

Initiatives and Standards for the Transition to Near-zero Steel Production

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Abbreviations

Abbreviation	Full text	Meaning
in tables of standards and initiatives		
C	Company	calculations and declarations are performed on a company level
Cert	Certification	the initiative includes a certification scheme
CS	Crude Steel	cast steel before further metal working
c-PCR	Complimentary PCR	further specification to a PCR for a product subgroup
De	Demand	using purchasing power of companies and governments to create an early demand market of near-zero steel
Fi	Finance	developing finance mechanisms such as grant, loans, interests to support technology and infrastructure development
Fw	Framework	providing reporting framework for GHG emission intensity
HA	High Alloy	high alloy steel with an alloy content normally over 10%
HRS	Hot Rolled Steel	normally hot rolled coil ready for delivery or further processing
LA	Low Alloy	low alloy steel with an alloy content normally under 10%
P	Product	calculations and declarations are performed on a product level
PCR	Product Category Rules	specifications to a standard on how to apply it to a product group
Po	Policy	developing policy support from governments
Ro	Roadmap	providing an overview of the possible emissions mitigation strategies
S	Site	calculations and declarations are performed on a site level
SP	Steel Product	the final steel product delivered from the sit/company
TBD	To Be Decided	the issue is not yet decided for the initiative
To	Tool	providing tools for rating a company's sustainability
Processes		
BF	Blast Furnace	process reducing iron ore to liquid pig iron
BOF	Basic Oxygen Furnace	converter process turning blast furnace pig iron into steel
DR	Direct Reduction	process reducing iron ore to iron in solid state
DRI	Direct Reduced Iron	product from DR process
EAF	Electric Arc Furnace	electric steelmaking process melting scrap or DRI
LF	Ladle Furnace	process after EAF or BOF to adjust temperature or analysis of liquid steel before casting
Other		
SDA	Sectoral Decarbonisation Approach	calculation rules depending on industry sector as suggested by Science Based Targets initiative

1 Introduction

Iron and Steel sector is one of the key players in achieving the sustainability in the future, accounting for 7-9% of the global greenhouse gas (GHG) emissions (Kim, 2022). To achieve the objective of the Paris Agreement, we have to take several actions in the next few decades. There currently exist several initiatives to support the transition to near zero steel production, providing roadmaps and guidelines for the iron and steel industry to realize decarbonisation step by step.

This report presents a general review of recent initiatives and standards on the decarbonization in the iron and steel sector. They cover decarbonisation from the corporate, national/regional to the global range. The aim of this study is to:

- identify the current standards, methodologies, tools, policies, platforms of low GHG-emission steel production that could be used by manufactures, buyers, investors and policymakers
- discover the barriers and gaps in creating global alignment of the near zero steel market

This work was performed in the Swedish project URSTARK, “Utredning av standardiseringsbehov kopplat till stålindustrins klimatomställning” led by Karin Östman from Jernkontoret and supported by a reference group with representatives from an ore supplier, ore based and scrap-based steelmaking and companies using steel.

In the report the concept “near zero steel” has been used as a neutral term and when the term “green steel” is used it is fetched from the nomenclature of the individual initiative.

2. Actors and Focus Areas of the Near zero steel production Initiatives and Standards

2.1 General

Organisations active in developing systems to promote the transition to low GHG steel production can be categorised depending on organisational type and their regional coverage. The following groups have been selected for this report:

- a. Standard organisations
- b. European Union
- c. Country membership organisations
- d. Company membership organisations
- e. Research organisations
- f. Ad Hoc organisations and partnerships

2.1.1 Organisations working in the different initiatives for meeting the Paris agreement

What is remarkable is that such a large number of organisations of different types have engaged in initiatives for abatement of GHG emissions. From the initial start of the United Nations, **UN**, founding of the Intergovernmental Panel on Climate Change, **IPCC**, in 1988 and the development of standards by International Standardisation Organisation, **ISO**, and the European Standardisation Organisation, **CEN**, on measuring and reporting GHG emissions and footprints for organisations and products to the immense interest of established and new organisations to participate in the development of rules to guide the transformation that we see today.

The main reason for this development may be found in that the standardisation process is by many considered too slow to take on rule development for the necessary transition of the industry and that the transition is on top of each members agenda in membership organisations why they feel forced to act. Other reasons may be that standards often are open to different interpretations and generally do not set limits or thresholds and instead focus on methods.

For Sweden the most important actor in this field is probably the European Union which has a number of frameworks of its own but the European Commission, **EC**, also participate in a number of initiatives on behalf of the European Union, **EU**, especially where countries are members.

2.1.2 Country membership organisations

- United Nations Climate Change, **UNCC**,
 - Race to zero campaign
- United Nations Industrial Development Organisation, **UNIDO**
- International Finance Corporation, **IFC**, (**World Bank Group**)
- The Financial Stability Board, **FSB**
- Group of seven, **G7**, intergovernmental economic organization consisting of seven major developed countries and EU.
- Organisation of Economic Co-operation and Development, **OECD**
- The International Energy Agency, **IEA**
- World Trade organisation, **WTO**
- Mission Innovation, **MI**, group of 22 countries and the European Commission
- The French Agency for Ecological Transition, **ADEME**

2.1.3 Company membership organisations

- World Economic Forum, **WEF**,
- International Chamber of Commerce, **ICC**,
- World Business Council for Sustainable Development, **WBCSD**
 - Partnership for Carbon Transparency initiative, **PACT**
- The World Steel Association, **worldsteel**
- The European Steel Association, **EUROFER**
- American Iron and Steel Institute, **AISI**
- EcoVadis

2.1.4 Research organisations, private organisations and think tanks

- World Resource Institute, **WRI**
- World Wildlife Foundation, **WWF**
- European Steel Technology Platform, **ESTEP**
- Rocky Mountain Institute, **RMI**,
- The Energy Research Institute, **TERI**, India
- Wirtschaftsvereinigung Stahl, **WV Stahl**, Germany
- E3G Think tank, **E3G**

2.1.5 Ad Hoc organisations and partnerships

- Mission Possible Partnership, **MPP**
- DISCLOSURE INSIGHT ACTION (former Carbon Disclosure Project), **CDP**
- Science Based Targets initiative, **SBTi**
- ResponsibleSteel™, **RS**
- The Climate Group, **CLIMATE GROUP**
 - SteelZero (in partnership with RS)
 - RE100 (renewable electricity)
- Global Steel Climate Council, **GSCC**, (Steel company consortium)
- **Climate Bonds Initiative**
- The International Finance Reporting Standards - Sustainability Accounting Standards Board, **IFRS-SASB**
- **Climate Action 100+**
 - Investor networks: Asia investor Group on Climate Change, CERES, Investor Group on Climate Change, The Institutional Investors Group on Climate Change, IIGCC, Principles for Responsible Investment

2.2 Standards currently affecting the climate work in the iron and steel industry

This section gives an overview of the standards currently affecting the climate work in the iron and steel industry. Relevant standards for the transition to near zero steel production are listed in [Table 2.1](#).

The main and traditional role of standardisation, performed by official international or national standardisation organisations, is to find unified methods to do calculations and assessments in order to increase transparency, and to make it possible to verify compliance with various requirements. Standards seldom, if ever, contain value judgements. Standard development is based on a consensus process which also makes it difficult to develop a standard with stricter requirements than can be agreed upon. Sometimes the final standards are also open for different interpretations.

Environmental product declarations, EPDs, are developed according to the **ISO 14025:2020** “Environmental labels and declarations — Type III environmental declarations — Principles and procedures” demanding third party auditing. EPDs are based on life cycle assessment, audited and published within an EPD system according to the EPD-system organisations’ Product Category Rules, PCRs. PCRs are based on the general LCA-standard:

- **ISO 14044:2006** “Environmental management — Life cycle assessment — Requirements and guidelines” outlines how an LCA should be performed to assess multiple environmental impacts and resources use for any product.

Life cycle inventory method for steel to support ISO 14044 is covered by:

- **ISO 20915:2018** “Life cycle inventory calculation methodology for steel products”

Multi impact product standards exist for building material including steel and can be considered PCRs:

- **ISO 21930:2017** “Sustainability in buildings and civil engineering works — Core rules for environmental product declarations of construction products and services”
- **EN 15804:2012+A2:2019** “Sustainability of construction works - Environmental product declarations - Core rules for the product category of construction products”
- **prEN17662** Execution of steel structures and aluminium structures - Environmental Product Declarations - Product category rules complementary to EN 15804 for Steel, Iron and Aluminium structural products for use in construction works.

Single impact standards exist, especially for GHG:

- **ISO 14067:2018** Greenhouse gases — Carbon footprint of products — Requirements and guidelines for quantification

For steel the following standards are developed:

- **ISO 14404:2013** “Calculation method of carbon dioxide emissions intensity from iron and steel production,” was first published in 2013. The ISO 14404 series is based on the worldsteel measurement standards. Three sub standards exist:
 - -1 Blast furnace route
 - -2 DR-EAF route
 - -3 EAF route
- **EN 19694-2:2016** “Stationary source emissions - Greenhouse Gas (GHG) emissions in energy-intensive industries - Part 2: Iron and steel industry”. For this standard EUROFER has developed Excel tools for reporting.

New ISO-standardisation projects that have reached the Draft International Standard levels are of relevance for the transition like standards for carbon neutrality and green debt instruments. A new standardisation project was decided by ISO in January 2023 for sectoral transition plans.

Furthermore, ISO published an International Workshop Agreement on Net Zero Guidelines during 2022 (IWA 42). An IWA is not a standard but a rapid response from ISO on an urgent need. This document “provides guiding principles and recommendations to enable a common, global approach to achieving net zero greenhouse gas emissions through alignment of voluntary initiatives and adoption of standards, policies and national and international regulation.”

Table 2.1 Relevant standards for the transition to near zero steel production (not exhaustive)

Product LCA/EPD/PCR Standards	
ISO 14044:2006	General LCA
ISO 14021:2017	Labels Type II
ISO 14025:2006	Labels Type III
ISO 14026:2017	Principles, requirements and guidelines for communication of footprint information
ISO 21930:2017	LCA for building products Super PCR
EN 15804:2012+A2:2019	LCA for building products Super PCR
prEN 17662	LCA for steel and aluminium c-PCR under EN15804
ISO 20915:2018	LCI for steel
ISO 14067:2018	Carbon footprint of products
EN 45557:2020	Recycled content in energy related products
Organisation or site greenhouse gas, GHG, Quantification and Reporting	
ISO 14064-1:2018	Quantification and reporting org
ISO/TR 14069:2013	Guidance to ISO 14064-1
ISO 14064-2:2019	Quantification and reporting project
ISO 14064-3:2019	Verification and validating statements
ISO 14694-1:2021	Stationary emissions GHG in energy intensive industries.
SS-EN 19694-1:2016	GHG Energy intensive industries general
SS-EN 19694-2:2016	GHG Energy intensive industries, iron and steel industry
ISO 14404-1:2013	CO ₂ Calculation method Steel complimentary calculation rules BF-BOF
ISO 14404-2:2013	CO ₂ Calculation method Steel complimentary calculation rules EAF
ISO 14404-3:2017	CO ₂ Calculation method Steel complimentary calculation rules DR-EAF
ISO 14404-4:2020	CO ₂ Calculation method Guidance on 14404
General standards supporting decarbonisation	
ISO 14097:2021	GHG mgmt. incl. investments and financing
ISO 14080:2018	Climate action
ISO/DIS 14068	Carbon Neutrality
ISO/DIS 14030-3	Green debt instruments, part 3 Taxonomy
ISO NWIP 2023	Requirements and guidelines for sectoral transition plans
IWA 42:2022	Net Zero Guidelines

2.3 The EU Initiatives currently affecting the climate work in the iron and steel industry

Regulations and directives are two instruments for The European Union to govern [\[Link\]](#). “A ‘regulation’ is a binding legislative act. It must be applied in its entirety across the EU” whereas “a ‘directive’ is a legislative act that sets out a goal that all EU countries must achieve”. Other instruments are The frameworks and initiatives from EU are outlined in [Table 2.2](#).

Product Environmental Footprint, PEF, is an LCA-methodology developed by the research organisations under the EC and is in principle aligned with ISO 14044. The system with PEF declarations is similar to the EPD-system based on EN15804 with PEFCR setting the rules for creating a PEF declaration.

PEF and EN15804 are not aligned and we do not know what rules will be used in the new Construction Product Regulation, CPR, that is developed at present.

Organisational Environmental Footprint, OEF, was developed in parallel with PEF and covers reporting at the organisational level.

Together with PEF and OEF the **ILCD database** has been developed providing free of charge inventory data that is free for developers of OEF and PEF declarations.

Other relevant actions from EU are the **Green Steel for Europe roadmap**, the provisions in the **EU Taxonomy**, the **Construction Products Regulation** and the **Eco-design directive**. What they all will include in the future is still to be seen.

Work is ongoing on rules for **substantiating green claims**.

As stated in COM (2023) 62 from February 1:st 2023 the outline for a new **Green Deal Industrial Plan for the Net-Zero Age** is based on four pillars:

- a predictable and simplified regulatory environment
- faster access to sufficient funding
- skills
- open trade for resilient supply chains

The first bullet intends to introduce a simplified regulatory framework for production capacity of a number of ‘net-zero’ products like batteries, electrolyzers, and CCS facilities.

Table 2.2 EU regulations, directives and initiatives (The weblinks are accessible on 2023-08-31)

Directives and initiatives	Type	Web	Level	Focus
Product Environmental Footprint PEF	Other	Link	P	Fw
Organisational Environmental Footprint, OEF	Other	Link	C	Fw
ILCD Database	Other	Link	P	Fw
Initiative on substantiating green claims	Ongoing	Link	C/P	Fw
Green Steel for Europe	Project	Link	C	Ro/Co
EU Taxonomy	Regulation	Link	C/P	Fi
Construction Products Regulation, CPR	Regulation	Link	P	Fw
Eco-design directive	Directive	Link	P	Fw
Net-Zero Industry Act	Plan	Link	C	Fw

2.4 Other initiatives currently affecting climate works in the iron and steel industry

2.4.1 Initiatives aiming at providing certification or labelling schemes

These initiatives are providing certification or labelling schemes for product, production site or near-zero production technology related with the near-zero emission transition. The certification or labelling system is usually developed through existing rules or standards.

The initiatives aiming at providing certification or labelling are summarized in [Table 2.3](#) and [Figure 2.1](#). More details can be found in [Table A1 in Appendix1](#).

