

Innovation Anchored in Operational Scale and Value-Creation



Intellectual Capital

KEY HIGHLIGHTS

Patents Granted	145
New products and applications developed*	12
Spent on R&D	₹856.56 crore

* The details provided are for India Operations

LINKAGES

Financial Capital	Social and Relationship Capital
Manufactured Capital	

Strategic Priorities

- SP-2** Scaling up Upstream though Doubling-down on Capacities
- SP-3** Scaling up Downstream through Portfolio Enrichment (Non-LME linked)
- SP-4** Strong ESG Commitment, Culture and Digital

Material Topics

- Economic Performance & Market Growth
- Digitalisation & Cybersecurity

Key Risks and Opportunities Addressed

- Cybersecurity and data protection risks
- Increased focus on decarbonisation
- Supply chain risks
- Rising demand for aluminium and copper products
- Development of low-carbon products
- Emerging applications for specialty alumina

Contribution to SDGs



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In a dynamic world with ever-changing priorities, few organisations would survive without innovation. At Hindalco however, innovation is the cornerstone of various philosophies ranging from customer centricity, sustainability as well as our constant endeavour to improve our offerings. We welcome simple yet dexterous models that demonstrate the ability to scale across the organisation.

We aim to establish industry-leading benchmarks in innovation, with our wide network of innovation centres and focused talent development. The legacy trust and capabilities of our R&D teams and philosophies— have allowed us to collaborate with the best minds across academia, thereby multiplying the depth and number of our undertakings — converting our capabilities into proven achievements.

Our innovation-first thinking has led us to hone our processes in upstream operations with intricate, tech-driven improvements. Our downstream operations innovate low-carbon, high-recycled content solutions for mobility, energy, infrastructure and electronics.

Our innovations also seamlessly transfer from minds to labs to plants, proving their performance in their ability to scale and become industry-ready. During the reporting year, these policies translated into various achievements, including super value-added products. Our efforts over the years have culminated in a number of patents we value, treasure and utilise to augment our business and make it future-ready.

Focus Areas

- Strengthening R&D for value-added products and applications
- New technological solutions
- Product quality and performance
- Digitalisation



Strategic R&D Powers Business Outcomes

Our R&D function continues to play a pivotal role in our ability to drive innovation and deliver differentiated outcomes. We aligned our R&D priorities closely with operational needs, evolving market requirements, thereby enabling faster translation of innovation into scalable business outcomes.

Our R&D efforts remained focused on enhancing resource efficiency and operational resilience across alumina refineries. During the year, we

- Advanced bauxite characterisation and processability studies to support consistent performance under varying ore qualities, while implementing targeted interventions for impurity control within the Bayer circuit.
- Undertook research into digestion and precipitation behaviour, evaluation of specialty chemicals for refinery applications, and technology assessments for alumina refining to enable improved extraction efficiency, liquor stability, and operational resilience.
- Continued emphasis on value-added and super value-added specialty alumina and hydrates, complemented by application development

- across flame retardants, solid surfaces, refractories, ceramics, abrasives, and advanced industrial uses to support downstream diversification.
- Strengthened quality enhancement, recovery optimisation; and sustainable metallurgy across copper operations.
- Expanded into new automotive applications in aluminium downstream such as crash components

Priority areas included improving copper cathode and copper continuous cast rod quality, increasing the recovery of copper, gold, and silver, and developing processes for the recovery of other critical metals. Sustainability-driven innovation remained paramount, with R&D efforts directed toward value creation from copper slag and fly ash, while achieving zero hazardous gypsum generation. Plant-scale initiatives focused on flow-rate optimisation, cathode quality enhancement and process development for Nickel recovery from effluent.

Innovation around Smelting: We continued to strengthen in-built smelting capabilities while improving process stability, energy efficiency and scalability across aluminium operations. Key initiatives included high-amperage pot design, development of energy-efficient smelting processes, reduction of net carbon consumption through specialised alumina coatings, and advancement of digital pot-control systems. Innovation in carbon anode optimisation supported productivity enhancement and energy reduction, while a strong emphasis on scalable deployment enabled proven inhouse technologies to be replicated across smelters.

Coatings & Lubricants: Development of advanced coatings, specialty lubricants and engineered materials enabled enhanced product

quality and extended asset life. It led to safer and efficient operations for customers and internal plants alike. We developed biodegradable hydraulic and gear lubricants, low-VOC coatings, non-stain work roll oil and soluble cutting oil while maintaining performance standards across operating conditions.

Downstream applications: We continue to strengthen the development of high-value aluminium downstream products, contributing to the growth of the downstream business. We have a strong focus on core material processes, enhanced understanding of application requirements, and increased collaboration with academic institutions for the development of future-ready sustainable materials. We have developed, among others, high-strength wire rods, direct-chill cast material foil stock for ultra-light gauge applications, crash-grade extrudable aluminium alloys for automotive applications, and extrusion profiles for battery enclosures.

