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The Path to Net Zero: A Miner's Playbook

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Nearly seven years ago, 195 countries committed to a legally binding international treaty known as the Paris Agreement to create a unified path toward a net-zero emissions world. Long-term goals of the agreement include substantially reducing greenhouse gas (GHG) emissions to limit the global temperature increase to 1.5 degrees Celsius over the next three decades and provide financing to developing countries to help enhance their abilities to adapt to and mitigate climate impacts.

These goals cannot be achieved without significant participation from the private sector. Therefore, what does Paris Agreement alignment mean for companies that produce and sell carbon- and energy-intensive products? Is there a place for these businesses on the path to decarbonization?

Progress Should Include the Highest Emitters

Within the metals and mining industry, both the operations and products at each point on the value chain are typically carbon intensive. For real progress to be made on reducing GHG emissions, high-emitting industries must be part of the solution, which is why we think a company like Alcoa not only has a role but may lead other sectors on the path to decarbonization. Alcoa mines bauxite, used to produce alumina, which is then used to produce aluminum. Alcoa sells some of its bauxite and alumina to third parties but primarily uses them for its own operations. As a result, the bulk of its sales are derived from selling aluminum. It is the largest third-party seller of aluminum, the largest operator outside of China, and the lowest emitter of carbon dioxide per ton across all global refiners. However, instead of simply offering token solutions to address climate change, like culling its smelters or selling to parties uninterested in adhering to the Paris Agreement, Alcoa is aiming to revolutionize the aluminum industry.

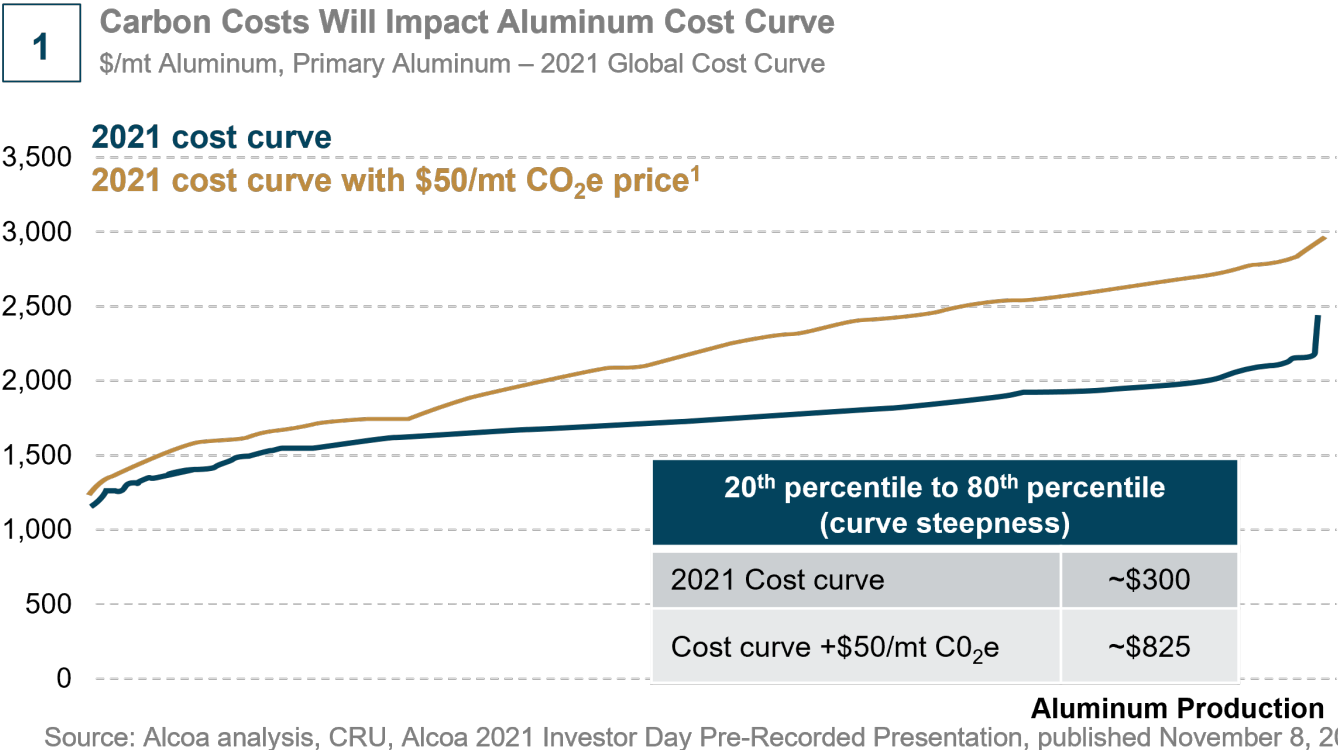
Can Low-Carbon Imply Low-Cost?

