March 2026

GreenHeatEAF newsletter #6

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

The project falls under the funding programme of Horizon Europe – Clean Steel Partnership.

The call topic is related to modular and hybrid heating technologies in steel production.

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This project has received funding from the European Union under Grant Agreement n° 101092328

In the context of the GreenHeatEAF project, process simulation plays a key role in complementing and extending the experimental and pilot trials in the investigation of the effects of using alternative carbon-bearing materials and hydrogen on the EAF-based steelmaking process and its products. Physical trials are time-consuming and expensive; thus, their number must be limited. Moreover, for economical, practical and safety-connected constraints, operating practices that are very far from common operations are seldom tested, despite being theoretically promising. In such a context, simulations that rely on a model which was tuned and adapted on real experimental data and proved to be reliable can expand the scope of the experimental investigations by enabling the investigation also of uncommon scenarios and/or the consideration of materials in quality and/or quantities that are not available for the practical test.

This newsletter is dedicated to one of the simulation models exploited within the project, i.e. the flowsheet model available at SSSA.

The adopted flowsheet model

The flowsheet model implemented represents the Electric Arc Furnace (EAF)-based steelmaking route up to the initial stage of Continuous Casting. It was originally developed to assess environmental and energy impacts of conventional and alternative operating conditions, but it was expanded and refined through time to enable detailed analyses of specific process aspects, including slag characterization. The model incorporates all the main steps typically involved in electric steel production: charging and melting operations, additions of materials and injections into the EAF, the EAF process itself, slag removal and tapping, additions during tapping and ladle transport, Ladle Furnace (LF) treatment, Vacuum Degassing (VD), the final stages of secondary metallurgy, and the first phase of continuous casting, namely the transfer of steel into the tundish.

The model structure allows the simulation of different phenomena and enables the estimation of key variables such as the quantity, temperature, and composition of molten steel at different stages of the process, slag mass and composition, electricity consumption, and overall mass and energy balances.

The input parameters of the model — e.g. metallic and non-metallic charges, process additions, target temperatures, gas injections, and minimum VD pressure—as well as the data used for model calibration (e.g., steel composition), correspond to variables that are commonly measured in industrial practice. As a result, the model can be readily adapted, validated, and applied to different steel plants and steel families (i.e. groups of steels with similar compositions). Moreover, its modular structure facilitates further modifications to perform targeted analyses.

"GreenHeatEAF contributes to gradual replacement of fossil fuels and fossil carbon materials with non-fossil gases and renewable C-sources. Therefore, GreenHeatEAF contributes to lowering NG, anthracite and coal exploitation, by decreasing GHG emissions through the use of sustainable gases (i.e., green Hydrogen, preferably internally produced) and materials (zero-impacting biomass)."

GreenHeatEAF

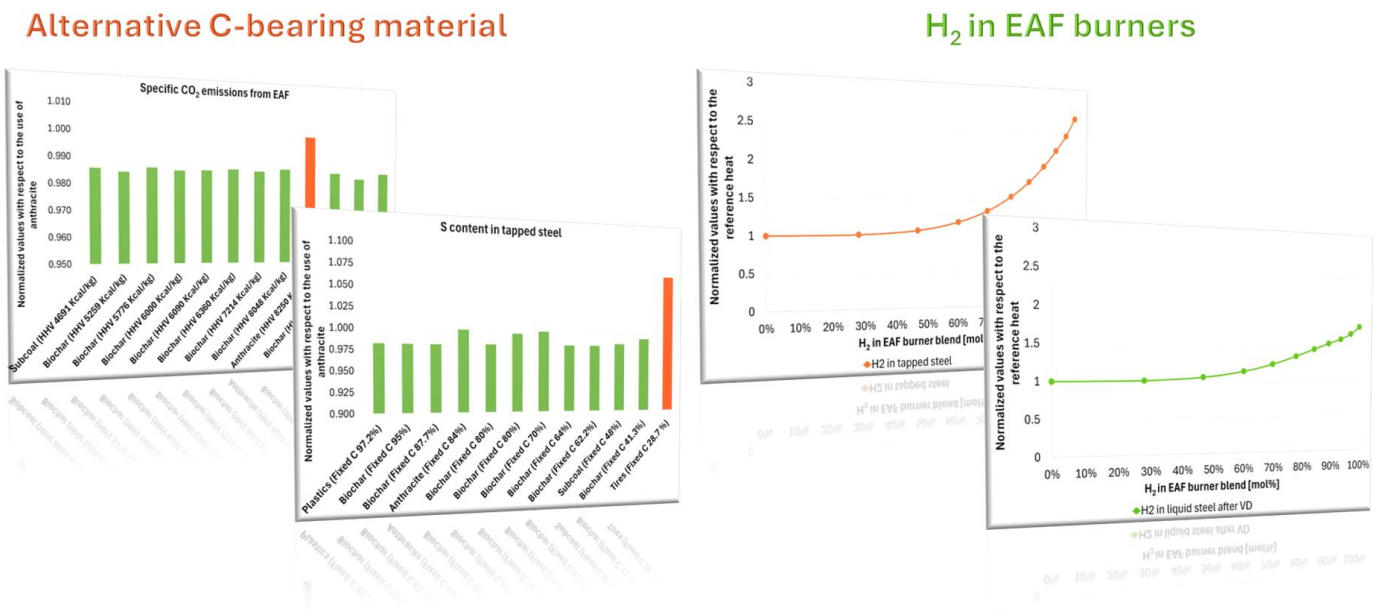

Figure 1. Examples of simulation results focused on the use of alternative C-bearing material in foaming process and hydrogen in EAF burners.

Use of the simulation asset within the project

Within GreenHeatEAF, the simulation asset of Scuola Superiore Sant'Anna has been further adapted and refined, especially as far as the EAF model is concerned, to consider the addition of alternative renewable Carbon-bearing materials (e.g. various types of biomasses and biochar, plastics), and the feeding of the EAF burners with blends of Hydrogen and Natural Gas. An extensive simulation study was carried out to assess the impact of different rates of replacement of fossil carbon charged or injected into the EAF on the steel and slag composition, fossil CO_2 emissions, EAF energetic requirements, etc.. This expands and complements the experimental investigations which were carried out by the industrial partners of the project, as these letter are obviously limited in number due to costs and time constraints. Moreover, sensitivity analyses related to the effects on steel composition of the use of hydrogen in EAF burners were also possible. In this latter context, the availability of a model representing the complete processing chain proved to be fundamental. In effects, the results of the simulations showed that, for instance, a higher Hydrogen content can be observed in some cases in the steel at EAF tapping, but we also proved that such slight increase can be easily faced and mitigated by the subsequent VD treatment, and, thus, does not negatively affect the quality of the final product.

Dissemination activities

The process simulation asset adopted within GreenHeatEAF has been preliminary presented in several scientific conferences, among which the *AISTech - Iron and Steel Technology 2025*, the *7th Conference on Clean Technologies in the Steel Industry (CTSI 2025)*, and the *7th European Steel and Application Days (ESTAD 2025)*.

Some results of the simulation are also discussed in an Open Access paper published in the important scientific journal *Steel Research International* and freely available at the following link.

https://onlinelibrary.wiley.com/doi/10.1002/srin.202501085

More information and some public documents are available on the project website

https://www.estep.eu/clean-steel-partnership/greenheateaf