UK Government

Bureau of Energy Efficiency
Ministry of Power, Government of India

Knowledge Exchange Platform
Transmitting Knowledge through Best Practices

ASPiRE Programme

Accelerating Smart Power & Renewable Energy in India

SECTORAL WORKSHOP & STUDY TOUR ON

BEST PRACTICES IN ENERGY EFFICIENCY IN ALUMINIUM SECTOR: A PATH FOR DECARBONISATION

WORKSHOP: **21 November 2022**
(09:30 – 17:00 IST / 04:00 – 11:30 GMT)

STUDY TOUR: **22 November 2022**
(09:00 – 13:00 IST / 03:30 – 07:30 GMT)

Hosted by:

Aditya Aluminium
Lapanga, Odisha

(A Unit of Hindalco Industries Ltd.)

ADITYA BIRLA
HINDALCO

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1. Background on ASPiRE Programme

During COP26, India had pledged to achieve net-zero emissions target by 2070; to get 50% of its energy from renewable resources and by the same year to attain 500GW non-fossil electricity capacity. These targets shall help India reduce its total projected carbon emissions by 1 billion tonnes and lower its emissions intensity by 45% by 2020 (over 2005 levels).

The UK and India share a key strategic partnership and as part of the '*3rd India – UK Energy for Growth Partnership*', an inter-ministerial energy dialogue was held on 8th October 2021 to strengthen collaboration on accelerating the move to global clean energy in the decade ahead. During this, the minsters endorsed '*Roadmap 2030 for India-UK Forward Action Plan*' on clean energy, improving energy efficiency measures, enabling use of green hydrogen, and increasing the switch to electric mobility. One of the actions under the *Forward Action Plan* was to launch the India-UK joint partnership technical assistance programme on Smart Power and Renewable Energy, titled '*Accelerating Smart Power and Renewable Energy in India" programme (ASPiRE)'*. One of the thematic areas of ASPiRE is industrial energy efficiency and decarbonisation (IEED).

The objective of ASPiRE is to catalyse increased investment in IEED, renewable energy, storage deployment and electricity distribution in India. The programme aims to catalyse increased investment that supports sustained & inclusive economic growth, low carbon and leads to poverty reduction including through the promotion and empowerment of women and other socially weaker groups.

A consortium led by KPMG has been selected by the Foreign, Commonwealth and Development Office (FCDO), UK as the implementing agency for ASPiRE programme in consortium with Idam Infra and Carbon Trust.

2. Rejuvenation of Knowledge Exchange Platform (KEP)

Under the ASPiRE programme, a rejuvenated Knowledge Exchange Platform (KEP) is being developed in collaboration with the Bureau of Energy Efficiency (BEE) to promote and share best practices & energy-efficient technologies among large-scale industries. The rejuvenated KEP web portal would be a one-stop shop for all energy efficiency needs of large industries covered under BEE's PAT Scheme. The rejuvenated KEP would include new features and would facilitate Designated Consumers (DCs) in adopting new and emerging IEED technologies offered by Indian and global technology suppliers.

The rejuvenated KEP would comprise of database of proven and emerging technologies available in India and globally. Further, the database would also provide details of technology suppliers and financial institutions, updated at regularly intervals.

The rejuvenated KEP would thus facilitate:

- Exchange of knowledge and information to enhance peer to peer learning
- Exchange of energy management best practices across sectors
- Access to IEED tools, technologies & technology providers available in India and globally
- Access to data sources and knowledge repositories to support knowledge translation
- Organise sector/ industry specific workshops/ seminars to enhance EE measures
- Enable knowledge and commercial partnerships

3. Aluminium Sector in India

The Indian Aluminium Industry is the second-largest producer of aluminium in the world with a share of ~5.3% of the global output. In FY21, India produced ~4 million tonnes (MT) of aluminium. The industry is highly concentrated with majority of the country's aluminium being produced by the top five companies. The aluminium industry in India is thriving at an enviable growth rate of 7% per annum, which is one of the highest in the world. Demand for aluminium has grown over the years from various sectors such as construction, electrical, automobile, packaging, etc. The export of primary Aluminium from India has witnessed a rapid rise over the years and the share of exports in aggregate production has risen to 54% in FY20 from 46% in FY16. India's primary Aluminium exports increased by approximately 50% during the first quarter of FY21. With the ease of COVID-19 restrictions in the country, exports grew by just 6.8% in Q2 versus 50% growth in the June 2020 quarter.

