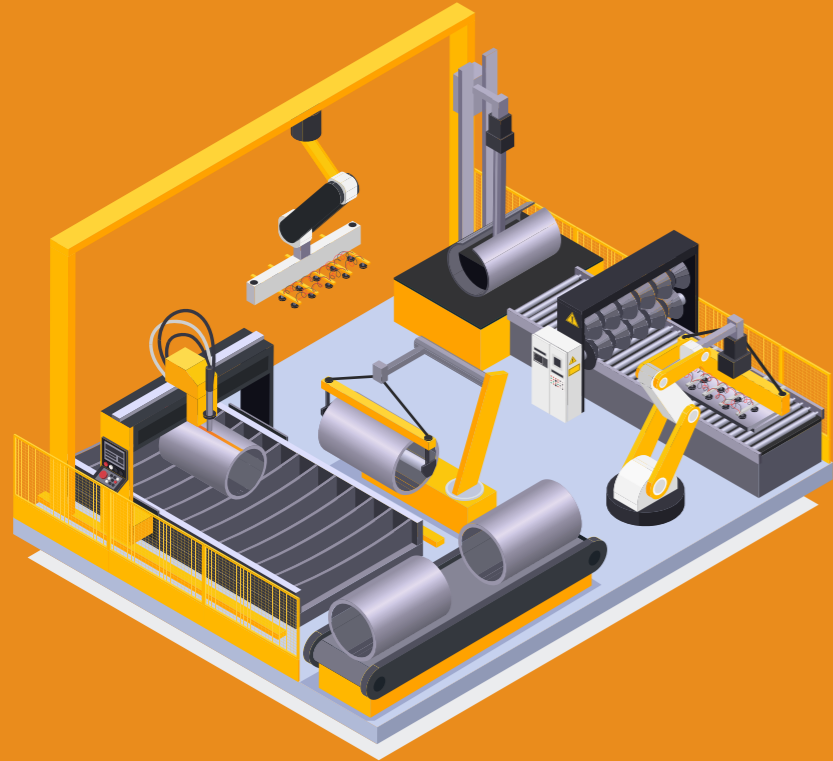


MANUFACTURED CAPITAL

Improving Operational Excellence



With more than 48 manufacturing locations, we are proud to be one of the largest Aluminium and Copper producers across the globe. We are proud to be a company manufacturing key metals required to achieve sustainability through electrification, lightweighting and decarbonisation, thereby standing true to our purpose of making the world greener, stronger and smarter.

Contribution to SDGs



Interlinkages with Material Topics and other Capitals

Material Topics	Capitals Connected
Market Presence Macro-Economic Fluctuations	Financial Capital Human Capital Natural Capital Intellectual Capital Social and Relationship Capital

Alignment with Strategic Priorities

- SP-1: Focus on Value-Added Products
- SP-2: Strong ESG Commitment

HIGHLIGHTS

15

Manufacturing locations in India

33

Operating locations of Novelis – a global leader in Aluminium recycling and largest Aluminium FRP producer globally

Utkal

Among the most economical producers of alumina in the world

Dahej

Largest custom Copper smelter at a single location in Asia

20 BAUXITE MINES

Operational across four states in India

3 COAL MINES

Operational across two states in India

Production Capacity

3.0 MMT

Alumina

1.30 MMT

Aluminum Metal

0.320 MMT

Aluminium VAP (FRP+Extrusion)