At Novelis, R&D remains closely aligned with market needs across beverage packaging, automotive, aerospace and specialty segments, guided by the Novelis 3x30 vision. A global network of research and customer solution centres spanning Kennesaw and Spokane (USA), Novi (USA), Stuttgart (Germany), Göttingen (Germany), Sierre (Switzerland), Koblenz (Germany), São José dos Campos (Brazil), Ulsan (South Korea), Shanghai and Zhenjiang (China) support the development of low-carbon products and productivity-enhancing manufacturing technologies. Strong emphasis is placed on building technical talent and succession capability, ensuring continuity of engineering expertise while connecting people, processes and technology.

Our innovation centres filed 189 patents and were granted 145 patents during FY 2025-26.

Delivering Value Through Innovation

Innovation Centres: Intellectual Capital to Value Creation

Innovation is driven through a network of dedicated centres that convert research capability into customer-validated products and scalable applications. During FY 2025-26, our centres executed innovation across the lifecycle ranging from laboratory-scale product development to pilot validation and customer acceptance across upstream materials, downstream applications, coatings, and global rolled products.

Our initiatives were focused on optimisation of alumina milling and sintering behaviour for spark-plug applications, replacement of zircon with ground alumina in investment casting, and improved polymer processability through controlled surface modification of specialty hydrates. Other process innovations include lime-addition optimisation and bauxite processability studies at Muri and Aditya refineries to enhance alumina extraction efficiency, digestion performance and liquor stability.

Aluminium Smelting Innovation Centre, along with the Mahan plant team, successfully commissioned the booster section to demonstrate a 400+ kA pot design and magnetic compensation loop technologies developed jointly with the Aditya Birla Science and Technology Company (ABSTC). This novel technology solution will facilitate higher amperage operations with improved energy efficiency. The Centre is also focusing on the deployment of technology solutions such as copper on-set collector bars and line design improvements to reduce specific energy consumption across smelters.

Innovations in oil and coating during the reporting period focused on improving performance, durability and sustainability across industrial applications. Key developments included acid-resistant roofing sheets, hydrophilic blue and gold coatings for air-conditioning fins, soluble coolants for CNC machining, profile cutting oils for extrusion operations, and a new range of biodegradable hydraulic fluids across multiple viscosity grades.

We conducted advanced research on circularity, quality and environmental performance for copper products. These included the substitution of limestone with waste gypsum sludge in Mitsubishi C Furnace operations, improvements in cathode quality aligned with refinery and CCR service level agreements, reduction of copper losses and weak acid generation in smelters, development of processes for nickel recovery from effluents, and production of clean gypsum for downstream board applications. These process enhancements supported the production of premium-quality copper cathodes, reinforcing our position in high-quality copper products.

We also continued to implement Life Cycle Assessment (LCA) across refinery and downstream operations to better understand and manage environmental impacts across the product life cycle. Insights from these assessments are used to inform process design, material selection and efficiency improvement initiatives, ensuring alignment with sustainability and performance expectations.

At Novelis, process innovation during the year was directed towards the improvement of metal yield and casting productivity. Furthermore, shaped bottom block technology was validated at production scale at the Pinda and Yeong Ju plants. Combining specially designed sheet ingot geometries with adapted hot-rolling practices, the

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technology consistently delivered an approximately 0.5% improvement in recovery at hot mill. Concurrently, the introduction of APEX casting technology at the Latchford plant increased casting speeds from 72 mm/min to 82 mm/min and reduced scalping requirements, contributing to improved recovery and stronger operating performance.

Reduction in Net Carbon Consumption through Alumina-Coated Anodes

Challenge: Carbon consumption is a major cost and sustainability driver in aluminium smelting, with net carbon consumption (NCC) directly influencing operating efficiency and emissions intensity. To improve anode performance and reduce overall carbon losses during electrolysis, we spearheaded an initiative to lower NCC while enhancing pot productivity across our smelter operations.

Initiative: We developed a special alumina-based protective coating and applied it to baked, rodded anodes to reduce surface oxidation during electrolysis. A dedicated anode-coating station was designed and installed at the Anode Rodding Shop, where the coating is uniformly applied under controlled conditions and subsequently dried prior to

potroom usage. Selected pots were identified for trial operation using coated anodes, and performance was closely monitored against reference pots, with evaluation based on butt weight, net carbon consumption and productivity metrics.

Outcome: The initiative delivered a reduction of 4-5 kg/T of aluminium in NCC, along with an increase in pot productivity of approximately 0.2 kg per pot per day and improved anode butt performance. During FY 2025-26, the initiative generated net hot-metal cost savings of ₹80 per tonne, reinforcing both economic and sustainability outcomes.

Aluminium Extrusions for Automotive Front and Side Crash Components

Initiative: We undertook a focused development programme to create automotive crash-grade aluminium alloys (20-C and 24-C) and high-strength alloys (28-S and 30-S) for front and side crash components. The objective was to achieve improved yield strength, elongation and bendability, while ensuring reliable performance in complex multi-hollow extruded profiles.

