

# ASPIRE PROGRAMME

## Accelerating Smart Power & Renewable Energy in India

### CONSULTATION WORKSHOP ON

### ***PATHWAYS FOR ENERGY EFFICIENCY AND DECARBONISATION IN THE INDIAN ALUMINIUM INDUSTRY*** SUMMARY REPORT

#### WORKSHOP:

August 28<sup>th</sup>, 2024

(09:30 – 17:30 IST / 04:00 – 12:00 GMT)

Vedanta Medows Community Hall, Vedanta  
Township, Jharsuguda, Odisha



Hosted by:

**VEDANTA LIMITED,**

(A Unit of Vedanta Ltd.)



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## Abbreviations

|                      |                                                                             |
|----------------------|-----------------------------------------------------------------------------|
| ASPIRE               | Accelerating Smart Power and Renewable Energy in India                      |
| BAU                  | Business As Usual                                                           |
| BEE                  | Bureau of Energy Efficiency                                                 |
| CAGR                 | Compound Annual Growth Rate                                                 |
| CPP                  | Captive Power Plant                                                         |
| CCUS                 | Carbon Capture Utilisation and Storage                                      |
| CCTS                 | Carbon Credit Trading Scheme                                                |
| CAGR                 | Compound Annual Growth Rate                                                 |
| CBAM                 | Carbon Border Adjustment Mechanism                                          |
| DCs                  | Designated Consumers                                                        |
| EV                   | Electric Vehicle                                                            |
| EC                   | Energy Conservation                                                         |
| ESG                  | Environment Social Governance                                               |
| FCDO                 | Foreign Commonwealth and Development Office                                 |
| GJ                   | Gigajoules                                                                  |
| GHG                  | Greenhouse gases                                                            |
| GEI                  | Greenhouse gas Emission Intensity                                           |
| GCI                  | Grid Controller of India                                                    |
| HFQ                  | Hot Form Quench                                                             |
| IDEEKSHA             | Industrial Decarbonisation and Energy Efficiency Knowledge Sharing Platform |
| IEED                 | Industrial Energy Efficiency and Decarbonisation                            |
| KPI                  | Key Performance Indicators                                                  |
| KEP                  | Knowledge Exchange Platform                                                 |
| MoEFCC               | Ministry of Environment, Forest, and Climate Change                         |
| MVR                  | Mechanical Vapour Recompression                                             |
| MOC                  | Material of Construction                                                    |
| MCL                  | Magnetic Compensation Loop                                                  |
| MTPA                 | Mellion Tonne per Annum                                                     |
| MTOE                 | Million Tonne of Oil Equivalent                                             |
| MtCO <sub>2</sub> /t | Million Tonne of Carbon dioxide per Tonne                                   |
| MoP                  | Ministry of Power                                                           |
| MW                   | Mega Watt                                                                   |
| NMEEE                | National Mission on Enhanced Energy Efficiency                              |
| NSCICM               | National Steering Committee Indian Carbon Market                            |
| NDC                  | Nationally Determined Contributions                                         |
| OHSAS                | Occupational Health and Safety Assessment Series                            |
| OPEX                 | Operating Expenses                                                          |
| PAT                  | Perform Achieve and Trade                                                   |
| SOP                  | Standard Operating Procedure                                                |
| SEC                  | Specific Energy Consumption                                                 |
| TOE                  | Tonne of Oil Equivalent                                                     |
| TPD                  | Tonne per Day                                                               |
| TPP                  | Thermal Power Plant                                                         |
| WHR                  | Waste Heat Recovery                                                         |

## Background

India is world's second-largest producer of Aluminium<sup>1</sup>, contributing approximately 6% to the global output. The Indian aluminium market was valued at ~INR 940 billion in 2023 and is predicted to grow ~1.75 times to INR 1650 billion by 2030, with a CAGR of ~8-10 % from 2024 to 2030<sup>2</sup>. In FY 2023, per capita aluminium consumption in India was around 3.1 kg, significantly below the global average of 12 kg<sup>3</sup>. Thus, Indian market offers a huge potential for demand growth of aluminium industry. To reach the global average of 12 kg per capita, India would need an additional annual consumption of 16 million tonnes, and if achieved India could become the second largest consumer of aluminium in the world. Moreover, government schemes and initiatives such as 'Make in India' scheme, smart city development programmes, rural electrification, the adoption of electric vehicles (EV), etc. are expected to further boost aluminium demand in the country. With these initiatives India's aluminium demand is expected to reach ~8 million tonnes by 2032, majorly propelled by industries like building & construction, transportation, packaging, electrical, along with emerging sectors like renewable energy, electric vehicles, defence, and aerospace<sup>4</sup>.

The current market size of the aluminium industry in India underscores its significant presence in the global trade dynamics. With a consistent increase in demand, the industry has been a substantial contribution to India's economic growth. Aluminium contributes to nearly 2% of manufacturing Gross Domestic Product (GDP) and with projected consumption growth, the share (% of manufacturing GDP) may go higher, reflecting its role as a key driver of economic activity, with its applications spanning over various sectors.

Vedanta, Hindalco, and NALCO are the primary producers, contributing nearly all of the 4.07 million tonnes of aluminium production in FY 2022-23<sup>5</sup>. Over the past decade from FY 2012-13, the Indian aluminium sector has experienced significant growth. Alumina production increased from 3.74 MTPA to 7.45 MTPA, and aluminium production increased from 1.72 MTPA to 4.07 MTPA. Energy consumption grew from 420 million GJ to 689 million GJ, with Vedanta consuming 48%, Hindalco 39%, and NALCO 13%.

### **Perform, Achieve, and Trade (PAT) Scheme for aluminium sector:**

The aluminium sector is one of the designated sectors covered under Bureau of Energy Efficiency's (BEE) flagship Perform, Achieve, Trade (PAT) scheme for large energy-intensive industrial sectors.

The aluminium production process starts with the mining of bauxite ore, an aluminium-rich mineral in the form of aluminium hydroxide. Approximately 90% of global bauxite is found in tropical areas. Bauxite mining contributes insignificantly in terms of scope 1 and scope 2 emissions. Major emissions from mining are primarily due to the thermal energy required in the process. The aluminium sector has been categorised based on its process into four subsectors: refinery, smelter, integrated, and cold sheet mills.

