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WHITE PAPER

Embodied CO_2 Emissions in Steel Imports to the U.S.

A White Paper on Steel Trade, Carbon Competitiveness, and Decarbonization

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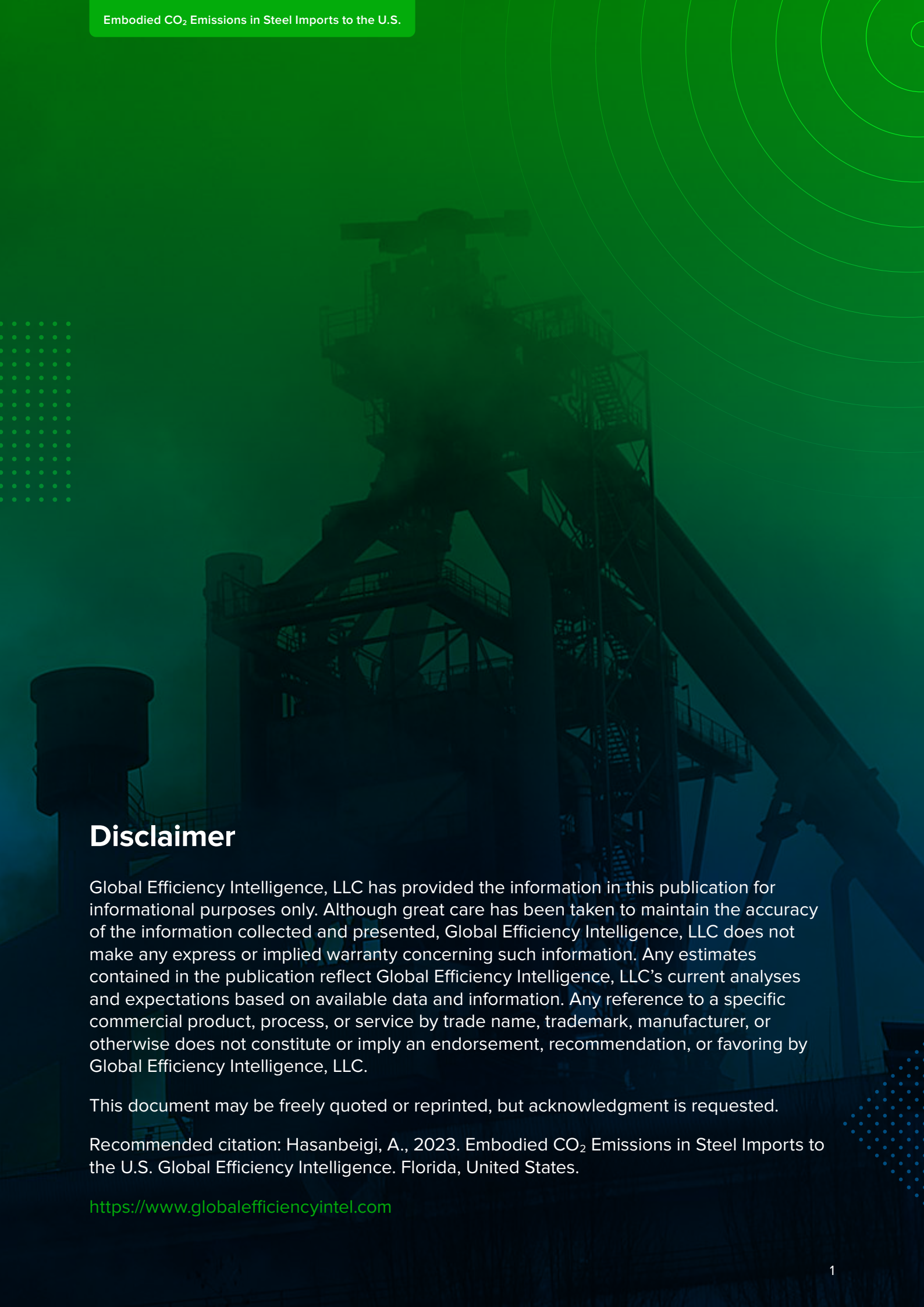

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Executive Summary

Approximately 24% of the steel produced globally is traded, with the U.S. importing 27.6 million tonnes in 2019, equating to 28% of the steel used in the country. The carbon intensity of steel production varies significantly between countries, leading to the risk of carbon leakage as production shifts to countries with lower climate ambitions or regulations. The U.S. steel industry possesses a carbon advantage over many of its import sources, which should be leveraged to promote cleaner domestic steel production and encourage decarbonization globally.