The initiative involved modifying alloy chemistry and heat-treatment routes to control grain recrystallisation

and growth, alongside specialised die designs to minimise peripheral coarse grains and enhance seam-weld strength. HIC-Semifab in collaboration with plant unit teams optimised extrusion and quench parameters to retain favourable microstructures, and tailored ageing treatments were developed to improve bending behaviour. Performance was validated through numerical simulations and industry-standard quasi-static and dynamic crash tests, enabling the development of material CAE cards for crash simulations.

Outcome: HIL-20-C and HIL-24-C alloys were successfully qualified for crash profile development with multiple automotive OEMs in India and Europe, strengthening Hindalco's position as a supplier of safety-critical aluminium extrusion solutions.

Nickel Recovery from Refinery Electrolyte Bleed

Challenge: In copper concentrates, nickel progressively accumulates in anodes during smelting and refining and subsequently dissolves into the electrolyte during electrorefining.

Initiative: We developed a technically and economically viable process for recovering nickel from de-copperised refinery electrolyte bleed streams containing approximately 5 g/L of nickel.

Outcome: We successfully completed lab-scale optimisation of the nickel recovery process and finalised a nickel carbonate recovery scheme for adoption in the Copper V project. The work culminated in the grant of a patent.

Sustainable Recycling of ETP Sludge in Copper Converting Operations

Initiative: To aid the recycling of ETP sludge generated from copper operations, a programme aimed to partially replace limestone chips used as flux in the Continuous Copper Converting Furnace. By substituting up to 50% of limestone with gypsum, it aimed to reduce CO₂ emissions by up to 7,500 TPA, while providing a sustainable, in-process solution for solid waste utilisation.

A structured process pathway was developed to enable safe and controlled reuse of the material. ETP sludge intended for recycling was segregated and dried in secured landfills to reduce free moisture. The dried sludge was transferred for granulation using a suitable binder, followed by controlled drying to achieve free moisture levels below 2%. The dried gypsum granules were subsequently shifted to the smelter flux storage area and introduced into the Copper Converting Furnace at predetermined limestone replacement ratios, with close monitoring of furnace stability and metallurgical performance.

Outcome: Pilot-scale trials successfully demonstrated the recycling of 310 tonnes of dry ETP gypsum sludge into the Copper Converting Furnace. Furnace performance remained stable, with all process and operational parameters maintained within acceptable limits.

Development and Deployment of Acid-Resistant Coatings for Industrial Roofing Applications

Challenge: Industrial facilities operating in chemical, fertiliser, metal processing and similar sectors are often exposed to highly corrosive environments characterised by acidic

fumes, vapours and occasional chemical spills. Prolonged exposure to such conditions can significantly reduce the service life of roofing systems, compromise structural integrity and lead to frequent maintenance interventions and unplanned shutdowns.

The objective of the initiative was to create durable, high-performance coatings capable of withstanding acidic corrosion, thereby extending roof life, protecting underlying substrates and reducing lifecycle maintenance costs.

Initiative: The development programme began with detailed assessment of corrosive exposure conditions and performance requirements specific to industrial roofing applications. Based on these inputs, specialised acid-resistant coating formulations were developed using advanced resin and additive technologies. Laboratory evaluation focused on key performance parameters, including chemical resistance, adhesion and long-term durability under simulated service conditions representative of actual operating environments.

Outcome: During FY 2025-26, the initiative successfully delivered and deployed acid-resistant roofing coating solutions at pilot scale.



Formulating High-Impact Products & Breakthroughs

We continue to strengthen our innovative capability by translating deep scientific expertise, process knowledge, and collaborative innovation into high-impact products and breakthroughs across alumina, aluminium, copper, downstream manufacturing, coatings; and Novelis' global portfolio. These developments reinforce our shift towards value-added, sustainable, and high-performance material solutions.

Product development efforts across the alumina value chain translated into multiple grades being accepted by customers, including MHV20 for composite panel applications, SF300 for polymer insulators, and IC03 for glass manufacturing applications. We found success in the development of UFB 1500, HCA5, HCA10, SMA1, and 4N high-purity alumina, while multiple products advanced to the pilot stage, including SMA2, HCA2, UFB1000, UFB1500, and spherical alumina grades.

We successfully developed two grades of Boehmite at pilot scale for lithium-ion battery separators and cathode edge-coating applications, supporting the growing domestic and global EV ecosystem. The portfolio was further strengthened with super-reactive 3N alumina grades for advanced technical and electronic ceramics, alongside the lab-scale development of high-purity 4N alumina targeting semiconductor and sapphire applications.

Innovation in engineered alumina also progressed during the year, supported by the development of spherical alumina through external technology collaboration for thermal conductive filler applications. In addition, coarse specialty alumina, HCA10, was designed to meet stringent spark-plug performance requirements.

Our product innovation efforts continued to expand high-performance aluminium applications across automotive, electrical, consumer electronics and precision manufacturing segments. During the year, we developed automotive crash-grade aluminium alloys, 20-C and 24-C, for extruded crash components, supporting evolving safety and lightweighting requirements.