The aluminium industry, with an annual consumption of over 7,500 metric tonnes of oil equivalent (toe)<sup>6</sup>, is identified as a Designated Consumer (DC) under the Energy Conservation Act, 2001.

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<sup>1</sup> [Top 10 Aluminium-producing Countries \(Updated 2023\) \(investingnews.com\)](https://www.investingnews.com/news/top-10-aluminium-producing-countries-updated-2023/)

<sup>2</sup> [India Aluminium Market Report Forecast Till 2030 \(alcicle.com\)](https://www.alcicle.com/reports/india-aluminium-market-report-forecast-till-2030/)

<sup>3</sup> [Indian Mineral Year Book, Indian Bureau of Mines](https://www.mines.gov.in/publications/indian-mineral-year-book/)

<sup>4</sup> [Metal-Asia-Cover-Story-June-2022.pdf \(vedantaaluminium.com\)](https://www.vedantaaluminium.com/media/2022/06/Metal-Asia-Cover-Story-June-2022.pdf)

<sup>5</sup> [Ministry of Mines, Government of India, Home](https://www.mines.gov.in/)

<sup>6</sup> <https://beeindia.gov.in/en/aluminium>

Fourteen aluminium plants have been notified as DCs till 2023 and have been included under PAT Scheme.

India is the world's second-largest aluminium producer, contributing ~6% to global output. The Indian aluminium market, valued at INR 940 billion in 2023, is projected to grow to INR 1650 billion by 2030 with a CAGR of 8-10%. Despite a low per capita consumption of 3.1 kg (global average is 12 kg), India holds significant growth potential. Achieving global consumption levels would require an additional 16 million tonnes annually, potentially making India the second-largest consumer. Government initiatives like 'Make in India' and EV adoption are expected to further drive demand, with projected consumption reaching 8 million tonnes by 2032, supported by sectors like construction, transportation, and renewable energy.

Aluminium contributes 2% to India's manufacturing GDP, and this share may rise with future growth. The sector, classified under BEE's Perform, Achieve, and Trade (PAT) scheme for energy-intensive industries, is divided into refinery, smelter, integrated, and cold sheet mills. With 14 designated aluminium plants under the PAT scheme, the industry plays a key role in India's economic and energy landscape.

The aluminium sector is one of the most energy-intensive industries, consuming large amounts of electricity and thermal energy throughout its production process, particularly in refining and smelting operations. Given its substantial energy demands, improving energy efficiency and reducing emissions are critical for the industry's sustainability. In collaboration with the Bureau of Energy Efficiency (BEE), the ASPIRE program has developed a draft report outlining "Pathways on Energy Efficiency and Decarbonisation Strategy for the Indian Aluminium Industry." This report provides strategic insights and actionable measures to enhance energy efficiency and decarbonise the sector and the best practices followed in the industry in various countries, aligning with India's broader goals for reducing industrial emissions and fostering sustainable growth.

This workshop has been organised to discuss the outcomes of the draft report on "Pathways on Energy Efficiency and Decarbonisation Strategy for the Indian Aluminium Industry" with various aluminium manufacturers in India and the Bureau of Energy Efficiency (BEE). Held on 28th August 2024 at Vedanta Ltd, Jharsuguda, Odisha, the event brings together key stakeholders to review the proposed technologies and strategies, share insights, and collaboratively identify actionable steps to enhance energy efficiency and reduce carbon emissions in the sector. The discussions aim to align industry practices with national sustainability goals and accelerate the decarbonisation of the aluminium industry.

### **About the Event:**

During the first half of the workshop, the ASPIRE team presented key features and outcomes of the report, followed by consultations with aluminium and alumina plants. In the second half, the aluminium and alumina plants presented best practices adopted in their units.

The workshop was carried with the following objectives:

- To seek feedback on key findings from the draft report on Pathways for Energy Efficiency and Decarbonisation in the Indian Aluminium Industry from key stakeholders.

- To apprise stakeholders on the impact of the PAT scheme, Carbon Credit Trading Scheme (CCTS), and Industrial Energy Efficiency and Decarbonisation (IEED) measures in the aluminium sector.

## Highlights

- 100+ physical participants were physically presented and 9 participants through virtual mode (MS Teams).
- 5 interactive sessions featuring 4 speakers from ASPIRE team and 2 from BEE team. Active participation from the government agency such as BEE and JNARDDC, and Aluminium manufacturing industrial organisation such as Vedanta, Aditya Aluminium, and BALCO from India.
- 20+ women participation.

## Inaugural Session



(L – R) Mr. Dipak Khandare, Mr. Ashish Sharma, Mr. Sunil K. Khandare, Mr. Sunil Gupta, Dr. Anupam Agnihotri, Mr. K. K. Chakarvarti, & Mr. V Jagadeesan

### Speakers



**Mr. Sunil K. Khandare,**  
Director, BEE



**Dr. Anupam Agnihotri,**  
Director, JNARDDC, Nagpur



**Mr. Sunil Gupta,** COO-  
Aluminium Business & CEO,  
Vedanta Jharsuguda



**Mr. Balawant Joshi,** Managing Director,  
Idam Infra, ASPIRE Programme Team



**Mr. K. K. Chakarvarti,** Senior Advisor,  
IDEEKSHA, ASPIRE Programme Team

## Key Takeaways:

- The global aluminium industry has the potential to reduce its emissions by 77% by 2050, cutting greenhouse gas emissions from the current 1.1 billion tonnes to 0.25 billion tonnes. However, this reduction is targeted to be achieved alongside a projected doubling of aluminium production by 2050 compared to current levels.
- The global Secondary aluminium production on the other hand is projected to increase by more than 50% during the same period.
- The Indian aluminium sector is one of the energy-intensive industrial sectors and has been focus sector on BEE's PAT scheme since its inception. India has second largest aluminium industry in the world contributing to 6% of the total global output. Aluminium industry consumes 13,500 units of power to produce 1 tonne of aluminium.
- Vedanta accounts for 60% of the India's total aluminium production with approximately 70% of its products exported to over 60 countries worldwide. Currently, value-added products from Vedanta are around 60% of its output and are expected to increase to 90% in a couple of months.
- Key drivers that require the aluminium industry to accelerate decarbonisation include-
  - Primary aluminium production to shifting from Western region to the Asian region. Reason being rise in cost of power, labour, environmental impact, alumina and logistics. The advantages with the Asian countries are as below:
    - Availability of coal,
    - Low labour cost and less stringent rules on environment.
  - Promoting secondary aluminium production, which is expected to grow at a CAGR of 5% in India at present scenario.
  - With introduction of CBAM in the European market most of the European countries have set a target to achieve net zero by 2050. While India with some other Asian countries aim to achieve the same by 2070.
  - India's global commitments to become carbon neutral by 2070. India's intermediate target includes the 55% reduction of GHG emissions and the use of 50% renewable energy (RE) power by 2030.