A Border Carbon Adjustment or Carbon Tariff is a policy tool that can help prevent carbon leakage and support the U.S. government's ambitious climate targets, including reducing emissions by 50%-52% below 2005 levels by 2030 and reaching net-zero emissions by 2050.

This white paper analyzes the CO_2 intensity and trade of steel in the U.S., as well as the carbon competitiveness of the domestic steel industry. Using 2019 as the base year, the analysis reveals that the total embodied carbon in steel imports to the U.S. was approximately 38 million tonnes (Mt) of CO_2. This is roughly 45% of the total CO_2 emissions of the steel industry in the U.S. in 2019.

If the imported steel were produced domestically, there would be a significant reduction in CO_2 emissions due to the lower carbon intensity of U.S. steel production. The potential annual CO_2 emissions reduction from producing imported steel in the U.S. amounts to approximately 11.3 Mt CO_2, or 13% of the total annual CO_2 emissions of the steel industry in the U.S. Leveraging the carbon advantage of the U.S. steel industry through policy measures like Border Carbon Adjustment or Carbon Tariff and Buy Clean can play a crucial role in achieving national and global climate goals.

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1. Introduction

A substantial amount of GHG emissions from the industry sector can be attributed to the products that are produced for export. The embodied GHG emissions associated with the production of products that are ultimately traded across countries are referred to as the Carbon Loophole (Hasanbeigi and Darwili, 2022). These emissions are a growing issue for global efforts to decarbonize the industry sector. Embodied emissions in traded goods are not accounted for in the countries that import and consume those goods,[1] but if they were, the promising climate trends in some countries would be negated or reversed. Approximately 25% of global CO_2 emissions are embodied in exported goods, thus escaping attribution in the consuming country (the end-user) and instead being debited on the producer side (Hasanbeigi and Darwili 2022).

Approximately 24% of the total steel produced globally is traded across borders (this is steel mills products and does not include steel contained in final consumer products) (worldsteel 2022). The U.S. imported over 27.6 million tonnes (Mt) of steel products from other countries in 2019 (AISI 2023). Imported steel accounted for approximately 28% of the steel used in the U.S. in 2019. Since the carbon intensity of steel production varies substantially between countries, the heterogeneous climate policies across countries risk intensifying carbon leakage as production continues to shift to countries with lower climate ambition or lesser-regulated countries.

The steel industry in the U.S. has a substantial carbon advantage over many countries it is importing steel from. On average (including both primary and secondary processes), the steel industry in the U.S. emits lower CO_2 emissions to produce a tonne of steel compared to many other countries. This carbon advantage should be leveraged to reward domestic cleaner steel production and encourage the decarbonization of this sector in other countries. Border Carbon Adjustment (BCA) is a policy tool for preventing carbon leakage as some countries, such as the U.S., are taking serious actions to tackle the climate crisis and achieve Paris Agreement's target.

[1] For example, countries only report their domestic carbon emissions (also known as production-based or territorial accounting) to the Intergovernmental Panel on Climate Change (IPCC).