We also completed process and product qualifications for smartphone enclosures, 6201-T4 high-strength wire rods for electrical applications, and specialised extrusion alloys with controlled surface microstructures



Anode baking section at Aditya aluminium plant

for two-wheeler front fork tubes. Further, the development of DC-cast foilstock alloys and rolling processes for ultra-light-gauge foil below 6 µm reflects our capabilities in precision manufacturing and advanced rolling technologies. These initiatives strengthen our portfolio across mobility safety systems, consumer electronics, power transmission, precision foils and advanced thermal management applications.

Advanced two-coat hydrophilic blue and gold coatings were developed for air-conditioning fins, alongside acid-resistant coatings for industrial roofing applications. Process reliability improvements included the development of non-staining work-roll bearing oil by Hirakud FRP to prevent surface staining and seal degradation during aluminium rolling. In addition, soluble and synthetic coolant oils were developed for the Chakan and Silvassa plants, thereby improving machining performance, tool life, and shop-floor efficiency.

At Novelis, a major highlight included the successful market introduction of RC170, a high-recycled-content automotive alloy launched in Europe and Asia, which received multiple global awards for eco-design and sustainability excellence. In beverage packaging, Novelis advanced BPA and PFAS-free coating solutions for can ends. It also developed a laminated can end sheet technology using coloured PET films, delivering lower solvent use, reduced energy consumption, and improved safety. Specialty applications saw the development of AA3105 H49 high recycled content alloys for roller shutter systems and a new heat-exchanger core alloy that reduces prime aluminium usage from 40% to below 10%, significantly lowering Scope 3 emissions. In aerospace, Novelis progressed its high-recycled content alloys for aircraft wing ribs, demonstrating the feasibility of closed-loop recycling for highly demanding aerospace applications.

Application Studies on Alumina Milling Behaviour for Spark Plug Applications

🔗 **Initiative:** With evolving performance and reliability expectations in automotive spark-plug ceramics, we undertook detailed application studies to evaluate the suitability of our alumina grades for this specialised electro-ceramic segment. The objective was to understand how alumina morphology and milling behaviour influence sintering performance, dielectric strength and manufacturing consistency, enabling entry into a new high-end application area.

We conducted application studies in alignment with customer-provided formulations, evaluating multiple calcined alumina grades for powder packing, green density, densification behaviour, microstructure development and dielectric strength. Based on the evaluations, we established a new process route to produce a tailored milled alumina grade, HCA3SG, with controlled mineraliser addition to achieve the desired crystal morphology. We also optimised milling time and feed alumina characteristics to maximise densification and electrical performance.

➡ **Outcome:** The HCA3SG grade demonstrated superior performance across both formulations, achieving dielectric strength above 50 kV/mm, fully meeting customer specifications. The material was approved for plant-level evaluation, marking our successful entry into a new specialty ceramic application segment.

Application of Calcined Alumina as a Zircon Substitute in Investment Casting

💡 **Challenge:** Rising cost pressures, supply risks and sustainability considerations in investment

casting created an opportunity to reduce reliance on zircon without compromising casting quality or process stability. We undertook an application-led study to assess calcined alumina as a viable alternative in high-temperature investment-casting systems used for critical automotive and electrical components.

🔗 **Initiative:** We carried out structured trials by progressively introducing calcined alumina, beginning with blended compositions and advancing to 100% zircon replacement. Multiple alumina grades were evaluated based on phase composition, particle-size distribution, purity and batch consistency. Key process parameters including slurry solids content, viscosity, wetting behaviour, stucco selection, drying characteristics, dewaxing and firing cycles were systematically optimised. Detailed material characterisation using SEM-EDAX, PSD and XRF enabled direct comparison with zircon-based systems and resolving the initial settling and coating challenges.

➡ **Outcome:** The study successfully validated FG20 alumina for 100% zircon replacement while maintaining dimensional accuracy and surface quality.

Development of Boehmite for Battery Separator and Cathode Edge Coating Applications

🔗 **Initiative:** As performance requirements across lithium-ion battery separator and cathode edge coating applications evolved, we developed Boehmite, an alumina monohydrate, as an advanced material platform. It also has uses as a catalyst, flame retardant and a thermal conductive filler.

With successful laboratory scale development, the development programme progressed from

laboratory validation to pilot-scale implementation, with a dedicated pilot facility at our Belagavi plant, successfully commissioned in FY 2025-26. The pilot resulted in the establishment of two Boehmite grades: UFB1000 and UFB1500, at bulk pilot scale. These products have since been fully characterised and are currently under customer evaluation for lithium-ion battery and allied applications.

➡ **Outcome:** The initiative has been a significant step in expanding our portfolio of Super Value-Added Products (SVAPs) while building in-house capability for advanced material development and scale-up. It enables our entry into battery and electric mobility value chains.