Table 2.3 Initiatives aiming at certification or labelling or thresholds. Initiatives in bold letters have been selected for deeper analysis. (The weblinks are accessible on 2023-08-31)

Initiative	Web	Organisations	Level	Focus
Achieving Net Zero Heavy Industry Sectors in G7 Members	Link	IEA	S	Fw
Responsible Steel	Link	Company rep. and independent advisors	S, P	Fw
Science Based Targets Initiative (SBTi)	Link	WRI & WWF & CDP & UNGC	C	Fw
Net Zero Steel Pathway Methodology Project (NZSPMP)	Link	SBTi & Partners	C	Fw
A label system for green lead markets	Link	WV Stahl	S	Fw
Industrial Deep Decarbonisation Initiative (IDDI)	Link	UNIDO, CEM, UK etc.	C	De
SteelZero	Link	Climate Group/ResponsibleSteel	C	De
Assessing low-Carbon Transition Initiative (ACT)	Link	UNFCCC, CDP, ADEME	C	Fw
First Mover Coalition (FMC)	Link	World Economic Forum	C	De
GSCC-The Steel Climate Standard	Link	GSCC	P	Fw
AISI- Steel production GHG Emissions Calculation Methodology Guidelines	Link	AISI	C	Fw
RE100	Link	Climate Group, CDP	P	De
EcoVadis	Link	EcoVadis	C	To
CRU	Link	CRU/RMI/ ResponsibleSteel	S	To
Climate Bonds Initiative	Link	-	C	Fi
SASB Standards GHG Emissions	Link	SBAB	C	Fi
Equator principles (EP)	Link	International Finance Corporation	C	Fi
Buy Clean California Act (BCCA)	Link	Department of General Services (DGS), the California Air Resources Board (CARB)	P	De
Climate Action 100+	Link	5 global investor representatives.	C	Fi
Glasgow Financial Alliance for Net Zero (GFANZ)	Link	UN Special Envoy, UNFCCC Race to Zero	C	Fi
Mass balance and Book and claim Proprietary certifications (examples)				
Xcarb™ Initiatives	Link	Arcelor Mittal	P	Fw
bluemint™ Steel	Link	thyssenkrupp Steel Europe	P	Fw
greentec steel	Link	voestalpine	P	Fw
Zeremis™ Carbon Lite	Link	Tata Steel IJmuiden	P	Fw
Kobenable Steel	Link	Kobe Steel	P	Fw
NSCarbolex™ Neutral	Link	Nippon Steel Corp	P	Fw

Achieving Net Zero Heavy Industry Sectors is a report by International Energy Agency (IEA), requested by Germany under its presidency of the G7. The work was built on analysis from IEA's Net Zero by 2050: A Roadmap for the Global Energy Sector. The report provides G7 members a toolbox of policies and financing mechanisms, definition of near zero emission for material production, as well as some recommendations to accelerate the transition of heavy industry sectors (cement and steel) (IEA, 2022).

ResponsibleSteel™ Standard, is the first global multi-stakeholder standard and certification programme for steel industry in November 2019. It covers not only environmental issue but also social and governance issues. The latest standard version is version 2 which published in September 2022. The current reporting framework not fully apply for high alloy and stainless steel (alloy content higher

than 8%). The technical specifications and GHG intensity performance thresholds for high alloy and stainless steels are currently under development. (ResponsibleSteel, 2022)

The Science Based Targets initiative, SBTi, is a collaboration between **CDP**, the United Nations Global Compact, **UNGC**, the World Resources Institute, **WSI** and the World Wide Fund for Nature, **WWF**. The initiative helps companies to develop emissions reduction targets which is aligned with the climate change goals of the Paris Agreement. Science based targets, SBTs, is defined as company's relative emission reductions over a time based on their starting emissions and activities. SBTs are set for individual company to track progress and evaluate their mitigation actions. SBTi should not be used for product comparisons or company intensity comparisons. SBTi uses Sectoral Decarbonisation Approach, SDA, to assist companies sets climate change goals and guidance from different sectors (e.g., oil & gas, cement, iron & steel etc.). The draft guidance for steel sector was published in November 2022 and under public consultation and revision until January 2023. Final guidance is planned in May 2023 (SBTi, 2022).

- **Net Zero Steel Pathway Methodology Project, NZSPMP**, is a collaborative project with SBTi to develop a clear Sectoral Decarbonisation Approach, SDA, in steel sector when steel companies are setting science based targets. NZSPMP aims to propose a set of key principles to help companies measure and set GHG reduction targets. The steering group of NZSPMP including ArcelorMittal, BlueScope, GFG Alliance, Tata Steel, worldsteel, ResponsibleSteel. The final project report was published in July 2021 (NZSPMP, 2021).

Assessing low-Carbon Transition Initiative, ACT, is a project aiming to developing ACT criteria and methodology through sectors. It helps the companies to assess their practice and action so that it meets the 2°C agreement. The method is based on the Sectoral Decarbonization Approach (SDA) developed by the Science-Based Targets initiative (SBTi). It considers steel or cast iron-making companies, steel-shaping companies and integrated companies, whatever the percentage of scrap used. A few performance indicators are provided in assessing the company's decarbonization actions with scores, e.g., emission target achievement, material investment, sold product performance, business model etc. The performance indicators and their weightings vary depending on the company type and the significance of its upstream emissions from raw materials. Thus, it applies for stainless steel producers. The methodology fosters companies' scrap recycling and reusing and deactivate the emission-intensive routes. The recent ACT methodology document for the iron and steel sector is version 2 and published in March 2022 (ACT, 2022). The management team is from ADEME and CDP.

Industrial Deep Decarbonisation Initiative, IDDI, was firstly launched in 2021 by United Nations Industrial Development Organization, UNIDO and Clean Energy Ministerial. It is the largest coalition of governments and private sector working to decarbonise heavy industry (i.e., steel, cement) and foster demand of low carbon materials through Green Public Procurement, GPP. IDDI is co-led by the UK, India and current members include Canada, Germany and United Arab Emirates. In November 2022, Japan and Sweden have announced their joining in IDDI. (UNIDO,2022) (UNIDO)

A Labelling System for Green Lead Market, is a classification system proposed by German Steel Federation (**Wirtschaftsvereinigung Stahl, WV Stahl**). The classification system is defined based on virtual reference plants making quality steel grades. It calculates emissions after rolling and allows credits emission for by-products, also takes the scrap ratio into account. The labelling system focuses on the demand mechanisms. The classification system is currently still under development. A rulebook with key specification has been completed already. Some more details are required for implementation in the rulebook, e.g., relevant precision of what should be measured, a list of emission factors, etc (WV Stahl, 2022).

SteelZero, is an initiative by Climate Group in partnership with ResponsibleSteel. The member companies are committed to make a public purchase commitment of 100% net zero steel by 2050. Commitment to a total of 50% of steel requirement by 2030 meeting one of the following criteria(Climate Group, 2023):

- ResponsibleSteel certified steel
- Steel sites that follow a science-based target approved by the SBTi
- Low Embodied Carbon Steel defined as a sliding scale with the variance of scrap ratio.

First Mover Coalition, FMC, is an initiative formed by a group of world's leading companies. It aims to using their purchasing power to unlock the untapped potential of emerging clean energy technologies in eight hard-to-abate sectors (steel, aluminium, cement, shipping etc.). The steel commitment in FMC requires members to purchase at least 10% near zero- emission steel by 2030. The criteria for near zero-emission steel should follow (World Economic Forum, 2022):

- Crude steel from near-zero CO₂ technology production facilities
- Emitting <0.4 t (with 0% scrap inputs) to <0.1 t (with 100% scrap inputs) of CO₂ /t crude steel (only include scope 1 and 2 in production)

It supports the development and deployment of two key technologies: direct reduced iron (DRI) and electric arc furnace (EAF) technologies. The commitment also aims to catalyze investment in low-carbon steel production by creating a market for low-carbon steel products.

The Global Steel Climate Council, GSCC, has in 2023 published a proposal for a technology-neutral standard "The Steel Climate Standard" to measure and report greenhouse gas emissions from steel production. The standard focuses on reducing greenhouse gas (GHG) emissions from the global steel industry using a science-based sliding scale over time to reduce greenhouse gas emissions from the steel industry in accordance with the Paris Agreement. The method covers all relevant emissions from Scope 1, 2 and 3 up to and including hot rolling. Assessment criteria linked to the sliding scale exist for two different product groups (flat and long). Emission averages for the product can be certified according to the method. The companies' emissions reporting must be third-party audited every three years and the reduction targets at least every five years. (Global Steel Climate Council, 2023)

Above mentioned initiatives are further analysed in Chapter 3.

2.4.2 Initiatives aiming at providing general information of decarbonization transition

These initiatives are not aimed for certification or labelling. It exists guidelines for reporting emission intensities. It also includes reports and suggestions for possible decarbonisation strategies. Some initiatives have focus to build up a network among key players (companies, stakeholders etc.).

The initiatives aiming at providing general information of decarbonization transition are summarized in [Table 2.4](#) and [Figure 2.1](#). More details can be found in [Table A1 in Appendix1](#).

Table 2.4 Reports, suggestions etc at present without certification. Initiatives in bold letters have been selected for further analysis. (The weblinks are accessible on 2023-08-31)

Initiative	Web	Organisations	Level	Focus
GHG protocol-corporate standard	Link	WRI/WBCSD	C	Fw
GHG protocol-product standard	Link	WRI/WBCSD	P	Fw
worldsteel CO₂ emissions data collection	Link	worldsteel	S	Fw
worldsteel LCI data collection	Link	worldsteel	P	Fw
CATENA-X (Automotive data network)	Link	German Federal Ministry for Economic Affairs and Energy'	P	Co
RMI-Steel Emission Reporting Guidance	Link	RMI	P	Fw
The Center for Climate Aligned Finance (CCAF)	Link	RMI	-	Fi
Leadership Group for Industry Transition (LeadIT)	Link	Representatives from Sweden, India, and the World Economic Forum.	-	Co
Net Zero Steel Initiative (NZSI)	Link	The Mission Possible Partnership (MPP)	-	Co
Green Steel for Europe (GRENSTEEL)	Link	EU	-	Ro
Clean Steel Partnership (CSP)	Link	European Steel Technology Platform (ESTEP)	-	Co
Achieving Green Steel Roadmap to a Net Zero Steel Sector in India	Link	TERI (India)	-	Ro
1.5°C Steel decarbonising the steel sector in Paris-compatible pathways	Link	E3G	-	Ro
What yardstick for Net Zero?	Link	WTO	-	Ro
RMI-Pursuing Zero-Carbon Steel in China	Link	RMI	-	Ro
Glasgow Breakthroughs	Link	Race to Zero	-	Po
CO ₂ emission Calculation Tool	Link	SKF	P	To
UN Convened Net Zero Asset Owner	Link	UN	-	Fi
Net Zero Industry Tracker	Link	WEF-Accenture	-	Co
ICC Framework for Responsible Environmental Marketing Communications	Link	ICC	P	De

The Greenhouse Gas Protocol, GHG Protocol, is a joint effort from two organisations: World Business Council for Sustainable Development, **WBCSD**, and the World Resources Institute, **WRI**. GHG Protocol have established following global standards for both private and public sectors:

- *GHG Protocol Corporate Accounting and reporting Standard* (2004) (GHGP, 2015): A standardized accounting method for reporting corporate GHG emissions. Also referred to as “Corporate Standard”. It has been widely used by businesses, NGOs, and governments around the world as the International Standards for developing and reporting a company-level GHG inventory. The Corporate standard has firstly defined a company’s direct and indirect GHG emissions into three scopes. It is obligated for companies to report all scope 1 emissions (i.e., direct emissions from owned sources) and all scope 2 emissions (i.e., indirect emissions from the generation of purchased electricity). Scope 3 emissions (other indirect emissions) is an optional reporting category.
- *Corporate Value Chain (Scope 3) Accounting and Reporting Standard* (2011) (GHGP, 2013): a supplement to the Corporate Standard, referred to as “Scope 3 Standard”. Aiming to assisting companies to understand and report indirect emissions from value chain.
- *Product Life Cycle Accounting and Reporting Standard* (2011) (GHGP, 2011): A Guidance document for companies to report life cycle GHG emissions with a specific product. Also referred to as “Product Standard”.

GHG Protocol also developed emission calculation tools (Excel spreadsheet) to help the companies in calculating GHG emissions. The iron and Steel tool (version 2, 2007) allows the calculation of CO₂ and CH₄ emissions from principal GHG sources, including: stationary combustion (including flares), offsite

and onsite metallurgical coke production, the production of sinter, Direct Reduced Iron, DRI, and of non-direct reduced Iron and Steel, as well as onsite and offsite lime production. The main GHG emission sources associated with iron and steel sector can refer to ([Link](#)). The methods and default emission factors in the tool are referring to 2006 IPCC Guidelines.

Climate Action data collection programme, was launched in 2008 by **The World Steel Association, worldsteel**. Currently worldsteel has two yearly data collection systems. One is **CO₂ Data Collection** and the other one is **LCI Data Collection**. **CO₂ Data Collection** (worldsteel, 2008) aims to create global average CO₂ intensity. CO₂ emissions intensity of crude steel production is reported through an online tool by its members. It provides the common methodology to ensure the sites' reported emissions are calculated with the same boundaries ([Link](#)) and parameters. The methodology of data collection is based on the international standard ISO 14404:2013-Calculation method of carbon dioxide emission intensity from iron and steel production. **LCI Data Collection** (worldsteel, 2021), provides data on the environmental profile of 16 key long and flat products (e.g., rebar, wire rod, plate, hot rolled coil etc). The study is following ISO 14040: 2006 and 14044:2006, with the goal of updating LCI data annually on both global and regional level. The LCI datasets can be used for LCA studies among interested groups. The dataset is free of charge to everyone. The recent LCI data release is the data from 2020 (worldsteel, 2021). The system boundary of the LCI data is from cradle-to-gate, includes net credits from end-of-life scrap using. The dataset collects primary data from 24 separate steelmaking process steps plus boilers, compressors, water intake, effluents, stockpile emissions and transportation of raw materials. It represents around 26% of global crude steel production in which 28 countries participated. The highest represented region is Europe. The sites participating represent over 35% of European steel production.

