

GHG EMISSION REDUCTIONS IN THE GLOBAL ALUMINIUM INDUSTRY

In all regions, aluminium producers are investing in innovative solutions that reduce their environmental impact aligned with the industry's three GHG emissions pathways, aiming to support global climate goals by 2050. This paper (version 2) shows a growth of projects from 16 identified projects in 2021, to 50 in 2022.

PATHWAY 1

Electricity decarbonisation

More than 60% of the aluminium sector's 1.1 billion tonnes of CO₂e emissions (2018) are from the production of electricity consumed during the smelting process. Decarbonised power generation and the deployment of carbon capture utilisation and storage (CCUS) offer the most significant opportunity to reduce emissions to near zero by 2050.

PATHWAY 2

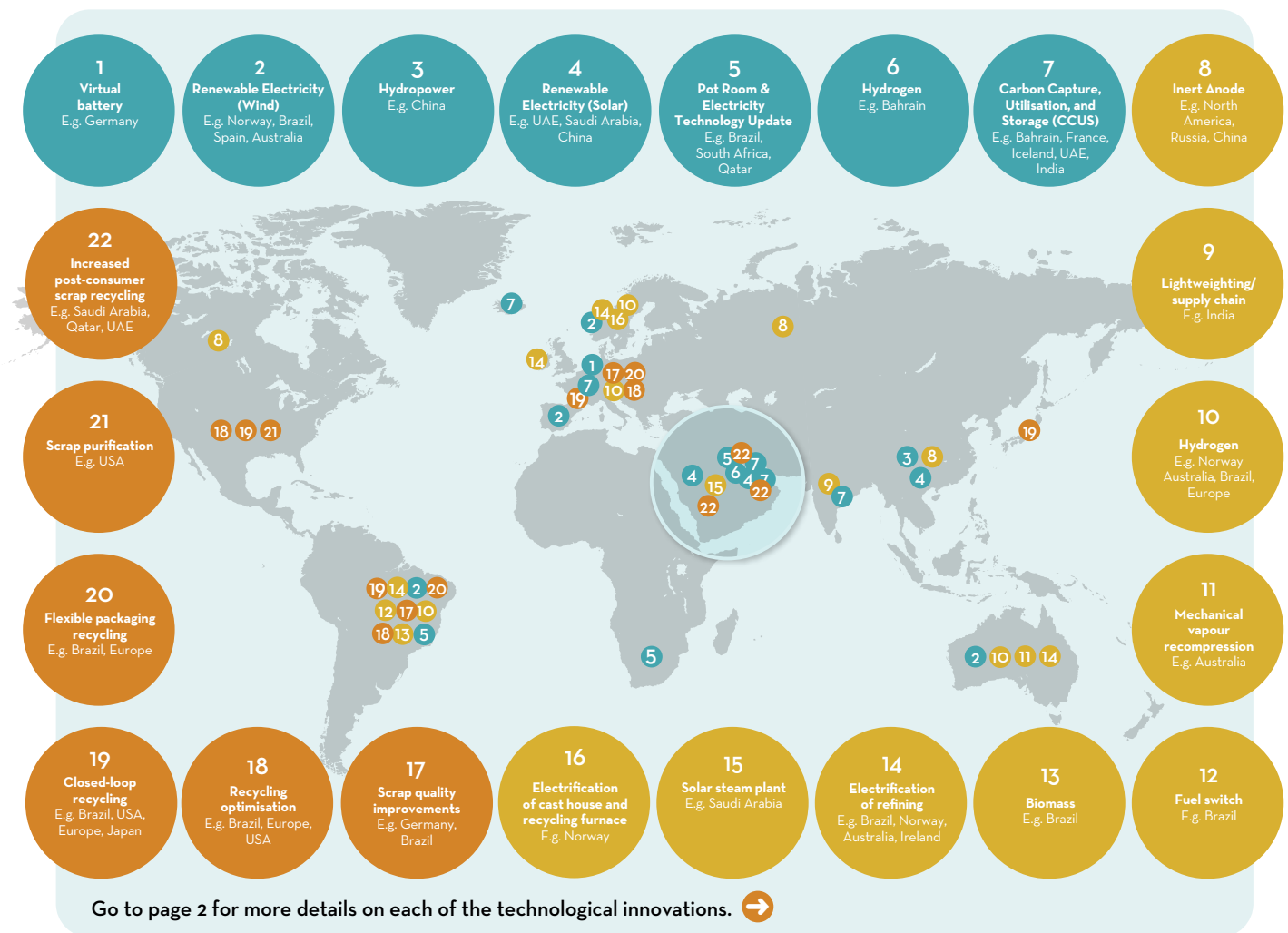
Direct emissions reduction

Electrification, fuel switching to green hydrogen and CCUS offer the most credible approach to reduce emissions from fuel combustion, while new technologies, such as inert anodes, can lower process emissions.

PATHWAY 3

Recycling and resource efficiency

Increasing collection rates, along with other resource efficiency actions, would reduce the need for primary aluminium by 20%, which in turn could cut the sector's annual emissions by around 300 million tonnes of CO₂e.