0.421 MMT

Copper Cathode

0.315 MMT

Copper Rods

0.4 MMT

DAP

4 MMT

Rolling capacity of Novelis operations

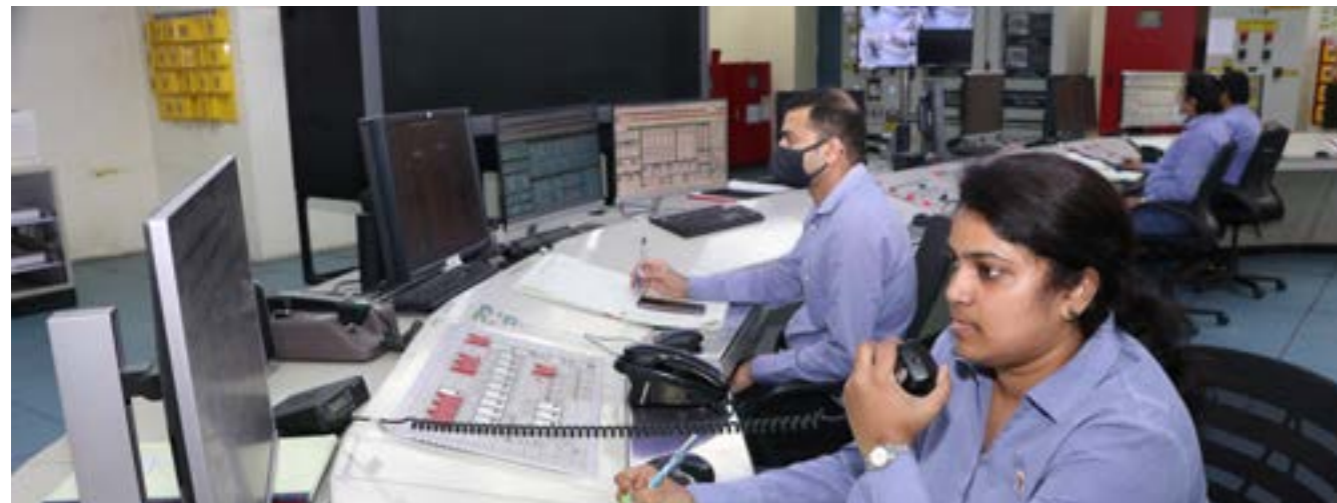
2.5 MMT

Recycling capacity of Novelis operations



Focus Areas

Manufacturing products that are Greener, Stronger and Smarter	Continuous improvement of our systems and processes	Reliable and safe working facilities
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Power plant control room

Our manufacturing capability, equipped with robust operational control measures, forms the core of our business. We nurture our capabilities through various initiatives focussed on achieving operational excellence and capacity enhancement. Hindalco’s manufacturing operations span across the entire value chain in Aluminium and Copper manufacturing. Our Aluminium operations encompass operating bauxite and coal mines, alumina refineries, smelters and manufacturing

value-added products. These are supported by captive power plants at respective locations, including renewable energy capabilities that are being added year on year.

Our Copper operations encompass Copper smelter, refinery and manufacturing of value-added products. The Copper operations also include the oxygen plant, sulphuric acid plant and precious metals refinery. All our manufacturing

operations are supported by captive power plants at respective locations.

Our international operations are driven by our wholly-owned subsidiary, Novelis, which focusses on flat rolled products and is a global leader in Aluminium recycling. With a rolling capacity of 4 MMT, Novelis is also the leader in Aluminium rolling operations across the globe.

Production during FY 2020-21

	FY 2017-18	FY 2018-19	FY 2019-20	FY 2020-21
Alumina ('000 MT)	2,709	2,893	2,768	2,699
Aluminium Metal (Primary) ('000 MT)	1,291	1,295	1,319	1,229
Flat Rolled Products ('000 MT)	268	289	291	232.59
Aluminium Extrusions ('000 MT)	45	47	41	37.54
Aluminium Foils and Converted Products ('000 MT)	14.47	17.47	17.9	18.8
(In MT)	FY 2017-18	FY 2018-19	FY 2019-20	FY 2020-21
Copper Cathode ('000 MT)	410	347	326	262
Copper Cast Rods ('000 MT)	156	245	245	235



Pot tending crane in operation at Aluminium Smelter

Operational Excellence

Operational excellence is one of the most important aspects of Manufactured Capital. To enhance it, we have taken up several initiatives such as Maintenance Strategy and Execution Framework (MSEF), introduction of Opportunities, Ideas and Concepts (OICs) and so on. We carry out world class manufacturing at our operations and our initiatives to improve the current processes towards achieving both operational excellence and profitable growth.

We focus on strengthening the management systems and processes as part of our operational excellence journey. Our corporate office and 15 manufacturing locations are all certified with integrated management systems, with the necessary certifications for Quality Management System (ISO 9001), Environment Management System (ISO 14001) and Occupational Health

and Safety Management System (ISO 45001). Our four units at Renukoot complex, Mahan Aluminium, Hirakud Power & smelter and Birla Copper at Dahej are ISO 50001 certified. Currently, two more units – Aditya Aluminium and Utkal refinery – are in process of being accredited. The first stage of audit has already been completed at the respective sites.

With increase in digitisation and dependence on information technology systems, data security has become an important aspect of business. To ensure data security and protect data of our operations and consumers, we have implemented the Information Security Management System (ISO 27001) across all our operations. To meet our automotive customers’ advanced quality requirements, primarily in downstream operations, we have implemented the International Standard for Automotive

Quality Management (IATF 16949) at the respective locations. Similarly, to cater to the requirements of the Aerospace Segment, AS 9100 certification has been acquired for our Alupuram extrusion, first ever extrusion plant in India to get this coveted certification after Hindalco Almix Aerospace Ltd (HAAL). The unit has also been granted a BIS licence. The Alupuram extrusion has also got the approval of an expert agency for the manufacture of Marine Class Supplies. All our products are Restriction on Hazardous Substance (ROHS) compliant and we conduct periodical tests through NABL accredited labs to ensure we do not exceed the prescribed limit of restricted materials.

