Hydro

Contributing to a just and green transition

Our approach

Hydro White Papers

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This white paper explores Hydro's role when it comes to actions we can take to support a just and green transition. Many of the solutions for the climate emergency trigger multidimensional dilemmas, and we are increasingly becoming aware of how renewable energy solutions will always have an impact on people, nature, ecosystems services and land-use.

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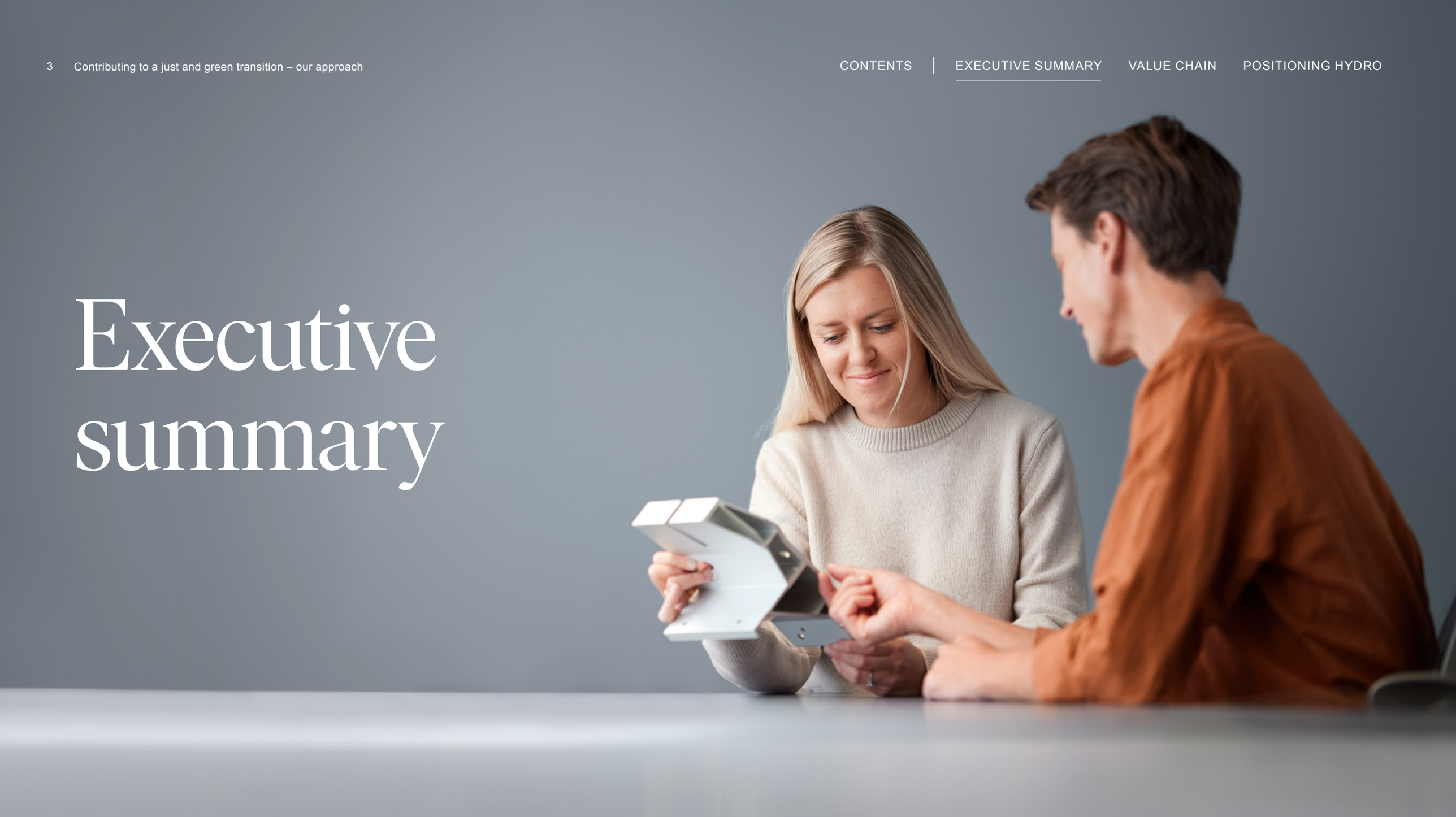
Executive summary



Executive summary

By 2050, it is estimated that the global population will exceed nine billion people, all of whom will have the right to be respected and have their basic needs met. However, under today's pattern of production and consumption, we are already exceeding our planet's ability to support the current global population. To be able to live within planetary boundaries today, and in the future, we must mitigate climate change, limit global warming to 1.5 degree, and protect natural systems. The societal changes needed for a low-carbon economy are transformative and businesses will play a critical role to drive change.

The combined challenge of rising social inequality, the nature crisis and the climate emergency is the interlinked sustainability dilemma that sits before us, and Hydro should always try to have a holistic approach. In an era marked by a deficiency in sustainable growth, we should also challenge our customers to understand that sustainability always means more than low carbon.

We will not solve the climate emergency unless we also protect and restore our nature, and reduce inequalities. In addition, the transition to a circular economy has become an essential concept for reconciling the objectives of economic growth and sustainable development, by decoupling production from resource depletion.

Against this backdrop, this white paper explores Hydro's role when it comes to the actions we can take to support a just, green transition. Many of the solutions for the climate emergency trigger multidimensional dilemmas, and we are increasingly becoming aware of how energy-intensive industry will always have an impact on people, nature, ecosystems services and land-use.

To create long-term value to all Hydro's stakeholders we have to adapt to the low-carbon economy – be carbon neutral by 2050 or earlier, contribute to a nature positive world and leave no one behind – based on circular business models.

Nature

We need nature to support a healthy society and underpin our global economy. It is estimated that more than 55% of the global GDP (ca. 58 trillion USD) is dependent on nature. In addition, nature is integral to delivering 14 out of the 17 global Sustainable Development Goals (SDGs). However, nature is now in crisis. Human activity has led to unprecedented rates of species extinction, and a significant decline in the global abundance of wildlife and natural habitat. This affects how responsible industrial companies should operate and take action to manage risks and impacts to nature linked to their operations and value chain. Multiple stakeholders are working to control nature related risks, with regulatory, finance and market expectations evolving rapidly. In 2022, the COP 15 of the Convention for Biological Diversity (CBD) agreed to a new Global Biodiversity Framework agreement that established global targets designed to halt and reverse nature loss by 2030, and put nature on a trajectory to full recovery from 2050. This global “Nature Positive” goal is a concept of regenerative nature, where the rate of nature loss and depletion we see today is reversed through increased conservation efforts, and more sustainable production and consumption.

Climate

Climate change has been an emerging trend for a long time, but the sense of urgency has increased dramatically over the past years. This has led to increased expectations and scrutiny towards companies to deliver tangible action to reduce emissions and deliver greener products. To limit global warming to well below 1.5 degrees and fulfill the Paris Agreement, business must play its part in collaboration with government and financing institutions to incentivize investment in new low-carbon technologies.

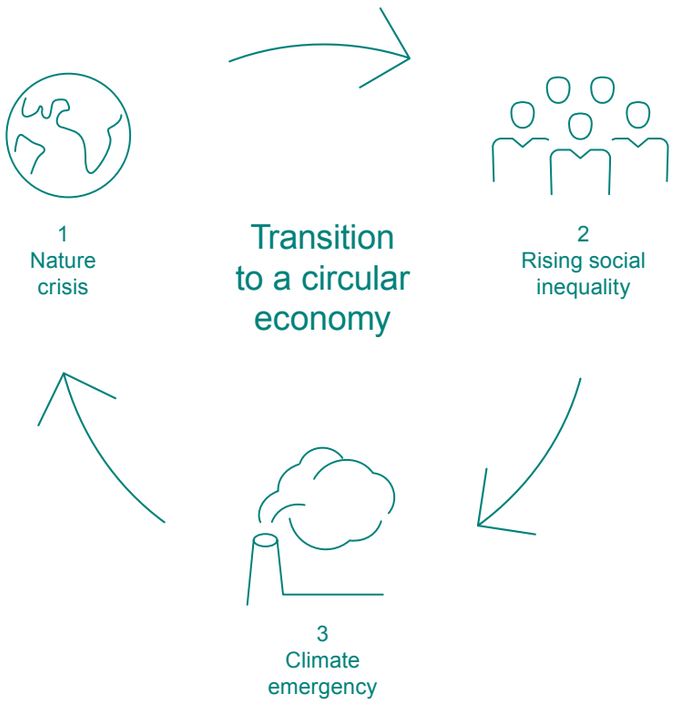
Social – impact on people

The nature crisis and climate emergency have an impact on people and livelihoods. Hydro must play its part to make the green transition a just one, providing decent jobs, supporting thriving and resilient communities, and ensuring social progress is not compromised by net-zero ambitions. At the core of our response lays our human rights due diligence, in our own operations as well as across the supply chain, our local community projects and skills initiatives.

Circular economy

The transition to a circular economy has become a theme more frequently discussed as a way to reconcile the objectives of economic growth and sustainable development by decoupling production from resource depletion, eliminating waste, and increased longevity of products. The overall aim is to eliminate waste and pollution, circulate products and materials at their highest value to avoid downgrading and regenerate nature, while facilitating innovation, collaboration, and new business opportunities. To achieve the target of nine billion people living well within planetary boundaries we must change the way we produce and consume.

Our dilemmas



It is now well understood that the nature, social and climate dilemmas are interconnected. Hence, integrating the nature crisis, social inequality and climate change into business strategy, is critical for any ompany today. Sometimes there will be trade-offs, other times, there may be reenforcing mechanisms between climate, nature and social.

The energy supply crisis has highlighted the challenges and dilemmas. Balancing renewable power development and the need to decarbonize society while preserving nature, protecting human rights and leaving no one behind raises the question of what is considered green or sustainable going forward.

Supplying the just and green transition with sustainable materials creates dilemmas that we in Hydro, with our extended value chain, have been working with for a long time. All products have a footprint and impact nature, climate, and people, regardless of the source. As this is becoming clearer to both civil society and our customers, we need to prove that our full sustainability footprint - from mine to end-consumer – is well managed. Some challenges and dilemmas are faced by the industry as a whole, regardless of the location of operations, others are more geographically dependent.

1
- Nature-positive, the new net-zero
- Deforestation-free products
- Ecosystem collapse
- Growth in communicable diseases
- COP 15: Putting a value on nature
- Demand for sustainable mining
- Historical legacies

2
- Inequality in the green transition
- Healthy planet a human right
- Indigenous rights
- Erosion of social cohesion, polarization
- Demographic imbalances
- Employment disruptions
- Changing nature of work

3
- Physical climate change
- Climate change mitigation
- Greener product expectations
- Energy transition technologies
- Definition of green energy

What is Hydro's role in the just and green transition?

Hydro's integrated aluminium value chain enables us to be a partner in our customers' and suppliers' journeys to deliver more sustainable products to the market. We do this by managing our climate, nature and social footprint. We develop ambitious roadmaps in line with global good practice, and build trust through transparency and reporting. This trust and transparency enable our customers to prove they deliver on their own sustainability ambitions and claims.

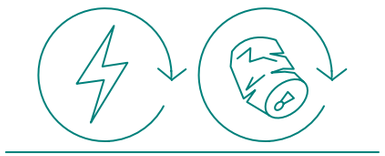
To be a supplier of materials and solutions that enable the just and green transition, we have developed roadmaps, targets and implemented concrete actions. Transparency along the value chain is key to achieve this as all industrial activity has a footprint and an impact that needs to be addressed and mitigated.

The Brundtland Commission (1987) defined sustainable development as meeting the needs of the present without compromising the ability of future generations to meet their own needs. For the past decades, Hydro has translated this statement into our business model. Sustainability in Hydro means to deliver the transparency and change required to mitigate the impact on climate, nature, and people to secure a green and just transition.

Within our roadmaps we address the key environmental and societal challenges and dilemmas that arise from our industrial activity on people, the climate, and on nature – and their interconnections.

Sustainability ambitions

Climate



Net-zero products and net-zero company by 2050 or before

Nature

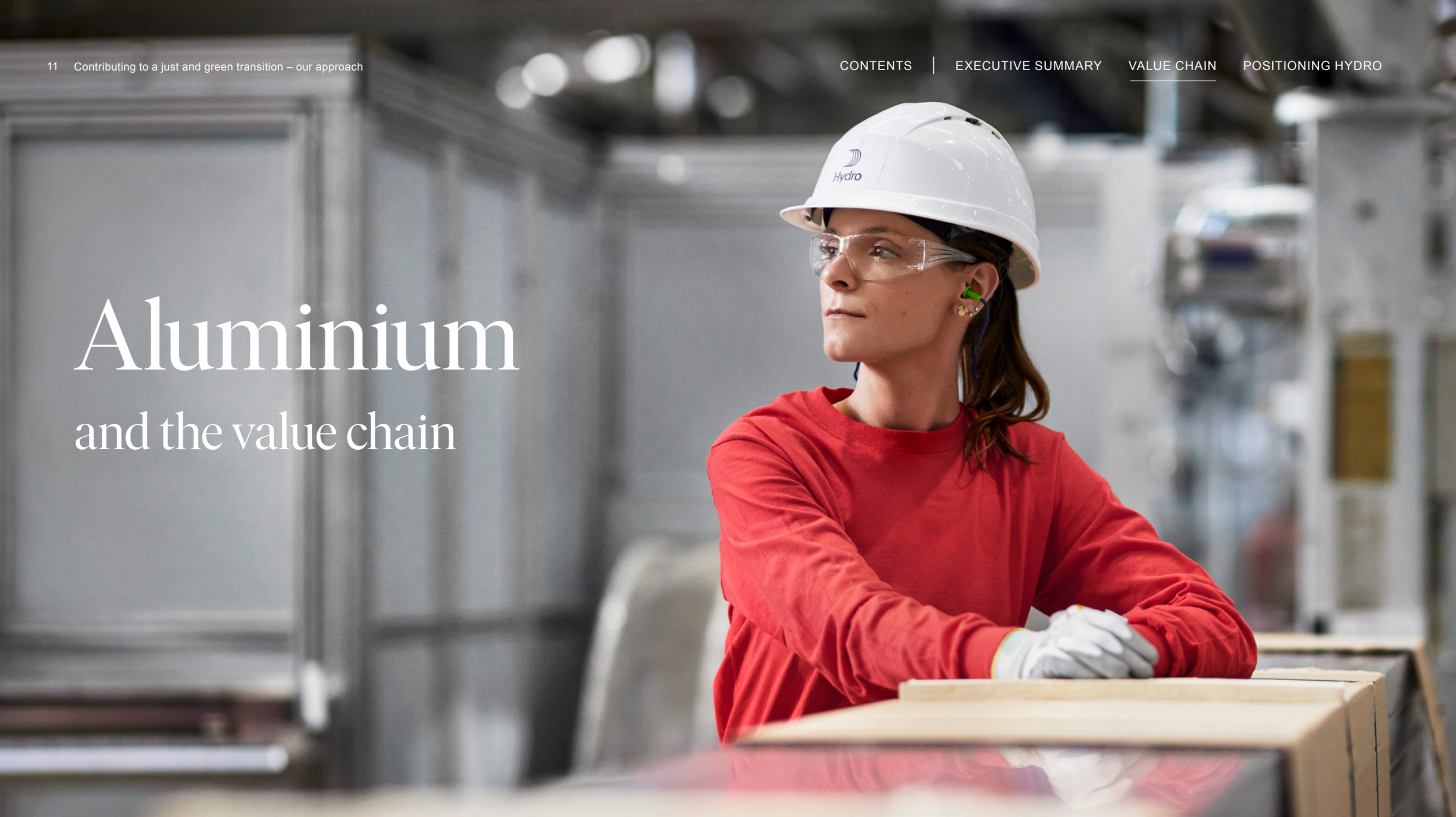
Protect biodiversity and reduce our environmental footprint

Social

Improve the lives and livelihoods wherever we operate

Aluminium

and the value chain



Aluminium and the value chain

Aluminium is an enabling material in the just and green transition. Aluminium plays an important role in lightweighting transportation, various components for solar and wind energy, batteries, building and construction, and high-voltage cables and power grid infrastructure. This will lead to an increased demand for aluminium going forward that needs to be met by low-carbon aluminium produced in a way that contributes to a nature positive world and a just transition.

