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Greenhouse Gas Index for Products in 39 Industrial Sectors: Iron, Steel, and Ferroalloys

NAICS CODE 331110

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Important Note

This module is not a stand-alone document. Readers should refer to the introduction for a more detailed overview and discussion of the Framework and procedures to determine the GGI and, especially, to the ***Note on Common References, Default Values, Acronyms and Abbreviations used in the Modules***. Common information includes default values for CO_2 emissions from electricity and thermal energy derived from coal, oil and natural gas; a list of acronyms and abbreviations; guidance on using the sources cited for US exports, imports, and production by sector, and CO_2 emissions from electricity produced in nations that export to the United States.

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1. Introduction and Background

The NAICS Code 331110 (iron and steel) has about 740 products. However, essentially all of them are derived from raw steel. During 2019, exports of products under this code were about $11 billion and imports were about $28 billion.[1] The US total production was about $105 billion in 2018.[2] Under the Framework we've proposed, rebates and import charges would be based on an upstream US GHG tax and the greenhouse gas indices (GGIs) for the imported and exported products.[3]

In this module, we determine GGIs—which track GHG process emissions and the contribution of the carbon content of products derived from fossil resources along the production and supply chain in a manner analogous to that used in value-added taxes—for raw steel. A minimum GGI of 0.50 tonnes CO_2e/tonne product is required for a product to receive an export rebate or be assessed an import charge. We refer to such covered products as GHG-intensive products. When multiplied by the GHG tax, the result is the relevant export rebate or import charge. The GGIs for raw steel manufactured in the United States are estimated here to be 1.88 tonnes CO_2e/tonne steel for basic oxygen raw steel and 0.562 tonnes CO_2e/tonne steel for electric furnace raw steel.

There are two basic technologies used to manufacture raw steel, which is then further rolled or processed to make various steel products that may be imported or exported. One process begins with a blast furnace that converts iron ore into pig iron through the use of coke and then continues into a basic oxygen furnace that reduces the carbon in the pig iron by combustion and heat derived from using oxygen to make raw steel. The other process uses as much as 100 percent scrap iron and steel in an electric furnace to make new raw steel but sometimes also uses some hot briquetted iron (HBI), pig iron, or iron units. The scrap raw material significantly reduces the energy needed to make such steel. The raw steel can then be rolled and shaped into the hundreds of steel products included under NAICS Code 331110.

This module provides a means for the Regulator to estimate, based on public information, initial export rebates for US exporters and charges for imports to the United States of GHG-intensive products if there were an upstream GHG tax that provided for such rebates and charges. This information would be useful to the

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[1] *See*: **https://usatrade.census.gov/data/Perspective60/View/dispview.aspx**

[2] *See*: AM1831BASIC01 (Annual Survey of Manufactures: Summary Statistics for Industry Groups and Industries in the US: 2018–2020), export and import data: **https://data.census.gov/cedsci/table?q=AM1831BASIC&tid=ASMAREA2017.AM1831BASIC01**.

[3] *See*: Flannery, Brian, Jennifer A. Hillman, Jan Mares, and Matthew C. Porterfield. 2020. *Framework Proposal for a US Upstream GHG Tax with WTO-Compliant Border Adjustments: 2020 Update*. Washington, DC: Resources for the Future. **https://www.rff.org/publications/reports/framework-proposal-us-upstream-ghg-tax-wto-compliant-border-adjustments-2020-update/**

Regulator in evaluating the information provided by exporters to indicate their requested rebate. Since steel products are imported from many countries, we have estimated import charges for 14 countries, and then provided a procedure to estimate such charges for the remaining countries exporting to the United States.

The major participants in this sector (manufacturers of coke, basic oxygen furnace and electric arc furnace steel, and integrated steelmaking facilities) are already obligated annually to determine and report to the US Environmental Protection Agency (EPA) their facility GHG emissions if they are over 25,000 tonnes per year. They will also know the amounts and types of covered products they manufacture, and, under the Framework in the United States, suppliers would be obligated to inform customers (and the Regulator) of the GGI values of GHG-intensive products that they sell. Therefore, US manufacturers have the information needed to determine the GGI values for GHG-intensive products they create in specific facilities.

The estimates in this module are based on publicly available information. More accurate and timely information to determine rebates and import charges could undoubtedly be obtained by the Regulator from either the industry association or firms (e.g., Global Efficiency Intelligence or CRU Group) that have a business of obtaining and marketing information about the GHG aspects of various corporate actions.

