I Like Smoke & Lightning, Heavy Metal Thunder, Part 2

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1. Introduction

The part 1 post for this series was over three years ago, and described and linked below.

I Like Smoke and Lightning, Heavy Metal Thunder: *This paper is about the metals industrial subsector, how these industries use energy and how they are evolving. The subject of this paper contains a segment on the largest industrial producer of these emissions, the Iron and Steel Industry Group.*

https://www.energycentral.com/c/cp/i-smoke-and-lightning-heavy-metal-thunder

I will repeat only two pieces of text from part 1. The first is below and describes the second.

This is a test for old rockers (like me): the title of this paper is from two lines in a famous single. In fact the first single inducted into the Rock & Roll Hall of Fame. What is the title?

The attribution (with a link to the full lyrics) is the last reference in this paper.

There are several pieces of new news regarding the iron/steel and aluminum sectors in this industrial subsector. These will be covered below.

2. Rationalizing the Market

The last U.S. Chief Executive (I forget his name) made plenty of really bad blunders. Alienating our best allies were among them. One bad move was a major trade-battle over the Iron/Steel and Aluminum Markets. This has been recently resolved.

WASHINGTON – The United States and the EU have today taken joint steps to re-establish historical transatlantic trade flows in steel and aluminum and to strengthen their partnership and address shared challenges in the steel and aluminum sector. As a part of that partnership, they intend to negotiate for the first time, a global arrangement to address carbon intensity and global overcapacity.[1]

The European Union and the United States have a shared commitment to joint action and deepened cooperation in these sectors and are taking joint steps to defend workers, industries and communities from global overcapacity and climate change, including through a new arrangement to discourage trade in high-carbon steel and aluminum that contributes to global excess capacity from other countries and ensure that domestic policies support lowering the carbon intensity of these industries.

In a demonstration of renewed trust, and reflecting long-standing security and supply chain ties, the United States will not apply section 232 duties and will allow duty-free

[1] The White House Briefing Room, Statements and Releases, "Joint US-EU Statement on Trade in Steel and Aluminum," Oct 31, 2021, https://www.whitehouse.gov/briefing-room/statements-releases/2021/10/31/joint-us-eu-statement-on-trade-in-steel-and-aluminum/

importation steel and aluminum from the EU at a historical-based volume and the EU will suspend related tariffs on U.S. products.

As a first step, the United States and the EU will create a technical working group charged with sharing relevant data and developing a common methodology for assessing the embedded emissions of traded steel and aluminum.

The global arrangement reflects a joint commitment to use trade policy to confront the threats of climate change and global market distortions, putting their workers and communities at the center of the trade agenda. The global arrangement will be open to any interested country that shares our commitment to achieving the goals of restoring market-orientation and reducing trade in carbon intensive steel and aluminum products.

There was a link to a fact sheet from reference 1, content from this is repeated below.

Today, the United States and the European Union announced their commitment to negotiate the world's first carbon-based sectoral arrangement on steel and aluminum trade by 2024. This announcement delivers a major win in the fight to address the climate crisis while protecting our workers and industry, and enabling them to compete in the global marketplace. The President believes that climate action must mean good jobs – and today's announcement demonstrates that we can work with our partners and allies to both reduce emissions, and protect and create good-paying union jobs at home.

The United States and the European Union also used the strength of their partnership to come to an interim arrangement for trade in the steel and aluminum sectors that modifies tariffs on European Union steel and aluminum providers, addresses global overcapacity, and toughens enforcement mechanisms to prevent leakage of Chinese steel and aluminum into the U.S. market. As a result of the arrangement, the Europe Union will remove its tariffs on a wide range of products, protecting American jobs, reducing costs for middle-class families, and maintaining U.S. export competitiveness.

Together, the United States and European Union will work to restrict access to their markets for dirty steel and limit access to countries that dump steel in our markets, contributing to worldwide over-supply. This arrangement will be open to any interested country that wishes to join and meets criteria for restoring market orientation and reducing trade in high-carbon steel and aluminum products.

This arrangement will:

Be a global first in the fight against climate change and countering distortive economic practices that harm our interests. Never have two global partners aligned their trade policies to confront the threats of climate change and global market distortions, ensuring that trade works to solve the challenges of the 21st century. The deal demonstrates President Biden's commitment to putting U.S. workers and communities at the center of our trade agenda.

Protect American jobs and industry and provide them with an advantage. American-made steel and aluminum is produced with far fewer emissions than dirtier alternatives made in the PRC and elsewhere. To date, American steel companies and workers have received no benefit for their low-carbon production. Low-carbon steel across all production types —and the workers who make it—will be incentivized and rewarded going forward.