Certification			General		
Company Level	Site Level	Product Level	Company/Site Level	Product Level	Unspecified
Science Based Target Initiative (SBTI)	Responsible Steel	Responsible Steel	GHG protocol - corporate standard	GHG protocol - product standard	Net zero Industry Tracker
Net Zero Steel Pathway Methodology Project (NZSPMP)	IEA-G7	Arcelor Mittal - Xcarb™ Initiatives	worldsteel- CO2 Data Collection	worldsteel- LCI Data Collection	Leadership Group for Industry Transition (LeadIT)
ACT	WV Stahl –green steel label	Thyssenkrupp - blueminet™ Steel		RMI-Steel Emission Reporting Guidance	MPP-Net Zero Steel Initiatives (NZSI)
AISI-Steel production GHG emissions calculation Methodology Guidelines	CRU-Emission Calculation Tool	Voestalpine - greentec steel		SKF-CO2 emission Calculation Tool	ESTEP-Clean Steel Partnership (CSP)
SteelZero		Tata - Zeremis™ Carbon Lite		ICC Framework for Responsible Environmental Marketing Communications	Green Steel for Euroope (GRENSTEEL)
First Mover Coalition (FMC)		Kobe Steel – Kobenable Steel		CATENA-X	TERI-Achieving Green Steel Roadmap to a Net Zero Steel Sector in India
Industrial Deep Decarbonisation Initiatives (IDDI)		Nippon - NSCarbolex™ Neutral			E3G-1.6C steel decarbonising the steel sector in Paris-compatible pathways
Climate Bond Initiative		GSCC-The Steel Climate Standard			WTO-What yards for Net Zerio?
SASB Standards GHG Emissions		RE100 (electricity)			RMI-Pursuing Zero CarbonSteel in China
Equator principles (EP)		Buy Clean California Act (BCCA)			Glasgow Breakthrough
Climate Action 100+					RMI-Center for Climate Aligned Finance
Glasgow Financial Alliance for Net Zero					UN Converned net Zero Asset Owner
EcoVadis					

Roadmap	Overview of the current state and possible emission reduction strategies
Collaboration	Exchange development status among the interests. (e.g. interactive database, dialogue)
Demand	Utilizing the coalition purchasing power to create the demand market of near-zero steel.
Tool	Tools or software to facilitate the emission accounting work.
Finance	To develop financing mechanisms to support
Policy	To develop government policy support
Framework	Methodology for GHG emission intensity accounting

Figure 2.1. Overview of the initiatives for near zero steel production

3. Comparison of the Reporting Framework for GHG Emission Intensity

In recent years, there has been a rapid growth of interest in the calculation and reporting of GHG emissions from iron and steel sector around the world. The GHG emissions values are used in different ways, for instance, classify the steel production into green and non-green steel, assess the site's carbon mitigation strategy whether aligned with Paris Agreement, build up the early market for demanding near-zero emission steel. As a result, various domestic and international emission accounting frameworks are used by different groups currently. What should be noted here is that unneglected differences exist in these accounting frameworks, such as system boundary, emission inventory and assessment basis.

Following initiatives' reporting frameworks have been selected for further study. The purpose of these initiatives is described in detail in section 2.4.1 and 2.4.2 of this report.

- GHG protocol -corporate standard
- GHG protocol-product standard
- worldsteel- CO₂ Data collection
- worldsteel-LCI Data collection
- Achieving Net Zero Heavy Industry Sectors in G7 Members (**IEA-G7**)
- Responsible Steel
- Science Based Targets Initiative (**SBTi**)
- Net Zero Steel Pathway Methodology Project (**NZSPMP**)
- A label system for green lead markets by WV Stahl (**WVStahl-Green steel label**)
- GSCC-The steel climate standard (**GSCC**)
- Industrial Deep Decarbonisation Initiative (**IDDI**) (To be developed)
- SteelZero
- First Mover Coalition (**FMC**)
- Assessing low-Carbon Transition Initiative (**ACT**)

The comparison of the different GHG emission reporting framework has been shown in Table 3.1.

Table 3.1 The comparison of the different GHG emission reporting framework

Initiative	Level	Steel	Scope	Transport	Mining	Alloy	Product	Source	Near Zero Steel kg CO ₂ /t	Allocation	Biogenic emissions	CCUS	Carbon offset
Description in section	-	-	3.3	3.3.3	3.3.3	3.3.3	3.1	3.2	3.6	3.4	3.3.1	3.3.1	3.3.1
GHG Protocol (Corporate Standard)	C	All	1+2+3 (L)					CO ₂ eq.		Electricity:2	CH ₄ , N ₂ O :3 CO ₂ :2	TBD	TBD
GHG Protocol (Product Standard)	P	All	1+2+3	✓	✓	✓	SP	CO ₂ eq.		Co-product:1 Recycling:1	2	TBD	2
worldsteel (CO ₂ data methodology)	S	All	1+2+3 (P)	X	X	✓	SP	CO ₂		1	1	2	2
worldsteel (LCI data methodology)	P	LA	1+2+3	✓	✓	✓	SP	CO ₂ eq.		1	2	2	2
ResponsibleSteel	S	LA	1+2+3	✓	✓	✓	CS	CO ₂ eq.	100% ore<400; 100%Scrap<50	Intermediate product:1 Process gas:1 Co-products (slag):2	3	1	2
IEA-G7	S	LA	1+2+3 (P)	O	✓	X	CS	CO ₂ , CH ₄	100% ore<400; 100%Scrap<50	Electricity:2	1	1	2
SBTi	C	All	1+2+3 (O)	O	X	O	HRS	CO ₂ eq.		2	2	TBD	1
NZSPMP	C	All	1+2+3 (L)	X	X	✓	CS	CO ₂ eq.		1	3	2	NS
WV Stahl	S	LA	1+2+3	✓	X	✓	HRS	CO ₂ eq.	100% ore<482; 100%Scrap<344	Slag/off gas: 1 Electricity/semi- product:2	NS	TBD	TBD
ACT	C	All	1+2+3 (L)		X	✓	SP	CO ₂		1	1	TBD	NS
SteelZero	C	All	1+2+3	TBD	TBD	TBD	CS	CO ₂ eq.	TBD	TBD	TBD	NS	1
FMC	C	LA	1+2	X	X	X	CS	CO ₂	100% ore<400; 100%Scrap<100	NS	NS	NS	NS
GSCC	P	LA	1+2+3	✓	✓	✓	HRS	CO ₂ eq.	<120	2	1 or 3	2	2

Level: C-company; S-site; P-product; **Steel:** LA-low alloy; **Scope:** P: partial; L: limited; O: optional; **Product:** SP-steel product; CS-crude steel; HRS-hot rolled steel

Transport/Mining/Alloy: ✓: included in accounting; X: excluded from boundary; O: optional in accounting; TBD: to be developed;

Allocation: 1: emission reduction from exported materials or energy is considered; 2: The site should bear full burden of the emissions for exported material or energy.

Biogenic Emissions: 1. The biogenic emissions are NOT included in accounting; 2. The biogenic emissions reported separately in accounting. 3. The biogenic emissions are included in accounting

CCUS: Carbon Capture Utilization Storage. 1- The emission reduction due to CCUS is considered in accounting. 2- The emission reduction due to CCUS is NOT considered in accounting

Carbon Offset: 1-Carbon offset is PARTIALLY considered in accounting, 2-Carbon offset is NOT considered in accounting

3.1 Boundary

The system boundary in an LCA states which process to include in the study. For a consistent accounting of the GHG emissions the boundary must be well defined and the same for studies that should be compared with other studies and should furthermore include a large share of the emissions for the steel production. A typical process flow for steel production within cradle-to-gate includes mining, ironmaking, transport, steelmaking, secondary metallurgy, casting, rolling, heat treatment, coating and other metal working. If cradle-to-grave is used, it should also include the inventory of steel product use and end-of-life processes.

In **Appendix 2**, the boundary of different accounting methods is presented.

Boundary ends at cast steel

The boundary of the downstream end of supply chain for **Responsible Steel, SteelZero, FMC** and **IEA-G7** is set after casting and excludes further semi-finishing and finishing processes such as hot rolling, cold rolling, coating, because of the heterogeneity of processes at facilities producing different products.

Boundary ends after hot rolling

The Iron & Steel core SDA boundary used in **SBTi, WV Stahl's Green Steel Label** and **GSCC** suggest defining the system as the production of hot-rolled steel instead of crude steel. The reasons of extending the boundary to include hot rolling step can be summarized as following:

- 95% steel production will go through hot rolling.
- Hot rolling consumes large amount of fuel for heating and therefore GHG emissions cannot be neglected.
- *The inclusion of hot rolling may simplify the emissions reporting from integrated plants.*

Boundary depending on ownership

In **GHG Protocol, NZSPMP, worldsteel, ACT**, the variable ownership of the steel company has been considered. The additional processing such as rolling, annealing, pickling, galvanizing, heat treating, coating and forging should all be included in the boundary for accounting if the process is owned by company.

Upstream boundary

The upstream boundary for **worldsteel, SBTi, ACT**, and **WV Stahl's Green Steel Label** excludes the mining process since the emission from this activity is considered as low impact compared with iron and steelmaking process.

SBTi's proposal for SDA from November 2022 also does not include so-called secondary metallurgy that takes place in ladle furnaces, vacuum induction melting, etc.

3.2 GHG gases

The GHG emissions includes consideration of the emissions of carbon dioxide (CO₂), methane (CH₄), nitrogen trifluoride (NF₃), nitrous oxide (N₂O), hydrofluorocarbons (HFCs), perfluorocarbons (PFCs) and sulphur hexafluoride (SF₆) etc. It is typically using Global Warming Potential (GWP) values relative to CO₂ (CO₂e) with a 100-year time horizon as published in the IPCC Assessment Report 6. The details of the GHG emissions for different accounting framework are listed in Table 3.2.

Table 3.2 GHG emissions included

Initiative	GHG emissions
GHG Protocol (Corporate Standard)	CO ₂ , CH ₄ , N ₂ O, HFCs, PFCs, SF ₆ , NF ₃ (7)
GHG Protocol (Product Standard)	CO ₂ , CH ₄ , N ₂ O, HFCs, PFCs, SF ₆ (6)
worldsteel (CO ₂ data methodology)	CO ₂
worldsteel (LCI data methodology)	All GHG gases
ResponsibleSteel	CO ₂ , CH ₄ , N ₂ O, HFCs, PFCs, SF ₆ , NF ₃ (7)
IEA-G7	CO ₂ , (CH ₄)
SBTi	CO ₂ , CH ₄ and N ₂ O
NZSPMP	All GHG gases
WV Stahl (Green steel label)	All GHG gases
ACT	CO ₂
SteelZero	CO ₂ -eq
FMC	CO ₂
GSCC	All GHG gases

In the accounting framework of **worldsteel**, **IEA-G7**¹ and **ACT** it is expected to report only CO₂ emissions for following reasons:

- The main GHG emissions of the iron and steel sector come from CO₂.
- It will facilitate data collection from companies. Direct CH₄ and N₂O emissions are usually lack of sufficient data.

3.3 Emission Scope

The emissions are normally categorized as scope 1, scope 2 and scope 3 based on GHG protocol.

The frameworks of **IEA-G7**, **NZSPMP** focus on the inclusion and exclusion of core emission process, rather than the definition of scope 1, 2 and 3. By doing this it can solve following two issues:

- The disclosure of emissions at the corporate level may differ based on the extent of vertical integration. In certain cases, vertical integration may encompass emissions-intensive upstream processes like sintering and coke production. If these processes are operated and owned by a steelmaker, the emissions will be classified as scope 1 (as per the GHG Protocol). However, for non-integrated operators, these same emissions would fall under scope 3 and may not be reported, posing challenges when comparing GHG emissions across the sector.
- Over time, the boundaries of scope 1, 2, and 3 are likely to become more flexible, further limiting comparability. For instance, with the increasing use of direct reduced iron (DRI) to facilitate a transition to hydrogen-based steelmaking, emissions could be categorized as scope 1 when DRI is produced using hydrogen generated on-site. The detailed variance of emission scope is further described in the subsequent sessions.

When accounting the GHG emissions, the data quality can be classified as following:

Primary data refers to information collected directly from original sources specifically for the purpose of measuring and monitoring GHG emissions. It involves conducting surveys, measurements, and

¹ Includes indirect CH₄ emissions from fossil fuel supply.

direct observations. Primary data collection methods are more resource-intensive but provide specific and site-specific information

Secondary data refers to information that has been collected by someone else or for a different purpose but can be utilized for GHG emissions accounting. It involves gathering existing data from published reports, databases, research papers, or government publications. Here are some examples of secondary data sources for GHG emissions accounting. Sometimes, default emission factors are applied when primary data is difficult to be collected. Secondary data sources offer broader and more general data for emissions estimation.

Verification refers to all the collected data should be verified by the third party.

3.3.1 Scope 1/ Direct emissions

Scope 1 emissions are direct GHG emissions from the assets owned by the company. Other than fossil fuel use, scope 1/direct emissions may also be influenced by consideration of biogenic emissions, carbon capture utilization and storage (CCUS) and carbon offset. Table 3.3 is a summary for accounting scope 1/direct emissions

Table 3.3 Details of Scope 1/direct emissions

	Biogenic emissions	CCUS	Carbon offset	Data Quality
GHG Protocol (Corporate Standard)	CH ₄ , N ₂ O: 3 CO ₂ : 2	TBD	TBD	P
GHG Protocol (Product Standard)	2	TBD	2	P
worldsteel (CO ₂ data collection)	1	2	2	P>S
worldsteel (LCI data collection)	2	2	2	P>S
ResponsibleSteel	3	1	2	P>S or D
IEA-G7	1	1	2	NS
SBTi	2	TBD	1	P>S
NZSPMP	3	2	NS	NS
WV Stahl – Green steel label	NS	TBD	TBD	P>S
ACT	1	TBD	NS	P
SteelZero	NS	NS	1	NS
FMC	NS	NS	NS	NS
GSCC	-Certified (1) -Non-certified (3)	2	2	V

TBD: to be developed, CCUS: carbon capture and utilization storage; NS not specified

Biogenic Emission: 1. The biogenic emissions are NOT included in accounting, considered as 0

2. The biogenic emissions reported separately in accounting.

3. The biogenic emissions are included in accounting, reported the same as fossil emissions

CCUS: 1- The emission reduction due to CCUS is considered in accounting

2- The emission reduction due to CCUS is NOT considered in accounting

Carbon offset: 1-Carbon offset is PARTIALLY considered in accounting,

2-Carbon offset is NOT considered in accounting

Data Quality: P-primary data, S-secondary data, D-default value; V-verification from third party

Worldsteel-CO₂ data collection, IEA-G7, ACT are considering the use of bioenergy as carbon-neutral. It means that the direct emissions from burning biogenic sources is not included in accounting or considered as 0. **GHG Protocol-Product Standard, SBTi, worldsteel-LCI** should report direct biogenic

emissions separately in accounting report. In **GHG Protocol-Corporate**, direct biogenic CO₂ emissions is not included in accounting but reported. For CH₄ and N₂O emissions from biomass it should be included in scope 1.

ResponsibleSteel, IEA-G7 considers the emission reduction from CCUS technology, while **worldsteel-CO₂, worldsteel-LCI, GSCC** are excluding the CCUS from its framework. SBTi and GHG Protocol are now under discussion for the accounting rules in related with CCUS. In **GHG protocol**, a new standards and guidance for companies to report emission inventory from activities related with carbon removals/storage and bioenergy are under development. The publication of this guidance is expected in early 2023.

SBTi and SteelZero stated that carbon offset should not be considered in the short-term emission target because it may create multiple problems like land use, fairness and climate justice. However, when the operational emissions reach zero and any remaining emissions may consider carbon offset in the frame work to reach the target of near-zero steel. **GHG Protocol-Product, worldsteel-CO₂, worldsteel-LCI, ResponsibleSteel, IEA-G7, GSCC** does not include carbon offset in its accounting framework.

The preferred data collection regarding scope 1 or direct emissions are prior to primary data. Here are some examples of primary data sources.

- On-site measurements: This involves using equipment and instruments to directly measure emissions from various sources, such as power plants, industrial facilities, or vehicles.
- Fuel consumption records: Gathering data on fuel consumption from records, invoices, or meter readings to calculate associated GHG emissions. This can include direct fuel combustion or indirect emissions from electricity consumption.
- Process data: Collecting information about production processes, including raw material inputs, chemical reactions, and energy consumption, to estimate emissions associated with specific activities.
- Emission factors: Conducting specific measurements to determine emission factors for different sources or activities. Emission factors represent the amount of emissions produced per unit of activity (e.g., kilograms of CO₂ per liter of fuel burned).

