Steel Criteria

Development of Eligibility Criteria under the Climate Bonds Standard & Certification Scheme

DRAFT BACKGROUND PAPER

Version History	Date
Issued as draft for public consultation	

Climate Bond Certified

List of acronyms

A&R	Adaptation and Resilience
BF	Blast furnace
BOF	Basic oxygen furnace
CBI	Climate Bonds Initiative
CCS	Carbon Capture and Storage
CCUS	Carbon Capture, Utilisation and Storage
CO2	Carbon dioxide
DRI	Direct-reduced iron
EAF	Electric arc furnace
EGS	Environmental, Social, and Governance
EU	European Union
GHG	Greenhouse Gas Emissions
IEA	International Energy Agency
IIGCC	Institutional Investors Group on Climate Change
IPCC	Intergovernmental Panel on Climate Change
IWG	Industry Working Group
NGO	Non-governmental organisations
NZSPMP	The Net-Zero Steel Pathway Methodology Project
RMI	Rocky Mountain Institute
SBTi	Science-Based Targets initiative
TWG	Technical Working Group
UoP	Use of Proceeds
Worldsteel	Worldsteel Association

Definitions

Biomass: Any organic matter, i.e. biological material, available on a renewable basis. It includes feedstock derived from animals or plants, such as wood and agricultural crops, and organic waste from municipal and industrial sources.

Carbon budget: a finite amount of carbon emitted to the atmosphere before warming will exceed specific temperature thresholds.[1]

Climate Bonds Initiative (Climate Bonds): An investor-focused not-for-profit organisation, promoting large-scale investments that will deliver a global low carbon and climate resilient economy. Climate Bonds seeks to develop mechanisms to better align the interests of investors, industry, and government to catalyse investments at a speed and scale sufficient to avoid dangerous climate change.

Climate Bond: A climate bond is a bond used to finance or re-finance, projects or expenditures needed to address climate change. They range from wind farms and solar and hydropower plants to rail transport and building sea walls in cities threatened by rising sea levels. Only a small portion of these bonds have been labelled as green or climate bonds by their issuers.

Certified Climate Bond: A climate bond that is certified by the Climate Bonds Standard Board as meeting the requirements of the Climate Bonds Standard (see below), as attested through independent verification.

Climate Bonds Standard (CBS): A screening tool for investors and governments that allows them to identify green bonds where they can be confident that the funds are being used to deliver climate change solutions. This may be through climate mitigation impact and/ or climate adaptation or resilience. The CBS is made up of two parts: the parent standard (CBS v2.1) and a suite of sector specific eligibility Criteria. The parent standard covers the certification process and pre- and post-issuance requirements for all certified bonds, regardless of the nature of the capital projects. The Sector Criteria detail specific requirements for assets identified as falling under that specific sector. The latest version of the CBS is published on the Climate Bonds website

Climate Bonds Standard Board (CBSB): A board of independent members that collectively represents $34 trillion of assets under management. The CBSB is responsible for approving i) Revisions to the CBS, including the adoption of additional sector Criteria, ii) Approved verifiers, and iii) Applications for Certification of a bond under the CBS. The CBSB is constituted, appointed, and supported in line with the governance arrangements and processes as published on the Climate Bonds website.

Climate Bond Certification: allows the issuer to use the Climate Bond Certification Mark in relation to that bond. Climate Bond Certification is provided once the independent CBSB is satisfied the bond conforms with the CBS.

Green Bond: A green bond is bond of which the proceeds are earmarked for environmental projects or expenditures. The term generally refers to bonds that have been marketed as green. In theory, green bond proceeds could be used for a wide variety of environmental projects, but in practice they have mostly been earmarked for climate change projects.

Technical Working Group (TWG): A group of key experts from academia, international agencies, industry and NGOs convened by Climate Bonds. The TWG develops the Sector Criteria - detailed technical criteria for the eligibility of projects and assets as well as guidance on the tracking of eligibility status during the term of the bond. Their draft recommendations are refined through engagement with finance industry experts in convened Industry Working Groups (see below) and through public consultation. Final approval of Sector Criteria is given by the CBSB.

Industry Working Group (IWG): A group of key organisations that are potential issuers, verifiers and investors convened by Climate Bonds. The IWG provides feedback on the draft sector Criteria developed by the TWG before they are released for public consultation.

[1] IPCC (2021). 6th Assessment Report.

Climate Bonds gratefully acknowledges the Technical and IWG members who supported the development of these Criteria. Members are listed in Appendix 1. Special thanks are given to Ali Hasanbeigi, the Technical Consultant supporting the development of the Criteria.

Table of Contents

1 Introduction

1.1 Overview

This document serves as a reference document to the Criteria Document for Steel. The purpose of this document is to provide an overview of the key considerations and issues that were raised during development of the Steel Criteria and provide the rationale for why requirements were chosen and set.

The Criteria were developed through a consultative process with the TWG and IWGs, and through public consultation. The TWG comprised academic and research institutions, civil society organizations, multilateral banks and specialist consultancies whereas IWGs are represented by industry experts as well as potential bond issuers, verifiers and investors. A 60-day period of public consultation offers the opportunity to any member of the public to comment on the Criteria. This document aims to capture these various dialogues and inputs and substantiate the reasoning behind the Steel Criteria.

Supplementary information available in addition to this document include:

1. **Steel Criteria brochure:** a 2-page summary of the Steel Criteria[2].
2. **Steel Criteria document:** the complete Criteria requirements.
3. Climate Bonds Standard V3**:** the umbrella document laying out the common requirements that all Certified Climate Bonds need to meet, in addition to the sector-specific Criteria (V3 is the most recent update version).
4. **Climate Bonds Standard & Certification Scheme Brochure:** an overview of the purpose, context and requirements of the Climate Bonds Standard & Certification Scheme.

For more information on the Climate Bonds Initiative and the Climate Bond Standard & Certification Scheme, see https://www.climatebonds.net/climate-bonds-standard-v3.

For the documents listed above, see https://www.climatebonds.net/standard/Steel

1.2 Funding the goals of the Paris Agreement

The current trajectory of climate change, expected to lead to a global warming of 2.7-3.1°C by 2100,[3] poses an enormous threat to the future of the world's nations and economies. The aim of the Paris Agreement is to limit warming to a global average of no more than 2°C higher than pre-industrial levels by the end of the century, and ideally no more than 1.5°C. The effects of climate change and the risks associated even with a 2°C rise are significant: rising sea levels, increased frequency and severity of hurricanes, droughts, wildfires and typhoons, and changes in agricultural patterns and yields. Meeting the more ambitious 1.5°C goal requires a dramatic reduction in global greenhouse gas (GHG) emissions.

At the same time, the world is entering an age of unprecedented urbanisation and related infrastructure development. Global infrastructure investment is expected to amount to USD 90 trillion by 2030, more than the entire current infrastructure stock.[4]

To ensure sustainable development and avoid dangerous climate change, this infrastructure needs to be low-carbon and resilient to physical climate impacts, without compromising the economic growth needed to improve the livelihoods and wellbeing of the world's poorer citizens. Ensuring that the infrastructure built is low-carbon

[2] To be released once Criteria are finalized following public consultation.
[3] According to Climate Tracker, under current policies we could expect 2.7 – 3.1ºC: http://climateactiontracker.org/global.html
[4] The Global Commission on the Economy and Climate (2018), 'Unlocking the Inclusive Growth Story of the 21st Century: Accelerating Climate Action in Urgent Times': https://newclimateeconomy.report/2018

raises the annual investment needs by 3–4%.[5] Climate adaptation needs add another significant amount of investment, estimated at USD 280–500 billion per annum by 2050 for a 2°C scenario.[6]

1.3 The role of bonds

Traditional sources of capital for infrastructure investment (governments and commercial banks) are insufficient to meet these capital needs; institutional investors, particularly pension and sovereign wealth funds, are increasingly looked to as viable actors to fill these financing gaps.

Capital markets enable issuers to tap into large pools of private capital from institutional investors. Bonds are appropriate investment vehicles for these investors as they are low-risk investments with long-term maturities, making them a good fit with institutional investors' liabilities (e.g., pensions to be paid out in several decades).

Bond financing works well for low-carbon and climate-resilient infrastructure projects post-construction, as bonds are often used as refinancing instruments. Labelled Green Bonds are bonds with proceeds used for green projects, mostly climate change mitigation and/or adaptation projects, and labelled accordingly. The rapid growth of the labelled green bond market has shown in practice that the bond markets can provide a promising channel to finance climate investments.

The Green Bond market can reward bond issuers and investors for sustainable investments that accelerate progress toward a low-carbon and climate-resilient economy. Commonly used as long-term debt instruments, Green Bonds are issued by governments, companies, municipalities, commercial and development banks to finance or re-finance assets or activities with environmental benefits. Green Bonds are regular bonds with one distinguishing feature: proceeds are earmarked for projects with environmental benefits. Green Bonds are in high demand and can help issuers attract new types of investors.

A green label is a discovery mechanism for investors. It enables the identification of climate-aligned investments even with limited resources for due diligence. By doing so, a green bond label reduces friction in the markets and facilitates growth in climate-aligned investments.

The green debt market grew at a rate of over 50% between 2015 and 2021[7]. It is forecasted that global green investment could reach the USD1tn milestone for a single year in 2022[8]. The potential for scaling up is tremendous, however, the market now needs to grow much bigger, and quickly. A recent study from McKinsey supports this view by suggesting that the spending needed to reach Net Zero goals by 2050 should be around USD9tn per year[9].

1.4 Introduction to the CBS

Activating the mainstream debt capital markets to finance and refinance climate friendly projects and assets is critical to achieving international climate goals, and robust labelling of green bonds is a key requirement for that mainstream participation. Confidence in the climate objectives and the use of funds intended to address climate change is fundamental to the credibility of the role that green bonds play in a low carbon and climate resilient economy. Trust in the green label and transparency to the underlying assets are essential for this market to reach scale but investor capacity to assess green credentials is limited. Therefore, Climate Bonds created the Climate Bonds Standard & Certification Scheme, which aims to provide the green bond market with the trust and assurance to achieve the required scale.

The Climate Bonds Standard & Certification Scheme is an easy-to-use tool for investors and issuers to assist them in prioritising investments that truly contribute to addressing climate change, both from a resilience and a

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[5] The Global Commission on the Economy and Climate (2016), 'Better Growth, Better Climate': http://newclimateeconomy.report/2016/wp-content/uploads/sites/2/2014/08/BetterGrowth-BetterClimate_NCE_Synthesis-Report_web.pdf

[6] UNEP (2018), 'Adaptation Gap Report 2018': file:///C:/Users/12035/Downloads/AGR_2018.pdf

[7] https://www.climatebonds.net/2022/01/500bn-green-issuance-2021-social-and-sustainable-acceleration-annual-green-1tn-sight-market

[8] ibid

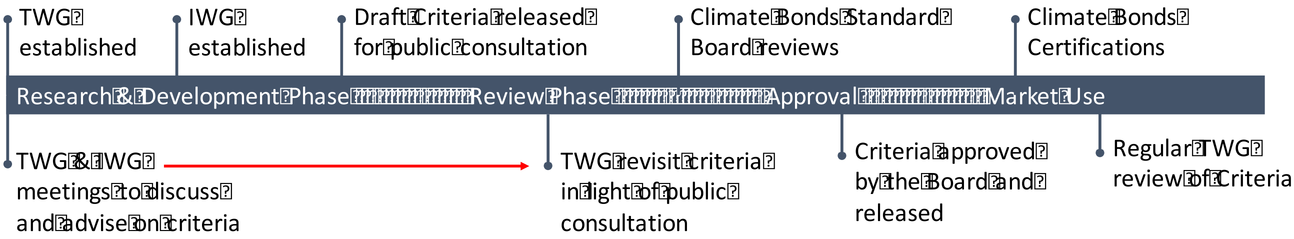
[9] https://www.mckinsey.com/business-functions/sustainability/our-insights/the-economic-transformation-what-would-change-in-the-net-zero-transition

mitigation point of view. It is made up of the overarching CBS detailing management and reporting processes, and a set of Sector Criteria detailing the requirements assets must meet to be eligible for certification. The Certification Scheme requires issuers to obtain independent verification, pre- and post-issuance, to ensure the bond meets the requirements of the CBS.

Existing Sector Criteria cover solar energy, wind energy, marine renewable energy, geothermal power, buildings, transport (land and sea), biofuel production, forestry, agriculture, waste management and water infrastructure. In addition to Steel, additional Sector Criteria currently under development include Basic Chemicals and Cement. Criteria are available at www.climatebonds.net/standards/sector-criteria.

1.5 Process for Sector Criteria Development

The CBS has been developed based on public consultation, road testing, and review by the Assurance Roundtable (a group of verifiers) and expert support from experienced green bond market participants. The Standard is revisited and amended on an annual basis in response to the growing green bond market. Sector specific Criteria, or definitions of green, are developed by TWG made up of scientists, engineers, and technical specialists. Draft Criteria are presented to IWG before being released for public comment. Finally, Criteria are presented to the CBSB for approval (see diagram below).



1.6 Structure of this document

This document supports the Steel Criteria. It captures the issues raised and discussed by the TWG, as well as the arguments and evidence in support of the Criteria. It is structured as follows:

- **Section 2** provides a brief overview of the sector, its current status, trends and role in mitigating and adapting to climate change.
- **Section 3** outlines the guiding principles i.e. differentiating between criteria for Use-of-proceeds bonds and criteria for general corporate purposes bond; describes the overarching considerations for setting the criteria; describes the process of selecting an emissions pathway for steel, the eligible scope and provides an overview of the criteria.
- **Section 4** describes the rationale behind the mitigation requirements.
- **Section 5** describes the rationale behind the adaptation and resilience requirements.

2 Sector Overview

2.1 What is Steel?

Steel is the third most abundant man-made bulk material on earth, exceeded only by cement and timber. Currently almost two billion tons of steel are produced annually[10]. Steel is manufactured and used all over the world, in everything from infrastructure to vehicles, wind farms and packaging. It is a low margin, highly traded commodity in a fragmented and highly competitive global industry.

On a regional basis, the largest producer by far is Asia, accounting for 72% of crude steel made in 2019. The EU and North America follow at 8% and 6%, respectively. On an individual country basis, production is concentrated in China (53%), India (6%), Japan (5%), the United States (5%) and Russia (4%)[10]. Production capacity for crude steel has doubled since 2000; three-quarters of that growth was in China[11].

Steel Production:

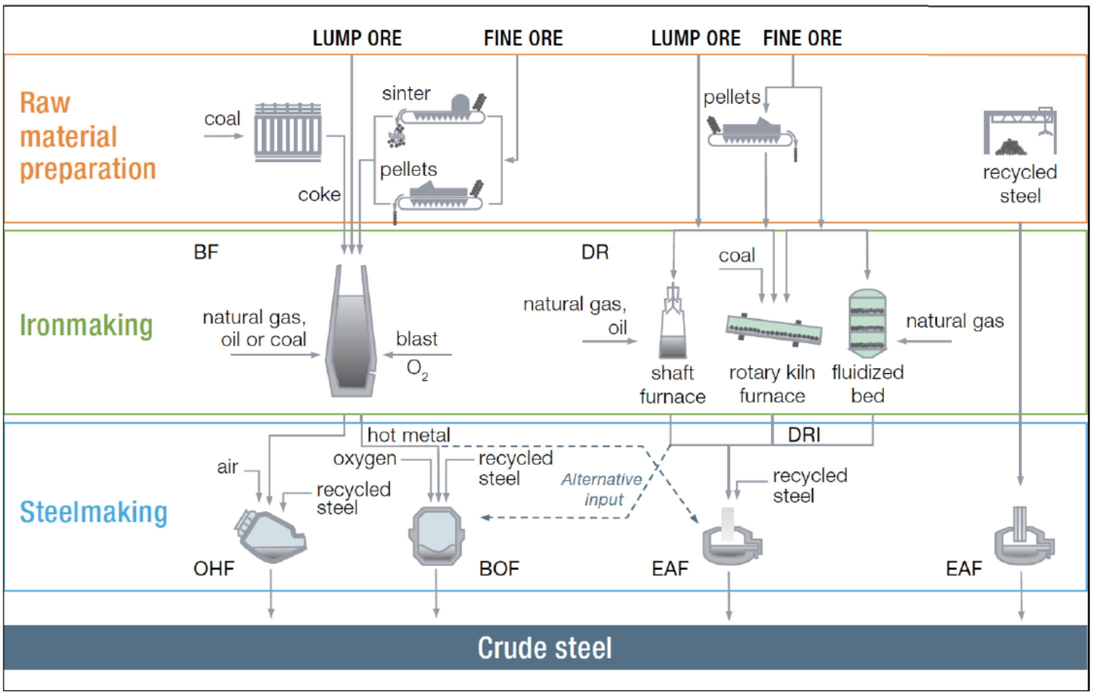


Figure 1. Steelmaking production routes (Source: World Steel Association)

There are two main ways of producing steel depicted in figure 1, using either primary or secondary sources. To produce steel from primary sources it is necessary to chemically reduced iron ore first. In the case of steelmaking using secondary sources this is done by directly melting recycled steel scrap. Primary and secondary sources can be used in combination at different rates in the main steelmaking processes that we will further describe in this section.