## Technical Session I – PAT and Carbon Credit and Trading Scheme (Indian Aluminium Sector)

### Speakers



**Mr. Sunil K. Khandare,**  
Director, BEE



**Mr. V. Jagadeesan,**  
Sector Expert, BEE

### Key Takeaways

- The Indian Carbon Market (ICM), established under the amended Energy Conservation Act, empowers the Central Government to notify Carbon Credit Trading Scheme (CCTS) and issue Carbon Credit Certificates (CCCs).
- The framework includes regulations for trading, defines the roles of key stakeholders, and outlines the accreditation for Carbon Verification Agencies.
- All Designated Consumers from Aluminium sector under Perform Achieve and Trade (PAT) scheme, which is based on Specific Energy Consumption (SEC), are transitioning from the PAT scheme to the CCTS, focusing on Greenhouse Gas (GHG) Emission Intensity (GEI).
- CCTS will operate under a mandatory compliance mechanism for obligated entities and a voluntary offset mechanism for non-obligated entities.
- Obligated entities, including the aluminium manufacturing units, would be assigned specific GHG emission intensity reduction targets based on India's Nationally Determined Contributions (NDCs) and sectoral potential for decarbonisation.
- The compliance mechanism mandates annual compliance, contrasting with the three-year cycle under PAT scheme. A comparison of PAT with the CCTS is shown in the table below:

| Scheme                         | Perform Achieve Trade                | Carbon Credit Trading scheme                                |
|--------------------------------|--------------------------------------|-------------------------------------------------------------|
| Based on                       | Specific Energy Consumption (SEC)    | GHG Emission Intensity (GEI)                                |
| Power conferred from           | Energy Conservation Act              | Energy Conservation Act<br>Environment Protection Act       |
| Benefits obtained by improving | Energy Efficiency                    | Energy Efficiency<br>Renewable Energy<br>Biogenic Emissions |
| Notification Done by           | Ministry of Power                    | MOEFCC                                                      |
| Cycle Period                   | 3 years                              | Trajectory period 3 Year                                    |
| Compliance Frequency           | Once in 3 Years                      | Every Year                                                  |
| M&V Done By                    | EmAEA                                | ACV Agency                                                  |
| Excess saving                  | Energy Saving Certificates (ESCerts) | Carbon Credit Certificates (CCC)                            |
| Value of Each Certificate      | 1 Tonne of Oil Equivalent            | 1 Tonne of CO <sub>2</sub> reduction                        |
| Penalty provisions             | EC ACT (SDA)                         | Environment Protection Act (MoEFCC)                         |

- PAT Scheme Data for Aluminium:
  - Number of Designated Consumers: 14.
  - Total Energy Consumption: 15.45 million TOE.
  - Total GHG Emissions: 76.5 million tonnes CO<sub>2</sub>.
- Targets for reducing GHG emission intensity will be established based on baseline audits, which involve extensive data collection and analysis of energy consumption, GHG emissions, and production over the past three years.
- A comprehensive baseline audit is planned for FY 2021-2024 to establish accurate GHG emission baselines and determine sector-specific targets.
- The audit process involves collaboration with stakeholders in the aluminium sector, and the finalized targets will be notified by the Ministry of Environment, Forest, and Climate Change (MoEFCC).
- Targets will be developed by calculating the GHG Emission Intensity (GEI) and setting a relative GEI reduction goal, aligned with national climate commitments and technological feasibility.
- The sector is required to provide detailed energy consumption and GHG emission data, ensure the availability of accurate baseline data, and engage in the audit process to establish robust emission reduction strategies.

## Technical Session II – Dissemination of findings of Draft Report on Pathways for Energy Efficiency & Decarbonisation in the Aluminium Industry'

### Speakers



**Dr. Anupam Agnihotri,**  
Director, JNARDDC,  
Nagpur.



**Mr. Ashish Sharma,**  
Senior Consultant, KPMG,  
ASPIRE Programme Team.



**Mr. Dipak Khandare,**  
Associate Director, Idam Infra  
ASPIRE Programme Team.

### Key Takeaways

- **Aluminium Industry Emissions:**
  - Contributes ~9% of India's industrial GHG emissions.
  - Carbon intensity: 16-20 tCO<sub>2</sub>e/tonne.
  - Achievements: 2.13 MTOE energy savings, ~8 MTCO<sub>2</sub>e emissions reduction in PAT cycles I-IV.
- **Indian Aluminium Industry Overview:**
  - 2nd largest global producer, contributing 6% of global output (FY 2023).
  - Capacity: 4.1 MMTPA aluminium, 9.2 MMTPA alumina (FY 2023).
  - Market value: 941 billion INR projected between 2024 and 2030.
- With rising international carbon tariffs and India's climate goals, a focused study on energy efficiency and decarbonisation pathways is critical for the Indian aluminium sector. This report was prepared under the UK-India bilateral initiative for accelerating smart power and renewable energy (ASPIRE).
- **Energy Mix & Emission Intensity:** Primary aluminium producers that primarily use hydropower in Europe and North America, as well as gas in the Middle East, have an emission intensity of 6-9 tCO<sub>2</sub>e/Mt. In contrast, producers in Asian countries, such as India, which depend more on coal-based thermal power plants, have an average emission intensity of approximately 19 tCO<sub>2</sub>e/Mt.