The emission factors if primary data from Scope 1 is not available, sometimes secondary data is also acceptable, like **worldsteel-CO₂, worldsteel-LCI, ResponsibleSteel, SBTi, WV Stahl**. For **GSCC**, all the collected data should be verified by the third party.

3.3.2 Scope 2/ Energy-related indirect emissions

Scope 2 emissions is termed as energy-related indirect emissions. It is not only referring to the purchased electricity, but also other emission source. Table 3.4 is a summary of the included scope 2 emission or energy related direct emissions.

The emission factor for reporting the emission factor of electricity have two methods: they are location-based (average) and market-based (contract specific). Different initiative framework may have different requirement regarding this, see Table 3.4.

Table 3.4 Details of Scope 2/energy related indirect emissions

	Purchased Energy Source					Data Quality
	Electricity	Steam	Heat	Cooling	H2	
GHG Protocol (Corporate Standard)	√	√	√	√		M+L
GHG Protocol (Product Standard)	√	√	√	√		
worldsteel (CO2 data collection)	√	√				NS
worldsteel (LCI data collection)	√	√	√	√		
ResponsibleSteel	√	√	√	√		NS
IEA-G7	√		√		√	NS
SBTi	√	√	√	√		NS
NZSPMP	√					M or L
WV Stahl -Green steel label	√					NS
ACT	√	√	√	√		L>M
SteelZero	√	√	√	√		Same as GHG protocol
FMC	√					NS
GSCC	√	√	√	√		M>L

√: Included in accounting; NS: not specified. 1-High priority; L: location-based, M: market-based

3.3.3 Scope 3U/ Other indirect emissions

Scope 3 emission is other indirect emissions such as material extraction, material preparation and processing, transportation. The differences of these indirect upstream emissions can vary a lot in different frameworks. The comparisons can be generally classified as following aspects, they are summarised in Table 3.5.

Upstream emission sources mainly include following categories:

- 1) Mining of iron ore
- 2) Mining of others (coke, limestone etc)
- 3) Production of pellets, iron products,
- 4) Production of lime
- 5) Production of coke
- 6) Production of ferroalloys
- 7) Production of hydrogen, biofuels
- 8) sorting and collection of scrap
- 9) Production of other fossil fuel such as natural gas
- 10) production of electrodes
- 11) production of other slag formers such as dolomite
- 12) Production of oxygen gas
- 13) production of other process gases such as Ar, N2
- 14) Transport of materials

Table 3.5 Details of Scope 3/ indirect emissions

Emission Source	1	2	3	4	5	6	7	8	9	10	11	12	13	14
GHG Protocol ² (Corporate Standard)			✓	✓	✓									
GHG Protocol (Product Standard)	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
worldsteel (CO ₂ data collection)	X	X	✓	✓	✓	✓	✓		✓	✓	✓	✓	✓	X
worldsteel (LCI data collection)	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
ResponsibleSteel	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓
IEA-G7	✓	✓	✓	✓	✓	X	✓		✓	X	X			O
SBTi	O	O	✓	✓	✓	O	O	O	O					O
NZSPMP	X	X	✓	✓	✓	✓	✓	X	X					X
WV Stahl -Green steel label	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
ACT	X	X	✓	✓	✓	✓	✓	X	X					
SteelZero	(TBD)													
FMC	X	X	X	X	X	X	X	X	X	X	X	X	X	X
GSCC	✓	✓	✓	✓	✓	✓	✓	✓	✓			✓	✓	✓

✓: Included in accounting; X: not included in accounting; O: Optional, (blank): not specified.

One of the major differences of Scope 3 or indirect upstream emissions is alloy production. It represents a decarbonization opportunity for the steel industry, thus, the process is within the boundary of **GHG protocol, ResponsibleSteel, NZSPMP, worldsteel, ACT, WV Stahl Green Steel label and GSCC** but is excluded in the system boundary in other initiatives. In **SBTi**, ferro-alloy production is excluded from SDA system boundary. However, it is recommended to include this in scope 3 for high-alloy and stainless-steel production.

In the framework of **SBTi, worldsteel, ACT, NZSPMP**, the mining and upstream transport of raw materials have been considered as low emissions and can be excluded from the reporting boundary. **IEA-G7** include the emissions associated with the extraction, beneficiation and transportation of iron ore and limestone in the indirect emissions.

The use of hydrogen, biogas or syngas in iron and steelmaking are modern decarbonization technologies. They are partially or fully covered in the accounting boundary for most initiatives.

FMC doesn't include emissions from scope 3 in accounting.

3.3.4 Scope 3D/ indirect downstream emissions

Scope 3D or indirect downstream emissions refers to GHG emissions outside of the boundary.

In the **GHG Protocol Product Standard**, if it is cradle-to-grave defined boundary, it may also include use, end-of-life phase other than material acquisition & pre-processing and production.

Responsible Steel only includes the GHG emissions associated with the storage or disposal waste or residual materials both on and off-site.

² GHG-Protocol Corporate refer to the Calculation sheet from iron and steel sector

3.4 Emission Allocation

ISO 14040/44 standard has suggested a few methods when accounting emission intensity within a multi-product system. Typical allocation methods include:

- System expansion: assign the emission credits for functional equivalence in producing another product.
- Physical allocation: Assign the burden between products based on the production volume.
- Economic allocation: Assign the burden between products based on their economic value.
- Process separation: It requires carefully splitting for each co-product. Difficult to achieve.

Table 3.6 is the summary of the emission allocation for selected frameworks

Table 3.6 Burden allocation of exported electricity, process gas, semi-products, co products and recycling

	Electricity	Intermediate-product	Co-products	Recycling	Process gas
GHG Protocol (Corporate Standard)	2	NS	NS	NS	NS
GHG Protocol (Product Standard)	NS	NS	1 (SE, P, E)	1	NS
worldsteel (CO ₂ data methodology)	1	1	1 (slag)	NS	1
worldsteel (LCI data methodology)	1	1	1 (SE)	1	1
ResponsibleSteel	NS	1	2	NS	1
IEA-G7	2	NS	NS	NS	NS
SBTi	2	2	2	NS	2
NZSPMP	1	1	1	NS	1
WV Stahl (Green steel label)	2	2	1 (slag)	NS	1 (BFG)
ACT	1	NS	1 (slag)	NS	1
GSCC	2	2	2	NS	2

NS: not specified;

1: emission reduction due to exported materials or energy is considered;

2: The site should bear the full burden of the emissions for exported material or energy.

3: Associated emissions reported separately

SE: system expansion method, P: physical allocation method, E: economic allocation method

In **GHG Protocol-corporate standard**, if a company sells surplus electricity it should report all direct emissions for co-generation under scope 1. Indirect emissions from generation of surplus electricity is reported separately in scope 3. The company that purchases the electricity should report it in its scope 2 indirect emissions. Thus, no credit is assigned for exported electricity.

In **worldsteel-CO₂ data collection**, slag credit can be calculated but do not need to be reported. Credits are given to exported process gases, energy, coal tar and benzole etc. **worldsteel-LCI data collection** selected system expansion to best show all steel industry products and co-products and their environmental impacts.

ResponsibleSteel and SBTi states that there is no reduction of GHG emissions for the site due to the production of by-products and co-products. It means the steel site should take full burden.

IEA-G7 only mentioned that no credit for exported electricity. The dealing with other co-products is not clearly specified in the report.

WV Stahl-Green steel label allows consideration of credits only for slag sand used in cement production and the use of blast furnace gases for generation of electricity and heat outside the plant.

3.5 Near Zero Steel Threshold

3.5.1 Initiative with sliding scale as a function of scrap ratio

In **ResponsibleSteel**, **IEA-G7**, **WV Stahl Green Label** and **FMC**, the emission intensity of near-zero steel is formulated as a function of the proportion of scrap use in the total metallic inputs. The increasing use of scrap can lower the emissions; however, the use of scrap should be the only mitigation strategy for the steel site as there is not sufficient scrap available in the market.

ResponsibleSteel and **IEA-G7** propose the same principles for near-zero steel (crude steel), which is based on IEA's modeling of future technology development in the steel industry and the development of the energy system. The IEA describes the system boundaries of the data base but not any detailed method of data collection. The methods also suggest different levels of low-emission steel that are above the near-zero level. The purpose is to be able to set procurement requirements that tighten over time. In the IEA's proposal, these have been set as multiples of the near-zero level. **FMC** has its own definition of near-zero steel (crude steel) which takes into account the proportion of scrap. Only scope 1 and 2 are included. It is not reported on what grounds the definition was developed. **The WV Stahl Green label** has the same principle but has started from specific technology combinations and calculated emission levels up to hot-rolled product for near-zero steel and today's state-of-art with levels of low-emission steel in between.

In the proposal for a sector guide, **SBTi's** has developed a proposal for a method that contains a sliding scale that takes into account the proportion of scrap. It is intended to be used when a steel company sets its science-based emission reduction targets. However, the method is not intended to be used to grade or certify steel.

In Figure 3.1, the threshold for different GHG emission frameworks is described with a sliding scale between 0% and 100% scrap use in the production.

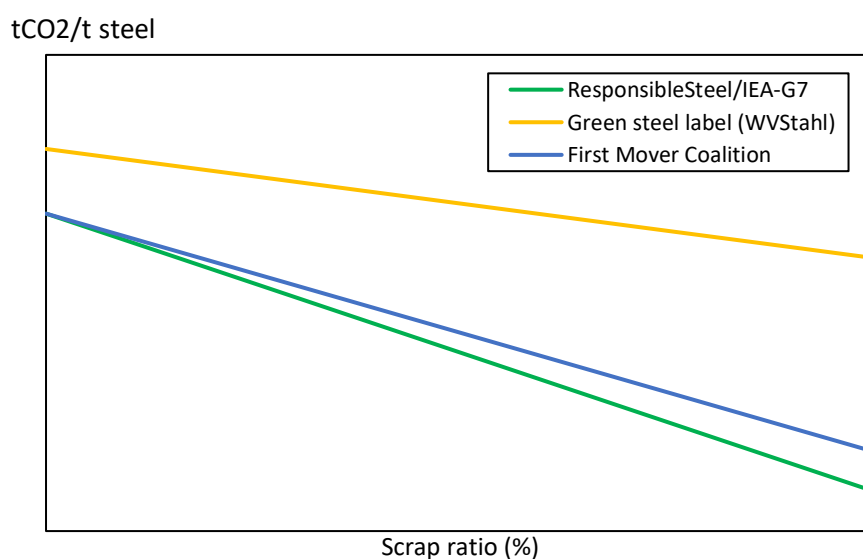


Figure 3.1. Near-Zero Steel Thresholds in the dependence of the scrap ratio

The scrap ratio is the dependent variable in these thresholds. The definition of the scrap types may include following types:

- internal scrap: scrap from crudes steel making unit then recycled within the same unit process
- home scrap: scrap from downstream steel production process within steelworks (e.g., rolling)
- Prompt scrap: or manufacturing scrap, generated during the manufacture of steel products by customer, have not reach the marketplace.
- End of life scrap: the post-consumer scrap after use phase
- non-ferrous metal scrap

ResponsibleSteel does not include the internal scrap while **SBTi** excludes non-ferrous metal scrap when calculating the scrap proportion. The scrap fraction is calculated as follows: all scrap as defined by the method entering the smelter / total amount of steel produced

There is no clear definition of what is included in scrap in **IEA-G7**, **FMC** and **WV Stahl Green label**. However, there will be a rulebook under development with additional details for the **WV Stahl Green label**.

3.5.2 Initiative with sliding scale as a function of time

There are also proposals where the climate footprint of the product is compared with general emission levels that decrease over time and are deemed to be in line with the global emission targets according to the Paris Agreement. The steel products are then compared regardless of manufacturing method and raw material. The Global Steel Climate Council (GSCC) is an example of such an initiative.

It is technically challenging to produce flat products and long products with identical carbon intensities. Flat products tend to have higher embodied carbon compared to other forms. GSCC distinguishes the intensity standard between long products and flat products for allowing more accurate comparison of product producing companies. Figure 3.2 shows the sliding scale standard. The company's accounted GHG emissions intensity for the specified product should be annually calculated and compared with this GSCC standard. The objective for low carbon steel is 0.12 tCO₂-eq/t HRS.

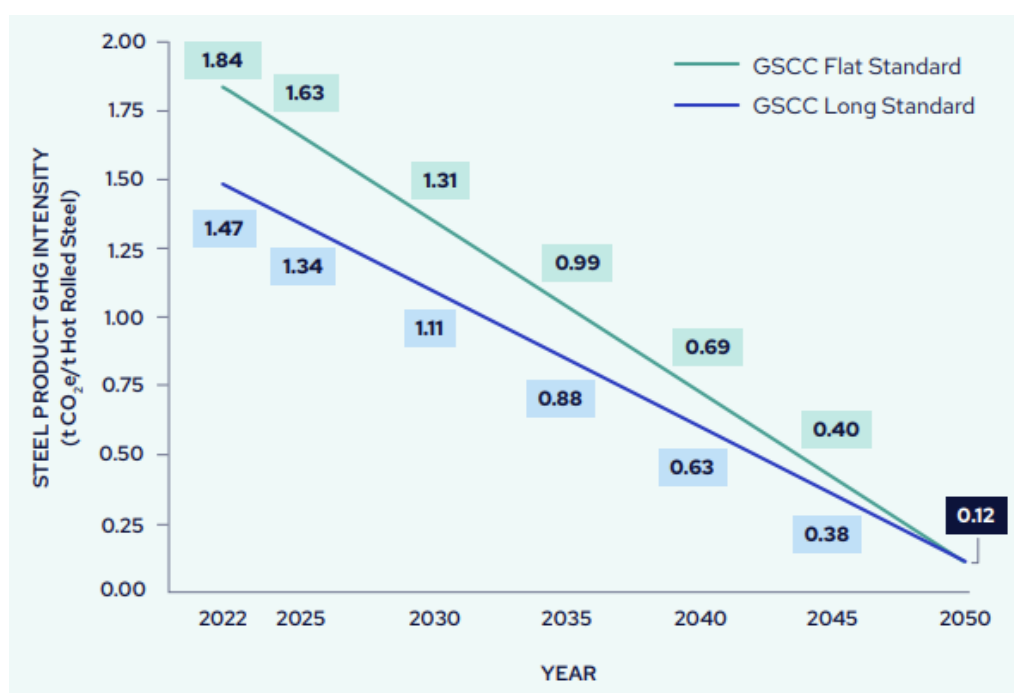


Figure 3.2 GSCC Flat and Long Steel Product Standards

4 Illustrative Examples

4.1 Case Study

To illustrate the difference among different emission reporting framework, a case study has been performed through static process modelling for steel production.

