

Green Steel Tracker 2.0: methodology for tracking and classifying announcements of low-carbon-emission projects in the iron and primary steel sectors.

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Emissions stemming from the steel sector contribute approximately 2.8 gigatonnes of CO₂ annually, equating to roughly 7% of the global CO₂ emissions and approximately 5% of emissions within the European Union (European Commission, 2022; IEA, 2023). These emissions play a pivotal role in elevating Earth's temperature ultimately contributing to climate change. To align the iron and steel industry with the objectives outlined in the Paris Agreement, which aim to cap global warming at no more than 1.5°C above pre-industrial levels, substantial reductions in carbon dioxide emissions is imperative.

The emission intensity of primary steel production from iron ore surpasses secondary steel production based on scrap. The most common primary production technologies are the Blast Furnaces (BF) and Basic Oxygen Furnaces (BOF), resulting in an emission intensity of primary steel of approximately 2.3 tonnes CO₂ per tonne of crude steel. On the other hand, secondary steel production, which predominantly utilizes the Electric Arc Furnace (EAF) route, has lower emission intensity, estimated at around 0.7 tonnes CO₂ per tonne of crude steel (worldsteel, 2022a).

Past years has shown that mitigating carbon dioxide process emissions from primary steel production is possible through the implementation of technologies powered by non-fossil energy sources. The options that rely directly on renewable electricity are, e.g., Molten Oxide Electrolysis (MOE) and EAF, and indirectly, through direct reduced iron using green hydrogen (H-DRI). The Green Steel Tracker developed by LeadIT aims to monitor the progress of initiatives developing and utilizing these technologies and that are part of a large-scale and time-bound company-wide plan for decreasing steel's carbon dioxide emissions.

This methodology document aims to describe the criteria used when including low-carbon-emission projects in the iron and steel industry within LeadIT's Green Steel Tracker. Additionally, it aims to describe the benchmarks used to assess the level of detail and transparency of project announcements. This methodology is presented as an iteration of a previous version of the Green Steel Tracker methodology, with the vision of fulfilling the demand for detailed and transparent information on low-carbon iron and steel production.

1. Green Steel Tracker objectives

The core objectives of the tracker are outlined as follows:

Consolidation and Classification of Low-Carbon Projects in the Primary Steel Sector

1. Categorization of steel manufacturers: Distinguish between project announcements originating from well-established steel manufacturers with current production capacities and emerging steel producers in the early stages of corporate strategy and plant development.
2. Identification of strategic technological shifts: Prioritize the inclusion of the most ambitious projects that are shifting away from fossil fuel sources and have the potential to enable important emission reduction in primary steel production. This includes transitions away from conventional Blast Furnaces (BF) and Basic Oxygen Furnaces (BOF) towards less carbon-intensive alternatives such as Hydrogen Direct Reduced Iron (H-DRI), Molten Oxide Electrolysis (MOE), Electric Arc Furnace (EAF), and other innovative pathways. Other alternatives such as CCS with biomass use, are important options, but have seen less commercial traction, are grouped under complementary tracking.
3. Grading Transparency: Present low-carbon steel production initiatives centred around primary steel production, categorized according to the extent of transparency on project details disclosed in announcements.

Compilation and Display of Climate Pledges for 2030 and 2050 by Leading Steel Manufacturers

Collate and present the climate commitments articulated by the top 50 volume steel producers, spanning both the short-term horizon of 2030 and the long-term projection through to 2050.

By adhering to this method, the tracker aims to provide an inclusive and comprehensive repository, with the highest degree of transparency, containing pertinent information regarding low-carbon initiatives within the primary steel sector and showcase the climate commitments of the leaders in steel production. This holistic approach aims to contribute to the monitoring of decarbonization practices and strategies within the steel industry, aligning with the overarching objective of industry transition.