Development of Super-Reactive 3N Alumina Grades (SMA1 and SMA2) for Advanced Technical and Electronic Ceramic Applications

🔗 **Initiative:** We developed super-reactive 3N alumina grades with soda content below 300 ppm and 100 ppm, expanding beyond our existing specialty alumina portfolio, which previously comprised reactive alumina grades with soda levels exceeding 600 ppm. Achieving such low soda levels is critical for electronic and semiconductor applications, as impurities directly influence electrical insulation performance, sintering behaviour and long-term reliability.

Super-reactive alumina with extra-low soda content exhibits high thermal reactivity, enabling easier sintering at lower temperatures and supporting dense, defect-free ceramic microstructures.

➡ **Outcome:** We successfully developed SMA1 (ultra-low soda, <100 ppm) at laboratory scale and SMA2 (extra-low soda, <300 ppm) at pilot scale. Samples of both grades are currently under customer evaluation.

Development of Extrusion Alloy and Heat-Treatment Process for 2-Wheeler Front Fork Tubes

🔗 **Initiative:** Front fork tubes for two-wheelers are safety-critical components that demand stringent control over surface quality, mechanical performance and anodised appearance. One of the key challenges in such applications is the presence of Peripheral Coarse Grain (PCG) and inclusions in extrusion billets, which can lead to cosmetic defects such as streaks after machining and anodising. Traditionally, these requirements were addressed using imported billets.

To reduce import dependence and improve in-house capability, we initiated a focused programme to develop extrusion alloys and heat-treatment processes with improved control over surface microstructure and inclusion levels. The initiative aimed to match and eventually exceed the performance of benchmarked imported billets.

HIC-Semifab carried out detailed material characterisation using optical microscopy, SEM and PoDFA analysis to understand critical phases and dispersoid behaviour in imported billets and compare them with in-house material.

➡ **Outcome:** During FY 2025-26, one extrusion profile was successfully qualified using Hindalco billets, with multiple additional profiles under evaluation. The latest trials indicate performance superior to imported billets, enabling gradual import substitution and strengthening our position in two-wheeler mobility applications.

Development of Two-Coat Hydrophilic Gold Coating System for Air Conditioner Fin Applications

🔗 **Initiative:** The performance and durability of aluminium fins used in air-conditioning units are strongly influenced by surface properties, particularly corrosion resistance and water drainage behaviour, both of which directly impact heat-exchange efficiency and product life.

We initiated the development of a two-coat hydrophilic gold coating system specifically designed for air-conditioner fin applications. The objective was to enhance corrosion protection, improve hydrophilicity and support reliable long-term performance for HVAC applications, while meeting OEM-defined functional and aesthetic requirements.

➡ **Outcome:** The developed system comprises two functional layers—a gold-coloured base coat engineered to improve corrosion resistance and adhesion to aluminium fins, followed by a hydrophilic top coat designed to promote uniform water film formation and rapid drainage. This combination supports efficient condensate flow, reduces water droplet formation and minimises corrosion-related degradation during service.

Co-Creating Innovation through Strategic Collaborations

Our innovation ecosystem comprises a robust network of collaborations with leading academic institutions, research laboratories, technology providers, and internal centres of excellence. During FY 2025-26, these

partnerships played a pivotal role in new product development, process innovation, and enabling the adoption of next-generation technologies across alumina, aluminium, copper, and downstream businesses. By

combining in-house expertise with external scientific and engineering capabilities, we continued to translate collaborative research into tangible operational and market outcomes.

Institution

IIT Madras

CSIR-CGCRI, Kolkata

Nippon Sanso and Chugai Ro

Joint projects with NICERA, Coimbatore

NETZSCH, Germany

BITS Pilani, Goa Campus

IIT Kharagpur

Dundee Sustainable Technologies, Canada and Glasslock

Collaboration Focus

Development of Aluminium Nitride, a high-value material for advanced electronic and thermal management applications

+ Under active development

Application studies of alumina in glass manufacturing processes

+ To expand Hindalco’s footprint in specialised industrial applications

Advanced the development of spherical alumina

+ At an advanced stage. Caters to thermal management and electronic applications.

Ready-to-press alumina for improved processability

Explored the production of narrow particle-size-distribution alumina using steam jet classification technologies enhancing consistency and performance in high-end applications.

Reducing arsenic, bismuth, and antimony levels in electrolytes and cathode products, while simultaneously supporting bleed reduction in refining operations.

Controlled-atmosphere pyrometallurgical experiments to evaluate alternative fluxes for the C-Furnace in the Mitsubishi smelting process, enhancing metallurgical flexibility.

Supported laboratory-scale studies for arsenic removal and the development of zero hazardous waste solutions

We also partnered with premier academic institutions to address emerging mobility and safety requirements. Joint work with IIT Madras and IIT Bombay focused on a hybrid manufacturing approach for electric vehicle motor housings, enabling design optimisation and material efficiency. Collaboration with IISc Bangalore supported the development of dynamic testing methodologies for automotive crash applications, strengthening our capabilities in safety-critical lightweight components.