The studied cases are consisting of following process:

- EAF-LF: Electric arc furnace (remelting scrap) and ladle furnace (quality adjustment)
- DR-EAF-LF: Reduction shaft furnace (direct reduction iron production) + EAF (melting mixes of DRI and scrap) + LF (adjustment)
- EAF-AOD: EAF (Remelting scrap/alloy) +AOD (decarburization, reduction and refining). Applied specially for stainless steel production.

Following two steel grades are select of interest:

- Carbon steel (CS): EN 1.0503, 0.5% Mn, 0.5%C. For tempering and quenching, normally used for mechanical engineering and automotive components.
- Stainless steel 304 (SS): EN 1.4301, 18%Cr, 8%Ni, 1.4% Mn, 0.03%C. It is good corrosion resistance and widely used in household appliances, food, and beverage industry etc.

The designed cases are presented in [table 4.1](#).

Table 4.1 Detailed information of studied cases

Case	Steel	Process	Scrap ratio
1	CS	EAF-LF	100%
2	CS	EAF-LF	20%
3	SS	EAF-AOD	80% (SS)

4.2 Inventory and assumptions

The inventory for steel production in the studied cases is generated from RawMatMix, a web-based material optimization tool. The process modelling follows some defined steps to calculate the inventory data. The prerequisite is the chemistry of the feedstock and product specification and some default parameter values such as the operation temperature, metal distribution factors. These data were selected as a typical value from previous work at Kobilde. The prerequisites and assumptions are not verified which may have its own limitations or uncertainty in results. These uncertainties can be reduced by implementing more detailed and recent inventory data for each process technology; however, the main purpose of this case study calculations was to compare the reported GHG emissions under different reporting frameworks. Thus, the results should be taken as indicative rather than definitive.

To simplify the calculations and easy compare the difference, following assumptions are made:

- The calculation based is 100-ton liquid steel production before casting. The inventory for process like casting, hot rolling is estimated. Assume no metal loss during casting and hot rolling.
- Emission factors are using CO₂ emission factor from worldsteel (worldsteel, 2022), it may differ from sources which emits other GHG gases such as CH₄, N₂O. The plant is Europe-based thus, electricity is using EU mix.

- The scrap used in the production are 100% from end-of-life scrap which is purchased from external site.
- No dust generation is considered.
- Site waste disposal, material recovery is not included.
- Assuming the transport distance of solid raw material (e.g., scrap, lime, coke) from manufacturing site to steel cite is 100km

The calculated inventory is presented in [table 4.2](#).

Table 4.2 Inventory and emission factors used for case studies

			Emission factor		CS	CS	304 SS
			Upstream	Direct	EAF-LF	DR-EAF-LF	EAF-AOD
			kgCO ₂ /unit		100Scrap	20Scrap	80SS Scrap
Process	Inventory	Unit			Amount	Amount	Amount
EAF/BF	Carbon scrap	kg	0.007		1012	200	67
	SS scrap	kg	0.007				700
	EAF coal	kg	0.79	3.66	13	8	2
	Coke	kg	0.224	3.257			2
	Electricity	kWh	0.145		389	651	469
	Natural gas	kWh	0.067	0.202	25	25	25
	Lime	kg	0.95		19	11	29
	Dolomite	kg	1.1		16	69	10
	Magnesite	kg	0.0636		0.5	0.5	7
	Electrode	kg	0.65	3.663	2	2	2
	FeSi	kg	4	0.004	2	4.7	5
	FeMn	kg	2.789	0.183			
	FeCr	kg	5.987	0.275			77
	FeNi	kg	8.676	0.037			56
	Oxygen	Nm3	0.355		30	25	15
	Pellet	kg	0.137			1214.5	
	H2 gas-DRI	GJ	5			5.48	
	Electricity-DRI	kWh	0.145			362	
	(DRI)	kg				(905)	
LF/AOD	SS scrap	kg	0.007				100
	Lime	kg	0.95				60
	Dolomite	kg	1.1				21
	Magnesite	kg	0.0636				16
	Oxygen	Nm3	0.355				69
	Ar	Nm3	0.103				17
	N2	Nm3	0.103				27
	Natural gas	kWh	0.067	0.202			123
	FeSi	kg	4	0.004			20
Hot rolling	Electricity	kWh	0.145		99	99	99
	Natural gas	kWh	0.067	0.202	516	516	516
Meltshop	Electricity (fan, grinding etc)	kWh	0.145		64	64	64
Transport	Truck (100km, diesel)	kg	0.0256		1063	1508	1172

4.3 GHG emissions of 1 ton steel production under different reporting framework

The GHGE emissions are calculated for carbon steel production with 100% scrap use and shown in Figure 4.1. The main differences are described as below:

- Scope 1: ResponsibleSteel shows the lowest value (77kgCO₂/t) due to the exclusion of hot rolling in accounting. SBTi has lower Scope 1 emissions than worldsteel is due to the exclusion of secondary metallurgy.
- Scope 2: Responsible shows the lowest value due to the electricity used in hot rolling is not calculated because hot rolling is outside the boundary.
- Scope 3: scope 3 emission in SBTi is not included if it is lower than 40% of total emissions. Worldsteel has lower scope 3 value than ResponsibleSteel is because mining is outside the boundary in worldsteel accounting framework.
- Total GHG: SBTi<ResponsibleSteel<worldsteel

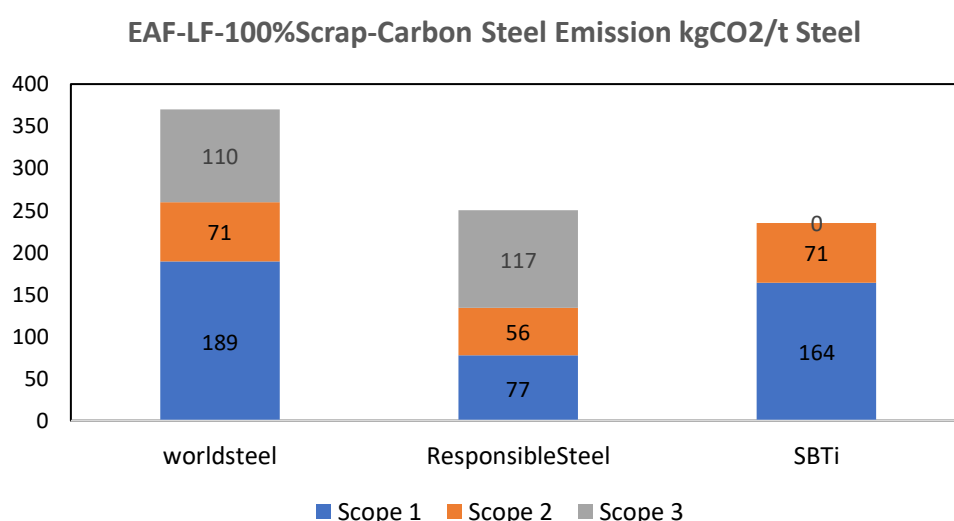


Figure 4.1 GHG emissions of carbon steel produced from EAF-LF process with 100% Scrap

Direct reduction iron is another typical iron material charged in the process when it is in shortage of scrap or the scrap quality is low. Figure 4.2 gives the assessment for carbon steel produced with the mixture of scrap and DRI. The assumed scrap ratio is about 20%. The main differences are described as below:

- Scope 1: ResponsibleSteel shows the lowest value (59kgCO₂/t) due to the exclusion of hot rolling in accounting. SBTi has lower Scope 1 emissions than worldsteel is due to the exclusion of secondary metallurgy.
- Scope 2: Responsible shows the lowest value due to the electricity used in hot rolling is not calculated because hot rolling is outside the boundary.
- Scope 3: Compared with the production scenario (100%Scrap) in Figure 4.1, the increased DRI result in an increase of slag former addition. This brings a high value of scope 3 emissions in general due to the high pollution process from production of lime, dolomite and magnesite. Scope 3 emission in SBTi is now included in this case because the total Scope 3 emissions are higher than 40% of total emissions. Among the three accounting methods, worldsteel shows the lowest due to the exclusion of mining.
- Total GHG: ResponsibleSteel<worldsteel<SBTi

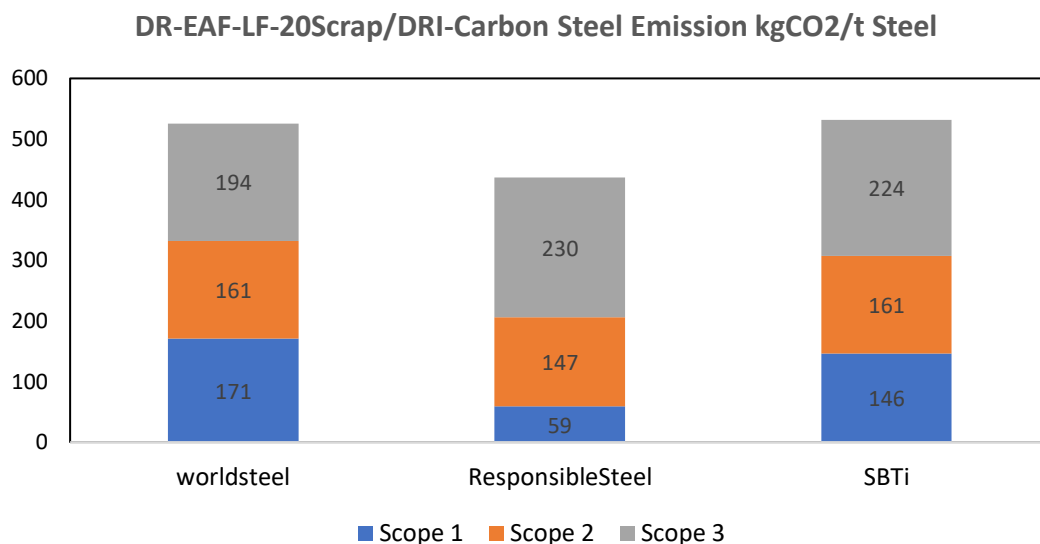


Figure 4.2 GHG emissions of carbon steel produced from DRI-EAF-LF process with 20% Scrap+DRI

When it comes to the accounting of stainless steel, it is currently not so many frameworks cover this due to the high alloy addition, for instance, Responsible Steel currently only applied for steel that has alloy content lower than 8%. Thus, it is not shown in Figure 4.3. The main difference of GHG emissions when using worldsteel and SBTi method to calculate stainless steel are described as below:

- Scope 1: SBTi has lower Scope 1 emissions than worldsteel is due to the exclusion of secondary metallurgy.
- Scope 2: No difference.
- Scope 3: SBTi shows lower scope 3 emissions due to the exclusion of secondary metallurgy where primary alloys are added for adjusting the stainless steel grades

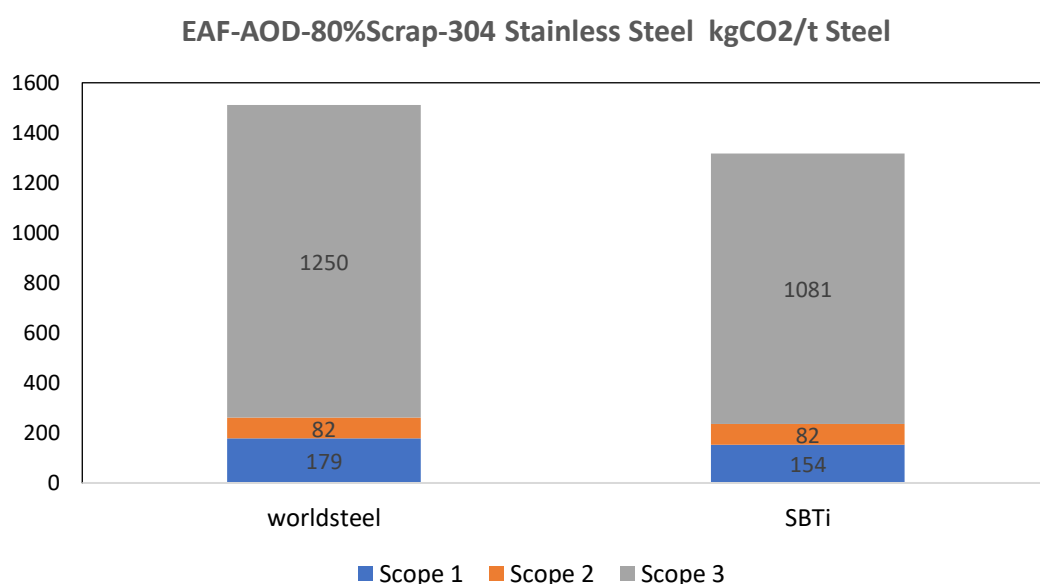


Figure 4.3 GHG emissions of 304 steel produced from EAF-LF process with 80% Scrap

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Appendix 1 Other initiatives related with near-zero steel production

Table A1 Other initiatives related with near-zero steel production (The weblinks are accessible on 2023-08-31)

Initiative	Web	Organisations	Level	Focus	Sector	Group	Overview
GHG protocol	Link Link	WRI & WBCSD	P/C	Fw	Multi	General	GHG Protocol have established global standards for both private and public sectors, both in corporate and product level. The Emission calculation tool (Excel spreadsheet) for iron and steel is for simple emission calculation from 2007
Worldsteel	Link	Worldsteel	P/S	Fw	Steel	General	Two yearly data collection systems. One is CO2 Data Collection and the other one is LCI Data Collection. CO2 Data Collection aims to create global average CO2 intensity. CO2 emissions intensity of crude steel production is reported through an online tool by its members. LCI Data Collection, provides data on the environmental profile of 16 key long and flat products (e.g., rebar, wire rod, plate, hot rolled coil etc).
Achieving Net Zero Heavy Industry Sectors in G7 Members	Link	IEA	S	Fw	Steel cement	Cert.	Requested by Germany under its presidency of the G7. The work was built on analysis from IEA's Net Zero by 2050: A Roadmap for the Global Energy Sector. The report provides G7 members a toolbox of policies and financing mechanisms, as well as some recommendations to accelerate the transition of heavy industry sectors.
Responsible Steel	Link	Representatives (Blue Scope, Arcelor Mittal) and independent advisors	S	Fw	Steel	Cert.	first global multi-stakeholder standard and certification programme for steel industry. It covers not only environmental issue but also social and governance issues. The current reporting framework not fully apply for high alloy and stainless steel (alloy content higher than 8%). The technical specifications and GHG intensity performance thresholds for high alloy and stainless steels are currently under development.
Science Based Targets Initiative (SBTi)	Link	WRI & WWF & CDP & UNGC	C	Fw	Multi	Cert.	The initiative helps companies to develop emissions reduction targets which is aligned with the climate change goals of the Paris Agreement. Science based targets, SBTs, is defined as company's relative emission reductions over a time based on their starting emissions and activities. SBTs are set for individual company to track progress and evaluate their mitigation actions. SBTi should not be used for product comparisons or company intensity comparisons. SBTi uses Sectoral Decarbonisation Approach, SDA, to assist companies sets climate change goals and guidance from different sectors (e.g., oil & gas, cement, iron & steel etc.). The draft guidance for steel sector was published in November 2022 and under public consultation and revision till January 2023. Final guidance is planned in May 2023.
Net Zero Steel Pathway Methodology Project (NZSPMP)	Link	ArcelorMittal, BlueScope Steel, GFG Alliance, Tata Steel, worldsteel and ResponsibleSteel	C	Fw	Steel	Cert.	a collaborative project with SBTi to develop a clear Sectoral Decarbonisation Approach, SDA, in steel sector when steel companies are setting science based targets. NZSPMP aims to propose a set of key principles to help companies measure and set GHG reduction targets. The final project report was published in July 2021.