The GHG-intensive products that steel manufacturers produce would be eligible for export rebates and subject to import charges based on their GGIs as described below. The GGI for basic oxygen steel is based on the GGIs for bituminous coal, iron ore, pig iron, coke used in the blast furnace to make pig iron, the CO_2 emissions from limestone used to make pig iron, the GGI for oxygen and fuel used in the basic oxygen furnace, and the electrode used, and the GGI for electricity used in operations. The GGI for electric arc furnace steel is based on the fuel and technology used to generate electricity for the furnace and the GGI of any HBI, pig iron, or iron units added to the raw material.

Raw and hot-rolled steel are made from steel that itself can be made either in a basic oxygen furnace or an electric arc furnace. Each of these processes uses different amounts of energy from sources that emit different amounts of CO_2 and other GHGs. Non-alloy, stainless, or alloy raw steel plates, slabs, blooms, or billets are imported or exported as are hot-rolled products (e.g., hot-rolled bars). Hot- and cold-rolled steel products are made from the raw steel and/or plates, slabs, blooms, or billets. The energy required for cold-rolling operations is only a small fraction of the energy required to make the raw material for plates, slabs, blooms, billets, or hot-rolled steel. Though small, this additional energy contributes to total emissions from the facility and, if determined, should be included in the total and allocated to products in proportion to their content of raw steel to determine their GGIs.

Although an electric arc furnace primarily uses steel scrap in its production of finished steel, that scrap is itself not a product for which its usage of energy and generation of

CO_2 can be determined—nor will it be considered in determining export rebates or import charges (see the discussion of recycled materials in Section 4.3 of the Framework report).

About 25 percent of US raw steel is derived from technology using a basic oxygen furnace, and the other 75 percent is made based on the electric arc furnace.[4] The processes to make raw steel are assumed not to emit CO_2 other than from the oxygen converted into CO_2 in the basic oxygen furnace and the manufacture of the coke used in the blast furnace. Taxed sources of emissions from coke are accounted for by their contribution as a product purchased from suppliers.

According to the Census Bureau (see footnote 1), imports to the United States of iron, steel, and ferroalloys in 2020 (through November) came from many nations—with the five leading exporters being Canada, Mexico, China, South Korea, and Brazil. The US Harmonized Tariff Schedule (HTS) has about 740 products with 10-digit HTS numbers listed under NAICS Code 331110 for steel. There are about nine other steel products listed in the HTS. For purposes of this analysis, those nine are judged to be sufficiently small in their contribution to total imports that they can be disregarded for rebate and import charge determinations at the start of the program.

To simplify the administrative challenge to determine the import charge and confirm the export rebate for such a large number of steel products, we recommend an approach based on allocation of GHG emissions from facilities to covered products based on the content by weight of the core product (CP), in this case raw steel, that is responsible for the majority of covered emissions. Given the total input to the facility (or sector) of taxed sources of GHG emissions, $CO_2e(TOT)$, and the total mass of raw steel M(CP) in all products, GGI for raw steel is determined as follows:

$$\begin{aligned} CO_2e(TOT) &= \text{total taxed sources of GHG emissions (tonnes } CO_2e\text{);} \\ M(CP) &= \text{total mass of raw steel products (tonnes of raw steel);} \\ GGI &= CO_2e(TOT)/M(CP) \text{ (tonnes } CO_2e\text{/tonne raw steel).} \end{aligned}$$

Firms that seek export rebates for the GHG-intensive products they produce based on their GGI values will be required to provide the Regulator with the following information as the basis for determining the GGIs for their raw steel and covered steel products as well as an export rebate:

a. whether the raw steel for the covered exported products was produced in a basic oxygen furnace or an electric arc furnace;
b. the average CO_2e emissions per unit weight of raw steel from all such production;
c. the electricity per unit weight used and its GGI to manufacture the raw steel contained in such products;
d. the weight of such raw steel in such products;

[4] **https://www.conklinmetal.com/steelmaking-101/**

e. the weight and GGIs of the coke and oxygen used to manufacture such steel from their various facilities making raw steel; and

f. if HBI, pig iron, or iron units are used to make electric arc furnace steel, the amount of such material used, and the GGIs for each.

Firms that currently do not measure the amounts of GHG emissions from their raw steel production or do not have the necessary information regarding their electricity usage can seek export rebates by using the US GGIs determined hereafter, provided they present to the Regulator the following information:

a. the weight of raw steel in the products derived from basic oxygen furnaces and that from electric arc furnaces;
b. the amount of HBI, pig iron, or iron units used per unit of electric arc furnace steel;
c. the amount of electricity for such raw steel; and
d. the GGIs and weight for their raw materials and electricity.