PATHWAY 1

1. Virtual battery

Germany

Increasing variable renewable energy in grid systems means aluminium smelters must find a way to deal with intermittent supply and operate flexibly. The addition of heat exchangers and ducting systems means smelters can act as virtual batteries responding to changes in electricity supply and demand as needed, as demonstrated in Germany.

4. Renewable Electricity (Solar)

UAE, Saudi Arabia, China

The use of solar power for aluminium production has been demonstrated, where electricity received from the grid is tracked and traced through the International Renewable Energy Certification System from an expanding solar project to the smelter.

7. Carbon Capture, Utilisation, and Storage (CCUS)

Bahrain, France, Iceland, UAE, India

Partnerships have been established to explore the feasibility of CCUS at smelters and address challenges including low concentration of off-gases.

10. Hydrogen

Norway, Australia, Brazil, Europe

Hydrogen could be used as a fuel source to produce high-temperature heat for industrial use. In Europe, opportunities to develop and operate hydrogen facilities to replace the natural gas used in cast houses and anode production are being explored. Meanwhile in Australia, the focus is on hydrogen as an alternative to natural gas in the calcination process at alumina refineries.

2. Renewable Electricity (Wind)

Norway, Brazil, Spain, Australia

Long-term contracts for renewable energy are being increasingly adopted to secure wind power supply to smelters. Such agreements enable further investment in wind turbines and growth in overall wind farm capacity.

5. Pot Room & Electricity technology update

Brazil, South Africa

In Brazil, 1,040 smelting pots will switch the smelter pot feeding process to an intermittent feed system that will reduce greenhouse gas emissions by an estimated 20%, as well as minimise consumption of aluminium oxide and improve energy efficiency.

PATHWAY 2

8. Inert anodes

North America, Russia, China

Commercial-scale prototype cells of inert anode technology are being tested in smelters in Canada and Russia. Inert anodes have the potential to eliminate all direct process greenhouse gas emissions from smelting.

11. Mechanical vapour recompression

Australia

As part of a trial in Western Australia, recycled steam will be used in the refining process to produce alumina. Through mechanical vapour recompression powered by renewable energy, waste steam that would otherwise be released into the atmosphere is redirected to a compressor that raises the pressure and temperature of the steam ready for reuse.

3. Hydropower

China

Over 4 million tonnes of smelting capacity will be relocated from coal-fired electricity-dependent regions to hydropower-rich provinces such as Yunnan. The change in power source for smelting could result in over 50 million tonnes of greenhouse gas emissions savings.

6. Hydrogen

Bahrain

Installation of a combined cycle power plant with a hydrogen-ready J-series gas turbine technology with a completion date of 2024.

9. Lightweighting/supply chain

India

A leading aluminium rolling company is using lighter and fuel-efficient transport as part of its efforts to find greener ways to supply to its customers. Its all-aluminium bulker can save up to 15,000 litres of fuel and 25 tonnes of greenhouse gases, and its 10-metre-long trailer, made from high-strength aluminium alloy, is 50% lighter than typical steel trailers.

12. Fuel switch

Brazil

Fuel switching can provide significant greenhouse gas savings. Switching a refinery from heavy fuel oil to liquefied natural gas could lower emissions by up to 600,000 tonnes at a single site.

13. Biomass

Brazil

In March 2020, utility partner company Combo Energia S.A. started operation of a new boiler system at the Alumina Refinery. CBA replaced its natural gas- and oil-fired boilers with a new boiler fueled by wood-chip biomass. The result is significantly lower scope 1 and 2 CO₂e emissions compared to 2019 (from 0,55 to 0,20 tCO₂/t aluminum oxide in 2021).

16. Electrification of cast house and recycling furnace

Norway

Direct electricity is being used for cast house and recycling furnaces.

19. Closed loop recycling

USA, Europe, Japan

Strengthening producer-consumer relationships has seen a rise in closed-loop recycling systems where manufacturing scrap can be collected and returned to the metal producer to be used again in the production process.

22. Increased post-consumer scrap recycling

Saudi Arabia, UAE

Build up of post-consumer scrap recycling infrastructure in regions with primarily primary production.

14. Electrification of refining

Brazil, Norway, Australia, Ireland

Electrification of refining with renewable energy sources has been used to replace coal and gas as the primary fuel source. Companies are exploring and implementing electric solution for both digestion and calcination.

PATHWAY 3

17. Scrap quality improvements

Germany, Brazil

Recycling is more efficient if scrap is sorted by alloy type. Companies have invested in advanced scrap sorting and shredding technologies that use X-ray transmission and sensors to better separate certain alloys.

20. Flexible packaging recycling

Europe, Brazil

New technology is enabling recycling of the aluminium content in multi-layered cartons and flexible aluminium and plastic packaging. Aluminium-plastic separation is 100% efficient, allowing the two materials to be fully recycled. The process will generate hydrogen that can be used to produce clean energy on-site. The project will help increase recycling rates, supporting a circular economy.