In 2016, Alcoa introduced a family of aluminum products under the brand Sustana, which is now the aluminum industry's most comprehensive portfolio of low-carbon products. These products may drive Alcoa's topline growth in the longer run while also lowering costs, especially as the market begins to distinguish between raw materials inflation and true pricing power of a low-carbon product. This pricing power will become more apparent as the market perception of low-carbon aluminum shifts to being viewed as a specialty product rather than a basic commodity. Peers such as Rusal, Rio Tinto, and Hydro have followed in Alcoa's footsteps and released low-carbon aluminum products. Premiums for low-carbon aluminum products reportedly run in the range of \$10 to \$15.

The world's only low-carbon, smelter-grade alumina brand is EcoSource, produced by Alcoa under its Sustana umbrella. EcoSource produces 50% less carbon than the global alumina industry average. While peers have developed low-carbon aluminum products, no one else has developed a low-carbon, smelter-grade alumina. Aluminum is only as "green" as its inputs, and alumina is a key component in aluminum.

It is prudent for Alcoa to include carbon pricing in its cost curve analysis, not only because it is an important factor in modeling, but because it shows how low-carbon solutions also can be low cost over time. This practice

could be an example for other sectors that are hesitant to increase capital expenditures (capex), operating expenses (opex), or R&D to incubate low-carbon technologies and solutions. [Chart 1](#) illustrates how Alcoa factors carbon pricing into its Sustana family cost curve.



1. Applies \$50/mt price to scope 1 & 2 emissions.

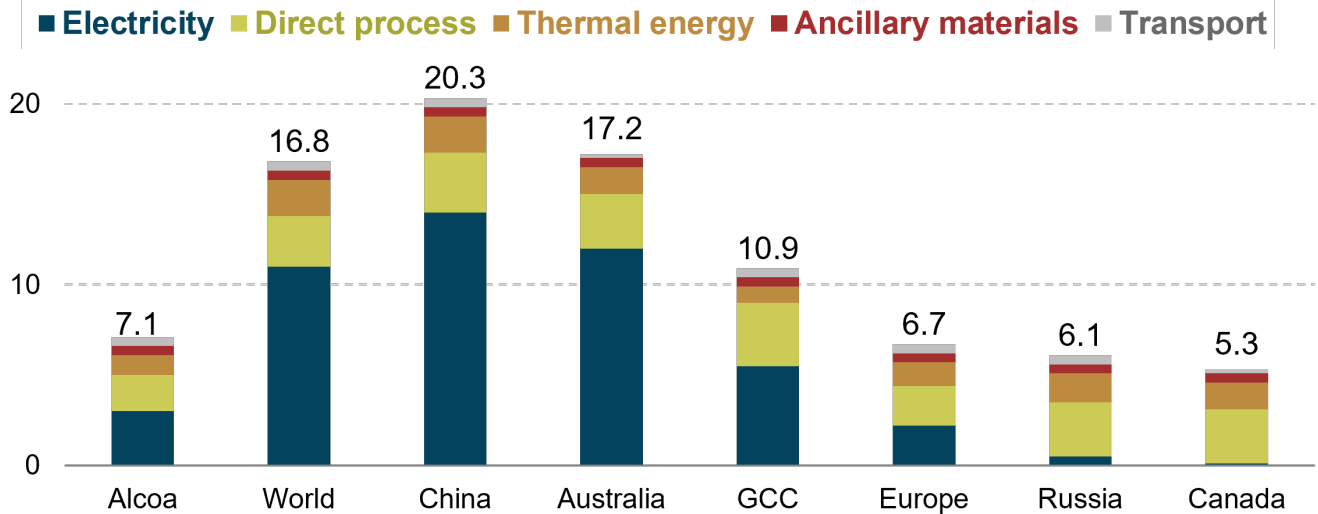
Alcoa and Rio Tinto have formed a joint venture, ELYSIS, to focus on creating a new process for smelting aluminum that would completely eliminate the carbon dioxide associated with direct smelting and replace it with oxygen. *Yes, they are inventing a process that not only eliminates all carbon dioxide from being emitted when aluminum is made but also produces oxygen as a by-product.* Apple is running proofs of concept with ELYSIS, and interest is growing across Alcoa’s customer base as the cost to use carbon in many parts of the world continues to increase. The ELYSIS technology package is going to be available for adoption or transfer to Apple in 2024. Hot metal production for Apple is estimated to begin in 2026 with other customers expected to ramp shortly afterwards.