The steel sector is the largest global consumer of coal, which provides almost 75% of its energy demand and is used to make coke, which is instrumental in the chemical reactions necessary to produce steel from iron ore[12].

[10] World Steel Association (2020), Steel Statistical Yearbook; 2020 concise version
[11] IEA (2020b), Clean Energy Innovation, IEA, Paris https://www.iea.org/reports/clean-energy-innovation
[12] International Energy Agency (2020a), Iron and Steel Technology Roadmap: Towards more sustainable steelmaking, IEA, Paris

Global production is dominated by the Blast Furnace and Basic Oxygen Furnace (BF-BOF) route that represents 72% of total production it is used to make mainly what is known as "primary steel". The process involves using high grade (metallurgical) coal as both an energy and heat source and as a reduction agent to remove oxygen from the iron ore. The BOF stage also involves the addition of other feedstocks in small quantities of other to reach the required steel quality[13].

There is also an alternative way to produce steel by feeding an Electric Arc Furnace (EAF) with either recycled steel or by Direct Reduced Iron (DRI). Estimates tell us that around 83% of steel produced is reused at the end of its life and section 3.3.4 gives more details regarding the use and availability of scrap. This steel scrap is then fed into the EAF to produced what is known as "secondary steel" and represents 23% of total steel produced[14].

The EAF can also produce steel combining scrap with iron produce with the Direct Reduction (DR) method. The DRI furnaces reduces iron ore using carbon monoxide and hydrogen, traditionally these two reducing agents are derived from natural gas or coal. Steel produced from a combined DRI-EAF route accounts for 6% of total steel produced. The DR-grade iron ore pellets used in this steelmaking method (usually 67% iron ore or more) originating mainly from South America (Brazil, Chile), Canada, Sweden, Bahrain, Oman and Iran[15].

2.2 Future of Steel

Low-carbon steel can be produced today using the EAF route, however the actual amount of scrap available globally is estimated to only be able to provide around a third of total steel demand[16]. By 2050, IEA modelling shows that under the Stated Policies Scenario (as well as the Sustainable Development Scenario), the share of secondary steel could rise to 45%, whilst overall steel demand increases 40% to 2,535 Mt[17]. The trend of increasing global steel demand that is forecasted lets us conclude that significant primary production will still be needed even if secondary production is maximized, this is described further in section 3.3.4. What this tells us about the future of steelmaking is that to produce low carbon steel, the DRI-EAF route will be needed but switching from fossil gas to green hydrogen to reduce the iron ore will be key[18].

Production in China is predicted to peak in 2025 and decline towards the national goal of net-zero by 2060 while production in India is expected to more than quadruple in the next 30 years. Differences in established production technologies shown in figure 2 and energy infrastructure are major determinants of current carbon intensity and subsequently the decarbonization pathways to be pursued at the regional level.

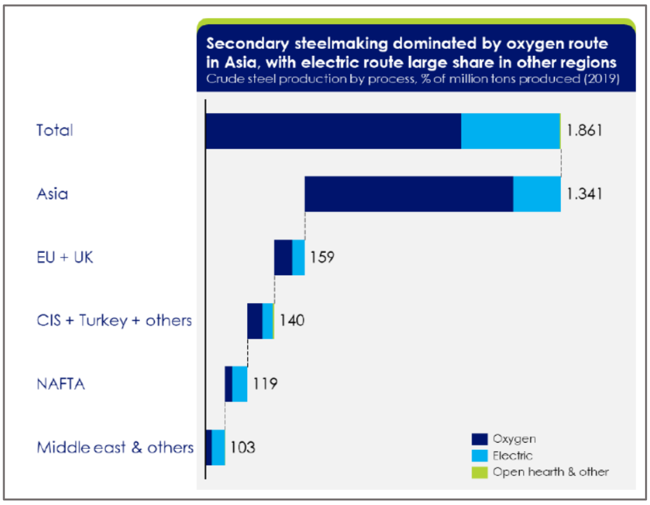


Figure 2. Steel production routes used by region (Source: The World Steel Association, 2020 World Steel in Figures)

[13] IIGCC (2021), Climate Action 100+, Global Sector Strategies: Investor interventions to accelerate net zero steel report, London. Available at: https://www.iigcc.org/resource/global-sector-strategies-investor-interventions-to-accelerate-net-zero-steel/
[14] ibid
[15] ibid
[16] The Circular Economy: a powerful force for climate mitigation, Material Economics, 2018.
[17] IEA, October 2020, Iron and Steel Technology Roadmap, available at: https://www.iea.org/reports/iron-and-steel-technology-roadmap
[18] Ibid and Steel Climate-Aligned Finance Working Group Pre-Read and Reference Document, RMI, 2021

Another important aspect to consider is the of the current steel production assets, these can operate for up to 50 years and their highly integrated nature means that change in one part of the process affects the others. This poses both challenges but also opportunities as the steel capacity in many countries will reach the end of its investment cycle before 2030, and the total global steel capacity will also reach an investment cycle end by 2050, this tells us what the limits and opportunities for producers are to invest in transition and avoid locking-in heavy emitting technologies[19], we go deeper into this topic in section 3.3.3.

2.3 Climate change and main decarbonization challenges for steel

The manufacture of steel (and its primary ingredient, iron[20]) is also a prolific contributor to global greenhouse gas (GHG) emissions. Steel industry emissions in 2019 reached 3.6 GtCO2 which represents around 9% of total energy sector emissions[21]. Looking at the emissions in detail, burning coal is responsible for most of the direct (scope 1) emissions of the sector (62%), this is followed by indirect (Scope 2) emissions (27%) from imported and onsite electricity and heat generation[22]. The traditional BF-BOF process is responsible for almost 85% of the scope 2 emissions with most of it released during the BF stage. Another smaller part of this scope 1 emissions (8%) is released during material preparation process also for the BF BOF process in coke preparation and the use of lime. The final addition is the emissions generated upstream and downstream of the process, mostly iron ore extraction and transport, which accounts for 3% of the total and brings up the total steel supply chain emissions to 3.7 GtCO2[23].

As Figure 3 shows, there is a lot of variability in the emissions intensity of different production routes. While the BF-BOF production which is reliant on coal use emits 2.3 tCO_2 /tonne of steel, scrap- EAF can reach lower levels of emissions, particularly when using low carbon energy, and has a global average of around 0.7 tCO_2/tonne.

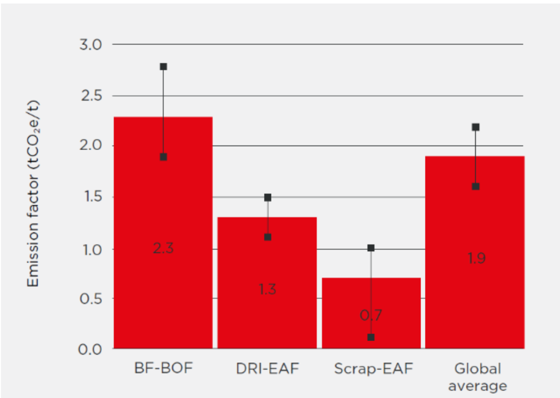


Figure 3. Global average intensity by production process[24] (Source: IIGCC)

The IIGCC in their Global Sector Strategies report for steel did the exercise of calculating a Business-as-Usual (BAU) scenario that showed that following current emissions growth rates (1% per year) without any material or energy efficiency improvements, or any shift away from BF-BOF to EAF or use of CCS/CCUS, emissions from steel could rise to 4.8 $GtCO_2$ by 2050. While this scenario is increasingly unlikely (some shift away from BF-BOF is almost certain given the rising volume of available scrap) it represents a convenient baseline to judge the impact of decarbonisation measures and the expectations from other scenarios[25].

[19] Steel Climate-Aligned Finance Working Group Pre-Read and Reference Document, RMI, 2021
[20] Although the main component of steel is iron, and it is the processing of iron that is the source of most GHG emissions in the manufacturing of steel, the iron and steel sector is typically referred to as, simply, steel
[21] IEA, Energy Technology Perspectives 2020. https://webstore.iea.org/download/direct/4165
[22] IEA, October 2020, Iron and Steel Technology Roadmap, available at: https://www.iea.org/reports/iron-and-steel-technology-roadmap
[23]Ibid
[24] From IIGCC: 2018 global scope 1 & 2 emission intensity factors used based on a variety of sources with data screened to ensure consistency of emission boundary
[25] ibid

The latest scenario modelled by the IEA for the steel sector, aims at reaching net zero by 2050 in a trajectory compatible with a 1.5°C global warming scenario. In the model, the scope 1 emissions of the steel industry fall by 29% from 2019 (2.5 GtCO2e) until 2030 and by 91% by 2050[26]. The assumptions that underpin this pathway include the contribution of available technologies such as increasing the proportion of steel produced from secondary sources, in addition to energy and material efficiency improvements to achieve 85% of the 2030 emissions reduction goals[27]. After 2030, most reduction goals are achieved by implementing advanced technologies such as CCS/ CCUS and hydrogen based DRI. Scope 1 emissions captured using CCS/CCUS rises from 0.1 GtCO2e in 2030 to 0.7 GtCO2e. [28]

2.4 Investment need

The IIGCC in its Global Sector Strategy report for Steel (2021), identifies the following key measures for the sector to reach net zero by 2050:

1. Increasing the proportion of steel produced by the scrap-EAF process
2. Enhancing material efficiency to limit steel demand growth
3. Further incremental improvements in energy efficiency of existing steel production capacity
4. Investing in (low emission) DRI-EAF capacity for primary steelmaking
5. Adapt CCS/CCUS technology to fossil-based steel production plants when technically and economically feasible.

Implementing these measures relies on a concerted effort from all stakeholders and also in the availability of capital. According to estimates made by the IIGCC, the total capex required for DRI globally might be at least $650bn and the incremental spending (i.e. the outlay above the cost of BF-BOF capacity) might be more than $400bn (excluding any additional investment needed in energy infrastructure). In addition, investment in CCS/CCUS will also be needed. Assuming the industry needs to capture 0.7 GtCO2e annually and applying an estimated capital cost of $400 per tCO2e, suggests that at least a $250bn will be needed for CCS/CCUS capex.[29]

Zero-carbon steel is technologically possible but relatively expensive, and deployment requires commercial-scale development and coordination across the value chain. The financial sector will play a critical role in this transition given the capital intensity of production and the role of lending within the investment, maintenance, and retirement cycles of production infrastructure. Identifying the cost benefit of retrofitting existing assets against investing in new zero-carbon production processes will be a challenge for steel producers without policy support, a clear demand signal, appropriate financing, and support from the financial community

[26] International Energy Agency, Net Zero by 2050, IEA, 2021.

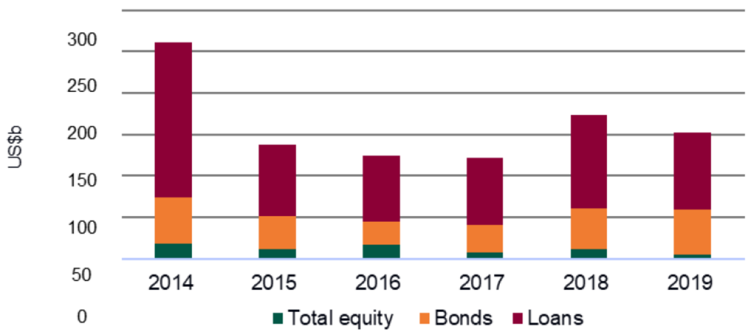
[27] IIGCC (2021), Climate Action 100+, Global Sector Strategies: Investor interventions to accelerate net zero steel report, London. Available at: https://www.iigcc.org/resource/global-sector-strategies-investor-interventions-to-accelerate-net-zero-steel/

[28] ibid

[29] ibid

2.5 Deals already seen in the sector

Bondholders have a key role to play in decarbonising the Steel industry, as shown in Figure 4, bonds make up a considerable piece of the financing mix of the sector. This is therefore an active market for the steel sector with the potential for high impact through setting Climate Bonds criteria such as these.



Source: Refinitiv (2020)

Figure 4. Capital raising in the steel sector[30]

The first steel company that issued an ESG bond was POSCO[31], this was a combination of a green and a social bond and marked the start of the industries' interest on integrating sustainability into their strategy to raise capital as shown in the other examples on figure 5.

Historically, heavy emitting sectors such as steel did not see a lot of issuances of green bonds, given the difficulty in identifying assets and projects compatible with green principles in the sector. Green bonds are asset-linked which means that funds (or use-of-proceeds) are earmarked for specific disclosed assets or projects. As an alternative to the use-of-proceeds bond instrument, transition bonds emerged more recently but have attracted a mixed reception targeted at their environmental credentials[32].

[30] Refinitiv (2020), from the Steel Climate-Aligned Finance Working Group (CAF) Pre-read reference document.

[31] POSCO, *POSCO Becomes the First-Ever Steelmaker to Issue ESG Bonds,* retrieved on February 2022 from: https://newsroom.posco.com/en/posco-issues-esg-bonds/

[32] NN Investment Partners, *Sustainability-linked bonds: a viable alternative for green bonds?,* Retrieved March, 2022 from: https://www.nnip.com/en-INT/professional/insights/articles/sustainability-linked-bonds-a-viable-alternative-for-green-bonds

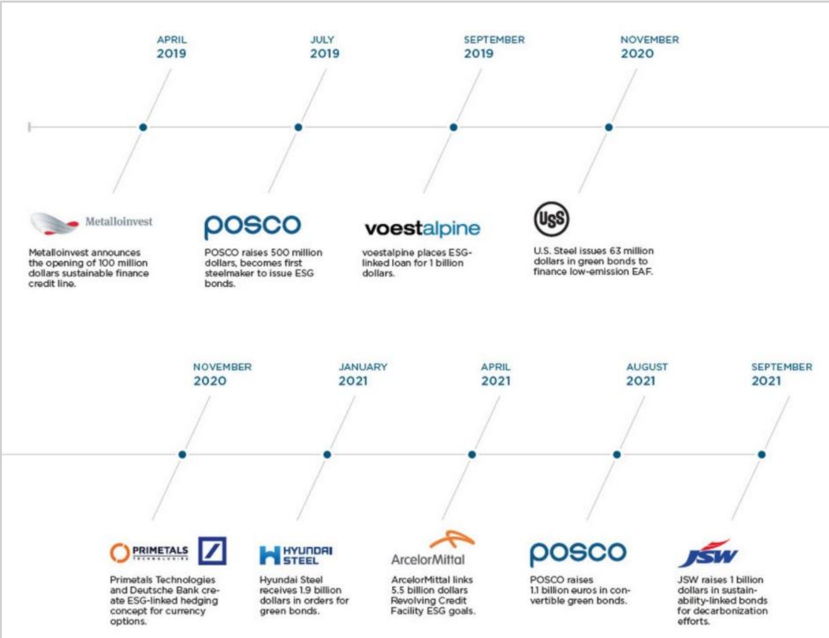


Figure 5: Timeline of steel companies use of sustainable finance[33]

In recent years there has been a noticeable rise in the issuance of so-called 'behaviour-based finance agreements' including Sustainability-Linked Bonds (SLBs) which are receiving high levels of interest from steel companies. The International Capital Market Association defines SLBs as any type of bond instrument for which the financial and/or structural characteristics can vary depending on whether the issuer achieves predefined sustainability or ESG objectives. It is a forward-looking performance-based instrument with a flexible structure. Entities that issue SLBs can set key performance indicators (KPIs) which are aligned with their sustainability strategies. It allows the issuer to set more general, overarching sustainability goals, rather than being tied to financing specific projects like building a low emissions plant or implementing an emissions mitigation technology.

JSW issued the first SLB by a steel company in September 2021, thus far (at time of writing) all bonds issued by steel companies in the sustainability finance domain have been SLBs (see summary in Table 1), which can prove to be valuable case studies for future entity-level criteria. They vary in the scope and ambition of environmental objectives linked to their bond structure, and we already see examples of emissions intensity (KgCo2/t crude steel) used as key metric.

Table 1. Examples of recent notable deals in the Steel sector.