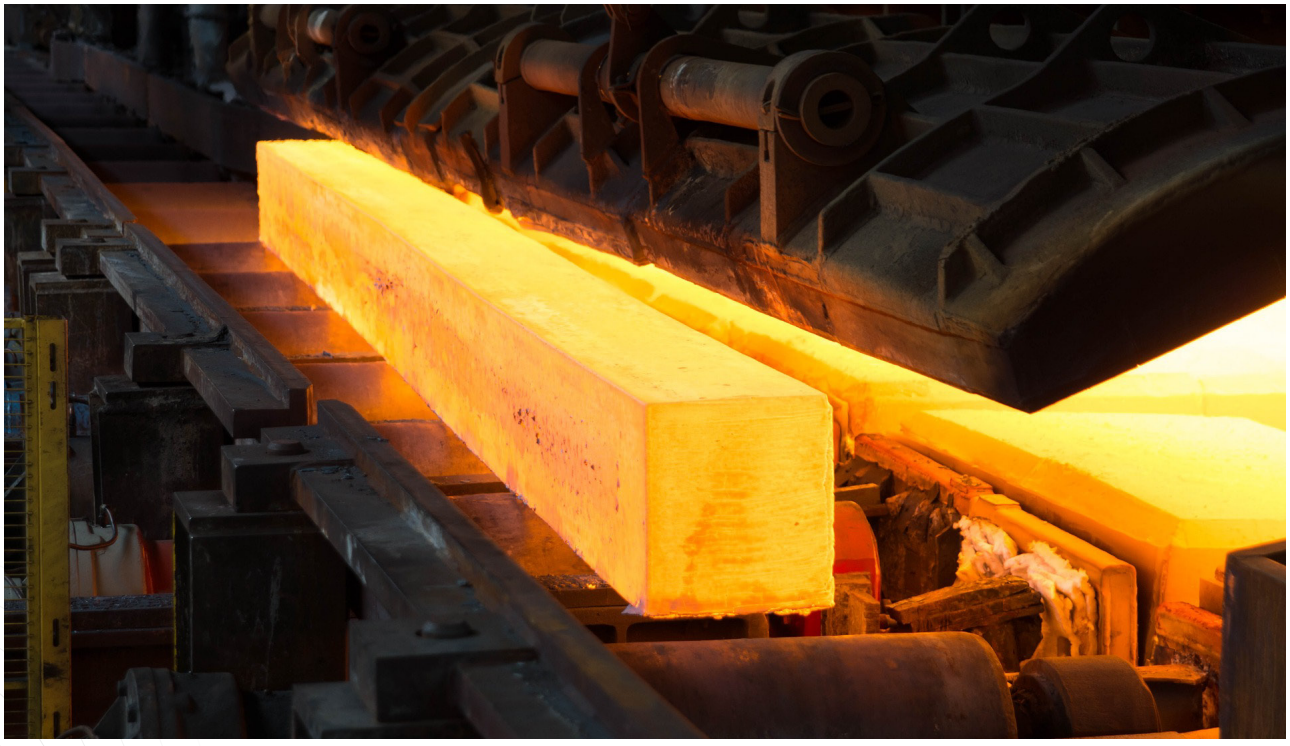
The United States government has a target of reducing emissions by 50%–52% below 2005 levels by 2030 and, as a part of the Paris Agreement, pledged to reach net zero emissions economy-wide by no later than 2050. The U.S. also has set a goal to reach 100% CO_2-free electricity by 2035, which will substantially help the deep decarbonization of industries such as steel and aluminum. The Inflation Reduction Act signed into law by President Biden in August 2022 includes $369 billion to address climate change.

This study analyzes the CO_2 intensity and trade of steel in the U.S. and the carbon competitiveness of the steel industry in the U.S.

2. Data and Methodology

This analysis uses 2019 as the base year. The steel production data for 2019 were obtained from (worldsteel 2020), and the steel import data for 2019 were obtained from (AISI 2023).

For the CO_2 intensity of steel production in different countries, values were obtained from Global Efficiency Intelligence's recent steel benchmarking report (Hasanbeigi 2022). The CO_2 intensity for steel production for 15 countries, including all major steel-producing countries, were available in this report. For those countries that did not have reported CO_2 intensity values (Hasanbeigi 2022), CO_2 intensity was estimated based on the CO_2 intensity of steel production in countries in the respective regions. However, the estimated CO_2 intensity of both EAF and BOF steel production was applied separately, and the EAF steel production ratio in each country (worldsteel 2020) was used to estimate the total weighted average of CO_2 intensity in the steel industry in each country. It should be noted that those countries where estimation of the CO_2 intensity of the steel industry was necessary to account for a small share of total U.S. steel imports.



