



Mighty Earth:

**ELIMINATING PETCOKE AND
DECARBONIZING ALUMINUM PRODUCTION**

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Decarbonizing Aluminum Production

What is petcoke?

Petroleum coke, or petcoke as it is commonly known, is a byproduct of the oil refining process, often produced when bitumen from tar sands is refined into crude oil.¹ Most petcoke is considered low grade, which contains high levels of sulphur and other contaminants like heavy metals. A lot of this petcoke is exported to China to use as fuel in coal-fired power plants. In contrast, high grade petcoke is low in sulfur and heavy metals and is often used to produce aluminum.

What is the role of petcoke in aluminum production?

High grade petcoke is a crucial ingredient for the production of aluminum. It begins by heating high grade petcoke to extreme temperatures of around 12,350 degrees Celsius, and then quickly cooling it. This new calcined petcoke has pores that allow “binding material to penetrate through the coke particles and form a solid carbon block, through which aluminum smelters conduct electricity into their smelting pots.” Over time, the anodes are consumed, roughly at the rate of 40 tons of calcined petroleum coke for each 100 tons of aluminum produced.”²

What role does China play?

China produces about half of the World’s aluminum,³ resulting in China importing large amounts of petcoke from trading partners. In 2013, China imported about 7 million metric tons of petcoke from the United States, a sharp increase from the 350,000 metric tons it imported in 2008. The imported petcoke is largely used as an alternative to coal, but as mentioned above, it is dirtier than coal with burned and is now raising health and environment concerns.⁴ There are also concerns that Chinese regulators do not fully recognize the dangers that Petcoke poses to local communities, which is allowing companies to pollute more than they would otherwise.

Why is it bad for the environment?

Low grade petcoke can be dirtier than coal when burned. According to environmental experts, “petcoke has 11 percent higher GHG emissions than coal, and nearly twice the emissions of natural gas.”⁵ As such, burning petcoke can harm local air quality by emitting common pollutants, including “carbon monoxide, sulfur dioxide, nitrogen oxides, particulate matter, and heavy metals, depending upon the chemical composition of the petcoke feedstock. These releases can take place through airborne dust particles during storage and through emissions during combustion.”

Why is Petcoke dangerous?

Petcoke is often left in large piles near urban areas. A literature review finds that “pulmonary inflammation was observed in long-term inhalation exposure studies. Epidemiological studies in coke oven workers have shown increased risk for cancer and chronic obstructive pulmonary diseases...”⁶ In addition to workers at these plants,

residents in local communities that are forced to breathe in the fine particle matters can be harmed as well.

In Port Arthur, Texas, the Oxbow power plant produces petcoke, and there have been substantial concerns on the health of effects on the surrounding communities. Approximately 2,600 people live within three miles of the Oxbow facility, where the vast majority of residents are low-income and people of color. The Centers for Disease Control and Prevention has found that the residents living closest to the power plant have an asthma rate of 13.7 percent. This is significantly higher than the overall rate for Port Arthur at 10.5 percent and the national average of 8 percent.⁷ Unfortunately, it can be difficult to prove the link between higher rates of asthma and other health concerns to the petcoke being produced at a specific facility.

There are also concerns over whether the Texas state regulator properly permitted Oxbow leading to an investigation by the EPA. The EPA stated:

“The Oxbow facility produces anode and industrial calcined petroleum coke and is one of the highest emitters of sulfur dioxide (“SO₂”) in Texas. It is located directly adjacent to the West Port Arthur neighborhood. The Oxbow facility is also a direct and indirect contributor of particulate matter (“PM”) pollution in West Port Arthur. West Port Arthur is a low-income, minority neighborhood which has long been subject to high levels of air pollution from nearby major industrial facilities.”

Residents living in Chicago, Illinois faced a similar battle several years ago. There were piles of petcoke near Chicago’s Calumet River, so much so that the skies would darken when it was windy. At a government meeting, local residents stated that the petcoke “collects on homes and cars. It prevents people from being able to enjoy outdoor spaces. It impedes economic development. It doesn’t bring in jobs. It precludes other industries and nice things like shops and cafés from moving into the Southeast Side.” Moreover, residents are concerned about breathing in particulate matter, potentially causing significant health problems like asthma and other respiratory issues.⁸

