Gradual integration of renewable Carbon and alternative non-Carbon energy sources and modular heating technologies in EAF for progressive CO_2 decrease

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ESTEP Spring Dissemination Event 2023
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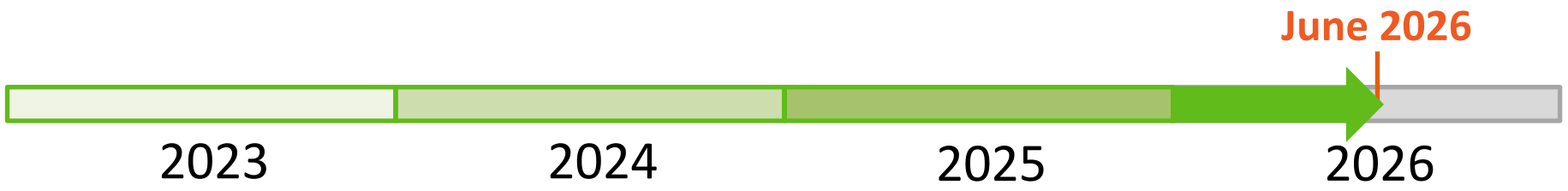
Key Data



Project key facts:

- Duration: 42 months (January 2023 – June 2026)
- Budget: 3.5 million Euro
- Type of Action: Innovation Action

CALL TOPIC: HORIZON-CL4-2022-TWIN-TRANSITION-01-16 Modular and hybrid heating technologies in steel production

Consortium

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European Steel Technology Platform

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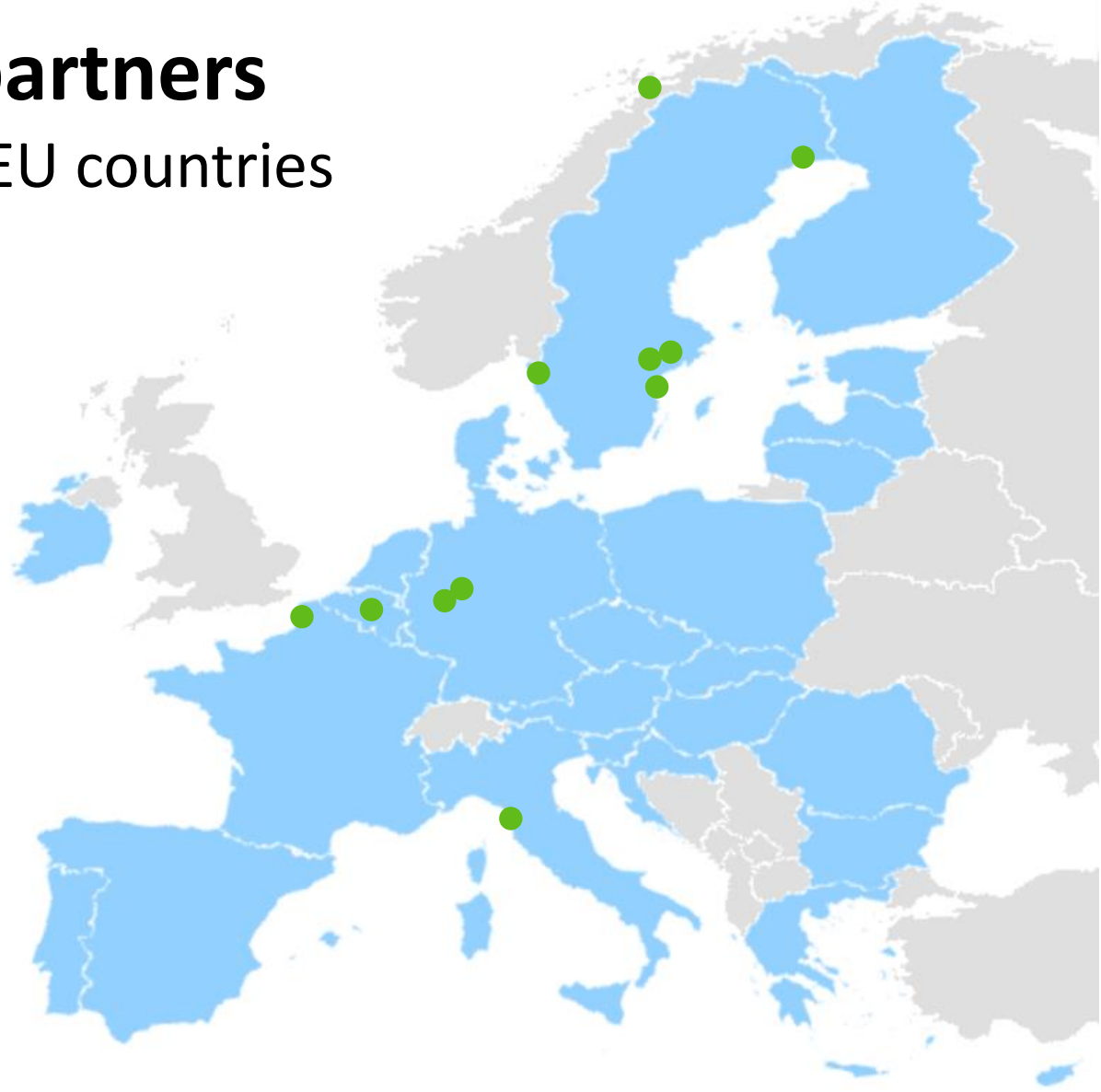
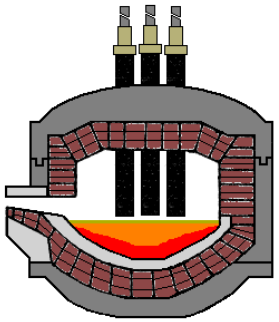
11 partners
from 6 EU countries