Results in lower prices for American consumers and families by providing relief for American manufacturers who rely on readily accessible, affordable steel and aluminum to make their products. Steel and aluminum are essential components of many manufactured goods, including automobiles, household appliances, building materials, and more.

Demonstrate the climate ambition and global leadership of the Biden-Harris Administration. Steel and aluminum production are two of the most carbon-intensive industrial sectors, accounting for roughly 10 percent of all carbon emissions — comparable to the total emissions of India. A carbon-based sectoral arrangement will drive investment in green steel production in the United States, Europe, and around the world, ensuring a competitive U.S. steel industry for decades to come.

Showcase the strength of the U.S.-EU relationship. The United States and European Union pledged at the U.S.-EU Summit in June to use the size of their collective economies to update the rules of the 21st century. Today's announcement delivers on that promise and builds on the successful resolution of the 17-year Boeing-Airbus dispute and the creation of the US-EU Trade & Technology Council.

3. Steel and Climate Change

The above section title / subject was mentioned in the prior section, and the text below follows-up on this.

3.1. The Recyclability of Steel

Because steel of all types can be recycled again and again without changing its properties, it is one of the most recycled materials in North America. In fact, almost 69% of steel is recycled every year. That's more than paper, aluminum, plastic and glass combined. It amounts to 80 million tons of steel recycled annually across the continent.[2]

3.2. Process Improvements

Technology advancements and evolving environmental control practices have helped the steel industry greatly reduce greenhouse gas emissions. The North American steel industry has reduced energy consumption by 60% since World War II, and has invested $7.5 billion in environmental control equipment since 1970. Going forward, governments will need to work in close collaboration with the steel industry and other stakeholders to ensure continued progress.

3.3. Considering the Steel Source

New reports from the Steel Market Development Institute (SMDI) show that greenhouse gas emissions from steel production are much lower in North America than in China. Mark Thimons, vice president of sustainability at SMDI, explained it best to the American Iron and Steel Institute: "In the sustainable design of steel-framed buildings, one of the most important decisions an owner or architect can make regarding environmental impact is to ensure the building's steel is produced in North America." In other words, #ChooseAmericanMetal to minimize your environmental impact.

[2] American Metal, "Minimizing Steel's Environmental Impact," https://www.chooseamericanmetal.com/steel-101/sustainability/

4. Parochialism Not Allowed

Most readers know that I try to stay close to home with my writings. However, when it comes to greenhouse gases (GHG), that's really not allowed. No matter how well California does in reducing our GHG, as long other states and countries continue to heavily emit carbon dioxide and other GHGs, we will still suffer the consequences, as we all live in the same atmosphere. So the excerpt below deals with this issue.

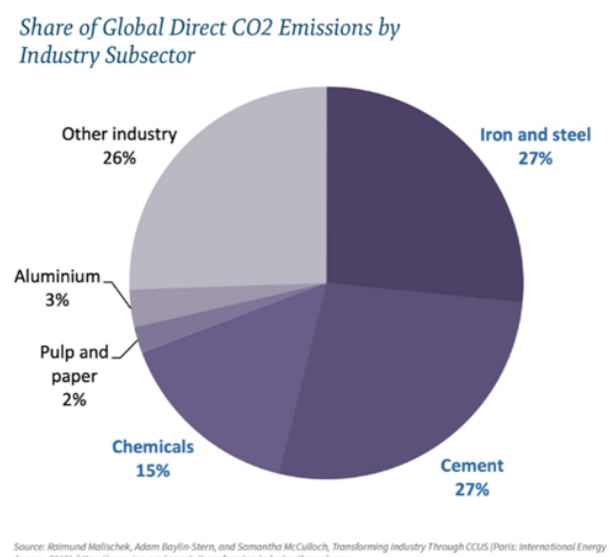
However, previous section discussed that the U.S. used a high percentage of recycled steel. There is also the fact that approximately 2/3 of the U.S. Steel Manufacturing is via electric arc furnaces (EAF). *The EAF is different from the blast furnace as it produces steel by using an electrical current to melt scrap steel and/or direct reduced iron. The EAF uses scrap steel and electricity to produce molten steel.*[3]

The EAF, also known as the mini-mill, primarily uses electric energy, and as electricity is decarbonized, so will steel production by EAFs. The other primary process, the integrated steel mill, will be more difficult to decarbonize. See part 1 of this series, linked in the Introduction for more information on these processes.