[33]Deutsche Bank AG, *Funding a zero-carbon future for steel*, retrieved March, 2022 from: https://flow.db.com/more/esg/funding-a-zero-carbon-future-for-steel

Issuer	Year	Description	Credentials
Guangxi Liuzhou Iron & Steel Group Co Ltd (China)	2021	CNY200M Sustainability-linked bond, with a term of 2+1 years and a coupon rate of 4.1%. It is linked to a Nitrogen Oxide Emissions Intensity target of 0.935 kg/t product from a 2020 baseline of 1.123 kg/t product.	Lianhe Equator EIA Co., Second Party Opinion
SSAB AB (Sweden)	2021	SEK2B Sustainability-linked bond. Tied to the KPI and target "reduction of absolute Scope 1 and 2 GHG emissions by 35% by 2032" from a 2018 baseline. Subject to penalty of a coupon rate step-up or an increase in the bond redemption price at maturity if target is not achieved. Target is aligned with the Paris Agreement's goal of keeping global warming to well-below 2°C	Sustainalytics, Second Party Opinion
Shandong Iron & Steel Group Co Ltd (China)	2021	CNY1B Sustainability-linked bond. Tied to achieving an energy intensity KPI of 592.00 kg ce/t from a 2020 baseline of 604 kgce/t by 2024. (Not linked to a coupon step up, check mandatory early redemption)	CCXGF Second Party Opinion
Baoshan Iron & Steel Co Ltd (China)	2021	CNY5B Sustainability-linked bond with a Nitrogen Oxide Emissions Intensity KPI that should not exceed 0.63 kg/tcs from the 2020 baseline of 0.67 kg/tcs. If the target id not met by the third year a coupon step up is included.	CCXGF Second Party Opinion
JSW Steel Ltd (India)	2021	USD500M Sustainability-linked bond. Tied to the KPI GHG Emissions Intensity (Scope 1 & 2) reduction of 23% for its three integrated steel plants. This is to reach a target of 1.95 t CO_2/tcs in 2030 from a 2020 2.52 tCO_2/tcs baseline (compatible with IEA SDS). If the company is not able to meet these targets the pricing on the bonds will be stepped up by 37.5bp for its residual life.	DNV GL Second Party Opinion
Anshan Iron And Steel Group Co Ltd (China)	2022	CNY2B Sustainability-linked bond, tied to an energy intensity target of 565 kg standard coal/t from a 584 kg standard coal/t 2020 baseline. If the target is not met a coupon step up will kick in in 2022.	CCXGF Second Party Opinion

3 Principles and Boundaries of the Criteria

3.1 Guiding Principles

The objective of CBI has been to develop steel sector criteria that can maximize viable bond issuances with verifiable environmental and social outcomes. This means the Criteria need to balance the following objectives:

- They form a set of scientifically robust, ambitious and verifiable targets and metrics; and
- They are usable by the market, which means they must be understandable for non-scientific audiences, implementable at scale, and affordable in terms of assessment burden.

The Criteria should:

- Enable the identification of eligible assets and projects (or use of proceeds) or entities or companies (general corporate purposes) related to steel investments that can potentially be included in a Certified Climate Bond;
- Deploy appropriate eligibility Criteria under which the assets and projects or entity can be assessed for their suitability for inclusion in a Certified Climate Bond; and
- Identify associated metrics, methodologies and tools to enable the effective measurement and monitoring of compliance with the eligibility Criteria.

Given that a number of protocols relevant to steel already exist (see Appendix 2), the TWG has taken care not to reinvent the wheel, but rather draw from these existing protocols and guidance.

The Steel Criteria are split into two distinct subsets, depending on the financial instrument being certified:

1. Use-of-Proceeds bonds (for example, green bonds)
2. General Corporate Purpose bonds (for example, Sustainability-Linked Bonds)

Each subset of criteria may share common requirements, pathways or metrics but require different demonstrations of compliance. Currently, these Criteria can only certify Use-of-Proceeds bonds which involve investments at the asset and activity level. On the other hand, for the purpose of certifying general corporate purpose bonds (e.g. SLBs) criteria for investments at the company level is expected to follow soon after. The following sections will make distinction between the guiding principles for certifying assets and activities (section 3.1.1), and the hallmarks for transition that guide criteria for general corporate purpose bonds (described in section 3.1.2).

3.1.1 Guiding principles – Use-of-Proceeds bonds

The guiding principles for the design of the Steel Criteria, which is a standard approach for all CBI criteria are summarised in

Table 2.

The Steel Criteria are made up of two components, both of which need to be satisfied for assets to be eligible for inclusion in a Certified Climate Bond. These are as follows:

1. Climate Change Mitigation Component – addressing whether the asset or project is sufficiently 'low GHG' to be compliant with rapid decarbonisation needs across the sector - see Sections 3 and 4 of the criteria document for details.
2. Climate Change Adaptation and Resilience Component – addressing whether the facility is itself resilient to climate change and furthermore not adversely impacting the resilience of the surrounding system. This encompasses a broad set of environmental and social topics – see Section 4.4 of the criteria document for details.

Table 2. Key principles for the design of Climate Bond Standard Sector Criteria

Principle	Requirement for the Criteria
Ambitious	Compatible with meeting the objective of limiting global average warming to a 1.5ºC temperature rise above pre-industrial levels set by the Paris Agreement.
Material	Criteria should address all material sources of emissions over the lifecycle. Scope 1 & 2 emissions should be addressed directly and scope 3 considered.
No offsets	Offsets should not be counted towards emissions reduction performance.
Resilient	To ensure that the activities being financed are adapted to physical climate change and do not harm the resilience of the system them are in.
Scientifically Robust	Based on science not industry objectives.
Granular	Criteria should be sufficiently granular for the assessment of a specific project, asset or activity. Every asset or project to be financed must comply.
Globally consistent	Criteria should be globally applicable. National legislation or NDC's are not sufficient.
Aligned	Leverage existing robust tools, methodologies, standards.
Technology neutral	Criteria should describe the result to be achieved.
Avoid lock-in	Avoid supporting development that may result in long term commitments to high emission activities.

3.1.2 Guiding principles – General Corporate Purpose bonds

Climate Bonds' focus to date has been Use of Proceeds (UoP) bonds but it is our intention to certify instruments beyond UoP, including corporate SLBs and similar (e.g. Sustainability Linked Loans - SLLs). This will allow us to provide guidance to issuers and assurance to investors around the credibility of those instruments, which can at present prove difficult to evaluate due to lack of consistency in approaches and metrics used by each issuer. This will require assessment both of the company's transition KPIs, and their ability to deliver on their targets. Such certification would follow the requirements set for UoP bonds, namely a standardised, common rule set, binary assessment, simplicity, transparency, and science-based criteria.

Nonetheless, the two subsets of criteria share many of the same guiding principles. The Climate Bonds Initiative sets out the following as key principles for setting entity level criteria:

- Science based.
- Testable.
- Relatively simple.
- Not reinvent the wheel.
- Consistent over time and companies.

Rather than the two components for green (mitigation and adaptation & resilience), the Climate Bonds Initiative has proposed five hallmarks for transition that are relevant to entities, these are summarized in Figure 6.

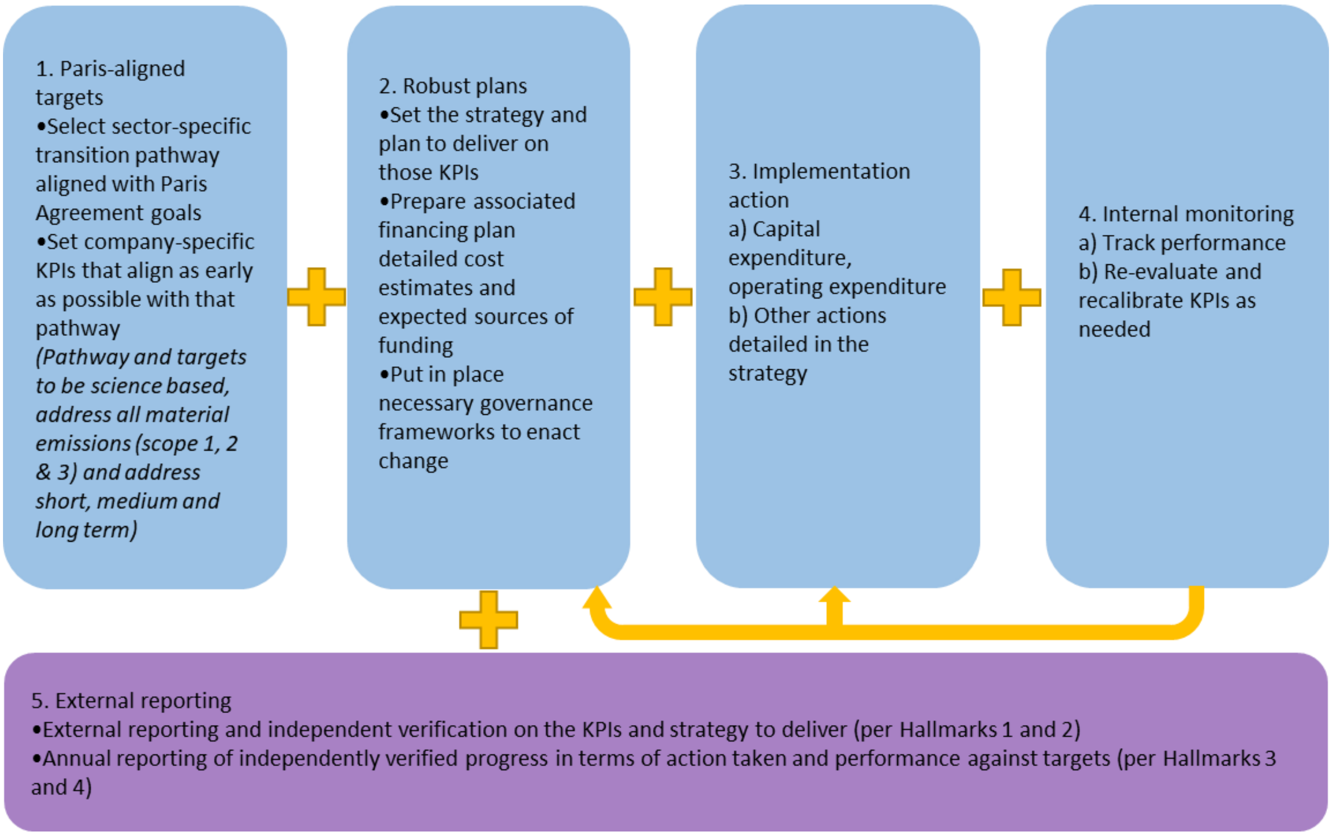


Figure 6. The Hallmarks of a credibly transitioning company

3.2 Assets and Activities Covered by these Criteria

The steel criteria set out requirements to certify potential investments in specific mitigation projects within an asset or facility, as well as in the entire asset or facility that produce steel or iron. Facilities that can be certified by the criteria include integrated steelmaking plants, scrap based Electric Arc Furnace (EAF) facilities, DRI-EAF production line and also DRI facilities.

The way these criteria have been set out is to focus on investments related to the main processes used to produce iron and steel, namely the plants where either a BF, DRI or EAF is present. This means that investments solely focus in mining[34] and facilities that are only dedicated to produce some of the raw material needed in the iron and steel production (e.g. coke, iron ore pellets, lime) are not eligible for certification as well as assets only dedicated to downstream activities such as rolling, and finishing. This is because the thresholds and other requirements established in the criteria are designed to account for the processes needed to produce iron and steel as a whole (as shown in figure 7). The same requirements cannot be used to certify separate pieces of the process, particularly when these facilities are located in premises where the main economic activity is not the production of iron and steel.

Steel scrap collection and sorting assets and activities are currently out of scope. The TWG discussions did not go in depth on this segment of the supply chain. According to the few discussions on the subject, held with members of the TWG and IWG, there are great variations in the way scrap is collected and sorted around the world. The literature suggests that there is a big opportunity for growth in this area especially in developing nations[35]. This activity could play a role in the CO_2 emissions mitigation of the sector due to the importance of increasing steel

[34] Integrated steel plants which are directly connected to a mine are still within scope.

[35] Xylia, M., Silveira, S., Duerinck, J., & Meinke-Hubeny, F. (2018). Weighing regional scrap availability in global pathways for steel production processes. Energy Efficiency, 1(5), 1135–1159. https://doi.org/10.1007/s12053-017-9583-7

recycling to the decarbonization of the sector explained in detail in the next section, hence, this activity shall be added as an update in the next revision of the criteria.

Stainless and high alloy steels production and associated activities are out of scope[36]. The first reason to prioritize the publication of criteria for steel above stainless is its market size. Stainless steel production in 2020 was 50.9 Mt[37] which means only 2.7% of total steel production for the same year (1878 Mt of steel[38]). Another reason is that there is an acute need to rapidly decrease the emissions of industrial sectors to avoid catastrophic climate change. A wider scope of activities would be more time-consuming because the particular challenges of this industry would render specific benchmarks and criteria to be set for the sector. Focusing on steel means a tool for the market will be available quickly, allowing certifications to speed up progress in the sector. Crucially, this does not mean the stainless-steel industry will never be the focus of Climate Bonds sector criteria. Such criteria could address these additional opportunities further down the line.

3.3 Overarching Considerations

3.3.1 Scope of emissions – Fixed Boundary Approach

Because of the highly fragmented nature of the steel industry, requesting companies to just account for scope 1, 2 and 3 emissions is not a practical approach when looking to set credible targets or calculating the product's carbon intensity. The scope of emissions of steel companies is affected by multiple variables including the company's ownership of different parts of the production process and the level of vertical integration. This variability causes inconsistent reporting across the industry[39].

To overcome this issue The Net-Zero Steel Pathway Methodology Project (NZSPMP) convened by a group of industry stakeholders together with the World Steel Association, recommends adopting a fixed system boundary approach. The idea is that the emissions intensity of steel shall be calculated by counting the contributions from a fixed set of processes, whether they represent scope 1, 2 or 3 for the reporting company. This is also a way to prevent companies shifting their assets, favouring the less emitting parts of the process, to avoid including those with higher emissions in their emissions disclosure[40].

The system boundary shown in Figure 7[41] follows these principles. The boundary includes raw materials and reductants preparation, steelmaking, casting, hot rolling and also auxiliary processes like the use of process gases to produce electricity. Upstream processes like iron ore mining and transport (upstream and downstream) are considered outside of the system boundary and don't need to be accounted for.

[36] Being outside of the scope of criteria does not indicate that the TWG view these assets and activities as inconsistent with meeting Paris Agreement goals or with a Paris-aligned economy. Rather, at this stage these Criteria do not take a stance on these issues. Future versions of the Steel Criteria may address these and set robust criteria alongside.

[37] International Stainless Steel Forum (ISSF) https://www.worldstainless.org/statistics/stainless-steel-meltshop-production/stainless-steel-meltshop-production-2014-2020/

[38] World Steel Association https://www.worldsteel.org/steel-by-topic/statistics/annual-production-steel-data/P1_crude_steel_total_pub/CHN/IND

[39] The Net-Zero Steel Pathway Methodology Project (2021),Final Report and Recommendations: https://www.netzerosteelpathwayproject.com/

[40] Ibid.