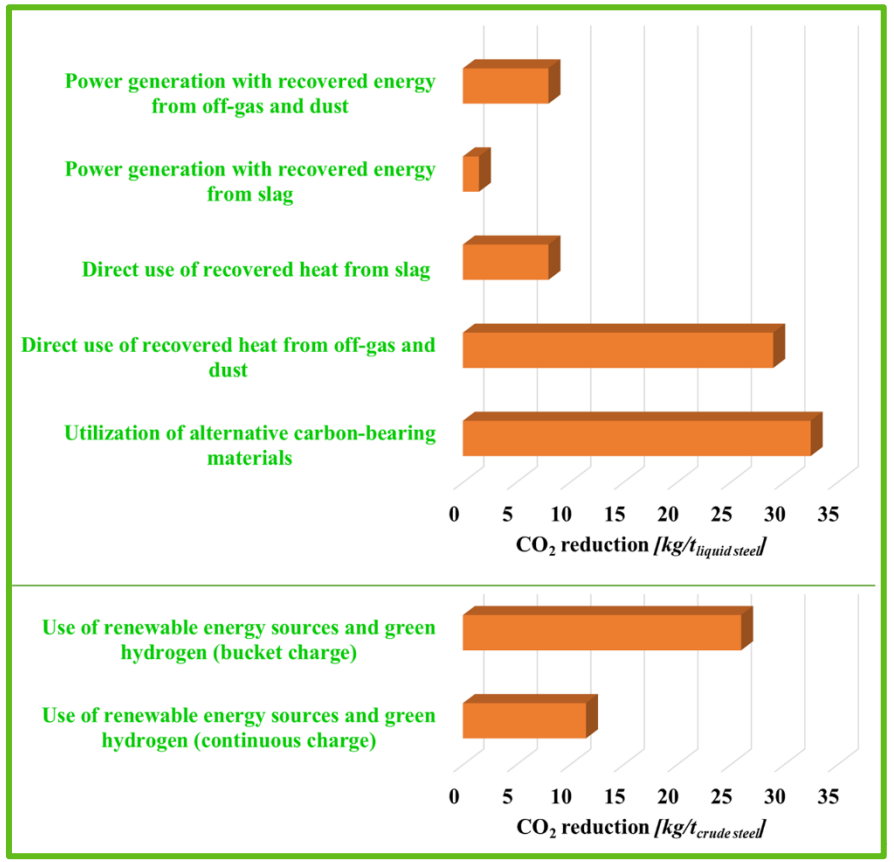


Background



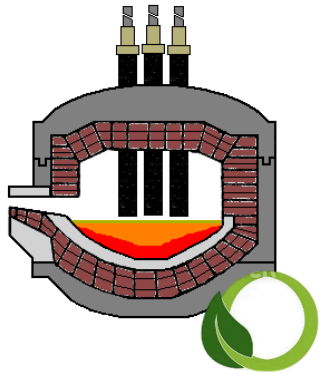
EAF-based steelmaking plays a fundamental role in the decarbonization of steel production, being at the core of the “circularity of steel” as well as strategic for the application of CDA and SCU technologies

Average potential CO_2 savings in EAF-based steelmaking related to integration of non-fossil and renewable energy sources, modular heating technologies and alternative heat recovery*.