Industrialization has been and continues to be key to the growth of economies around the world. These industries, however, emit greenhouse gas (GHG) emissions. In 2017, heavy industry emitted more GHG emissions than agriculture, buildings, power and heat, and transportation. To avoid the worst impacts of climate change, science dictates we must reach net-zero GHG emissions around 2050, which requires deep decarbonization from all sectors including industry.[4]

The industrial sector includes heavy industry and manufacturing in several categories. These industries include cement, chemicals, steel, aluminum, paper, mining, manufacturing, food processing, waste processing, and other manufacturing and processing industries. These industries are diverse, and so there is no one solution for reducing emissions in all heavy industries. Many, however, are energy-intensive, consuming about 40 percent of global energy demand.

Industrial activities emit carbon dioxide (CO_2), nitrous oxide, methane, and fluorinated gases—all potent GHGs. Direct emissions from heavy industry make up between one-fifth and a quarter of global greenhouse gas emissions. Approximately 76 percent of industrial GHG emissions is CO_2. As shown in figure 1, iron and steel production contributes about 27 percent of the sector's direct CO_2 emissions…



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[3] American Iron and Steel Institute, "Steel Production," https://www.steel.org/steel-technology/steel-production/

[4] Stephen Naimoli and Sarah Ladislaw, Center for Strategic & International Studies, "Climate Solutions Series: Decarbonizing Heavy Industry," Oct 5, 2020, https://www.csis.org/analysis/climate-solutions-series-decarbonizing-heavy-industry

Excluding the emissions from purchased electricity, the two main sources of GHG emissions in the industrial sector are energy used for heat and conversion processes. Many heavy industries require high-temperature heat, which is usually generated by the combustion of fossil fuels ...

4.1. Technological Solutions

Technology is one part of the puzzle in decarbonizing industry. These could include using zero-carbon energy sources, utilizing new industrial processes, capturing and using or storing CO_2 from electricity and heat sources or from processes, and efficiency improvements.

Low-carbon energy sources like biomass, hydrogen, or electricity could substitute for fossil fuels in providing process heat for industry. Many industries currently rely on coal- and natural gas-fired boilers for heat, which contribute about 42 percent of the sector's total GHG emissions. Various industries already use hydrogen made from natural gas for processes such as refining, ammonia production, or steel production. Hydrogen made from natural gas with carbon capture equipment or made through electrolysis with renewable energy could provide an opportunity for low- or zero-emissions hydrogen to play a larger role in industry—it could continue to be used as a feedstock and could potentially be combusted for heat. Under current conditions, however, creating hydrogen through electrolysis is an expensive process and it is more expensive than other low-carbon heat sources and significantly more expensive than using fossil fuels.

Biomass may have some application as a heat source in industry but can also serve as a feedstock for chemicals. The economic feasibility of biomass as a fuel or as a feedstock varies based on the availability and carbon content of the biomass feedstock. Some industries already use biomass, including to produce biofuels, to use in pulp mills, or to co-fire with coal in boilers to generate power or heat.

Electricity is also likely to play a role in industrial process heat, as electric resistance heating could reach 1,800 degrees Celsius, which meets the temperature needs of many industries including paper, steel, and cement production. As with electrification in other sectors, decarbonization through electrification would require the electricity to be produced from zero-carbon sources.

Novel processes, including ones that incorporate electricity, could be another piece of the puzzle. These would be aimed at lowering process emissions, which come from the conversion of raw materials into intermediate or final products. Startup Boston Metal is marketing its metal oxide electrolysis process, for example, which it says converts iron ore to iron and oxygen with electricity instead of coking coal. This would avoid the CO_2 emissions from the coking coal, the limestone, or any of the various processing facilities involved in the steelmaking process. Similarly, in the aluminum industry, Alcoa and Rio Tinto have partnered to develop a carbon-free aluminum smelting process that replaces the traditional carbon anode with a ceramic one, eliminating the resulting CO_2 emissions. Both of these companies have secured customers for their zero-carbon products, but it will take time to bring their platforms to scale and to eventually replace conventional facilities with their zero-emissions technology.

Carbon capture, use, and sequestration (CCUS) is another option that could allow industry to continue using the energy sources they rely on while reducing or eliminating the CO_2 they emit. This could also reduce or eliminate the CO_2 emissions that are a byproduct of materials conversion processes. Once captured, the CO_2 could be *sequestered in geologic formations or could be used in products. It is worth noting, however, that not all uses for CO_2 avoid emissions—soda carbonation, for example, simply defers emissions as the gas is ultimately released into the atmosphere from the soda. At present, natural gas with CCS is generally cheaper than other low-carbon options for producing heat for industrial processes, though this may change if other options mature or as market conditions change.*

The most common uses for CO_2 are currently to inject it into oil wells for enhanced oil recovery or to inject it into soda for carbonation, but several new opportunities exist for using captured CO_2 in products. A few examples include storing CO_2 in concrete, using it to create synthetic liquid fuels, turning it into polymers for plastics, using it to grow algae that will in turn capture more CO_2, and making it into lightweight materials that could substitute for metals. Many of these solutions are nascent and would require more R&D as well as commercialization, but they could emerge as viable options in the future.