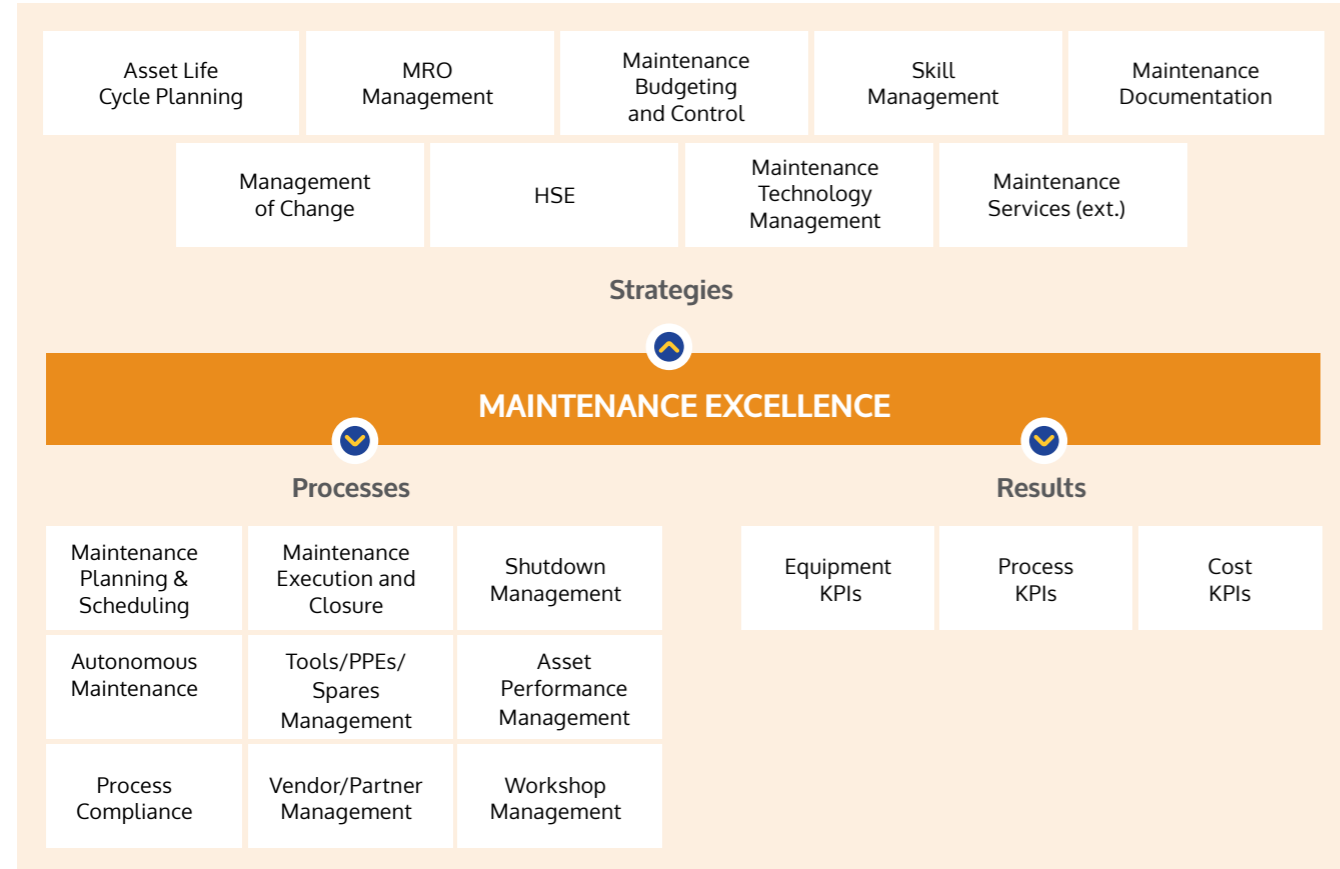
## MAINTENANCE STRATEGY AND EXECUTION FRAMEWORK

Malfunctioning of equipment, including unplanned or unforeseen impairment of equipment function, can adversely affect the plant and our business. Our sustainable equipment management strategies help us tackle these issues in a planned way.

Usually, the reasons for equipment failure are inadequate maintenance strategies, non-conformance of standard operating and maintenance practices, use of substandard spares and so on. To ensure that there are no unplanned disruptions, we have developed a comprehensive asset management policy, termed the Maintenance Strategy and Execution Framework (MSEF).

