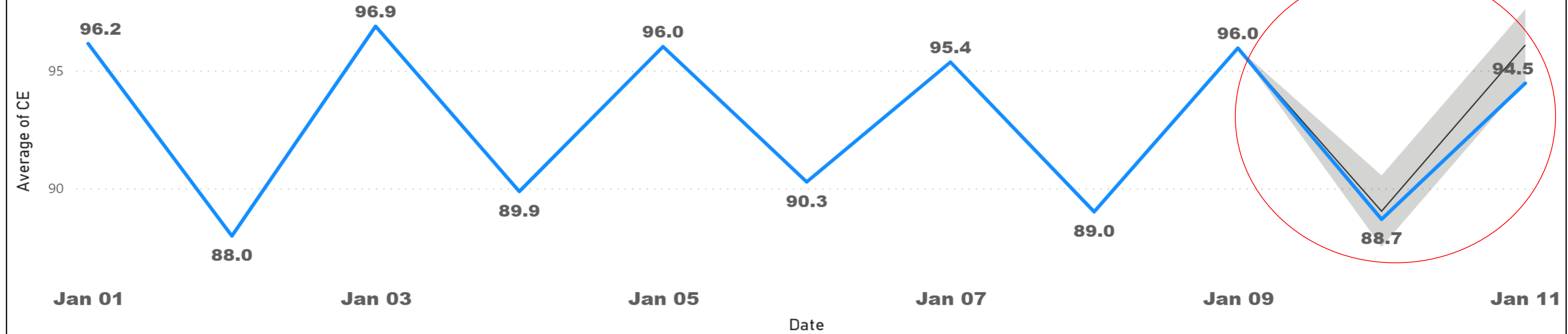
POT START STOP

LINE START STOP

PL1	0	0
PL2	7	3
PL3	7	0
PL4	0	0
Total	14	3

PREDICTIVE ANALYSIS AND Q & A ANALYSIS

Average of CE by Date



Ask a question about your data

Try one of these to get started

top ce lines by min purity

top ce lines by ALf3
KG/MT

top rooms by ae last 3
days

top sections by % pots
rc>1

top sections by aLf3
KG/TON

what is the % pots in RC
by sow

[Show all suggestions](#)



Innovation 1 : close to 100 % Graphitization of Pots

- **Converted 949 pots out of 960 pots into graphitized cathode and plan is in place to convert all pots into graphitized cathode**
- **Helped in reducing Specific DC Energy consumption to the tune of 55 kWh/MT and increase the amperage of operation by another 5 KA**
- **Close to 100% of the entire Pot line has been graphitized**
- **Annual energy savings of 247.73 Lakh kWh**

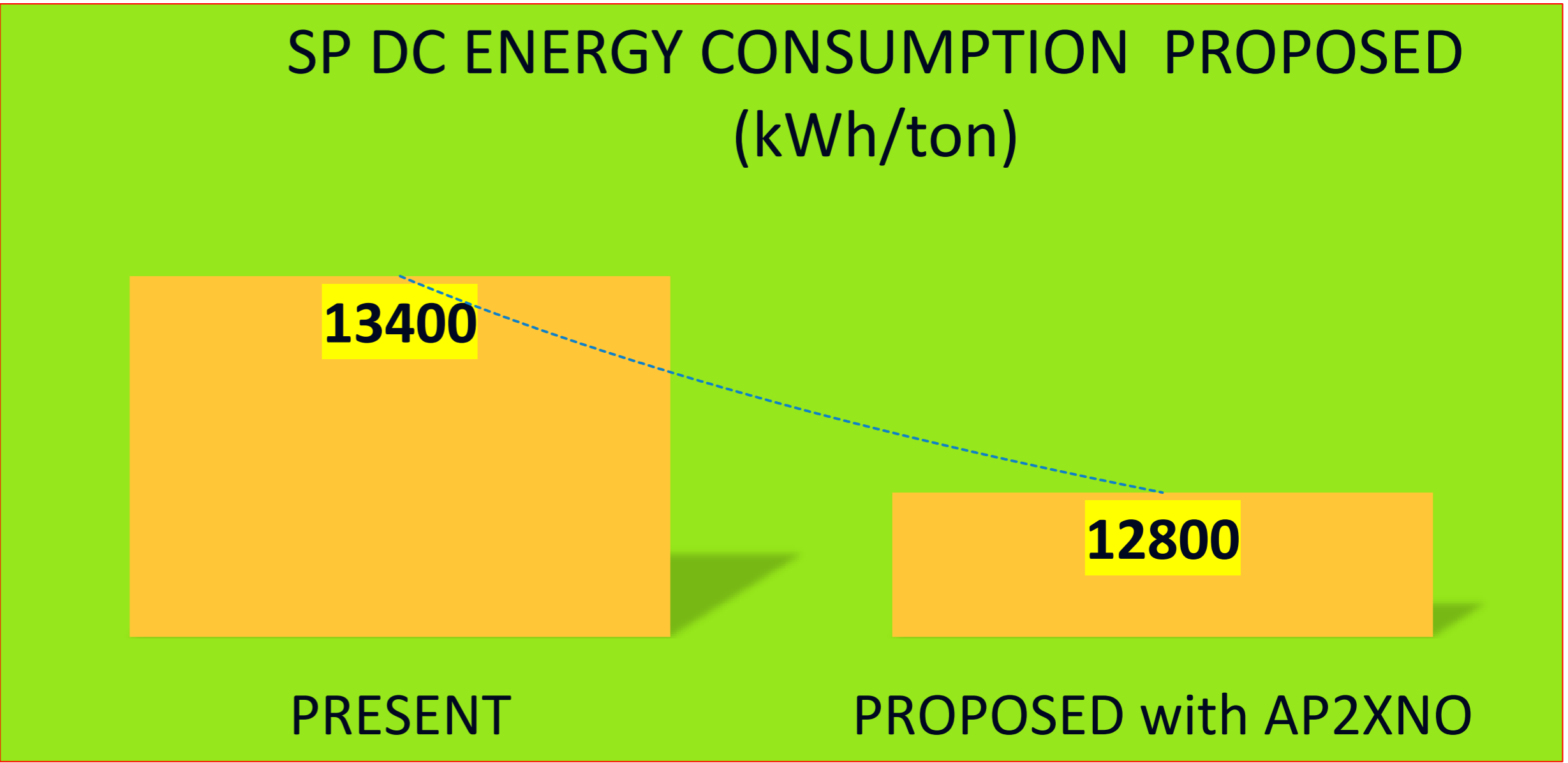
Innovation : 100 % Graphitization of Pots