15. Solar steam plant

Saudi Arabia

The world's largest solar steam plant for alumina refining is being developed: a solar steam solution will provide most of the steam using solar based solution. This will reduce 600,000 tonnes of CO₂ per year; almost 50% of the refinery's current emissions.

18. Recycling optimisation

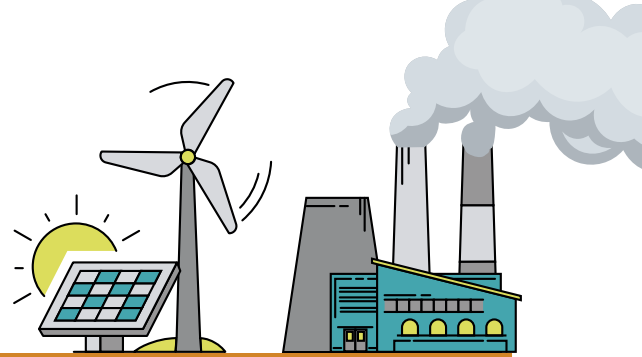
Europe, USA

Aluminium producers of cansheet and beverage cans in Europe are working towards a fully circular economy within 10 years. A roadmap is aiming for 100% aluminium beverage can recycling by 2030 through improved waste collection systems; better-sorting infrastructure; recovering aluminium from bottom ash treatment; and better consumer engagement.

21. Scrap purification

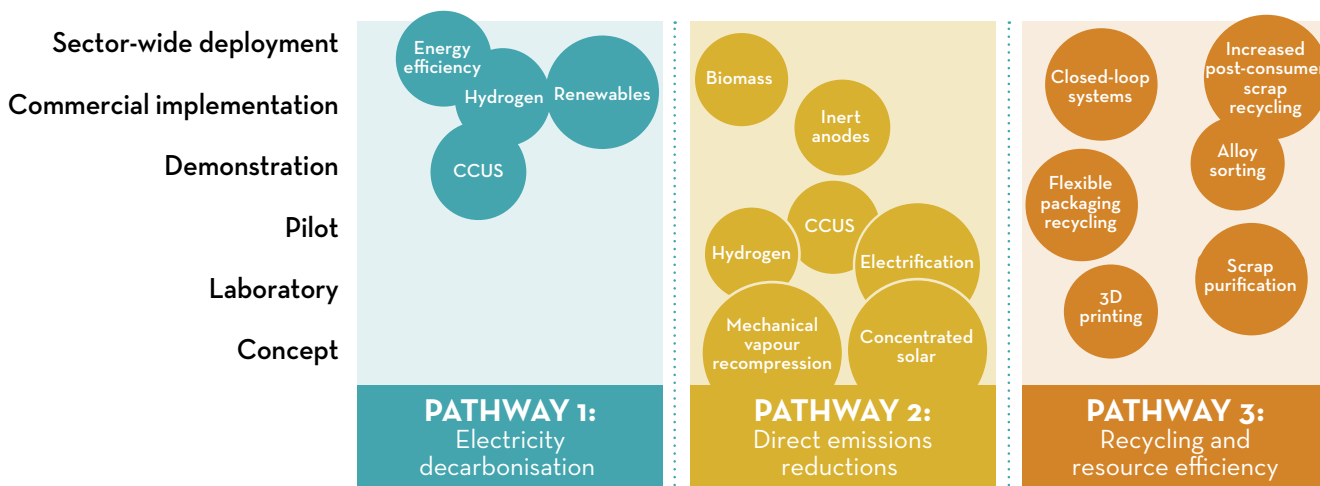
USA

The purification process can convert low-quality post-consumer aluminium scrap to purity levels coming from commercial smelters.



TECHNOLOGY MATURITY ACROSS THE THREE DECARBONISATION PATHWAYS

GHG emission reductions will require a range of technologies that are at various stages of development.



How can climate action be accelerated across the aluminium sector?

Aluminium provides climate-friendly solutions to some of the highest GHG-emitting sectors in our society. As demand for aluminium products grows, the development and deployment of decarbonisation technologies across the industry will be critical. This challenge is too big for any sector to overcome on its own and will require action and collaboration from stakeholders across the value chain.

Climate action in the aluminium sector could be accelerated with:



Policy

Frameworks that recognise a range of different solutions will be needed to enable the scaling up of key technologies and to incentivise circularity.



Investment

Ensuring access to capital at local, national and regional levels would enable the transition and support solutions to mitigate climate change.



Transparency and disclosure

Clearly defined metrics and common approaches enable dialogue, track progress and allow for informed decision making.



Public-private partnerships

Combining private technology and innovation with public resources would reduce risk and deliver impactful projects.



Customer-producer partnerships

Foster beneficial relationships across the supply chain and work towards a shared value or vision.



Collaboration

Collaboration within the sector, between sectors and with other actors will help develop and deploy essential, high-capital infrastructure and technology.

The IAI facilitates technology development, standardising reporting, transparency of data, and fostering collaboration with others on behalf of the global aluminium industry.