- **Production and capacity utilisation** in the Indian Aluminium industry are compared to global peers, with Indian companies capacity utilisation is in the ranging from 97% to 102% while global counterparts operate in the range of 100% to 109%.
- India's leading performer in energy consumption is around 53 GJ/Mt, slightly higher than the global leading performer at about 50 GJ/Mt.
- **Leading Decarbonisation Practices:**
  - **Low-Carbon Energy Sources:** RE adoption & Green hydrogen in calcination.
  - **Energy Efficiency & Monitoring:** Copper insert collector bars, and Magnetic Compensation Loop (MCL).
  - **Circular Economy & Waste Management:** Recycling of bauxite residue, spent pot lining, and dross.
  - **Technological Advancements:** Inert anodes for smelting, Carbon Capture Utilisation and Storage, Hal zero technology, Mechanical vapour Recompression for alumina refinery.
- **Aluminium Production Estimates:** Based on historical trends from FY 2012-23 and planned capacity additions, production is expected to reach **5.87 MTPA** by FY 2032-33.
- **Energy Consumption Estimates:** Energy consumption will rise to ~1,060 million gigajoules (MGJ), up 1.5 times from 2023, driven by an increase in production capacity to ~6 MMT.
- **Emission Intensity Estimates:** For Business As Usual (BAU) scenario, energy intensity is maintained **168 MGJ/MT** and emission intensity at **18.31 MTCO<sub>2</sub>/MT**. In the optimistic scenario, Envisions a **1% annual improvement** in energy efficiency is envisioned alongside an increase in renewable energy (RE) penetration from **~30% in FY 2024-25** to **~50% by FY 2032-33**.
- **Conclusion and Way forward:**
  - **Policy Enablement:** Offering incentives should be provided to lower renewable energy costs and improve financing for low-carbon technologies. Developing standardized certifications and updating procurement policies will also be crucial. A focus on promoting a circular economy and enforcing the Environment Protection Act alongside the Vehicle Scrap Policy is necessary. Additionally, introducing quality standards for imported scrap and establishing a domestic carbon market will further support these initiatives.
  - **Leadership Commitments:** Engaging industry stakeholders in energy efficiency (EE) and decarbonisation target setting is essential. This includes developing capacity-building measures, organising regular cross-industry workshops, and implementing career progression initiatives that support women.
  - **Collaboration:** Collaborative initiatives such as the Mission Possible Partnership (MPP) and the IDEEKSHA platform can drive joint training programs to enhance skills in circular economy practices, leveraging the 2030 Roadmap for India-UK relations. Additionally, collaboration on developing certifications and standards for lower-carbon footprint aluminium is essential.

- **Research and Development:** Encouraging Indian research institutes should collaborate with key stakeholders to implement extended producer responsibility and promote the demonstration of advanced low-carbon technologies. They should also work with relevant agencies to introduce certifications for low-carbon footprint and secondary aluminium while encouraging R&D through collaboration.

## Technical Session III – Consultative Discussion with Industry Stakeholders on the Draft Report

### Speakers



**Dr. Anupam Agnihotri**, Director,  
JNARDDC, Nagpur.



Industry Stakeholders

## Key Takeaways

### Panel for the feedback session:

Mr S K Khandare (Director-BEE), Mr Jagadeesan (Sector Expert, BEE), Dr Anupam Agnihotri (Director – JNARDDC), Mr Ashish Sharma (KPMG), Mr K K Chakarvarti (Idam Infra), Mr Dipak Khandare (Idam Infra)

- Following are the key major points discussed during the feedback session shown in the table below:

| Company Name                   | Feedback from participant                                                                                                                                                                                                                                                                                                                                                                                             | Response by Panel Members                                                                                                                                                                                                        |
|--------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Vedanta (Smelter, Jharsuguda)  | <ol style="list-style-type: none"> <li>Whether REC will be included in the CCTS scheme or not.</li> <li>Definition of REC should be align with how it is defined in other countries</li> <li>Fungibility of Carbon Credit certificates across the world</li> <li>Meeting RPO target on biomass is challenging due to unavailability of biomass</li> <li>Is there any incentive program on decarbonisation?</li> </ol> | <p>For point no 1 to 4 (related to CCTS), BEE is working on it.</p> <p>Presently there is no scheme for incentives for decarbonisation. However, PAT, and CCTS are designed to motivate industries to go for decarbonisation</p> |
| Vedanta (Refinery, Laljigaarh) | Presently MVR technology is used for small quantities of the steam (200 TPD) in Lanjigarh unit                                                                                                                                                                                                                                                                                                                        | Panel has informed that it is technically proven and ALCOA has done the pilot project, and it is technically successful. However, there                                                                                          |

|                                      |                                                                                                              |                                                                                                                                                                                                                                                                                                                                                                                          |
|--------------------------------------|--------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                                      |                                                                                                              | are issues in the economic viability of MVR Technology                                                                                                                                                                                                                                                                                                                                   |
| Vedanta (Smelter, Jharsuguda)        | Comparison/ Benchmarking on DC and AC consumption in smelters shall be Incorporated.                         | Panel informed that there is very limited information available on benchmarking on AC and DC consumption. Draft Report has provided a comparative statement for Indian and Top Global 5 companies based on the data availability. Information on AC consumption is available with the International Aluminium Institute (IAI) which is at the regional level and not at the plant level. |
| Hindalco (Aditya Aluminium, Lapanga) | How recycling like SPL, and Dross recycling help in reducing the carbon emissions in the plant?              | It will reduce the overall emissions and conserve the resource in the system.                                                                                                                                                                                                                                                                                                            |
| Vedanta – Smelter Jharsuguda         | The CCTS should have a trial period similar to the PAT system.                                               | BEE informed that the CCTS scheme was supposed to be launched in FY 2023-2024, however, notification could not be published during this FY. So, by default current year FY 2024-2025 can be considered as a trial period. Notification is likely to be released by the end of current FY.                                                                                                |
| Vedanta – Smelter Jharsuguda         | Utilisation of Low carbon Fuel like Natural Gas in Anode Baking Furnaces and blending in power plant boilers | This feedback was given to BEE by Vedanta after the workshop                                                                                                                                                                                                                                                                                                                             |