Collaborative efforts during the year remained central to advancing indigenous technology and decarbonisation objectives across operations. In partnership with ABSTC we led the development of an indigenous digital pot control system at the Hirakud smelter, enhancing process stability and reducing dependence on external technology providers. Additionally, an inter-divisional collaboration between HIC Aluminium and HIC Alumina supported plant-level initiatives to achieve lower net carbon consumption through anode coating processes, contributing to decarbonisation of smelting operations.

At Novelis, collaboration during the reporting period was enabled through organisational and digital integration. R&D established a Single Agenda aligned with regional Single Operating Agendas, improving transparency and cross-functional coordination across the global organisation. The rollout of Accolade as a technical project management platform across regions including MEX, NE, NSA, R&D, and the 3×30 office significantly enhanced

collaboration, governance, and visibility across innovation projects. These steps lay the foundation for a more integrated, end-to-end innovation model, with further expansion planned in the coming year.

Collectively, these collaborative initiatives underscore belief that complex challenges are best addressed through co-creation and trust.

Development of Spherical Alumina for Thermal Conductive Filler Applications

🔗 **Initiative:** Rising demand for efficient thermal management materials across electronics, automotive and coatings applications has increased the need for advanced fillers with superior heat-dissipation performance. Spherical alumina, characterised by its uniformly rounded morphology, enables dense packing within composite matrices, creating efficient heat-conduction pathways and delivering higher thermal conductivity than conventional irregular shaped alumina powders.

To address these evolving market requirements, we initiated the development of spherical alumina as a Super Value-Added Product (SVAP), with a strategic focus on entering thermal interface materials and functional filler applications.

» **Outcome:** As part of this programme, three spherical alumina grades with median particle sizes of approximately 5 µm, 50 µm and 70 µm were successfully produced using our specialty alumina as feed material. These grades are undergoing validation at customer’s end.



Charting the Roadmap for Future-Ready Innovation

Our future R&D strategy is anchored in building scalable technological capabilities, self-reliance, and expanding sustainable materials. Across businesses, R&D priorities are increasingly focused on capacity creation, advanced materials development, circularity-led solutions, and capability building. A key area of focus is the expansion and strengthening of upstream capabilities through capacity development and process excellence. This includes the conceptualisation and basic engineering of a new alumina refinery at the Samri location, alongside continued technology and equipment-related support to the Aditya Alumina Refinery to optimise performance and enhance readiness. As raw-material characteristics continue to evolve, systematic bauxite processability studies for all new bauxites entering our refineries will remain a strategic priority to safeguard productivity and extraction efficiency. Efforts are underway to establish Aluminium Nitride as a new value-added material for high-performance electronics and advanced ceramics. This year, leadership team has given new challenging programme to develop inhouse 300 kA potline technology. This future-ready innovation can help upgrade old smelters in the future.

To translate these strategic priorities into measurable outcomes, we are strengthening the R&D ecosystem through targeted capability-building initiatives. These include augmenting scientific capacity through focused hiring, enrolling high-potential scientists under the Technical Career Path (TCP) programme for deep specialisation, and delivering structured training through the Hindalco Technical University. Future R&D initiatives are shaped by circular economy principles, advanced metallurgy and expansion into emerging applications. Focus areas include building pyrometallurgical expertise for recycling, supported by the creation of laboratory and pilot-scale infrastructure that lays the foundation for recycling-led growth. Concurrently, dedicated research facilities are being developed for new product platforms such as Inner-Grooved Tubes and advanced alloys for specialised applications, supported by strategic collaborations with national and international partners to accelerate technology incubation and knowledge transfer.

Execution of these strategies is enabled through systematic development of research infrastructure, including new laboratories and pilot plants, together with capability enhancement through advanced computational tools such as CFD-based modelling collaborations. A well-defined technology roadmap aligns near-term research initiatives with long-term strategic ambitions, ensuring continuity from concept to commercial deployment.

Future Strategies for Research and Development at Novelis

Product	Continue to drive the development of high-recycled content alloys and solutions for all our end segments (Beverage Packaging, Automotive, Aerospace, Specialties) and support the adoption of these new products by our customers through the joint execution of specific demonstrator / prototype trials
Process	Focus on core process technology development to develop innovative cost-effective processes that will give Novelis the industry lead in the rolling and recycling field
Support	Provide best-in-class-class technical assistance to our Plants (optimising processes efficiency) and to our Customers (optimising product performance)
People	Ensure more cross-functional exchanges for our technical talents to develop an holistic understanding of the technical challenges (R&D, Sales, Operations)

Lab-Scale Development of High-Purity Alumina (4N Grade) for Semiconductor and Sapphire Applications

🔹 **Initiative:** We initiated the laboratory-scale development of 4N-grade (99.99%) high-purity alumina as part of its specialty alumina innovation programme.

As part of this programme, a pre-calcined alumina feed was initially prepared at bench scale through an external agency using technology support provided by the ABSTC. Building on this feedstock, Hindalco Innovation Centre–Alumina (HICA) conducted systematic calcination and milling trials to achieve the targeted alumina purity of 99.99%, along with the required surface area and sub-micron particle size distribution.