In FY21, India's per capita aluminium consumption stood at 2.5 kg as against worldwide average of 11 kg and 24 kg that of China. According to a NITI (National Institution for Transforming India) Aayog study, enhancing India's per capita aluminium consumption to global average would require an annual increase of 16 MT in consumption. The major aluminium consuming sectors include power (~44%), construction (17%) and consumer durables & transportation (10-12%).

In order to meet the growing aluminium demand, India, having large reserves of bauxite (primary source of aluminium), would need to increase its bauxite production by over 3 times to ~70 million tons by 2030-2032 (w.r.t. 2019).

Perform, Achieve, and Trade (PAT) Scheme for Aluminium Sector

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.

Primary aluminium production involves two major processes: refining of bauxite to alumina; followed by smelting of alumina to aluminium. Smelting is an energy-intensive process and consumes electrical energy, accounting for about 85%–90% of the total electrical energy consumption. The aluminium sector has been categorised based on its process into four subsectors: refinery, smelter, integrated, and cold sheet mills.

An aluminium industry, with an annual consumption of over 7,500 tonnes of oil equivalent (toe), is notified as a Designated Consumer (DC) under the Energy Conservation Act, 2001. Majority of the DCs from Odisha, Karnataka, Jharkhand, Chhattisgarh, Maharashtra, and Uttar Pradesh have already been notified under PAT.

The achievement of Aluminium Sector in terms of IEED at the end of PAT cycle II is presented in Table 1 below.

Table 1: IEED potential and achievement of Aluminium sector under PAT Scheme

Total Number of DCs Notified in PAT Cycle I to VI	Energy Efficiency (MTOE)		Decarbonisation ($MTCO_2$)	
	Potential (PAT Cycle I to VI)	Achievement (PAT Cycle I & II)	Potential (PAT Cycle I to VI)	Achievement (PAT Cycle I & II)
14	1.061	1.303	3.628	4.456

4. Decarbonisation of Indian Aluminium Industry

Fourteen industries from the Aluminium sector, covered under the PAT scheme, cumulatively consume ~10.85 MTOE and emit ~37.13 $MTCO_2e$ annually. These industries offer an energy saving potential of ~1.061 MTOE and decarbonisation potential of 3.628 $MTCO_2e$.

Some of the initiatives/ commitments adopted by leading aluminium industries in India to achieve decarbonisation of the aluminium industry, are discussed below:

- Vedanta Ltd. – committed to decarbonise its aluminium business operations in the long term. It has set a target of achieving a 24% reduction in GHG (Greenhouse Gas) emissions intensity by FY25
- A coalition of six major Indian aluminium industries including Hindalco Industries Ltd., signed up for an '*Industry Charter for Near-Zero Emissions by 2050*'. Initial proposals and ideas include integrating renewables in the grid, electric mobility, and green hydrogen technologies. Increasing its presence in downstream aluminium products and use of recycled aluminium are important levers in Hindalco's decarbonisation

strategy. Recycling aluminium requires just 5% of the energy used to produce primary aluminium with only 5% of the associated greenhouse gases

- NALCO (Angul, Odisha) – successfully commissioned a pilot-cum-demonstration of carbon dioxide sequestration plant in its captive power plant

In addition to above, aluminium industries have adopted following key operational best practices and technologies as part of their IEED measures:

- 100% graphitised cathode installation
- Improvement of conversion efficiency of rectifier systems
- Graphitised pots current efficiency improvement and average voltage reduction
- Silicate based anode coating technique applied in reducing the top oxidation which has a major impact on Net Carbon Consumption
- AC to DC conversion efficiency improvement
- Use of RUC (Ready to use Cathode) copper inserted collector bar for pot cathode
- Reducing the dead pot residual voltage to zero by a shorter current path having a higher cross-section and lower current density
- Fitch fuel catalyst use in the Bake oven and cast house to save HFO consumption and to reduce emissions in the Bake Oven and cast house (around 5 % of fuel saving)
- Biomass Co-firing in boilers
- Energy Analytic Platform using Power BI with AI and energy saving using copper insert
- Digital smelter solution (first in India), deployed at an aluminium smelter in Jharsuguda, Odisha - uses digital twin technology for human-less monitoring, operational control thus enhancing energy & resource efficiency through remote advisory system
- OSIsoft PI (Process Information) System, an industrial IoT solution, implemented in Jharsuguda uses machine learning to boost operational efficiency and productivity

5. Potential technology interventions for enhancing energy efficiency/ decarbonisation in Aluminium Sector

Some of the potential areas for technology intervention to facilitate rapid transition of aluminium sector's journey to net-zero, have been identified below:

- Waste heat recovery and utilisation technologies for different fuels (e.g., Hydrogen) including options for industrial symbiosis with low-grade heat technologies (ORC)
- Technological processes such as 'Eco-contact' to reduce voltage drop at conductor joints, inert anode technology, Wetted Cathode Technology, Multipolar Cell Technology, and Calciner main burner nozzle replacement
- Adoption of emerging low-carbon technologies like fuel switchover, Hydrogen, Carbon Capture Usage & Storage (CCUS), etc.

- Hot water generator to replace the steam boiler in the Tension Leveller process
- Develop supply chain solutions to increase the recycling of mixed scrap metal using different technologies (e.g., electric arc furnace)

Leverage strengths and capabilities of UK Aluminium Sector

The aluminium sector in the UK contributes ~**£10 billion** annually to the country's economy. The UK aluminium sector offers some key technologies and solutions along with best practices in the areas of electrolysis (process improvements and inert anodes), material lightweighting, recycling and secondary production, advanced kilns and furnaces, digital technologies, etc. One such technology includes, a highly efficient lightweighting technology – 'hot form quench (HFQ)', producing high strength aluminium which is as a cost-effective alternative to steel or low strength aluminium.

Strengths and capabilities of UK aluminium sector can be leveraged to facilitate rapid transition of Indian aluminium sectors' journey to net-zero, through adoption of best practices, technologies and solutions.

In order to facilitate access to leading best practices and technologies of UK aluminium sector, some key UK organisations such as the UK Aluminium Federation, Innoval Technology, Foundation Industries Group of Innovate UK (KTN), Opex Group, Global Nano Network and UK Advanced Forming Research Centre (leading UK research centre on metals forming), are participating in the below mentioned sectoral workshop on **21 November 2022**.

6. Sectoral Workshop on Best Practices in Energy Efficiency in Aluminium Sector: A path for decarbonisation

A one-day workshop on "***Best Practices in Energy Efficiency & Decarbonisation in Aluminium Sector***" is being organised on **21st November 2022** at Aditya Aluminium, Odisha. The workshop will cover various aspects of aluminium sector such as PAT scheme, aluminium smelting, alumina refinery, captive power generation, circular economy, and new emerging technologies (e.g., inert anode). The workshop is designed to provide national and international organisations a platform to present their best practices and technologies for IEED in the aluminium sector. The workshop would thus enable in capacity building of aluminium sector stakeholders.

ASPiRE programme promotes gender equality and the sectoral workshop is expected to deliver GESI (Gender Equality and Social Inclusion) through the participation of women and stakeholders from marginalised groups from large energy-intensive industries.

The detailed workshop agenda has been provided in Annexure.

