

Grid Power, Industrial Might: The Energy Solution to America's Aluminum Problem



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Producing primary aluminum ranks among the most energy-intensive industrial processes on Earth. A single aluminum smelter consumes approximately 11 terawatt-hours of electricity each year, an amount similar to the annual consumption of a major U.S. city like Boston or Nashville. To remain economically competitive, an aluminum smelter requires a long-term electricity contract lasting between 10 and 20 years at a rate of about 30 to 40 dollars per megawatt-hour.ⁱ Since energy costs make up roughly 40 percent of total production expenses,ⁱⁱ the industry is highly sensitive to fluctuations in power prices and supply, which has earned it the nickname “congealed electricity.”

Aluminum forms the foundation of both the U.S. economy and national security. Its unmatched blend of lightweight strength, corrosion resistance, and electrical conductivity makes it indispensable for military vehicles, missile systems, and the high-voltage transmission lines that keep the nation's grid alive. The Department of Defense depends on aluminum for armor plating, structural components, and propellants, while the commercial sector relies on it for everything from power infrastructure to automobiles and commercial aviation. Without aluminum, the backbones of modern industry and military technology weaken.

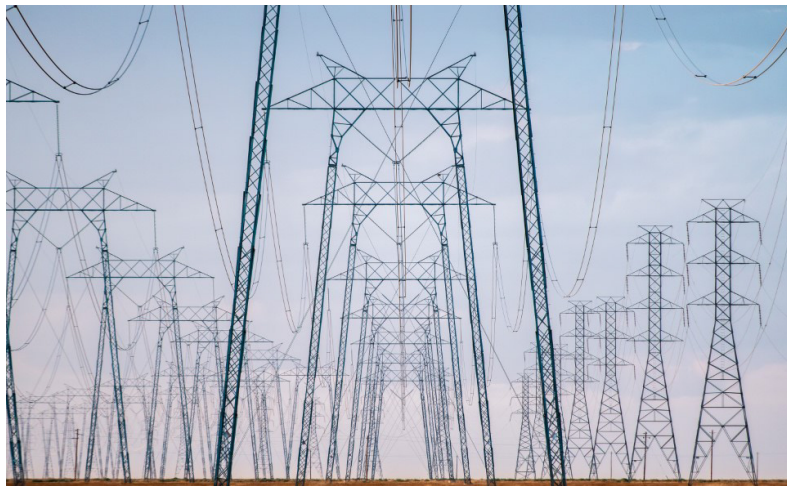
The Power Price Problem: Case Studies of Decline

Despite its strategic importance, the U.S. primary aluminum industry faces a crisis. As of 2024, there were only four operating smelters in the United States, with two additional curtailed facilities.ⁱⁱⁱ The combined capacity of these six smelters is about 1.43 million tons,^{iv} but actual production is just 678,000 tons, only 52 percent of total capacity and the lowest output since the 1950s.^v This decline is directly attributable to the lack of access to affordable electricity, which has forced smelters to curtail or cease operations and deterred new investment. Tariffs on aluminum imports, originally implemented under Section 232 of the Trade Expansion Act of 1962, were expanded to 50 percent in June 2025 with the goal of restoring the domestic industry to 80 percent capacity utilization,^{vi} which would produce more than 1 million tons of aluminum annually. Achieving this target would demand an additional 6.3 billion kWh of electricity, highlighting the scale of the energy challenge facing the industry.

"It's important for us to have low-cost, long-term energy in order to make aluminum in the United States."

- Bill Oplinger, CEO, Alcoa Aluminum





The Global Context: Competitive Disadvantages

The U.S. aluminum industry is at a significant competitive disadvantage compared to global producers, particularly those in regions with abundant, low-cost energy. Canada and Norway, both hydropower superpowers,^{vii} produced five times more and two times more aluminum, respectively, than the United States did in 2024.^{viii} Over the past ten years, China has grown its aluminum production significantly, consolidating its position as the world's largest producer. In 2013, China's annual primary aluminum output was approximately 22 million tons.^{ix} By 2024, China had nearly doubled its output, reaching 43 million tons, almost 64 times the output

of the United States in the same year.^x Without intervention to stabilize and reduce energy costs, the United States risks losing its remaining smelters and becoming entirely dependent on foreign aluminum, much of it from adversarial nations, for both civilian and defense needs.

Firm, Baseload Power Meets Aluminum's Cost and Reliability Needs

As highlighted above, electricity represents about 40 percent of total production costs for aluminum, and stable, predictable rates are vital for long-term planning and competitiveness.^{xi} Firm baseload power, delivered by technologies such as geothermal, hydropower, and nuclear generation, provides the steady, high-quality electricity that aluminum smelters require.

In 2019, Alcoa secured a seven-year agreement for its smelter in Massena, New York for a 240 megawatt hydropower allocation through the New York Power Authority. Thanks to this agreement and the smelter's colocation with the St. Lawrence River, the power rate was indexed to the price of aluminum and has increased or decreased depending on the market price of aluminum.^{xii} Agreements such as these ensure smelters have access to low cost, reliable, firm power, enabling continuous operations that maintain the workforce and strengthen local economies.

Transmission Expansion Secures America's Long-Term Industrial Advantage

Supplying large industrial users, especially those without the margins for colocation, with more reliable, lower-cost power than they receive today requires expanded transmission, the nation's power highways. Expanded transmission capacity enhances reliability and reduces the risk of outages, which cost the U.S. economy an estimated \$150 billion annually.^{xiii} For large manufacturing enterprises, a single hour of downtime can result in losses exceeding \$5 million.^{xiv} A robust, modern transmission network enables power to flow across regions, smoothing localized fluctuations in supply and demand. By reducing congestion and giving access to lower-cost generation, it helps limit price volatility and strengthens reliability. This stability makes the United States a more attractive destination for defense-critical, energy-intensive manufacturing, providing the predictability industry leaders need when committing to new or expanded domestic production facilities.

Policy Solutions and the Path Forward

To secure the future of the U.S. aluminum industry and support the broader goal of reindustrializing America's defense-critical supply chains, policy solutions must focus on expanding transmission infrastructure, stabilizing energy costs through resource adequacy, and supporting long-term power contract structures for industrial users. Without these reforms, the United States risks losing its remaining smelters, increasing reliance on imports, and compromising its ability to meet national security needs in times of crisis. The aluminum story is a microcosm of the larger challenge: securing America's industrial future requires a modernized grid capable of powering the next generation of manufacturing, defense, and innovation.