COMPARISON OF GRAPHITIZED CATHODE AND SEMI-GRAPHITE CATHODE

PARAMETERS	GRAPHITIZED	SEMI-GRAPHITE
Cathode Resistance	1.50 $\mu\Omega$	2.00 $\mu\Omega$
Pot Voltage	Low	High
Bath Temperature	Low	High
Amperage of Operation-KA	High	Low
Productivity	High	Low
Current Efficiency	High	Low
Sp DC Energy-Kwh/MT	Low	High



INNOVATION 2: AP2XNO: A JOINT INITIATIVE BETWEEN NALCO & RIO TINTO ALCAN



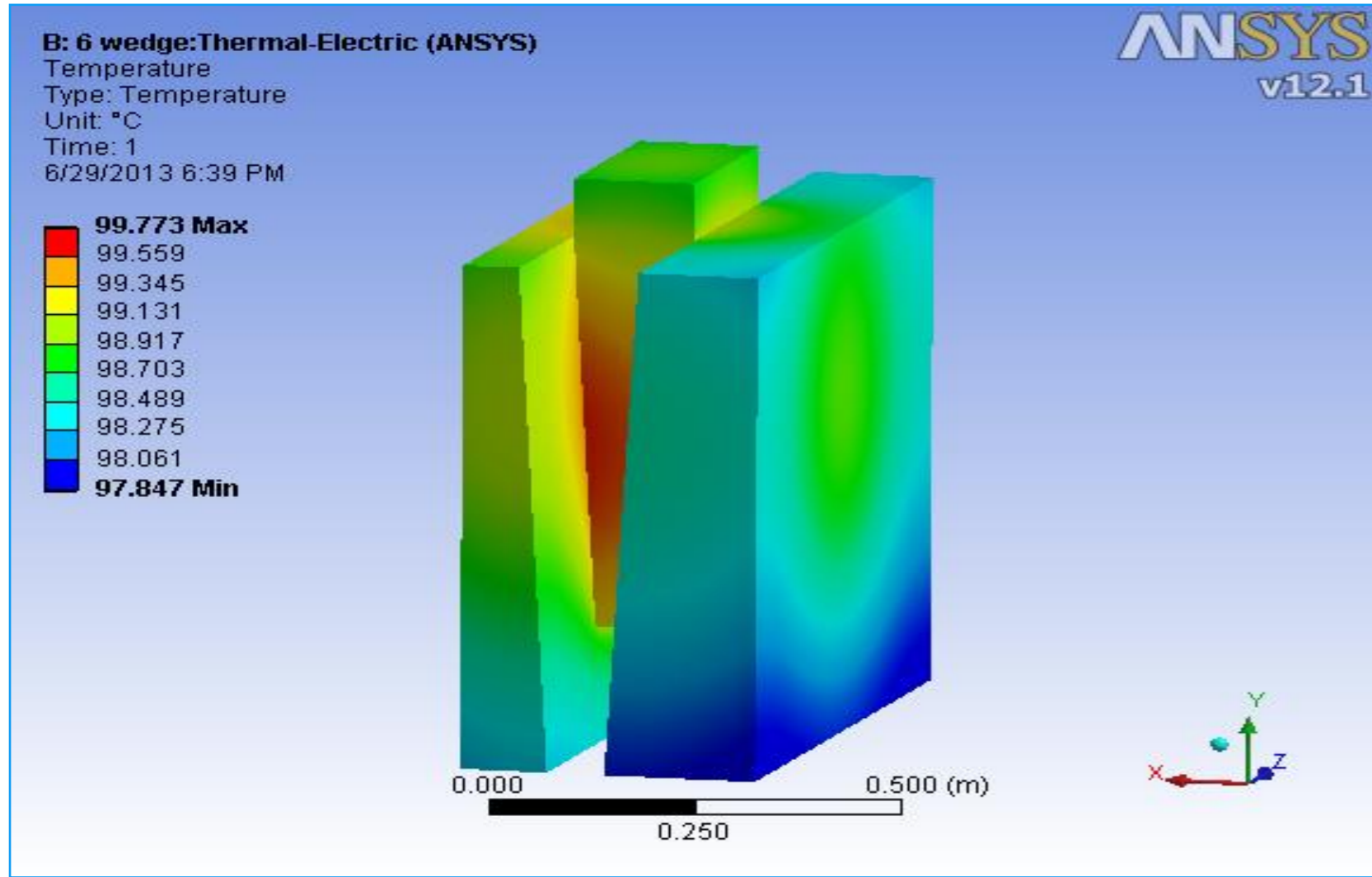
Innovation 3

INNOVATIVE BY-PASS JOINT

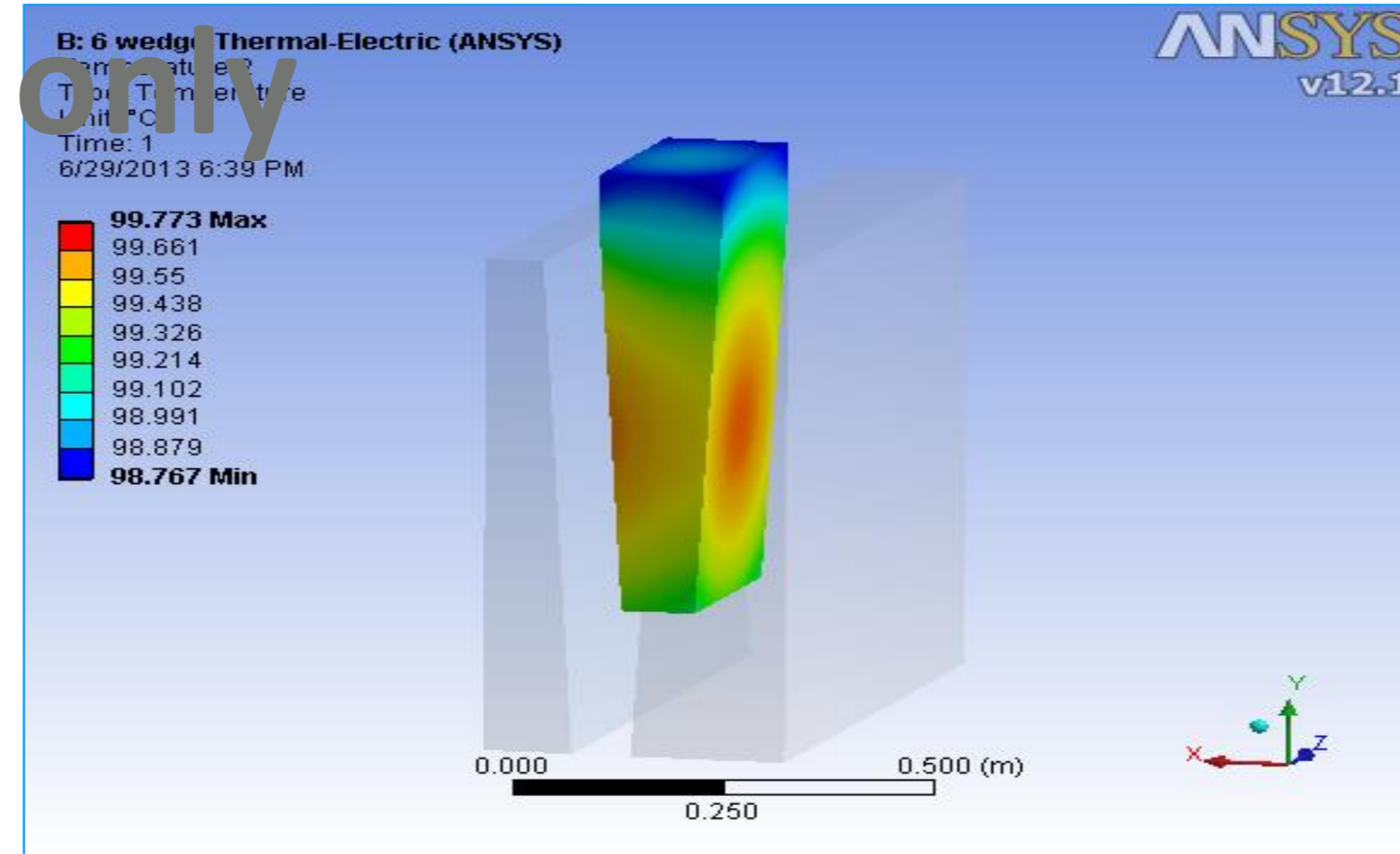


Modeling and Simulations of the modified Bypass joint

Temp. profile : wedge & busbar

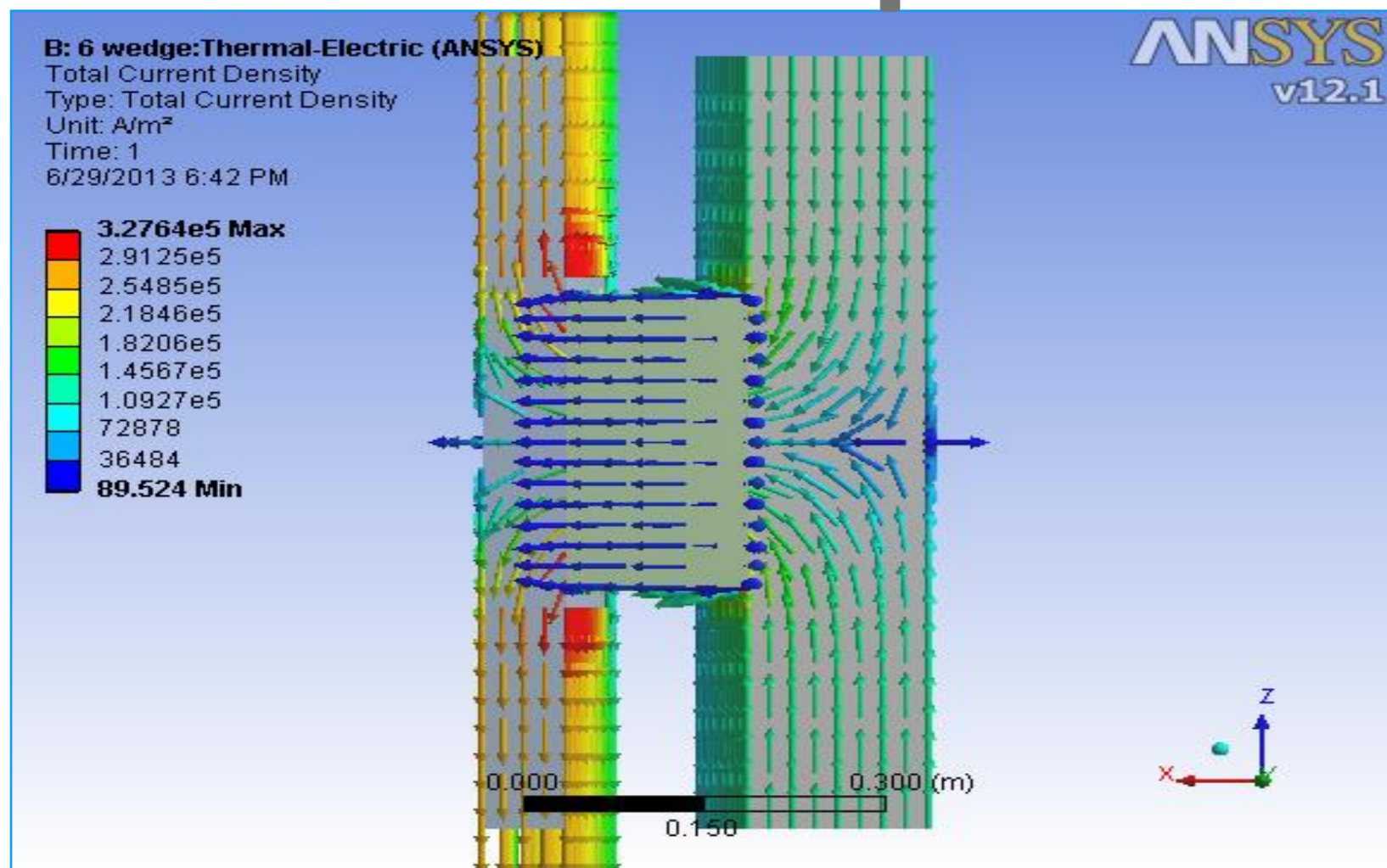


Temp. profile: wedge