ESTEP, Improve the EAF scrap route for a sustainable value chain in the EU Circular Economy scenario, 2021

Demands and overall project objective



EAF steelmaking process needs to adapt to new challenges:

- change from fossil C and energy sources to bio-based C and green H_2;
- use of different iron carriers from first grade scrap to more DRI/HBI with various C-content and low-grade scrap;
- decrease of heat/energy losses with advanced/modular recovery technologies and advanced control systems;
- material valorization considering by-products changes.

Project Objective: to demonstrate the integration of non-fossil fuels and renewable C-sources in EAF process to decrease CO_2 emissions and dependence from fossil energy and C-sources markets by also focusing on improvement of heat recovery solutions.

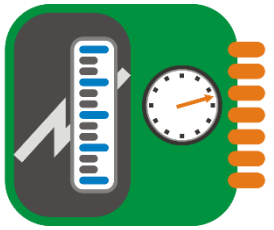
Detailed technical objectives

- Integration of **non-fossil gases flows** in EAF processes with different charge materials and configurations towards GHG reduction and green transition of steelmaking

- Development of **modular regenerative and alternative heating technologies** for increasing in-process **heat recovery from off-gases** and **maximizing slag latent heat exploitation** for their valorization.

- Demonstration of the technical feasibility of **biomass/biochar exploitation for non-fossil energy intake** in EAF process ;

- Coupling of **novel measurement techniques** and **optimized control strategies** to manage exploitation and facilitate integration of novel non-fossil heat/energy sources and streams.



Overall project concept

GreenHeatEAF will adapt, develop and demonstrate technologies for integrating non-C gases and renewable C-materials and for obtaining a wide control range of the whole heat capacities in EAF processes considering **EAF role in both scrap- and iron-based route**.

3 uses cases:

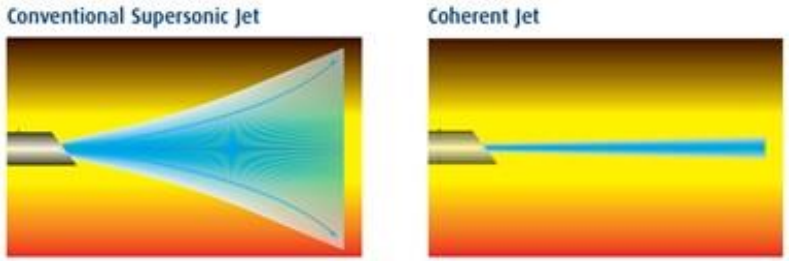
- Integration of non-C gases flows;
- Fossil C-sources replacement with biomass/biochar;
- Modular and alternative heat recovery.

Parallel and complementary application of:

- **Demonstration and Pilot Tests,**
- **Digital Simulations**
- **Monitoring and Control strategies**.