Beginning in the second year, in order to obtain an export rebate such producers must determine and provide CO_2e emissions data from production to the Regulator as well as information about the GHG-intensive raw materials used.

The average GHG emissions from fuels used to manufacture electricity in the relevant country should be used to determine the CO_2 emissions from electricity use associated with production of the imported steel products—unless and until more specific, verifiable information for the nation as a whole or for electricity use by individual firms is provided to the Regulator.[5]

An important note: We emphasize that the estimates in this module are meant only to provide indicative, representative values for the GGIs of US steel products. Some of the public data on which the calculations rely are dated and probably are not representative of industry performance today. Actual values will depend on determination of the GGI for each specific product created at a specific facility. Since companies, associations, and commercial firms that collect and market information about products' energy/GHG emissions profiles can provide more accurate information than was used here, the Regulator should seek such information when determining potential import charges or evaluating requests for export rebates. The estimates here do not account for all chemicals or other raw materials that may have incurred the GHG tax directly or indirectly. Subject to the administrative costs to evaluate all such inputs and be consistent for both export rebates and import charges, the Regulator should strive to accept all verifiable raw material inputs to the GGI for specific products of specific facilities.

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[5] Such national average electricity information can be found in the International Energy Agency's *World Energy Balances 2020*: **https://www.iea.org/subscribe-to-data-services/world-energy-balances-and-statistics**.

2. Basic Oxygen Furnace Raw Steel

We begin this section with an example that illustrates the major sources of GHG emissions that contribute to determination of GGI for raw steel from a basic oxygen furnace (BOF). The raw material for BOF steel is usually pig iron from a blast furnace. That, in turn, is further processed to raw steel with coke from converted coal, and limestone that decomposes into CO_2 and calcium oxide when heated. Following this example, which is based on less recent data from various sources, we use information from the 2022 report Steel Climate Impact: An International Benchmarking of Energy and CO_2 Intensities[6] that provides more uniform, up-to-date estimates and comparisons of CO_2 emissions in 2019 from manufacturing steel in the United States and fifteen other countries using both the basic oxygen and electric arc furnace. The 2022 report provides final values for emissions from steel making without providing explicit details for how various inputs and processes contribute.

The following example illustrates how a manufacturer would compute its GGI for BOF raw steel. It describes contributions to CO_2e(TOT) from iron ore mining and processing; pelletizing iron ore; bituminous coal mining; use of coke, oxygen, and limestone; and from use of fossil fuel for thermal energy and electricity for the blast furnace and basic oxygen furnace.

Contributions to CO_2e(TOT) are as follows:

- Iron ore mining: The 2002 report *Energy and Environmental Profile of the US Mining Industry* indicates that 94,400 Btu are required to extract and process the ore.[7] This results in a contribution (94,400 Btu/short ton) (1.1 short tons/tonne) (0.0733 tonnes CO_2e/MBtu) = 0.0076 tonnes CO_2e/tonne ore. Iron ore pelletizing: A 2013 report by Lawrence Berkeley Laboratory indicates that the energy consumed by pelletizing iron ore is 2.1 GJ/short ton. [8] This results in a contribution (2.1 GJ/short ton iron ore) (1.1 short ton/tonne) (947,800 Btu/GJ) (0.0532 tonnes CO_2e/MBtu from natural gas) = 0.116 tonnes CO_2e/tonne iron ore. Iron ore total: The total contribution from mining and pelletizing iron ore is 0.124 tonnes CO_2e/tonne ore.
- Bituminous Coal Mining: The coke needed is assumed to be produced from bituminous coal mined from underground. A decades-old study for the US Department of Energy indicates that 420,000 Btu/short ton coal are required

[6] *See*: Ali Hasanbeigi, Steel Climate Impact: An International Benchmarking of Energy and CO_2 Intensities, April 7, 2022. **https://www.ourenergypolicy.org/resources/steel-climate-impact-an-international-benchmarking-of-energy-and-co2-intensities/.**

[7] *See*: ITP Mining: Energy and Environmental Profile of the US Mining Industry: Chapter 4: Iron) December 2002.