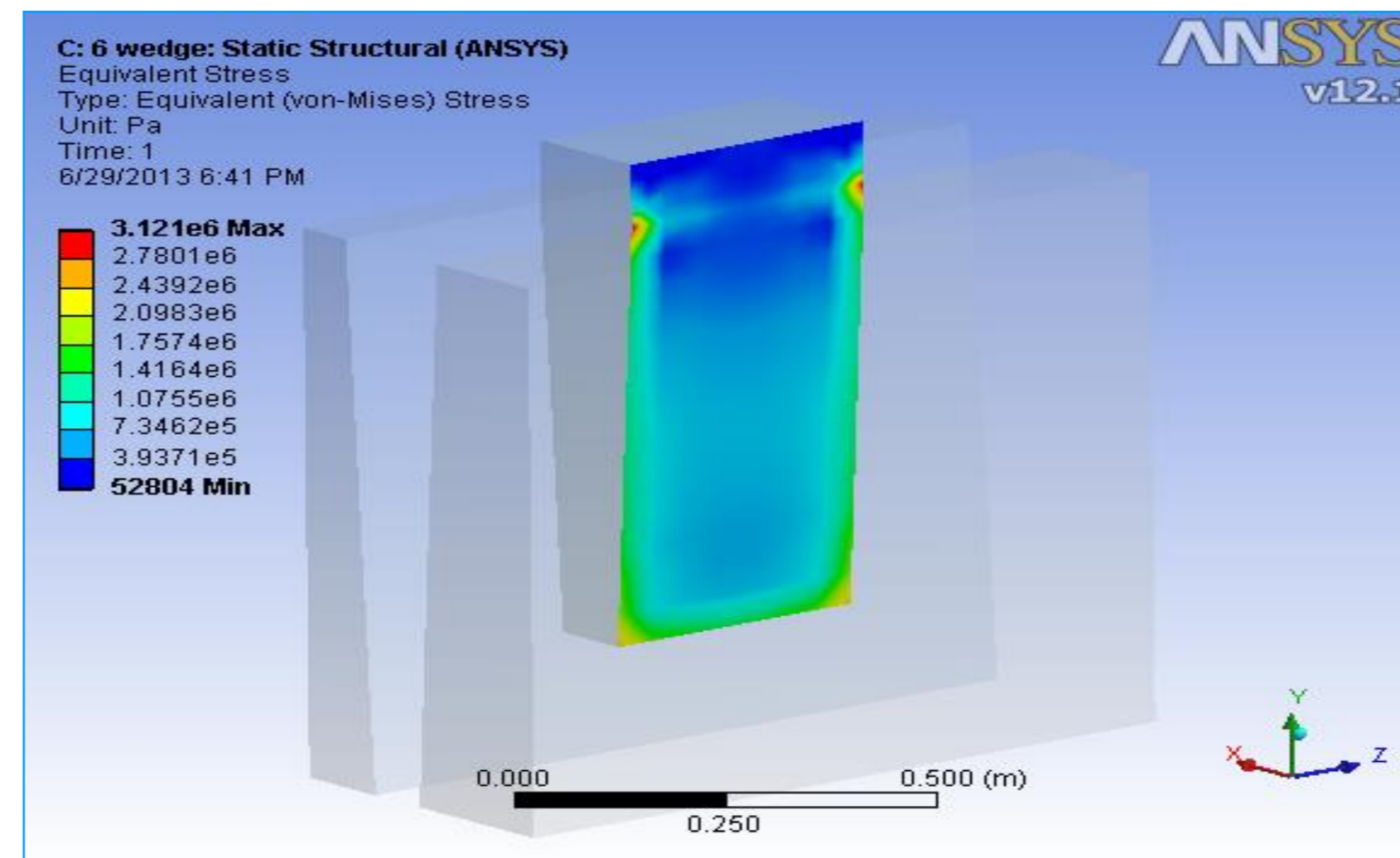


decrease in voltage drop up to 33.33 %.

Current flow profile



Stress at wedge contact surface



Decrease in kWh = 9 million kWh



Innovation 4 : 100 % Replacement of desiccant driers with energy efficient refrigerant driers

- Two desiccant type driers #1 & #2 were replaced with more energy efficient refrigerant type driers
- Rupees 23.6 lakh was the investment resulting in annual savings of rupees 87,38,275
- Annual electrical energy saved was about 25,92,960 kwh
- Dryness of compressed air has improved dramatically

GHG Inventorisation and Public Disclosure in Sustainability Report in Web Hosting

GreenHouse Gas Emissions

Fuel	Unit	GHG Emissions 2019-20	GHG Emissions 2020-21	GHG Emissions 2021-22
HFO (Scope 1)	tCO2e	6,19,874	6,13,674	6,31,201
LDO (Scope 1)	tCO2e	12,294	13,626	11,873
Coal (Scope 1)	tCO2e	93,25,614	96,12,147	88,08,272
Diesel (Scope 1)	tCO2e	20,428	23,052	21,671
LPG (Scope 1)	tCO2e	58	38	46
Electricity from Grid (Scope 2)	tCO2e	2,52,418	31,217	11,32,426
Emission from PFC (Scope 1)	tCO2e	87,902	94,166	98,484
Process carbon Emission from electrolysis in pots (Scope 1)	tCO2e	6,38,005	6,39,641	7,14,760
Process carbon Emission from anode baking (Scope 1)	tCO2e	60,707	59,315	55,725
Total Scope 1+ Scope 2 GHG Emissions	tCO2e	1,10,17,300	1,10,86,876	1,14,74,458