Louisiana has more petcoke factories than any other state, and many of these factories are located near minority communities. A resident living in Ironton, a predominantly black community in coastal Louisiana, said that “Dust is everywhere, and we’ve had more childhood asthma and adult bronchitis in this area than we did in the past.”⁹ In early 2014, environmental organizations noticed a black plume of coal and petcoke dust coming from a plant owned by United Bulk Terminals. A local paper “spotted coal and coke debris, some as large as fists, dotting mile-long stretches of elevated marsh platform created by coastal restoration programs that were pumping sediment inland from the Mississippi River into open water near Lake Hermitage and Bayou Dupont on Plaquemines’ west bank.” After the company refused to fix their pollution, environmental organizations filed a lawsuit, which forced United Bulk Terminals to lessen their pollution, including forcing the company to stop loading and unloading during high winds and utilizing water sprays to minimize dust.¹⁰

The Aluminum Industry

Total emissions from traditional aluminum production can be divided in two ways: 30 percent are from direct emissions and about 70 percent are from indirect emissions. Of the latter, more than half derive from the use of electricity to turn bauxite into aluminum. The U.S. has a relatively high final energy intensity in producing aluminum when compared to other countries like India and the UAE. By contrast, countries like Canada have a relatively light energy intensity, due to its use of hydropower, which produces 90 percent of Canadian aluminum.¹¹ In the United States, several companies cite the cost of electricity as the largest operating cost, accounting for up to 40 percent of the cost of producing aluminum.¹²

Reducing cumulative GHG emissions is crucial in meeting climate goals, and it will require a multi-variate strategy to do this, including the use of anode technology.



Decarbonizing Aluminum

In 2021, three firms – Alcoa, Century Aluminum, and Magnitude 7 Metals LLC – operated six primary smelters across the United States. The global aluminum sector contributes approximately 1.1 billion tons of carbon dioxide, representing about 2 percent of global greenhouse gases (GHGs). Demand for aluminum is expected to increase 80 percent by 2050, increasing the sector’s total output of GHGs unless changes are made to the production of aluminum.

Reducing Petcoke Through Advanced Technology

In aluminum production, inert anode technology reduces direct greenhouse gas emissions and eliminates the need for petcoke. In fact, a joint venture between Alcoa and Rio Tinto announced earlier this year led to ELYSIS, which eliminates all emissions and uses inert anode technology. This is expected to be commercially available by 2024. Apple has already signaled its intent to use inert anode technology for some of its products, which will likely encourage other market participants to follow a similar path. According to ELYSIS’s CEO Vincent Christ, “This is the first-time aluminum has been produced at this commercial purity, without any greenhouse gas emission and at industrial scale.”¹³

Electric Grids

In addition to eliminating the use of petcoke, aluminum producers should strive to use low-carbon or carbon-neutral electricity grids, which would cause a substantial decline in GHG emissions. Globally, about 56.9 percent of power consumption for primary aluminum smelting comes from coal and another 9.7 percent from natural gas. Approximately 34 percent of the power mix consists of zero-emissions electricity, including 31.3 percent from hydroelectricity and 0.7 percent from nuclear.¹⁴ In the United States, only about 20.1 percent of electricity derives from renewable sources, and these sources are generally far from smelting facilities.

The United States needs to improve its electric grids and transmission capacity in order to avoid bottlenecks and curtailment. This can be costly and require billions in investment. In addition, regional politics in the United States makes this even more challenging, given the fact that Texas and Florida have their own grids. Improving a larger, national grid can be much easier and more cost effective than improving smaller, regional grids.

The Biden Administration’s Inflation Reduction Act (IRA) takes important steps in improving the nation’s energy grid. For example, IRA includes investment opportunities in pollution-reducing upgrades at aluminum facilities. It also allocates billions of dollars to the Department of Energy aimed at upgrading, repurposing, and replacing energy infrastructure and sets aside funds to retrofit facilities for EV and other clean transportation manufacturing.¹⁵

Conclusion

Technologies currently exist to make aluminum without the use of petroleum coke. Although petcoke is a cheap source of energy, it causes and exacerbates respiratory and other health problems in small, mostly rural, communities. American companies producing aluminum should shift to newer technologies over the next ten years, as they become more widely available and more cost-effective options. In addition, the Biden Administration should utilize the IRA and other government programs to encourage companies to update the electric grid, especially in ways that benefit historically hard-hit communities that have experienced deindustrialization and the closures of coal mines or coal-fired power plants.¹⁶ Also, the Biden Administration should be vigilant in monitoring the use, sale, and export of petcoke to ensure companies do not simply export petcoke overseas, which would only serve to shift the health effects from American communities to foreign communities.

Might Earth is calling aluminum producers to:

- Eliminate the use of petcoke in the production of aluminum and shift to technologies that are carbon neutral by 2035.
- Adopt specific annual targets immediately for the reduction of petcoke in the use of aluminum.
- End the exportation of petroleum coke to overseas markets like China.
- Announce a plan with power suppliers to source, by 2035, 100% renewable energy to meet the global electricity needs for carbon-neutral production of aluminum.

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