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€ 11,078,742.50

48 MONTHS

16 PARTNERS

7 COUNTRIES

COORDINATION TEAM

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FIREFLY

Flexible, predictive and Renewable Electricity-powered electrochemical toolbox For a sustainable transition of the catalyst-based European chemicaL industrY.

THE FIREFLY CONCEPT

The FIREFLY project supports the sustainable evolution of the catalyst-based chemical industry towards its electrification and reduced third-party dependence on metals and fossil energy.

The FIREFLY concept relies on the development of:

- Electro-driven technologies for metal recycling from spent, waste, and off-specification catalysts available in Europe
- Efficient integration of renewable electricity
- A digital tool for predictive decision-making
- Production of (electro)catalysts for innovative (electro)chemical processes that overcome traditional production routes associated with high operating conditions, greenhouse gas emissions, and lack of circularity

The current production of metal-based catalysts relies mainly on procedures that are not sustainable, as they intensively consume chemicals and non-renewable energy, under harsh operating conditions. As a pioneer in catalyst technology, Europe has the important responsibility to green the catalyst production and recycling.

Three project stages

01
M1-M30

The technologies involved in the concept will be developed to TRL4, accompanied by an integrated sustainability assessment that will support the selection of the most promising technology routes based on their environmental and techno-economic performance.

02
M31-M48

The selected flowsheets will form the FIREFLY process, in a small-scale pilot. They will be demonstrated at TRL6 in the predictive, RES powered, and flexible production of new metal-based (electro)catalysts from secondary resources, as well as their application in innovative (electro)chemical processes of selected chemicals.

03
M1-M30

The activities and results will be effectively communicated, disseminated, and exploited to a wide set of stakeholders.

OBJECTIVES

Power-to-catalysts and chemicals fostered via electrochemical recycling

The FIREFLY project is the pioneering research initiative set off to drive the catalyst-based chemical industry towards electrification and to reduce external reliance on metals and fossil fuels. The FIREFLY concept uses electricity generated from RES to manufacture (electro)catalysts from secondary resources, in a new sustainable approach that will significantly reduce production costs.

7 specific objectives to attain the project's goal:

1. Research, develop, and optimise to TRL4 innovative and sustainable electrified technologies for recycling metal-based catalysts and the downstream (electro)chemical synthesis of strategic (electro)catalysts.

2. Research, develop, and optimise the powering by RES considering performance, environmental friendliness, and cost-efficiency in this electrification scenario.

3. Research, develop, and optimise a machine learning/artificial intelligence (ML/AI) based digital tool to support the decision-making of the enhanced metal recycling and catalyst production processes.

4. Develop the modelling- and simulation-based engineering framework to support the understanding, innovation and optimisation of the design, operation, validation, and demonstration of the FIREFLY process.

5. Demonstrate the TRL6 electrified FIREFLY process for the recycling of metal-based catalysts, simultaneous production of (electro)catalysts, and validation of the latter in selected (electro)chemical applications.

6. Assess the integrated sustainability of the FIREFLY concept and benchmark it versus the State of the Art (SoA) recycling processes and production of catalysts and selected chemical manufacturing applications.

7. 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 (R&I) and market uptake.

IMPACT

New electrochemical conversion routes for the chemical industry.

By leveraging downstream synthesis of strategic metal-based (electro)catalysts, the FIREFLY project is expected to develop at TRL6 a sustainable process for the flexible, RES-powered electro-driven recycling of metals.

Expected mid-term outcomes

Electrification of the industrial production process by shifting from the chemical conversion process to an electrochemical conversion process.

Efficient integration of renewable electricity to drive the conversion process.

Overall material savings (waste reduction) compared to the classical production routes.

Energy savings compared to the conventional production routes.

Competitive costs of the new process technology and its integration in the processing line, including upstream and downstream.

Significant reduction of CO_2, including the emissions related to the generation of electricity.

Expected long-term outcomes

Global leadership in clean and climate-neutral industrial value chains, circular economy and digital systems and infrastructures, through innovative production, new business models, sustainable-by-design advanced materials and technologies enabling the switch to decarbonisation in all major emitting industrial sectors.