➡ **Outcome:** The developed high-purity alumina was benchmarked against established competitor materials and subsequently shared with customers for technical evaluation. In FY 2025-26, the newly

established laboratory-scale process demonstrated strong capability to consistently produce alumina meeting 4N-grade quality requirements.

This development establishes a foundation for progressive advancement towards higher-purity and application-specific alumina grades aligned with future technology and market demand.

Magnetic Compensation Loop (MCL) Pilot Implementation at Mahan Smelter

♥ **Challenge:** As aluminium smelters move towards higher amperage operation to improve productivity, maintaining pot stability and energy efficiency becomes increasingly critical. At elevated amperages, unbalanced electromagnetic forces can disrupt metal pad stability, increase electrical resistance and adversely affect current efficiency.



Cyber Resilience tabletop Exercise conducted at our corporate office in Mumbai

🔹 **Initiative:** To enable stable, energy-efficient, high-amperage operation, Hindalco implemented a Magnetic Compensation Loop (MCL) at the Mahan smelter. The initiative aimed to demonstrate energy savings through improved magnetic balance and to develop a roadmap for future amperage ramp-up beyond 400 kA with lower specific energy consumption.

Computational study was undertaken by the Aditya Birla Science and Technology Centre (ABSTC), covering electromagnetic modelling, conductor design, busbar integration, civil supports, insulation philosophy and mechanical-thermal stability. Based on this study, we implemented the MCL on a pilot section comprising 10 pots at the Mahan potline, with an optimised conductor layout and power configuration.

➡ **Outcome:** The pilot implementation demonstrated energy savings of approximately 212 kWh per tonne of aluminium, while enabling a stable increase of 7 kA in operating amperage in the pilot pots. Importantly, the trials also established strong in-house capability to design, implement and optimise magnetic compensation solutions, creating a robust foundation for broader deployment.



Information Security and Cyber Resilience

Our digital transformation journey is underpinned by an uncompromising commitment to information security and cyber resilience. Governed by our [Information Security Policy](#), the Information Security Management System (ISMS) provides a structured framework to safeguard our digital ecosystem while proactively addressing an evolving threat landscape through advanced technologies, robust security processes and continuous awareness initiatives.

Under the guidance of our Chief Digital Information Officer (CDIO) and Chief Information Security Officer (CISO), we align our cybersecurity practices with global standards. In alignment with best practices, we continue to follow the NIST cybersecurity framework, supported by Cyber Maturity Assessments (CMA) to periodically evaluate the effectiveness of controls and identify improvement opportunities. Our digital risk framework is further strengthened through independent reviews by external firms, covering the Business

Continuity Management System (BCMS) and broader risk-management practices. These reviews enhance organisational resilience and ensure readiness to manage potential disruptions in a structured and timely manner.

A central pillar of our cybersecurity architecture is the Cyber Defence Command Centre (CDCC), which serves as a unified monitoring and incident-response hub. All critical servers and IT infrastructure have been onboarded onto the CDCC, enabling 24x7 surveillance, real-time threat detection and rapid response to incidents. Structured escalation mechanisms enable employees to report cybersecurity incidents, vulnerabilities, or suspicious activities in a timely manner. This is supported by a comprehensive IT risk register that documents key risks, potential impacts and corresponding mitigation measures. The register enables systematic tracking, governance oversight and timely closure of identified risks, strengthening the overall cyber resilience.

Our ISO 27001-certified IT infrastructure provides a recognised baseline for information security management as we continue to strengthen our cyber resilience through independent assurance and proactive risk management. Semi-annual vulnerability assessments and penetration tests conducted by external auditors enable early identification of vulnerabilities, timely remediation and continuous improvement of our security controls. Periodic internal audits are conducted to assess the effectiveness of information security controls, supported by a skilled and dedicated internal audit pool to ensure robust audit execution.

To strengthen the overall information-security posture, several new initiatives and technologies have been adopted across IT and OT environments. Data privacy



Cyber Security training at Aditya Location

measures have been implemented to ensure secure handling of sensitive and personal information in line with regulatory requirements. We have adopted a structured approach to align with the requirements of the Digital Personal Data Protection Act (DPDPA) through key privacy initiatives. We conducted a Hawk Eye assessment to identify gaps and define a remediation roadmap for strengthening data protection controls. We have also established a Record of Processing Activities (ROPA) to enhance visibility and governance over personal data processing. Additionally, we have implemented a cookie consent management mechanism across external-facing websites to ensure end-user transparency and regulatory compliance. These efforts collectively reinforce our commitment to robust privacy governance and compliance readiness.

Micro-segmentation has been deployed to minimise lateral movement within the network, reducing the impact of potential security incidents. Local Administrator Password Solution has been implemented to manage and secure local administrator credentials,

significantly reducing the risk of privilege misuse. Endpoint encryption has been enabled to protect data at rest, and in OT environments, advanced security solutions has been deployed to enhance visibility, monitoring and threat detection for industrial systems.