Efficiency is likely to be key to reducing emissions from industrial processes. By one estimate, efficiency improvements can save 15 to 20 percent of the fuel used to generate energy across some of the highest-emitting industries. Efficiency measures alone will not decarbonize the sector but can move emissions in the right direction. However, energy efficiency measures can have unintended consequences. Energy efficiency improvements can lead to the rebound effect, where the ability to do more with the same amount of energy leads to an increase in production and, thus, less savings than anticipated (though it still means a net reduction of energy use). In addition, investments in energy efficiency upgrades may delay the conversion to zero-emissions technology because of the additional capital costs on top of those that went into the efficiency upgrades.

4.2. Policy

Many of the technology options for industrial decarburization require time and effort and are not currently economic. Policy, therefore, will necessarily play a role in driving their adoption and additional behavior change. Policy options may include encouraging or mandating the increased use of the technology solutions presented above, but they may also include options like reuse and recycling programs, carbon pricing, material substitution, or direct support for R&D.

Given the increased costs of alternative heat options in industry, countries wishing to incentivize their industries to decarbonize are likely to institute policies to drive innovation and scale to reduce their prices. Australia, for example, released its national hydrogen strategy in 2019. Germany released its own national hydrogen strategy in June 2020. Both countries' plans seek to make their respective governments leaders in the hydrogen supply chain for domestic use and export. They both commit to support the research, development, and scale-up of low-cost hydrogen produced from renewable energy or natural gas with CCS; establish economic incentives for industries to switch to hydrogen for heat and use in industrial processes; and develop the workforce needed for their industries. To scale hydrogen and establish markets, Australia's plan includes establishing hydrogen hubs where many users are located, allowing infrastructure to be strategically placed to serve several consumers. Germany's plan includes helping to develop roadmaps for individual subsectors and references hydrogen's suitability as an industrial feedstock. While Australia's plan dismisses the idea of setting quotas or targets for use in individual sectors in the near future, Germany's plan leaves open the door to implementing demand-side measures like quotas for low-carbon steel. These are *not the only possible policy interventions to promote new decarburization options but serve as examples of prominent government strategies currently being pursued.*

Reuse and recycling programs can help reduce the need for virgin materials, but chemical and economic barriers may require new solutions. In this context, reuse refers to taking final products out of one use and putting it to another use while recycling refers to the breaking down of a product back to raw materials and converting it to something else. In the metals industry, many metals have recoverable materials but they may not ultimately be recycled due to low prices or technical difficulty in breaking them down to their component parts. Governments could design policies to increase the economic attractiveness of recycling and increase penalties for disposal. In the chemicals industry, there are opportunities to recycle chemicals such as solvents and even reuse some byproducts of industrial processes as feedstocks in others. Governments can implement policies to encourage recycling or reuse of chemicals by helping to establish the necessary facilities for recycling, setting "circular economy" guidelines that minimize waste in the industry, or by penalizing companies that failed to meet certain thresholds for recycling and reuse.

Governments could also incentivize a move away from fossil fuels in their processes with carbon pricing. Carbon pricing has been discussed previously in this series, but in the industrial sector, it could potentially incentivize the innovations needed to drive down the costs of alternative heat sources and inputs to industrial processes. It would also be simpler than regulating by subsector; it would set a price across industries and allow operators to make the investments or changes that are most appropriate for their particular facilities. It would, however, lead to higher costs for some industries than others, particularly petrochemicals and cement. In addition, a carbon price that would be politically acceptable could be set at a level that addresses the "low-hanging fruit" but does not drive deep decarburization because the technology needed for that is more expensive. For example, hydrogen production from natural gas without any emissions mitigation has a leveled cost of $1-1.5 per kilogram. Adding CCS with an 89 percent capture rate would bring the cost up to $1.7-2.15 per kilogram. Producing hydrogen with grid-powered electrolysis would cost $4.5-6 per kilogram. Ultimately, carbon pricing would need to be complemented by other measures, such as investments and R&D policies, to drive the level of change necessary to achieve net-zero emissions…

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[5] Mars Bonfire, Steppenwolf, "Born To Be Wild", 1968, https://www.lyricsmode.com/lyrics/s/steppenwolf/born_to_be_wild.html