

Steel Production Greenhouse Gas Emissions Calculation Methodology Guidelines

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Background

In recent years, there has been a surge of interest in the calculation and reporting of greenhouse gas (GHG) emissions from industrial sectors as part of a broader focus on decarbonization in the United States and around the world. These GHG emissions values are used in various ways, including in environmental disclosures and reports, policy and trade decision-making, life cycle assessment studies involving steel products, sustainable certifications, and sustainability messaging or marketing. As a result, various domestic and international groups are studying and developing calculation approaches to determine GHG emissions from steel production in order to develop standards, policies, procurement frameworks, and decarbonization roadmaps. These groups are working quickly and simultaneously, and while there is some collaboration, significant differences remain and continue to evolve in the scope, system boundaries, assessment basis, and other key aspects of the resulting GHG calculation methodologies.

Objective

This document aims to provide clarity on the topic of GHG emissions calculations and presents a set of guidelines for AISI and its members to use when engaging in initiatives and policy-related discussions pertaining to the development of carbon steel and stainless steel production GHG emissions calculations. The guidance presented herein is in alignment with established methods and applicable International Organization for Standardization (ISO) requirements utilized when developing the AISI life cycle inventory (LCI) data for industry average American steel products. The document is designed to be a living document and will be updated to reflect new standards and evolving best practices as they emerge (see *Governance* section). It is not intended to be a new standard but is instead intended to inform efforts underway by others working to directly or indirectly develop GHG emissions calculation methodologies.

The primary objective of this document is to establish a consistent and robust calculation approach for GHG emissions from steel production with a focus on product-level disclosures and corporate-level reporting. However, we acknowledge these calculations and the results will be used to enable and demonstrate GHG emission reductions by the industry, which should prioritize achieving significant direct GHG reductions at the site level (Scope 1) to reduce the overall GHG impact of the steel industry, while also achieving beneficial indirect GHG reductions (Scopes 2 and 3).

Methodology Guidelines

This section presents guidelines for steel production GHG emissions calculation methodologies organized by topic area. It is intended to reflect the latest and best practice recommendations in a rapidly evolving topic area, but does not supersede existing practices and requirements for the development of independently produced and certified Environmental Product Declarations (EPDs).

Assessment Scope

The scope in this instance refers to the system boundaries of the study, or which specific processes, steps, or stages are to be included in a given assessment. The commonly used term "cradle-to-gate" originates from the practice of life cycle assessment (LCA) and refers to all processing steps required to manufacture a defined product. This scope boundary is typically described as inclusive of all steps from the extraction of raw materials from the earth through to the final step before a defined product leaves the manufacturing plant gate, or is ready to be distributed for use. In the case of steelmaking, the "cradle" represents processes like the mining of iron ore and the "gate" signifies the steel mill gate.

With the emergence of corporate GHG inventory accounting, the concept of assigning emissions to numbered scopes has become prevalent for the reporting of emissions associated with direct and indirect company operations. According to the U.S. Environmental Protection Agency (EPA),[1] Scope 1 emissions are direct GHG emissions that occur from "sources that are controlled or owned by an organization (e.g., emissions associated with fuel combustion in boilers, furnaces, vehicles)." Scope 2 emissions are indirect GHG emissions associated with the purchase of electricity, steam, heat, or cooling. Scope 3 emissions are caused by the upstream and downstream supply chain of a company's operations and include the purchase of raw materials, production of fuels, and distribution and use of products.

Guidance: For all calculation purposes, including trade, procurement, and company reporting, include a comprehensive cradle-to-gate scope analogous to Scope 1, 2, and upstream raw materials, energy, and transportation Scope 3 emissions for all major GHG emissions (see table below).

For completeness, consistency, and transparency purposes, all major production processes from raw material extraction or collection, fuel production, transportation of raw materials and fuels, ironmaking, and steelmaking, through to finished steel products leaving the mill should be included as shown in *Table 1*. This assessment scope is consistent with AISI's industry average LCI data for American steel products. In terms of the Greenhouse Gas (GHG) Protocol[2] categories, this represents all Scope 1, Scope 2, and the following Scope 3 categories: purchased goods and

[1] https://www.epa.gov/climateleadership/scope-1-and-scope-2-inventory-guidance

[2] https://ghgprotocol.org/

services (Scope 3.1), fuel- and energy-related activities not included in Scope 1 or Scope 2 (Scope 3.3), upstream transportation and distribution (Scope 3.4), and waste generated in operations (Scope 3.5).