2. Green Steel Tracker project selection

2.1. System Boundaries

The data collected for the tracker, and made available at LeadIT’s website, focuses on public announcements of low-carbon primary steel production. The key reason is that while both primary and secondary steel production routes contribute significantly to process emissions intensity, the emission intensity of primary steelmaking is about three times that of its secondary counterpart. In addition, the secondary steel-making process is primarily using EAFs, which does not necessitate a process change to be decarbonised. EAF emissions can be almost entirely reduced by changing to renewable electricity.

The projects included in the tracker aim at mitigating emissions originating from the steelmaking process and new BF-BOF capacity announcements in general are not considered as the main tracking but are kept as complementary tracking if equipped with CCS. A depiction of the technology tracking system boundary can be found in Figure 1.

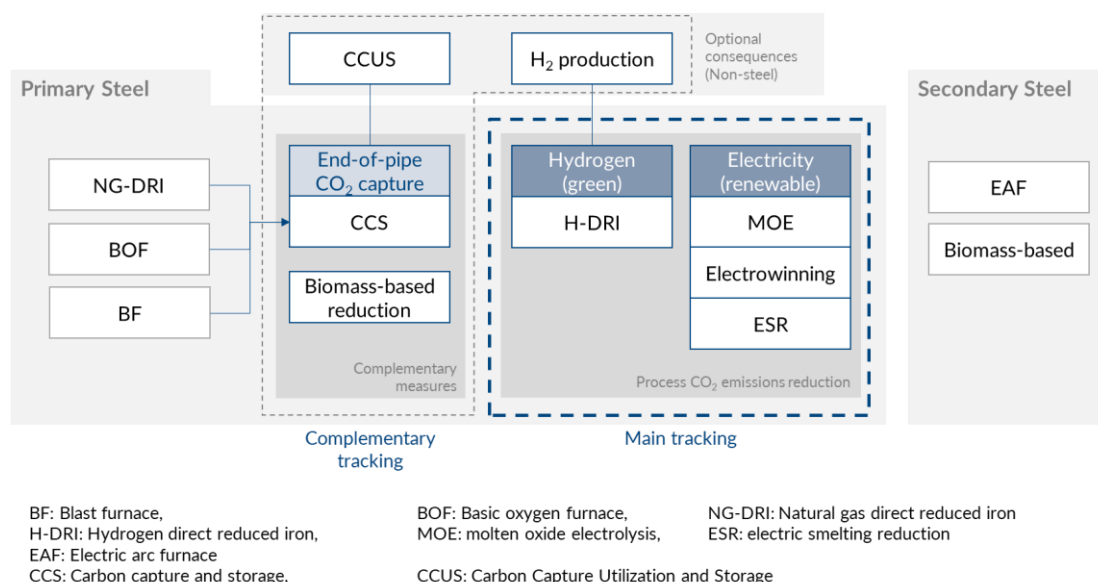


Figure 1. System boundaries for the selection of the low-carbon projects considered in the Green Steel Tracker.

Main tracking

The main project tracking is focused on iron and steel projects using **renewable energy and renewable-sourced hydrogen**. Primary steel production technology using renewable electricity directly includes but is not limited to, molten oxide electrolysis (MOE), electrowinning and electric smelting reduction (ESR), and the indirect use includes but is not limited to renewable sourced hydrogen for direct reduced iron (H-DRI). All these offer alternatives for primary steel production. The tracker includes all project announcements where renewable sourced hydrogen—commonly known as green hydrogen—is employed for the direct reduction of iron. In some cases, direct reduction project announcements outline a gradual transition from natural gas (NG) to hydrogen as the fuel source. Such projects, when they have a clear ambition for progressive evolution toward hydrogen, are incorporated into the tracker.

Complementary tracking

Complementary tracking considers the announcements of certain carbon capture and storage (CCS) projects, additional initiatives to produce green hydrogen associated with steel plants, and the utilization of biomass-derived substitutes for conventional coal and coke, such as biochar.

