

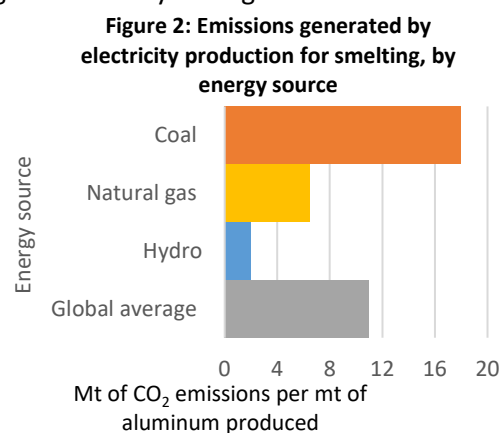
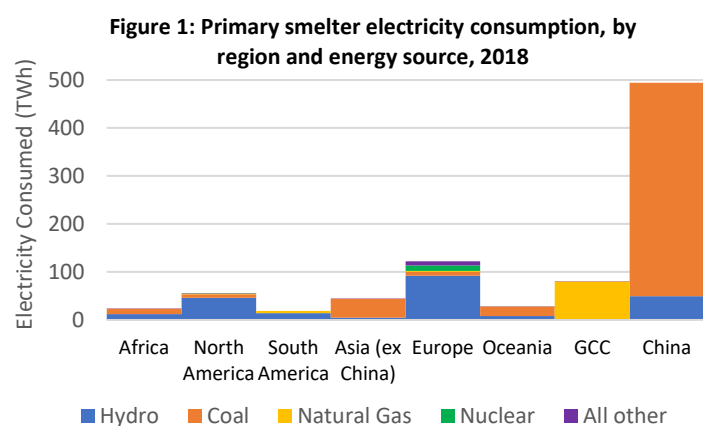
## Carbon Border Adjustments: A Catalyst for Lower Aluminum Industry Emissions?

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*The global aluminum industry is a major source of greenhouse gas (GHG) emissions (primarily carbon dioxide (CO<sub>2</sub>)). However, efforts are underway throughout the industry to promote the use of “low-carbon” aluminum and to adopt technologies that reduce GHG emissions.<sup>1</sup> In addition, the EU is considering a carbon border adjustment that could raise prices for imported aluminum products that are manufactured using carbon-intensive energy sources such as coal. Such trade policies, analyzed here, could help accelerate the industry’s move toward a lower carbon future.*

**Emissions in the Primary Aluminum Industry:** According to the Columbia Climate Center, the production of new (i.e., primary) aluminum is estimated to account for 1 percent of global GHG emissions. Direct emissions are generated from the fuel used to mine bauxite ore, refine the ore into alumina, and to smelt the alumina into pure molten aluminum. Indirect emissions are generated from creating the electricity required for the electrolysis (i.e. smelting) of aluminum. Aluminum smelting is an energy-intensive process—primary smelters are estimated to account for 4 percent of global electricity consumption. Not surprisingly, the electricity required to power smelters is the largest source of GHG emissions in the primary aluminum production process, accounting for about 55 percent of the total.

**Emissions by Region and Energy Source:** As the world’s largest producer of primary aluminum, China is the leading contributor to the global industry’s GHG emissions. Data from the International Aluminum Institute (IAI) indicate that China accounted for 56 percent of global primary aluminum production in 2019. Moreover, the country’s smelters rely predominantly on coal power plants for their electricity needs (see figure 1). Of the three major energy sources that supply electricity to the global primary aluminum industry (coal, hydropower, and natural gas), coal accounts for the highest amount of GHG emissions—approximately 18 metric tons (mt) of carbon dioxide (CO<sub>2</sub>) are generated per mt of primary aluminum produced (see figure 2). Emissions per ton from hydro powered smelters are about 2 mt of CO<sub>2</sub>; emissions from natural-gas powered smelters range from 5-8 mt; and the global industry average is 11 mt.



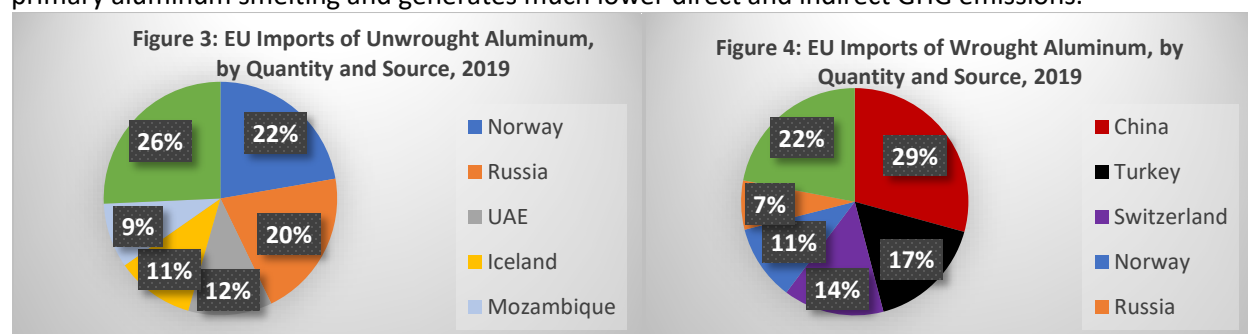
Sources: Hobson, “[Hydro-powered Smelters Charge Premium for ‘Green’ Aluminum](#),” Reuters, August 2, 2017; IAI, “[Primary Aluminum Smelting Power Consumption](#),” accessed June 29, 2020. GCC stands for Gulf Cooperation Council which includes Bahrain, Kuwait, Oman, Qatar, Saudi Arabia, and the United Arab Emirates. Data for Europe include Russia, Iceland, and Norway.