Product qualities and roadmap to net-zero make aluminium key for the green transition

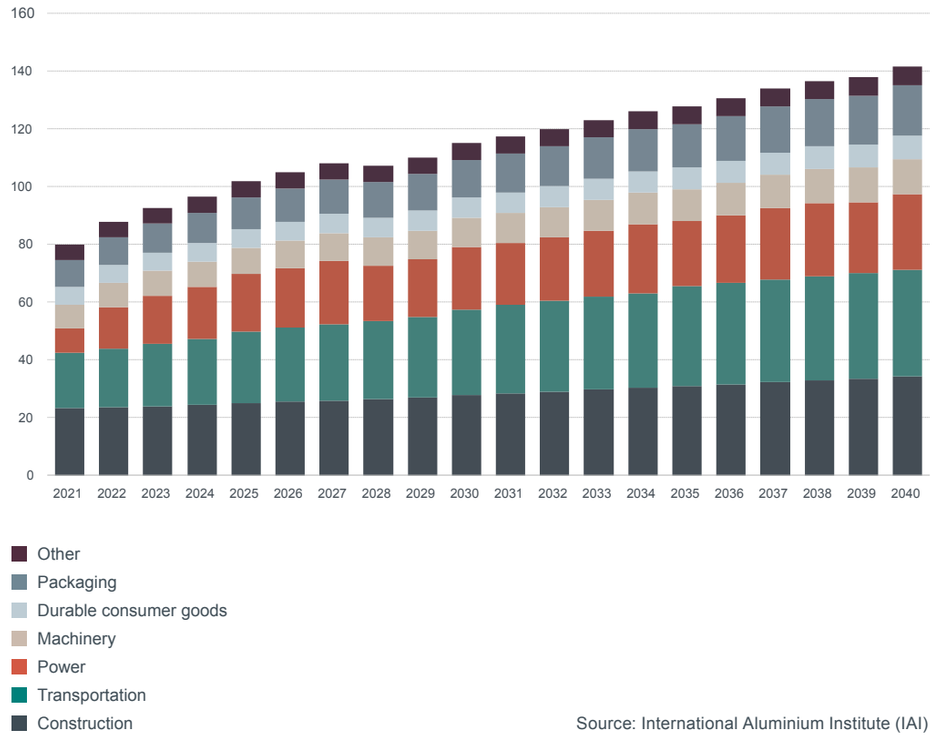
- ☑ Key **properties** of aluminium match requirements – lightweight, conductive, corrosion resistance
- ☑ **Infinitely recyclable** with low energy need and high resource efficiency
- ☑ Aluminium based on renewables has significantly **lower footprint** than the global average
- ☑ Aluminium has a **clear roadmap** to net-zero emissions [1]

[1] Source: International Aluminium Institute (IAI), https://international-aluminium.org/resource/aluminium-sector-greenhouse-gas-pathways-to-2050-2021/

Importance of aluminium within key green transition technologies

PV	●
Electric vehicles	●
Wind power	◑
Electricity networks	●
Concentrated solar	●
Hydropower	◑
Bio-energy	◑
Hydrogen	◑
Nuclear	◔
Geo-thermal	◔

Sectoral aluminium demand 2021–2040
Million metric tons



Source: International Aluminium Institute (IAI)

Case study

Aluminium in the low-carbon economy

Aluminium's light weight and conductivity makes it a great material for electrical applications – both in infrastructure applications such as power lines and in smaller applications such as cars.

Aggressive environments accelerate the effects of corrosion – and copper is not immune to corrosion. Aluminium is self-protected by a stable oxide layer and, when following some simple design guidelines, its corrosion resistance is superior. By nature, it is immune to formicary corrosion and holds up in a variety of environments.

Read more
How we can substitute aluminium for copper in the green transition (shapesbyhydro.com)
Substituting copper with aluminium (shapesbyhydro.com)

Flexibility. Aluminium is easy to extrude, which means that all kinds of complex shapes can be produced. This cannot be done with other metals. For example, micro-channel tubes can only be extruded in aluminium, not in copper.

Lighter weight. Aluminium tubes and heat exchangers weigh just half as much as the copper equivalent, providing a substantial reduction in system cost.

Thermal performance. For fin-and-tube heat exchangers, there is no measurable difference in functional performance between aluminium and copper tubing. The limiting factor is the heat transfer coefficient between the air and fins.

Case study

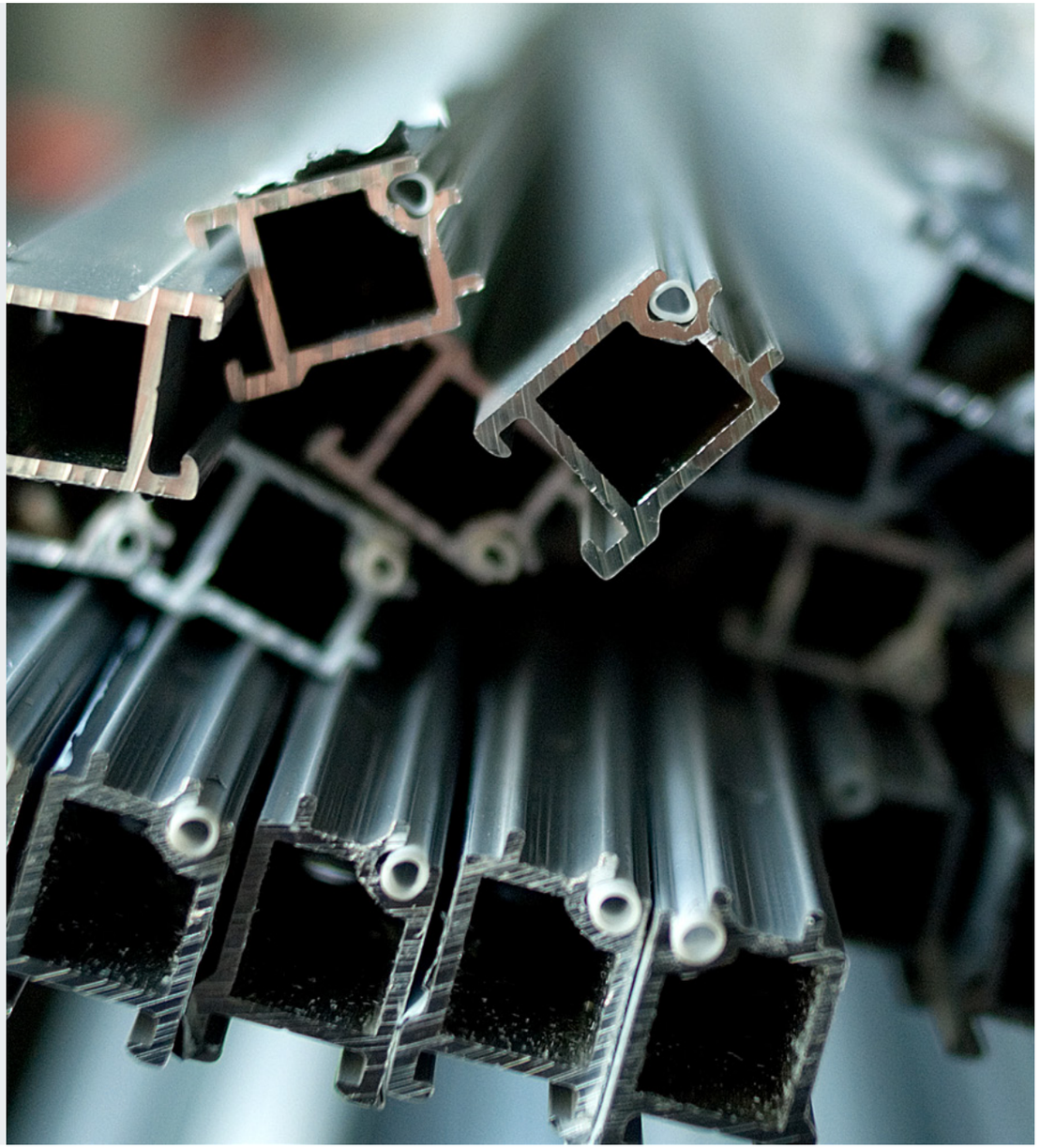
Aluminium in windows

Choosing materials for your next window is based on much more than aesthetics. The energy efficiency, recyclability and end-of life of aluminium makes it a very attractive material for windows.

Systems materials compete on price, durability, flexibility, aesthetic value, energy efficiency and end-of-life handling, including recyclability. Energy efficiency is key, because the frame of a window can greatly affect its energy efficiency. The polyamide thermal break inside the aluminium window frame gives it the properties to compete with PVC in energy efficiency.

Another aspect when choosing material for your window is the durability and replacement frequency. An aluminium window requires low maintenance, and it will not rot or warp. At the end of its lifetime it can be recycled into another window without the aluminium loosing its properties.

Read more
Why you should choose aluminium for your window (shapesbyhydro.com)



Case study

Lightweighting cars

Aluminium in cars can both reduce the use-phase emissions from the tail-pipe and the embedded footprint for manufacturing the car over it's life-cycle. Studies have shown that replacing steel with aluminium in cars can reduce CO_2 emissions from the car by 15-20 kg CO_2 per tonne aluminium during the lifetime of the car.

Over the past decade, tailpipe emissions have been reduced dramatically driven by lightweighting and efficiency measures. This creates a shift towards how to reduce the emissions generated in the production of the car and in its end-of-life phases from both regulators and consumers.

Sourcing of sustainable raw material and metals will increasingly become the focus of car manufactures, reducing emissions, protecting nature, and respecting human rights at the same time.

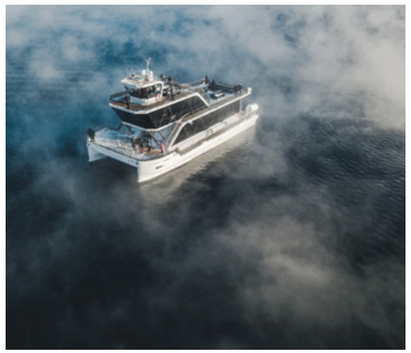
Aluminium's properties and inherent footprint can contribute to both reducing the use-phase emissions footprint of a vehicle, and the recyclability of aluminium is a benefit at the end-of-life.

Read more
How lightweighting can make greener the automotive industry (shapesbyhydro.com)

Source: European Aluminium

Why aluminium?

Strong and light
Aluminium is a very light metal, with a specific weight of 2.7 (g/cm3), which is one-third that of steel. The strength of the metal can be increased by adding small quantities of other metals (alloys). The low weight reduces energy consumption related to transportation, and hence also emissions of green-house gases and other pollutants.



Highly corrosion resistant
As the metal itself forms a protective oxide coating (that is immediately reformed if the metal is cut or scratched), it is highly corrosion resistant. This property can be further improved by various types of surface treatment. This property prolongs the useful life of aluminium in cars and buildings, and reduces the need for maintenance. This also reduces environmental impacts related to replacement and maintenance.

Good reflective qualities
Aluminium can reflect both heat and light, and together with its low weight, makes it an ideal material for reflectors in, for example, light fittings. High energy efficiency in the reflectors contributes to reduced environmental burden.

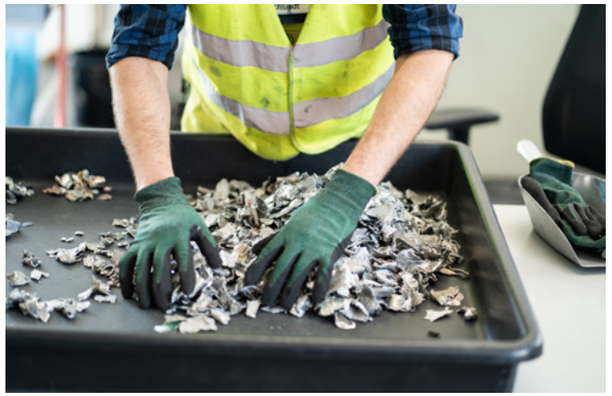
Good conductivity
Aluminium is a good conductor of heat and electricity, and in relation to its weight, is almost twice as good a conductor as copper. These properties make aluminium the material of choice to achieve energy efficient systems for electrical transmission systems and other applications, such as heat transfer components.

Why aluminium?

Easy to form and process
Aluminium is ductile and has a low melting point. It can easily be processed in a number of ways - both in a cold and hot condition. Its great ductility allows design flexibility and aluminium products to be integrated in advanced applications in transport and buildings industries.

Non-combustible
Aluminium used in buildings, constructions and transport equipment is non-combustible. It will only burn in a fine powder form or as very thin film. Aluminium will melt when temperatures exceed 660 °C - without releasing any gases.

Impermeable, non-toxic and odorless
Aluminium foil, even when rolled to just a 0.007 mm thickness, is still completely impermeable and lets neither light, aroma nor taste substances in or out. Moreover, the metal itself is nontoxic, and releases no aroma or taste substances. Aluminium is therefore widely used in food and drink packaging. The efficient conservation of food reduces wastage of food, which is an important environmental and resource advantage. Furthermore, the low weight of the packaging reduces energy in transportation. The impermeability of aluminium foil also reduces cooling needs.



Easy to recycle
The re-melting of aluminium requires little energy compared to production of primary aluminium, and metal loss in the remelting process is less than 3 percent. Only about 5 percent of the energy required to produce the primary metal initially is needed in the recycling process. Around 75 percent of the aluminium ever produced is still in use and constitutes a resource bank for use in the future.

How it's made

Aluminium today is made from extracting bauxite rock, refined into alumina, smelted into primary aluminium. One tonne of aluminium typically needs 4-6 tonnes of bauxite, reduced to 2 tonnes alumina. The production process is resource and energy intensive, and generates significant amounts of GHG emissions and waste. In addition, all industrial activity has an impact on the environment, people and their livelihoods.

Robust balance sheet • Workforce, technology and R&D • Relations to local authorities and communities • Environmental, social and economic impact in supply chain

	Bauxite	Alumina	Energy	Primary	Casting	Extrusions	Products
Main inputs	• Bauxite resources • Water • Land clearance • Bauxite pipeline	• Bauxite • Caustic soda • Lime • Water • Coal • Oil	• Land use • Water reservoirs	• Alumina • Aluminium fluoride • Electricity • Coke • Pitch • Water	• Primary aluminium • Process scrap • Post-consumer scrap • Natural gas • LNG		• Extrusion ingot • Electricity
Main outcomes	• Bauxite • Rehabilitated land • *Tailings* • *Biodiversity impact*	• Alumina • *Bauxite residue* • *GHG emissions* • *SO_2 emissions* • *NO_x emissions*	• Hydropower • Flood control • *Regulated watersheds* • *Biodiversity impact*	• Primary aluminium • *GHG emissions* • *SO_2 emissions* • *Fluoride emissions* • *Spent potlining*	• Standard, sheet and extrusion ingots, primary foundry alloys and wire rod • *NO_x emissions* • *Dross*		• Extruded solutions for building and automotive industries, consumer goods etc. • *Environmental impact*

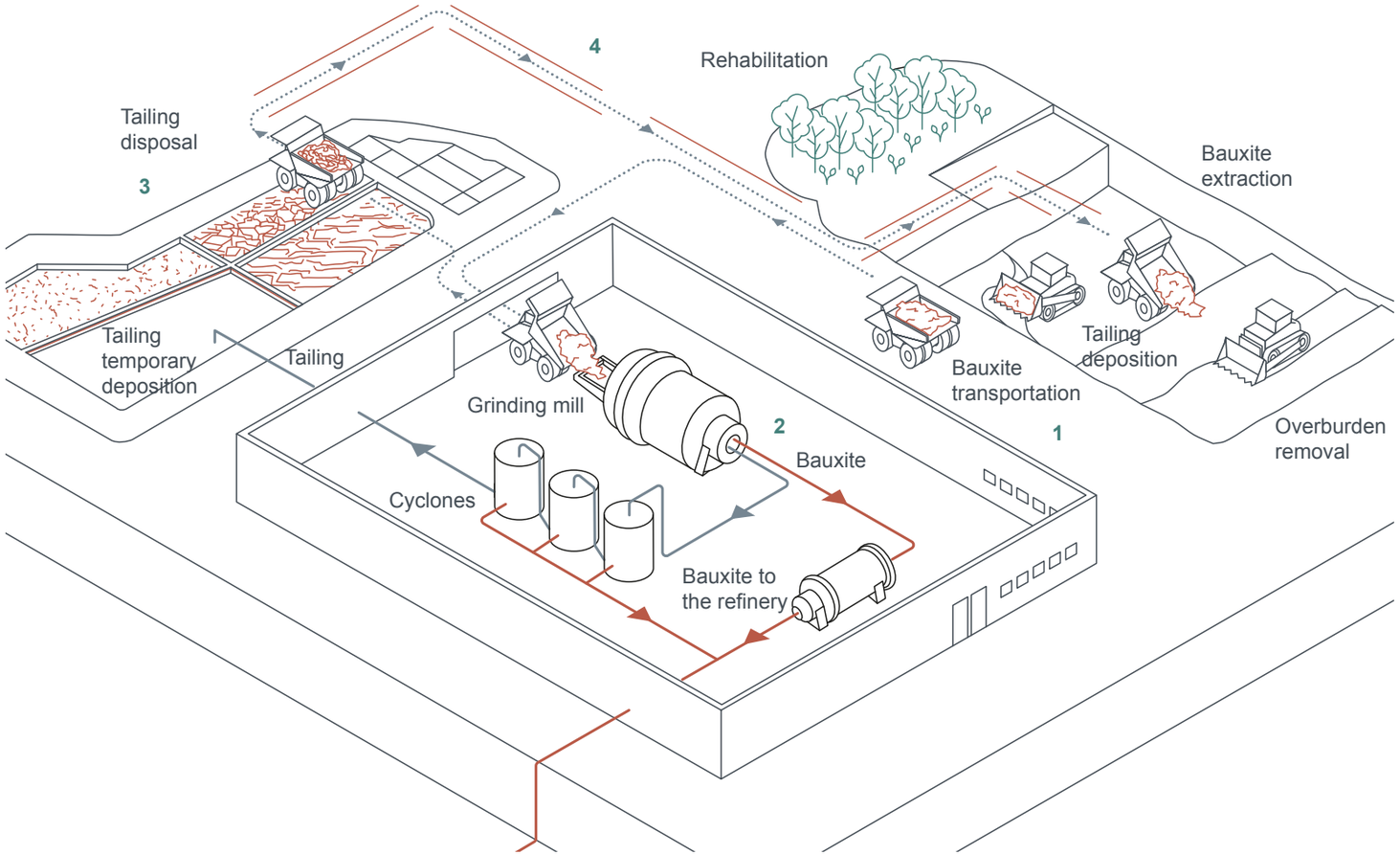
Recycling

Community impact and stakeholder value • Reputation Income and shareholder value • Salaries, taxes and suppliers' income • Health & safety, job satisfaction and skills

Bauxite

The majority of world bauxite production is from surface mines, and 90 percent of the world's bauxite reserves are concentrated in tropical and sub-tropical regions – a belt around the equator, typically in areas with high biodiversity value. The largest reserves are found in Australia, Guinea, Brazil, Vietnam, Jamaica and Indonesia.