*GHG emissions are estimated based on actual usage of fuels and electricity, IPCC emission factors, CEA grid emission factor, actual production figures and Aluminium sector GHG workbook

Mean PFC emissions intensity(t CO₂e/t Al)



FY 2016-17

FY 2017-18

FY 2018-19

FY 2020-21

FY 2022-23

■ Mean PFC emissions intensity(t CO₂e/t Al) global av

■ Mean PFC emissions intensity(t CO₂e/t Al) NALCO AVG

Utilisation of Renewable Energy sources

Source	Year	Installed capacity (in MW)	Generation (in Million kWh)
SOLAR	2020- 21	0.8	0.52
SOLAR	2021- 22	0.8	0.73
SOLAR	2022- 23	0.8	0.703
WIND	2020- 21	198.4	285
WIND	2021- 22	198.4	320
WIND	2022- 23	198.4	292.56
TOTAL RENEWABLE INSTALLATION IN MW	199		
TOTAL THERMAL INSTALLATION	1200 MW		
% RENEBLE GENERATION	17 %		



Net Zero Approach

Activity Timelines

Short Term (1-2 Years)

- ENCON Schemes
- Renewable Energy
- Centralised GHG Inventory

Medium Term (2-5 Years)

- ENCON Schemes
- Reduction in dependency on Grid electricity (Reduce Scope 2 Emission)
- Tree Plantation
- Renewable Energy
- Carbon Capture, Utilisation and Storage (CCUS)

Long Term (5-10 Years)

- Implementation of Advance Technology for Electrolysis Energy Reduction.
- Implementation of Digitisation for PFC Emission Reduction
- Switch to Natural Gas
- Tree Plantation
- Carbon Capture, Utilisation and Storage (CCUS)
- Renewable Energy

Natural (>10 Years) Investment Cycle

- Grey to green hydrogen
- Tree Plantation
- CCUS
- Renewable Energy

Envisaged Emission Mitigation Pathway

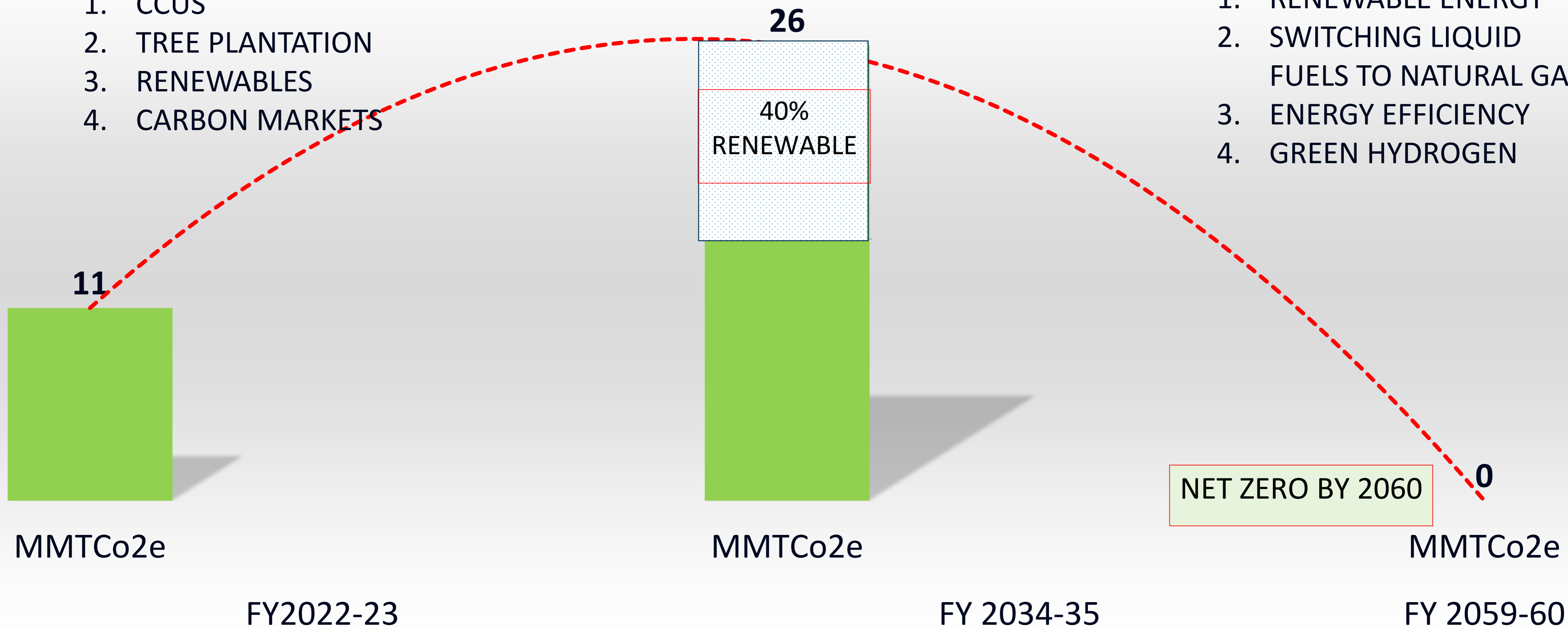
OFFSET EFFORTS

1. CCUS
2. TREE PLANTATION
3. RENEWABLES
4. CARBON MARKETS

GHG Emission (due to Proposed expansion)