A label system for green lead markets	Link	The German Steel Federation (Wirtschaftsvereinigung Stahl)	S	Fw	Steel	Cert.	The classification system is defined based on virtual reference plants making quality steel grades. It calculates emissions after rolling and allows credits emission for by-products, also takes the scrap ratio into account. The labelling system focuses on the demand mechanisms. The classification system is currently still under development. A rulebook with key specification has been completed already. Some more details are required for implementation in the rulebook, e.g., relevant precision of what should be measured, a list of emission factors, etc.
Industrial Deep Decarbonisation Initiative (IDDI)	Link	UNIDO, CEM, UK etc.	C	De	Multi	Cert.	It is the largest coalition of governments and private sector working to <u>decarbonise heavy industry</u> (i.e., steel, cement) and foster demand of low carbon materials through Green Public Procurement, GPP. IDDI is co-led by the UK, India and current members include Canada, Germany and United Arab Emirates. In November 2022, Japan and Sweden have announced their joining in IDDI.
SteelZero	Link	Climate Group in partner. ResponsibleSteel	C	De	Steel	Cert.	The member companies are committed to make a public purchase commitment of 100% net zero steel by 2050. Commitment to a total of 50% of steel requirement by 2030 meeting one of the following criteria:1. Responsible steel certified 2. Steel sites follow SBTi 3. Low embodied carbon steel
First Mover Coalition (FMC)	Link	World Economic Forum	C	De	Multi	Cert.	The FMC is a coalition of companies using their <u>purchasing power</u> to create early markets for innovative clean technologies across <u>eight hard to abate sectors</u> . <u>Commitment of steel purchasers</u> <u>At least 10% (by volume) of all our steel purchased per year will be near-zero emissions (as per FMC definition) by 2030</u>
Assessing low-Carbon Transition Initiative (ACT)	Link	UNFCCC, CDP, ADEME	C	Fw	Multi	Cert.	ACT provides guidance and assessment methodologies as an accountability framework to support and assess companies' strategies and actions contribution to the Paris mitigation goals. The general approach of ACT is based on the Sectoral Decarbonization Approach (SDA) developed by the Science-Based Targets initiative (SBTi)
Steel production GHG Emissions Calculation Methodology Guidelines	Link	AISI	C	Fw	Steel	Cert.	The primary objective of this document is to establish a calculation approach for GHG emissions from steel production with a focus on product-level disclosures and corporate-level reporting.
GSCC Steel Standard	Link	The Global Steel Climate Council, Inc. (GSCC)	S	Fw	Steel	Cert.	The focus of the GSCC is to establishing a standard that is 1. Technology/production method regardless 2. Has a system boundary that includes Scope 1, 2 and 3 emissions. 3. Aligns with a science-based glide path to achieve a 1.5 degree scenario by the year 2050.
RE100	Link	Climate Group, CDP	-	De	Electricity	Cert.	RE100 is a global initiative bringing together the world's most influential businesses <u>committed</u> to 100% renewable electricity. RE100 companies must select a target date for achieving 100% renewable electricity. The minimum requirements are: 100% by 2050, with interim steps of at least 60% by 2030 and 90% by 2040
EcoVadis	Link	EcoVadis	C	To	Multi	Cert.	EcoVadis provides business sustainability ratings. Methodology covers 7 management indicators across 21 sustainability criteria, in four themes: Environment labour& Human Rights, Ethics, and Sustainable Procurement. It is based on leading standards and is supervised by an international scientific committee.

CRU	Link	CRU together with RMI, ResponsibleSteel	S	To	Multi	Cert.	Emissions Analysis Tool allows company to compare emissions across the complete value chain on a digital platform. It has access to standardised data and methodologies calibrated to existing schemes such as EU ETS, worldsteel, IAI.
Climate Bonds Initiative	Link	-	C	Fi	Multi	Cert.	A labelling scheme for bonds and loans. Rigorous scientific criteria ensure that bonds and loans with Certification, are consistent with the 2 degrees warming limit in the Paris Agreement. The Steel Criteria lay out the requirements that Steel production asset projects must meet to be eligible for inclusion in a Certified Climate Bond and for companies on a credible transition path to issue transition labelled debt. The Criteria apply to manufacture and production of steel and do not address other stages of the value chain.
SASB Standards GHG Emissions	Link	SBAB	C	Fi	Multi	Cert.	SASB Standards enable organizations to provide industry-based sustainability disclosures about risks and opportunities that affect enterprise value. This supplement provides an overview of SASB's approach to greenhouse gas emissions and related topics in the SASB Standards and offers guidance for reporting entities that wish to disclose Scope 1, 2, or 3 emissions.
Equator principles (EP)	Link	International Finance Corporation IFC	C	Fi	Multi	Cert.	The Equator Principles (EP) are intended to serve as a common baseline and risk management framework for financial institutions to identify, assess and manage environmental and social risks when financing Projects.
ICC Framework for Responsible Environmental Marketing Communications	Link	ICC	P	De	Multi	General	The Environmental Framework provides added guidance and commentary to help marketers understand how to apply principles of substantiation and qualification to a number of specific environmental terms used in advertising. <u>For marketing communication purpose</u>
Buy Clean California Act (BCCA)	Link	Department of General Services (DGS), the California Air Resources Board (CARB)	P	De	Steel Glass etc.	Cert.	The Buy Clean California Act (BCCA) was one of the first procurement policies to require agencies to set GWP limits and to require disclosure of environmental product declarations (EPDs) for certain materials used for state construction projects.
Climate Action 100+	Link	5 global investor representatives.	C	Fi	Multi	Cert.	The Climate Action 100+ was the largest global investor engagement initiative. It was to assess the performance of focus companies against the initiative's three high-level goals: emissions reduction, governance, and disclosure. It defines key success indicators for business alignment with the goals of the Paris Agreement to limit global temperature rise to 1.5°C. The Benchmark draws on analytical methodologies and datasets to provide investors and other stakeholders with a robust tool to facilitate focus company engagement and action
Glasgow Financial Alliance for Net Zero (GFANZ)	Link	UN Special Envoy, UNFCCC Race to Zero campaign,	-	Fi	Multi	Cert.	GFANZ supports its members by developing the tools and frameworks that will help them make good on their net-zero commitments in accordance with those criteria. GFANZ was founded to expand the number of net zero-committed financial institutions and to establish a forum for addressing sector-wide challenges associated with the net-zero transition, helping to ensure high levels of ambition are met with credible action.
Steel Emissions Reporting Guidance	Link	RMI	P	Fw	Steel	General	The purpose of this guidance is to provide a tool for steel companies to report emissions in a way that enables the development of a differentiated market for low embodied emissions steel that promotes the necessary investments to decarbonize the sector.
Xcarb™ Initiatives	Link	Arcelor Mittal	P	De	Steel	Cert.	Xcarb™ green steel certificates and Xcarb™ recycled and renewably produced for products made via the Electric Arc Furnace route using scrap.

The Center for Climate Aligned Finance (CCAF)	Link	RMI	-	Fi	Multi	General	The Centre’s mission is to serve as an engine room for the financial sector to partner with corporate clients to identify practical solutions through deep partnerships with industry, civil society and policymakers to facilitate a transition in the global economy to net-zero emissions by mid-century.
Leadership Group for Industry Transition (LeadIT)	Link	Representatives from Sweden, India, and the World Economic Forum.	-	Co	Multi	General	This interactive database gathers 30 industry transition roadmaps that have been developed by the thirteen countries that are LeadIT members. The Transition Tracker allows exploring these roadmaps in an engaging and interactive manner, and analysing their content across different sectors and different countries. It enables users to pull out key trends, as well as similarities and differences across countries or sectors.
Net Zero Steel Initiative (NZSI)	Link	The Mission Possible Partnership (MPP)	-	Co	Steel	General	The initiative will work alongside and build on existing efforts—including dialogues led by industry associations, international roadmaps, labelling initiatives, R&D partnerships and corporate efforts. It will reflect the perspectives of ambitious players and demonstrate how steel can be a key part of a net-zero economy. MPP will bring together ambitious industry leaders and their suppliers, customers, and capital providers, along with the relevant governments. The initiative provides a platform for these stakeholders to align on a net
Green Steel for Europe (GRENSTEEL)	Link	EU	-	Ro	Steel	General	The project aims to develop a technology roadmap and define mid- and long-term pathways for the decarbonisation of the steel industry; analyse funding options; assess the economic, social, environmental and industrial leadership impacts of EU policy options; and ensure the dissemination of results and stakeholder engagement. “Green Steel for Europe” relies on a detailed and finely structured work plan across 5 work packages (WPs). “Green Steel for Europe” supports the EU towards achieving the 2030 climate and energy targets and the 2050 long-term strategy for a climate neutral Europe, with effective solutions for clean steelmaking.
Clean Steel Partnership (CSP)	Link	European Steel Technology Platform (ESTEP)	-	Co	Steel	General	CSP will ensure a coordinated, sustainable approach across stakeholders, technologies, production routes and countries.
Achieving Green Steel Roadmap to a Net Zero Steel Sector in India	Link	TERI (India)	-	Ro	Steel	General	This comprehensive Roadmap provides an overview of the current state of the steel sector and details a range of possible emissions mitigation strategies.
1.5°C Steel decarbonising the steel sector in Paris-compatible pathways	Link	E3G	-	Ro	Steel	General	This study examines those challenges, unpacking for the first time at global and regional levels the implications for steel decarbonization of a 1.5°C compatible transformation pathway. Using the Global Change Analysis Model (GCAM) to explore the gap between current policy trajectories and 1.5°C consistent pathways and the role of key technologies and demand-side measures in achieving accelerated steel decarbonization. It draws out policy implications at the global level and in the six largest steel producing regions: China, Europe, India, Japan, South Korea, and the US.
What yardstick for Net Zero?	Link	WTO	-	Ro	Multi	General	The information brief analyses the challenges posed by different accounting methodologies for measuring the carbon content of products and recalls WTO principles agreed by the TBT Committee for the development of international standards, guides and recommendations.

RMI-Pursuing Zero-Carbon Steel in China	Link	RMI	-	Ro	Steel	General	Report analyses the specific path of China's steel industry to achieve zero carbon by 2050. The report maps out three steps for the industry's decarbonization: demand reduction, steel recycling, and switching to low-carbon alternatives.
Glasgow Breakthroughs	Link	Race to Zero	-	Po	Multi	General	With the Glasgow Breakthroughs, governments are committing to put in place a global policy framework for the Power, Road Transport, Steel, Hydrogen and Agriculture sectors, to act domestically to work towards these targets, and measure progress with the Global Checkpoint Process.
CO2 emission Calculation Tool	Link	SKF	P	To	Steel	General	SKF has created a tool which allows us to calculate steel related, upstream embodied CO2e, as well as that resulting from our own operations. We use this tool and the data it generates to help customers design and specify lower embodied carbon products. We see that our longstanding focus on climate results in lower embodied carbon products, compared with those of our competitors. This gives SKF a competitive advantage, lower scope 3 emissions for the customer and lower emissions overall. The software executes CO2 calculations, based on data input and connected databases
UN Convened Net Zero Asset Owner	Link	UN	-	Fi	Multi	General	The UN-convened Net Zero Asset Owner Alliance (NZAOA) is a member-led initiative of institutional investors committed to transitioning their investment portfolios to net-zero GHG emissions by 2050 – consistent with a maximum temperature rise of 1.5°C. The Alliance members are the finance industry's first to set intermediate targets, which include CO2 reduction ranges for 2025 (22 – 32%) and for 2030 (49% – 65%).
Net Zero Industry Tracker	Link	WEF-Accenture	-	Co	Multi	General	establishes a new framework to monitor and support the progress of heavy industries towards net zero
CATENA-X (Automotive data network)	Link	German Federal Ministry for Economic Affairs and Energy'	P	Co	Auto.	General	an ongoing initiative where suppliers to the automotive industry can put in their product data in a joint database to create transparency

Appendix 2 System Boundary of Different Reporting Framework

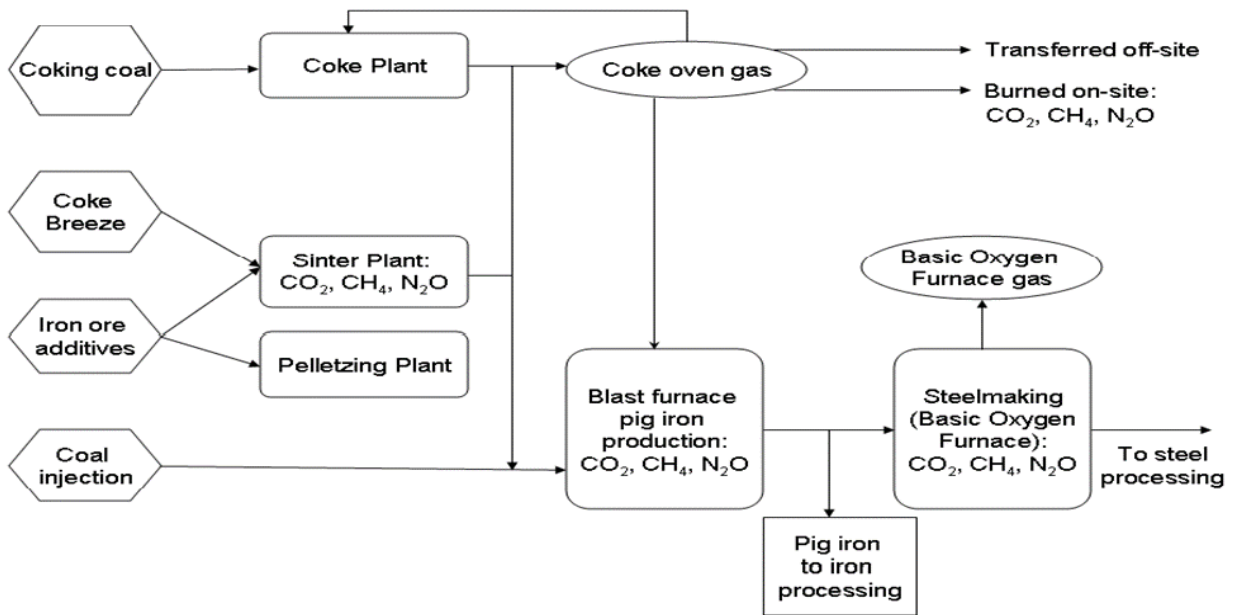
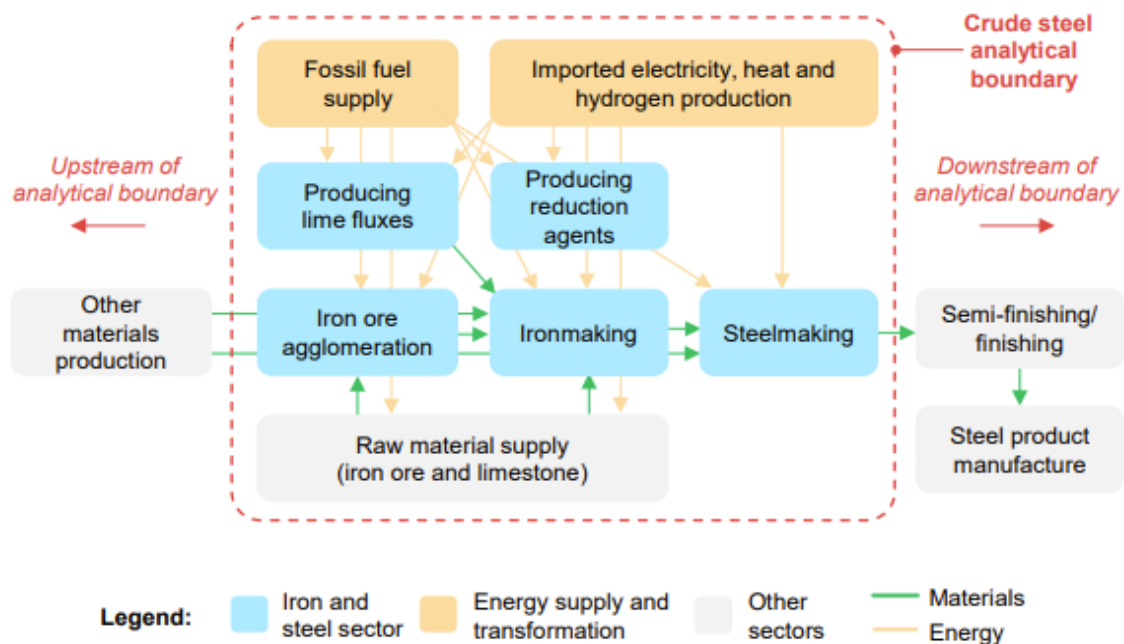