[41] Based on the work by the Steel Climate-Aligned Finance Working Group (CAF) facilitated by the Rocky Mountain Institute (RMI)

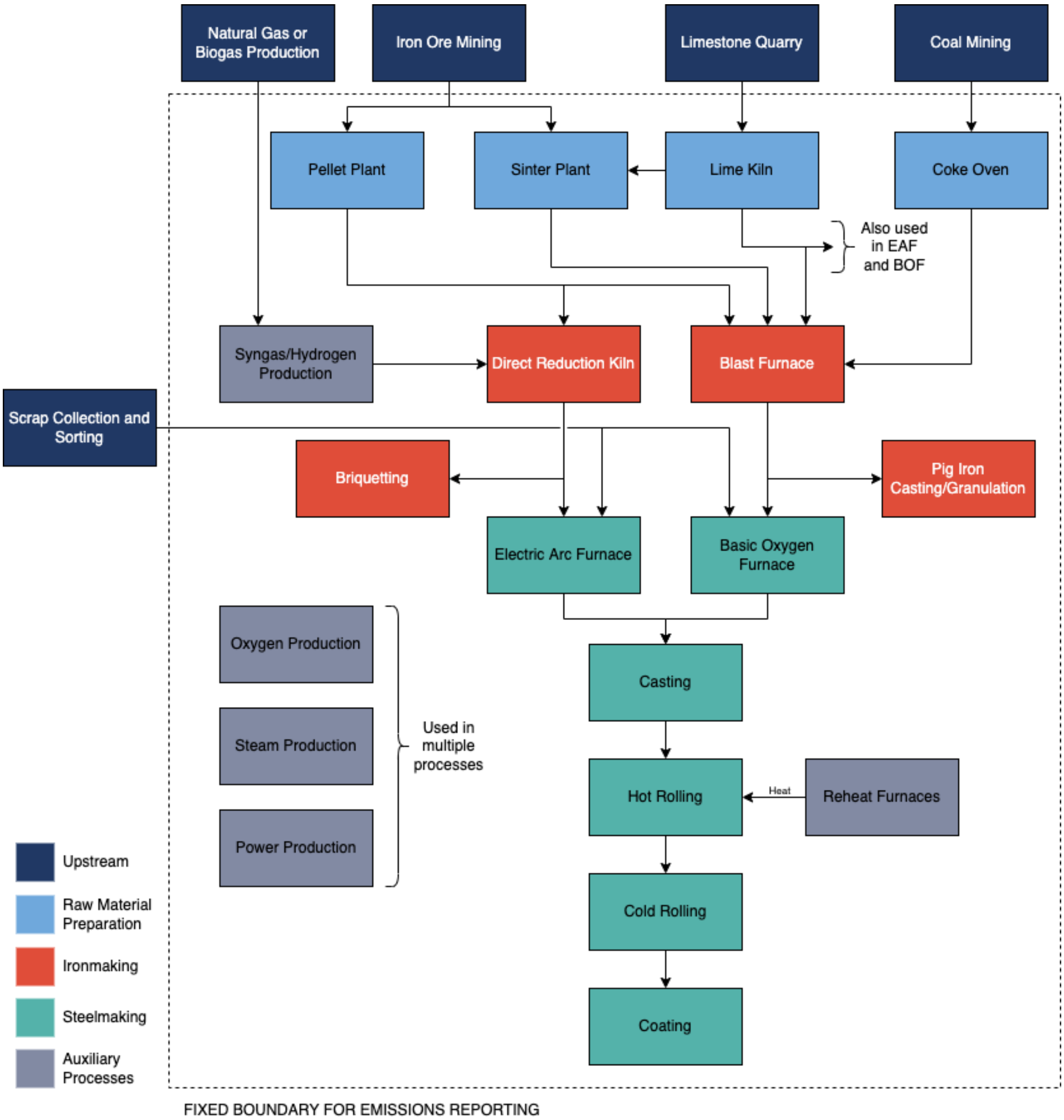


Figure 7 . Fixed system boundary for steel emissions.[42]

3.3.2 Differentiating between primary and secondary steel production:

The existing steelmaking routes explained in previous sections involve the use of two main material sources: primary and secondary. Primary sources of steel refer to iron ore that needs to be processed to separate the iron from the oxygen that is present in its natural iron oxide state. On the other hand, secondary sources of steel don't need to go through this processing because it refers to recycled steel, collected from pre-consumer and post-consumer sources of iron and steel scrap that can be remelted in an EAF to produce steel[43].

[42] Provided by RMI's Climate Aligned Finance Steel Working Group.
[43] The Net-Zero Steel Pathway Methodology Project (2021),Final Report and Recommendations: https://www.netzerosteelpathwayproject.com/

In the previous section the stark difference between the CO_2 emissions of different production routes has been highlighted. The main reason for this is that a lot of energy is needed for the chemical reaction that reduces iron ore when on the other hand, scrap is already in the metal state.

Furthermore, steelmaking methods cannot be strictly separated into primary and secondary "routes" of production, because in practice, the main production routes can use different amounts of primary and secondary inputs. Figure 8 summarizes this, while the EAF can use up to 100% of secondary inputs, the BOF can take up to about 30%.

To set CO_2 emissions targets, we have adopted the approach recommended by the Net-Zero Steel Pathway Methodology Project (2021) that advice that steel makers should set two different emissions reduction targets, based on the amount of primary and secondary inputs used in the production of steel. For these criteria this means that the carbon budget used to set the decarbonization pathway (further explained in section 3.4), has been divided in 2, to account for the difference in the level of emissions intensity that results from varying the rates of primary and secondary inputs used. The way in which the emissions reduction trajectory was set has been developed by the Rocky Mountain Institute under the work of the Climate Aligned Finance Steel Working Group and is described in part 3.4 of this document.

In the criteria when referring to primary and secondary steel, these are defined as:

Primary steel: refers to the production of steel using iron products that have been obtained from the reduction of iron ore. This includes pig iron, hot briquetted iron (HBI) and direct reduced iron (DRI).

Secondary steel: refers to the proportion of steel produced using steel scrap[44].

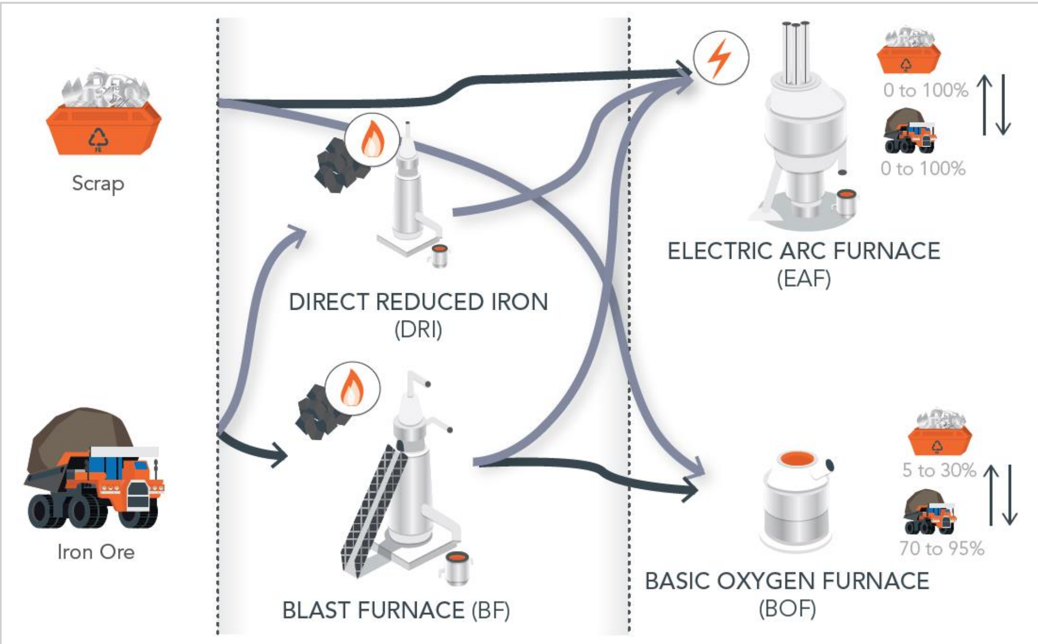


Figure 8. Use of primary (iron ore) and secondary (scrap) inputs in different steelmaking routes

3.3.3 Distinctions in criteria between new and existing production facilities

The criteria distinguish between criteria for investments on new facilities and on existing ones.

Considering the lifetime of most steel plants, it is important to avoid the lock-in of certain technologies that do not deliver the sufficient emissions reductions, keeping in mind that most new plants built today will still be

[44] The Net-Zero Steel Pathway Methodology Project (2021),Final Report and Recommendations: https://www.netzerosteelpathwayproject.com/

online in 2050. There are already low carbon steel production technologies available, and it is expected that more will become commercially ready before and beyond 2030. Since steel production facilities can operate for many years, new facilities should already be built with CO_2 emissions mitigation technologies in place or avoiding CO_2 generation entirely by limiting the use of fossil fuels[45].

On the other hand, when looking at existing facilities, we aim at avoiding investments that would lock-in heavy emitting technologies, without overlooking those producers that will make credible efforts to reduce their current emissions. BFs can add additional 15 to 20 years to their service life after a relining, that takes place typically after 20 years of operation[46]. Adding relining to the count, it is estimated that a BF-BOF production line can stay in service for as long as 50 years. Studies tell us that around 71% of steel's global coal-based capacity will require reinvestment by 2030. This presents the opportunity for steel producers to either invest in relining and risking locking-in assets that are not compatible with a 1.5°C pathway or switching to alternative technologies aligned with decarbonizing the industry[47].

Consequently, we have limited the age of existing BF that can get certification on investments to improve energy efficiency (subject to meeting the criteria) to only those that started operation from 2007, these are highlighted by a blue shade in Figure 9. The principle behind this is to allow "newer" facilities that are still not going for relining (because they have not reached the relining age yet), to lower their emissions and reach the emissions intensity targets shown in Figure 11 before 2030 by implementing a bundle of mitigation measures. These investments in emissions reduction in "newer" facilities can only take place until 2030, which is before the asset reaches the relining age. After 2030, these facilities need to decarbonize more aggressively according to the pathway in Figure 11. Whereas older facilities, that should in any case, get a significant investment in relining, cannot qualify unless the investment will entail a major retrofit to reduce emissions by more than 50%. What this suggests is that, in line with what a number of decarbonization roadmaps state, BFs that don't retrofit to significantly mitigate carbon emissions with e.g. CCS by 2030, will most likely become stranded assets.

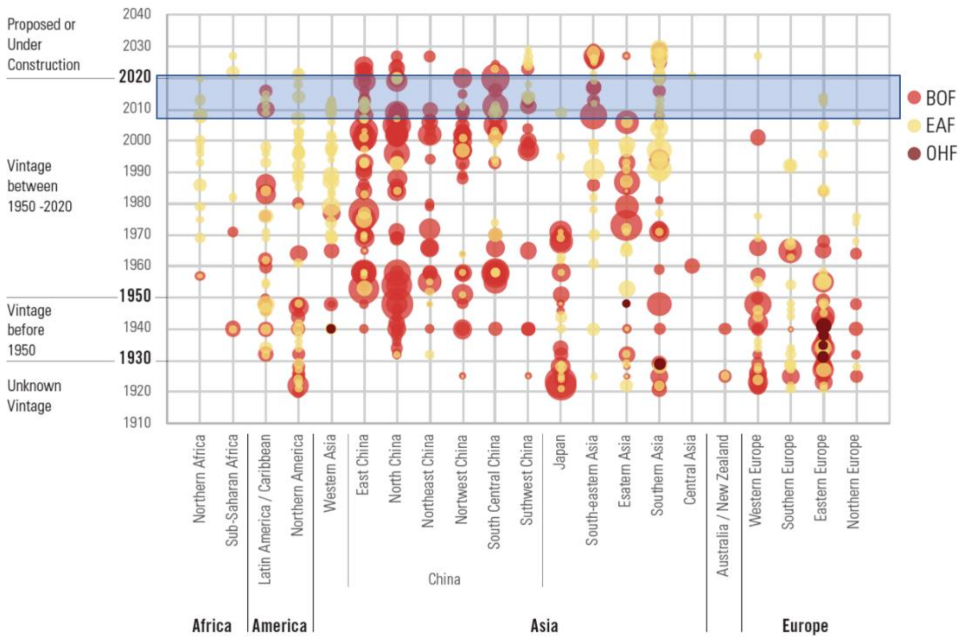


Figure 9. Global steel production in 2019 by type and era of build according to data from the GEMs database. The blue shades has been added to highlight the range of BOF facilities(in red) that have been built after 2007 and are eligible for certification subject to meeting the criteria (Adapted from: Bataille et al.[48])

[45] International Energy Agency (2020), Iron and Steel Technology Roadmap: Towards more sustainable steelmaking, IEA, Paris

[46] ibid

[47] Agora Industry, Wuppertal Institute and Lund University (2021): Global Steel at a Crossroads. Why the global steel sector needs to invest in climate-neutral technologies in the 2020s.

[48] Bataille, C.; Stiebert, S., and Li, F. (2021), Global facility level net-zero steel pathways: technical report on the first scenarios of the Net-zero Steel Project, IDDRI. Available at: http://netzerosteel.org

3.3.4 Considerations regarding the use of scrap

Increasing circularity in the steel sector is one of the key measures to reduce the sector's emissions. This requires investments in boosting the share of steel produced with the scrap- EAF process and a concerted effort along the steel value chain to increase the proportion of recycled steel available particularly in markets where collection and processing schemes may not be well established yet. Three main measures were identified by Material Economics (2018) to improve steel's circularity, steel losses need to be minimized, secondary steel production processes need to improve to produce high quality steel and solutions need to be found to reduce scrap contamination particularly with copper[49]. Also it is important to

It is expected that the availability of scrap will increase in emerging markets like China and India[50] in the 2020s. Despite this, scrap supply relies on current infrastructure reaching their end of life, which tends to be long due to steel's high durability. There is variability in the amount of steel that will be produced from scrap according to various models, ranging from 40 to 56%[51], with the IEA Net zero by 2050 scenario estimating 46% of steel produced from scrap in 2050[52].

The models show us that recycled steel is a finite source that will not be enough to satisfy all steel demand by 2050, this is shown in the projections from Arcelor Mittal in figure 10, where nevertheless is shown that secondary sources can cover the increase in demand.

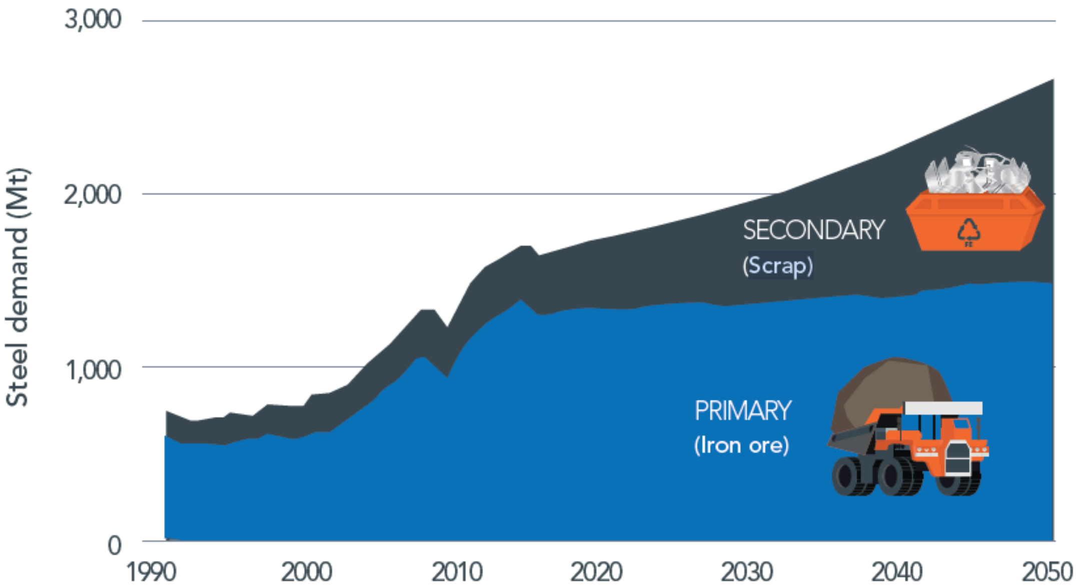


Figure 10. Projection of global steel demand to 2050 with split of primary and secondary production[53] (original source: ArcelorMittal).

Some issues that may arise from focusing the transition of the steel sector on increasing the use of secondary inputs only, have been identified by the industry as part of "The Net-Zero Steel Pathway Methodology Project". The initiative concluded that due to the limited global availability there are risk of scrap flowing to the regions of highest demand and leaving others to just focus on primary sources without overall emissions reduction; also the differences in supply would be exacerbated by the regional differences in climate policy and ambition.

[49] The Circular Economy: a powerful force for climate mitigation, Material Economics, 2018.
[50] Xylia, M., Silveira, S., Duerinck, J., & Meinke-Hubeny, F. (2018). Weighing regional scrap availability in global pathways for steel production processes. Energy Efficiency, 1(5), 1135–1159. https://doi.org/10.1007/s12053-017-9583-7
[51] IPCC, WG III contribution to the Sixth Assessment Report, 2021.
[52] International Energy Agency (2021), Net Zero by 2050, IEA, Paris.
[53] The Net-Zero Steel Pathway Methodology Project (2021),Final Report and Recommendations: https://www.netzerosteelpathwayproject.com/

As a consequence, these criteria attempt to cover the different possibilities available to decarbonize the sector, thus, incentivizes the use of scrap but it is not the only option available, and it is up to the issuer to invest in the option that best suits its regional conditions.

3.3.5 Addressing scope 2 emissions

The technological shifts that need to occur in the steel sector for its decarbonization also rely on the availability of renewable energy to power near zero technologies. Considering that these criteria attempt to incentivize investments in EAF, green hydrogen based DRI and electrolysis of steel, all heavily relying on grid electricity, it is important to note that for these technologies, the main source of emissions are those related to scope 2 or indirect emissions from purchased electricity. This means that the emissions factor of the grid (kg CO_2/kWh) plays an important role in the emissions intensity of these types of plant.