MITIGATION PATHWAY

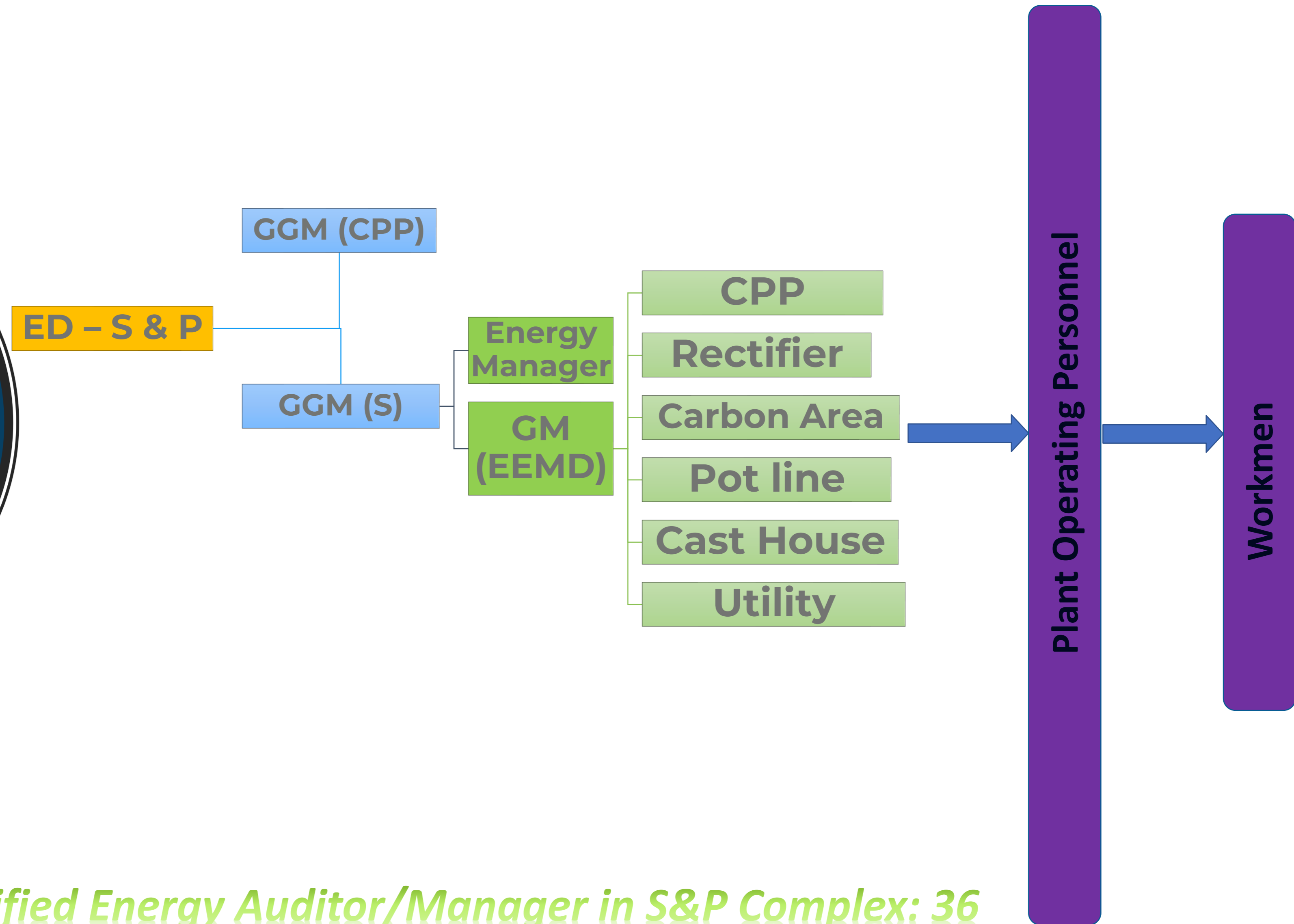
1. RENEWABLE ENERGY
2. SWITCHING LIQUID FUELS TO NATURAL GAS
3. ENERGY EFFICIENCY
4. GREEN HYDROGEN





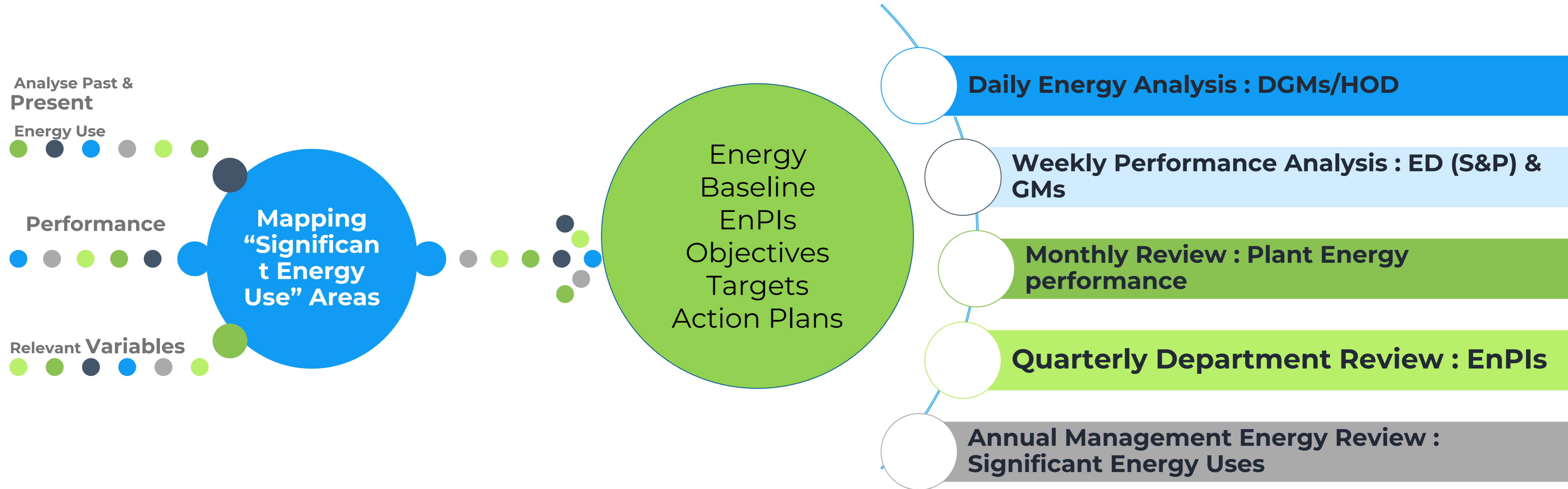
Total no. of plants planted - 17.55 Lakhs
Actual no. of plants survived - 11.52 Lakhs
Average survival % age - 65.65%