ELYSIS is not just beneficial for the environment, but it was designed to also compete with conventional technology from a financial perspective. Since it uses zero carbon, the product is expected to garner a premium in the market relative to traditional aluminum and low-carbon aluminum products. At the same time, ELYSIS is targeting 15% lower operating costs than conventional methods. While ELYSIS will require additional costs via proprietary technology and materials, it will not require significant plant property and equipment and maintenance, which are necessary in the production of traditional aluminum. As a result, the amount of labor needed will also be reduced.

Charts 2 and 3 show how innovation within Alcoa has improved efficiencies and reduced costs as the company prepares to move along its net-zero pathway.

Breakthrough Technologies – Lower Costs, Increased Efficiency, and Lower Carbon

Emissions (mt CO₂/mt Aluminum), Scope 1, 2, and 3 carbon intensity, 2020¹

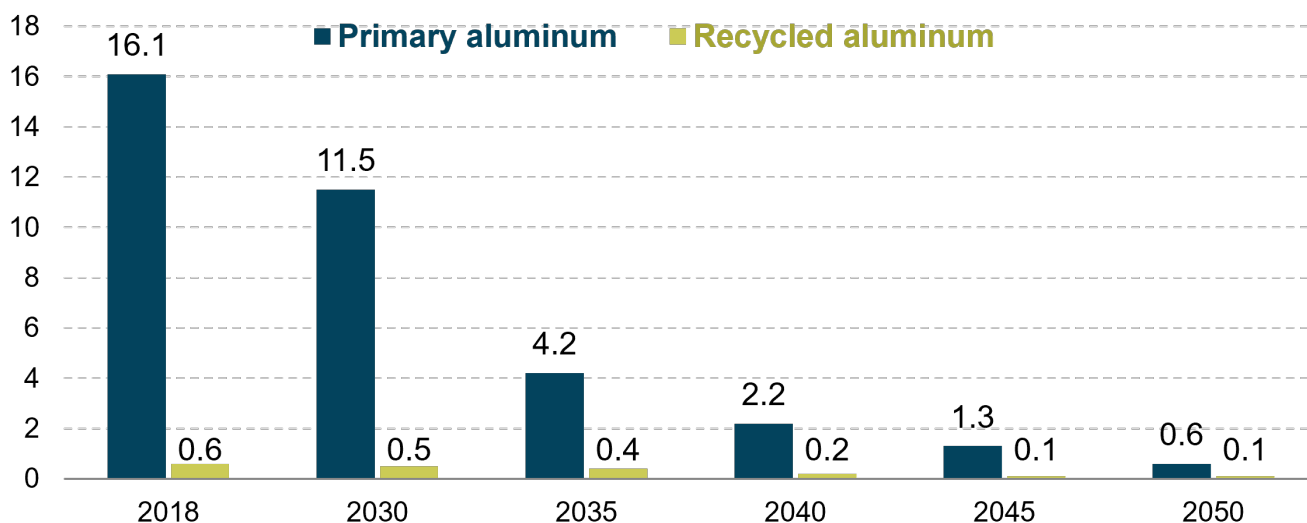


Source: IAI, Alcoa 2021 Investor Day Live Presentation, published November 9, 2021

1. Emissions (mt CO₂ /mt Aluminum) include Scope 1, 2, and 3 except for downstream customers beyond midstream producers such as rolling mills, extrusion plants, etc. Emissions within the average include Scope 3 emissions from raw material suppliers and transportation but exclude alloying agents. Does not include Scope 3 resulting from use of externally sold bauxite and alumina. Data from Alcoa internal data for Alcoa-specific electricity, direct process, and thermal energy. Data from IAI all else.

IAI Emissions Pathway for 1.5-Degree Scenario

Emissions (mt CO₂/mt Aluminum)



Source: International Aluminum Institute (IAI), Alcoa 2021 Investor Day Live Presentation, published November 9, 2021

Conclusion

Leaders and adopters of the Paris Agreement can be found across all sectors, including materials. As companies and countries continue on their paths toward a net-zero world, carbon pricing is likely to pressure the returns of business models that are carbon intensive. The investments Alcoa is making demonstrate there is opportunity for these companies to not only exist in a net-zero world but perhaps be more competitive and generate higher returns. Ultimately, net-zero commitments cannot be achieved without participation from materials companies such as Alcoa.

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