To address these emissions the TWG has agreed to request issuers to demonstrate the procurement for low carbon electricity to prevent carbon leakage and moving emissions from one part of the value chain to another. Thus, the criteria included the requirement for renewable-based captive power generation or renewable-based power purchase agreement. Renewable energy includes energy produced from renewable sources such as wind, solar, and small hydropower generation.

3.4 Setting an emissions pathway for Steel

The Steel sector needs to decarbonise its activities to align with the requirements of the Paris Agreement. How fast and by when, can be portrayed as a transition pathway. Steel companies that align their activities with such a transition with a clear plan could potentially achieve Climate Bonds certification. In line with the principles that govern how criteria are developed, transition pathways can be adopted from other initiatives where it is consistent in approach and developed through a high degree of scrutiny from academia and industry experts such as that developed by the Transition Pathway Initiative, the Science Based Targets Initiative (SBTi) and the Steel Climate-Aligned Finance ("CAF") Working Group.

Evaluating existing material for adoption as criteria requires that the chosen pathway and underlying methodology meets certain principles. For example, where possible it should:

- Be based on a robust methodology and stakeholder engagement
- Be aligned with an ambition level of limiting global warming to 1.5°C
- Be globally applicable, not based on regional data or standards
- Represent a level playing field for all stakeholders and geographies
- Be based on a carbon intensity of production metric
- Be specific to the steel sector and focus on steel production as the scope of emissions
- Provide a pathway out to 2050 at least, with intermediate points

The options listed below were brought up for the consideration of the TWG for adoption in this steel criteria:

- The EU Taxonomy on Sustainable Finance
- Transition Pathway Initiative (TPI)
- Steel Climate-Aligned Finance Working Group (CAF)

Other pathways were used as reference and are part of the research work behind the criteria but were already discarded for its usage as targets in the criteria document, these include those developed by PNNL[54], IDDRI[55] and the One Earth Climate Model[56].

[54] Yu, S., Lehne, J., Blahut, N., & Charles, M. (2021). 1.5°C Steel: Decarbonizing the Steel Sector in Paris-Compatible Pathways . PNNL, E3G.

[55] Global facility level net-zero steel pathways: technical report on the first scenarios of the Net-zero Steel Project, by Dr. C. Bataille; Stiebert, S. P.Eng, and Dr. Li, F. (2021), IDDRI.

[56] https://www.uts.edu.au/research-and-teaching/our-research/institute-sustainable-futures/our-research/energy-futures/one-earth-climate-model

Apart from considering the points listed above, the pathways evaluated as main options were, at the moment of having this discussion, the most relevant ones being developed by initiatives with purposes aligned with those of these criteria. Ultimately, the main reasons to pick this set of options for the TWG to evaluate were: to keep consistency with other initiatives without sacrificing ambition and to ensure that the practicality and usability of the chosen approach was being vetted by a wide group of stakeholders. Finally discussing the details of each pathway, the TWG agreed on adopting the RMI's CAF split trajectory approach. The other options evaluated are described for reference in appendix 2.

3.4.1 Chosen pathway: The Climate-Aligned Finance (CAF) Framework for Steel

Several of the largest lenders to the steel sector, including ING, Societe Generale, Citi, UniCredit, and Standard Chartered, joined together to develop this framework to assess and disclose the "climate alignment" of their steel finance portfolios. The creation of a standard that includes a common benchmark, metric, and methodology for calculating climate alignment, provides a level playing field for the sector's investors and lenders and sends a clear and consistent signal to the industry regarding stakeholder expectations, and ultimately, the availability of capital.

The steel climate-aligned finance framework has established a sector-specific methodology that optimizes for the correct incentive structure to both maximize scrap and encourage capital investments in low-carbon steelmaking technologies. An "alignment score" is calculated for each steel producer based on their annual emissivity and scrap utilization, and plotted against an "Alignment Zone," comprising two net-zero scenarios, in line with no-to-low overshoot of 1.5°C.

The lower of the two scenarios, the IEA Net-Zero Emissions pathway (NZE)[57], is constructed as a top-down global economy model, while the Mission Possible Partnership Technology Moratorium (MPP-TM) scenario[58] is sector specific, employing an asset-by-asset approach. This scenario optimizes for cost pre-2030 and applies a ban on new high-carbon assets post-2030, ensuring that no assets would be stranded prematurely. Although the MPP-TM is appropriated for the purposes the CAF working group intends to use it for, it is not compatible with CBIs principle of keeping alignment with 1.5°C, as it uses a larger carbon budget compatible with low overshoot of 1.5°C as shown in table 3. For this reason the TWG decided to adopt the CAF approach only using the IEA Net-Zero Emissions pathway (to be referred from now on as IEA NZE) pathway in these criteria.

Table 3. Comparison of carbon budgets. (Adapted from material provided by RMI)[59]

	IEA NZE	MPP TM
Steel sector emissions in 2050 (Gt CO2e) (scope 1 and 2)	54.5[60]	69.6
Global economy emissions in 2050	500	640[61]
Portion of steel emissions of total carbon budget	10.9%	10.9%[62]

[57] More information about this scenario can be found in this report: https://www.iea.org/reports/net-zero-by-2050

[58] More information about this scenario can be found in this report: https://missionpossiblepartnership.org/wp-content/uploads/2021/10/MPP-Steel_Transition-Strategy-Oct19-2021.pdf

[59] Sources: International Energy Agency, Net Zero by 2050, IEA, 2021; Net-Zero Steel Initiative, Net-Zero Steel Sector Transition Strategy, October 2021

[60] This value is not disclosed by the IEA NZE. Value calculated based on a linear interpolation to estimate annual steel production and direct (scope 1) emissions based on the stated production and emissions values for 2020, 2030, 2040 and 2050 from the IEA NZE. Annual scope 2 emissions are estimated based on the technology mix stated in the IEA NZE for 2020, 2030 and 2050.

[61] This value is not calculated by MPP, since it is a sector specific model. Figure calculated by assuming the same portion of emissions for the steel sector of the global carbon budget as the IEA NZE (10.9%) and then applying this amount to determine a global emissions value.

[62] Assumed to be the same portion of carbon budget as the IEA NZE.

While proposed by the five working group banks, the proposed methodology has been informed by nearly twenty total financial institutions, several global steel producers, and an Expert Committee of technical experts and civil society representatives.

Parallels with CBI

The steel CAF methodology can be applied both at the asset level, for dedicated financing, and at the corporate level, for general corporate purposes. Similarly, this framework could serve as criteria for both Use-of-Proceed bonds and Sustainability Linked Bonds.

Importantly, the CAF methodology is built to be applicable to the entire steel industry and aligns with the CBI objective of being implementable at scale. Through delineating a separate benchmark for primary steel and secondary steel, the emissions intensity thresholds are more meaningful for primary steel producers, who otherwise may not issue a green bond if they were held to the same KPI as secondary producers. In addition, the CAF methodology applies a fixed boundary approach (see figure 7), which enables a more direct comparison of the emissions performance between steelmakers. This methodology, proposed by the Net Zero Steel Pathways Methodology Project ensures emissions aren't being shifted to elsewhere in the supply chain.

To establish consistency both for the steel industry, and their investors and lenders alike, the steel CAF framework serves the needs of CBI by offering something that achieves the CBI guiding criteria, is ready-made, and sector specific.

Assumptions that underpin the International Energy Agency's Net Zero Emissions by 2050 model (NZE) and how does it achieve net zero emissions in the steel sector by 2050[63]:

The NZE models the transition needed for the global energy sector to achieve net-zero CO2 emissions by 2050 in a way that is consistent with a 50% probability of limiting global temperature rise to 1.5°C, without overshoot[64].The model delivers the optimal share of technology choices by country and region over time by optimizing emissions reductions and minimizing costs, while satisfying demand for steel. To do so, the model includes specific carbon pricing mechanisms where relevant (e.g., the European Union's Emissions Trading System).

The NZE discloses the inclusion of the following technologies and practices: BF-BOF, blast furnace retrofits, scrap-based EAF, hydrogen-based DRI-EAF and natural gas-based DRI-EAF, iron ore electrolysis, CCUS-based primary, smelting reduction, and technologies using bioenergy. In addition, the NZE models material and energy efficiency measures, assuming global demand for steel is 12% higher in 2050, compared to 2020. Additionally, the model includes carbon pricing assumptions starting in 2025 in advanced economies, emerging markets, and developing economies, which ramps up to 2025.

--- add table with more detail----

The NZE reports only direct (scope 1) emissions for the steel sector, while it attributes indirect (scope 2) emissions from electricity consumption from steelmaking to the power sector. The NZE is not fully open-access; emissions data for the steel sector is only reported in decadal increments and scrap utilization is only reported in 2020, 2030, and 2050. The model's assumptions are not fully disclosed.

Adjustment of the scope of the NZE trajectory to be consistent with the scope of the fixed system boundary[65]:

Since the NZE scope of emissions is inconsistent with the fixed system boundary for the steel sector (see figure 7), adjustments were made to include indirect (scope 2) emissions to the NZE trajectory.

The IEA utilizes a similar system boundary for its Energy Technology Perspectives (ETP) report on the iron and steel sector[66]. As the NZE's modelling assumptions are partially based on the ETP[67], a similar system boundary for the NZE scenario was assumed. Yet, while the system boundary for steel might be similar, the NZE attributes

[63] From: Rocky Mountain Institute, Climate Aligned Finance Working Group, Jan 2022, "Steel Sector Decarbonization Pathway: An Alignment Zone Approach"
[64] International Energy Agency, Net Zero by 2050, IEA, 2021
[65] From: Rocky Mountain Institute, Climate Aligned Finance Working Group, Jan 2022, "Steel Sector Decarbonization Pathway: An Alignment Zone Approach"
[66] IEA (2021), Iron and Steel, IEA, Paris https://www.iea.org/reports/iron-and-steel
[67] According to the International Energy Agency's Net-Zero by 2050 Scenario report (International Energy Agency (2021), Net Zero by 2050, IEA, Paris), "the projections in the NZE were generated by a hybrid model that combines components of the IEA's World Energy Model (WEM), which is used to produce the projections in the annual World Energy Outlook, and the Energy Technology Perspectives (ETP) model." See reports for further details.

the steel sector's indirect (scope 2) emissions associated with electricity consumption to the power sector. As a result, the NZE trajectory needed to be modified to include a scope of emissions consistent with the fixed system boundary proposed.

To do so, scope 2 emissions for the NZE trajectory were estimated based on available information from the NZE (Table 4). The NZE discloses scrap fraction and steel production by technology type. The amount of purchased and self-generated electricity required for each technology type were determined using the assumptions included in the MPP ST-STSM model.

Table 4. NZE steel production by technology type[68]

Technology Type[15]	Share of Production (%)				Purchased Electricity (GJ/t)	Self-Generated Electricity (GJ/t)	Scrap Input (%)
	2020	2030	2040	2050			
Conventional primary steel production (BF-BOF and DRI-EAF)	68%	57%	28%	3%	0.4	0.8[16]	15%
Scrap-based EAF	32%	38%	42%	46%	2.2	0.0	100%
H2-DRI-EAF	0%	1%	9%	16%	6.1	0.0	0%
Electrolysis-based primary	0%	0%	4%	7%	12.1	0.0	0%
CCUS-based primary	0%	4%	17%	29%	7.0	0.0	15%

Source: International Energy Agency, *Net Zero by 2050*, IEA, 2021.

Purchased and self-generated electricity vary in their emissions intensity, so a different emissions factor was assigned to each source. The emissions factors for purchased electricity from now through 2050 were based on the global electricity grid emissions factors by decade published in the NZE[69] (Table 5).

Table 5. NZE emissions factors for purchased electricity[49]

Year	Electricity Grid Emissions Intensity (kg CO2/MWh)[70]
2020	438
2030	138
2040	-1
2050	-5

Self-generation of electricity only applies to BF-BOF-based production technologies. The emissions factor for self-generation of electricity was calculated at 530 kg CO_2/MWh, based on a 70/30 composition of blast furnace gas[71] and coke ovens gas being fed to onsite power generation with an assumed conversion efficiency of 37%[72]. The emissions factor was assumed to be constant since the only way to change it is to change the steel production process itself, which the NZE accounts for over time by shifting production technologies. This approach is consistent with the MPP ST-STSM model.

Once scope 2 emissions for steelmaking were estimated, these were added to the NZE's disclosed scope 1 emissions to generate the total emissions for the NZE trajectory in 2020, 2030, 2040, and 2050[73].

In addition, since the NZE only reports on a decadal basis, emissions and scrap utilization data was interpolated linearly to generate yearly data from 2020 through 2050.

[68] Fraction of total production derived from scrap was used as the estimate for the scrap-based EAF share of production; values for 2040 are based on a linear interpolation between 2030 and 2050. Shares for H2 DRI-EAF, Electrolysis, and CCUS are provided directly from IEA NZE. The remaining share is assigned to BF-BOF/DRI-EAF. Based on data from International Energy Agency (2021) Net Zero by 2050: Net Zero by 2050 Scenario - Data product - IEA; as modified by RMI.
[69] International Energy Agency, Net Zero by 2050, IEA, 2021
[70] Negative emissions in 2040 and 2050 occur from the application of bioenergy with carbon capture and storage. Emissions intensity is from Table A5 in the IEA NZE.
[71] The emissions factors for coke oven gas and blast furnace gas are 44 and 260 kg CO2/GJ respectively, based on data from the EPA. (www.epa.gov/sites/production/files/2020-04/ghg-emission-factors-hub.xlsx).
[72] Based on assumptions by the World Steel Association.
[73] Emissions from processes that are scope 3 for a steelmaker, (e.g., production of pellets, purchased coke, etc.) would be included in the NZE boundary.

Figure 11 shows the resulting decarbonization trajectories for primary and secondary steel production based on the NZE adjusted as previously explained, and table 6 shows the respective emissions intensity values.

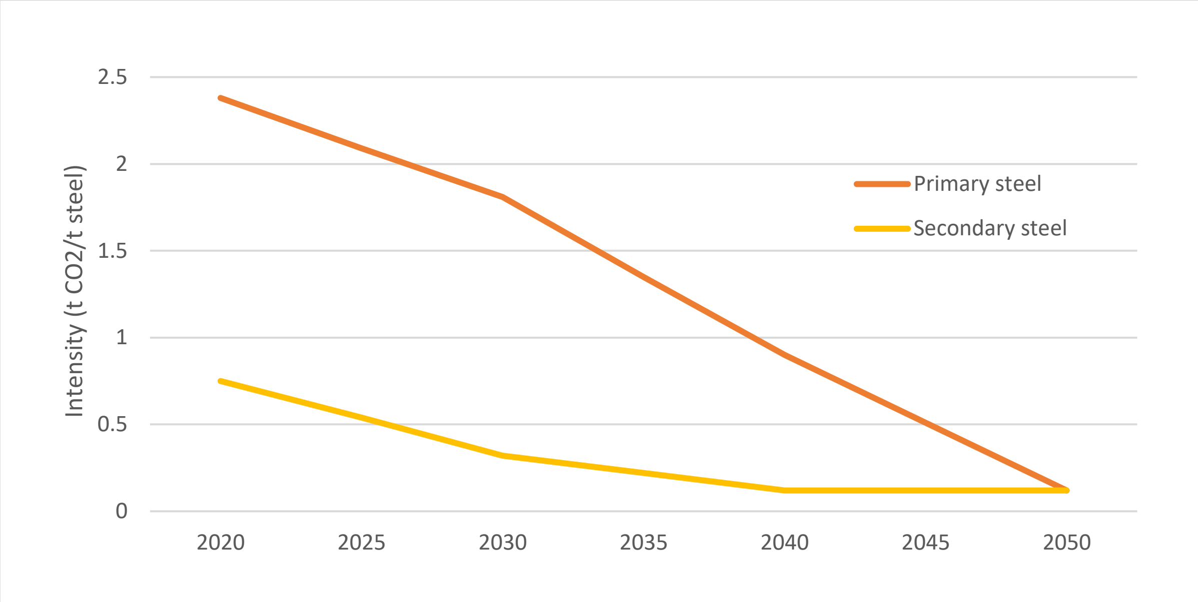


Figure 11. Decarbonization trajectories for primary and secondary steel production[74]

Table 6. Emissions intensity values for primary and secondary steel across the IEA NZE trajectory (courtesy of RMI).