In most locations, strip mining is used to access the bauxite, and the average thickness of the bauxite ore layer is between 4-6 meters, but can vary from 1 to 40 meters. Due to this relatively narrow thickness, bauxite mining is considered land-use intensive and, to access the bauxite layer, the surface vegetation, top soil and overburden must first be removed. The type of vegetation varies depending on the geographical location of the mine and the historical land utilization, from agriculture to grasslands and rainforest. After mining, there is also a need to restore the areas impacted back to a pre-mine state or, in some cases, back to a natural state. Depending on the ecosystem type, rehabilitation back to a natural state can take decades and requires significant technical expertise to ensure that this is feasible.



1 Mining
2 Mineral processing
3 Temporary Tailing disposal
4 Tailings dry backfill

The quality and properties of the bauxite rock differ between the different geographic regions. In Brazil, where Hydro is present, the excavated bauxite needs to be washed to remove clay and soil before it is transported to the alumina refinery. This process generates a clay-like slurry called tailings. Tailings does not contain any hazardous substances, but the water content and quantity generated means it must be stored in specially designed Tailings Storage Facilities (TSFs). Safe storage of tailings is a challenge for the mining sector, and the Global Industry Standard for Tailings Management have set explicit requirements for all tailings storage facilities to increase governance and safety.

Bauxite tailings have traditionally been stored in permanent TSFs, creating a long-term waste legacy for the industry. However, Hydro has developed and pioneered a methodology for drying the tailings and returning it to the mined areas as part of the rehabilitation process. This "Tailings Dry Backfill" approach will eliminate the need to build new TSFs in the future. Read more about this approach on page 49.

Due to the scale of the bauxite mine, there is an inherent social risk if not managed responsibly. It is essential for extractive companies to understand the social context of where they operate and engage directly with society to build resilient communities and respect their human rights. The types of social risk present, and the solutions needed to address them, will vary greatly from country to country, based on their socio-economic status and development. Overall, extractive industries have a particular responsibility to build resilient communities and respect human rights, and this should always be the key focus for the different social and other programs initiated by companies involved in mining and refining.

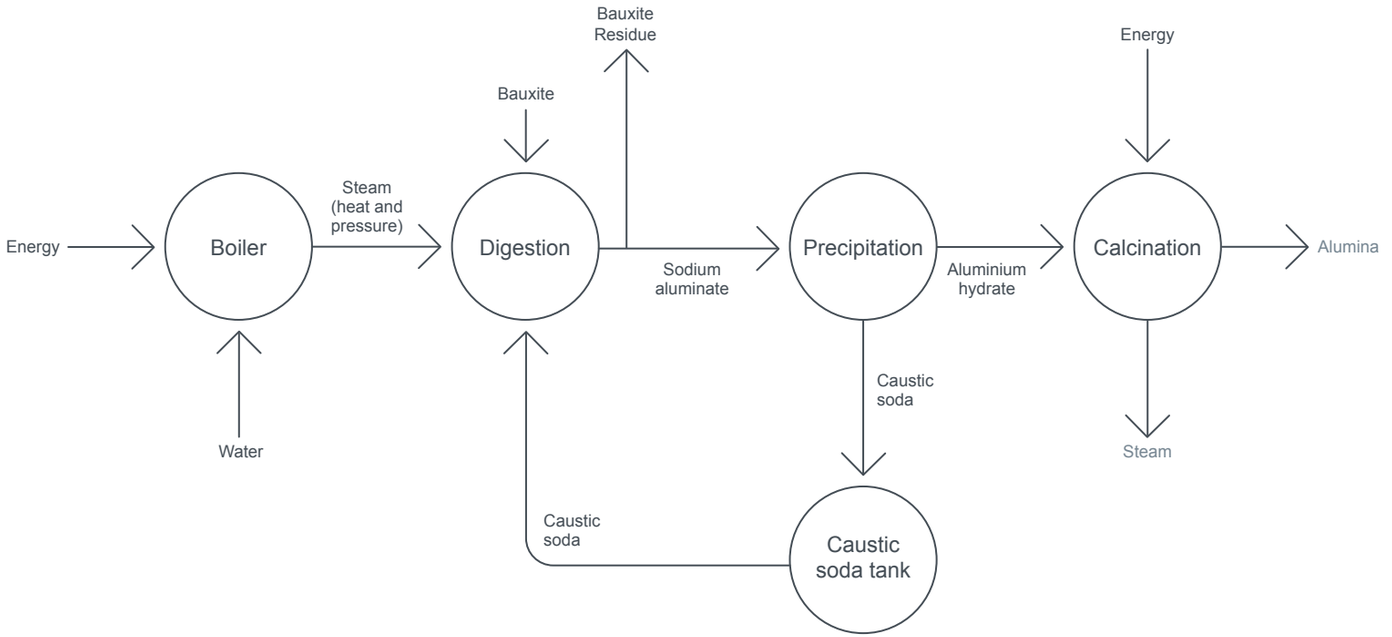
The broader social aspects also include revenue and contract transparency, mineral resource governance, and engagement with partners across the value chain on social risks.

Alumina

The bauxite rock is refined to alumina using the Bayer process. This is a complex chemical process where the two main inputs are bauxite and caustic soda. The process also requires significant quantities of steam to generate the heat and pressure necessary to digest the bauxite. This makes alumina refining both water- and energy-intensive and, depending on the energy source, can lead to significant GHG and non-GHG emissions. Most alumina refineries are dependent on fossil fuels like coal, heavy fuel oil or LNG. Use of fossil fuels will also lead to emissions of sulfur dioxide, nitrogen oxides and dust, which can have very localized impacts on the environment. New technologies are being developed that will allow for decarbonization of the process, through electrification and substitution of traditional fossil fuels with alternatives like green hydrogen, that will largely abate these GHG and non-GHG emissions in the future.

The chemical digestion of bauxite generates equal quantities of alumina and bauxite residue. While the bauxite residue is non-hazardous, there is caustic soda entrained within the residue that has a high pH. The bauxite residue is often press-filtered to remove as much of the entrained caustic soda as possible, which can then be reused in the digestion process. After press-filtration, the bauxite residue is significantly drier, but still contains some residual caustic soda content. It must therefore be safely stored in specially designed residue storage areas, in combination with a wastewater treatment plant that can safely treat leachate and rainwater run-off. As with tailings storage, safe and responsible storage of bauxite residue is governed by the requirements set by the Global Industry Standard for Tailings Management.

The long-term storage and management of bauxite residue is an industry-wide challenge, and a lot of research is being conducted to identify ways in which residue generation can be reduced and reutilized for other purposes. See case study on Bauxite Residue Reutilization on page 49.



Primary aluminium

The process to make liquid aluminium from alumina is electro-intensive. The current technology dominating the industry is the Hall-Héroult process, where CO_2 and PFC (perfluorocarbons) gases are formed as a by-product in the process. The largest challenge facing the aluminium industry is how to develop emission-free technologies for primary aluminium production. There are several companies looking into this, and Rio Tinto and Alcoa's Elysis technology, and Hydro's proprietary HalZero are currently leading the development (read more on page 32). To safeguard existing assets, solutions for carbon capture and storage are also being explored.

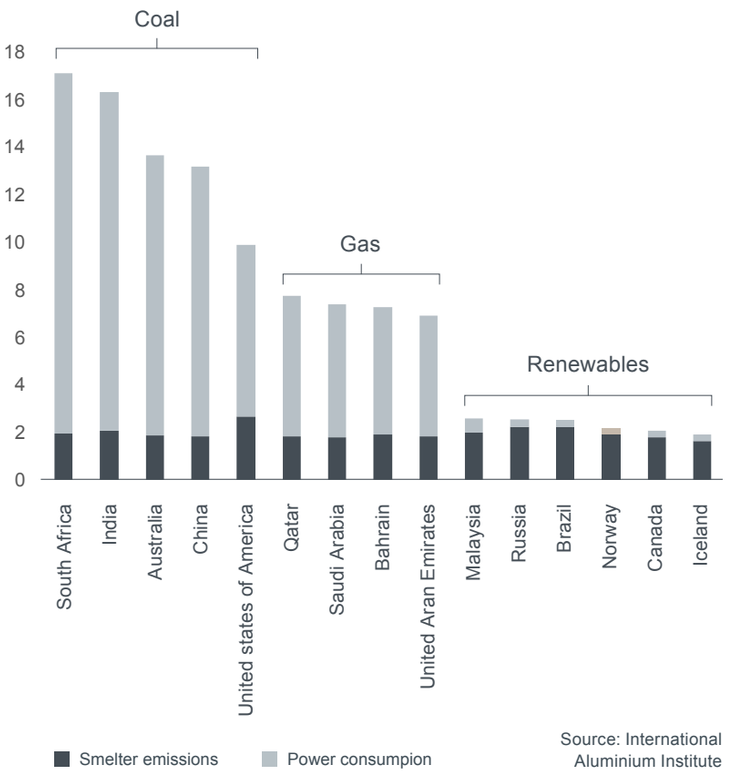
In the Hall-Héroult process, the alumina is dissolved in an electrolytic bath, and an electric current is passed between a positive carbon anode made of coke and pitch, and a negative cathode as part of the lining where the bath is contained. There are two sources of GHG emissions related to this process: from electricity generation and process emissions, and from the consumption of the carbon anode. To minimize GHG emissions, it is important with operational to ensure a stable process, as PFC gases, with very high global warming potentials, are created if the production is unstable.

Because of the electro-insensitiveness of the process, the GHG emissions from one tonne of aluminium produced will vary significantly depending on how the electricity consumed in the process was generated. The direct GHG emissions from consumption of the carbon anode is usually around 1.6-2 tonnes of GHG pr tonne aluminium. The indirect GHG emissions from electricity consumption can be between 0-16 t/t depending on whether the electricity was generated with renewables or coal-fired power plants.

In addition to the GHG emissions, primary aluminium production also emits sulfur dioxide, nitrogen oxides and fluoride, which can have very localized impacts on the environment. Many of these pollutants are captured using gas-treatment technologies like wet and dry scrubbers. The cathode lining of the electrolytic cell also degrades over time and must be periodically replaced. The waste material removed from the cell, referred to as spent pot lining (SPL), consists of two main parts: the carbon cathode and the insulating refractory material. The carbon part is considered hazardous as it is contaminated with soluble cyanide and fluoride. If this material gets wet, in can also produce an alkaline leachate. There are opportunities to recover and reuse parts of the SPL and also incinerate the carbon-rich parts to recover energy. The refractory material, if not contaminated, can also be reused in cement manufacturing. However, if these opportunities for reuse or recycling are not locally available, it is also possible to safely dispose of the SPL in landfills.

CO_2e emissions from primary aluminium production

Tonnes CO_2e/tonne aluminium, 2023



Source: International Aluminium Institute

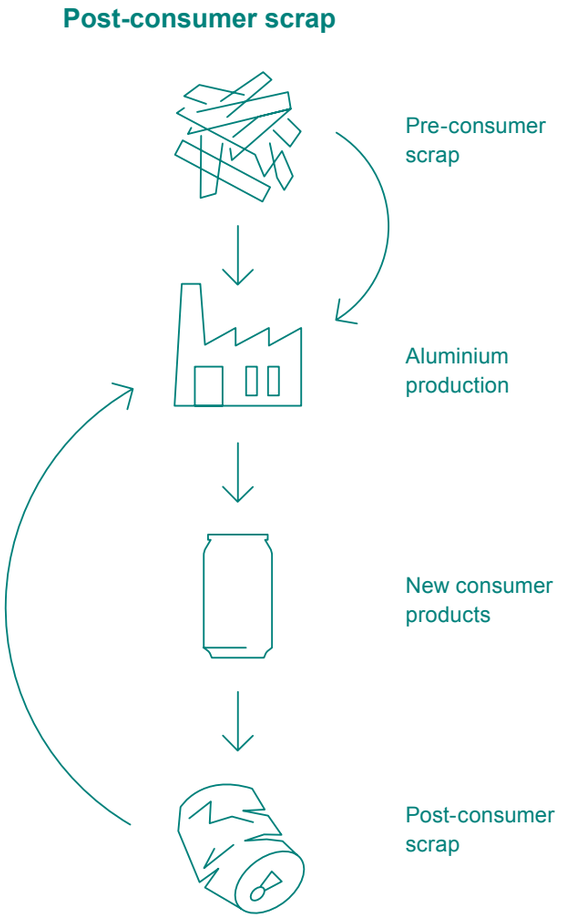
Recycling

The inherent properties of aluminium make it a highly recyclable material. It can be recycled infinitely without degradation in quality and recycling requires 95 percent less energy than primary aluminium production.

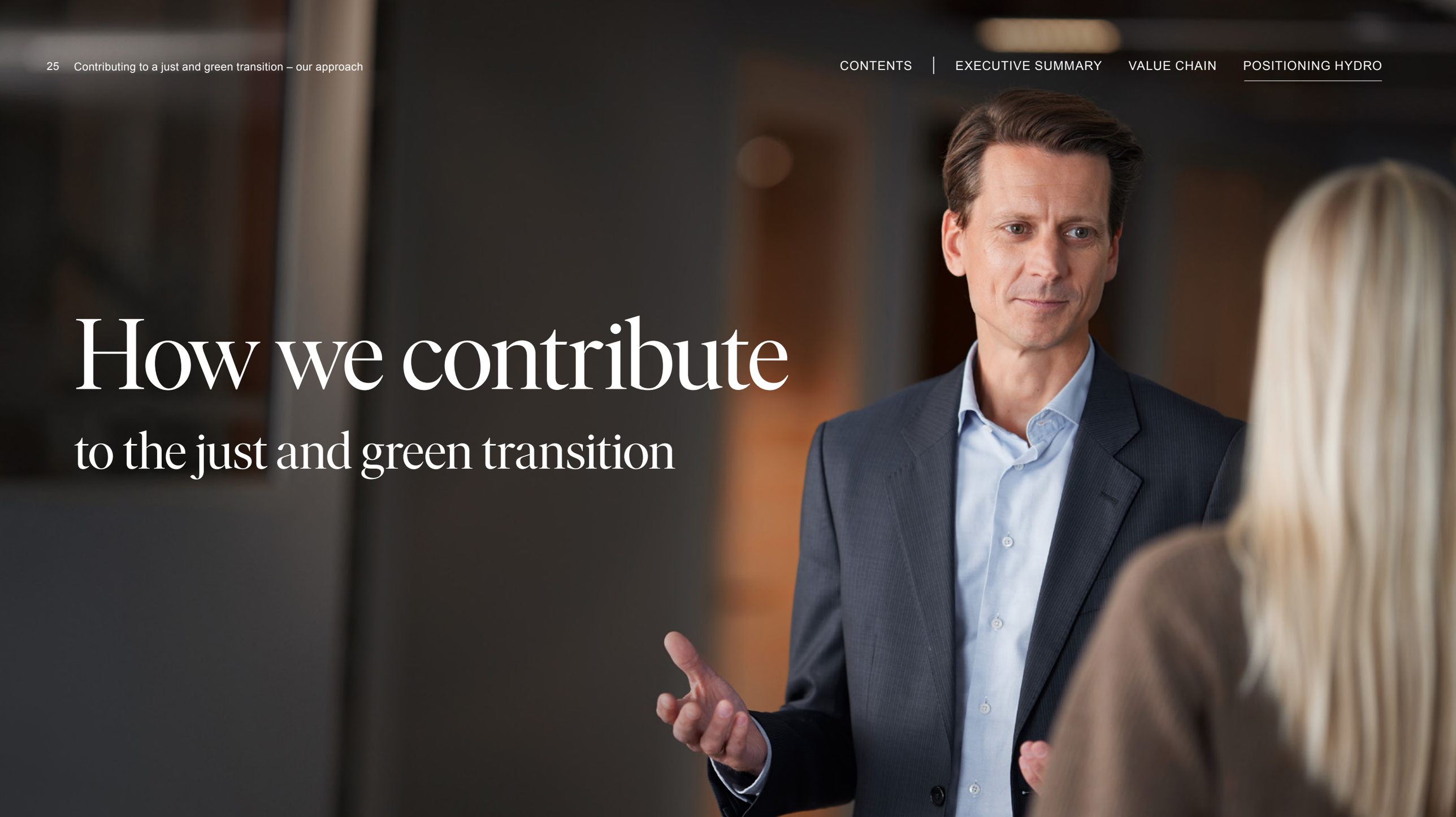
Process scrap from own production and other companies, as well as post-consumer scrap from the market are remelted into new products. The carbon footprint of recycled pre-consumer scrap or process scrap is dependent on its metal origin. Thus, process scrap from aluminium produced by coal power comes with a much higher footprint than process scrap from hydropower-based aluminium. Post-consumer scrap, however, comes with no historical carbon footprint, as this metal is entering its next lifecycle.