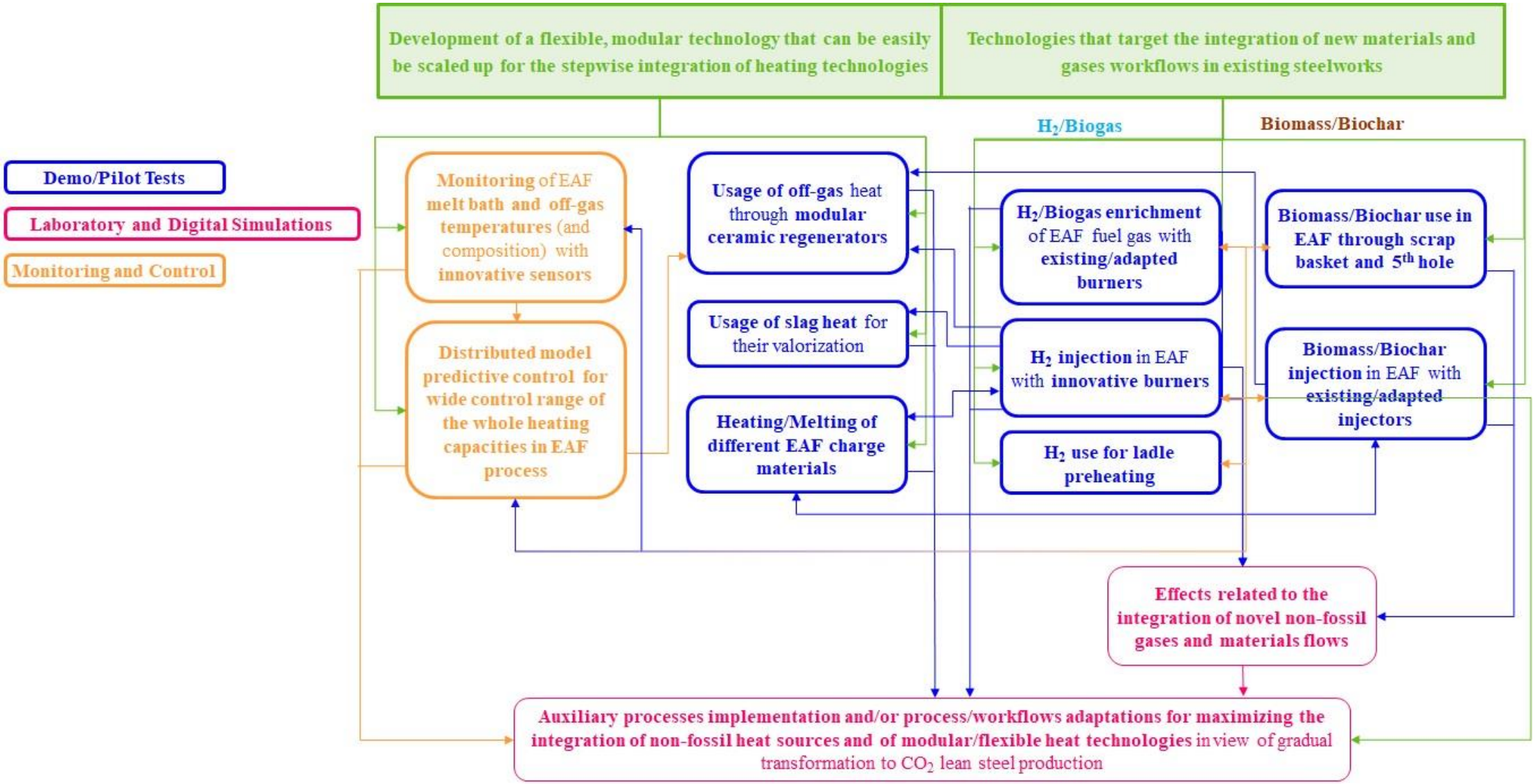
Foreseen progress beyond State of the Art

- **Hydrogen Enhanced Combustion** (HEC) pilot tests with LINDE's Coherent Gas injection technology (CoJet)
- **Heat recovery** from off-gas (novel ceramic recuperator) and slags



- Demonstration of **H2 use** and **biomass injection** in EAF in a wide range of scenarios and considering the integration of H2 production (e.g. by electrolysis) and of biomass production/upgrading in steelworks
- Improved knowledge on the effects of charging methods, H2 and biomass injection on off-gas profile and EAF slag chemistry.
- **New value chain for future EAF slag** to make it suitable for cement production
- **Novel CFD model** covering influence of suction speed, furnace pressure and false air ingress on post-combustion reaction efficiency in EAF freeboard, and **extended EAF flowsheet models** covering **use of non-fossil fuels and renewable C sources**
- Test of a **contactless acoustic system to measure off-gas temperature**
- **Flexible and distributed control solution** to manage heat capacities

Mindmap


Development of a flexible, modular technology that can be easily be scaled up for the stepwise integration of heating technologies
Technologies that target the integration of new materials and gases workflows in existing steelworks
H2/Biogas
Biomass/Biochar
Demo/Pilot Tests
Laboratory and Digital Simulations
Monitoring and Control
Monitoring of EAF melt bath and off-gas temperatures (and composition) with innovative sensors
Distributed model predictive control for wide control range of the whole heating capacities in EAF process
Usage of off-gas heat through modular ceramic regenerators
Usage of slag heat for their valorization
Heating/Melting of different EAF charge materials
H2/Biogas enrichment of EAF fuel gas with existing/adapted burners
H2 injection in EAF with innovative burners
H2 use for ladle preheating
Biomass/Biochar use in EAF through scrap basket and 5th hole
Biomass/Biochar injection in EAF with existing/adapted injectors
Effects related to the integration of novel non-fossil gases and materials flows
Auxiliary processes implementation and/or process/workflows adaptations for maximizing the integration of non-fossil heat sources and of modular/flexible heat technologies in view of gradual transformation to CO2 lean steel production

GreenHeatEAF

Thank You for Your Attention!

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