	CAF IEA NZE Trajectory	
Year	**Primary Intensity** (t CO_2/t steel)	**Secondary Intensity.** (t CO_2/t steel)
2020	2.38	0.75
2025	2.09	0.54
2030	1.81	0.32
2035	1.35	0.22
2040	0.90	0.12
2045	0.51	0.12
2050	0.12	0.12

Splitting the carbon budget in primary and secondary steel production:

The carbon-intensity of steelmaking varies by technology type and metallic inputs used as explained in section 3.3.2. Primary steel production is significantly more carbon-intensive than secondary production since it largely uses metallurgical coal to reduce iron ore. Given the large discrepancy in emissions between these two sources of steel, separate emissions reduction trajectories were developed.

[74] Rocky Mountain Institute, Climate Aligned Finance Working Group, Jan 2022, "Steel Sector Decarbonization Pathway: An Alignment Zone Approach"

Utilizing a single global steel carbon budget to measure the sector's emissions could incentivize steel producers to increase the utilization of scrap as a decarbonization strategy. However, since global scrap availability is finite as explained in section 3.3.4, this strategy is limited in its ability to reduce the sector's overall emissions. Instead, the approach outlined here separates the carbon budget into decarbonization trajectories for primary and secondary steel. This can shift the focus to transitioning primary steel production, leading to the adoption of clean end-state technologies for steelmaking rather than a more incremental approach that risks moving emissions between steelmakers. This approach reflects the market realities of the sector and provides the insights needed to determine the climate alignment of steel companies[75].

Differentiation between emissions from primary and secondary steel production[76]:

This required creating two decarbonization trajectories for the emissions intensity of primary steel production and secondary steel production from the NZE trajectory (Figure 11). This is done by splitting the total carbon budget for the sector in the following way:

1. Determine the fraction of steel production by primary and secondary inputs (scrap charge) used in the NZE.

2. Set the starting point of the decarbonization trajectories for secondary steel production for the model starting at an estimate for the 80th percentile of 100% scrap-based EAF emissions (see next note).

3. Allocate remaining emissions from the model to primary steel production.

The 80th percentile of emissions intensity for 100% scrap-based EAF producers was selected as the proposed threshold for splitting the sector's carbon budget and derive the primary and secondary decarbonization trajectories[77]. This was done to ensure the correct incentive structure, such that:

- Primary producers (mainly BF-BOF operators) have an incentive to increase their scrap use in the short-term, and
- Primary producers are incentivized to make capital investments in low-carbon steelmaking technologies in the medium-term

The threshold was tested under different decarbonization targets steelmakers would have to meet based on the same scrap input range and the scenario which provided the most incentive was chosen.

[75] Taken from the "Briefing – Split Trajectory" from the Steel CAF WG, provided by RMI. More details about the approach can be found in this document.
[76] RMI CAF, Jan 2022, "Steel Sector Decarbonization Pathway: An Alignment Zone Approach"
[77] ibid

4 Determining mitigation criteria

The mitigation requirements are based on a strategy to be part of an economy that is net zero by 2050. The steel sector can get very close to net-zero emissions with technology that it is currently available or at high technology readiness level (TRL)[78].

The following sections lay out the rationale for the mitigation requirements set out in the Steel Criteria.

4.1 Setting criteria for new steel production facilities

The research on steel decarbonization tells us that it is possible to reach near zero emissions by 2050 using technologies that are already available or have high TRL (technology readiness level)[79]. Based on this, the TWG has agreed on only allowing certification of those greenfield projects that will already implement a technology that is near zero.

The criteria set for new facilities (see criteria document section 3.1), lists eligible low emissions iron and steel production technologies and also sets additional requirements. These additional requirements focus on the challenges posed by each of these technologies and being able to overcome these challenges will depend on factors related to the location of the plant. Consequently, the list aims at providing enough flexibility to producers to use the technology that will provide the most emissions mitigation based on the conditions and context of the plant location.

A description of the eligible type of facilities, the technologies involved, level of maturity and main challenges is presented in table 7. The challenges column explains the rationale behind the additional requirements specified for some of the technologies. Cross cutting mitigation criteria is explained in section 4.5.

Table 7. Near zero steel production technologies eligible for certification under the criteria for new steel production facilities[80]. The information reflected in this table is intended to provide information on the current state of the technologies and their potential and challenges for decarbonizing the industry, this table does not necessarily reflect the assumptions made on the IEA NZE pathway.

TECHNOLOGY	MATURITY	CHALLENGES
BF-BOF Production Line with integrated CCUS: Captures CO_2 emissions from the blast furnace gases or from cogeneration plant gases	Demonstration projects, available by 2030	The full extent of emissions reduction depends on the ability for large-scale permanent storage or use of captured CO2. High capture rates still have to be proven through demonstration projects. CCUS does not completely eliminate emissions, as very high capture rates (>90%) are difficult to achieve. The application of carbon capture technologies incurs a penalty in energy efficiency that increases with capture rate. Moreover, there are multiple emission points in BF-BOF installations, increasing the technical complexity required for CO2 capture (mostly from the blast furnace,

[78] IEA, October 2020, Iron and Steel Technology Roadmap, available at: https://www.iea.org/reports/iron-and-steel-technology-roadmap
[79] ibid
[80] This table has been compiled with information taken from: appendix 1 in: Yu, S., Lehne, J., Blahut, N., & Charles, M. (2021). 1.5°C Steel: Decarbonizing the Steel Sector in Paris-Compatible Pathways; Table 4 in: Bataille, C.; Stiebert, S., and Li, F. (2021), Global facility level net-zero steel pathways: technical report on the first scenarios of the Net-zero Steel Project, IDDRI. Available at: http://netzerosteel.org and the IEA (2020), Iron and Steel Technology Roadmap: Towards more sustainable steelmaking, IEA, Paris

		but also from basic oxygen furnace and the coking plant[81]. Therefore in order to implement CCUS technology, the capture rate should be at least of 70% of emissions to be considered for certification.
Smelting Reduction Production Line with Integrated CCUS Type of process in which liquid hot metal is produced from iron ore without Coke. Based on HISARNA, a type of smelting reduction in which Iron ore fines are injected at the top of cyclone converter furnace along with pure oxygen, while coal powder is supplied at the bottom. The process Reduces iron ore into liquid pig iron without coke production and iron ore agglomeration steps. Pig iron is fed into BOF where it undergoes oxygen treatment similar to BF- BOF route	Available by 2028 (demonstration scale)	CCUS challenges similar as above, but this process takes advantage of the fact that CO2 emissions from Cyclone Converter Furnace exit as concentrated stream (85-95% CO2) which facilitates carbon capture.[82] Therefore in order to implement CCUS technology, the capture rate should be at least of 70% of emissions to be considered for certification.
Fossil Gas-Based DRI-EAF Production Line with Integrated CCUS	Existing facilities already exist in United Arab Emirates and Mexico	The full extent of emissions reduction depends on the ability for large-scale permanent storage or use of captured CO2. High capture rates still have to be proven through demonstration projects. Does not completely eliminate emissions, as very high capture rates (>90%) are difficult to achieve. The application of carbon capture technologies incurs a penalty in energy efficiency that raises with capture rate. Therefore in order to implement CCUS technology, the capture rate should be at least of 70% of emissions to be considered for certification.
(100%) Hydrogen-Based DRI-EAF Production Line or standalone (100%) Hydrogen-Based DRI plant: Pure H_2 reduces iron ore, which is then melted with scrap steel in an EAF	Demonstration projects: HYBRIT EAF-DRI-H2 pilot plant became the first to supply fossil-free steel to a customer	Emissions can vary based on the sources from which hydrogen is produced, e.g. steam methane reforming (SMR) is associated with both CO2 and CH4 emissions. Hydrogen produced from electrolysis can achieve very low emissions, but this depends on type of electricity used. A carbon intensity of electricity under 200g CO2/kWh is needed for electrolytic hydrogen to have lower emission levels than hydrogen from SMR. Moreover, EAF installations also need a source of

[81] Witecka, W. K., Dr. Oliver Sartor, Philipp D. Hauser, D. C. O., Dr. Fabian Joas, T. L., Frank Peter,, Fiona Seiler, Clemens Schneider, D. G. H., . . . Yilmaz, Y. (2021). Breakthrough Strategies for Climate-Neutral Industry in Europe. Agora. Retrieved from https://static.agora-energiewende.de/fileadmin/Projekte/2020/2020_10_Clean_Industry_Package/A-EW_208_Strategies-Climate-Neutral-Industry-EU_Study_WEB.pdf

[82] Net-Zero Steel Initiative, Net-Zero Steel Sector Transition Strategy, October 2021, MPP, RMI and ETC. Available at https://www.energy-transitions.org/publications/the-net-zero-steel-sector-transition-strategy/

		carbon for making steel from iron ore, which can add around 53 kgCO2/t steel[83]. The carbon can come from pulverized coal, captured CO2, biomethane or other sources of biogenic carbon, each option having a different impact on overall emissions. Therefore the hydrogen used in the DRI process needs to meet the thresholds set in the criteria document section 6.1 and explained in section 4.5 of this document.
Scrap Based Electric Arc Furnace (EAF): Steel scrap is melted in an electric arc furnace. Fossil gas is sometimes used for preheating, also in finishing and casting for temperature control.	Currently available	Due to limited availability of scrap (see section 3.3.4) and the need to use primary steel in the production of high-quality steel for some applications an EAF-scrap pathway cannot currently cover all steel production needs. Emissions intensity vary based on the carbon intensity of the electricity used and the amount of scrap. A set percentage of scrap has been established in order to make sure that the emissions level of the facility is low. Those facilities that cannot reach this level of scrap inputs, fill the gap with primary inputs from 100% hydrogen based DRI facilities, the hydrogen needs to meet the threshold explained in section 3.7.1 of this document.
Electrolysis of Iron Ore Steelmaking Production Line: Direct electrification of steelmaking. Technologies in development: electrowinning process and high temperature molten oxide.	Early stage of development (small prototypes)	This process is carbon neutral if renewable energy is used to power the process. Subsequently, the criteria requests for a plan that attest to the efforts of the plant to use renewable energies. See section 3.3.5 for background information on addressing scope 2 emissions.

4.2 Setting criteria for steel production facilities operational prior to 2022

These criteria are set at the facility level, this means for certifying whole facilities producing iron or steel which may also include the implementation of mitigation measures. The requirements that have been set up in section 3.2 of the criteria document are made up of: mitigation criteria specific to each type of facility and cross-cutting criteria for all facilities in scope, the background information for this last component is explained in section 4.5.

[83] Vogl, V., Åhman, M., & Nilsson, L. J. (2018). Assessment of hydrogen direct reduction for fossil-free steelmaking. Journal of Cleaner Production, 203, 736-745.

To test if facilities that are currently operating are making credible efforts to decarbonize, the TWG looked first at the current CO_2 intensity of the main production routes around the world. These are shown in figure 12 and 13, the first shows the CO_2 intensities for the BF-BOF process which is responsible for most emissions in the sector as explained in section 2.3. and the second shows the average CO_2 intensities for EAF production around the world. These data were compared to the IEA NZE decarbonization trajectory in figure 11 to see how much the average emissions intensity in the industry needed to decrease, the information in figure 12 was compared to the primary trajectory and the data in figure 13 to the secondary trajectory while also considering the scrap share used in EAF in each country.

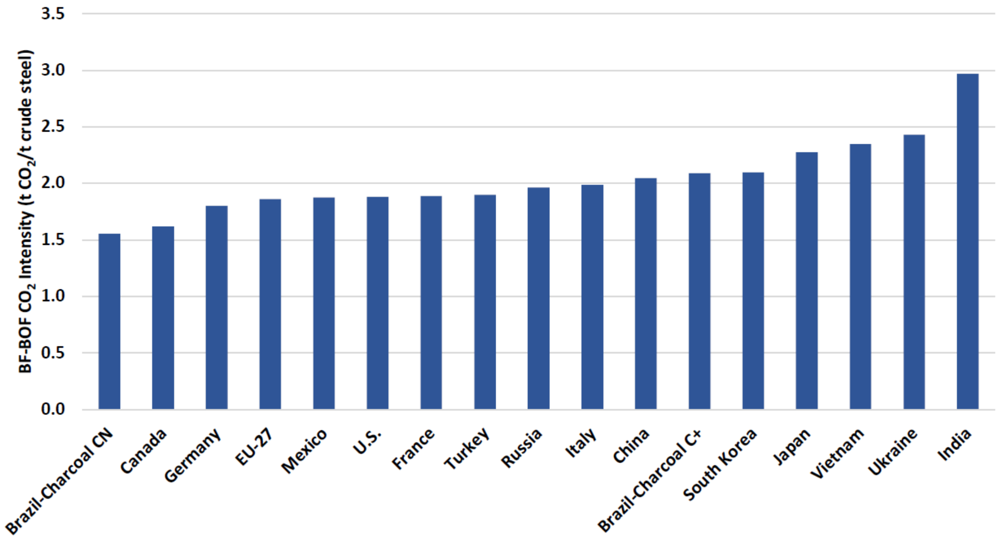


Figure 12. The CO2 intensity of BF-BOF steel production in (studied) countries/region in 2019[84]

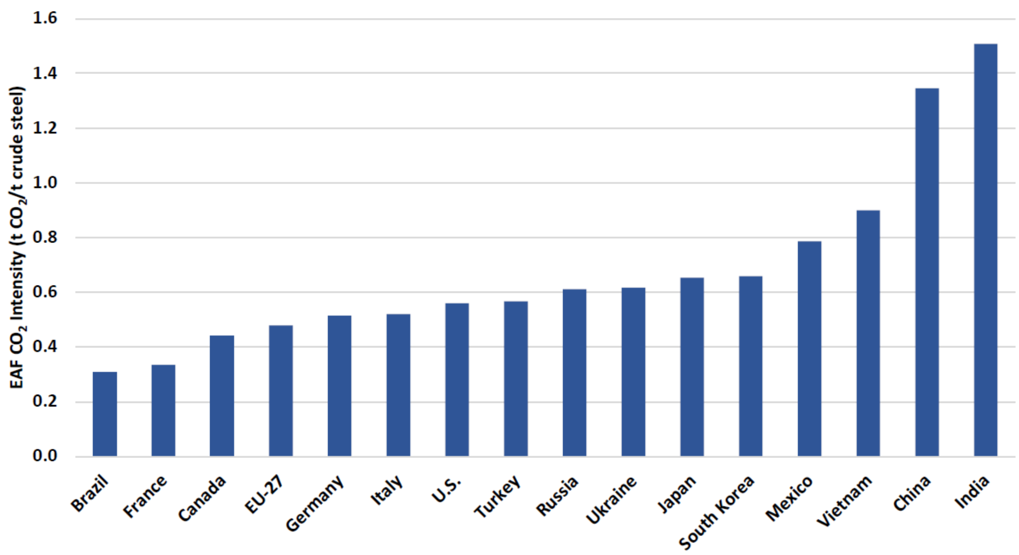


Figure 13. The CO2 intensity of EAF steel production (in the studied countries/region) in 2019[85]

[84]Source: Hasanbeigi, A. 2022. Steel Climate Impact - An International Benchmarking of Energy and CO2 Intensities. Global Efficiency Intelligence. Florida, United States. Available at: https://www.globalefficiencyintel.com/steel-climate-impact-international-benchmarking-energy-co2-intensities
[85] ibid

First, the criteria aim at increasing the proportion of steel produce by the EAF process, which is already low carbon (global average of scrap based EAF is 0.7 tCO_2/t steel) and has the potential to fully decarbonize by using renewable energies, increasing the use of scrap or using DRI made from 100% green hydrogen. Therefore, the TWG did not considered necessary to set a threshold for this technology. The biggest opportunity to lower emissions in the EAF process is in the use of clean energies, thus eligible projects should show that there is a plan to address scope 2 emissions, this is further explained in section 3.3.5.

Secondly let's look at the primary route, which includes both BF-BOF and DRI. Figure 12 shows that there is potential for a lot of the existing BF-BOF production to increment its energy efficiency and reduce emissions by 2030, when the primary threshold in Figure 11 will be at 1.81 tCO_2/t steel. Then we discussed what measures were available for existing facilities to implement and if these were enough to bring facilities to the emissions intensity levels needed in the mid-term (2030) and the long term (2050). Table 8 shows a summary of the measures available and the potential for emissions mitigation of each. It is important to note that the mitigation potential of these measures depends on many factors, and these are average estimations. The conclusion from the TWG is that the current technologies for refurbishment cannot bring existing BF-BOF plants to the carbon neutral levels of 2050, but in many cases, these can reduce emissions to the levels required in 2030. The latter will happen only if the measures are implemented in bundle, thus individual measures alone are not eligible.