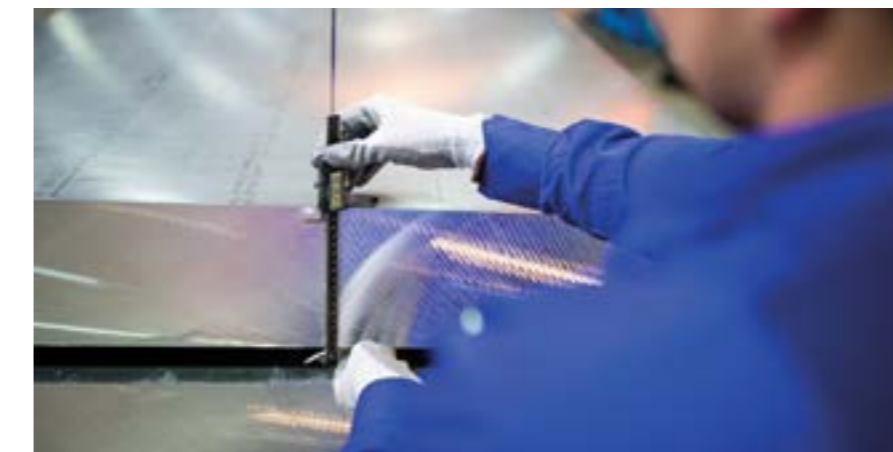
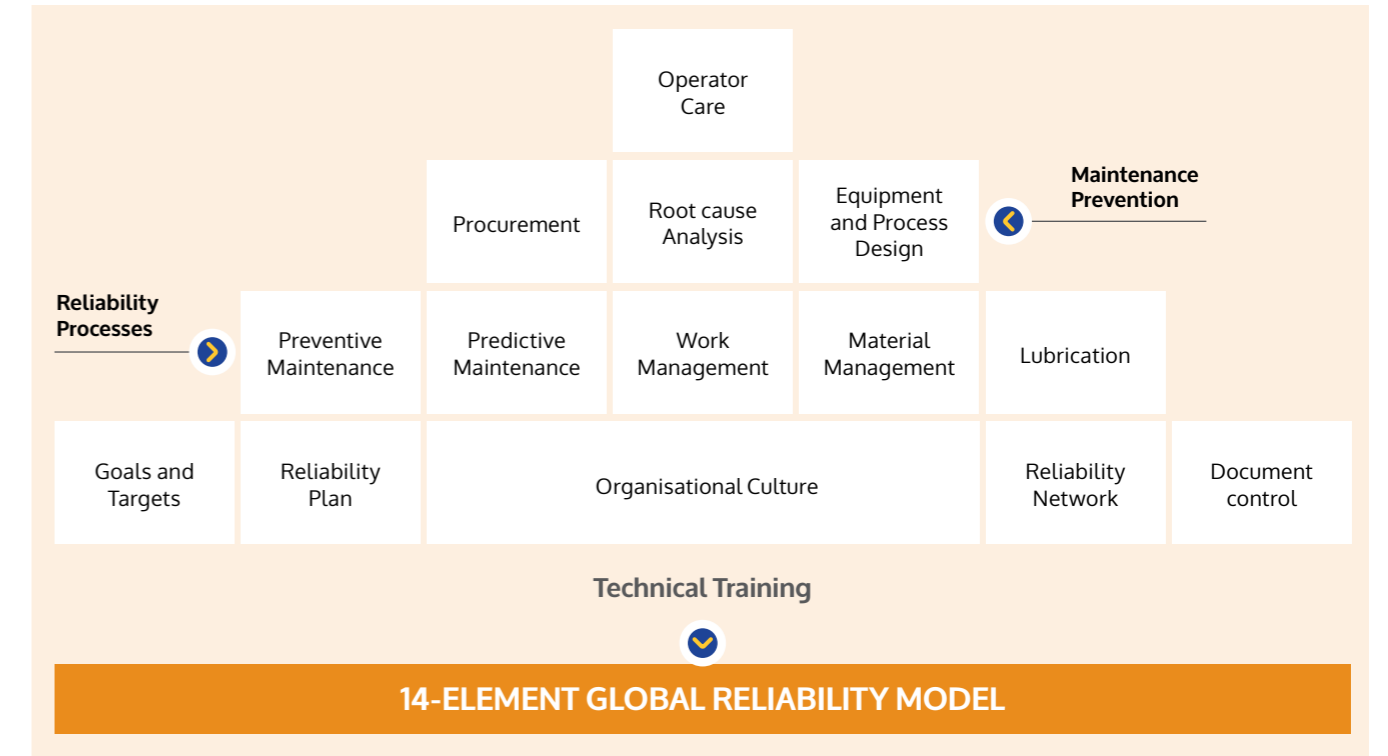
The framework has multiple subprocess areas which directly or indirectly aid equipment maintenance function. All these subareas follow a collection of best practices either in the form of strategic initiatives, practices or results that are produced. This framework is based on Plan Do Check Act (PDCA) principles. Further, we revise and imbibe our framework

based on internal and external best practices. Currently, the framework is referred to for any maintenance execution or as a goal to achieve excellence.



### Reliability Journey at Hindalco Downstream

Our downstream units have shown remarkable performance, especially in the second half of FY 2020-21. One of the key drivers of this performance was the adoption of the Reliability Model, which has been implemented by the downstream units over the last three years. We are following a unique '14-Element Global Reliability Model', which is similar to the one guiding Novelis operations and ensures the strengthening of our systems in every aspect.