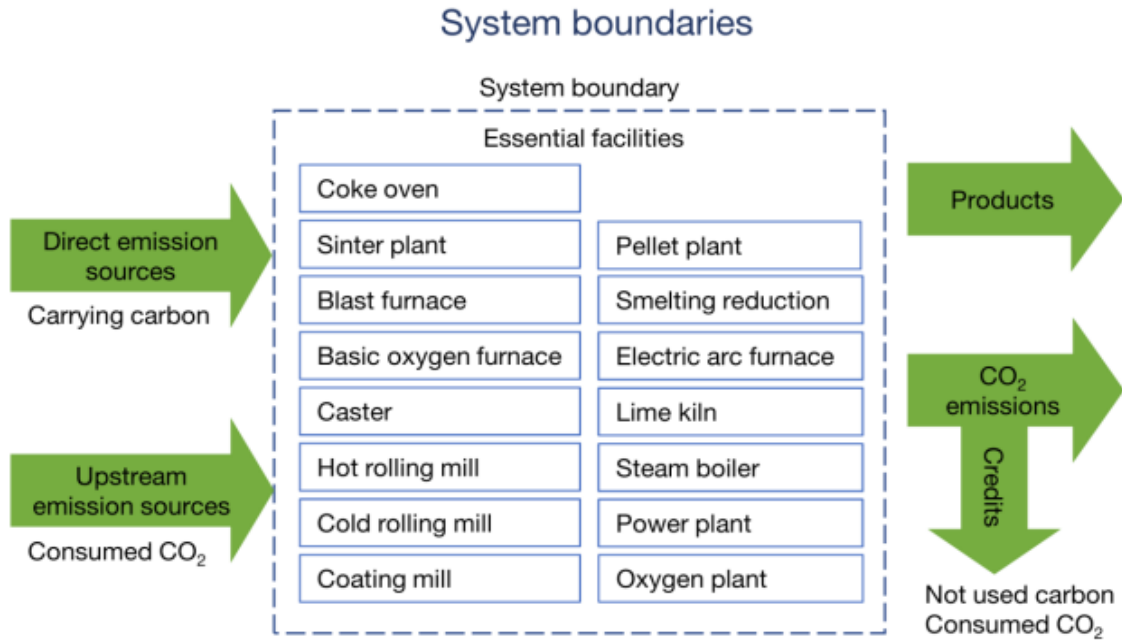
Figure A2- 1 The main GHG emission sources associated with iron and steel production (GHG protocol)



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Notes: "Other materials production" refers to the production of material inputs to the iron and steel sector besides iron ore and limestone, including electrodes, alloying elements and refractory linings.

Figure A2- 2 Analytical boundary for defining near zero emission steel production (IEA/G7)



Upstream value of mining and transport is excluded from the system boundary.

Upstream value of petroleum products for oil refining is included.

Upstream CO₂ value: sum of CO₂ emitted during the production of each item

Upstream energy value: sum of energy consumed during the production of each item

Figure A2- 3 System boundary of worldsteel

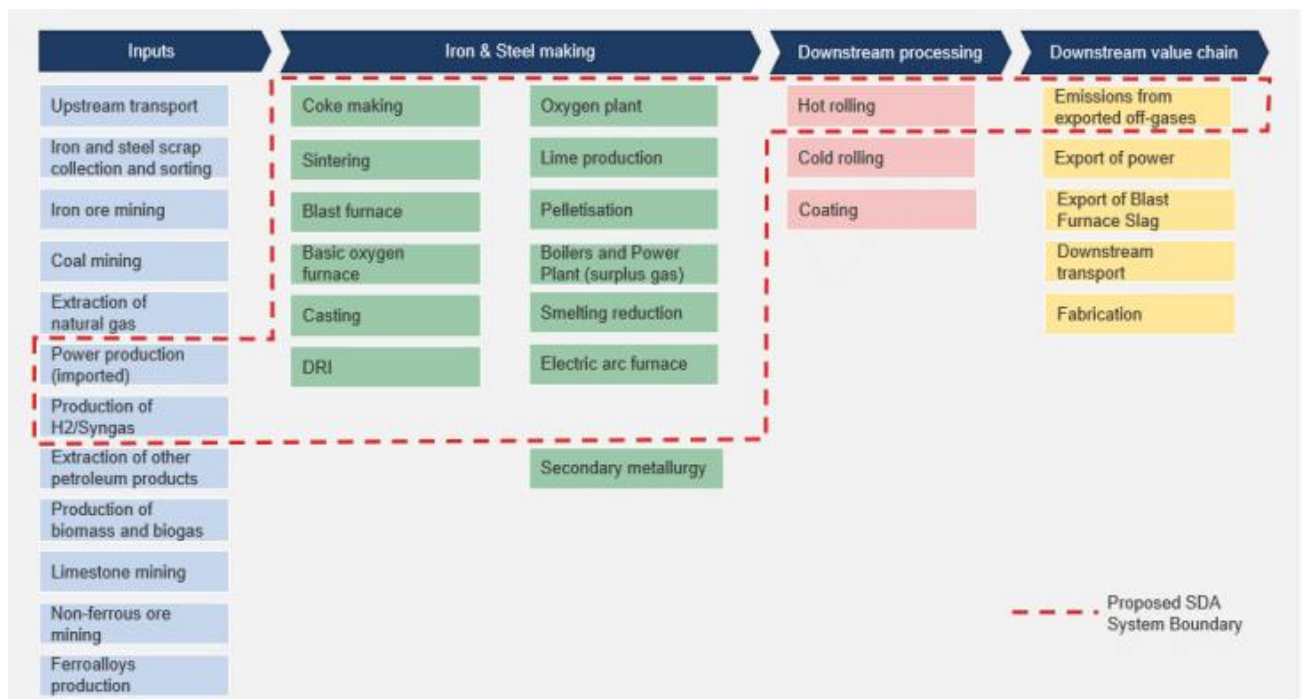


Figure A2- 4 Iron & Steel core SDA boundary (SBTi)

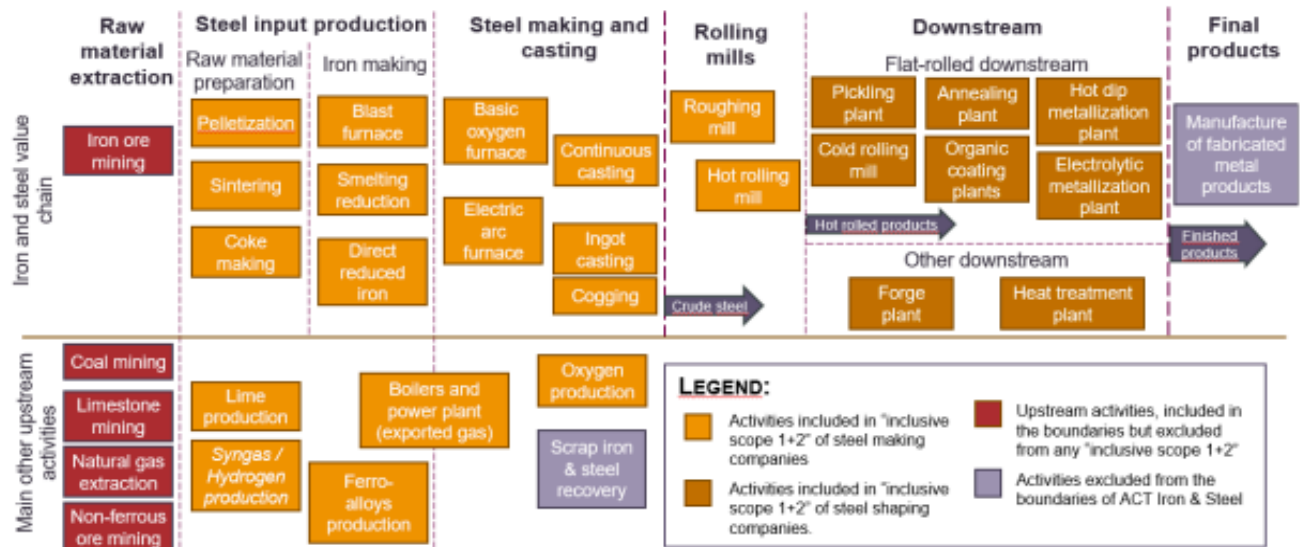


Figure A2- 5 Boundaries for the iron and steel sector (ACT)

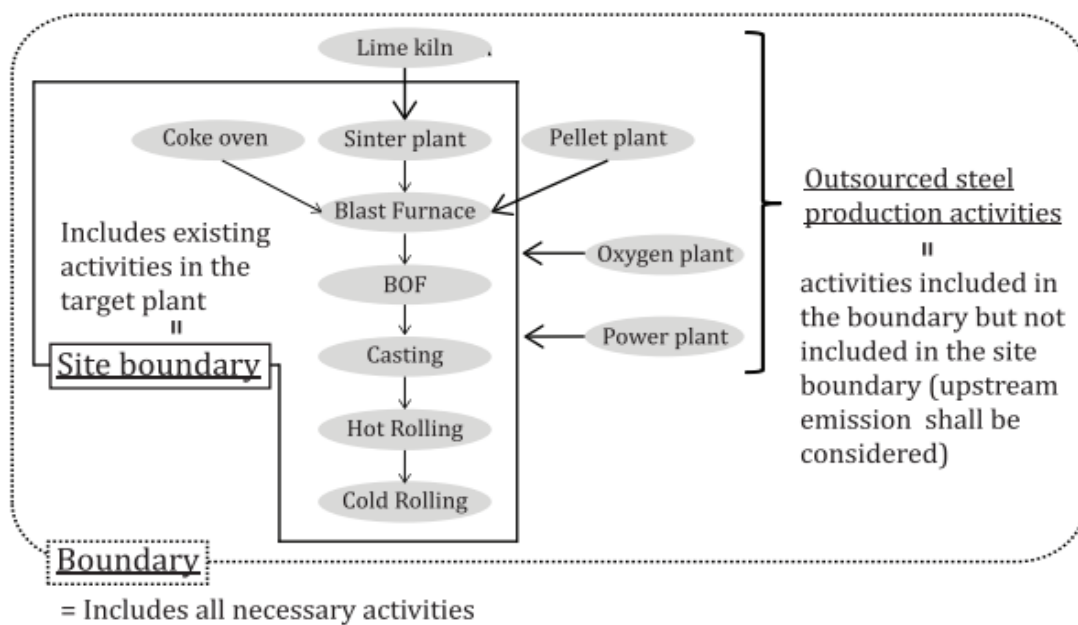


Figure A2- 6 Conceptual diagram of boundary and site boundary (ISO 14404)

