AgiFlex Newsletter #1

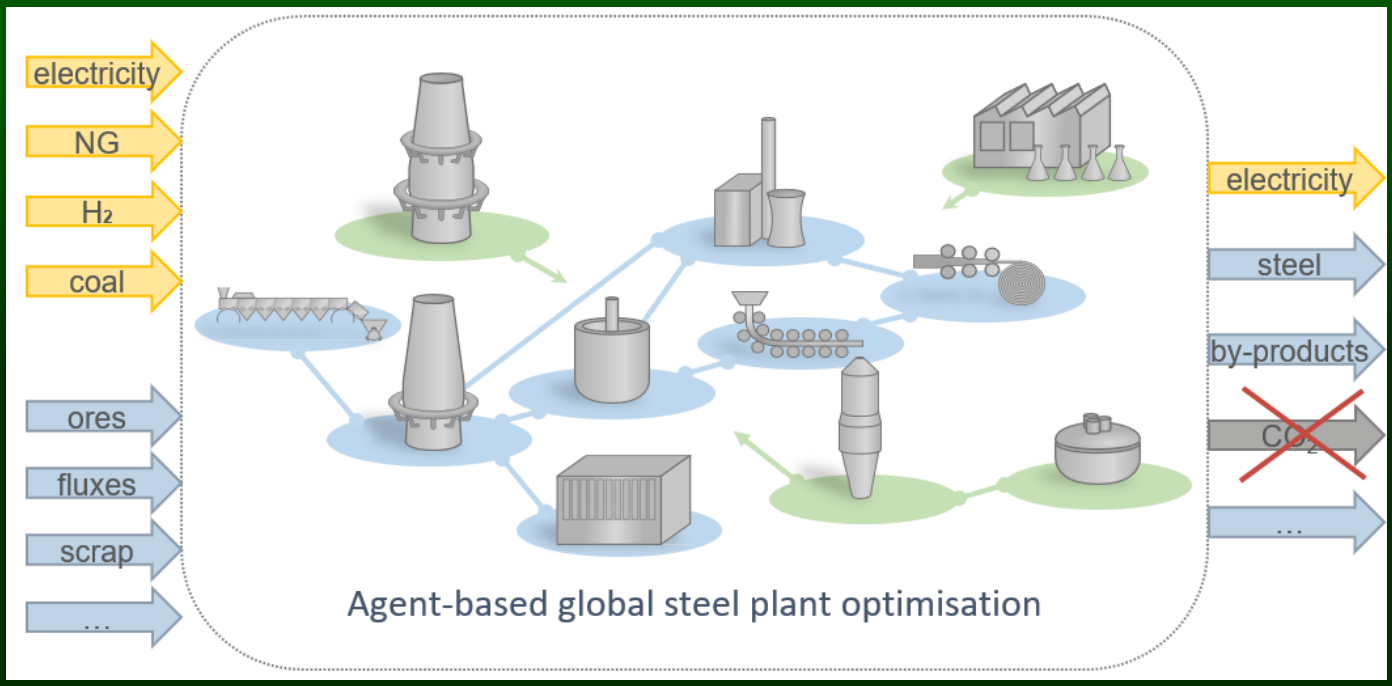
March 2025

The European industry is undergoing a transition of unprecedented scale to tackle climate change by planning introduction of new production processes. The gradual replacement of carbon by hydrogen as the main reductant will strongly increase the demand for renewable electricity, which will become an existential challenge for decarbonization. Availability and cost of possible energy carriers with low C-footprint cannot be accurately forecasted, thus the sustainability of the operation and investments cannot be reliably assessed by static scenario analysis. The energy crisis further emphasized the problem by inducing large short-term price fluctuations, primarily for electricity and gas.

The Challenge of the Project

Adequate tools are urgently needed for operation planning under fluctuating market conditions and decision-making concerning options to invest in more sustainable process steps to suppress carbon emissions during all phases of the green transition. **AgiFlex develops a generic agent-based computational tool by which the sustainability of steelmaking can be optimized, considering external and internal constraints**. It will apply digital twins for current and future production steps, with transfer functions expressing the relations between input and output material, energy, and CO_2 emissions. The agents estimating environmental and economic impact of the units, will be evolved by a distributed agent-based optimization algorithm that determines the best operation strategy or the best investment scenario with respect to the transition towards C-neutral operation of the plant.

Project co-funded by the Horizon Europe programme
G.A. 101138813



An innovative approach

State-of-the-art approaches based on fixed flowsheets cannot explore the whole space of plant configurations, particularly due to new possible points of operation of steelworks under transition, where traditional and new unit processes interact, e.g., by efficient use of gases. The breakthrough innovation of AgiFlex lies in the holistic agent-based tool for process and energy integration that finds promising operation points and configurations of the steel plant with respect to efficient carbon use without considering an a-priori fixed plant flowsheet. The considered processes include current as well as future steel production processes like Direct Reduction Plants, Electric Arc Furnaces, units of gas production (e.g., water electrolysers) and conversion (e.g., syngas reformers and CO_2 electrolysers), and external energy sources (e.g., electricity, natural gas, biomass).

The plant setup will strongly affect the quantities and qualities of available by-product gases and their potential points of use, which determines the final emissions of a steelworks. To further explore the potential to mitigate CO_2 emissions in steelmaking, the possibility to export syngas of given composition from the steel plant will also be considered.