We follow a three-pronged strategy that focusses on reliability foundation, reliability processes and maintenance prevention. During the last three years, our downstream plants have developed and uniformly deployed the

novel concept of '5 Bucket Preventive Maintenance (PM) adherence' and 'Fixed Preventive Maintenance Time Window'. All the downstream units today are at 95%+ PM completion every month, which has resulted in sustainable gains

across our operations. Our downstream units work cohesively and collaborate to resolve technical issues.

There are established forums like Monthly Reliability Calls and Quarterly Reliability Workshop, which are utilised to develop the right asset maintenance strategy and technological upgradation. In addition, there is a sharp focus on 11 Reliability KPIs, which every unit is required to monitor on a monthly basis to ensure continuous improvement. More than 300 best practices have been deployed across downstream units. Our annual audit ensures that the system is working effectively.

**300+**  
Best practices implemented across downstream units

## EXPLORING OPPORTUNITY, IDEAS AND CONCEPTS

At Hindalco, we focus on creating an impact on all our pillars - customers, cost and cash, while incorporating safety and sustainability. We encourage our employees to explore opportunities that serve people and the planet. One example is the indigenously designed and manufactured Aluminium bulker launched by Hindalco. With an increased payload of 2 tons over a steel bulker, the Aluminium bulker cuts logistics cost and carbon footprint.



The Opportunities, Ideas and Concepts (OICs) are evaluated by the OIC board. The shop floor teams follow 'Kaizen', which means change for the better through continuous improvement, whether big or small. Kaizen competitions have been held in the mining units in FY 2020-21 and other units are carrying out similar events to sustain the Kaizen culture at Hindalco. This is one way our employees are creating value for our customers. We

also conduct cross-functional internal audit at our manufacturing sites to ensure that all the sites and mines are following the safety standards and guidelines.

Some process improvement projects that we have implemented across our operations are project engineering, Plan Do Check Act (PDCA), 7 Basic Quality tools (7QC), Kaizen events, Lean manufacturing, and Six Sigma. This

has resulted in optimising resources, reducing energy consumption, producing quality products and enhancing safety.

**₹2 CRORE**

Savings from Central Quality Team's measures to improve packaging and procurement quality

Some of the process improvement projects in FY 2020-21:

### Mahan

- Our team at Mahan took up an energy saving project to eliminate line loss by shifting the high-tension meter from Bargawan Substation to Bhikhajhariya Intake pump house
- The team also took up a project to reduce Promag-Ni consumption by developing a system for establishing correlation between input metal Na level from shuttle and pot analysis and Promag Ni efficiency (500kg/month)

### Aditya

- Our team at Aditya reduced anode rejection from 0.2% to 0.15%

### Renusagar

- We were able to achieve a reduction in unburnt fly ash from 1.10% to 0.84% and bottom ash from 1.42% to 1.29%; thereby improving boiler efficiency by 0.1% and correspondingly plant heat rate improvement by 3.0 kCal/kWh

### Packaging and procurement quality improvement in downstream operation

- The Build Quality in Process (BQiP) framework helps us assess the strengths and opportunities for

improvement at our downstream units. It has 24 criteria which include First Pass Yield (FPY), Management of Change (MOC), Layered process Audit (LPA) and others

- To reduce packaging and transit related issues, our central quality team took corrective and preventive action against complaints on a monthly basis. It was observed that proper enforcement could prevent material from getting wet. Some other practices to mitigate post-manufacturing issues and improve overall delivery performance were standardisation of lashing materials and methods, implementation of truck check sheet, strengthening layered process audit in packaging warehouse areas. As a result, the total number of complaints came down from 220 in FY 2019-20 to 155 in FY 2020-21
- Central quality team also provided technical support to strategic procurement in finalising quality suppliers, deciding the SOPs and standardising the specification for procurement of various packaging consumables in downstream units. The savings incurred on account of this initiative was over ₹ 2 Crore



### World Class Manufacturing (WCM) and Integrated Management System (IMS)

We have designed a World Class Manufacturing (WCM) and Integrated Management System (IMS) portal which is now live. This is being used as a platform to share Kaizens, OICs, Continuous Improvement Projects, Process Capability, IMS documents, World Class Manufacturing (WCM) KPIs and calendar of WCM and IMS events. The portal provides a user-friendly platform seamlessly tying all the functions.

With the launch of this portal, the activities are now available in secured cloud environment and reduces the risk of data loss. The units have also digitised Kaizen, suggestion modules and internal customer satisfaction surveys for quick and easy access.



A view of the Mahan Smelter, The plant was conferred Mission Energy's 'Best Energy Efficient' Plant in coal preparation category (2021)

## WORKING IN COLLABORATION

As a part of Hindalco’s Operation Collaboration projects, our teams across different plants have taken up various projects to improve operational efficiency.