Projects that depend exclusively on CCS, without replacing the blast furnace-basic oxygen furnace (BF-BOF) setup are subjected to thorough evaluation. This includes the climate commitments of the steel producer, clarity on how to achieve high mitigation levels with complementary biomass, and the timeline and status of applying CCS. An example of this classification could involve a steel manufacturer forging a partnership with diverse industrial stakeholders to showcase the CCS technology or progressive developments from pilot to demonstration plants toward larger-scale deployment.

Although the tracker focus is on the implementation of H-DRI, it is relevant to monitor parallel production of green hydrogen by the steel manufacturers. An example of when this could be included is a steel producer's announcement of the production of green hydrogen in collaboration with other partners, but without explicitly specifying the use of said hydrogen in the steel production process.

Announcements of projects employing biomass-based energy sources, specifically biochar (also referred to as bio-charcoal) are also included in the complementary scope. However, such project announcements are only included if the biomass source is transparently articulated, and its sustainable sourcing is verified.

Regarding secondary steel production, projects announcing a shift from primary using BF-BOF to secondary steel production using electric arc furnace (EAF) are reviewed but not actively included in the tracker due to limited additionality to CO₂ mitigation at the global level. That is, although a transition to EAF leads to emission reductions for the producer in question, the scope for expanding secondary steel at the global level is limited, and the primary steel must be produced by another supplier when the first supplier shift strategy to secondary steel.

2.2. Project selection process

All projects included in the tracker are considered to have good intentions to decarbonise steel production. Based on this premise, the selection of projects relies on the extent of information available within the project announcements to classify the project and the iron and steel company climate commitments. Going further, the assessment of project announcement transparency is based on the comprehensiveness of the announcements. The objective of this screening and selection process is to establish a transparent and informative classification system that represents the varying levels of transparency exhibited by each low-carbon-emissions steel project. Project selection is guided by the following questions:

Set of guiding questions for project selection and inclusion

General assessment

- Is the project focusing on primary steel production?
- Are basic project data details (scale, timeline, technology to be used) available?
- Which type of company (existing or emerging) is hosting the project?
- What are the investment strategies (greenfield or brownfield) for the projects?
- What are the climate targets of the steel producer leading the project?

Specific assessment

- Which projects fall into the main tracking? *Such projects intend to transform steel production processes to reduce emissions.*
- Which projects fall into the complementary tracking? *Such projects plan to use complementary measures such as capture end-of-pipe emissions or hydrogen production associated with iron and steel decarbonisation.*

- Which projects fall into the weak ambition tracking? *Such projects are not tied to company-wide climate targets.*

By asking these questions, the Green Steel Tracker intends to reveal how detailed green steel project announcements are and thereby the transparency level. The categorization of the level of detail provided in the project announcement, is outlined in the flow diagram presented in Figure 2. Projects are first classified in three types of tracking: main, complementary, and weak. The specific technology options for each tracking category are listed in Table 1.

Table 1. Type of tracking according to project and technologies considered. (: not limited to these technologies only)*

Type of tracking	Characteristic	Technologies included*
Main tracking	Carbon direct avoidance	H-DRI (renewable sourced hydrogen) MOE Electrowinning ESR EAF using green iron
Complementary tracking	Carbon capture and hydrogen production	CCS/CCUS for BF-BOF Biomass-based reduction H ₂ production (renewable sourced)
Weak ambition tracking	Steel producer has not publicly available climate targets but has announced a low-carbon steel production project	All of above

In the project selection flowchart, guiding questions are asked to determine i) if the project relates to primary steel production, ii) in which type of tracking category the project should be included and iii) the level of transparency of the project announcement. The details of each level of transparency are presented in Table 2.

