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MAGAZINE

The European Commission awards the SYRIUS project: a step forward for hydrogen in steelmaking

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FBK participates by bringing the expertise and research of the Sustainable Energy Center

EU CORE Consulting and Politecnico di Milano officially launched the **Horizon Europe SYRIUS project**, “SOEC HYDROGEN INTEGRATION AND CIRCULAR USE IN STEELMAKING PROCESS”, during the Kick-off Meeting hosted on 26th and 27th of February by the project partner Acciai Speciali Terni Spa.The steel sector is a major contributor to global CO2 emissions, responsible for 9% of global anthropogenic CO2 emissions, and it consumes an average of ~5.2 MWh of primary energy per tonne of steel produced.

Reducing its environmental impact is a major challenge, requiring new technologies, improved **energy efficiency a**nd more circular energy systems. That’s where SYRIUS comes in—supporting the industry by enabling hydrogen production and circular energy use in steelmaking process.

“FBK is ready to contribute expertise to the SYRIUS project, which aims to integrate SOE electrolyzers within steel manufacturing sites. This is a critical step in decarbonizing hard-to-abate sectors. FBK-HYRES is ready to advance the integration of hydrogen technologies to drive sustainable practices within the steel industry and promote the importance of dynamic simulation and advanced control in this sector” reports **Matteo Testi**, Head of the HyRES Unit.

Elena Crespi, researcher of the unit and Science Ambassador at FBK, adds: *“the main objective of the project is to demonstrate how the integration of a solid oxide electrolysis system within a steel mill can contribute to the decarbonization of steel production. FBK’s activity, linked to the modeling and simulation of the dynamic behavior of the system, will contribute to the optimization of the electrolyzer’s*

operating strategy, an important aspect in minimizing operating costs and degradation."

What makes SYRIUS a turning point?

With € 10 million grant and less than five years' timeline, SYRIUS will contribute to support the steel sector by demonstrating the integration of a 4.2 MW_{el} Solid Oxide Electrolysis Cell (SOEC) into a real Electric Arc Furnace (EAF) plant. This SOEC will produce 100 kg/h of green hydrogen, which will contribute to feeding a fuel flexible 280 t_{steel}/h – 84 MW_{th} slab reheating furnace.The electrolyser will be operated synergically with the furnace, the hydrogen storage, the steel plant shiftable/sheddable loads and two virtually aggregated solar PV plants, all managed by an advanced Energy Management System (EMS).

This action will demonstrate operational flexibility and high efficiency of SOEC electrolysers and the CO2 savings achievable by substituting fossil fuels with hydrogen and optimally operating a PV-based steel plant. SYRIUS also sets industrial circularity at the project core by generating steam for the SOEC through furnace off-gas heat recovery, implementing by-product oxygen recovery in the furnace and analysing options for water recycling.

The action is expected to reduce the steel reheating process CO2 emissions by 5,600 tonnes per year during the project.

Turning innovation into impact

The SYRIUS innovative concept will be demonstrated at a steel plant in Terni, operated by Acciai Speciali Terni (AST), a key player in Europe's stainless-steel sector. With more than 1,000 tonnes of stainless and specialty steel produced per year, this site provides the ideal setting for validating hydrogen integration in real conditions of steelmaking industry. By deploying a high-temperature electrolyser system in the operational environment, SYRIUS will showcase SOEC, waste heat recovery, and advanced energy management working together to reduce emissions and improve process efficiency. The pilot plant will showcase the practical feasibility of SOEC electrolysis in a steel production environment while laying the foundation for broader industrial adoption, delivering tangible scientific, social, and economic benefits, including:

(i) increase energy security and flexibility in industrial operations;

(ii) reference model for the EU hydrogen market, thanks to the features of its ground-breaking hydrogen production and process integration technology;

(iii) improved energy efficiency with potential to recover more than 2,5 TWh/y of useful heat when extended to a projected share of the global steel industry, and circularity promoted;

(iv) significant CO2 savings, with the potential to exceed 11 Mt per year in the same scenario of technology scale-up in the steel industry;

(v) job creation and upskilling.

The SYRIUS technical novelties will be supported by a viable business case focused on process integration creating ready-to-adopt solutions and expanding market opportunities in the short to medium term. By demonstrating the feasibility of SYRIUS concept in a working steel plant, the project will pave the way for broader industrial adoption. EMS will coordinate hydrogen production,

storage, and use, ensuring efficient and flexible operations.

As a result, SYRIUS will significantly contribute to EU policies and initiatives in consideration of the role that hydrogen is expected to play in filling the gap between electrification and hard-to-abate sectors, perfectly aligning with the 2050 climate neutrality goals of the European Green Deal.

A strong consortium for the implementation

In such an outstanding context, fruitful collaborations and common objectives are crucial for the success of SYRIUS. Coordinated by EU CORE Consulting SRL – an SME specialised in providing services of project design and management especially in collaborative research projects – this geographically spread out consortium sees the participation of two universities, one research foundation, three SMEs and five large companies which are well-known industrial players and technology providers:

- **Politecnico di Milano** (IT) will be the SYRIUS Scientific Coordinator and will focus on the advanced modelling and validation of the SYRIUS plant and its components to analyse system performance and determine the most effective plant management strategies, as well as the development and design of the EMS.
- **Rheinisch-Westfaelische Technische Hochschule Aachen** (DE) will assess the environmental and social benefits and circularity of the new system in relation to its installation and operation costs, entailing the assessment of the process throughout the project duration.
- **Fondazione Bruno Kessler** (IT) will enrich the consortium with the multidisciplinary expertise of the Center for Sustainable Energy, which will focus on technical activities mainly related to the development of a dynamic model of the plant and of a digital twin of the SOEC system, and will lead the activities on the dissemination of research results.
- **Aktsiaselts Elcogen** (EE) and Elcogen OY (FI), both part of the same entity, Elcogen Group plc, will contribute their expertise as providers of solid oxide cell and electrolysis technologies and supply stacks designed for large-scale production, developed on a specialised platform.
- **Tenova Spa** (IT) will provide the technology and consequently coordinate the requirements and design of SOEC and heat recovery integration, with re-heating furnaces.
- **Baker Hughes** (IT) will oversee the design and manufacturing of the multi-stack and scalable Solid Oxide Electrolyzer (SOEC) prototype, including installation and testing aiming to demonstrate the SYRIUS plant prototype at Technology Readiness Level 7 (TRL7). Additionally, the company will lead the project exploitation strategy.
- **Acciai Speciali Terni Spa** (IT) will be the end-user company and will therefore provide site preparation, permitting, plant installation and commissioning.
- Safety assessment, standardisation and pre-certification of the innovative electrolyser system installed at the steel plant will fall under the purview of **Kiwa Nederland** (NL), as a Global Certification Company.
- **Vincotte** (BE) will contribute to the overall safety of the complete installation by enrolling a 360° holistic approach amongst the different stakeholders to enable a uniform compliant and conform installation. Besides that, Vinçotte will carry out pre-certification of the hydrogen produced versus the requirements of a Renewable Fuel of Non-Biological Origin (RFNBO) as stipulated in RED II.

Clean Hydrogen Partnership

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