Recycling post-consumer scrap comes with challenges. The metal has to be collected and properly sorted, before being recycled back to high quality products. The main challenge with post-consumer scrap is to make sure the quality of the metal is preserved in the recycling process, and to identify the alloys and properties of the used metal purchased. Hydro has, however, successfully been able to overcome these challenges through advanced sorting and recycling technologies – resulting in the launch of Hydro's high recycled content brand CIRCAL.

The different aluminium alloys is what gives aluminium products their unique properties and is the reason why a car's "crash box" remains intact while the hood of the car absorbs the energy in a car accident. The alloy composition is what makes aluminium recycling challenging, as it has to be sorted according to alloys to retain its properties. Mixing alloys generally makes it difficult to use the recycled aluminium for its original purpose again.



Post-consumer scrap is defined as aluminium scrap that comes from products which have fulfilled the purpose for which they were produced (ISO 14021). This scrap might range from aluminium cans with a lifetime of about 60 days, to buildings with a lifetime of more than 50 years. When this scrap is recycled, it starts its second life as a recycled product, with no carbon footprint attached to it except from the remelting. As a result, post-consumer scrap has a carbon footprint of about 0.5 or less tonnes of CO_2e per mt of aluminium. This footprint results from scrap collection, transportation, sorting and remelting.



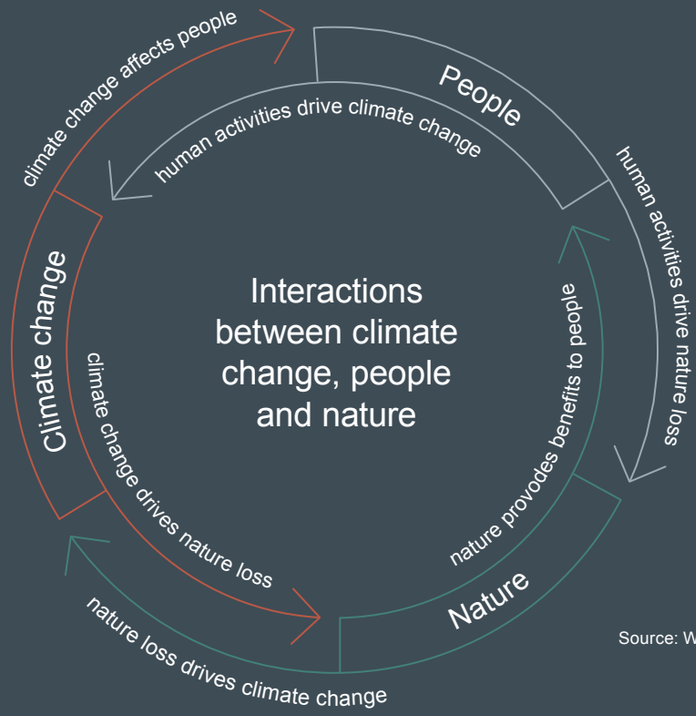
How we contribute

to the just and green transition

How we contribute to the just and green transition?

Sustainability in Hydro is addressing the challenges related to demand for natural resources to supply the just and green transition. There are sustainability challenges and opportunities present at every step of the value chain and across Hydro's operations – some of these are unique to Hydro and our locations, others are industry-wide.

Our ambition is to be a partner in our customer's decarbonization journeys -and to be able to take this position we must develop and shape the market for low-carbon and sustainable products in partnerships, addressing all elements of sustainability – climate, nature, social and circular economy.



Source: WWF

To be a desired partner, we have to work to decarbonize our entire operations and in parallel develop spearhead products that shape and create the market for low-carbon products together with customers and partners. Hydro's unique position with control of the entire aluminium value chain enables us to provide transparency from mine to metal on the impact on people and nature, in addition to climate change. This becomes increasingly important as the regulation shifts to emphasize the embedded emissions of a product. This shift is already present in the automotive industry where the regulators have been successful in reducing tail-pipe emissions, and now shift towards looking at the vehicles entire life-cycle, including the material input.

Sustainability in Hydro means to deliver the transparency and change required to mitigate the impact on climate, nature, and people to secure a green and just transition.

Hydro's activities in bauxite mining and alumina refining have a larger exposure to social and environmental issues due to the nature of the operations and the geographic location of our assets in Northern-Brazil.

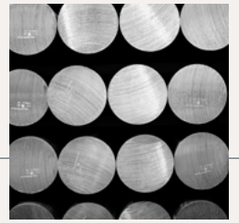
Our business

Bauxite & Alumina

Hydro Bauxite & Alumina is working to improve its position on the alumina industry cost and carbon curves, with Alunorte moving from the first quartile of alumina refineries in terms of carbon intensity, to the first decile in 2025. To reach the targets for greenhouse gas emissions reductions, Hydro has replaced fuel oil with liquid natural gas at the Alunorte alumina refinery, and installed electrical boilers that use renewable electricity Further installation of electrical boilers will eliminate the use of fossil fuels at Alunorte, except for the calcination process. This will enable the growth in sales of low-carbon alumina and aluminium, at an expected growing premium.

To reduce the environmental impact of our operations, Hydro's has developed the Tailings Dry Backfill methodology at the Paragominas mine, which eliminates the need for new permanent tailings storage facilities and permits rehabilitating areas affected by mining operations faster. Hydro also supports social and economic development in the communities where its operates.

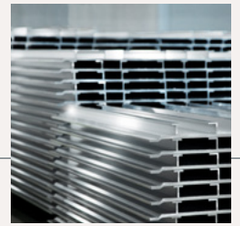
Aluminium Metal



More than 70 percent of the electricity used for Hydro's primary aluminium capacity is based on renewable power, a large share of which is sourced from our captive hydropower production. This is the foundation of delivering low-carbon aluminium at competitive cost in the long term, and enables Hydro's seventeenth percentile placement on the global primary aluminium cost curve in 2022. Hydro aims to become net-zero by 2050, and our climate efforts are concentrated along three main pathways to net-zero emissions.

Aluminium recycling requires 95 percent less energy than primary aluminium production and can be recycled infinitely without degradation in quality and we have a portfolio of low-carbon aluminium brands. Going forward, Hydro will grow the portfolio of lower-carbon aluminium products, demanding higher premium pricing. This is supported by Hydro's recycling ambitions to increase the total use of post-consumer scrap to between 850 and 1200 kt per annum, compared to 280 kt in 2020.

Extrusions



Sustainability is an integrated part of the business and Hydro Extrusions is working closely with customers across most industries to deliver products and solutions that help our customers reduce their carbon footprint, and improve sustainability and transparency in their supply chain. This includes the Hydro EcoDesign process that helps our customers create products with increased functionality and a lower-carbon footprint.

Extrusions applies additional levers to improve its carbon footprint, including sourcing aluminium with a carbon footprint that is lower than the average, increasing the use of recycled post-consumer scrap and reducing the emissions from our operations.

Energy

Hydro Energy is working to find solutions for a renewable future and develop the renewable industries of tomorrow. Our mission is to enable decarbonization and electrification of society and industries by developing and operating renewable energy, by using wind, solar- and hydropower. Energy storage solutions are also necessary for the green transition.

As one of Norway's largest producers of renewable energy, our hydropower operations provide around 10 TWh of clean energy annually for our Nordic aluminium production.

Hydro Energy aims to grow its portfolio of new energy solutions, while also addressing and managing the social and environmental impacts that comes with land use. Hydro's energy production and new energy solutions contribute to a net-zero society.

Climate

The negative impact of climate change on our lives is increasing as we continue to live outside of the planetary boundaries. With continued climate change, the severity of the negative impacts will increase.

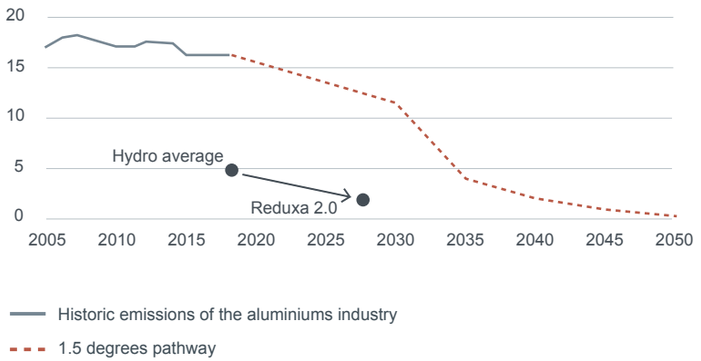
Increased extreme weather events will impact company assets and local communities in which they operate. The necessary just transition to a low-carbon economy requires metals and materials, and we believe that Hydro and low-carbon aluminium can play an important role in this transition while also reducing global greenhouse gases.

The aluminium industry is facing a huge challenge to reduce emissions to the level consistent with reaching the Paris agreement and limiting global warming to 1.5 degrees. According to the Paris-aligned pathways developed by the International Aluminium Institute, process emission intensity from primary aluminium production will have to decrease from the current global average of 14.8 t CO_2e/t Al to 0.5 by 2050, and the emission intensity of recycled aluminium must be reduced from the current average of 0.6 t CO_2e/t Al to 0.1. To reach these emissions levels requires significant investments and R&D across the industry as a whole, as the technology to produce zero-carbon primary aluminium is currently not available.

Hydro has committed to reaching net-zero emissions by 2050 or earlier. Reaching this we have set a roadmap and climate strategy along three main pillars: becoming a net-zero company, delivering net-zero products and enabling a net-zero society. Due to the aluminium value chain, we can deliver net-zero products to our customers before we as a company reach net-zero emissions.

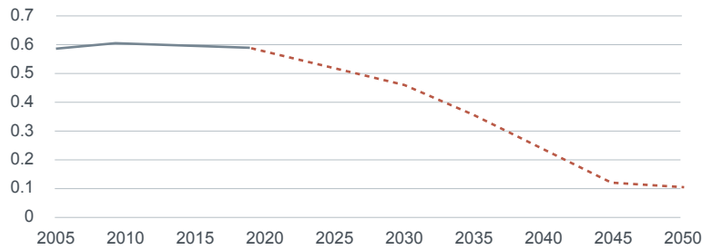
Primary Aluminium process emissions

CO_2e emissions intensity (tonnes per tonne)



Recycled Aluminium process emissions

CO_2e emissions intensity (tonnes per tonne)



Source: IAI, Greenhouse Gas Pathways, 2021

Net-zero company

Hydro's climate strategy is an integral part of our overall business strategy, aiming at driving improvements and development within the company. Impact on the climate strategy is also a criteria for all significant investment decisions. The strategy includes reducing the climate impact of our operations as well as taking advantage of business opportunities by enabling our customers and society to do the same.

2018 → Reducing Hydro's CO_2 exposure through portofolio changes

2025 → Fuel switch, electrifying boilers, grid mix improvements, smelter process improvements

2030 → New initiatives identified to maintain 30% target – will depend on market development, public programs and regulation

2050 → Renwable power, green hydrogen and biomethane, smelter emissions

If we look at the composition of Hydro's sources of greenhouse gas emissions they can be divided into four main categories.

- GHG emissions from the electrolysis process constitutes around 30% of Hydro's total emissions and are the hardest to abate.
- GHG emissions from generating the electricity we purchase, so called scope 2 emissions, also constitute around 30 percent.
- Natural gas we use in our casthouses, for recycling and remelting aluminium, extrusion processes and anode production, constitute around 10% of Hydro's total emissions.
- Fossil fuel consumption at Alunorte alumina refinery, which also constitute around 30 percent of Hydro's total emissions.

Hydro's climate strategy and the roadmap and initiatives we have in place until 2030 are primarily related to the fuel switch in Alunorte, where we will change from heavy fuel oil to natural gas in the calcination and replace coal with electric boilers for steam generation. In 2030, we are left with the hardest to abate emissions.

We are developing and maturing the technology needed to take out the last emissions. Our proprietary HalZero technology and CCS (carbon capture and storage) both address the electrolysis process emissions – where we are already close to the theoretical minimum of emissions from today's technology. With CCS and HalZero in place – it's realistic to speak of emission free primary aluminium production.

Addressing emissions from electricity generation, and purchased electricity is mainly outside of our control, because it is influenced by the share of renewable energy in the grids where we operate. However, we are looking at ways of sourcing directly from renewable sources to these locations.

Some industrial processes are heat intensive and are not possible, feasible or sensible to electrify, like the calcination process in alumina refining. Here we are looking into solutions, such as green hydrogen or bio-fuel.

Hydro is also a larger purchaser of raw materials, including aluminium and the metal required for aluminium alloys. The aluminium we purchase externally supplies our recyclers and extrusion plants, and the greenhouse gas emissions associated with production of this raw material makes up the majority of Hydro's scope 3 emissions.

Greenhouse gas emission categories

Scope 1

Direct emissions from our production processes or fossil fuel combustion

Scope 2

Emissions associated with generation of electricity we purchase

Scope 3

Indirect emissions from producing goods and raw materials we use as input factors upstream, or further processing of our products downstream, including transportation both up and down stream.

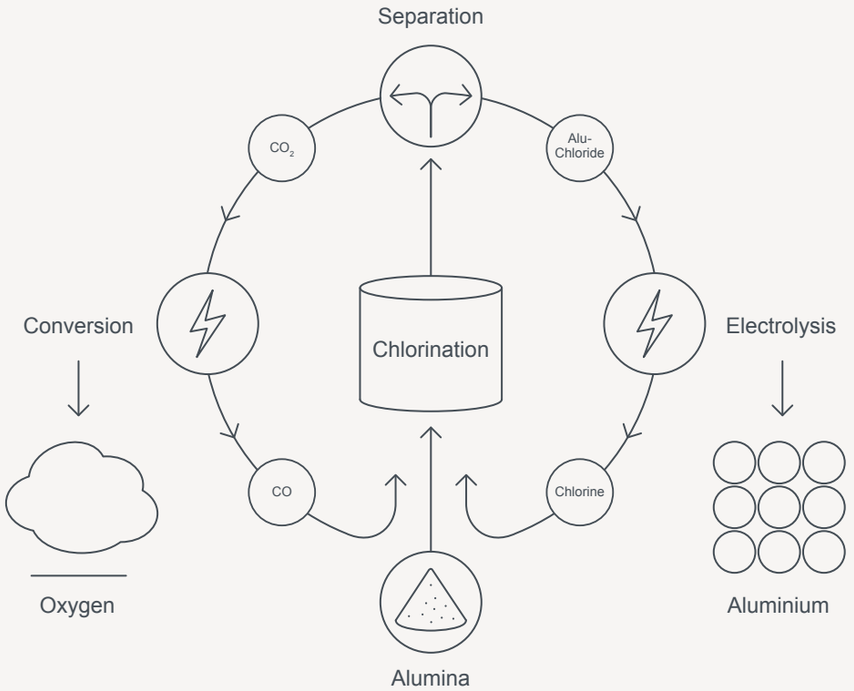
HalZero

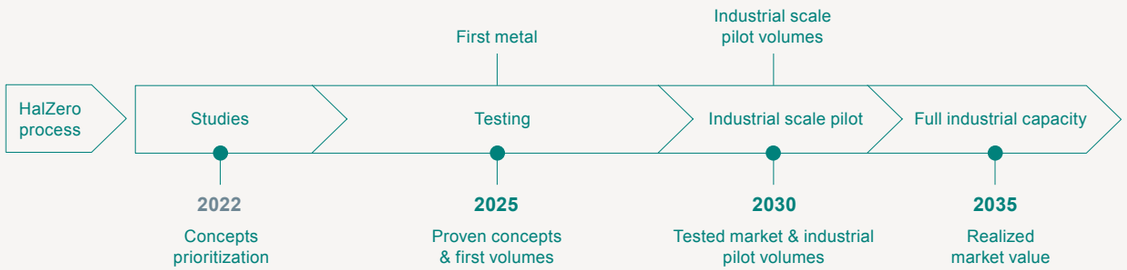
For six years, Hydro's technologists have worked to develop a breakthrough technology for primary aluminium production. The proprietary HalZero[1] technology is based on converting alumina to aluminium chloride prior to electrolysis in a process where chlorine and carbon are kept in a closed loop, and where the only emission is oxygen.