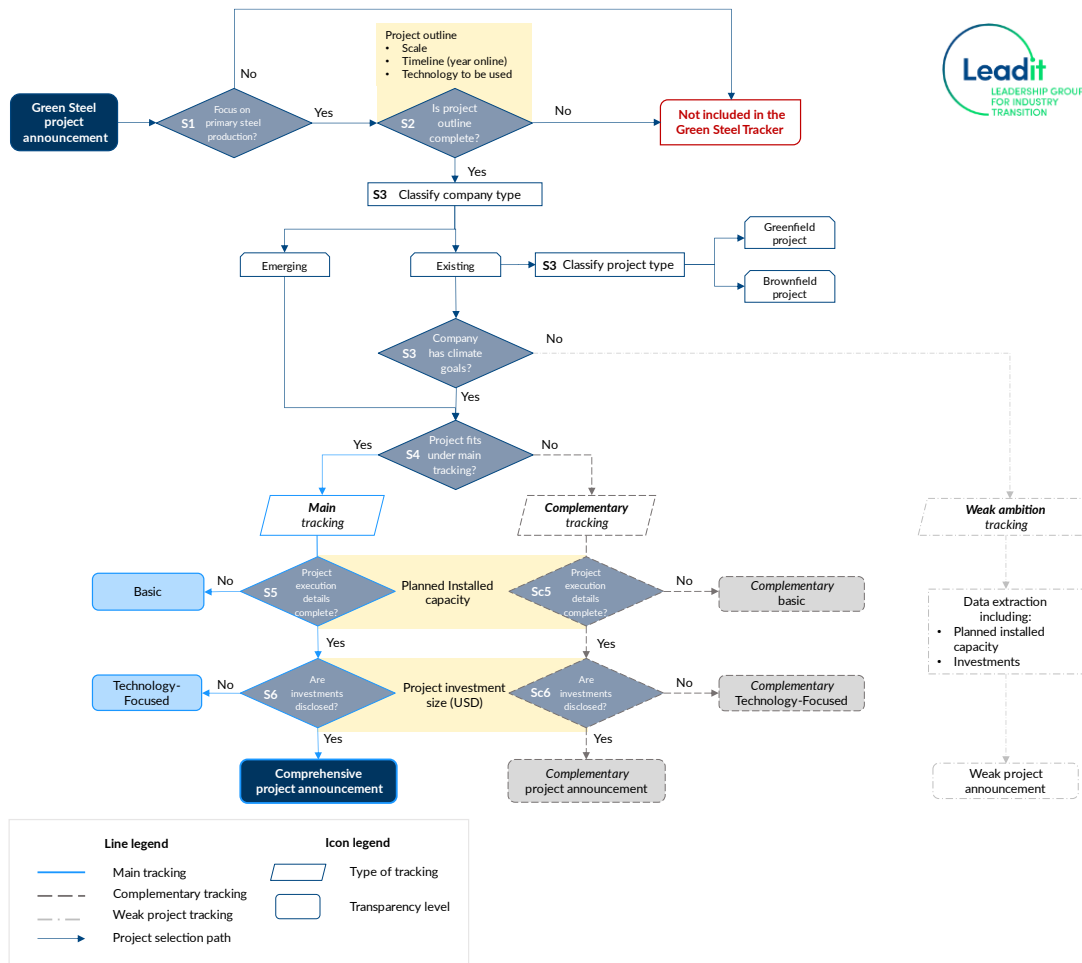


Figure 2. Project selection and transparency levels according to the available information

Table 2. Project classification according to transparency level – Applicable for projects from steel producers with defined climate goals