<sup>1</sup> Primary unwrought aluminum is aluminum (either pure or subsequently alloyed) produced directly from electrolytic smelting of alumina, typically at a primary smelter. Secondary unwrought aluminum (usually alloyed) is produced by melting down aluminum scrap along with some primary aluminum and alloying metals. Wrought aluminum includes products that are rolled, drawn, extruded, forged, or otherwise mechanically formed from unwrought aluminum.

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**New Technologies:** Energy intensity (i.e., the amount of energy required to produce a metric ton of primary aluminum) in the global aluminum industry declined between 2000-17 due to advancements in smelting technology. In recent years, Chinese producers have constructed large, vertically integrated, and energy-efficient smelters that have among the lowest average energy intensity in the world, however these smelters are primarily supplied with electricity from captive coal-fired power plants. Outside of China, other aluminum producers have made advancements in emissions technology and are marketing “low-carbon” primary aluminum produced using less carbon-intensive sources of energy such as hydropower. Firms such as Rusal, Alcoa, Rio Tinto, and Norsk Hydro now sell certified “low-carbon” aluminum. In 2019, Alcoa and Rio Tinto partnered with Apple and the governments of Canada and Quebec to fund a joint venture called “Elysis” to develop a “carbon-free” smelting technology. This technology replaces carbon-based anodes with proprietary inert anodes that produce oxygen as a byproduct. The Elysis technology could eliminate 6.5 million mt of GHG emissions annually.

**EU Carbon Border Adjustment (CBA):** While the primary aluminum smelting industry has made significant progress in reducing energy intensity and GHG emissions, a 2019 proposal by the EU (the largest import market for unwrought and wrought aluminum products) to apply a CBA (i.e., tax) to imports of aluminum and other products could intensify these efforts. While the EU has yet to determine how a CBA would be calculated and applied, it could have a significant impact on the global supply chain for aluminum given the large differences in GHG emissions across producing countries. Although the EU imported most of its unwrought (i.e., primary) aluminum from low-carbon producers in Norway, Russia, and Iceland in 2019, China accounted for the largest share of the EU’s imports of downstream wrought aluminum (see Figures 3 and 4) and these products predominantly embody Chinese-produced primary aluminum. A CBA would likely raise the price for aluminum products imported from countries that are dependent on carbon-intensive energy sources like coal (e.g., China) relative to those countries who rely on lower carbon-emitting sources of energy like hydropower (e.g., Norway, Russia, Iceland), and to a lesser extent natural gas (e.g., GCC region). For example, in a scenario where the EU adds a CBA of 20€/mt of CO<sub>2</sub> emissions to imported aluminum products using emissions data presented in Figure 2, imports from China could face a total CBA of 360€/mt of primary aluminum, while imports from Norway and Russia may only face a CBA of 40€/mt. A CBA is also likely to benefit secondary unwrought aluminum producers who melt recycled scrap aluminum to produce unwrought aluminum, a process that is 92 percent more energy efficient than primary aluminum smelting and generates much lower direct and indirect GHG emissions.



Source: Global Trade Atlas. HS 7601 (Figure D); HS 7604, 7605, 7606, 7607, 7608 (Figure 4).

Sources: Alcoa. “[Elysis](#).” May 10, 2018; Aluminum Association. “[Secondary Production](#).” Accessed June 30, 2020; Edwards, Neil. “With Green Aluminum Flowing, Manufacturers Struggle to Make Product ESG Top Priority.” *Forbes*, July 22, 2020; Fernandez Pales, Aracelia, Peter Levi, Tiffany Vass. “[Tracking Industry 2019: Aluminum](#).” IEA, May 2019; Guarascio, Francesco and Jonas Ekblom. “[What an EU Carbon Border Tax Would Look Like](#).” *Reuters*, December 10, 2019; Home, Andy. “[Sustainability the New Battleground for Aluminum Producers](#).” *Reuters*, October 22, 2019; IAI. “[Primary Aluminum Production](#).” June 22, 2020; IAI. “[Primary Aluminum Smelting Energy Intensity](#).” May 19, 2020; Nellis, Stephen. “[Apples Buys First-ever Carbon-free Aluminum from Alcoa-Rio Tinto Venture](#).” *Reuters*, December 5, 2019. Tyabji, Nico and William Nelson. “[Mitigating Emissions from Aluminum](#).” Columbia Climate Center, accessed June 26, 2020.

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