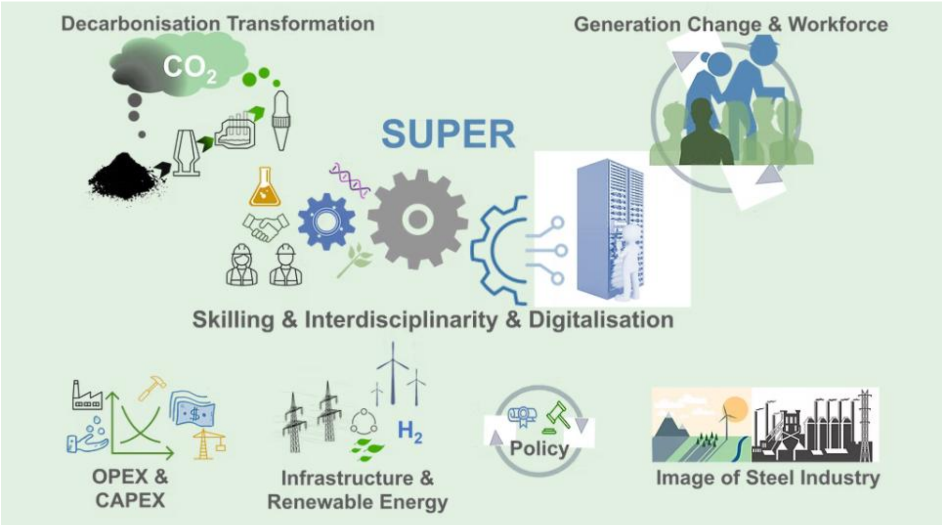
Topic: RFCS-2024-02-AM
Granting authority: European Research Executive Agency
Project starting date: 1 June 2025
Project end date: 31 May 2027

Funded by the European Union

Sustainable fUture steel Production and pEople Recruiting and skilling



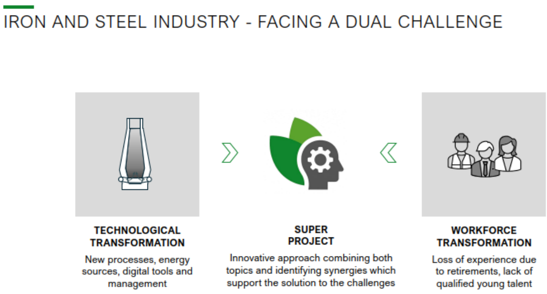
Newsletter n. 1

Decarbonising Steel: Technology Pathways for a Climate-Neutral Future

The European steel industry stands at the centre of one of the most ambitious industrial transformations ever undertaken. Achieving climate neutrality while maintaining competitiveness, security of supply and industrial sovereignty requires a fundamental rethinking of steel production technologies and value chains.

To discuss these challenges and opportunities, the SUPER project organised in Feb 2026 a webinar dedicated to **decarbonisation technologies in the iron and steel industry**, bringing together experts and stakeholders to review current developments, future technology pathways and the next steps towards low-carbon steel production.

The Dual Challenge Facing the Steel Industry: European steel producers are confronted with two major transitions occurring simultaneously.

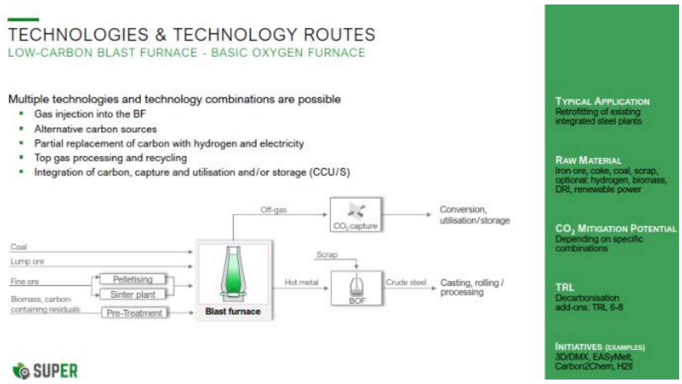


Technological Transformation : industry must adopt new production routes, renewable energy sources, digital solutions and innovative process configurations to drastically reducing CO_2 emissions.

Workforce Transformation: companies face demographic challenges, including the retirement of experienced workers and increasing competition for highly skilled young talent to implement and operate future technologies. The SUPER project was established just to address these interconnected challenges by linking technological innovation with recruiting, skilling & workforce development.