[8] Hasanbeigi, Ali, and Lynn Price. 2013. Emerging Energy-Efficiency and Carbon Dioxide Emissions-Reduction Technologies for the Iron and Steel Industry. **https://china.lbl.gov/sites/default/files/guidebooks/6106e-steel-tech.pdf**

for an underground coal mine and beneficiation of the coal, while 98,000 Btu/short ton are required for a longwall coal mine.[9] Assuming the average of these two numbers and that oil products are the major energy source, the contribution to CO_2e(TOT) = (259,000 Btu/short ton coal) (1.1 short ton/tonne) (0.0733 tonne CO_2e/MBtu) = 0.021 tonnes CO_2e/tonne coal.

- Coke: Approximately 1.5 tonnes of coal (which we assume is 65% carbon)[10] produce 1 tonne of coke.[11] The report cited in footnote 7 indicates that 5.5 to 6.5 GJ thermal energy from natural gas are required to produce a ton of coke, which we assume to be 92% percent carbon.[12] These result in a contribution to CO_2e(TOT) from coke of (1.5 tonnes coal/tonne coke) (0.021 tonnes CO_2e/tonne mined coal) + (6.0 GJ/short ton coke) (1.1 short ton/tonne) (947,800 Btu/GJ) (0.0532 tonne CO_2e/MBtu from natural gas) + (0.65 tonnes carbon/tonne coke) (44 tonnes CO_2e/12 tonnes carbon) = (0.0315 + 0.3328 tonnes + 2.38) tonnes CO_2e/tonne coke = 2.74 tonnes CO_2e/tonne coke.
- Oxygen: The module on industrial gases estimates that the GGI for oxygen (O_2) as 0.37 tonnes CO_2e/tonne O_2, based on producing 95 percent O_2 using the PSA process with electricity derived equally from coal and natural gas as fuel.
- Limestone: Limestone is composed primarily of calcium carbonate ($CaCO_3$); it disintegrates in the blast furnace to CO_2 and calcium oxide that becomes part of slag. We assume that the contribution from limestone is 44 tonnes CO_2 per 100 tonnes limestone = 0.44 tonnes CO_2/tonne limestone (see also the module on cement).

A 1986 EPA publication indicates that the production of 1 tonne of iron requires 1.4 tonnes of ore; 0.5 to 0.65 tonnes of coke; and 0.25 tonnes of limestone.[13] According to Britannica, 110 cubic meters of oxygen are required per tonne of BOF raw steel.[14]

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[9] **ITP Mining: Energy and Environmental Profile of the US Mining Industry. December 2002: Chapter 2: Coal**

[10] See: Bowen, B.H. and M.W. Irwin Coal Characteristics. 2008, **https://www.purdue.edu/discoverypark/energy/assets/pdfs/cctr/outreach/Basics8-CoalCharacteristics-Oct08.pdf**

[11] *See*: **https://www.corsacoal.com/about-corsa/coal-in-steelmaking/**

[12] How Steel is Made", American Iron and Steel Institute. **https://www.steel.org/steel-technology/steel-production/**

[13] See: AP 42, Fifth Edition, Volume I Chapter 12: Metallurgical Industry October 1986. **https://www.epa.gov/air-emissions-factors-and-quantification/ap-42-fifth-edition-volume-i-chapter-12-metallurgical-0**

[14] See: **https://www.britannica.com/technology/steel/Basic-oxygen-steelmaking**

So, the GGI for BOF raw steel would be determined as follows:

$$
\begin{aligned}
\text{GGI} &= CO_2e(\text{TOT}) \text{ per tonne BOF raw steel;} \\
&= [\text{1 tonne iron/tonne BOF raw steel}] \\
&\quad [(\text{1.4 tonnes ore/tonne iron}) (\text{0.124 tonnes } CO_2e\text{/tonne ore}) \\
&\quad + (\text{0.575 tonnes coke/tonne iron}) (\text{2.74 tonnes } CO_2e\text{/tonne coke}) \\
&\quad + (\text{0.25 tonnes limestone/tonne iron}) (\text{0.44 tonnes } CO_2\text{/tonne limestone})] \\
&\quad + (\text{110 cubic meters } O_2\text{/tonne BOF raw steel}) (\text{0.0014 tonnes O2/cubic} \\
&\quad \text{meter } O_2) (\text{0.37 tonnes } CO_2e\text{/tonne } O_2) \\
&= (0.174 + 1.58 + 0.11 + 0.057) \text{ tonnes } CO_2e\text{/tonne BOF raw steel} \\
&= \text{1.92 tonnes } CO_2e\text{/tonne BOF raw steel.}
\end{aligned}
$$

This GGI for BOF raw steel (from this example using older data) is higher than the GGI reported below. A part of the difference is due to this analysis having included the CO_2e estimated to have occurred in the context of mining iron ore and coal for coke. A larger part of the difference is probably due to the data for this analysis being fifteen or more years earlier than the data used in the GGIs reported below. In the last 15 years facilities in the United States have invested in means of producing BOF raw steel with fewer GHG emissions.