## Technical Session IV – Key Energy Efficiency & Decarbonisation Strategies Adopted by Indian Aluminium Industries

### Speakers



**Ms. Vysyaraju Harika,**  
Technical Analyst-Potline;

**Ms. Prapti Varshney,** Lead-  
Innovation Cell;

**Mr. Swapnil Hirave,** Manager-  
Pot Repair/Lining/Delinning -  
Vedanta, Jharsuguda



**Mr. Ranjan Mishra,** Associate  
GM, BALCO



**Mr. Jay Prakash Soni,**  
Asst.GM

**Mr. Sourav Kumar Gorain,**  
Manager, Aditya Aluminium,  
Hindalco



**Mr. Sanjaya Kumar Jena,**  
General Manger –  
Commissioning & EM

**Mr Soumava Das** - Deputy  
Manager, Energy & Carbon-  
Lead Vedanta Limited, Lanjigarh



**Mr. Prafulla Chandrakar,** Lead  
O&E CPP

**Ms. Payal Agrawal,** Lead  
Chemist, CPP Water System  
Vedanta, Jharsuguda

## Key Takeaways

Power team from Vedanta Ltd, Jharsuguda presented the best practices for energy conservation and decarbonisation. The team shared projects were undertaken taken in the 135 MW CPP and 460 MW TPP in last three years.

- Following projects were implemented by Vedanta, Jharsuguda: boiler penthouse air sealing, CW pump from star to delta conversion, separating the two condensers (HP & LP) in their 600 MW unit, Installation of SOFA in Boiler to reduce super heater and Reheater space, Sinter cast roller installation, CWP impeller coating etc.
- Plant used the OSI- PI System, a collection of software programs that allow data collection, historicizing, finding, analysing, delivering and visualizing to construct an energy monitoring system.
- Greenhouse Gas Emissions intensity was reduced by 28% while production tripled between FY 2012 and FY 2023.
- Specific energy consumption trends were presented for smelter 1 & 2. Key initiatives include Vedanta Lining Design (VLD2.0), Vedanta Pot Controller, Hydro jet cleaning of airlift pipe in FTP, 100% Graphitisation journey (13000 kWh/MT), India's largest electric forklift fleet deployed – step towards Net Zero Emission.
- Vedanta's approach to waste utilisation was also discussed. A new product Restro Ultra which is produced by using RE and recycled metal recovered from dross processing that reduces GHG emission and waste generation. The company is also coprocessing SPL mixed fines in the cement industry – achieving 100% recycling of spilled bath, coke dust and anode butt generated from process resulting in reduction of raw material consumption and waste generation.
- Team Aditya Aluminium (Hindalco) presented Decarbonisation initiatives at Aditya Aluminium, Hindalco. Presentation covered the following points: Decarbonisation Pathways on Electricity decarbonisation (RE Power, Solar, Wind, Hydro), Direct Emissions (Process Efficiency, Innovation Supply Chain CCUs), Recycling (Reduce, Reuse, Recycle).
- Hindalco has set Net Zero target by 2050 focusing on Efficiency improvement, fuel switch to LNG, Renewables, Refinery electrification, CCU mineralisation, Renewable with storage/Green Hydrogen, Inert/Alt Anode, Nuclear Power etc to achieve Net Zero target.
- HFP based system to Natural gas – based firing system in Anode baking Furnace.
- They have explained various digital initiatives like digital benchmarking Smart dashboards, andOsi-Pi data management system etc for direct emission reduction.
- Team BALCO presented Energy efficiency and decarbonisation strategies adopted by the plant. Following are the presentation points that follows:
- BALCO aims to be Net Zero emissions by 2050. By 2030, it targets to decrease GHG emission intensity of its operations by 30% compared to FY 2021.
- Decarbonisation of power generation, the deployment of Efficiency improvement through R&R, RE Power procurement and Biomass co-firing. Technology adoption for smelting operations such as CCUS, Copper inserted cathodes, pot controller upgradation, etc to reduce the emissions.
- By FY 2030 the total emission will be reduced by 2.2 Mn tCO<sub>2</sub>e per year. 4.02 MTCO<sub>2</sub>e will be reduced due to RE Power utilisation and 1.84 MTCO<sub>2</sub>e from additional efficiency improvement projects.

- Balco has undertaken various initiatives such as graphitised cathodes and, copper insert cathode in smelter, pot controller upgradation, biomass cofiring in TPP, RE Power procurement etc.
- Metal team Vedanta Lanjigarh has presented Energy Efficient initiatives for climate change through its Net Zero efforts. Following are the main points made during presentation.
- Team explained the alumina manufacturing Process and Energy mapping & distribution chart of last 5 year. They presented specific steam consumption (1.68, 1.68, 1.74 T/T in FY 2022, FY 2023, FY 2024 respectively), specific furnace oil consumption (72.04, 69.1, 69.05 Kg/T in FY 2022, FY 2023, FY 2024 respectively), and specific electrical energy requirements (217.54, 226.69, 227.49 kWh/T in FY 2022, FY 2023, FY 2024 respectively) to produce per tonne of product.
- Plant implemented PDS area electrical energy reduction project and get benefits to save electrical energy saving around 768 MWh/annum and GHG saving 545 tCo2/annum. Similarly, the digestion heater heat transfer co-efficient improvement project implemented and got benefits of 80000 tonne/annum (4 heater) steam energy saving and 15200 tCo2/annum GHG saving.
- Plant also implemented with anti-frictional coating in alkaline cooling water pumps project, Installation of HT capacitor banks in four major substations in refinery, Evaporation 1&2 steam Economy improvement from 3.5 to 3.8 tonnes of moisture/tonne of steam.
- Vedanta Lanjigarh achieved a reduction 69000 tonnes of CO<sub>2</sub> emissions in FY 2024 from ENCON projects.
- Team also explained roadmap towards green alumina and tonnes of CO<sub>2</sub> emission trends & reduction plan. They have decided decarbonisation roadmap by 2030 with reduction in TCO<sub>2</sub> by 30%.
- Vehicle decarbonisation drives at Vedanta Lanjigarh was undertaken. 4 out of 6 forklifts converted to EV, 8 EV forklifts conversion targeted till FY 2025.