One significant project is Pot Turnaround Time. As pots play a significant role in the electrolysis process of our Aluminium smelters, reduced pot turnaround time could reduce the process completion time and increase production efficiency. One day of pot turnaround time reduction approximately leads to 700T per year of additional production, resulting in profits of ₹ 3.5 Crore per year. Our operation team has been able to achieve remarkable weighted average reduction across our plants at Aditya, Mahan, Renukoot and Hirakud. Our achievement in this field has led to cross learning across all the plants to improve areas of operation.

### Operation improvement across plants

#### Aditya

Taking inspiration from Renukoot plant, Aditya plant is in the process of setting up a system for in-house treatment and disposal of Spent Potlining (SPL). It is also using rock digger and poclaim for pot delining, and has a dedicated team to look after shifting and earthing trolley connection at Mahan to prevent unwanted delays.

#### Hirakud

The operation team at Hirakud is also exploring the possibility of setting up in house treatment and disposal of SPL. In addition, the plant is working

on reducing idle time between shell delining and shell removal through better transportation system.

#### Mahan

Mahan started milling of anode beam surface, which has helped better anode contact. In addition, the operation team is making use of wooden slabs to help save pot tending assembly time through manual intervention.

#### Renukoot

Renukoot is working on reducing delays or idle time between two activities; exploring ways to tackle situations where crane is unavailable for activities. It also successfully tried using cold ramming paste in pot.

### Improving energy efficiency

We continuously monitor our processes by benchmarking anode quality, productivity, efficiency and quality and compare our performance across industry best practices. Our plants at Aditya and Mahan are performing well in all the above aspects by staying within the standards of electrical resistivity, silica, vanadium, sodium etc. while simultaneously improving production, efficiency and quality. The plant at Aditya has the highest productivity in kg/pt/day among the 22 AP30 smelters, is sixth highest in current efficiency and ranks fourth in metal purity.

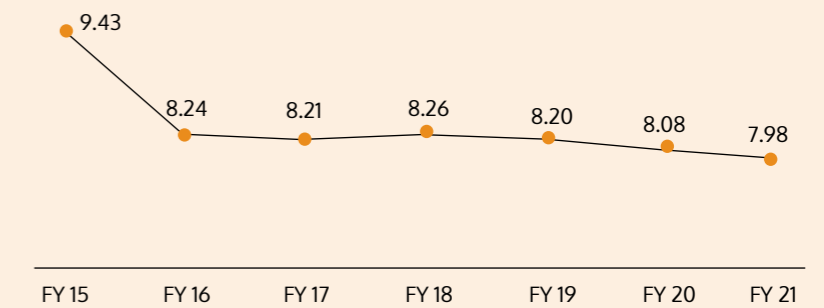
The captive power plant and Aluminium smelter at Aditya has shown a significant improvement, thus reducing energy consumption and GHG emission. It has significantly increased generation of solar power and utilisation of fly ash since FY 2018-19. It has also worked on improving water consumption reduction, pot productivity, CPP boiler efficiency and so on.

Our plant in Renukoot was able to perform successful simulation trials required for BrahMos missiles under the BrahMos development programme. We are collaborating with other Aluminium rolling companies and the next set of trials are under development. That the improvement of processes and products is essential to increase customer satisfaction, was also highlighted at the three-day training on advanced Total Quality Management conducted by a renowned faculty at Hindalco during the year.

### Mega Collaboration Project to Reduce Auxiliary Power Consumption in CPPs across Hindalco

Auxiliary power consumption (APC) is an important parameter contributing to efficiency of captive power plants (CPPs). At Hindalco, we have CPPs operational at Aditya, Mahan, Hirakud and Renusagar locations. As part of the mega collaboration initiative across these four locations, the teams collaborated with the objective to find possible ways to reduce APC. The result was encouraging and led to a drastic reduction in APC from 9.43% in 2014-15 to 7.98% in 2020-21.

#### APC (%) for Aditya, Mahan, Hirakud and Renusagar (Cumulative)



The initiative had three stages with the first involving knowledge sharing across all the plants. Teams at respective plants shared the initiatives taken up with other plants, resulting in a horizontal deployment of ideas and projects. The second stage involved technology innovation and energy audits across the plants. The final stage resulted in achievement of operational excellence. During last three years of implementation, the plants have cumulatively shared and implemented 166 projects in their own plants.

Some of the projects taken up for APC reduction involved installation of variable frequency drives (VFDs), replacement of inefficient equipment such as compressors, motors. Replacement of oversized equipment with smaller-sized equipment has increased efficiency of pumps and motors. De-staging of condenser extraction pump and boiler feed pumps has helped as well. Data monitoring and analysis of energy consumption of equipment have optimised processes.