Values from the report *Steel Climate Impact* (see footnote 6) cited below for CO_2/tonne of steel are estimated from bar charts in the report and are accurate to perhaps a few percent. Also, the rankings from highest to lowest are as shown in the charts. Although these estimates do not include some sources that could contribute to the GGI of steel (e.g., non-CO_2 GHGs and some small, additional contributions to supply chain emissions), they do capture dominant sources that contribute to the GGI. We use them as the basis for our indicative estimates both here (in Section 2) and in Section 3.

Using values from the source in footnote 5, based on emissions in 2019, we estimate the GGI of BOF raw steel made in the United States as 1.88 tonnes CO_2e/tonne BOF raw steel.

2.1 Export Rebates

If there were an upstream GHG tax of $20 per tonne of CO_2, this GGI would result in a $37.60 rebate per tonne of BOF raw steel.

2.2 Import Charges

The CO_2e emissions intensities of blast furnace–basic oxygen furnace steel production in 14 countries have been listed in Figure 8 of the *Global Efficiency Intelligence* report (footnote 6). Until the importer provides the Regulator with the necessary information (listed as items a-f in Section 1), the Regulator could use a weighted average of the estimates of the 14 other countries' CO_2e intensities (i.e., not that of the United States and excluding Vietnam) based on their production of BOF steel products in HTS Codes 7301-3 and 7306–7328 in 2020 to determine the GGI for the other countries of the world. This average is 2.0 tonnes CO_2e/tonne BOF raw steel. The importer must provide the Regulator with the weight of raw steel in the imported product and the amount of such steel that was made by either or both of the basic oxygen furnace and electric arc furnace processes (see next section).

The weighted average GGI (2.0 CO_2e/tonne BOF raw steel; see below) for the 14 countries, excluding the United States and Vietnam, was determined based on data published by the World Steel Association on the total crude steel production in 2020 by country and process.[15]

For imports of products covered by NAICS Code 331110 from countries other than the United States that are made from basic oxygen steel, the Regulator may use the charges determined below as initial estimates. Based on the GGIs for BOF raw steel, if there were an upstream GHG tax of $20 per tonne of CO_2, the import charges for the 14 countries for BOF raw steel contained in products covered by NAICS Code 331110 would be as follows:

Table 1. Import charges under an upstream GHG tax of $20 per tonne of CO_2

	GGI tonnes CO_2e/tonne steel	**Import Charge** $ per tonne steel
Brazil	1.55	31.00
Canada	1.62	32.40
Germany	1.72	34.40
Mexico	1.85	37.00
United States	*1.88*	*37.60*
France	1.88	37.60
Turkey	1.92	38.40
Russia	1.97	39.40
Italy	2.01	40.20
China	2.05	41.00
South Korea	2.09	41.80

[15] *See*: **2021-World-Steel-in-Figures.pdf (worldsteel.org)**

Japan	2.29	45.80
Vietnam	2.36	47.20
Ukraine	2.42	48.40
India	2.96	59.20

3. Electric Arc Furnace Raw Steel

The GGI for electric arc furnace (EAF) raw steel is based on the electricity used to manufacture the steel, which can be generated from coal, natural gas, or non-fossil sources. Each such source will result in a different GGI for the steel. The scrap input does not impact the GGI. If feedstocks include HBI, pig iron, or iron, their GGIs will contribute to the GGI for the electric arc furnace raw steel. As described above in Section 2, based on the 2022 report *Steel Climate Impact* (see Figure 11 in footnote 6), the US GGI for EAF raw steel is 0.562 tonnes CO_2e/tonne EAF raw steel. That report does not indicate the amounts of the various energy sources for the electricity used in the arc furnaces. Thus, as noted above, the exporters and importers must provide the Regulator with verifiable information about the following:

a. the weight of raw steel in the products derived from electric arc furnaces;
b. the amount of HBI, pig iron, or iron units used per unit of electric arc furnace steel;
c. the amount of electricity for such raw steel; and
d. the GGIs and weights for their raw materials (e.g., oxygen and ferroalloys) and electricity.