	Main tracking Carbon direct avoidance	Complementary tracking
<p>Basic announcement</p> <p>Projects with basic information on limited parameters, such as scale, timeline, and technology to be used.</p> <p>No details about capacity to be installed</p>	Basic	Complementary basic
<p>Technology-Focused announcement</p> <p>Projects with <u>basic</u> information and details in capacity to be installed.</p> <p>Strong emphasis on the chosen technology details</p> <p>No details the project investment size</p>	Technology-focused	Complementary Technology-focused
<p>Comprehensive project announcement</p> <p>Projects including details on <u>basic</u> information, <u>technology</u> to be used and <u>investments</u>.</p> <p>Data points include: installed capacity, timeline, year of start of operations, capacity to be installed for iron and steel, and investment size.</p> <p>Priority is given to projects focusing on carbon direct avoidance.</p>	Comprehensive project announcement	
<p>Complementary project announcement</p> <p>Projects under complementary tracking with details on <u>basic</u> information, <u>technology</u> to be used and <u>investments</u>.</p> <p>Restricted to projects with focus on carbon capture and hydrogen production</p>		Complementary project announcement

To further explain the flowchart introduced in Figure 2, the more detailed steps employed in classifying the project announcements by transparency level are as follows:

S1 Step 1: Focus on primary steel production?

Projects included in the Green Steel Tracker correspond to primary steel production. Projects aiming to transition from primary steel to secondary steel production or those involving a change of technology in secondary steel production are not considered.

S2 Step 2: Is project outline complete?

The most basic information about green steel projects is named here as the *project outline*. For a project to be considered, the complete project outline should be available, encompassing:

- Project scale (pilot, demonstration, full scale)

- Project implementation timeline (Year online)
- Technology to be utilized

In this step, a screening for these elements is performed. If any of the project outline elements are absent, the project is not considered.

S3 Step 3 – Classify company type, project type, and verify if *Company has climate goals?*

To be able to use the tracker data to monitor both the transformation of existing assets as well as new production capacity, we classify projects as belonging to existing companies or emerging companies and note if investments by established actors are brownfield or greenfield. A classification by nature of companies and investments is made to facilitate the differentiation between established steelmakers and new participants in the market.

For the projects belonging to existing companies, in this stage it is verified if the iron and steel companies have defined climate commitments. If the company has climate goals, the assessment continues to Step 4.

- If the company does not have ambitious goals, ideally Paris Agreement aligned, the project is assessed separately under the weak ambition category.

S4 Step 4 – *Project fits under main tracking?*

Considering that the company leading the project has climate goals, the project announcement is screened to assess whether the project aligns with the main tracking focus or not.

As presented in Figure 2, if the project qualifies for main tracking, it follows the path of *Main tracking*, and if not, the path of *complementary tracking*.

- A project on the path of Main tracking aims to transform the iron and/or steel production process from the BF-BOF route to a lower emission intensity route. This is evaluated according to the technology system boundaries presented in Figure 1 and Table 1.
- A project on the complementary tracking path relates to primary steel production but does not aim to directly remove iron and steel process emissions. Projects included in *complementary tracking* can either be linked to CCS or CCUS technologies which capture end-of-pipe emissions, or hydrogen as presented in Table 1. Hydrogen production projects are related to steel plants generating H₂ without clearly specifying whether the hydrogen will be used for steel production.

Complementary projects are considered with caution, particularly if there is no information regarding any upgrades of existing BF-BOF equipment to capture carbon emissions, thus locking in further emissions.

S5 Step 5 – Are project execution details complete?

Details from project execution are collated in this stage according to the path chosen in the previous step. The type of details may vary as follows:

S5 - Main tracking	Sc5 – Complementary tracking
<p>The project announcement is screened for details about the iron and steel production capacity.</p> <p><u>Required details:</u></p> <ul style="list-style-type: none"> • Iron production capacity in Mtpa • Steel production capacity in Mtpa <p>If this data is absent from the announcement, it is classified as a “basic” announcement.</p> <p>If the data is available, the evaluation proceeds to the next phase (S6).</p>	<p>The project announcement is screened for details about the carbon capture capacity or the hydrogen production capacity.</p> <p><u>Required details:</u></p> <ul style="list-style-type: none"> • Carbon capture capacity in tCO₂/year • H₂ production capacity in MW <p>If the project lacks this information, it is classified as “<i>Complementary basic</i>” announcement.</p> <p>If the data is available, the evaluation continues to the next phase (Sc6).</p>

S6 Step 6 – Are investments disclosed?