Even a 0.1% saving in APC, according to our estimates, results in close to ₹ 10 Crore per year across the four CPPs. The project has thus led to significant improvement in operational efficiency and cost savings. Our APC plan also aims to reduce consumption at Aditya, Mahan, Renusagar and Hirakud plants to enable an approximate cost saving of ₹ 30 Crore.

## WORLD CLASS MANUFACTURING

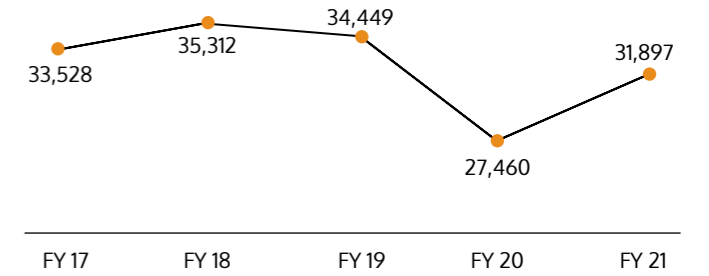
At Hindalco, the concept of 'World Class Manufacturing' (WCM) improves our processes to build organisational capability and culture through a transformation in team-level engagements, improvement in our stakeholder relationships and ability to resolve and improve our basic conditions.



Hindalco through its subsidiary Hindalco-Almex Aerospace Limited (HAAL), is a proud supplier of aerospace and defence grade Aluminium alloys for India's prestigious missions like Chandrayaan, Gaganyaan and various PSLV and GSLV launches. This is testament to Hindalco's capability in providing high end technological solutions for our customers.

We were able to achieve a saving of ₹ 168.74 Crore in FY 2020-21 through the implementation of 2,658 Continuous Improvement projects. In addition to that, there was increased participation from our employees across locations who submitted a total of 31,897 Kaizens.

Number of Kaizens



### A Bottom-up Approach at Mahan to Drive Innovation



Aerospace grade Aluminium manufactured from primary metal supplied by Mahan Aluminium went into outfitting Chandrayaan II.

Our Mahan operations set an example by achieving operational excellence milestone during the year. This was the result of active engagement by senior leadership at the plant and respective operational teams. Some of the initiatives which have facilitated changes at various levels and created a buzz of continuous improvement culture are:

- Pillar (committee) specific review by Unit Head and Plant Head
- Regular model area visits by leadership team

- Unit Head's WCM focussed interaction on shop floor
- Surprise calls to small group members

In addition to this, activities like Quarterly Waste Walk drive, Workmen Technical Trainings at Gemba, monthly theme celebrations such as Quality Month, Maintenance Month, Innovation Month, digitisation of Kaizen/suggestion submission have also impacted the employees, who are now actively and more enthusiastically participating to achieve standards of WCM.

The activities at Mahan have resulted in long-term savings, productivity enhancement, cross functional learnings and involvement of the last man in the journey of excellence. Mahan has been able to achieve a total of 4,291 Kaizens, 97 completed CI Projects and 60 OIC projects in 2020-21 with the help of these activities. Mahan has rewarded around 450 employees and workmen for WCM activities in the fiscal.



Hiralakud FRP- Cold rolling mill operations

**Alumina Navigation**

Alumina is one of the most important raw materials in our operations. We transport alumina between refineries and smelters, depending upon the demand and supply at locations. Surplus alumina is also sold to other industries.

Location of our refineries and smelters, the dynamic demand supply scenario and different process requirements add complexity in balancing alumina supply across these locations. However, we are proud to say that there has not been any production cut due to shortage of alumina in any of our smelters. This is the result of our reliable alumina navigation approach, which transported alumina through rail. The number of rakes has grown from six rakes in 2015 to a fleet of 12 rakes in 2021, with one more being introduced this year. We have been able to navigate more than 1.5 million tons of alumina with the fleet strength despite facing the challenging traffic conditions of Indian railways. We have exported a total quantity of 335,702 MT along with a total domestic sale of 157,099 MT since 2015.

**12 RAKE**

Owned by the Company help maintain alumina supply across plants and to other industries

**₹8,000 CRORE**

Proposed investment in Hiralakud, Silvassa and Mundra plants

**Our Future Expansion Plans**

We are planning to expand our Aluminium downstream business with a focus on VAP over the next 3-7 years. Our products would cater to customised requirement for varied and complex applications of Aluminium. We plan to invest around ₹ 8,000-10,000 Crore in expanding flat rolling capacity at Hiralakud, new extrusion plant at Silvassa and in a greenfield site at Mundra with a recycling facility. The Hiralakud plant capacity for flat rolled products is estimated to be 340 KTPA. The planned capacity of the extrusion plant at Silvassa is 34 KTPA, which would have three extrusion presses to service premium customers in building and construction, automobile and transport, electrical, consumer and industrial good sectors. In addition, the new extrusion and recycling unit at Mundra is awaiting land acquisition process and would have a capacity of 93 KTPA.