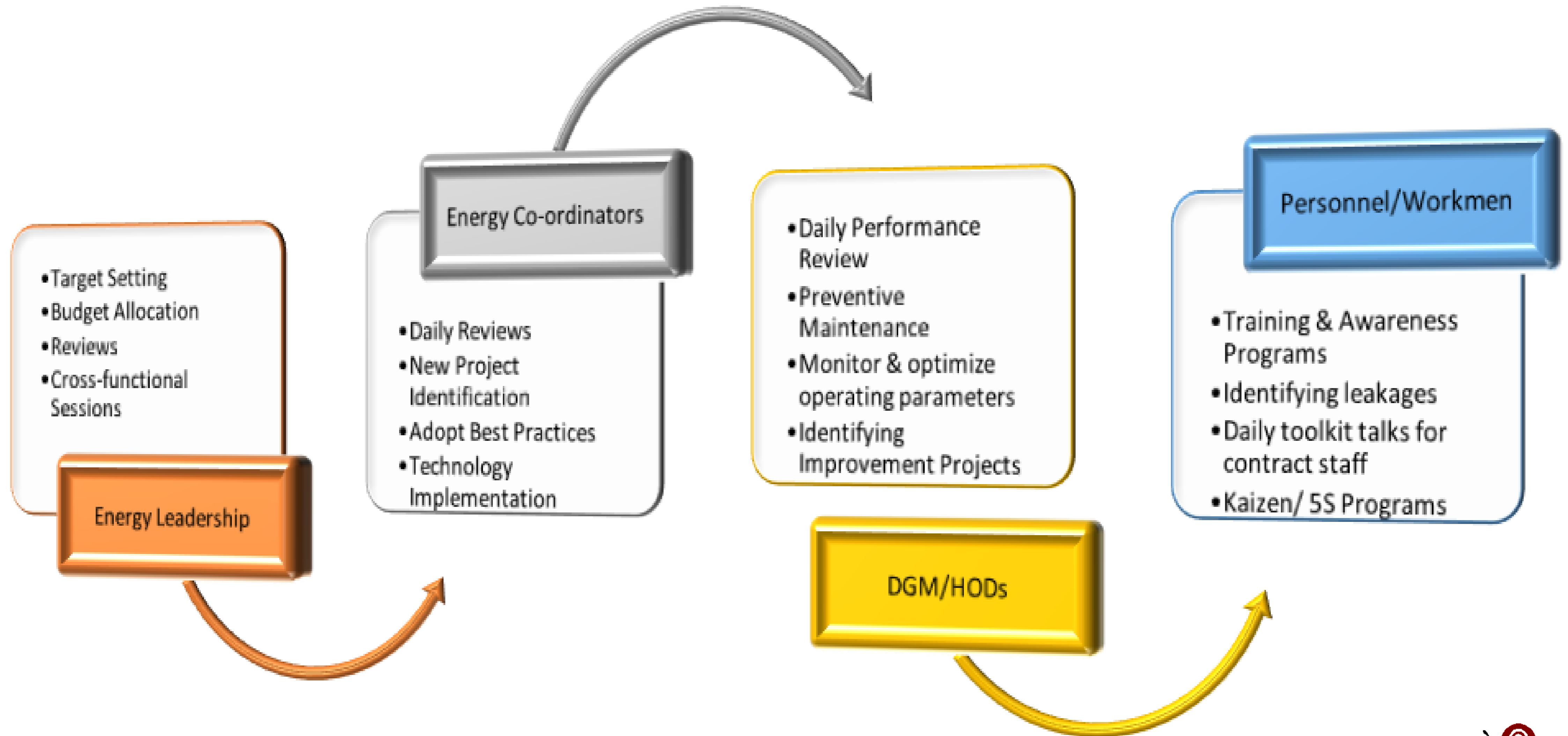
BEE Certified Energy Auditor/Manager in S&P Complex: 36

Energy Planning & Review



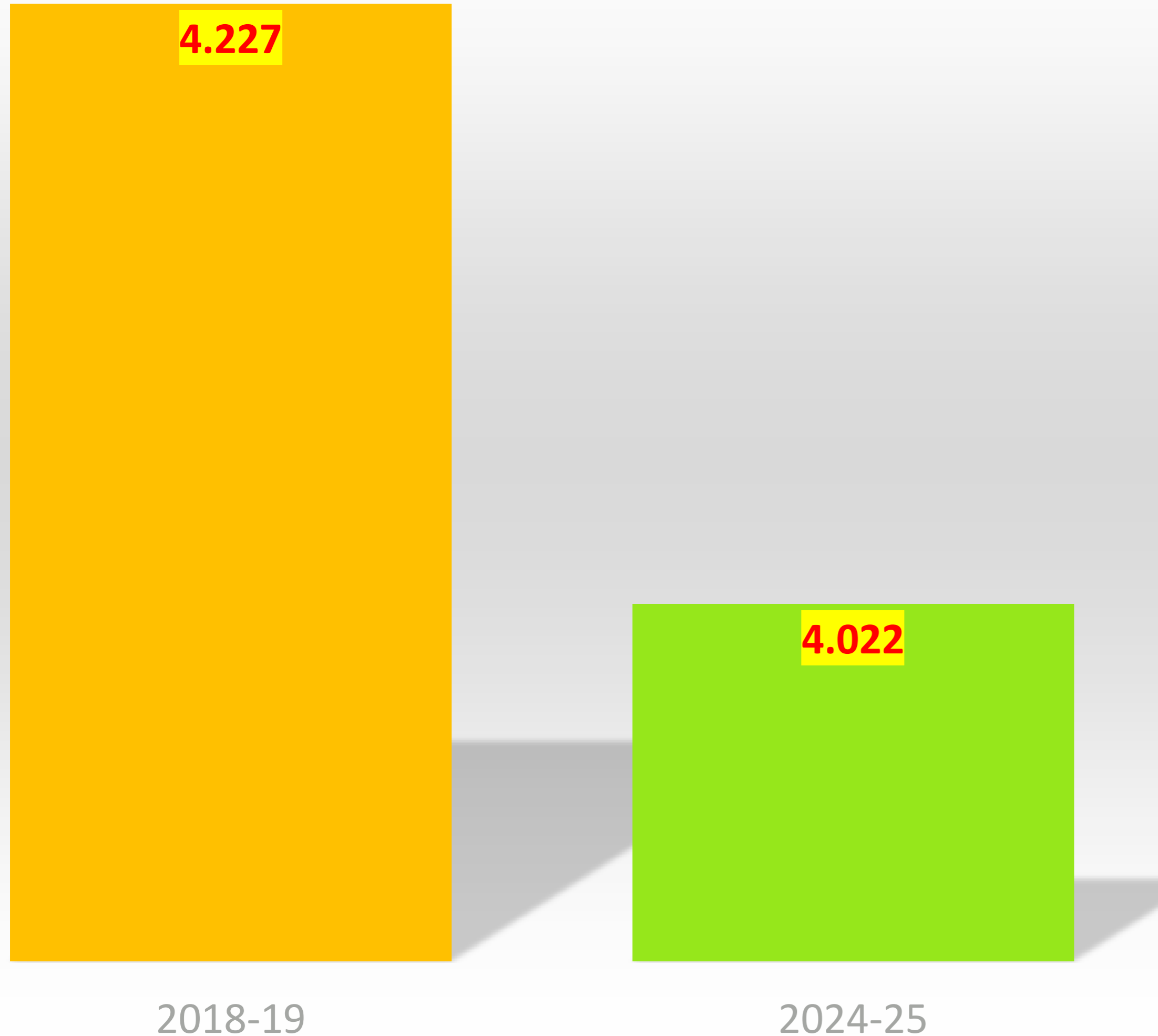
Energy Performance Indicators (EnPIs) set at Department level : 22