## Technical Session V – Key Decarbonisation Levers for Aluminium Industry



**Dr. Anupam Agnihotri**, Director, JNARDDC, Nagpur.

### Key Takeaways:

- Dr. Anupam Agnihotri, Director, JNARDDC presented a submission on New and Emerging Technologies for Decarbonising the Aluminium Sector. Key Takeaways are as follows:
- Aluminium industry faces the challenges of reducing its CO<sub>2</sub> emissions to align with climate targets. Aluminium contributes ~2% to India's overall manufacturing GDP, and Aluminium sector emissions are predicted to increase by 50% by 2050 under a business-as-usual scenario.
- There is potential to cut emissions by ~68% through shift from coal-based electricity used for the smelting process alone. Other major emissions are in thermal energy consumed during alumina refining and process CO<sub>2</sub> from primary aluminium smelting (respectively ~15% and ~9%).
- Dr. Agnihotri presented a CEEW graph showing the emission mitigation pathway for India's aluminium sector. He stated that gas-wet heat recovery (WHR) generates energy and the German RFP Institute's project, which uses WHR systems to convert cells into batteries and employs advanced technologies to lower greenhouse gas emissions. Here is good option in India's aluminium sector that is CCS and CCU to achieve Net Zero target and GHG emissions.
- Three pathways for GHG emission reductions defined by the International Aluminium Institute. First is Electricity decarbonisation, second is Direct Emission reduction, and third is Recycling & Resource efficiency. Near 100% aluminium recycling rates, improved scrap sorting, elimination of pre-consumer scrap and metal losses could reduce the need for primary aluminium by 20% by 2050.
- He explained technological innovations all over the globe. Germany innovating technology for making aluminium pots that function as virtual batteries. In China over 4 million tonnes of smelting capacity will be relocated from coal-fired electricity to hydropower.
- He outlined decarbonisation pathways such as inert anode, use of hydrogen, CCUS, direct electrification, waste heat recovery, Low-temperature digestion, fluidised bed calciners, electric boilers etc for direct emission reduction.

- Climate action in the aluminum sector could be accelerated through **Policy** frameworks to enable the scaling up of key technology and to incentivise circularity. **Investments** are necessary to meet mitigation of targets. **Transparency and disclosure** enable dialogue, track progress, and allow facilitate for decision-making. **Customer–producer partnerships**, and **collaboration** within the sector, between sectors will help develop and deploy essential, high-capital infrastructure and technology.

## Concluding Session

- Enhancing energy efficiency and decarbonisation of industries, particularly aluminium Sector, is crucial to achieving sustainability and facilitating India's energy transition to net zero.
- ASPIRE programme intends to support large energy-intensive industries in the adoption of low-carbon technologies and solutions through collaboration with global technology suppliers including from the UK.
- Stakeholders in the Indian aluminium sector have already shown keen interest in this draft report. However, expediting the deployment of these innovative and low-carbon technologies requires systematic interventions that support technology transfer.
- The workshop successfully deliberated on innovative measures adopted by Indian aluminium Industries and new-age technologies and solutions required to accelerate the decarbonisation of aluminium sector.

## Feedback from the Participants

- Around 90% of the participants responded that they were more than satisfied with the outcomes of the workshop (*provided an 8+ rating on a scale of 10*).
- About 93% of the participants rated the quality and content of the delivery as more than satisfactory (*provided an 8+ rating on a scale of 10*).
- Technical Session IV – Key Energy Efficiency & Decarbonisation strategies adopted by the Indian Aluminium Industries were highly appreciated by the participants.
- Many participants recommended to organise similar sectoral workshops in aluminium sector for the leading decarbonisation practices and more about CCTS.
- Participants expressed the potential opportunities for technology interventions for industrial energy efficiency (IEE)/ decarbonisation for their organisation
  - Low carbon technologies
  - Waste heat recovery and utilisation output
  - Recycling technology and process
- Women account for ~15% of total employee strength in most of the participating organisations.
- Participating organisations have undertaken various initiatives to promote Gender Equality and Social Inclusion (GESI), including:
  - Ensuring equal opportunities for both genders in terms of tasks and support to achieve set targets addressing any gender biases in recruitment, performance evaluations, and promotions
  - Implemented the government of India's mission Shakti is a program to empower women and girls in the organisation.

## Way Ahead



**Group photograph of Participants**

The sectoral workshop on consultation received encouraging feedback, with a significant number of important participants, such as BEE officials and well-known Indian aluminum manufacturers. National organisations utilised this workshop as a forum to share innovations and best practices for improving Industrial Energy Efficiency and Demand (IEED) measures in the Indian aluminum industry. In the near future, it is anticipated that the workshop will have a noticeable and long-lasting effect on the field. The forthcoming tasks to sustain this momentum comprise:

- Offering guidance and support to large energy-intensive industries, including those in the aluminium sector, to identify technologies, solutions, and financing options for increased adoption of IEED interventions.
- Establishing additional discussion forums to facilitate the exchange of knowledge and information, contributing to the formulation of effective policies.

*"Great workshop! Extremely informative and well organised."*

*- Mr. Prafulla Satapathy,  
AVP, E&I, CPP*

*Aditya Aluminium, Lapanga*

*"Excellent Workshop. Looking forward to attending more in the future"*

*- Ms. Smruti Rekha Mahakud ,  
Assistant manager  
Vedanta jharsuguda*

## Gallery





For more information please contact:

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## Attendance Sheet

| S. No | Name                     | Designation                         | Organisation                         |
|-------|--------------------------|-------------------------------------|--------------------------------------|
| 1     | Mr. Jay Prakash Soni     | Asst. General Manager               | Hindalco - Aditya Aluminium Lapanga  |
| 2     | Mr. Sourav Kumar Gorain  | Manager                             | Hindalco - Aditya Aluminium Lapanga  |
| 3     | Mr. Mukul Modak          | AGM                                 | Hindalco - Aditya Aluminium Lapanga  |
| 4     | Mr. Sanjit Prasad        | Senior Manager                      | Hindalco - Aditya Aluminium Lapanga  |
| 5     | Ms. Rasmi Ranjan Swain   | DGM                                 | Hindalco - Aditya Aluminium Lapanga  |
| 6     | Mr. Himansu Kumar Dash   | DGM                                 | Hindalco - Aditya Aluminium Lapanga  |
| 7     | Ms. Shatakshi Pandey     | GET                                 | Hindalco - Aditya Aluminium Lapanga  |
| 8     | Ms. Monalisa Nag         | Asst. Engineer                      | Hindalco - Aditya Aluminium Lapanga  |
| 9     | Mr. G. Arun              | AGM                                 | Hindalco - Aditya Aluminium Lapanga  |
| 10    | Mr. Prafulla Satapathy   | AGM                                 | Hindalco - Aditya Aluminium Lapanga  |
| 11    | Ms. Samanta Mali         | Senior Manager                      | Hindalco - Aditya Aluminium Lapanga  |
| 12    | Mr. Ummed Verma          | Manager                             | Hindalco - Aditya Aluminium Lapanga  |
| 13    | Mr. Santanu Das          | Deputy Manager                      | Hindalco - Aditya Aluminium Lapanga  |
| 14    | Mr. Atanu Maity          | AGM                                 | Hindalco Industries Ltd Hirakud      |
| 15    | Mr. Khileshwar Gajpal    | Sr. Manager                         | Hindalco Industries Ltd Hirakud      |
| 16    | Mr. Ritesh Chandel       | Manager                             | Hindalco Industries Ltd Hirakud      |
| 17    | Mr. Suraj Suna           | Manager                             | Hindalco Industries Ltd Hirakud      |
| 18    | Mr. Vivek Agrawal*       | Asst. Gen. Manager                  | Hindalco Industries Limited Renukoot |
| 19    | Mr. Surya Kant*          | Dy. Gen. Manager                    | Hindalco Industries Limited Renukoot |
| 20    | Mr. Manash Ranjan Mishra | Associate GM                        | BALCO Industries Limited             |
| 21    | Mr. Anish Rao            | Manager                             | BALCO Industries Limited             |
| 22    | Mr. Kariveda Sreekanth   | Assistant Manager                   | BALCO Industries Limited             |
| 23    | Mr. Ranjan Mishra        | Associate GM                        | BALCO Industries Limited             |
| 24    | Mr. Sanjaya Kumar Jena   | General Manger – Commissioning & EM | Vedanta Limited Lanjigarh            |
| 25    | Mr. Dipan Kumar Dutta    | AGM- Electrical 3 MMTPA             | Vedanta Limited Lanjigarh            |
| 26    | Mr. Soumava Das          | Deputy Manager - Energy Management  | Vedanta Limited Lanjigarh            |

| S. No | Name                     | Designation                                             | Organisation                                        |
|-------|--------------------------|---------------------------------------------------------|-----------------------------------------------------|
| 27    | Mr. Debadutta Ray        | Deputy Manger - Red Area Operations                     | Vedanta Limited Lanjigarh                           |
| 28    | Mr. Amarnath Pandit      | Incharge- White-1 operations                            | Vedanta Limited Lanjigarh                           |
| 29    | Mr. Abhijit Sinha        | General Manager (SH&E)                                  | NALCO Industries Limited– Angul                     |
| 30    | Mr. Amar Kumar Sahu      | General Manager (Metallurgy)                            | NALCO Industries Limited– Angul                     |
| 31    | Mr. Abinash Panda        | DGM(Electrical)                                         | NALCO Industries Limited– Angul                     |
| 32    | Mr. Priyant Sahoo        | Senior Manager (Electrical)                             | NALCO Industries Limited– Angul                     |
| 33    | Dr. Asmita Marathe*      | Product Manager- Advisory & Sustainability              | Bureau Veritas                                      |
| 34    | Mr. Sanjay Chaturvedi    | Vice President                                          | Mahaan Aluminum, Hindalco Industries Ltd, Singrauli |
| 35    | Mr. Gaurav Verma         | Gaurav Verma                                            | Mahaan Aluminum, Hindalco Industries Ltd, Singrauli |
| 36    | Mr. Rahul Tiwari         | -                                                       | Vedanta Jharsuguda                                  |
| 37    | Mr. Jajneswar Das        | COO-Metal                                               | Vedanta Jharsuguda                                  |
| 38    | Mr. Ajay Pandey          | COO-Power                                               | Vedanta Jharsuguda                                  |
| 39    | Mr. Kamal Dewangan       | SBU Head- Carbon                                        | Vedanta Jharsuguda                                  |
| 40    | Mr. Manoj Kesari         | SBU Head- Cast House                                    | Vedanta Jharsuguda                                  |
| 41    | Mr. Praveen Kumar R      | SBU Head- PSCS                                          | Vedanta Jharsuguda                                  |
| 42    | Mr. Sachin Kumar Gupta   | Deputy SBU Head- PSCS, Energy Manger-Smelter            | Vedanta Jharsuguda                                  |
| 43    | Mr. Gaurav Tandon        | Deputy Head – Potline                                   | Vedanta Jharsuguda                                  |
| 45    | Mr. Mitesh Pandya        | Head ESG Aluminium Sector                               | Vedanta Jharsuguda                                  |
| 46    | Mr. Amit Kumar Tyagi     | Head -Environment                                       | Vedanta Jharsuguda                                  |
| 47    | Mr. Alok Nigam           | Deputy SBU Head - Carbon                                | Vedanta Jharsuguda                                  |
| 48    | Mr. Dushyant Kumar Gupta | Head - Cast House - 2                                   | Vedanta Jharsuguda                                  |
| 49    | Mr. Mangu Srinivas       | Head Electrical Maintenance & Power System              | Vedanta Jharsuguda                                  |
| 50    | Ms. Sindhu pandre        | Head-Reliability & MP, Power System and Common Services | Vedanta Jharsuguda                                  |
| 51    | Mrs. Suprita Nanda       | Deputy Head Power Projects                              | Vedanta Jharsuguda                                  |