Then, in order to set the criteria specific for BF BOF production facilities, the following additional aspects were considered:

1) **Preventing carbon lock-in:** in section 3.3.3 it was explained the lock-in risk of allowing investments in new and existing BF-BOF facilities. In order to overcome those risks, eligible investments in existing BF-BOF facilities need to only take place in those that have been operating for less than 15 years. This means that the facility still has not reach relining age (20 years in operation), accordingly, a credible mitigation investment will be aimed at implementing measures to decrease the facility's carbon emissions (cap year 2030) without extending the life of the plant. On the other hand, this also means that all BF-BOF facilities that have been operating for longer than 15 years do not qualify (in the same way) because it is assumed that any investment in these older assets will lock-in emissions, unless a credible way to significantly decarbonize these plants (at least by 50%) becomes available.
2) **Emissions reduction in BF-BOF below 15 years**: to come up with the decarbonisation percentages set in the criteria (15% and 20%), these had to represent both what is attainable (i.e. the maximum level of mitigation ambition that can be achieved with current technologies) and it has to be enough to reach the 2030 thresholds for primary production in the pathway. The average emissions intensity of 2 tCO_2/t crude steel was used as a deciding threshold for emissions reduction of BF-BOF below 15 years. Then for facilities with emissions intensity equal or lower than 2 tCO_2/t steel, 15% reductions is attainable and ambitious and for plants with higher emissions intensity, this can be achieve setting the threshold at 20%, keeping in mind that these newer plants tend to be more efficient, and emissions intensities do not go higher than 2.2 tCO_2/t steel[86] *(check reference)*
3) **Emissions reduction in BF-BOF above 15 years**: On the other hand the 50% used as requirement for older facilities assumes that the only transition investment possible for an old BF-BOF, other than decommissioning, needs to involve a total refurbishment of the facility, such that it will lower the emissions enough to reach a threshold lower than that of 2030. Currently, lowering emissions in existing BF-BOF by 50% can only be achieve by implementing CCUS. The rationale behind setting this requirement, agreed by the TWG, assumes that finance may be needed to test transition technologies to refurbish existing BFs and further lower emissions, thus 50% lower emissions was considered significant enough (if also cross cutting criteria is met).

[86] Source: Hasanbeigi, A. 2022. Steel Climate Impact - An International Benchmarking of Energy and CO2 Intensities. Global Efficiency Intelligence. Florida, United States. Available at: https://www.globalefficiencyintel.com/steel-climate-impact-international-benchmarking-energy-co2-intensities

Table 8. Examples of mitigation measures that could be applied to existing facilities to reduce emissions and their CO2 emissions reduction potential (Multiple Sources).

Example use of proceeds (Capital investments)	CO_2 emissions reduction potential (compared to conventional BF-BOF intensity)[87]
Installation, upgrade, and operation of heat recovery systems	5%-15%
Optimization of Blast Furnace (e.g. Pulverize Coke Injection, Top Gas Recycling, Stove waste gas heat recovery)	17%-21%
Optimization of Basic Oxygen Furnace (e.g. Recovery of BOF gas and sensible heat)	1%
Optimization of Coke Plant – (e.g. Coke Dry Quenching)	1-3%
Optimization of Sinter Plants (e.g. Sinter Plant Heat Recovery)	1%
Optimization of EAF (e.g. Oxyfuel burners, EAF scrap preheating, CHP from waste heat)	30% (*compared to conventional EAF route)
Optimization of rolling and finishing and reheat furnace (e.g. High Efficiency Burner, Flue-gas monitoring, combustion optimization, exhaust gas heat recovery)	5%
Fuel switching to low-/no-carbon fuels, sustainable biomass, green H_2, electrification of heat	Varies depending on the alt fuel and substitution rate. But overall substantial potential
Near net-shape casting	5%
Installation, upgrade, and operation of advanced sensors and digitized control equipment and systems	1% - 3%
Installation, upgrade, and operation of carbon capture, utilization and storage equipment	30% - 90%

For the DRI route a slightly different approach was take, the following aspects were considered:

- Average global emissions of DRI facilities are at 1.3 tCO2/t steel[88] which is already lower than the 2030 threshold from the primary trajectory in figure 9.
- The maximum level of mitigation ambition that can be achieved with current DRI technologies is higher than that of BF BOF. This is because most DRI plants use fossil gas to reduce iron ore, this can be blended or substituted with hydrogen and if green hydrogen is used, emissions can be reduced significantly.
- Furthermore, there are a few facilities around the world that use coal based DRI technology, the criteria specifically states that these should have a higher level of ambition in emissions reduction of minimum 50%.

[87] ArcelorMittal. 2019. Climate Action Report.
DEEDS (Dialogue on European Decarbonisation Strategies). 2020. Industry - Iron and steel technology list.
Hasanbeigi, Ali; Arens, Marlene; Price, Lynn; (2013). Emerging Energy Efficiency and CO2 Emissions Reduction Technologies for the Iron and Steel Industry. Berkeley, CA: Lawrence Berkeley National Laboratory BNL-6106E.
Fraunhofer ISI and ICF. 2019. Industrial Innovation: Pathways to deep decarbonization of Industry. Part 1: Technology Analysis. Institute for Industrial Productivity (IIP). 2015. Industrial Efficiency Technology database- Steel industry.
Worrell, E., Blinde, P. Neelis, M., Blomen, E., Masanet, E. 2010. Energy Efficiency Improvement and Cost Saving Opportunities for the U.S. Iron and Steel Industry: An ENERGY STAR Guide for Energy and Plant Managers.
Asia Pacific Partnership for Clean Development and Climate, (2010). The State–of-the-Art Clean Technologies (SOACT) for Steelmaking Handbook (2nd Edition).
Energy Transitions Commission (ETC). 2018a. Mission Possible: Reaching new zero carbon emissions from hard-to-abate sectors by mid-century.
Energy Transitions Commission (ETC). 2018b. Reaching zero carbon emissions from steel.
[88] IIGCC (2021), Climate Action 100+, Global Sector Strategies: Investor interventions to accelerate net zero steel report, London. Available at: https://www.iigcc.org/resource/global-sector-strategies-investor-interventions-to-accelerate-net-zero-steel/

Subsequently, eligible investments in DRI facility should be ambitious enough to reduce emissions by 20% if fossil gas is used and 50% if coal-based gas is used, by 2030 or issuers should show more ambitious plans to completely switch to hydrogen or capture emissions in fossil gas-based facilities.

4.3 Setting criteria for decarbonization measures within steel production facilities

For financing of capital investments (decarbonisation measures) within existing facilities, the TWG agreed that the plant needed to also meet the criteria set up for certifying whole steel production facilities, which rationale was explained in the last section. Even if this differs from an investment that would finance the whole facility in that it involves investments that are focused on the measures or specific areas of improvement within the asset.

What this requirement implies is that particularly for primary production of steel, implementation of individual measures within facilities will not suffice to achieve the 2030 reduction targets that will allow the sector to contribute to keeping global warming at 1.5°C.

Key mitigation strategies identified by the TWG for the Steel sector to decarbonise are shown in table 8.

4.4 Setting criteria for companies in the steel sector

Increasingly, companies are turning towards different financial instruments to green bonds to finance their activities. This is especially pertinent for industry and Steel, where all sustainable labelled bonds in the past year have been general corporate purposes rather than use of proceeds bonds (see section 2.5). A lack of standards for such instruments can open the way to greenwashing, where companies may be setting sustainability linked KPIs that are insufficient for meeting the Paris Agreement, or otherwise have no robust plan in place to meet those KPIs.

Climate Bonds aims to develop criteria in time that can certify both Use of Proceeds (UoP) bonds and General-Purpose bonds in the Steel sector. UoP bonds are intended as the first stage of development, with criteria for entity level transition to follow soon after once the expansion of the Climate Bond Standard is completed. This will require criteria that suitably reflect the hallmarks discussed in section 3.1.2.

In general, the rationale for the criteria to certify general corporate purpose bonds has been explained throughout this document. First, companies need to meet the decarbonization pathway in figure 11 (explained in section 3.4.). Then, all the company's facilities need to also meet the adaptation and resilience criteria explained in section 5 and the cross-cutting criteria described in section 4.5. Finally, in order to ensure consistency with the 1.5°C trajectory the company needs to commit to build all new facilities according to the criteria for new facilities.

4.5 Setting cross-cutting criteria for all facilities

4.5.1 Additional criteria for the use of hydrogen as a reducing agent

Facilities that use hydrogen as a reducing agent, need to meet the thresholds set in section 6.1 of the criteria document. These are a projection of decreasing threshold values that ensure that hydrogen related assets and activities included in the use of proceeds or entity are aligned to a transition pathway that contributes to the 1.5°C target.

A hydrogen sector level pathway was not available at the time of finishing these criteria, subsequently, the approach used in the Basic Chemicals criteria was adopted and it is explained below.

The 2022 threshold is taken from the EU taxonomy[89]and the approach in setting such thresholds is based on the 10% best performing facilities in Europe during a given period. For the 2030 threshold, the projection was done using the SBTi cross-sectoral pathway method[90]. Afterwards, the life cycle GHG emission values for hydrogen produced from renewable energy and feedstock alternatives (biomass) projected by the Hydrogen Council[91] were taken as reference to set out the thresholds for 2040 and 2050. This projection reveals that achieving the thresholds adopted in these criteria is feasible.

The Climate Bonds Initiative is currently developing criteria for hydrogen. Once the hydrogen criteria are published, it shall supersede the requirements set in this section.

4.5.2 Additional criteria for the use of biomass as a reducing agent

These additional criteria refer to the use of biomass in blast furnaces as an alternative reducing agent or fuel to coal. This method is already available in some regions, particularly Brazil where charcoal derived from biomass is used, other upcoming technology uses torrefied waste wood instead[92]. The substitution of coal for biomass is only partial and scalability of the technology is constrained by the availability of sustainable biomass and the many environmental trade-offs related to its use[93].

The Climate Bonds Initiative has criteria for Bioenergy that has been adapted for the uses required by the steel sector.

4.5.3 Additional criteria for CCS and CCUS

CCS is the process of capturing (concentrating from diluted sources), transporting and storing CO_2 in order to prevent its release into the atmosphere. Carbon storage can be in open, closed or cycling systems[94]. Open systems include natural systems such as in biomass growth and soil. Closed systems include the geological storage in lithosphere or deep oceans and mineral formations. Cyclic systems include the conversion of CO_2 into fuels or chemicals, this form is also known as carbon capture and utilisation (CCU). For the purposes of this criteria document, CCS refers specifically to closed systems as in geological storage since this is the one with the largest storage life span[95].

The technologies required for carbon capture are in early stages of development, but it is expected to make progress towards commercialisation. In addition, care should be taken in regard to the end use of the product generated from CO_2. This is mainly because if the CO_2 is immediately released into the atmosphere during end product use, the mitigation is ephemeral. This means, additional restrictions are included for the end product, which should be a long-lasting or recyclable product so as to keep CO_2 in a loop.

The EU taxonomy has set up criteria for CCS which has been adopted for the purposes of this steel criteria.

4.5.4 Additional criteria for fossil gas

Whilst it remains a fossil carbon, at this stage the criteria allow for fossil gas in new facilities only if emissions are abated, this means in combination with CCUS and for existing facilities prior to 2030. It is important to highlight that emissions from fossil gas extraction, processing and transportation may mean that fossil gas-based systems (both energy and steel production) have a higher life cycle impact than coal-based systems. This can happen due to fugitive losses and leakage of the product which is largely made up of the greenhouse gas methane which has a more potent impact on global warming[36]. Because the majority of these emissions happen upstream (i.e. they

[89] https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A32021R2139

[90] SBTi (2015). SECTORAL DECARBONIZATION APPROACH (SDA): A method for setting corporate emission reduction targets in line with climate science. https://sciencebasedtargets.org/resources/files/Sectoral-Decarbonization-Approach-Report.pdf

[91] Hydrogen Council (2021). Hydrogen decarbonisation pathways. A life cycle assessment. Available at: https://hydrogencouncil.com/wp-content/uploads/2021/01/Hydrogen-Council-Report_Decarbonization-Pathways_Part-1-Lifecycle-Assessment.pdf

[92] IEA, October 2020, Iron and Steel Technology Roadmap, available at: https://www.iea.org/reports/iron-and-steel-technology-roadmap

[93] Yu, S., Lehne, J., Blahut, N., & Charles, M. (2021). 1.5°C Steel: Decarbonizing the Steel Sector in Paris-Compatible Pathways, PNNL, E3G.

[94] Hepburn, C, Adlen, E, Beddington, J et al. (2019) The technological and economic prospects for CO_2 utilisation and removal. Nature, 575 (7781). pp. 87-97. ISSN 0028-0836

[95] According to the IPCC, well-selected, well-designed and well-managed geological storage sites can maintain CO2 trapped for millions of years, retaining over 99 per cent of the injected CO_2 over 1000 years. IPCC Special Report on Carbon Dioxide Capture and Storage, https://www.ipcc.ch/site/assets/uploads/2018/03/srccs_wholereport-1.pdf

are scope 3 emissions), they are not within control of the steel production facilities. To account for these potential issues, the criteria document specifies the need for methane leakage prevention, monitoring and mitigation measures to be implemented. Issuers are referred to existing guidance on these matter[96].

[96] UNECE (2019) Best practice guidance for effective methane management in the oil and gas sectors. Monitoring, Reporting and Verification (MRV) and Mitigation. United Nations 2019.
https://unece.org/fileadmin/DAM/energy/images/CMM/CMM_CE/Best_Practice_Guidance_for_Effective_Methane_Management_in_the_Oil_and_Gas_Sector__Monitoring__Reporting_and_Verification__MRV__and_Mitigation-_FINAL__with_covers_.pdf

5 Adaptation and Resilience

The IPCC defines adaptation as: "The process of adjustment to actual or expected climate and its effects. In human systems, adaptation seeks to moderate or avoid harm or exploit beneficial opportunities. In some natural systems, human intervention may facilitate adjustment to expected climate and its effects." [97].

The IPCC defines resilience as: "The capacity of social, economic and environmental systems to cope with a hazardous event or trend or disturbance, responding or reorganizing in ways that maintain their essential function, identity and structure, while also maintaining the capacity for adaptation, learning and transformation." Capacity for adaptation and for resilience will depend on available assets and their distribution within a population as well as institutional infrastructure.

The Climate Resilience Principles further offers the below definition to inspire investors and issuer engagement: Climate resilience investments improve the ability of assets and systems to persist, adapt and/or transform in a timely, efficient, and fair manner that reduces risk, avoids maladaptation, unlocks development and creates benefits, including for the public good, against the increasing prevalence and severity of climate-related stresses and shocks.

Climate adaptation and resilience mitigation criteria are designed to ensure that a project itself is resilient to climate change and that it does not affect the resilience of other sectors. The development of the requirements for the A&R component was based on CBI's "Climate resilience principles" document[98]. Figure 6 gives an overview of the six principles for resilience.

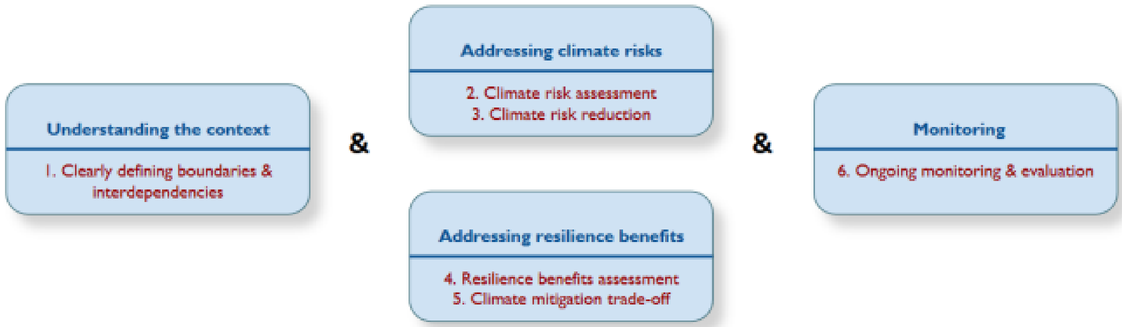


Figure 14 The CBI's principles for Resilience

Although the principles provide a framework and serve as guidance for general aspects to consider, it is also recognised the challenges and limitations to assess the adaptation and resilience aspects in general. Such limitations include the lack of awareness of climate resilience benefits and a common language, robust data on climate risks and common methodologies for climate risk assessment, lack of capacity and interdependencies with other assets or actors in the supply chains. It is also acknowledged that A&R has inherent complexities which makes it harder to quantify and it can be very context specific, depending not only on location but also on the type of asset, the type of risk looked at, the level of severity and frequency of the risk, and so on. The frequency and magnitude of the impacts are commonly underestimated by companies.