**COVID-19 Response**

During these challenging times, we ensured that we faced all hindrances with a daunting spirit. Our Copper plant in Dahej was operational by June 2020, despite minimal staff causing problems

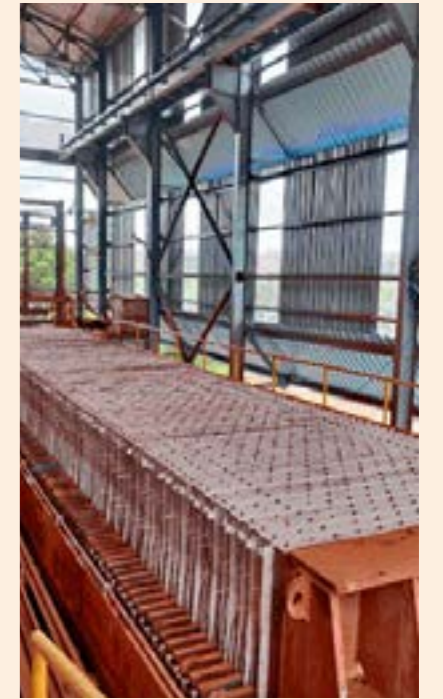
of loading/unloading ships. Migration of labour also caused disruption, but we could overcome the problem with the Birla Copper leadership team's plan of 'Creating a pool of resources between various facilities' and 'Re-distributing shift loads'. Our Aluminium business was fully operational within a few months, with the normalisation of operations in Aditya, Mahan, Renukoot and Hiralakud. Initially, our downstream plant operation at Renukoot-FRP and Hiralakud FRP could only run at 30-40% and 50-60% of the respective capacities but became fully operational within a few months. Most importantly, our Utkal refinery continued to operate at full scale except for a brief period.

Our operations and maintenance teams have become more self-reliant and technically sound. We were able to find ways to optimise maintenance activities and curtail redundant time-based replacement. We have standardised our maintenance approach for upstream and downstream plants and improved equipment reliability and availability across the board. We were also able to take various cost saving approaches for maintenance of our plants. The new ways of working that we evolved during the time, are keeping plants operational with reduced staff and improving the digital abilities of our marketing teams so that they could connect and deal with customers online.

**Innovation Wins the Day**

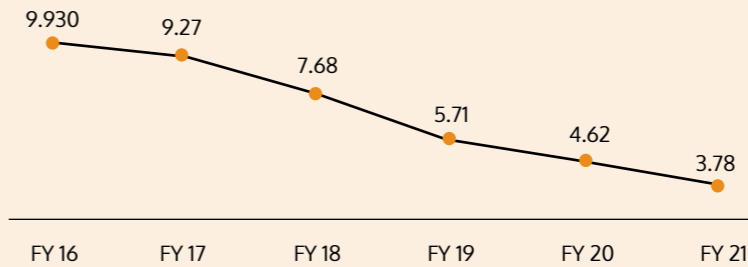
Our culture of innovation and technological excellence have optimised processes and improved specific consumption of raw materials and energy. This was evident again at our four alumina refineries Renukoot, Utkal, Muri and Belagavi, which produce hydrate, smelter and chemical grade alumina. Caustic loss, through liquor with red mud residue in the Bayer process, was having a huge impact on the cost of production of alumina.

To control the loss, plate and frame filters were installed across all the refineries. The improved processes have enabled us to bring down the loss from 9.9 kg/MT to 3.8 kg/MT. The use of plate and filters has also helped reduce the moisture content of red mud by 22-23%, making it easier to handle and utilise the residue for cement plants.



Belagavi Filter Press

**Caustic Loss Reduction Kg/MT of hydrates**



**Can Crush: A Big Step Towards Sustainable Packaging**

With a recycling capacity of 2.5 MMT, Novelis operations have taken a significant stride towards circular economy. During 2020-21, Novelis has achieved an average of 61% of recycled Aluminium inputs.

Many of the automobile companies are procuring recycled Aluminium from Novelis to make new products. Novelis is also helping an automobile company to recycle and reuse 90% of the Aluminium scrap it is producing. This is an outcome of closed loop recycling method developed in collaboration with the automobile manufacturer. Novelis has also received several awards for its innovation in electric vehicle battery enclosure, demonstrating its commitment to excellence and innovation.

The Hindalco subsidiary is also working on meeting customer requirement for sustainable packaging around the world. Currently, Novelis is the leading global buyer as well as the recycler of used beverage cans, recycling more than 74 Billion cans this year. Towards this, the Novelis team in Asia has initiated a Can Crush Campaign to raise awareness on the benefits of can recycling.

**74 BILLION**

Cans recycled by Novelis in 2020-21