| S. No | Name                      | Designation                          | Organisation            |
|-------|---------------------------|--------------------------------------|-------------------------|
| 52    | Mrs. Mansi Chauhan        | Head PR & Corporate Communications   | Vedanta Jharsuguda      |
| 53    | Mrs. Snigdharoopu Biswal  | Business Excellence LE -Power & Lead | Vedanta Jharsuguda      |
| 54    | Ms. Vysyaraju Harika      | Technical Analyst - Potline          | Vedanta Jharsuguda      |
| 55    | Ms. Prapti Varshney       | Lead - Innovation Cell               | Vedanta Jharsuguda      |
| 56    | Vaibhav Upadhyay          | Head potline                         | Vedanta Jharsuguda      |
| 57    | Mr. Sunil Gupta           | CEO, Vedanta Ltd                     | Vedanta Ltd, Jharsuguda |
| 58    | Mr. Dileep Nigam          | AGM                                  | Vedanta Ltd, Jharsuguda |
| 59    | Mr. Suneel Gangula        | AGM                                  | Vedanta Ltd, Jharsuguda |
| 60    | Mr. Gaurav Nayan          | Asst. Manager                        | Vedanta Ltd, Jharsuguda |
| 61    | Mr. Abhishek Verma        | Asst. Manager                        | Vedanta Ltd, Jharsuguda |
| 62    | Mr. Manoj Ekka            | -                                    | Vedanta Ltd, Jharsuguda |
| 63    | Mr. Mahendra Tnaya saho   | Asst. Manager                        | Vedanta Ltd, Jharsuguda |
| 64    | Ms. Shrestha Ranjan       | Asst. Manager                        | Vedanta Ltd, Jharsuguda |
| 65    | Mr. Sagar Kumar           | Asst. Manager                        | Vedanta Ltd, Jharsuguda |
| 66    | Mr. Sridhar Nayak         | Manager                              | Vedanta Ltd, Jharsuguda |
| 67    | Mr. Harjyoti das          | Asst. Manager                        | Vedanta Ltd, Jharsuguda |
| 68    | Mr. Vignesh R             | -                                    | Vedanta Ltd, Jharsuguda |
| 69    | Ms. Sagrika Das           | -                                    | Vedanta Ltd, Jharsuguda |
| 70    | Mr. Satheeshwaran         | Asst. Manager                        | Vedanta Ltd, Jharsuguda |
| 71    | Mrs. Smruti Mahakud       | Asst. Manager                        | Vedanta Ltd, Jharsuguda |
| 72    | Mr. Aritra De             | -                                    | Vedanta Ltd, Jharsuguda |
| 73    | Ms. Kumari Ambika         | -                                    | Vedanta Ltd, Jharsuguda |
| 74    | Ms. Yashaswi Chauhan      | -                                    | Vedanta Ltd, Jharsuguda |
| 75    | Ms. Shrasti Yede          | Asst. Manager                        | Vedanta Ltd, Jharsuguda |
| 76    | Mr. Bachaspati Madhukalya | Asst. Manager                        | Vedanta Ltd, Jharsuguda |
| 77    | Ms. Dharitri Mallik       | -                                    | Vedanta Ltd, Jharsuguda |
| 78    | Mr. R Sharukh             | -                                    | Vedanta Ltd, Jharsuguda |

| S. No | Name                       | Designation                    | Organisation            |
|-------|----------------------------|--------------------------------|-------------------------|
| 79    | Mr. Sathes Kumar Manokaran | -                              | Vedanta Ltd, Jharsuguda |
| 80    | Ms. Prasanta Jyoti Malakar | Asst. Manager                  | Vedanta Ltd, Jharsuguda |
| 81    | Ms. Prachi Omer            | -                              | Vedanta Ltd, Jharsuguda |
| 82    | Mr. Shravan Kumar Naik     | -                              | Vedanta Ltd, Jharsuguda |
| 83    | Ms. Nikita Mittal          | Asst. Manager                  | Vedanta Ltd, Jharsuguda |
| 84    | Mr. Sonu Kushwaha          | Asst. Manager                  | Vedanta Ltd, Jharsuguda |
| 85    | Mr. Mohmmmed Ishan         | -                              | Vedanta Ltd, Jharsuguda |
| 86    | Mr. Gautam Sharma          | GET                            | Vedanta Ltd, Jharsuguda |
| 87    | Mr. Gopi Krishna           | -                              | Vedanta Ltd, Jharsuguda |
| 88    | Mr. Soumya kant Lenka      | -                              | Vedanta Ltd, Jharsuguda |
| 89    | Mr. Prafulla Chandrakar    | Lead O&E CPP                   | Vedanta Ltd, Jharsuguda |
| 90    | Ms. Payal Agrawal          | Lead Chemist, CPP water system | Vedanta Ltd, Jharsuguda |
| 91    | Mr. Lokesh Sahu            | -                              | Vedanta Ltd, Jharsuguda |
| 92    | Ms. Sagrika Majumder       | Asst. Manager                  | Vedanta Ltd, Jharsuguda |
| 93    | Mr. Sannidhihsv Musalaih   | -                              | Vedanta Ltd, Jharsuguda |
| 94    | Mr. Akshay Khandelwal      | -                              | Vedanta Ltd, Jharsuguda |
| 95    | Mr. Ravi Thapa             | HR                             | Vedanta Ltd, Jharsuguda |
| 96    | Mr. Samarth Agrawal        | Assist. Manager                | Vedanta Ltd, Jharsuguda |
| 97    | Ranjana Ray                | Potline                        | Vedanta Ltd, Jharsuguda |
| 98    | Dr. Anupam Agnihotri       | Director                       | JNARDDC, Nagpur         |
| 99    | Mr. Sunil Khandare         | Director, BEE                  | ASPIRE Programme Team   |
| 100   | Mr. V Jagadeesan           | Senior Sector Expert, BEE      | ASPIRE Programme Team   |
| 101   | Mr. Ashish Sharma          | Senior Consultant, KPMG        | ASPIRE Programme Team   |
| 102   | Mr. Balawant Joshi*        | Managing Director, Idam Infra  | ASPIRE Programme Team   |
| 103   | Mr. K. K. Chakarvarti      | Senior Advisor, IDEEKSHA       | ASPIRE Programme Team   |
| 104   | Mr. Dipak Khandare         | Associate Director, Idam Infra | ASPIRE Programme Team   |
| 105   | Mr. Vimal Patel*           | Consultant, Idam Infra         | ASPIRE Programme Team   |

| S. No | Name                      | Designation                   | Organisation          |
|-------|---------------------------|-------------------------------|-----------------------|
| 106   | Mr. Kunal Singhal*        | Senior Manager,<br>Idam Infra | ASPIRE Programme Team |
| 107   | Mr. Shiva Prasath<br>S R* | Analyst, Idam Infra           | ASPIRE Programme Team |
| 108   | Ms. Anashua Aich*         | Analyst, Idam Infra           | ASPIRE Programme Team |

\*Attended Virtually