Energy Review - Mechanism



PAT TARGET 2024-25 : NALCO,S&P Complex ,Angul

TOE/T OF PRODUCT



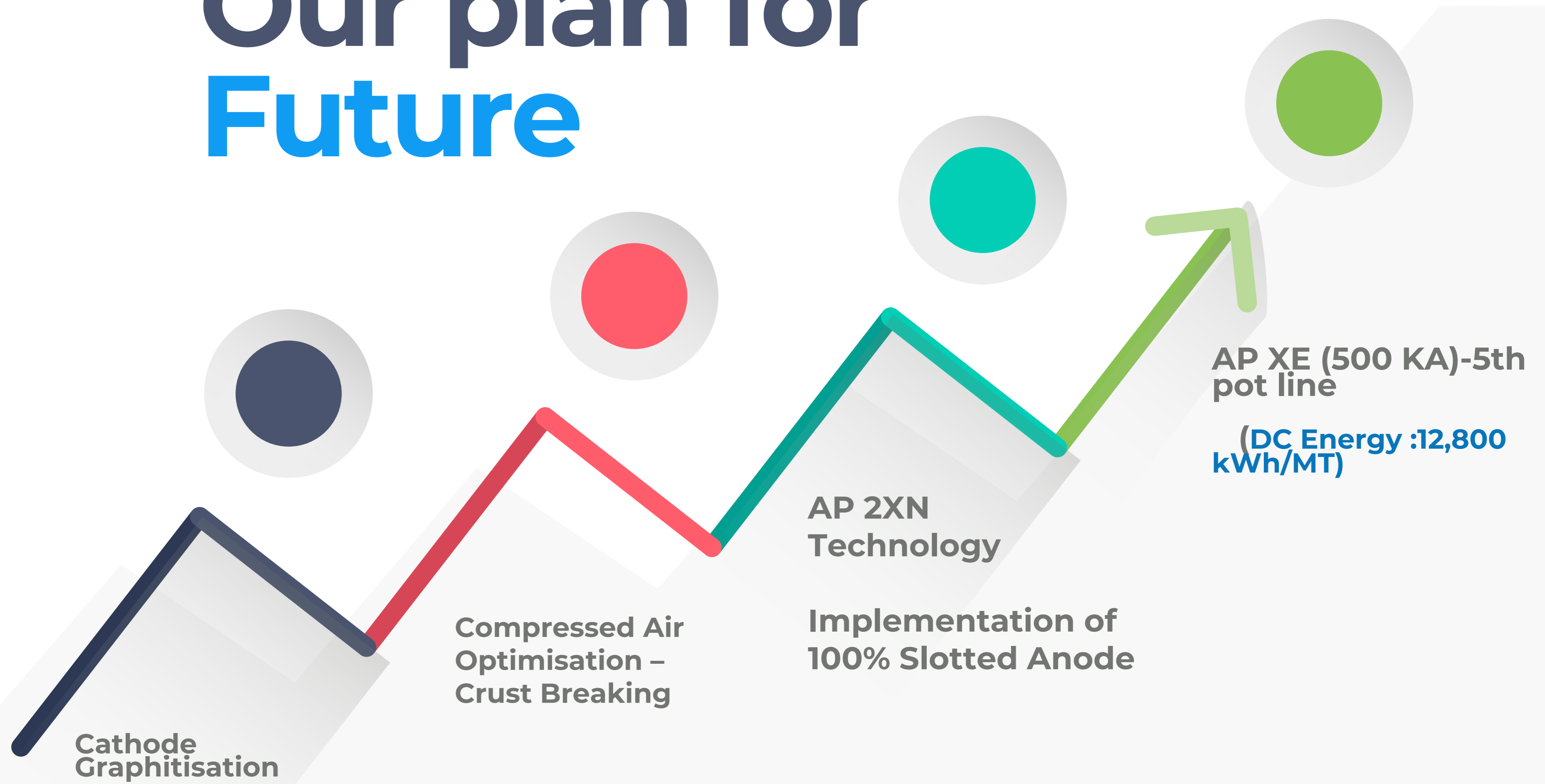
REDUCTION (TOE/T OF PRODUCT)

0.205

REDUCTION TARGET

4.85%

Our plan for Future



Cathode Graphitisation

Compressed Air Optimisation - Crust Breaking

AP 2XN Technology

Implementation of 100% Slotted Anode

AP XE (500 KA)-5th pot line

(DC Energy :12,800 kWh/MT)

THANK YOU