Exploring the Main Decarbonisation Routes: The webinar presented a review of key technology pathways currently being developed and demonstrated across Europe. These technologies differ in maturity, infrastructure requirements and potential contribution to climate neutrality

The Main Routes

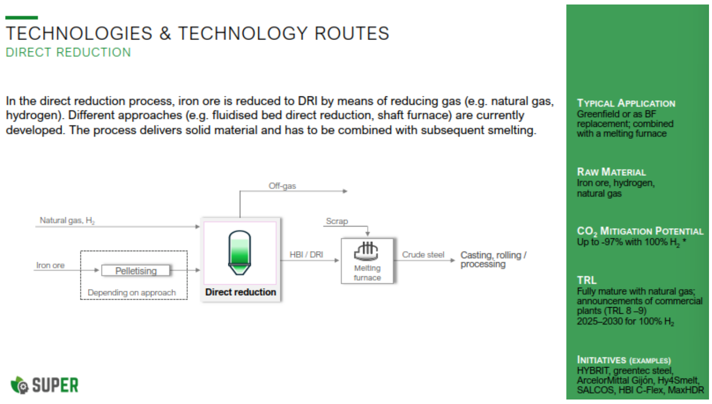


Low-Carbon Blast Furnace – Basic Oxygen Furnace (BF-BOF)

Existing integrated steel plants can significantly reduce emissions through process improvements such as:

- hydrogen injection;
- top-gas recycling;
- alternative carbon sources/biomass;
- carbon capture, utilisation and storage (CCUS).

These solutions offer pathways for retrofitting existing facilities while maintaining production capacities. However, challenges remain regarding hydrogen availability, carbon management infrastructure and commercial-scale CO_2 capture deployment.



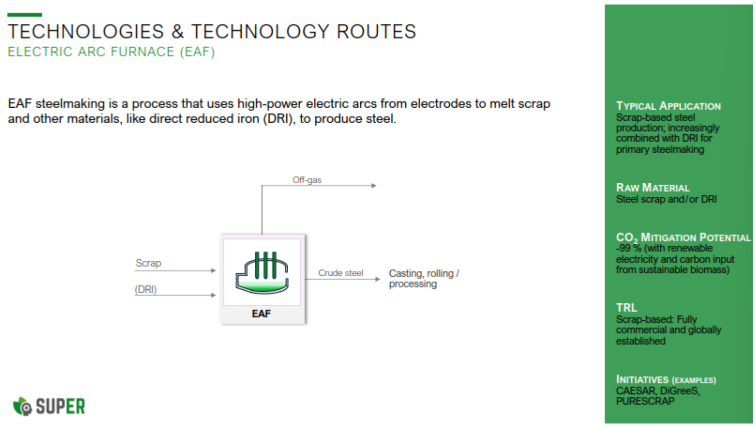
Hydrogen-Based Direct Reduction (DRI)

Direct reduction technologies are becoming one of the most promising decarbonisation routes.

By replacing fossil reducing agents with hydrogen, emission reductions of up to 97% may be achievable under favourable conditions. Several major European projects are already advancing commercial implementation.

Key challenges include:

- ***availability of DR-grade iron ore;***
- ***green hydrogen supply;***
- ***renewable electricity requirements;***
- ***hydrogen transport and storage infrastructure.***

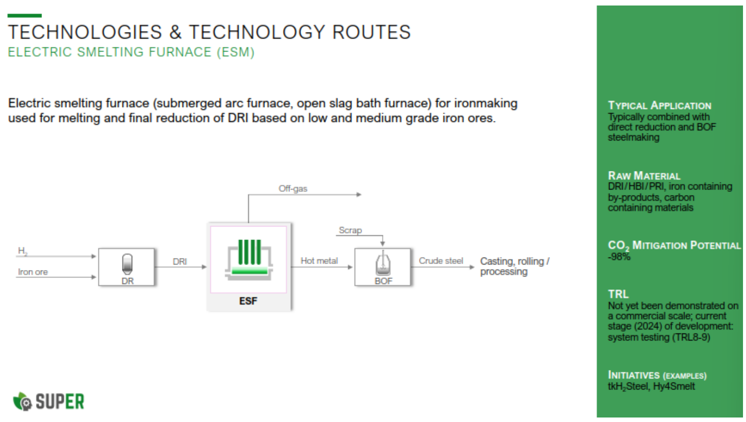


Electric Arc Furnace (EAF)
Electric Arc Furnaces already represent one of the most mature low-carbon steelmaking solutions.