Location: Appropriate geographic or other spatial boundaries for climate risk and benefits assessments for assets and activities in the sector was discussed as well as consideration of the broader system affected by those assets and activities. There are expected internal and external interdependencies between assets or activities in a given

97 Summary for policymakers. In: Climate Change 2014: Impacts, Adaptation, and Vulnerability.Part A: Global and Sectoral Aspects. Contribution of Working Group II to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change [Field CB et al. (eds.)]. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA, pp. 1-32. http://www.ipcc.ch/pdf/assessment-report/ar5/wg2/ar5_wgII_spm_en.pdf

98 CBI (2019). Climate Resilience Principles. A framework for assessing climate resilience investments. https://www.climatebonds.net/climate-resilience-principles

sector and between sectors (which become evident when a climate event results in a potential failure of value chains) but there can also be opportunities to maximise resilience benefit.

When developing criteria for setting the boundaries for assessment, it was proposed to separate the analysis as follows:

- Capital assets
- Production
- Logistics and supply (including raw materials, utilities and their distribution),
- Labour

Key infrastructure dependencies were identified with special relevance for the sector including water, gas, energy and other key utilities necessary to run the iron and steel production and keep the adaptation and resilience equipment and infrastructure operating during any outage arising from climate change events. All these infrastructure dependencies are to be included in the production element.

Timeframes: Appropriate time horizons for climate resilience assessments need to be set for the assets and activities in scope. The criteria to base the time horizon for the assessments are set based on the typical lifetimes of assets in the sector which is 30 years on average (though it is recognised that some may last for 50 years or more).

Disclosure: As part of the monitoring and evaluation principle, there are requirements for reporting and disclosing risks assessments. Currently there are a number of issues seen:

- a lack of alignment or harmonisation as reporting is often undertaken on a voluntary basis
- the level of completeness can be low which leads to accusations of greenwashing
- the frequency for reporting and updating the assessment varies (recognising that the time horizons for revisiting the assessments will likely depend on the level of risk of a facility: low risk facilities can have long time horizons, and high-risk facilities short time horizons). Depending on the severity of the risk the time horizon can be set.

Other aspects to consider when setting the A&R requirements are listed as follows:

Identification of the key climate risks – including hazards, exposures and vulnerabilities - likely to be experienced by assets and activities in that sector. Some insurance companies, such as FM global, can provide a useful source of data for risk assessments.

Models, methodologies and data sets that would be most appropriate for determining likely physical climate risks to be faced in context for activities and assets in the sector.

Climate change risk measures and metrics for assets and activities in the sector – e.g. how should assets and activities deal with these risks? How this could be evaluated?

Based on the discussions presented above, the assessment methodology includes a verification list that the verifier should complete when assessing an asset or project. It is recognised that this may not be complete, but is presented as the most robust available, given the complexities and several angles of the topic, and the lack of robust and more quantitative methodologies and tools. This approach has been adopted from the work done by the TWG of A&R for the Basic Chemicals criteria. The group used as reference documentation from Lux Research and guidelines from the UK Chemical Industry Association[99], and Dale (2021)[100] to develop the verification list that subsequently has been adapted for the steel sector. More information on this is given in Section 4.3 below.

Wider environmental and social risks are complex and interconnected and should be assessed under these Criteria, however the following points are noted:

[99] Chemical Industries Association (2015). Safeguarding chemical businesses in a changing climate. How to prepare a. Climate Change Adaptation Plan. https://www.cia.org.uk/LinkClick.aspx?fileticket=KW8WF8CBZG0%3D&portalid=0

[100] Dale, S.(2021). Disaster Planning: Improve Your Plant's Resilience. Become more proactive in dealing with acute and chronic natural disasters. CHEMICALPROCESSING.COM. https://www.chemicalprocessing.com/articles/2021/disaster-planning-improve-your-plants-resilience/

- The Climate Bonds Standard is focused on climate impacts – including low GHG-compatibility (mitigation) and also climate adaptation and resilience. Defining resilience can be challenging. However, it is clear that many topics which have been a part of environmental and social assessments for a number of years overlap significantly with the resilience of affected populations and ecosystems and their ability to adapt to climate change.
- The most obvious example is the potential impact of climate change on hydrological conditions, and consequently water supply and local livelihoods. Another is climate change exacerbating ecological problems such as impaired species migration and algal blooms. Environmental and social impacts such as these, already complex and interconnected, become more so when climate change impacts and risks are taken into account, and there is a logic to addressing all key environmental factors, rather than trying to separate them out.
- The Climate Bonds Standard does not usually address primarily social impact issues, these were discussed but not considered within scope.

5.1 Practical requirements for this Component

Leverage existing tools

The knowledge and literature on adaptation and resilience impacts of steel production facilities is limited as this area is in its infancy. The A&R Component will require consideration of a highly complex and varied set of issues across the environmental and social spectrum for which data, methodologies and metrics may not be available. Qualitative methods based on verification lists or questionnaires have been proposed which can however be leveraged. It is not appropriate for Climate Bonds to commit resources to address these issues, and the guiding principle of simplicity shall be applied at this time. More robust criteria can be developed over time as more information is generated and integrated in the subsequent revisions of the Criteria.

However, it should be noted that existing methods do not always fully or explicitly cover the additional, often interrelated impacts connected to climate adaptation and resilience. Many of the risk assessments and management processes specified by existing guidelines will be a prerequisite for identifying A&R risks, but more may be needed to fully address them given that this is an emerging topic.

Minimise the assessment burden

In addition, there needs to be a balance between rigour and practicality. Any Criteria with a prohibitively expensive assessment burden will discourage certification. Any methodology adopted therefore need to avoid this.

A binary 'pass'/'fail' outcome rather than scores or grades

Certification decisions under the Climate Bonds Standard are binary – applicants are either certified or not. Therefore, the A&R Component needs to be framed in terms of pass/fail thresholds. Where an assessment tool provides scores or grades for a facility, consideration has been given to what threshold 'score' or result should represent a pass for the purposes of Climate Bonds Certification.

Retrospective application

Finance raised in this sector may be for new, greenfield facilities, for retrofits or upgrades to existing facilities, or they may be a straight refinancing of an existing facility. Therefore, any proposal and associated approved assessment tool under this Component needs to be usable for both new and existing facilities.

This is not a straightforward issue; as in the case of refinancing, the facility may have been operating for a number of years. It may have been compliant with best practices in place at the time of its implementation but may not meet current best practice requirements. The selected methodology and tool will therefore need to be able to address and resolve any 'legacy issues' that may be identified.

5.2 Existing tools and guidelines considered

A range of existing tools and guidelines with the most potential to be leveraged for the Steel Criteria are listed below.

Risk Assessment and Climate Scenarios

- The ISO 14091:2021 Adaptation to climate change – Guidelines on vulnerability, impacts and risk assessment standard offers guidelines for assessing the risks related to the potential impacts of climate change.[101]
- Risks can be characterised by the associated annual probability of failure or annual costs of loss or damage
- For risk assessment, the TCFD The Use of Scenario Analysis in Disclosure of Climate Related Risks and Opportunities is recommended.
- A broad range of models can be used to generate climate scenarios. Users should apply climate scenarios based on representative concentration pathway (RCP) 4.5 and 8.5 or similar / equivalent to ensure consideration for the worst-case scenario. (The IPCC 'Shared Socioeconomic Pathways' to develop potential temperature scenarios. SSP5-8.5 is the highest warming pathway, SSP3-7.0 the second highest and so on).
- The IPCC Sixth Assessment report also provides an indication as to how different temperatures impact the likelihood and severity of different climate impacts
- A framework for risk management for climate security. https://www.c2es.org/document/degrees-of-risk-defining-a-risk-management-framework-for-climate-security/
- Climate Change Risk Assessment Guidelines. https://www.ctc-n.org/system/files/dossier/3b/D4.2%20Climate%20change%20risk%20assessment%20guidelines.pdf

[101] https://www.iso.org/standard/68508.html

Appendix 1: TWG and IWG members

CBI Technical Consultant:

Global Efficiency Intelligence, US – Ali Hasanbeigi

Technical Working Group (TWG) Members

Lund University, Sweden - Max Åhman

Science Based Targets initiative (SBTi) and CDP, UK - Brenda Chan

The Institutional Investors Group on Climate Change (IIGCC) - Dan Gardiner and Jose Lazuen

Berkeley Lab, US - Hongyou Lu

Rocky Mountain Institute, US - Lucy Kessler and Lachlan Wright

European Bank for Reconstruction and Development (EBRD), UK - Robert Adamczyk

Kobolde & Partners AB, Sweden - Rutger Gyllenram

Pacific Northwest National Laboratory (PNNL), US - Sha Yu

WMG The University of Warwick, UK - Zushu Li

Transition Pathway Initiative (TPI), UK - Antonina Scheer

Industry Working Group (IWG)

Members of the following organizations have participated in IWG meetings through the development of these criteria:

- Affirmativ IM
- Alacero
- Arcelor Mittal
- Baosteel
- Bayern nlb
- Bluescope
- Citi
- Danske Bank
- Deloitte
- ERM CVS
- Gerdau
- ING
- ISS ESG
- JCRA
- JSW
- NAB
- NNIP
- Nomura
- Severstal
- SGCIB
- Sustain Advisory
- Sustainalytics
- Tata Steel
- TERNIUM BR
- Unicredit
- Voestalpine
- Worldsteel

Appendix 2: Work on steel sector decarbonization by other initiatives

The EU Taxonomy on Sustainable Finance

The EU Taxonomy on Sustainable Finance[102] (hereafter referred to as the EU Taxonomy) is a set of green definitions enshrined in EU law whereby all investors must disclose the extent to which their EU investments align with the EU Taxonomy. In other words, the Taxonomy lays out the criteria for EU investments to be referred to as 'green'.

It categorises criteria by economic activity. Therefore, the manufacture of Steel is included in the EU Taxonomy[103]. It contains two thresholds that can be met for a Steel manufacture activity to be making a significant contribution to climate mitigation. The TWG evaluated these thresholds as a potential starting point for criteria, but as these are single thresholds, not pathways, they were not determined as suitable for criteria purposes. For extra context, the EU Taxonomy threshold for steel production represents the average emissions of the top 10% most efficient Steel manufacture installations in the EU. *To be completed*

The Transition Pathway Initiative (TPI)

The Transition Pathway Initiative[104] is a global initiative led by asset owners and supported by asset managers. They assess company's preparedness for the low carbon economy transition. TPI quantitatively benchmarks companies' carbon emissions against the international targets and national pledges made as part of the Paris Agreement. The approach used by TPI carbon performance assessment is based on a Sectoral Decarbonisation Approach (SDA) [105], reflecting robust International Energy Agency (IEA) modelling of sector-specific carbon budgets, taking into consideration the cost of decarbonising each sector.

It provides year-by-year thresholds to form a pathway to 2050 (see table 9, where applicable thresholds for the 1.5 pathway are in the red square) and is specific to the Steel sector with Steel production in scope. The IEA's work is used to derive three benchmark emissions paths. For this project, the 1.5°C scenario with a 50% probability of holding the global temperature increase to 1.5°C is the relevant one (see green path in Figure 15).

The measure of emissions intensity used is scope 1 and 2 GHG emissions from steelmaking per unit of crude steel produced, in units of metric tonnes of CO2 equivalent per tonne of crude steel.

Note on how the SDA is applied:

- A global carbon budget is established with input from a climate model (i.e. IEA's NZE)
- The global carbon budget is allocated across time and to different regions and industrial sectors
- In order to compare companies of different sizes, sectoral emissions are normalised by a relevant measure of sectoral activity (e.g. physical production, economic activity). This results in a benchmark pathway for emissions intensity in each sector:

  Emissions intensity = Emissions / Activity
- Companies' recent and current emissions intensity is calculated, and their future emissions intensity can be estimated based on emissions targets they have set (i.e. this assumes companies exactly meet their targets).
- Together these establish emissions intensity pathways for companies.

[102] https://ec.europa.eu/info/business-economy-euro/banking-and-finance/sustainable-finance/eu-taxonomy-sustainable-activities_en#regulation

[103] It can be found in the Technical Annex here: https://eur-lex.europa.eu/resource.html?uri=cellar:d84ec73c-c773-11eb-a925-01aa75ed71a1.0021.02/DOC_2&format=PDF

[104] More information on how the methodology behind this pathway can be found here: https://www.transitionpathwayinitiative.org/publications/103.pdf?type=Publication

[105] SBTi goes further into the SDA here: https://sciencebasedtargets.org/resources/files/Sectoral-Decarbonization-Approach-Report.pdf

Table 9. Projection of emissions and crude steel production used to calculate intensity paths (Courtesy of TPI, based on IEA and TPI's own calculations)

	2019	2030	2040	2050
National Pledges				
Scope 1+2 CO2 emissions (Mt)	3,106	3,426	3,386	3,218
Steel production (Mt)	1,869	2,099	2,319	2,533
Carbon intensity (tCO2 / t steel)	1.66	1.63	1.46	1.27
Below 2 Degrees				
Scope 1+2 CO2 emissions (Mt)	3,106	2,904	1,863	1,059
Steel production (Mt)	1,869	1,952	1,993	2,054
Carbon intensity (tCO2 / t steel)	1.66	1.49	0.93	0.52
1.5 Degrees				
Scope 1+2 CO2 emissions (Mt)	3,106	2,187	906	102
Steel production (Mt)	1,869	1,937	1,958	1,987
Carbon intensity (tCO2 / t steel)	1.66	1.13	0.46	0.05

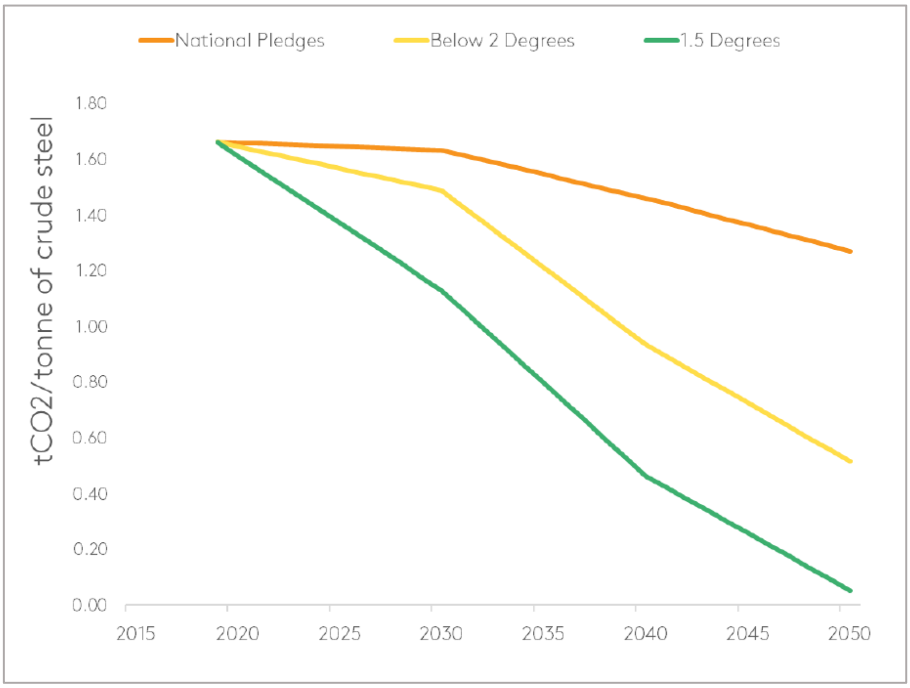


Figure 15. Benchmark global carbon intensity paths for the steel sector (Courtesy of TPI)

Science Based Targets initiative (SBTi)

SBTi is in the process of developing a 1.5oC-aligned emissions intensity pathway specific to the Steel sector[106]. This is expected to be available soon and is viewed by Climate Bonds and the TWG as holding promise as a pathway that could meet all of the criteria discussed earlier in this section. Upon publication of the pathway, the TWG will review the methodology and decide whether or not it can be adopted as criteria to replace the IEA NZE pathway proposed in the interim.

Other pathways evaluated

- PNNL
- IDDRI
- IEA Net Zero by 2050 report[107]
- One Earth Climate Model[108]

[106] https://sciencebasedtargets.org/sectors/Steel
[107] https://iea.blob.core.windows.net/assets/beceb956-0dcf-4d73-89fe-1310e3046d68/NetZeroby2050-ARoadmapfortheGlobalEnergySector_CORR.pdf
[108] https://www.uts.edu.au/research-and-teaching/our-research/institute-sustainable-futures/our-research/energy-futures/one-earth-climate-model