Beyond technology and controls, we continue to take cognisance of the critical role people play in strengthening cyber resilience. Ongoing communication and awareness initiatives are designed to embed responsible digital behaviour and reinforce vigilance across functions, complementing technological safeguards. As part of this effort, the Cyber Suraksha Abhiyaan awareness initiative is conducted to enhance user awareness regarding emerging cyber threats, Gen AI, Data Privacy and promote secure digital practices across the organisation. The programme included structured awareness and training activities such as online courses, infographics, screensaver online sessions, newsletters and engagement initiatives to reinforce the importance of information security, safe handling

of organisational data and adherence to cybersecurity best practices. In addition, cybersecurity simulation campaigns were undertaken to assess user preparedness, strengthen threat identification capabilities and improve response behaviour against real-world cyberattack scenarios. Insights from these exercises enabled identification of awareness gaps and supported targeted improvements, further strengthening organisational cyber resilience. The initiative also reinforced the principle of shared responsibility for cybersecurity and contributed to building a proactive security mindset across employees, enhancing the overall security posture of the organisation.

Collectively, these measures have helped us maintain secure, stable and reliable IT operations. We remain committed to continuously strengthening our digital resilience, safeguarding information assets and building a trusted, future-ready IT environment that supports business continuity, innovation and long-term value creation.

During the year, one data breach was recorded. However, it did not involve any customer data. The data breach occurred in the third party's system, leading to the exposure of data of our employees. The incident originated from the third-party systems and involved neither any compromise of our internal IT infrastructure nor any system critical to our core operations. The incident has already been reported to CERT-In and the matter continues to be monitored in co-ordination with the third party.

Cyber Crisis Management and Organisational Preparedness

📌 **Initiative:** We initiated a Cyber Crisis Management (CCM) programme to strengthen organisational resilience against high-impact cyber events.

It was implemented through a series of scenario-based tabletop exercises designed to simulate real-world cyber crisis situations. These scenarios included ransomware attacks, data breaches and IT/OT disruptions, each mapped to predefined CCMP playbooks. The exercises were conducted in a controlled, discussion-based format, where participants walked through roles, responsibilities, escalation pathways and decision-making steps as per the established crisis framework.

A series of tabletop exercises were planned as part of the programme. During FY 2025-26, the majority of these exercises were successfully conducted, involving CXO leadership, plant users, and IT teams. Each session was facilitated through structured moderation, with focused observation of response gaps and post exercise reviews to capture key lessons learned and define improvement actions.

➡ **Outcome:** The exercises significantly improved awareness and clarity around cyber crisis roles and responsibilities across stakeholder groups while strengthening collaboration between leadership, IT and plant teams. It reduced ambiguity in response actions and enhanced confidence in managing large-scale cyber disruptions. It helped identify gaps in communication flows, escalation timelines and dependency management, enabling proactive refinement of the Incident Response Plan & documentation of CCMP.

Insights from the exercises were documented and used to improve response procedures, escalation mechanisms and coordination models.

Responsible AI and Secure Use of Emerging Technologies

At Hindalco, the deployment of artificial intelligence (AI) and emerging digital technologies is guided by a strong commitment to responsible, secure and ethical use. Our “Secure Usage of Generative AI Technology” policy establishes clear guidelines to ensure data protection, minimise risks and promote accountable adoption of AI. Access to AI capabilities is governed through defined approval mechanisms and role-based controls, particularly in cases involving advanced or potentially sensitive applications. The use of external and open-source AI platforms is subject to prior approval, while enterprise-approved solutions are deployed within secure environments to limit exposure to data privacy and cybersecurity risks. We emphasise transparency and accountability in AI usage. Users are required to validate AI-generated outputs and exercise caution while sharing such content, ensuring that decisions informed by AI are subject to human oversight. Clear internal

guidelines reinforce responsible use and help distinguish AI-generated outputs in decision-making contexts, strengthening trust and informed usage across stakeholders.

To maintain reliability and performance, AI-enabled systems are implemented with continuous monitoring and validation practices. Periodic reviews, supported by governance mechanisms such as Architecture Review Board and Information Security oversight, ensure that models and tools remain relevant, accurate and aligned with business objectives. Fairness, data privacy and security form central pillars of our AI governance framework. The policy strictly prohibits the sharing of personal, confidential or sensitive organisational data including financial, customer and intellectual-property information on external AI platforms. Data used in AI systems is required to be anonymised and limited to the minimum necessary, mitigating risks of bias, misuse and unintended disclosures.

To ensure accountability, users and developers are held responsible for the outcomes of AI-assisted decisions, with defined escalation and approval pathways for exceptions. This structured governance approach enables traceability and provides mechanisms to review and address any unintended outcomes arising from AI deployments. Building organisational awareness remains a key priority. Through training and awareness initiatives, employees are trained on cybersecurity risks and responsible AI practices, fostering a culture of vigilance and informed adoption.

Collectively, these measures enable us to harness the benefits of AI while safeguarding data integrity, ensuring ethical deployment and reinforcing stakeholder trust in a rapidly evolving digital landscape.