When powered by renewable electricity and supplied with high-quality scrap or low-carbon DRI, EAF-based production can achieve extremely low carbon footprints while enabling a more circular steel economy.

Future development priorities include:

- ***improving scrap quality and availability;***
- ***advanced sorting technologies;***
- ***increased recycling efficiency;***
- ***enhanced process digitalisation and control.***



Electric Smelting Furnace (ESF)
Electric smelting technologies are emerging as a promising complement to direct reduction routes.
These processes enable efficient treatment of DRI and lower-grade iron ores while supporting highly flexible low-carbon production systems.
Several large-scale demonstration initiatives are currently progressing towards industrial deployment.

Key challenges:

- ***Large-scale green hydrogen production, transport and storage infrastructure needed***
- ***Availability of renewable carbon input and renewable electricity needed***
- ***Furnace design of a smelter, detailed design of the process route (beneficiation of the ore to higher qualities, carbon content, and metallisation of DRI, carbon in smelter hot metal, optimized scrap rates, etc.).***

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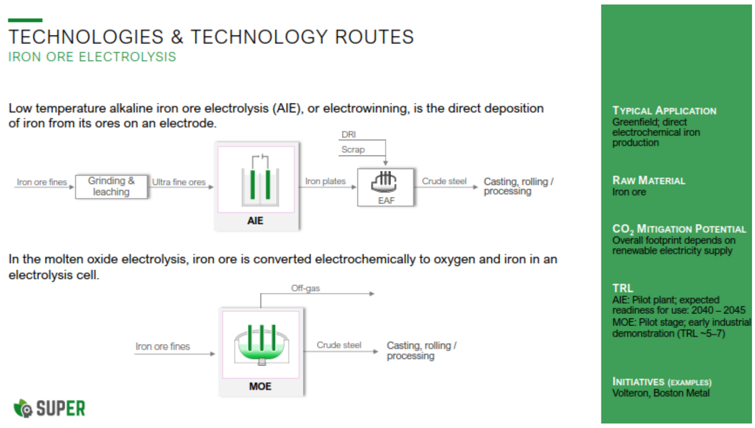

Iron Ore Electrolysis

Looking further into the future, electrochemical production routes may offer completely new methods of producing iron without conventional reduction processes.

Both Alkaline Iron Electrolysis (AIE) and Molten Oxide Electrolysis (MOE) are under development and could become commercially relevant between 2035 and 2045

While these technologies promise substantial emission reductions, they will require large quantities of renewable electricity and further technological development before widespread deployment becomes possible.

The Supporting Role of Carbon Capture

Carbon Capture, Utilisation and Storage (CCUS) technologies are expected to play an important role across several steelmaking routes. Current European research and demonstration projects are exploring ways to integrate capture systems into steel plants while creating new opportunities for CO_2 utilisation in industrial ecosystems. Continued development of transport, storage and utilisation infrastructure remains essential for large-scale implementation.

Looking Towards 2050: A key objective of the **SUPER project** is to develop updated decarbonisation scenarios for the European steel industry for **2030, 2040 and 2050**. Taking into account current economic and geopolitical developments, the project is assessing future production levels, technology deployment pathways, CO_2 reduction trajectories, renewable electricity demand, hydrogen needs, and raw material requirements.

To support decision-making, SUPER is developing three complementary scenarios:

- **Reference Scenario**
- **Mixed Implementation Scenario**
- **Impact-Based Scenario**

These scenarios will provide stakeholders with a clearer understanding of the pathways and conditions needed to achieve a successful industrial transition.

The Road Ahead - The decarbonisation of European steelmaking will not be achieved through a single technology. Instead, it will require a combination of solutions, including **hydrogen-based processes, electrification, circular economy approaches, carbon management, digitalisation, and workforce upskilling**.

*By combining technology assessment, stakeholder engagement, and workforce-focused activities, the **SUPER project** aims to contribute to a realistic and sustainable roadmap for a competitive, low-carbon European steel industry by 2050.*