A further innovation conveyed by AgiFlex consists in the fact that **variations in key variables, such as the price of electricity and emission certificates, or availability of external gases are considered** in the assessment. Therefore, it is possible to find a robust system design that can suppress emissions efficiently despite fluctuating boundary conditions

Key Objectives

- Development of a framework of multi-agent system using digital twins for site-wide production and energy management
- Implementation of digital twins of process steps of integrated steelworks
- Studies of scenarios with different framework conditions and process chains
- Development of optimized strategies for decarbonisation transformation
- Implementation of **AgiFlex demonstrators** for production and energy management of real-world integrated steelworks

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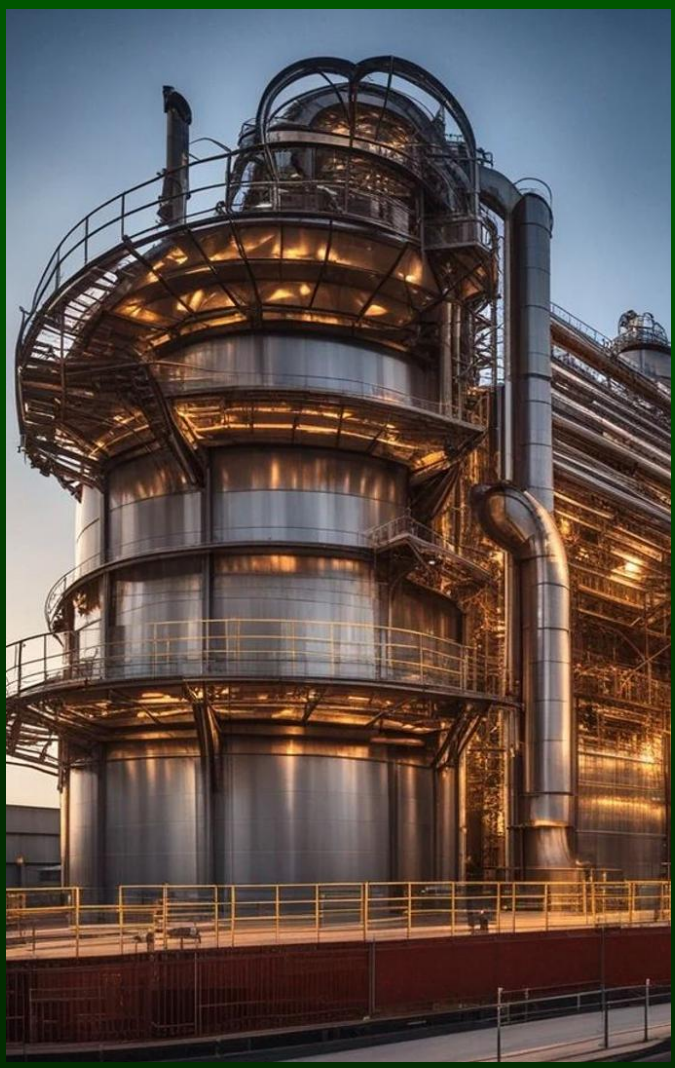
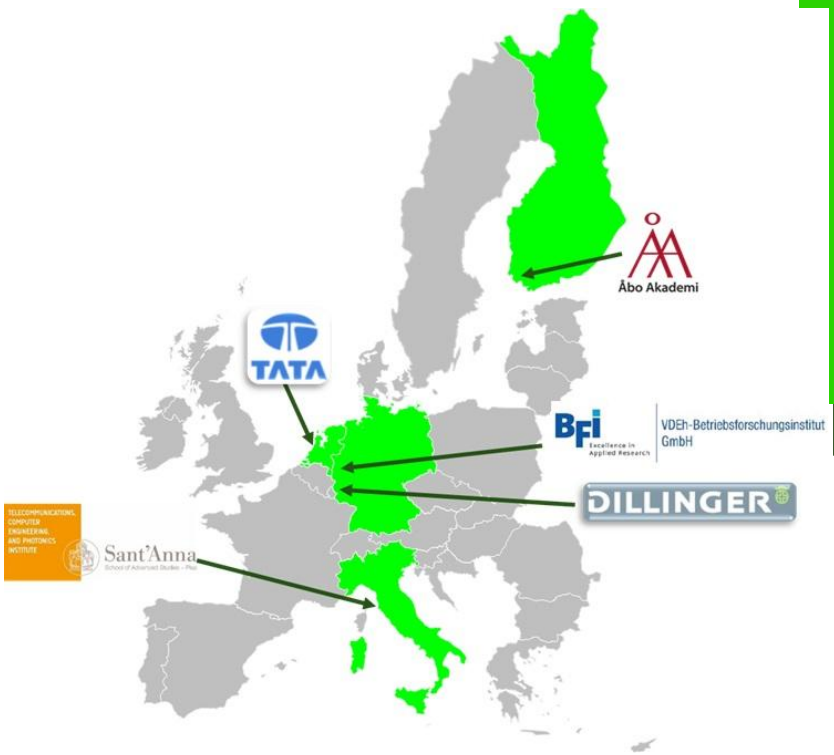
Consortium

The AgiFlex project will be carried out by an interdisciplinary and well-balanced consortium with large experience in the steel sector and the technologies to be implemented. Four different countries are represented (Finland, Germany, Italy and The Netherlands), ensuring wide dissemination of project results and deployment of the proposed solution. The consortium involves two steelworks (Tata Steel and Dillinger), two Universities (Abo Akademi, the coordinator, and Scuola Superiore Sant'Anna) and one research organisation, (VDEh-Betriebsforschungsinstitut BFI) with complementary skills that enable optimal coverage of the different project activities.



The involvement of two important Steel Companies ensures proper assessment of the proposed approach through the development of two AgiFlex demonstrators that will be in-field validated.



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