Both Scope 1 CO_2 emissions (onsite emissions) and Scope 2 (mainly electricity-related emissions) are included in this analysis. Also, the embodied carbon in imported carbon-intensive intermediary products such as pig iron and direct reduced iron (DRI) also are included in the CO_2 intensities (Scope 3) (Hasanbeigi 2022). Only CO_2 emissions are considered in this analysis. Other GHG emissions (CH_4, N_2O, etc.) are not included in this analysis. Only emissions associated with the commodity steel trade are included in this study. The embodied emissions in steel-containing goods/products (cars, machinery, etc.) are not included in this analysis.

Using the quantity of imported steel and the CO_2 intensity of the steel industry in each country that the U.S. imported steel from, we estimated the embodied carbon in imported steel. Figure 1 shows some of the major countries from which the U.S. imported steel in 2019. The top seven countries accounted for 70% of the U.S. steel imports.

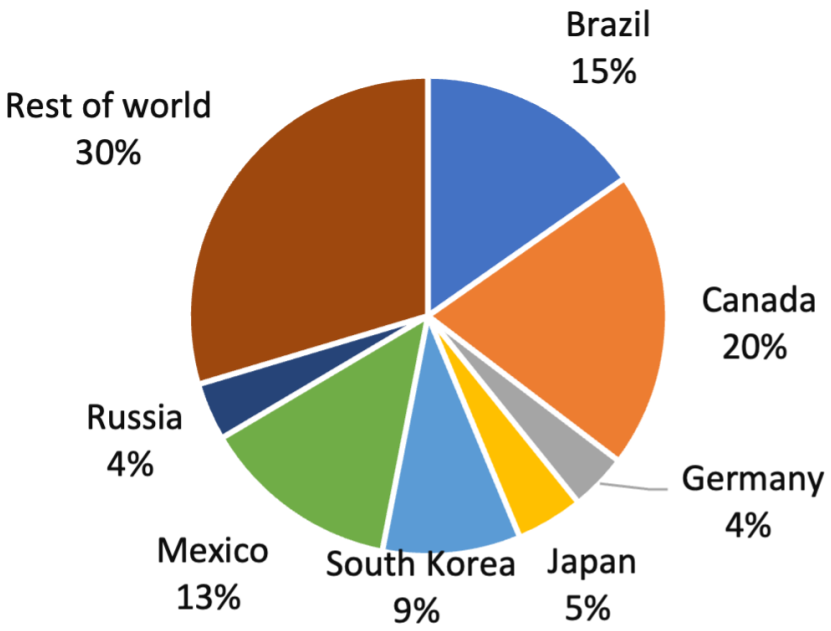


Figure 1. Major countries from which the U.S. imported steel in 2019 (AISI 2023).

3. Embodied CO_2 Emissions in the U.S. Steel Imports

Using the data and method explained above, we estimated the embodied carbon in imported steel. Figure 2 shows some of the major countries that the U.S. imported embodied carbon in steel in 2019. The top seven countries accounted for 70% of the U.S. steel imports of embodied carbon in the steel.

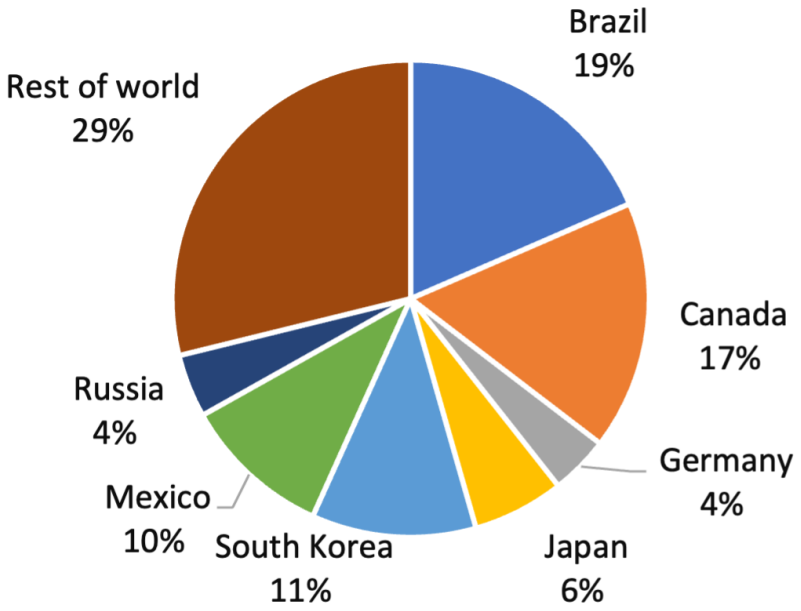


Figure 2. Major countries from which the U.S. imported embodied carbon in steel in 2019.