As in the previous section we begin with an example that illustrates the major sources of GHG emissions that contribute to determination of GGI for EAF raw steel. The 2014 report Electric Furnace Steelmaking[16] provides the following information about EAF steel: On a global basis scrap is about 75 percent of metal inputs, direct reduced iron and hot briquetted iron (DRI and HBI) provide about 15 percent with the balance 10 percent being pig iron and hot metal. The graphite electrode is consumed at the rate of about 1.1 kg/tonne iron, and 391 kWh/tonne steel and 35 kWh/tonne thermal energy provided by natural gas. If the EAF steel is produced solely from scrap, the scrap would not make a contribution to the CO_2e(TOT) (see Section 4.3 of the Framework for a discussion of the treatment of scrap).

So, contributions to GGI occur as follows:

- Electrode: (1.1 kg graphite/tonne EAF) (1 tonne graphite/1000 kg graphite) (1 tonne carbon/tonne graphite) (44 tonnes CO2/12 tonne carbon) = 0.004 tonnes CO2e/tonne EAF raw steel;
- Electricity: (391 kWh/tonne EAF steel) (0.42 tonnes CO2e/1,000 kWh) = 0.164 tonnes CO2e/tonne EAF;

[16] Jorge Madia, Chapter 1.5 Electric Furnace Steelmaking in Treatise on Process Metallurgy-Volume 3 (2014).
https://www.researchgate.net/publication/285175113_Electric_Furnace_Steelmaking#fullTextFileContent

- Thermal energy: (35 kWh/tonne EAF steel) (0.42 tonnes CO2e/1000 kWh) = 0.0147 tonnes CO2e/tonne EAF raw steel;
- Other non-scrap feedstocks (HBI, pig iron, iron): These are assumed to amount to 25 percent by weight of the EAF raw steel. We assume that the GGI for these feedstocks is the same as that for BOF raw steel: (0.25 tonnes other/tonne EAF) (2.66 tonnes CO2e/tonne other) = 0.665 tonnes CO2e/tonne EAF raw steel.

GGI = CO_2e(TOT) per tonne EAF raw steel;
= (0.004 + 0.164 + 0.015 + 0.665) tonnes CO_2e/tonne EAF raw steel
= 0.848 tonnes CO_2e/tonne EAF raw steel.

Note that the contribution from non-scrap feedstock is significant. While this GGI is higher than many of the EAF GGIs listed below, in particular the US result, 0.562 tonnes CO_2e/tonne EAF raw steel, this could be in part because the data used above is from nearly a decade earlier than information in the Table.

The following results for export rebates and import charges for EAF steel are based on 2019 data from the more recent report (see Figure 11 in footnote 5).

3.1 Export Rebates

If there were an upstream GHG tax in the United States of \$20 per tonne of CO_2, the rebate for a tonne of hot rolled steel derived from electric arc furnace raw steel (with GGI = 0.562 tonnes CO_2e/tonne EAF raw steel) would be \$11.24. For any form of steel, if its GGI is below the threshold for covered products (0.50 tonnes CO_2e/tonne steel), there would be no rebate.

3.2 Import Charges

There are substantial imports of steel products covered by NAICS Code 331110 made with EAF raw steel with GGIs both above and below 0.50. Those GGIs and potential import charges if the GHG tax were \$20 per tonne of CO_2 are as follows:

Table 2. GGIs and potential import charges under a GHG tax of $20 per tonne of CO_2

	GGI tonnes CO_2e/tonne steel	Import Charge $ per tonne steel
Brazil	0.296	0.00
France	0.326	0.00
Canada	0.429	0.00
Germany	0.503	10.06
Italy	0.518	10.36
US	*0.562*	*11.24*
Turkey	0.577	11.54
Ukraine	0.592	11.84
Russia	0.606	12.12
Japan	0.636	12.72
South Korea	0.651	13.02
Mexico	0.784	15.68
Vietnam	0.888	17.76
China	1.30	26.00
India	1.51	30.20

For imports of products covered by NAICS Code 331110 from countries other than those above, the Regulator should use the weighted average GGI of the countries named above, other than the United States and Vietnam, which is 0.98 tonnes CO_2e/tonne EAF raw steel. This weighted average GGI was determined based on the total crude steel production by country and process published by the World Steel Association for 2020.

As noted above, oxygen and ferroalloys are used to make electric arc furnace steel. They would cause the GGI for imported steel to be higher than calculated above. Thus, the Regulator may decide to estimate the average usage of oxygen and ferroalloys in imported electric arc furnace steel and to add such additional GGIs to the above weighted average GGIs.