Hydro technologists have succeeded in modeling and verifying the HalZero process at our research and development laboratory in Porsgrunn, Norway. The results of the initial test phase were promising, and the process design studies have shown that an industrial-scale HalZero plant will have power consumption and operating expenditure about the same as current electrolysis technology. Capital expenditure is expected to be comparable to new conventional smelter capacity. The HalZero process will be applicable for greenfield aluminium plants or brownfield replacement of obsolete potlines, where the smelter infrastructure can be re-used.

Significant research is still required to mature the HalZero process toward industrialization. The components of the HalZero technology are at different Technology Readiness Levels and there is still significant risk associated with the full process system. Pilot testing in laboratory scale is ongoing and if successful, the ambition is to produce first pilot volumes by 2025. Scaling up pilot testing will require significant investment and public-private partnerships. Hydro's goal is to have an industrial-scale pilot up and running by 2030, making the HalZero technology viable for implementation in new electrolysis capacity from 2030 onwards.

[1] The name HalZero alludes to the common way of naming Hydro Aluminium cell technology – HAL – and our promise to deliver zero emissions.





Hall-Heroult with carbon capture and storage (CCS)

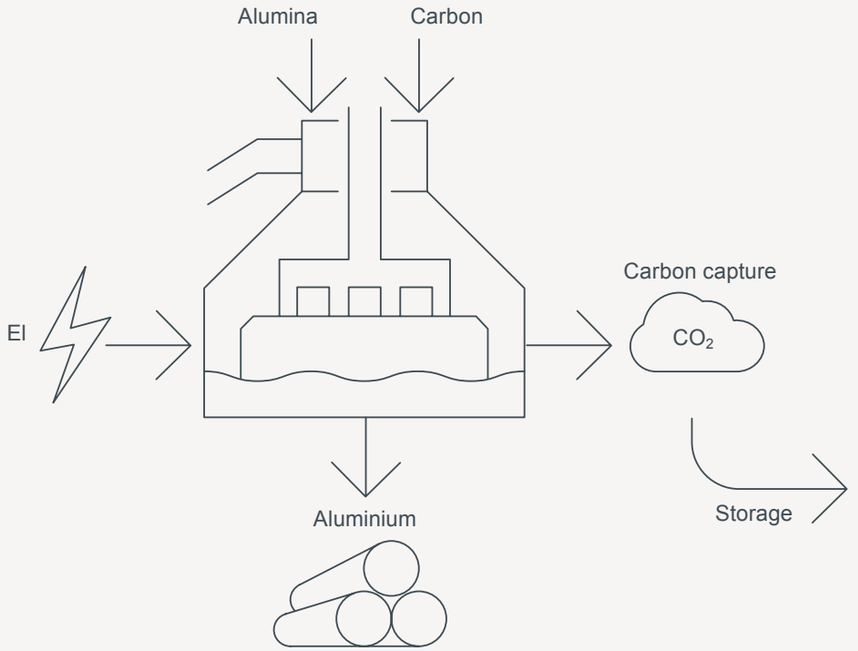
The off-gas in aluminium smelters has a relatively low concentration of CO_2, at approximately- 1%. So far, most carbon capture technologies have been developed for capturing the off-gas from fossil power production and industries with higher concentrations of CO_2, typically above 4%. In addition to the low concentration of CO_2, the off-gas from aluminium smelting contains some pollutants that challenge compatibility with existing capture technologies.

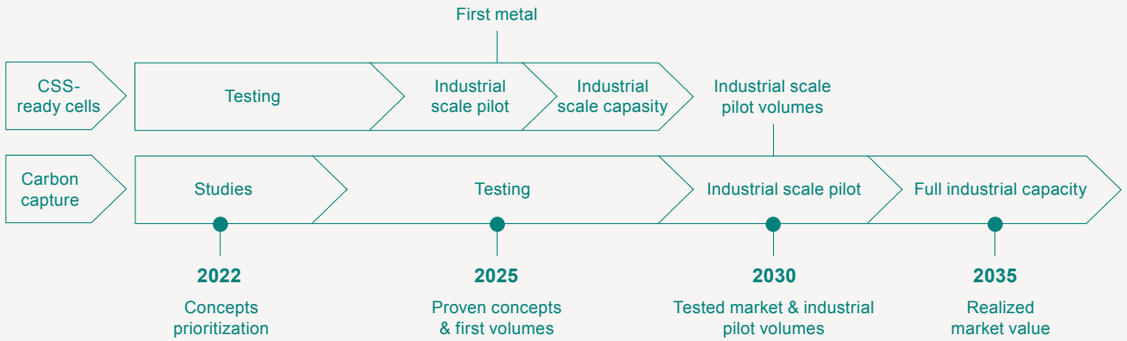
Further development is needed, and Hydro has evaluated more than 50 CCS technologies and developed a roadmap for testing and piloting the most promising ones up to industrial scale. The goal is to have an industrial-scale pilot running by 2030.

Studies have shown that off-gas capture may be a viable option to capture most of the CO_2 from an aluminium smelter, even though the power need and operational costs will increase as the installation is dimensioned towards a 100% capture rate. In addition, and as a supplement, Hydro is exploring options for direct air capture (DAC) units at its smelters. For some capture technologies, this has the advantage that process heat can be recovered for use in the DAC unit, lowering power demand and operational costs.

In parallel, Hydro is working on developing solutions that can be retrofitted onto existing electrolysis cells to make them capture ready.

To reach its ambitious climate targets, Hydro is working with several technology providers to develop solutions for off-gas capture and direct air capture while working to understand the future market for CO_2 management in Europe. The ambition is to have an industrial-scale pilot up and running before 2030.





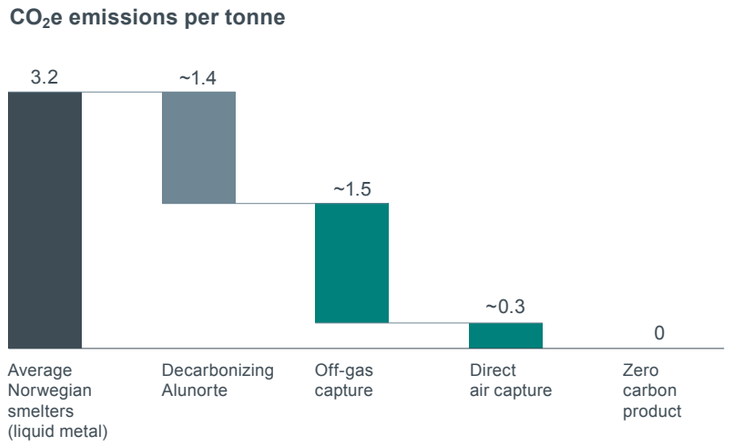
Net-zero products

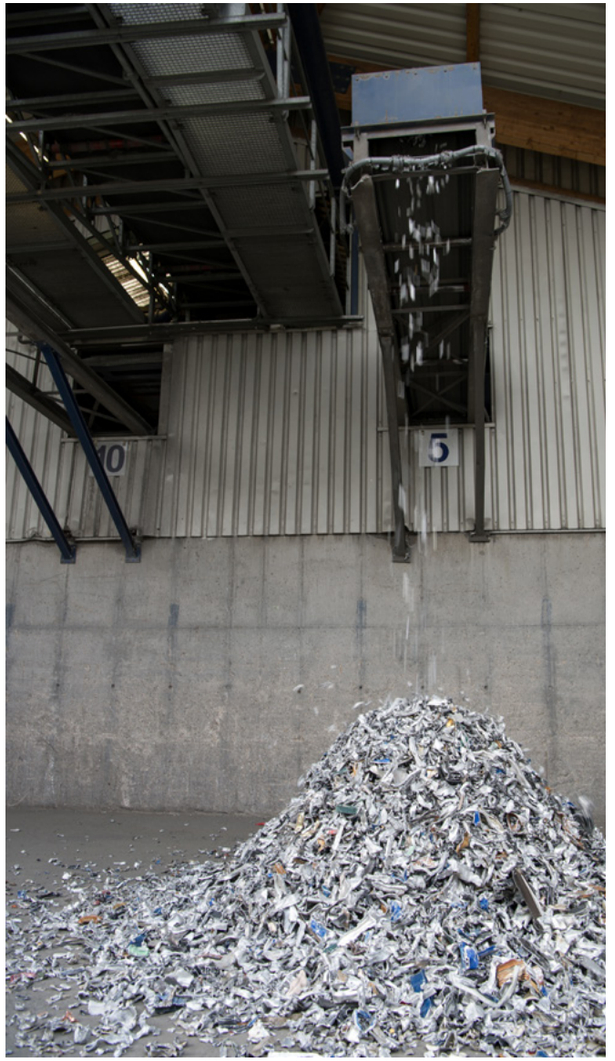
While we are working to decarbonize Hydro as a company, addressing our scope 1-3 emissions, we see we are able to deliver net-zero products to the market earlier. We are working along different paths to deliver net-zero products to the market, where the fastest route is through recycling of post-consumer scrap.

1

Carbon capture and storage, and direct air capture to decarbonize our existing primary aluminium facilities

Through capturing off-gases at smelters, we aim to reduce electrolysis emissions for existing smelters. We have evaluated more than 50 CCS technologies, and developed a roadmap for testing and piloting the most promising up to industrial scale. The most likely outcome will be a combination of off-gas capture and direct air capture to eliminate 100 percent of the emissions.



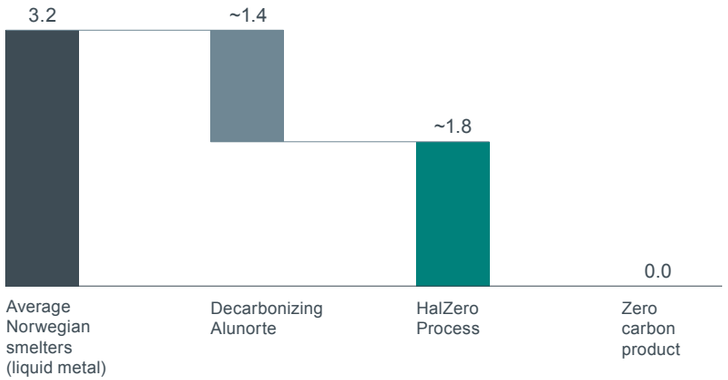


2

Our own proprietary HalZero technology for carbon-free processes for primary aluminium production

Through utilizing our proprietary HalZero chloride process, we can convert alumina to aluminium chloride prior to electrolysis in a process where chlorine and carbon are kept in closed loops, resulting in a fully decarbonized process. We have been working on lab-scale for more than five years on this technology and have developed a roadmap for translating this to industrial scale before 2030. This way we can fully decarbonize the smelting process by eliminating emissions for both electrolysis and anode baking. Hydro's HalZero technology will be relevant for new capacity post-2030.

CO_2e emissions per tonne



Includes scope 1 and scope 2 emissions from mine to metal

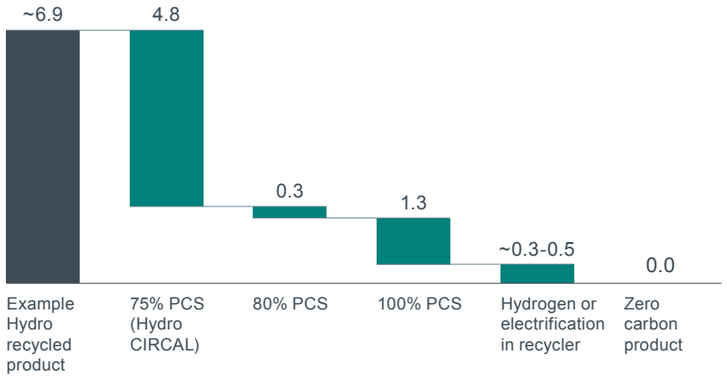
3

Utilizing more post-consumer aluminium scrap

We plan to improve our recycling capacity to sort and utilize more difficult PCS aluminium. We already produce Hydro CIRCAL, a certified recycled and low-carbon aluminium product of more than 75 percent post-consumer scrap. We have demonstrated our ability to produce this also with 100 percent post-consumer scrap, but to do this in a profitable way at scale requires utilizing greater amounts of difficult, unsorted and contaminated scrap. In order to achieve this we will utilize advanced laser-based sorting (LIBS). In order to have a fully decarbonized scrap based product we also need to use direct electricity or hydrogen in our remelting furnaces at the recyclers.

Delivering net-zero products based on primary aluminium also requires decarbonization of our alumina refinery in Brazil. With 70 percent of Hydro's primary aluminium production using renewable electricity, and the low-carbon aluminium brands Hydro REDUXA and Hydro CIRCAL, we differentiate our product portfolio from our peers. Many customers choose Hydro's aluminium due to its low-carbon footprint.

CO_2e emissions per tonne



Recycling of aluminium – not all recycled aluminium is equal

As an industry, we have a responsibility to educate our customers and support the circular transition with a clear understanding of the carbon footprint of recycled aluminium. If we don't account for this accurately, there could be significant consequences.

At Hydro, we believe the solution is to recognize that not all recycled aluminium is equal. When recycled aluminium is made from used beverage cans, windows, or car parts, the material starts a second life. Previously used aluminium is referred to as "post-consumer" scrap, and its carbon footprint is close to zero. Recycling of post-consumer scrap will be increasingly important in the future – representing potentially almost 50 percent of the aluminium supply in the future. To incentivize collection, sorting and recycling of post-consumer scrap is thus essential for the green transition of the aluminium industry.

Recycled aluminium made from secondary production or "pre-consumer" scrap is different. This material comes from "leftovers" in the production processes, and has not yet completed its life and must retain the carbon footprint of its original production processes. If this is not done, the material's production emissions are not accounted for, artificially creating an impression that the carbon footprint of pre-consumer scrap is equal to that of post-consumer scrap. It is thus important that the carbon footprint of pre-consumer scrap reflects its material origin – resulting in high carbon footprint when produced using coal power, and low-carbon footprint when produced using renewable power. In this way, increased collection and recycling of post-consumer scrap is incentivized – supporting the green transition.

It matters where and how aluminium is produced.

Read more

- No time to waste – recycling white paper

Case study

Høyanger Hydrogen pilot

At Høyanger, we are planning a new recycling plant, with a 5 MW pilot for using green hydrogen to power one furnace. This pilot is key for the decarbonization of Hydro, testing one of the very promising technologies for decarbonizion of high heat processes. What we learn from this pilot will be key to the decarbonization strategy going forward.

The hydrogen project enables decarbonization of recycling aluminium with 100% post-consumer scrap content. This means the aluminium produced in this step is very close to zero, with only very small emissions from the delaquering process. The aluminium will be mixed to form ingots for sale. Decarbonization of recycling is the fastest route to near zero carbon aluminium.

The recycling plant is planning to use hydrogen instead of LNG for a remelter furnace in step 1 (5 MW) and potentially the whole recycling plant in step 2 (more than 13 MW). Step 1 will save 4000 tonnes of CO_2e annually and step 2 will double this amount.

This is our first pilot to show our operational capabilities to do fuel switch in a fullscale industrial plant. The pilot is estimated to start execution in 2024.

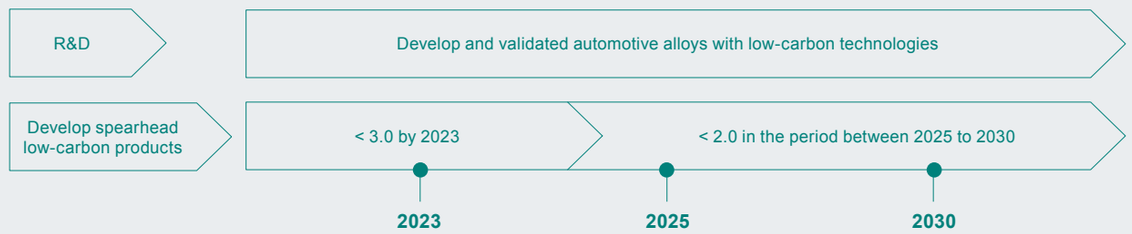
	Pilot	Phase 2
	5 MW	>13MW
Saves annually	4000 tonnes of CO_2e	> 8000 tonnes of CO_2e

Case study

Partnering with Mercedes-Benz on the road to zero

Two frontrunners in decarbonizing strategies have teamed up to reduce the climate impact of the automotive industry. The objective of the collaboration between Mercedes-Benz and Hydro is to develop low-carbon aluminium for automotive applications by 2030 and beyond.