Figure 3 shows the embodied carbon in steel imports in a list of 20 countries that the U.S. imported steel from plus Other (U.S. imports from countries other than the 20 listed in the figure). The Other category represents only 10% of total steel imports to the U.S. Brazil, Canada, South Korea, and Mexico are the top four exporters of embodied carbon in steel to the U.S.

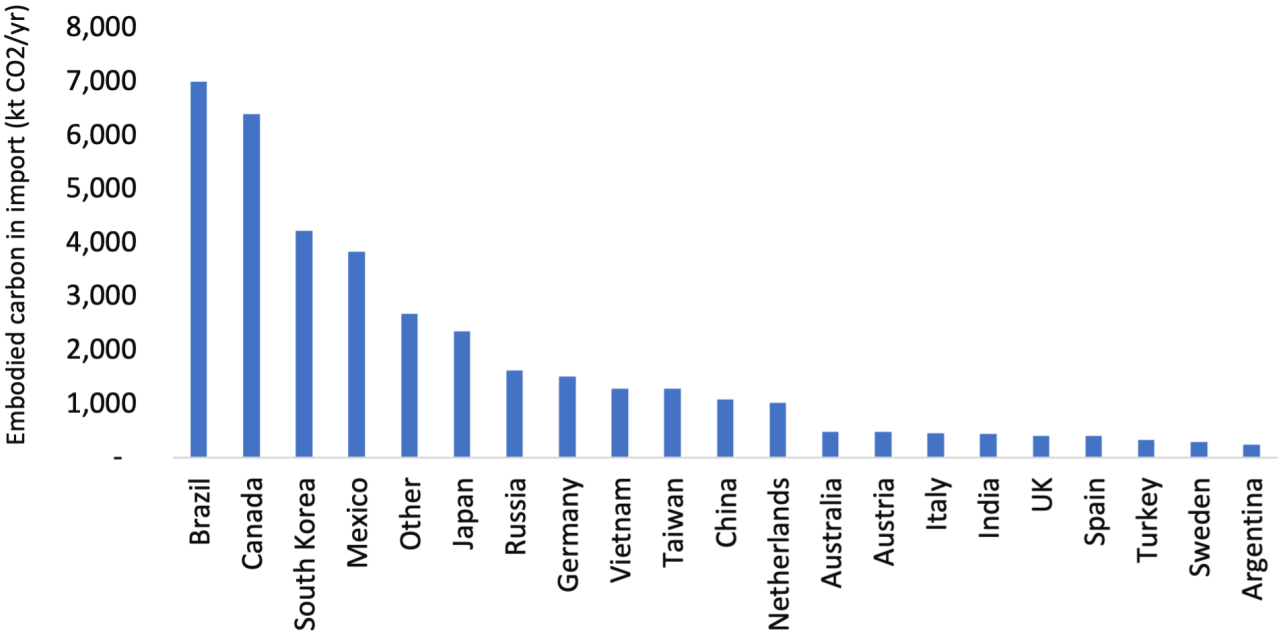


Figure 3. Annual embodied carbon in steel imports to the U.S. ranked by countries in 2019.

The total embodied carbon in steel imported to the United States was approximately 38 million tonnes (Mt) of CO_2 in 2019. This is about 45% of the total CO_2 emissions of the steel industry in the U.S. in 2019.

If the imported steel was produced in the U.S. instead, there would be a substantial reduction in CO_2 emissions (Figure 4) because the steel industry in the U.S., on average, has a substantially lower carbon intensity compared to many countries it is importing steel from (Hasanbeigi 2022). This is primarily because 70% of the steel produced in the U.S. in 2019 was produced by the electric arc furnace (EAF) production route, which has substantially lower carbon intensity compared to primary steel production by blast furnace-basic oxygen furnace (BF-BOF) production route.