7. Study Tour of Aditya Aluminium Plant, Lapanga, Odisha

A study tour/ visit of Aditya Aluminium, Lapanga, a flagship unit of Hindalco, has been organised on **22nd November 2022** (09:00 – 13:00 IST). The plant, located at Lapanga, Sambalpur, Odisha, has a production capacity of 380,000 tonnes per annum (TPA) powered by a 900 MW captive plant. The smelter plant is based on AP-36S technology (RTA) from Aluminium Pechiney, France involving numerous processes, quality parameters, and safety aspects at different levels. The process is quite intricate in nature as it handles very high currents to the tune of 368 kA and new-generation controls. Aditya Aluminium's performance is one of the best amongst all the twenty-two, AP-36 smelters across the globe, in terms of metal quality, producing the best grades of Aluminium i.e., P0404, P0405 & P0406. Globally, products of this plant are recognised as '*Good Western Metal*'. To overcome the challenges of cost, quality, and sustenance and to emerge as a global leader in the primary aluminium sector, Aditya Aluminium has evolved itself as a '*Smart Manufacturing Setup*'. The energy performance of the plant is depicted in the table below:

Table 2: Energy consumption performance of Aditya Aluminium (2019-2022)

Description	Unit	2019-20	2020-21	2021-22
Annual production - Hot Metal	Metric Tonne	3,65,734	3,55,881	3,65,464
Annual electrical energy consumption	Million kWh	5,162.9	5,049.1	5,160.6
Specific electrical energy consumption	kWh/ tonne	14,117	14,187	14,121

The Aluminium manufacturing process requires monitoring and analysis of consumption data at the substation feeder level and demand and consumption analysis at equipment level. To achieve this goal in a cost-effective manner, Microsoft Power BI with an AI platform was deployed at Aditya Aluminium plant. The real-time data derived from smart meters, installed at the various feeders, is loaded into Microsoft Power BI to get deeper insights with AI analytics for sustainable decision-making. This process innovation has resulted in the transformation of the reactive decisions to predictive and preventive strategies in managing energy consumption of Smelter. The plant/ field visit is crucial for fostering dialogue and developing understanding about this '*Smart Manufacturing Setup*'. The field visit will provide an opportunity to understand the energy efficient technologies and decarbonisation processes undertaken at Aditya Aluminium. This study tour/plant visit would also enable transfer of technologies & best practices between industries and thus foster an ambitious, mutually beneficial and outcome-focused relationship.

Annexure – Sectoral Workshop Agenda

Theme: Best Practices in Energy Efficiency in Aluminium Sector: A path for decarbonisation

Date: Monday, 21 November 2022

Time: 09:30 – 17:00 IST / 04:00 – 11:30 GMT

Venue: Club House, Aditya Aluminium, Lapanga, Odisha

Time (IST)	Name of Session	Presenter
Inaugural Session		
9:30 - 9:35	Welcome address	Representative Aditya Aluminium
9:35 - 9:40	Introduction of ASPiRE Programme	Ms. Radhika Tomar, Head – Energy Sector Reform, British High Commission, FCDO
9:40 - 9:45	Special Address by Jawaharlal Nehru Aluminium Research Development and Design Centre, Nagpur (JNARDDC)	Dr. Anupam Agnihotri, Director, JNARDDC
9:45 - 9:50	Special Address by Bureau of Energy Efficiency (BEE)	Shri S. K. Khandare, Director
9:50 - 9:55	Special Address by Vedanta Aluminium	Shri Nitin Tiwari, COO-Metal
9:55 - 10:00	Special Address by Aditya Aluminium	Shri Sameer Nayak, Plant Head, Aditya Aluminium
10:00 - 10:10	Inaugural Address by the Chief Guest	Shri Kailash Pandey, Head-Hirakud Cluster, Hindalco Industries Ltd
10:10 - 10:15	Vote of Thanks	Shri. Balawant Joshi, MD, Idam Infrastructure Advisory (ASPiRE Team)
10:15 - 10:35	Tea Break	
Technical Session I – PAT Scheme		
10:35 - 10:40	Moderator	Shri S. K. Khandare, Director, BEE
10:40 - 11:00	Impact of Perform Achieve and Trade (PAT) Scheme and initiatives by BEE	Shri Jagadeesan V Sector Expert, BEE
11:10 - 11:15	Discussions	
Technical Session II – Sharing of Best Practices by Aluminium Smelter Plants and Circular Economy		
11:15 - 11:20	Moderator	Dr. Anupam Agnihotri, Director, JNARDDC
11:20 - 11:35	Emerging Technology for Aluminium Sector-Inert Anode Technology and Circular Economy	
11:35 - 11:55	Energy Analytics Platform using Power BI with AI for energy reduction in smelter	Shri Jay Prakash Soni, Aditya Aluminium
11:55 - 12.15	"DHARITRI" – the journey of de-carbonisation by Vedanta Ltd., Jharsuguda, Odisha	• Shri Sashi Kant Shah • Shri Rajesh Kumar Tiwary • Shri Bibhudatta Mohanty • Shri Ramesh Patro