Guidance: Direct (Scope 1) emissions should be calculated using the EPA GHG Reporting Rule[3] methodology for U.S.-based facilities, with the addition of those facilities below the 25,000 metric tons CO_2e per year reporting threshold. Direct Scope 1 emissions should also include ancillary sources of on-site GHG emissions that are not included in the EPA GHG Reporting Rule methodology.[4]

GHG emissions from biogenic sources, including biochar, biomass, biogas, and biofuels should be determined in accordance with U.S. EPA's GHG Reporting Rule (for Scope 1 emissions). Preparation of EPDs with biogenic sources should follow calculation approaches in the Product Category Rules (PCR) for North American Steel Construction Products[5] for EPDs and in the GHG Protocol Corporate Standard for corporate reporting (note that the GHG Protocol is expected to publish a *Land Sector and Removals Guidance*[6] that will address this topic in 2023).

Purchased electricity (Scope 2) is a key energy source for steel production, particularly electric arc furnace (EAF) steelmaking and product rolling and finishing processes. Increasingly, companies are employing renewable energy instruments, like renewable energy credits (RECs) or power purchase agreements (PPAs), including virtual PPAs, to reduce the carbon intensity of consumed electricity. Significant debate continues about whether and which of these instruments result in actual emissions reduction. Accordingly, there is a lack of consistent guidance on when and how these instruments should be used to determine the carbon footprint of a given product as reported in an EPD. The Product Category Rules (PCR) for North American Steel Construction Products[7] requires the use of regionally specific grid mix data based on EPA's Emissions & Generation Resource Integrated Database (eGRID)[8] to represent purchased electricity in EPDs. (Note: For steel produced outside the U.S., a credible, regionally representative grid mix must be used for calculations relative to purchased electricity.) Optionally, where a chain of custody can be traced by kWh and origin (not just CO_2e attributes), results reflecting renewable electricity purchases may be reported in a separate table. For corporate reporting, the GHG Protocol[9] has a market-based reporting mechanism that allows for consideration of RECs and PPAs.

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[3] https://www.epa.gov/ghgreporting

[4] Such as mobile and emergency equipment fuel use, refrigerants, etc.

[5] Product Category Rule (PCR) Guidance for Building-Related Products and Services Part B: Designated Steel Construction Product EPD Requirements, UL 10010–34, Second Edition, Dated August 26, 2020. Note: Biogenic carbon accounting methods are described in UL's core PCR Part A Building-Related Products and Services.

[6] https://ghgprotocol.org/land-sector-and-removals-guidance

[7] PCR for Designated Steel Construction Product EPD Requirements, Ibid.

[8] https://www.epa.gov/egrid

[9] https://ghgprotocol.org/scope_2_guidance

Guidance: GHG emissions from purchased electricity (Scope 2) must be derived from local electricity grid factors for construction product EPDs in accordance with applicable PCR requirements. AISI encourages reporting of GHG emission results inclusive of renewable/clean PPAs and RECs as additional information in EPDs, and this additional information should also be used as the basis for product-specific trade and procurement programs. To ensure credibility, these instruments must satisfy traceability and additionality requirements. PPAs and RECs meeting these criteria should also be incorporated into industry-wide and corporate-level GHG emissions reporting in accordance with specific requirements of the applicable standards, such as the market-based approach in the GHG Protocol.

Assessment Basis

The basis for GHG emissions calculations can vary depending on how the information will be used. For example, assessments at the product level represent aggregated GHG emissions associated with all processes needed to manufacture a specific steel mill product like structural sections or hot-dip galvanized coil. The GHG emissions are typically reported as an emissions intensity per unit of finished product, such as tons CO_2-equivalent/ton steel product (e.g., tons CO_2e/ton structural sections). For corporate reporting, emissions are often reported as absolute emissions for company operations inclusive of all product types for a given year.

Recent trends toward more granular and transparent data have resulted in increasing demand for facility-specific and product-specific GHG emissions estimates. For example, the Buy Clean California Act (Public Contract Code Sections 3500-3505)[10] mandates the GHG emissions for specified steel construction products be below established thresholds as reported in facility-specific EPDs.

Guidance: GHG emissions should be calculated at the product level for trade, procurement, and EPD purposes. A company-wide basis should be used for corporate reporting and include Scope 1, 2, and upstream raw materials, energy, and transportation Scope 3 emissions (both absolute emissions and emissions intensity).

Data Sources

The results of GHG emissions calculations are heavily dependent upon the scope and basis of the analysis as well as the quality and representativeness of the data used in the calculations. Primary data collected directly from the facility via purchasing records, utility bills, production data, waste management data, etc. is the highest quality and most accurate data and should be used wherever possible. For purchased raw materials, fuels, and electricity, it is critically important that data used

[10] https://www.dgs.ca.gov/PD/Resources/Page-Content/Procurement-Division-Resources-List-Folder/Buy-Clean-California-Act

to estimate extraction and production processes are from reputable sources, are the most up-to-date, and are regionally representative. It is particularly important that the sources of data are identified for raw materials and energy sources that are key contributors to the GHG emissions associated with steel production, including pig iron, direct reduced iron (DRI) and hot briquetted iron (HBI), natural gas, and purchased electricity.