Figure 4 shows the amount of annual CO_2 emissions reduction if the imported steel was produced in the U.S. instead. Only in the case of steel imports from Italy and Spain, the emissions reduction values in Figure 4 are slightly negative, indicating that if the steel imported from these countries were to be produced in the U.S., the CO_2 emissions would increase marginally since these countries have slightly lower average CO_2 emissions for their steel industry. Italy and Spain combined account for less than 4% of total steel imports in the U.S.

The total annual CO_2 emissions reduction if the imported steel was produced in the U.S. in 2019 is approximately 11.3 Mt CO_2. This is equal to 13% of the total annual CO_2 emissions of the steel industry in the U.S.

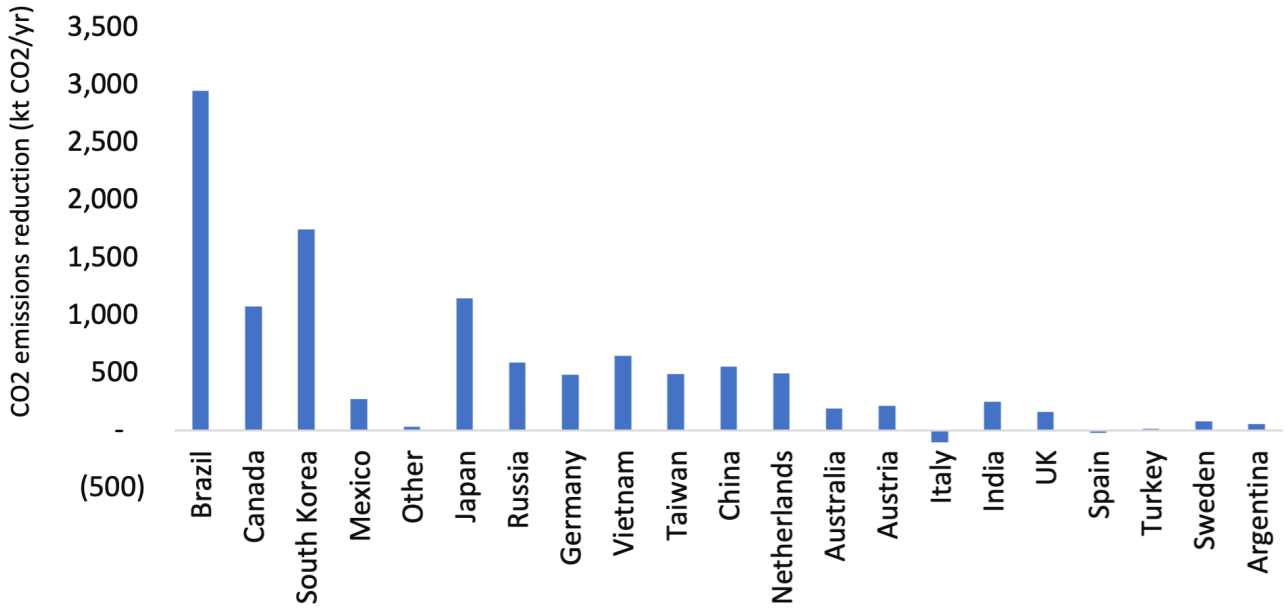


Figure 4. Annual CO_2 emissions reduction if the imported steel was produced in the U.S. instead in 2019.

4. Key Takeaways

The key takeaways from this white paper are:

- Global steel trade constitutes about 24% of total steel production; U.S. imports make up 28% of the steel used in the country.
- The carbon intensity of steel production varies significantly between countries, leading to carbon leakage risks.
- The steel industry in the U.S. has a carbon advantage over many import sources, which can be leveraged for cleaner domestic production and global decarbonization.
- Total embodied carbon in steel imports in the U.S. in 2019 was approximately 38 Mt CO_2, equivalent to 45% of total CO_2 emissions from the steel industry in the U.S.
- Potential CO_2 emissions reduction from producing imported steel domestically is approximately 11.3 Mt CO_2/year, or 13% of total annual CO_2 emissions of the steel industry in the U.S.
- Leverage the carbon advantage of the steel industry in the U.S. through policy measures like Border Carbon Adjustment or Carbon Tariff and Buy Clean to achieve national and global climate goals.

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