Time (IST)	Name of Session	Presenter
12:15 - 12:35	Best Practices to achieve the ESG Targets	BALCO (Chhattisgarh)
12:35 - 12:55	Energy Reduction & Decarbonization in Aluminium Smelter	Shri Deepak Gokhale, Aditya Birla Science & Technology Company
12:55 - 13:15	Mahan Aluminium – Taking strides on the Decarbonization path	Shri Yogendra Bhati, Mahan Aluminium, Madhya Pradesh
13:15 - 14:00	Lunch Break	
Technical Session III – Sharing of Best Practices by Alumina Refinery, Captive Power Plant (CPP) and Technology Suppliers		
Alumina Refinery		
14:00 - 14:05	Moderator	Shri Mukesh Chaddha, Former Head Alumina Department, JNARDDC
14:05 - 14:25	Energy efficient technologies for Alumina Refinery	
14:25 - 14:45	Energy Efficiency initiatives undertaken at Vedanta Lanjigarh Refinery	Vedanta Limited, Lanjigarh Alumina Refinery
14:45 - 15:05	Green Energy for a better tomorrow	Hindalco Industries, Belagavi
Captive Power Plant (CPP) Generation and Technology Suppliers		
15:05 - 15:10	Moderator	Shri K. K. Chakarvarti, Sr. Advisor, KEP (ASPiRE Team)
15:10 - 15:30	Auxiliary Power Consumption Reduction in Aditya CPP	Ms. Ankita Wadighare, Mr. Sourav Gorain, Aditya Aluminium
15:30 -15:50	"Urja" – The source of power (Best Practices for Energy Conservation) by Vedanta Ltd., Jharsuguda, Odisha	• Shri Rupak Sarkar • Shri Prafulla Chandrakar
15:50 - 16:10	Energy Saving Opportunities in Compressed Air System	Shri Ashwin Majhi, Godrej Electricals & Electronics
16:10 -16:30	UK Aluminium Federation Sustainability Strategy and the Route to Net Zero (Virtual Presentation)	Ms. Nadine Bloxsome, Sustainability Manager, UK Aluminium Federation
16:30 - 16:50	Efficient Air Compressors -Emerging Technologies	Shri Hitesh and Gopal Reddy, Atlas Copco
16:50 - 17:10	Sustainability in the global aluminium industry (Virtual Presentation)	Dr. Michael Kenyon, Senior Materials Engineer, Innoval Technology (UK)
Feedback and Workshop Concluding Session		
17:10 - 18:00	Discussions, Feedback and Concluding Remarks	• Shri. Kailash Pandey, Head-Hirakud Cluster • Shri Sameer Nayak, Plant Head, Aditya Aluminium • Shri S. K. Khandare, Director (BEE) • Ms. Sanyukta Das Gupta, Policy Advisor, Just Transition and Energy Efficiency, British High Commission,

Time (IST)	Name of Session	Presenter
		FCDO • Dr. Anupam Agnihotri, Director, JNARDDC • Shri Nitin Tiwari, Vedanta • ASPiRE Team
18:00 onwards	High-Tea	