Hydro and Mercedes-Benz will collaborate from 2023 to 2030 on a common roadmap aiming to develop aluminium solutions and applications with low-carbon footprint (below 3.0 and with ambition to come near zero) and are approved alloys for automotive applications.

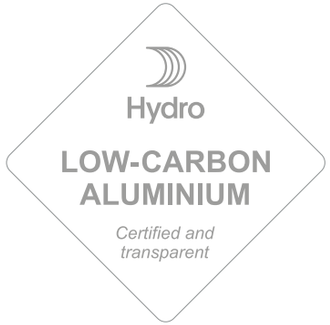


Hydro's low carbon and recycled product offerings

In response to climate change and the challenges facing the world, Hydro offers certified low-carbon and recycled aluminium products which help customers minimize the carbon footprint of their products while ensuring responsible production.

Hydro's low-carbon aluminium products carry a carbon footprint below 4 kilogram CO_2-equivalents (CO_2e) per kilogram aluminium compared to the 14.8 kilogram world average, and are designed to help customers reach their sustainability goals and meet the growing demands of climate conscious consumers.

Transparency is also key to understanding the actual climate impact of the end product. Hydro Low-Carbon Aluminium and Hydro Recycled Aluminium come with a documented environmental footprint, from mining or scrap source to the final metal, including input materials and transportation (Scope 1-3).



Hydro Low-Carbon Aluminium
Our low-carbon primary aluminium is produced using renewable power in the form of wind, solar, and hydropower and hyper-efficient production process, as with our low-carbon product Hydro REDUXA.

Our low-carbon offerings also include a range of recycled products with a high share of post-consumer aluminium scrap allowing for a footprint below 4 kilogram CO_2e per kilogram aluminium. Hydro CIRCAL is a premium, verified product containing at least 75% post-consumer scrap and carrying a market leading low CO_2 footprint of around 2 kilogram CO_2e per kilogram aluminium. We also offer low-carbon recycled products with a combination of recycled pre-consumer scrap, post-consumer scrap and low-carbon primary aluminium, with the promise of a footprint below 4.0 kilogram CO_2 per aluminium produced.

Learn more about how you could harness the power of Hydro REDUXA low-carbon aluminium.

Hydro Recycled Aluminium
In addition, Hydro produces recycled aluminium made from a combination of recycled pre-consumer scrap, post-consumer scrap, and primary aluminium collected and recycled close to the source, via our network of local recycling plants. The pre-consumer scrap comes from Hydro's and our customers' manufacturing sites, and the post-consumer scrap has lived a life in a product. The footprint varies according to the production site. Hydro offers Environmental Product Declarations (EPDs) for these products documented with share of pre-consumer and post-consumer material.

All our low-carbon and recycled aluminium comes from ASI[1] Performance Standard certified plants and with transparent disclosure of carbon footprint.

Learn more about how Hydro CIRCAL recycled aluminium could benefit your project.

[1] Learn more about the Aluminium Stewardship Initiative (ASI) at https://aluminium-stewardship.org/

Nature

Potential dependencies	• Surface water • Water flow maintenance • Climate regulation • Natural hazard protection	• Surface water • Ground water • Water flow maintenance • Climate regulation • Natural hazard protection	• Climate regulation • Natural hazard protection	• No material dependencies defined	• No material dependencies defined
Value chain activity	Bauxite mining 	Alumina refining 	Primary aluminium 	Aluminium recycling 	Aluminium extrusion 
Potential impacts	• Land-use change • Freshwater withdrawal • Non-GHG air emissions • Water Pollutants • Solid waste	• Land-use change • GHG emissions • Non-GHG air pollutants • Water emissions • Solid waste	• GHG emissions • Non-GHG air pollutants • Water emissions • Solid waste	• Non-GHG air emissions	• No material impacts defined

Nature-related impacts and dependencies for the aluminium value chain, based on internal evaluation and aligned with SBTN's Materiality Screening Tool and ENCORE's database of sector dependencies.

Nature related impacts and dependencies

As a global aluminium and energy company, Hydro recognizes the negative impact its global operations, and their associated value chain, can have on biodiversity and ecosystem services. Hydro's activities are relevant to all five of the main drivers of nature loss:

- Land- and sea-use change
- Direct exploitation of natural resources
- Climate change
- Pollution
- Introduction of invasive, alien species

Hydro's operations are also dependent upon ecosystem services provided by nature, including the provision of water, regulation of climate and protection from physical hazards, like floods and landslides. Aluminium production, specifically, is also dependent on the supply of energy, raw materials and other services that can impact biodiversity and ecosystems at the local, regional and global level. It is therefore Hydro's responsibility to manage the risks associated with these impacts and dependencies where they occur in the company's operations and business activities.

Biodiversity and ecosystem services

Hydro, as an integrated aluminium company that extracts and processes raw materials, recognizes the negative impact our global operations can have on biodiversity and ecosystem services. We therefore have a focus on responsible practices towards biodiversity management, and implement a risk-based approach to identify and minimize the biodiversity impact of our operations.

Within Hydro's aluminium value chain, the largest impact to biodiversity occurs at our mining operations in Paragominas in Northern Brazil. Although the area is characterized by habitat already degraded by human activity prior to mining, we recognize it still has an inherent biological and ecosystem value that we should seek to preserve and rehabilitate. There are areas of forest that would be considered natural habitat and we have confirmed the presence of several threatened species, some of which are endemic to the region.

Protect biodiversity

1:1 rehabilitation of available mined areas within two years (ongoing)

No net loss of biodiversity in new projects (ongoing)

No-go for new projects in UNESCO WHS and IUCN PAs I-IV

Land use change and removal of species habitat is the main way our mining operation can impact biodiversity features. Since taking ownership of the mine in 2008, Hydro has developed a strong reforestation program that seeks to mitigate the impact of forest removal through timebound targets to replant and reforest the areas. Currently, we work to progressively rehabilitate mined areas available for reforestation and replant within two complete hydrological seasons, referred to as Hydro's "1:1 rehabilitation target," and have successfully closed the historical deforestation gap inherited from the mine's former ownership.

These efforts in Paragominas are further supported by active research into mining rehabilitation methods, and measuring and monitoring the impact of our mining activities on biodiversity. This active research is conducted by the Brazil-Norway Biodiversity Research Consortium (BRC), an international group of research institutes, funded by Hydro.

Beyond our bauxite mining operation, we require that all sites perform risk assessments to identify material risks, and impacts to biodiversity and ecosystem services and, if identified, take appropriate mitigating actions to manage them. If there are risks to priority biodiversity features, like natural and critical habitat, then we require that sites develop a dedicated Biodiversity Action Plan to document this, and define the mitigating measures and monitoring that will be implemented.

Where Hydro makes investments into new projects or significant expansions to existing projects that can impact upon priority biodiversity, we require the project must be able to fully mitigate those impacts through preventative and remediative measures such that there is no residual impact to those features by closure of the project. This is defined as Hydro's "No Net Loss" ambition for new projects and major changes to existing operations. We have also committed to not develop any new projects within UNESCO World Heritage sites and legally protected areas listed as IUCN Protected Area Management Categories I-IV.

Read more

Biodiversity and ecosystem services:

- Global Supporting: Position Statement on Biodiversity and Ecosystem Services
- Global Procedure: Biodiversity and Ecosystem Services

Biodiversity and rehabilitation at Paragominas bauxite mine

Hydro owns and operates one bauxite mine, located in the municipality of Paragominas, in the northern part of Pará State, Brazil. This region is located within the Brazilian Amazon, in an area defined as the “Arc of Deforestation” and characterized by extensive deforestation for cattle ranching and soy production. Hydro’s mine covers an area of ca. 18 500 hectares which, prior to the mine, was a mix of both natural primary forest, secondary natural forest and agricultural land. The remaining primary forest, although considered natural habitat, has been historically impacted by selective logging to remove the tallest, commercially valuable trees from the area.

Despite this history of human impact, the remaining forest can still be considered part of a very specific biome in the Amazon, called the Belem Endemism Centre (BEC). A number of threatened fauna and flora species are present in the mine, some of which are endemic to the region. It is critical that Hydro takes measures to minimize and restore impacts to these biodiversity features in our day-to-day operations.

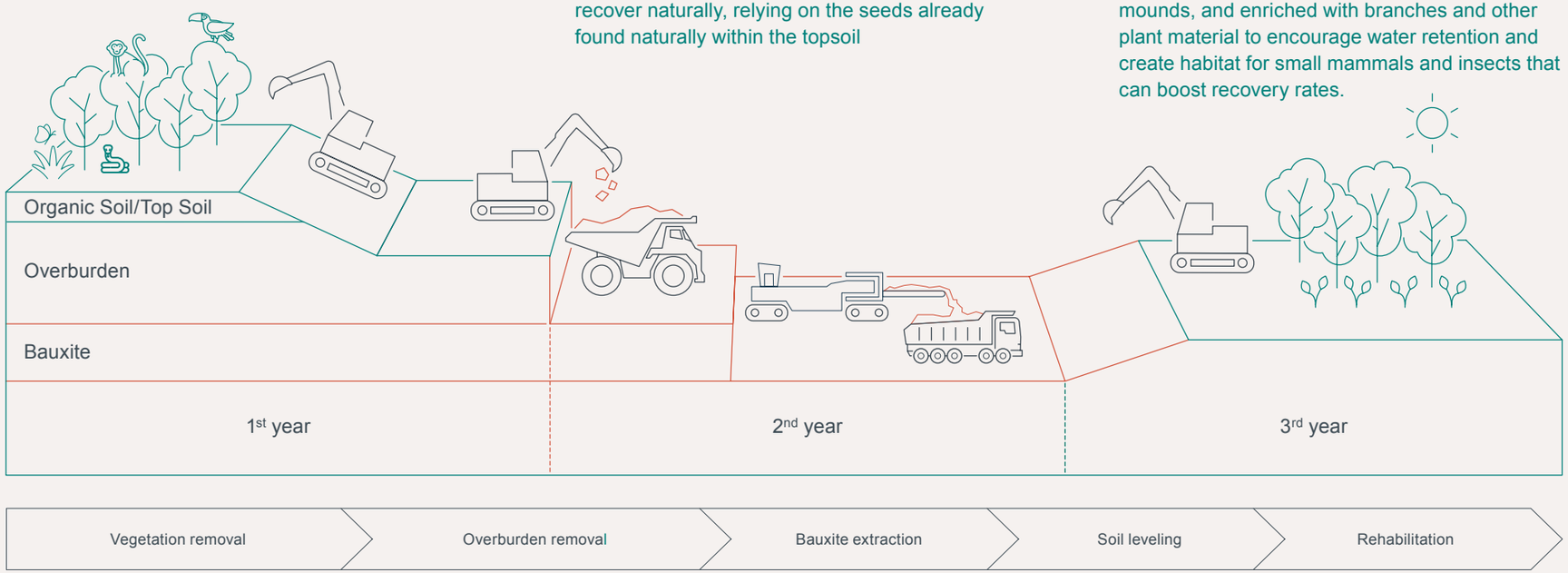
The rehabilitation process actually begins even before an area is deforested. Specialists conduct surveys of the area to record the type and abundance of plant species present, and also collect seeds and epiphytes that can be used to replant the areas after mining. There are also actions taken to remove small mammals and other types of fauna out of the area safely. Once the vegetation is supressed, the topsoil layer is removed and stored carefully, to preserve the nutrients and the natural seed bank contained within the soil. The overburden is then removed and deposited in adjacent areas that have already been mined.

The area is then mined in strips and, once all the bauxite has been removed, dry tailings are deposited into the area and covered with overburden. The topsoil is then carefully returned to the area to avoid compaction and shaped to allow for water retention. It is at this point that one of three rehabilitation techniques can be applied:

1 Natural regeneration: The area is allowed to recover naturally, relying on the seeds already found naturally within the topsoil

2 Plantation: Seedlings, grown in Hydro’s own plant nursery, are replanted in the area. The species composition closely matches what was there before mining. Hydro grows over 100 different native tree species, and produces up to 300,000
3 individual plants every year.

4 Nucleation: This is similar to the plantation method, but the soil is first shaped into small mounds, and enriched with branches and other plant material to encourage water retention and create habitat for small mammals and insects that can boost recovery rates.



Water stewardship

Water is a shared resource used by communities, ecosystems and economic activities. Access to water remains one of the biggest global challenges of the 21st century. Growing pressure on water resources, from population and economic growth, climate change, pollution, and other challenges, has major impacts on our collective social, economic, and environmental well-being.

Hydro's operations are reliant on access to sufficient water resources. Although our operations consume very little water, with the exception of evaporative losses, we do withdraw and discharge very large volumes of freshwater. We can therefore have a significant influence on the availability and quality of water in the catchments where we operate and must consider these impacts in our approach to water management.

The term "water stewardship" is increasingly used by industry, governments, and NGOs to describe actions to improve the efficiency and cleanliness of business operations and supply chains, while also facilitating the sustainable management of shared freshwater resources through collaboration. It recognizes that both business and societal risk is ultimately created when water is poorly managed or over-exploited.

As part of our own water stewardship approach, Hydro annually assesses the water balance of our global operations and determines to what extent we are located in water scarce regions. We use the World Resource Institute's Aqueduct tool to map the locations of our operational sites and determine which are located in water-stressed areas. In recent years, only a very small proportion of our sites are located within these areas, and those sites typically have a closed-loop water system that increases water reuse and minimizes our impact on the wider water catchment.

In reality, our most material water risks relate to the quality of the water we discharge into the environment, across our operational portfolio, and the management of excess volumes of water (e.g. from flooding and rainfall) at our bauxite mining and refining operations in Brazil.

All our operational sites treat their own wastewater, or deliver it to a third-party or municipal wastewater treatment plants for appropriate cleaning before discharge. In most instances, we follow the local and national regulations to determine the desired quality of our effluent discharge and monitor the appropriate parameters to ensure compliance.

We can also expect climate change to increase our exposure to flood risks at some of our key operational sites. It is important to identify those risks, and take positive steps to increase our resilience and capacity to manage them. An example of this is the significant improvements to our water management system in Alunorte, where we have not only increased our capacity to store and treat wastewater, but also increased our ability to direct and control the different water streams on site with additional redundancies in pumping capacity.

Read more

Documents under water:

- Global Supporting: Position Statement on Water Stewardship
- Global Procedure: Water Stewardship

Non-GHG emissions to air

Emissions to air are generated as a by-product of the aluminium production process and are produced at all stages of the value chain. Key air emissions generated by our operations include fluorides, sulphur dioxide, nitrogen oxides, polycyclic aromatic hydrocarbons and others. Typically, emissions to air are tightly regulated at a local and national level, and Hydro's operations strive to be legally compliant with those regulations.

Beyond legal compliance, Hydro has a responsibility to evaluate the pollution risk linked to our emissions to air, and how that may impact the environment and human health. Actions can then be taken to avoid and reduce potentially harmful emissions, through process optimization and effective treatment. All of our operational sites maintain an emissions monitoring program to measure and report on material emissions to air.

At our alumina refinery, Alunorte, the use of coal and heavy fuel oil emits significant quantities of sulphur dioxide, nitrogen oxides and particulate matter. The World Health Organization considers all three emissions as major contributors to air pollution, and there are strict legal permit limits placed on the refinery. In addition to maintaining compliance with these legal limits, the decarbonization project for the refinery will also lead to significant reductions in non-GHG emissions. It is this project that underpins Hydro's 2030 target to reduce material non-GHG emissions by 50%, from a 2017 baseline.

At our fully owned smelters in Norway, we have implemented a number of measures to reduce emissions of sulphur dioxide, nitrogen oxides, fluorides and polycyclic aromatic hydrocarbons (PAHs). Firstly, extraction systems within the operational areas ensure process and fugitive off-gases are captured. This captured airflow can then be treated through a combination of dry and wet scrubbers to reduce the concentrations of pollutants. Seawater-fed wet scrubbers are an effective means for capturing acidifying gases like sulphur dioxide.

To increase operational performance, Hydro has a set a target to reduce specific fluoride emissions from our fully-owned smelters to below 0.35 kg / tonne aluminium. This performance level is equivalent to what is required of a completely new build smelter within the EU.