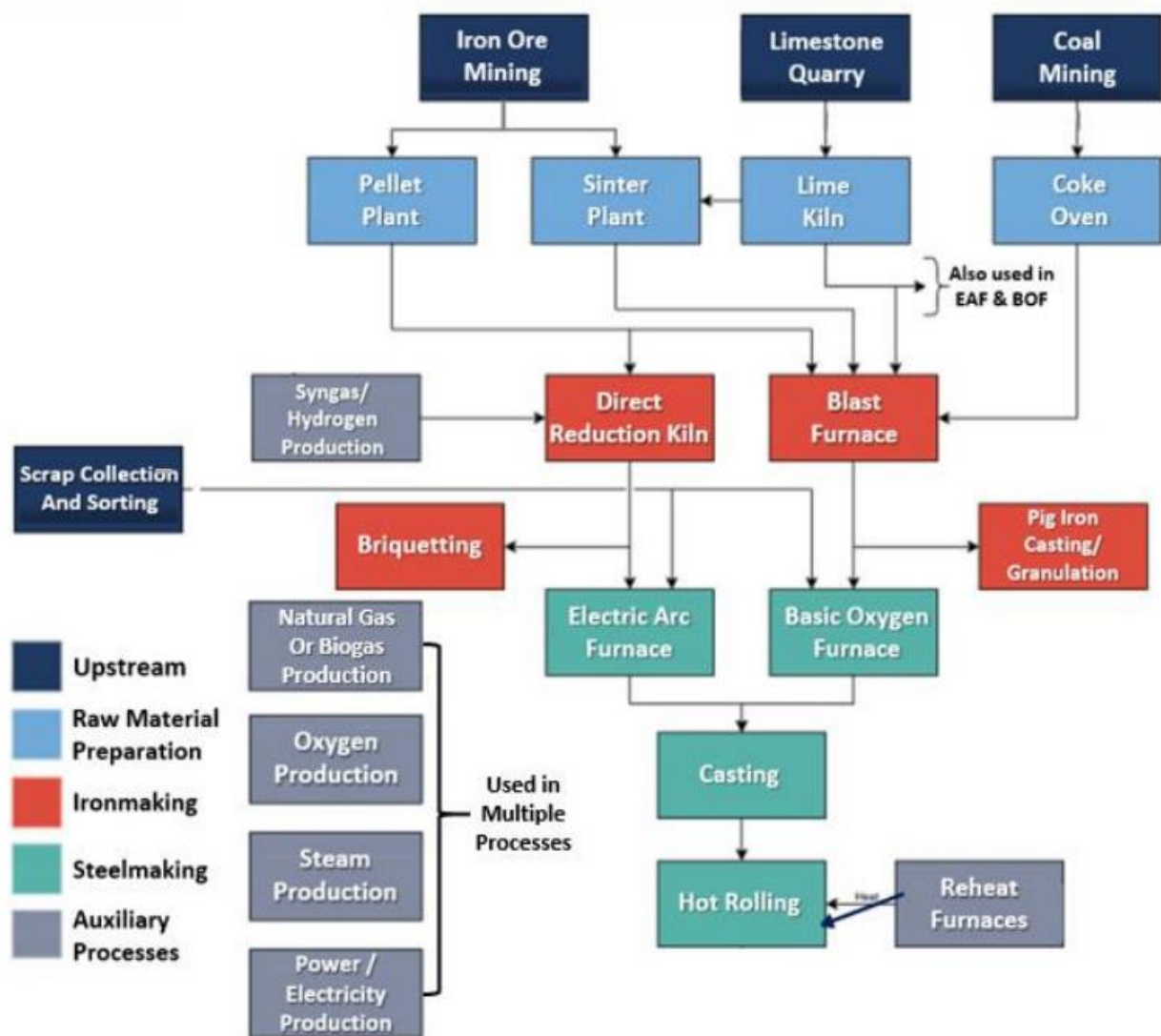


Figure A2- 7 Boundary of GSCC Standard

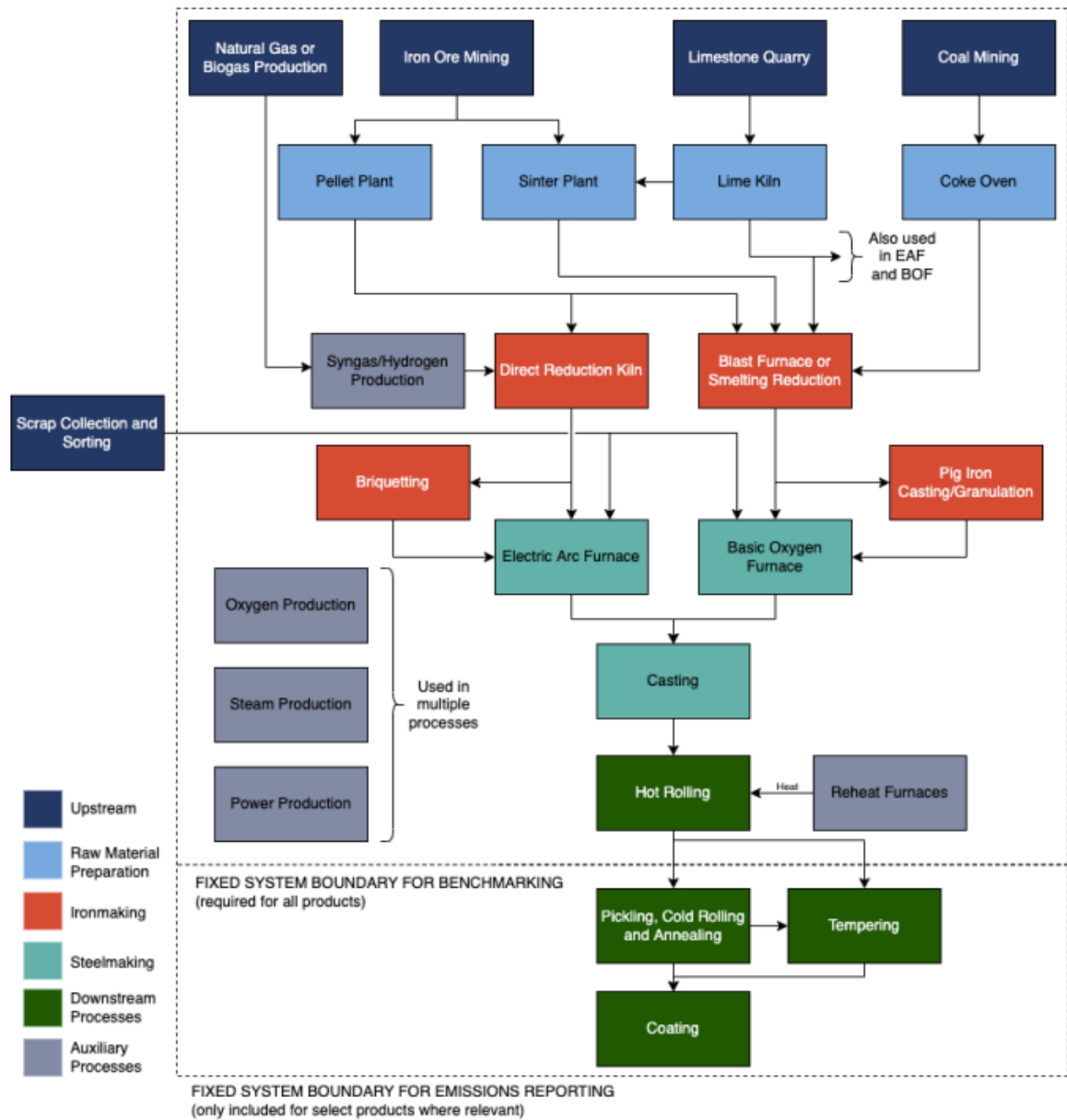
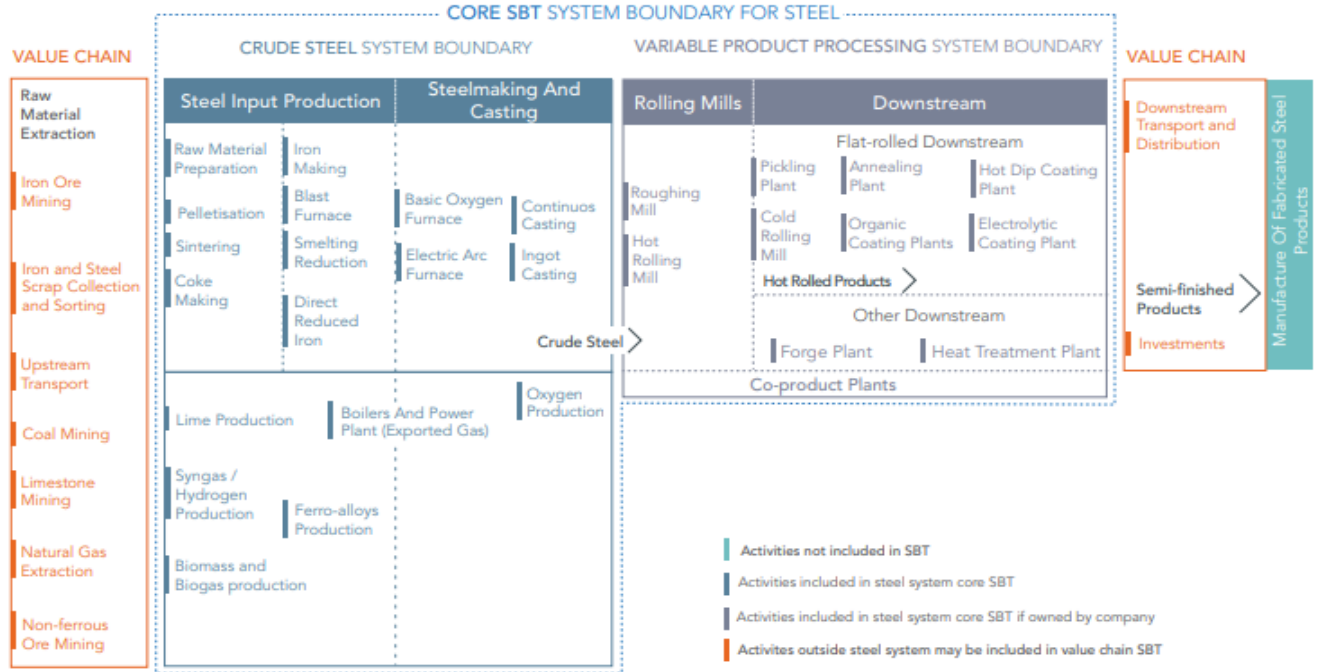


Figure A2- 8 Fixed system boundary for steel sector emissions reporting (RMI)



Source: adapted from ACT project draft iron and steel methodology (ACT, 2021).

Figure A2- 9 Core SBT System boundary for steel (NZSPMP)



Figure A2- 10 Recommended System boundaries for consistent GHG Reporting in the Steel Industry (AISI)

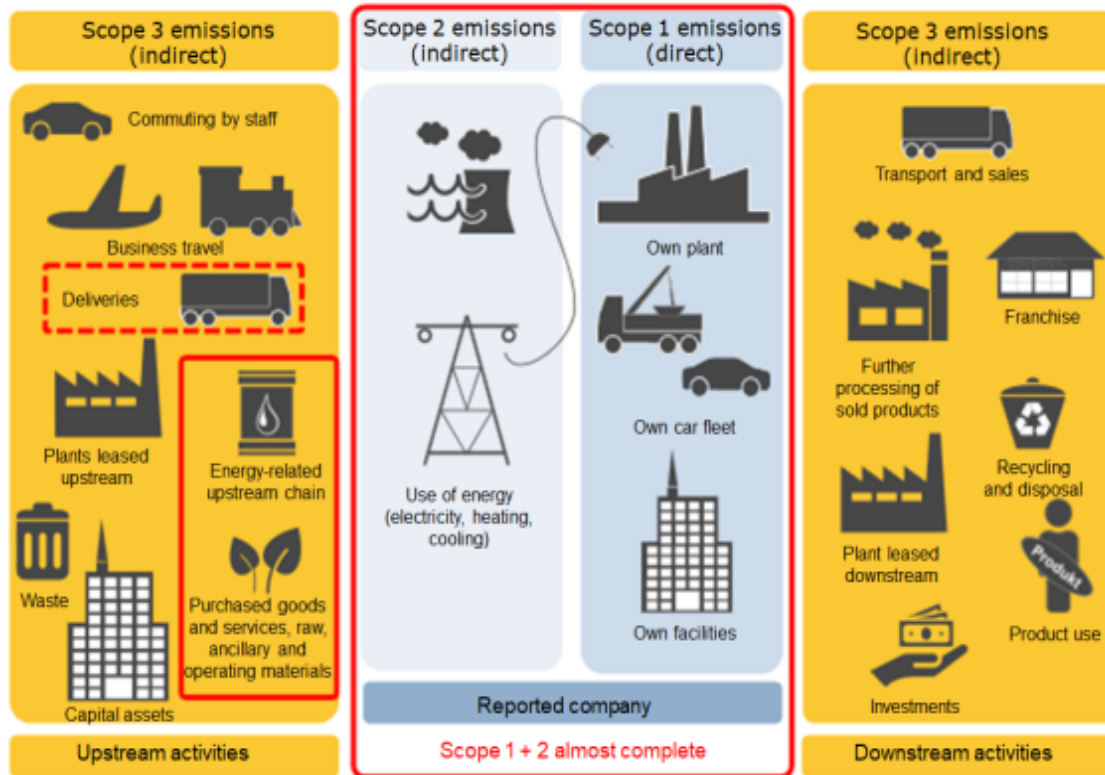


Figure A2- 11 Emissions included for the classification system (WV Stahl)

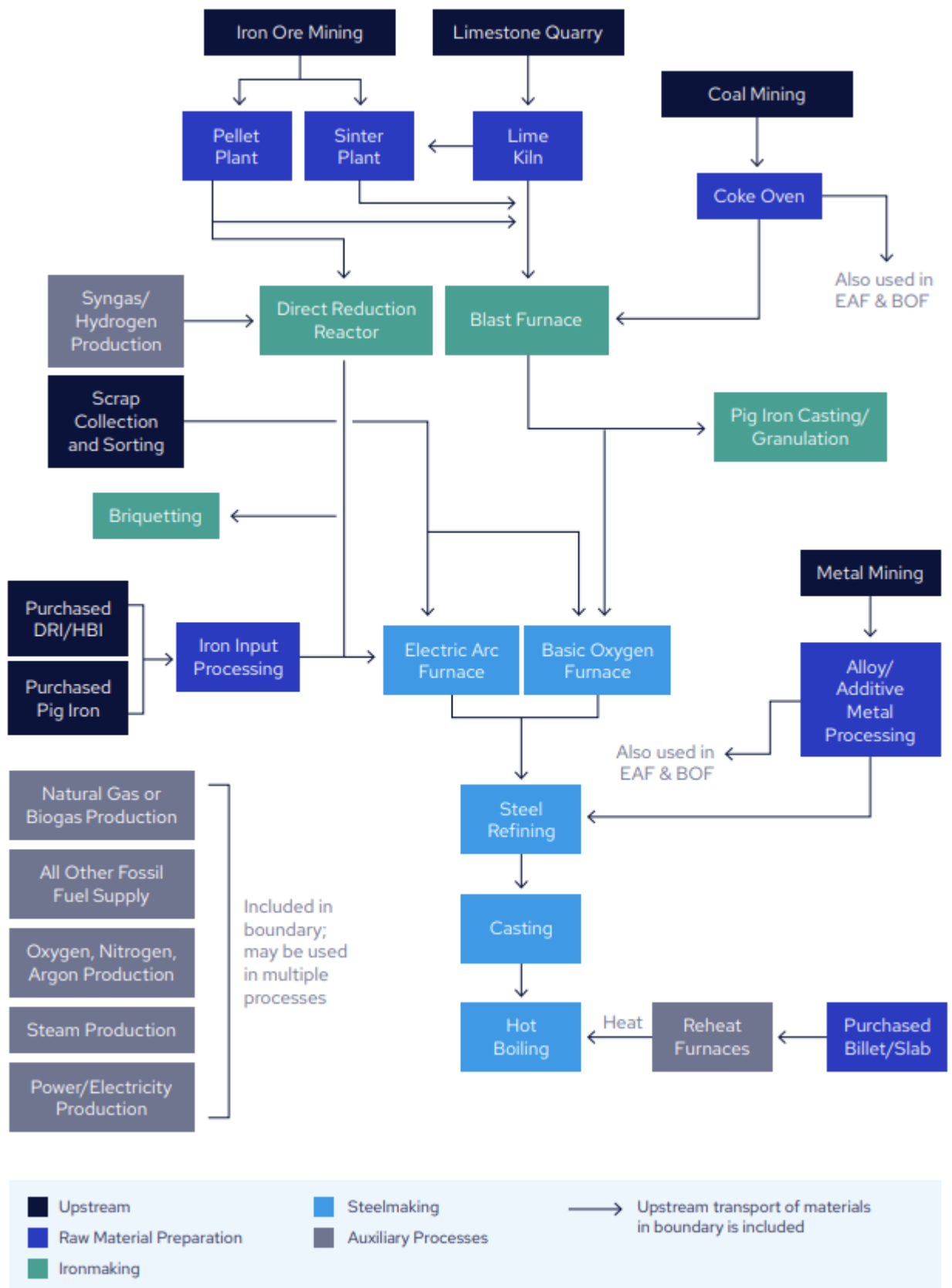


Figure A2- 12 GSCC Operational Boundary