Guidance: Primary data should be used wherever possible, including from steel industry suppliers. Emission factors for purchased materials must be derived from reputable data sources and be regionally and temporally representative. The source of data should be disclosed for transparency purposes, particularly for imported materials and fuels. EPA data should be prioritized for purchased electricity (based on eGRID regions) and for transportation fuels.

Allocation Approaches

When a manufacturing process has more than one product or results in the production of beneficially used co-products, a calculation termed "allocation" is performed to assign an appropriate share of the impacts to each product and co-product. Per ISO 21930:2017[11] requirements, which establish the overarching rules for the development of construction product EPDs, and the GHG Protocol used for corporate-level reporting, physical allocation (the assignment of a share of the impact based on physical properties such as mass or energy content) should be the first choice if allocation is necessary. The World Steel Association utilizes the system expansion approach for its LCI data collection methodology, which assigns all the carbon emissions to the product (steel) and enables the calculation of credits for co-products based on the substitution of materials and fuels they displace in a given application, such as the use of steel slag to displace cement in concrete production. The system expansion allocation method is prohibited in ISO 21930. Economic allocation, which assigns a share of impact based on the prices of primary products and co-products, is identified as the least preferable option in the ISO 14044:2006[12] standard that governs LCA practices, and is to be used only when allocation cannot be performed using other approaches. Because of the limitations on the use of economic allocation and system expansion in the relevant ISO standards and the GHG Protocol, physical allocation (partitioning followed by allocation based on energy and mass) has been identified as the appropriate allocation approach.

Guidance: Physical allocation (partitioning followed by allocation based on energy and mass) should be used to account for steel co-products for all EPD, trade and procurement purposes to enable consistent assessment of the impacts or benefits of steel co-products.

[11] https://www.iso.org/standard/61694.html

[12] https://www.iso.org/standard/38498.html

Allocation is also used to determine the credits or burdens applied to the recycling of materials when products reach their end-of-life. As this methodology guidance pertains to the calculation of GHG emissions associated with steel production, the use and end-of-life treatment of steel products are outside the scope of this document. No credits or burdens should be considered for the recycling of steel scrap at end-of-life in steel production cradle-to-gate emissions calculations.

Offsets

In the context of GHG emissions calculations, offsets are considered quantified GHG emission reductions that occur outside of a company's value chain which are used to neutralize GHG emissions caused by the company directly or indirectly. Carbon offsets or credits should not be used in the calculation of GHG emissions as reported for EPD, trade or procurement purposes.

Guidance: Offsets[13] or carbon credits from GHG reduction activities outside a company's value chain should be excluded from GHG emissions calculations for EPD, trade or procurement purposes. The use of offsets in corporate-level reporting should follow requirements in applicable standards such as the GHG Protocol, including transparent documentation, and derivation using credible accounting standards.

Reporting and Interpretation

To protect and enhance the credibility of steel industry GHG emissions reporting, it is critically important that the methodology and results of GHG emissions calculations are clearly and transparently reported. This should include identification of specific processes, materials, and energy sources included in the scope of the assessment, an explanation of methodological considerations like co-product allocation, and identification of key data sources and emission factors used in the assessment.

Supplemental Information: GHG Emission Reduction Targets and Decarbonization Initiatives

Initiatives aimed at setting GHG emission reduction targets over time and proposing pathways for decarbonizing steelmaking often include a raw steel or "crude" steel assessment basis at the facility level, which draws the system boundary at the EAF or basic oxygen furnace (BOF) casting process where the first solid form of steel is created. Proposals have been recently made to include the hot rolling process in this system boundary as it is a common process for most steel products, can result in significant GHG emissions, and represents a decarbonization opportunity for the steel industry. The inclusion of upstream processes, such as mining of iron ore and ferroalloy production, is inconsistently addressed in decarbonization initiatives, which creates comparability and data collection challenges for the industry. A complete and comprehensive scope aligned with the guidance contained herein is recommended, from raw material extraction

[13] It is important to note that carbon capture and sequestration is not considered an offset as it represents permanent, measurable and verifiable emissions reductions from within a company's operations and/or value chain.

through to the hot rolling or hot strip mill process step, including iron ore mining and ferroalloy production.

For the application of GHG emissions calculations to GHG reduction target setting and decarbonization initiatives, the use of RECs, PPAs, and offsets should follow the guidelines contained herein as well as applicable standards or program requirements. Emissions reductions internal to a company should be prioritized before employing offsets for emissions reduction.

Governance

These recommendations are to be updated as new guidance, procedures, rules, or regulations emerge. To ensure that this controlled document remains up to date, the guidelines in this document will be reviewed and revised by the AISI Sustainability Committee, at least annually, and approved by the AISI Board prior to being published as a revised version.

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1.0	November 3, 2022	--

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