Reducing emissions

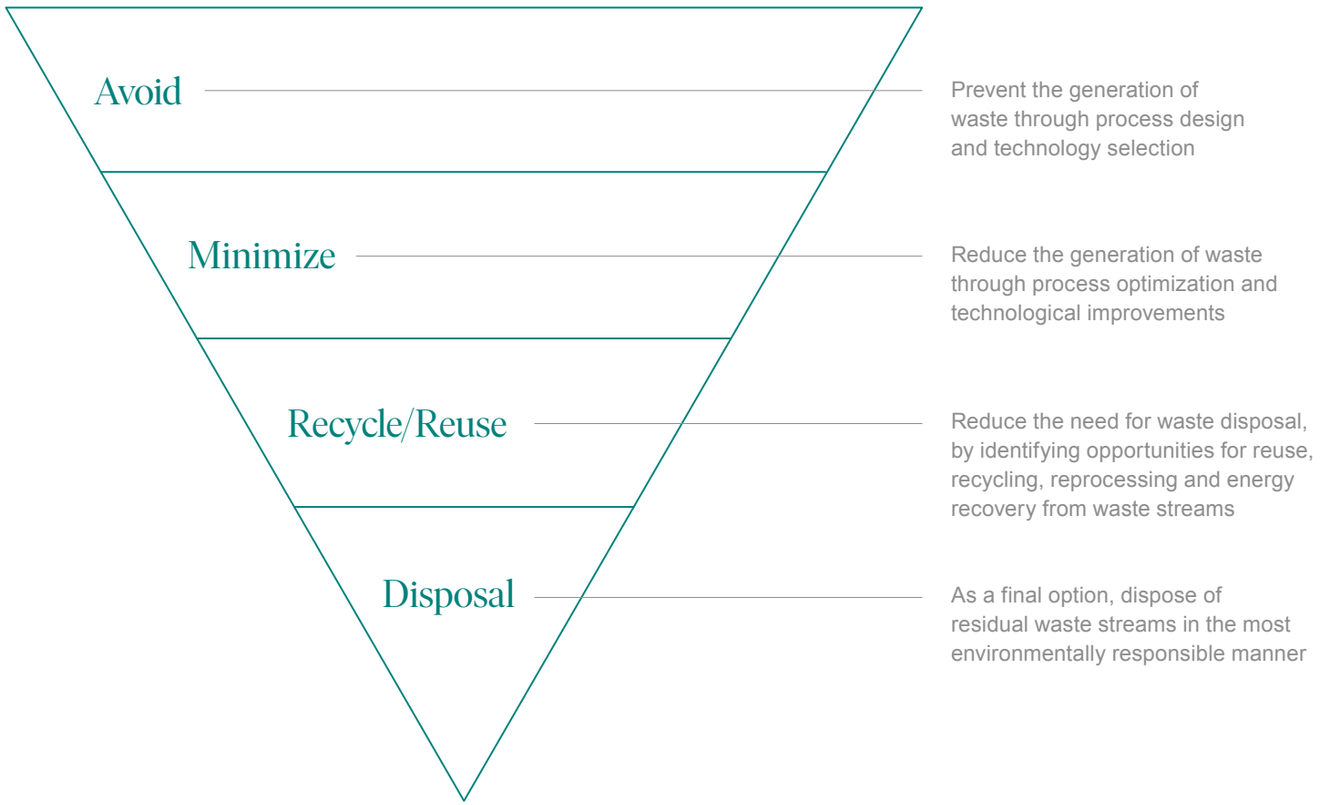
Reduce material non-GHG emissions by 50% by 2030 (2017 baseline)

Waste management

Waste is another by-product of the aluminium production process. In general, these wastes are classified, stored and disposed off according to the applicable regulations of the country in which the production site is located. However, Hydro has a responsibility beyond legal compliance to identify ways in which we can reduce our waste footprint.

To achieve this, our waste management approach follows the waste mitigation hierarchy. This hierarchy defines a series of process options, from most favorable to least favorable, to protect human health and the environment from impacts associated with the generation, storage, handling, transportation, and disposal of wastes. It aims to maximize the benefits from raw materials and process operations, so as to minimize the generation of waste. Following this approach, we have established a long-term target to eliminate the landfilling of recoverable waste by 2040. This target excludes bauxite tailings and residue, but accounts for all other operational waste-streams produced by our aluminium value chain operations.

Waste mitigation hierarchy



Our biggest challenges with respect to waste management occur primarily in our upstream processes. Tailings and bauxite residue from our mining and refining operations are by far the largest waste streams in our value chain and account for more than 90% of the total waste production in Hydro's consolidated activities. The production of spent pot lining (SPL) in our smelting operations is also a challenge as it is difficult to identify ways to effectively recycle this hazardous material.

Elimininating waste

Bauxite Tailings Dry Backfill (ongoing)

Landfill <35% of spent pot lining generated, by 2030

Utilize 10% of bauxite residue generated, by 2030

Eliminate landfilling of all recoverable waste, by 2040

Eliminate the need for new permanent bauxite residue storage, from 2050

Case study

Tailings dry backfill

Hydro's new method for storing bauxite tailings from its mine in Brazil has proven to be a more sustainable solution, and supports our sustainability ambitions to protect biodiversity and reduce our environmental footprint.

The tailings dry backfill technology allows inert tailings from bauxite mining to be returned to the already open and mined areas, before the rehabilitation process, instead of being deposited in separate, permanent storage areas. After drying in temporary storage for 60 days, the bauxite tailings are put back into the mined areas before the area is rehabilitated and reforested. This will further reduce the environmental footprint of bauxite mining and increase operational safety. The tailings from bauxite mining are chemically and physically similar to what was removed during the mining process.

Case study

Bauxite residue reutilisation

Globally, only 3 percent of the 150 million tonnes of bauxite residue generated annually is recycled. As part of our commitment to minimize operational impacts, we acknowledge the need to push research and development further to explore how to reuse bauxite residue. Research is currently conducted at local, national and international scientific institutions to utilize residue from Alunorte in the production of cement, secondary minerals, aggregate for concrete and soil conditioner, and more.

Research is also underway in partnership with the Federal University of Pará to use tailings from Paragominas in the production of roof tiles, bricks , refractory materials, low-carbon cement and even biodegradable plastic. We aim to reuse 10 percent of the bauxite residue generated by 2030, and to eliminate the need for new permanent storage areas for bauxite residue by 2050.

Wave Aluminium is our partner to build a plant to process bauxite residue from Alunorte, aiming to recover commercially viable materials from the waste product. When constructed, the plant in Barcarena will initially have the capacity to process 50,000 tonnes of residue per year, delivering on Hydro's vision to contribute to a circular economy.

Case study

SPL roadmap

Hydro has established a target to reduce the landfilling of spent potlining (SPL); By 2030, we will landfill less than 35% of SPL generated by our operations. To realize this goal, we have established a number of programs to explore opportunities across the waste mitigation hierarchy to achieve this. Research is being conducted to extend the electrolysis pot lifetime, to reduce the frequency of having to reline and replace the pot materials. Other research initiatives are linked to reducing the hazardousness of the first and second cut material of the SPL, to maximize opportunities for recycling and reuse internally, or within other industries like cement manufacturing.

Social

Social sustainability is about how we impact people through our business, both directly through our operations and indirectly through our value chain. With Hydro's integrated value chain, 32,000 employees, 25,000 suppliers, production sites in more than 40 countries and a high number of customers, our company has the potential to impact a large number of people.

The relationship between social sustainability, climate, and nature is increasingly being understood and receiving attention. Social sustainability is inextricably linked with climate change and the degradation of nature in two key ways:

1

Climate change and the degradation of nature undermine people's access to basic human rights, such as clean water, food and housing. There is also a strong link between climate change and other human rights breaches, including those associated with violent conflicts in a society.

2

The second link relates to the transition required to address climate change. It is widely recognized that the large-scale and fast-paced changes that need to take place as part of the green transition will create winners and losers and will impact vulnerable communities the most, unless such impacts are managed as part of the process. The 2015 Paris Agreement includes a clear recognition that the green transition must also be just, a recognition which has been further established and operationalized by the UN's 2030 Agenda "Leave No One Behind."

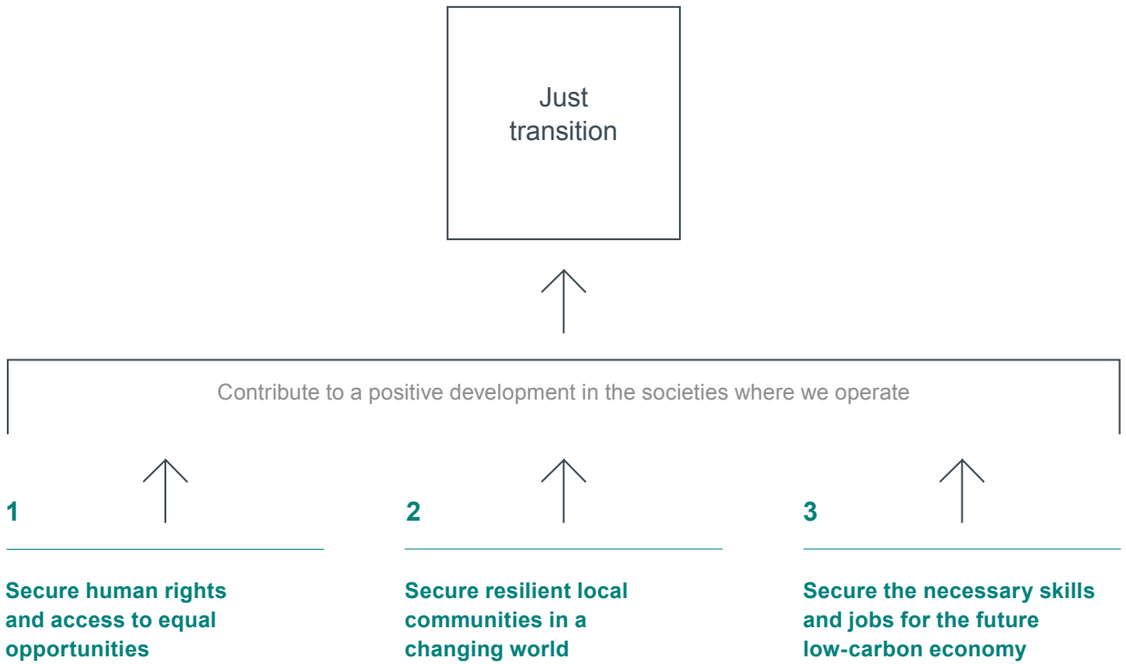
Just Transition

An economy-wide process that produces the plans, policies and investments that lead to a future where all jobs are green and decent, greenhouse gas emissions are at net-zero, poverty is eradicated, and communities are thriving and resilient.

Source: Just Transition Centre
(part of the International Trade Union Confederation)

Hydro's just transition framework

Hydro has developed a framework for supporting a just transition, focused on three key outcomes: respecting human rights and providing access to equal opportunities, contributing to resilient local communities, and supporting people to gain the necessary skills and jobs for the future low-carbon economy.



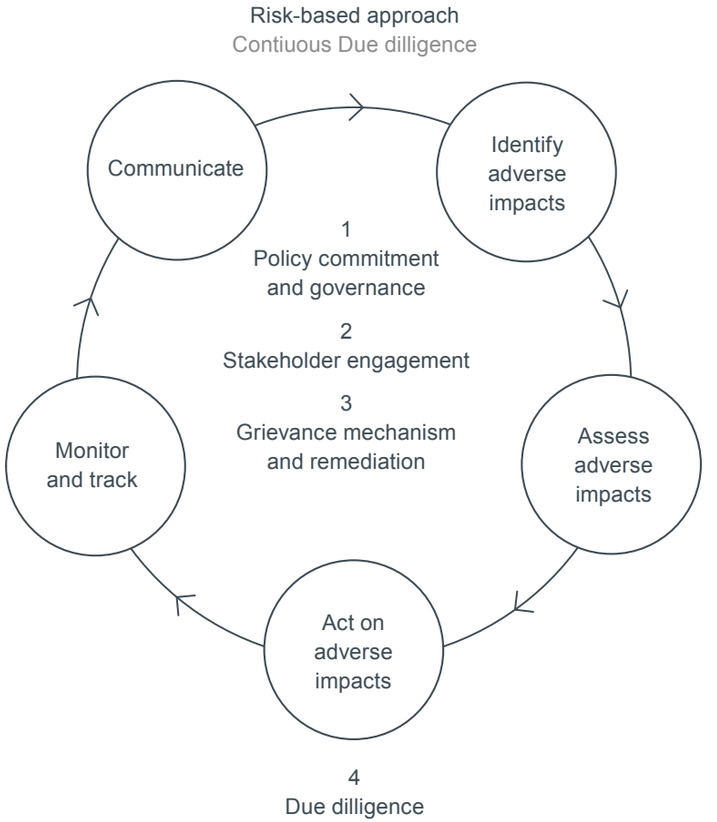
1

People have human rights protected and have access to equal opportunities

Respecting, supporting and promoting human rights is the foundation of our just transition work. While Hydro's ambition of improving lives and livelihoods wherever we operate goes beyond respecting human rights, the positive impact we seek to achieve can only be created when the rights of people affected by our operations and in our value chain are respected.

While companies' responsibility to respect human rights and address other social impacts associated with their business has long been recognized, recent years have seen a considerably jump in expectations from regulators, civil society and our customers. Legislation now requires companies to identify how they may impact peoples' human rights both in their own operations and in the value chain, and to put in place effective mitigation if they are at risk of breaching peoples' human rights.

Hydro conducts human rights due diligence, which is an internationally acknowledged methodology for companies to identify and address actual and potential human rights impact associated with their operations, including in their value chain. The methodology was initially introduced with the United Nations Guiding Principles on Business and Human Rights and has been further operationalized in the OECD Guidelines for Multinational Enterprises on Responsible Business Conduct.



2

Local communities are resilient in a changing world

Hydro can only succeed as a company if the communities around us also succeed, and investing in positive development is an important part of mitigating risk and negative impact. Through offering jobs, buying services, paying taxes and fees, and by being good neighbors, we contribute to the society to which we belong.

A key element in Hydro's approach to local community value creation and just transition is to strengthen the societies and communities where we operate. The way we do this differs from country to country and between communities. The main contribution is generated from our operations through production and purchase of goods and services, direct and indirect job creation, and tax payments. We engage in capacity building through targeted programs, to develop the competence of groups as well as individuals, and we have partnerships aiming to further enhance the public's knowledge about Hydro and our operations. In addition to Hydro's targeted programs, Hydro employees engage actively in supporting local communities on a voluntary basis.

In developing our just transition framework, we have looked at the communities where we have the largest presence, as well as communities which are uniquely exposed to just transition challenges to prioritize our work. Some of these at-risk communities face challenges related to poverty and inequality, physical climate change and challenges related to decarbonization efforts changing the nature of jobs and required skills in communities. While our approach to supporting resilience varies depending on the local context, a common factor is our partnership approach, working with local partners with strong knowledge of the local context, as well as strong engagement with local community representatives.

3

People have the necessary skills and jobs for the future low-carbon economy

A risk associated with decarbonization efforts is that social equalities increase as new technologies introduce the need for a different type of skill-set or bring other changes to the labor market. To address this, Hydro's just transition framework includes a focus on ensuring people have the necessary skills and jobs for the future low-carbon economy. For further information about this, see "Reaching 500,000 – building skills for the world of tomorrow."

Hydro's human rights due diligence consists of four core elements

1 **Policy commitment and governance**
Hydro's Human Rights Policy outlines our commitment to respect, support and promote human rights. The commitment is integrated in key procedures, including supply chain management, new projects, portfolio management and risk management. The policy us approved by the Executive Leadership Team and is available at Hydro.com.

2 **Stakeholder engagement**
We engage and collaborate with stakeholders internally and externally to understand and evaluate the effectiveness of our human rights management. This includes NGOs, unions, local associations, authorities and other relevant stakeholders. Engagement with stakeholders who may be impacted by our activities is particularly important. The type of dialogue conducted with affected stakeholder depends on the human rights risks identified, and the needs and expectations of those potentially affected.

3 **Grievance mechanism and remediation**
Grievance, or complaint, mechanisms are important tools to inform us of our impact on individuals and groups. To help facilitate informed and effective participation with people who are potentially affected by our operations, we establish or facilitate access to grievance mechanisms. We have several grievance mechanisms depending on stakeholder groups. At many of our sites, we collect information and complaints through community dialogue. In situations where we identify adverse human rights impact that we have caused or contributed to, we work to cooperate in, promote access to and/or provide remediation.

4 **Ongoing due diligence (Identify, assess, and act on adverse impacts; monitor, track, and communicate actions and results)**
As part of the due diligence process, we identify actual or potential adverse impacts on human rights, assess these impacts based on their severity and implement mitigative actions to address these. We also monitor and track the effect of the actions we put in place and communicate about the impacts and risks we have identified, the action taken and its effect.

