



FIREFLY A PROCESSES4PLANET SUCCESS STORY

Greening the European Chemical Industry

Context



Europe is the second-largest chemicals producer in the world, according to the [CEFIC Chemdata International](#). The chemical industry is not only vital to the European economy but also a crucial supplier for major key industrial sectors and responsible for 10% of global fossil fuel consumption, emitting approx. 3.3 Gt of GHG annually. Around 90% of chemical processes and 60% of all industrial products rely on catalytic processes. These chemical reactions are based on metals linked to the catalytic activity, most of them labelled as [Critical Raw Materials \(CRMs\)](#). As a result of high energy and raw material utilisation, the current production and recycling of catalysts mainly hinges on processes that are not sustainable or economically feasible. In the context of minerals supply shortages, strengthening the competitiveness of the European chemical industry needs increased metal recycling.

FIREFLY – a Processes4Planet Project



Funded by Horizon Europe under a Processes4Planet call, FIREFLY (*Flexible, predictive, and Renewable Electricity-powered electrochemical toolbox for a sustainable transition of the catalyst-based European chemical industry*) kicked off on 1 January 2024. Proposing a pioneering technology, the FIREFLY project aims to electrify a large part of the chemicals value chain in a sustainable way (environmental, economic, and social): power-to-catalyst and chemicals fostered via electrochemical catalyst recycling. FIREFLY also aims to cut greenhouse gas emissions in the chemical sector by using renewable energy and sustainable recycling methods and replacing traditional, polluting processes with clean, energy-efficient technologies. The project is implemented by a consortium of 16 partners under the coordinator of the A.SPIRE member, [VITO](#).

To achieve its ambitious goals, the P4Planet project focuses on developing electro-driven metal recycling, integrating renewable electricity, creating predictive digital tools, and producing innovative catalysts to reduce emissions and improve sustainability in chemical processes.

A Potential Decarbonisation Tool For the Chemical Sector



Chemicals

Although young, almost two years after its start, the project shows potential in supporting the green transition of the chemical industry. FIREFLY conducts the integration of Renewable Energy Sources (RES) in the processing chain and manufacturing of (electro)catalysts from the said secondary resources. The innovative RES-powered technologies proposed by FIREFLY are expected to substantially reduce CO₂ emissions across various industrial processes:

The expected results are 65% CO₂ emission reduction compared to state-of-the-art recycling methods.

Additionally, the new electrochemical production of ammonia could reduce emissions to just 0.2 tonnes of CO₂ per tonne of NH₃, compared to 2.2 tonnes using the traditional process. This represents a total reduction of CO₂ emissions of about 90%.



Also, one of its electrochemical technologies, Electro-driven Solvleaching (ESLX), has demonstrated an over 85% Pd (palladium) recovery (lab scale level) from the spent catalysts of the lignin depolymerisation process.

Additionally, 98% Pd recovery from the synthetic solutions has been demonstrated by Gas-diffusion Electrocrystallisation (GDEx) technology.

Palladium is on the [list of Critical Raw Materials of the European Commission](#).



Furthermore, electroleaching (ELX) - one of the numerous technologies explored in FIREFLY, aims to reduce water consumption by approximately 60% (~7 m³ water eq. per kg of input material is needed in the SoA process).

This, paired with the replicability of the solution, amplified through the team's strategy to communicate, disseminate and exploit the activities and results of the project to interested stakeholders in the chemical value chain to ensure further research and innovation and market uptake (one of the seven objectives of the project) indicate that Firefly has the potential to become a valuable tool to support the chemical sector in decarbonising and strengthening its competitiveness.

Empowering Women and SMEs in Research and Leadership

On a societal level, FIREFLY aims to raise awareness of sustainability and innovation and highlight the role of renewable energy-powered electrochemical processes in achieving a circular economy among stakeholders and the public at large. The project ensures widespread dissemination of results through newsletters, social media outreach, and presentations at industrial and scientific conferences. Moreover, to achieve its ambitious goals, Firefly also hinges on inclusive innovation and collaborative impact, reflecting a commitment to fostering gender equity while supporting small and medium-sized enterprises (SMEs). The team has more than 30 women involved in research and management tasks (out of which nine are leading tasks related to research activities). The Firefly consortium includes six SMEs. *“These efforts collectively contribute to societal well-being and the transition towards a sustainable future”*, says the project’s team.

The Coordinator's Angle

The FIREFLY team states that what makes the project a success story is that it *“emerges as a pioneering initiative, steering the catalyst-based chemical industry towards sustainable electrification and reducing reliance on third-party metals and fossil energies. FIREFLY addresses key areas: electro-driven metal recycling, electrochemical synthesis of metal-based catalysts, utilisation of renewable energy sources, and showcasing these catalysts in innovative processes that challenge the status quo of energy consumption, greenhouse gas emissions, and circularity deficits. FIREFLY also delves into optimising renewable energy use and developing an AI-driven tool to enhance decision-making in metal recycling and catalyst synthesis.”*



A.SPIRE considers the FIREFLY project a success story, even at this early stage, for its promising progress in advancing sustainable technologies, reducing emissions, and promoting inclusivity, reflecting its potential to transform the European chemical industry, bringing it one step closer to the Processes4Planet 2050 SRIA vision.

Check out the FIREFLY project’s [website](#).

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