In this phase, the project announcement is examined to collect investment data. Disclosure of investment size indicates that an estimation of the resources required for project execution has been conducted.

S6 - Main tracking	Sc6 - Complementary tracking
<p><u>Required details:</u></p> <ul style="list-style-type: none"> • Size of investment towards the specific project <p>If the project lacks this information, it is classified as a “Technology-Focused” announcement.</p> <p>If the investments are available, the project is classified as a “Comprehensive project announcement”.</p>	<p><u>Required details:</u></p> <ul style="list-style-type: none"> • Size of investment towards the specific project <p>If the project lacks this information, it is classified as a “<i>Complementary Technology-Focused</i>” announcement.</p> <p>If the investments are available, the project is classified as a “<i>Complementary project announcement</i>”. This indicates that although the information is complete, the project is not focused on the main tracked technologies.</p>

3. Leading steel producers' climate commitments

In addition to new project announcements, the tracker also monitors the climate commitments of the top 50 volume steel producers. For this, only existing companies that have tangible steel production volumes according to the World Steel annual report (worldsteel, 2022b) are considered. Climate commitment data is sourced from company reports and press releases.

First, publicly available information about the company goals for 2030 and 2050 is extracted and reported as the targeted emissions reduction, this is accompanied by the baseline year used. The purpose of this assessment is to identify which companies have established a target to be carbon neutral by 2050, have higher ambitions and aim to be neutral before 2050, and which indicate they will reach it only after 2050. Lastly, companies with no target year for carbon neutrality are listed.

Second, the scope of greenhouse gas emissions reduction is identified. For this, the GHG Protocol emissions' scope is followed. The review results in identifying which companies commit to reducing direct emissions (scopes 1 and 2) and which commit to reducing direct and indirect emissions (scopes 1, 2 and 3). If no emission scope is pursued, this is noted.

4. Sources of uncertainty

Confidential projects and information not publicly announced are not tracked and no data of this kind is gathered. Hence, projects might be overlooked if no public announcements are made.

Companies are encouraged to get in touch with [The Secretariat](#) if a project that was recently announced is not considered in the tracker. The Secretariat will validate that the announcement information is public and feed it to the tracker.

Language is a barrier and might slow or prevent the identification of projects with language different than Swedish, English, and Spanish.

5. Validation

Project selection and data collection are performed to ensure that the green steel projects included in the tracker are aligned with the tracker's objectives.

Publicly available announcements: all project announcements included in the tracker have been published in online publicly accessible material. Confidential information is not considered in data collection nor included in the tracker.

Source verification: sources of information used include official project announcements, industry reports, relevant media outlets, and relevant and reputable publications. URLs to the information source can be found in the tracker database and the users can verify them.

Source traceability: Sources and their URLs may change after being published. To overcome this obstacle, all sources included in the tracker dataset are, from this methodology update, stored in a cache service (i.e., the Internet Archive <https://web.archive.org/>). This should enable users of tracker dataset to access the sources included going forward.

Methodology alignment: Projects are evaluated against predefined criteria established by the tracker methodology to determine their compatibility with the tracker's focus on low-carbon steel production and company climate commitment.

Peer review: The methodology and dataset are peer-reviewed by experts within the steel decarbonisation field who review the dataset before updates are published. The review includes an assessment of alignment to the tracker methodology. Peer review is conducted by experts at Lund University.

Collaboration projects: If projects involve collaborations, partnerships, or joint ventures, the nature of these collaborations is verified in more than one source.

Regular Updates: Data validation is an ongoing process. As new information becomes available, existing project details are collected and reviewed. General updates of the tracker and dataset are uploaded at least once every six months.

6. References

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