Human rights due diligence is integrated in relevant business processes, including in the enterprise risk management process. As part of the diligence process we have identified prioritized human rights areas we are most at risk of impacting.

Access to equal opportunities is addressed partly through our human rights due diligence, and our focus on the rights of vulnerable individuals and groups in particular. Through our diversity, inclusion and belonging program we operationalize our commitment to provide equitable employment opportunities, and treating all employees fairly and with respect.

Hydro's prioritized human rights areas

Forced labor, modern slavery and child labor abuse

Discrimination and harassment

Freedom of association and collective bargaining

Decent working conditions

Health and safety

Access to information and participation in dialogue

Land rights and resettlement

Vulnerable individuals and groups

Some examples of Social programs: Embarca, Tipitix and Sustainable Barcarena initiative

Barcarena and the surrounding municipalities in Pará state in Northern-Brazil face serious social challenges, high levels of violence, unemployment and poverty. Hydro's Alunorte alumina refinery and primary aluminium production facility Albras are located in Barcarena, and the 250 km pipeline that transports bauxite slurry from Paragominas across seven municipalities. The region has limited access to essential services and it has a low score on the Human Development Index.

To support local development, Hydro has launched a range of social programs across Pará state, encompassing the seven municipalities where it operates. These programs are directed towards promoting sustainable development, education, income generation, capacity building and the conservation of Amazonian biodiversity, all while upholding human rights. They are structured around four key areas: Education and skills, value chain, quality of life, and biodiversity.

We have continually improved our strategy for investment in social programs and initiatives by engaging in transparent, respectful dialogues with our stakeholders. Our efforts are best illustrated by these three examples:

- Hydro Sustainability Fund (HSF): Established in 2019 with a commitment of BRL 100 million over ten years to support Barcarena's sustainable development. Currently, HSF funds over 30 projects, spanning from income generation, cultural promotion, to environmental preservation. HSF collaborates with 137 organizations under the Sustainable Barcarena Initiative (IBS) and partners with external contributors like USAID and the Mitsui Bussan do Brasil Foundation.
- Ativa Barcarena: An initiative that fosters sustainable food production and family farming, offering technical assistance, training, and promoting local products.
- Todos pelo Trabalho: This network provides free training and professional qualification courses, partnering with SENAI, SENAC, and IFPA, in collaboration with the municipality of Barcarena.
- TipTix: A project that bolsters the commercialization of products from local family producers, with a focus on community agri-food entrepreneurship. It also offers access to marketing services and microcredit.

In addition to these social initiatives, Hydro's employee volunteer program plays a crucial role in fostering internal engagement and addressing community needs. A large group of employees participates in volunteer programs organized at several of our locations in Brazil, engaging in activities such as food donations, fundraising, seed planting, and training for community leaders.

These initiatives illustrates Hydro's commitment to a just transition.

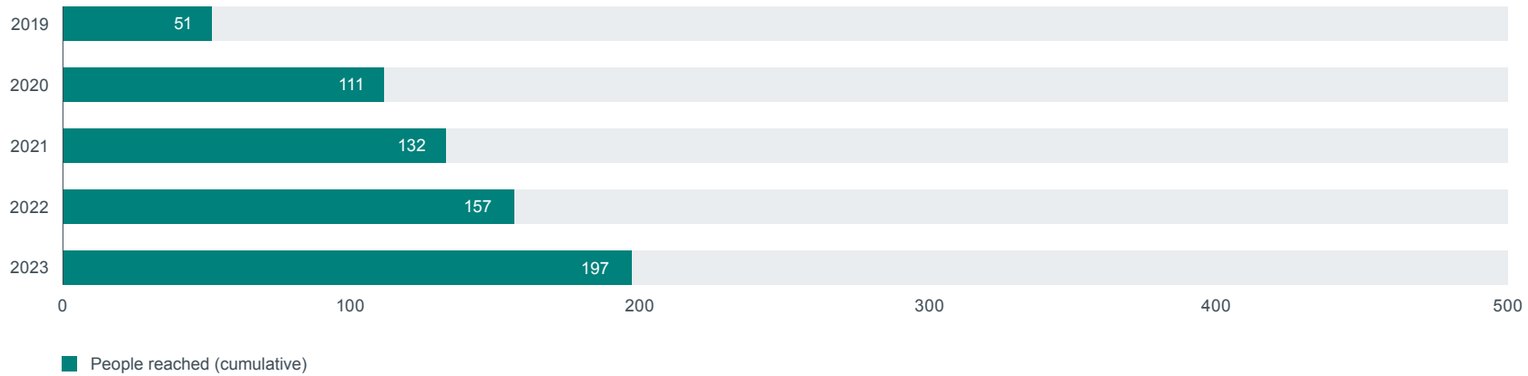
Reaching 500,000 – building skills for the world of tomorrow

Hydro's future success ultimately depends on the success of the local communities we operate, and is encompassed in our ambition to improve people's lives and livelihoods.

To retain and build a competent and skilled workforce is important for all companies, both for our increasingly digitized and sophisticated operations and sites, and for our specialized supply chains. The skills needed for jobs in the future will not be the same as today. To contribute to the development of the communities where we operate and build resilient supply chains, we have committed to contributing to quality education and capacity building for 500,000 people in our communities and for business partners from 2018 until the end of 2030.

Total people reached with skills and education towards 2030 target of 500,000

Thousand people



These 500,000 come in addition to the capacity building all our current employees receive through regular on-the job training and competence building.

The skills building initiatives we have identified seek outcomes and impacts that are mutually beneficial for Hydro as well as the wider society.

We contribute to quality education in our communities, especially within science, technology and maths, but also entrepreneurship and organizational skills.

- We seek to promote decent work throughout our value and supply chain (see below, Responsible Supply Chain, for details) and help educate strategic suppliers to strengthen their ability for economic growth and diversify their customer portfolio.
- In certain areas, such as the Pará state in Brazil, we also help strengthen local communities and institutions through capacity building on human rights and good governance.

Towards 2030, we will increasingly measure the impact of our different initiatives to better understand and target our educational efforts.

Responsible supply chain

With more than 25,000 suppliers, we have a significant indirect impact on society and the environment through our supply chain, and our suppliers are all important contributors to the success of our business. We engage, influence and work with our suppliers for continuous improvement and to mitigate potential negative impacts to people and the environment in our supply chain. A responsible supply chain is increasingly becoming a key element of our ability to deliver on our sustainability ambitions.

Our Approach

Our approach to responsible sourcing is based on the OECD Due Diligence Guidance for Responsible Business Conduct, and can be summarized in three steps:

1

Mapping of risks

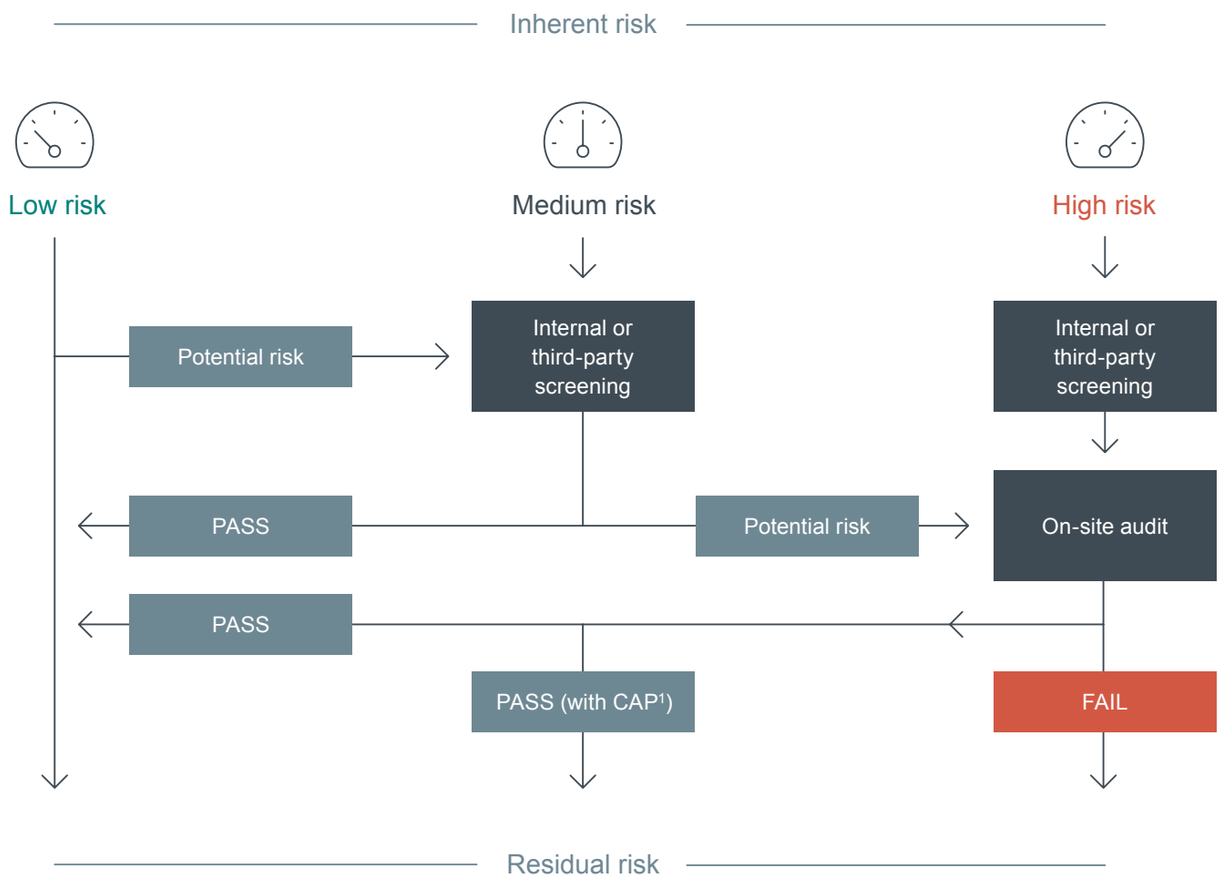
All suppliers are subject to a qualification process, including mapping of risks related to business practice, human rights, working conditions and environment. If we identify any concerns related to such issues, we conduct a more comprehensive review or audit of the potential supplier to clarify if the supplier meets our requirements before any agreements are signed. The mandatory due diligence process for all high risk suppliers is described in the company-wide procedure, Sustainability in the supply chain, and is based on three levels of inherent sustainability risk levels. See illustration on our supplier due diligence process on the next page.

2

Clear expectations

Hydro's Supplier Code of Conduct sets out the minimum sustainability requirements for all our suppliers. The code is based on internationally recognized standards such as the Universal Declaration of Human Rights, UN Global Compact and the ILO Core Conventions.

Supplier due dilligence process



[1] Corrective action plan

3

Support and development

We build our relationship with our suppliers on mutual trust and development. We actively discuss and promote ethical business practice, safe working conditions, human rights and environmental issues.

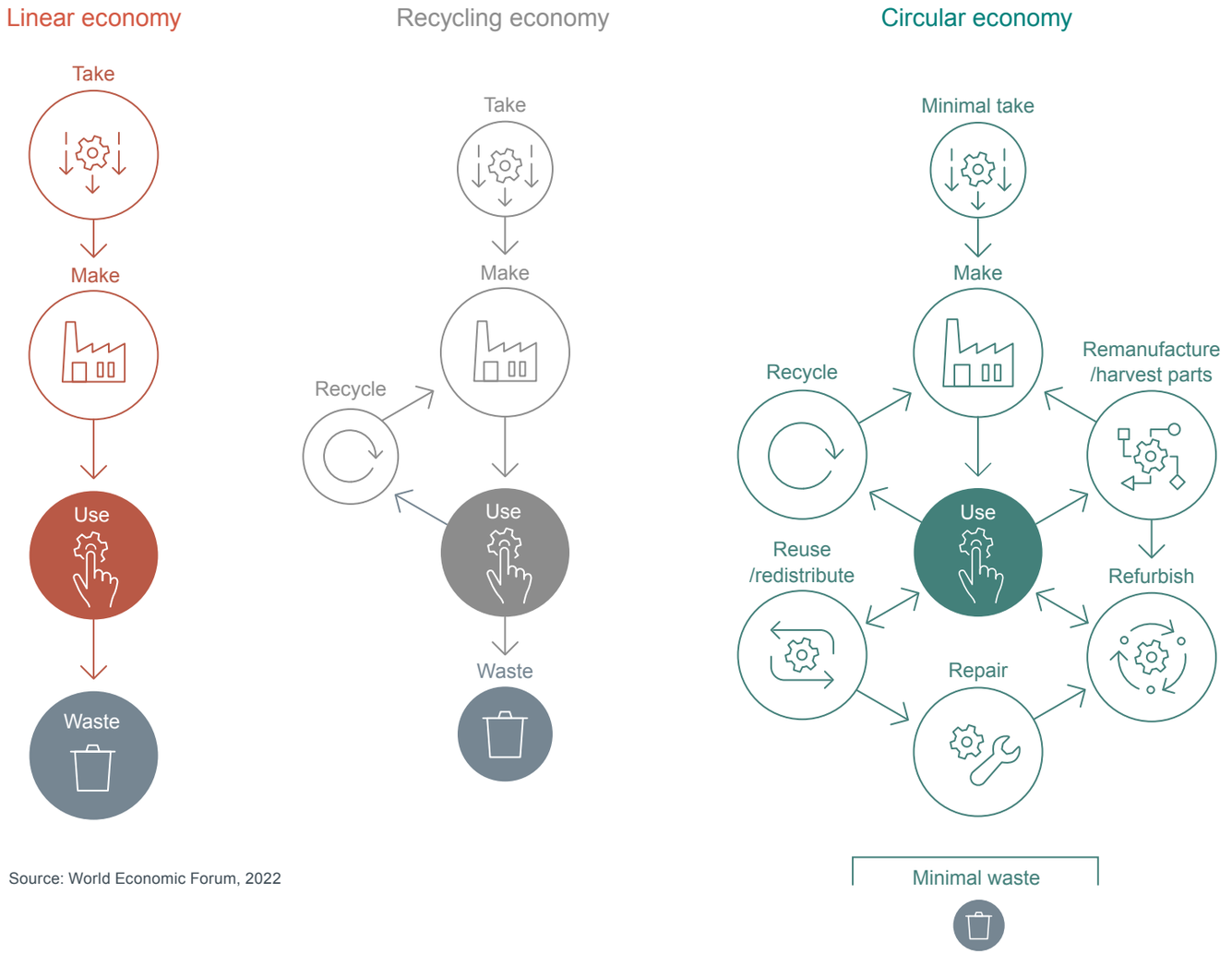
The principles set out in Hydro's Supplier Code of Conduct are made binding through contractual clauses to ensure suppliers and business partners reflect the values and principles Hydro promotes. Standard contracts also include clauses on auditing rights and the supplier's responsibility to actively promote the principles with its own suppliers/contractors and sub-suppliers/sub-contractors of any tier that have a material contribution to the supply of goods and services to Hydro under the contract. Failure to comply with the principles may result in a termination of the contract, but when possible, we always seek to work with our suppliers on improvement.

This is also important for our downstream customers and end-consumers – they need to trust that the products and solutions from Hydro can be traced and tested back to the mine, and that the comprehensive sustainability footprint – environmental and social – is documented for the right-sholders involved.

Circular economy

Circular Economy – enabling circularity

The transition to a fully circular economy requires a rewiring of the linear value chain, to design ecosystems where waste and pollution are eliminated, and all material and product flows circulate at their highest value.



Source: World Economic Forum, 2022

The circular economy is a concept that reconciles economic growth and sustainable development, and is widely regarded as to have three objectives: eliminate waste and pollution, circulate products at the highest quality for as long as possible, and to design products and services to regenerate nature. The concept emphasizes collaboration and innovation to address these challenges.

In Hydro, circular economy means supplying the transition to a low-carbon and resource efficient economy with more sustainable materials use through partnerships and innovative business models.

To enable this transition we have set up a framework to prioritize sectors, geographies, suppliers, and customers to take a proactive approach to integrate circular economy principles in business development around three main pillars: innovate for circularity, recycling and sorting, and waste to value.

Proactive

Reactive

Innovate for circularity

Develop products and solutions that fit within a circular economy. A proactive approach to design out waste, and accommodate recycling, reuse, refurbishment, disassembly and promote resource efficiency.

Recycling and sorting

Strengthen the recycling agenda, securing access to PCS and strengthen sorting to avoid downgrading, exploring new business models.

Waste to value

Turn waste to value. Develop business case for key waste streams to turn them into resources.

Design by Artbox

Hydro

Industries that matter

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Hydro is a leading aluminium and renewable energy company committed to a sustainable future. Our purpose is to create more viable societies by developing natural resources into products and solutions in innovative and efficient ways.