



PRESS RELEASE
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GREENING THE EUROPEAN CHEMICAL INDUSTRY WITH DIGITAL TOOLS AND NEW RECYCLING ROUTES

Catalysts may not make today's headlines, yet they drive 90% of chemical processes and support 60% of industrial products. Europe's chemical industry depends on catalysts made with metals such as palladium and platinum, most of which are imported. With supply chains under pressure, the EU-funded project [FIREFLY](#) is building new ways to recover these metals from spent catalysts using innovative (electro)chemical technologies integrated with renewable electricity and supported by an AI-based predictive tool. Two recent steps bring that goal closer.

CHOOSING THE MOST SUSTAINABLE RECYCLING ROUTES

Current recycling methods are energy-intensive and often miss the economic aspect, leaving large quantities of spent catalysts unused. According to [Eurostat](#)¹, end-of-life recycling input rates for metals requested by the chemical industry remain low, while [Johnson Matthey's 2025 Report](#) warns of a deficit in secondary supply for platinum group metals.

↻	⌘	TIME	2013	2016	2019	2022
RAWMAT						
		Cobalt	16	0	22.1	22
		Copper	20	55	16.9	55
		Molybdenum	17	30	30	30
		Nickel	32	33.9	17	16
		Palladium	35	9.7	27.8	10
		Platinum	35	11.5	25.3	11
		Titanium	6	19.1	19.1	1
		Vanadium	0	44	1.7	1
		Zinc	8	30.8	31	34

FIREFLY aims to address this gap by combining (electro)chemical processes powered by renewable electricity with predictive digital planning tools. This approach reduces environmental impact and improves decision-making compared to traditional recycling processes. Earlier this year, partners published a [benchmarking study](#) comparing FIREFLY technologies with conventional routes such as pyrometallurgy and hydrometallurgy.

Contribution of recycled materials to raw materials demand - end-of-life recycling input rates (EOL-RIR); Source: Eurostat Data Browser

¹ Source: Eurostat Data Browser, accessed on 12 January 2025, url: [\[cei_srm010\] Contribution of recycled materials to raw materials demand - end-of-life recycling input rates \(EOL-RIR\)](#) The indicator measures, for a given raw material, how much of its input into the production system comes from recycling of "old scrap" i.e. scrap from end-of-life products. The 'end-of-life recycling input rate' (EOL-RIR) does not take into account scrap that originates from manufacturing processes ("new scrap").

The review assessed technical, economic and environmental indicators, including recovery efficiency, selectivity and energy use. Results showed FIREFLY processes like Electrochemical transformation in organic solvents (ETOS), Gas-diffusion electrocrystallisation (GDEx) and Electro-driven solvleaching (ESLX)/Electro-driven solvent extraction (ESX) achieve high recovery yields while reducing environmental impact and enabling renewable energy integration.

Building on the previous benchmarking article, FIREFLY recently completed an Integrated Life Cycle Sustainability Assessment (ILCSA) for palladium-based waste streams, combining environmental and economic indicators to compare several recycling routes. The analysis, considering not only technical and energy performance, but also yield, upscaling potential as well as integration with renewables, showed that combining [KU Leuven's](#) mechanochemical processing with [VITO's](#) gas-diffusion electro-crystallisation offers the best balance of economics and environment among the routes evaluated in the analysis. ETOS, another technology developed by KU Leuven, was also retained for its promising potential, especially for liquid Pd streams. The routes involving [TECNALIA's](#) Electroleaching (ELX) and the combined MCP+GDEx technologies will now be prepared for pilot-scale testing.

A DIGITAL TOOL TO GUIDE RECYCLING DECISIONS

FIREFLY has also built an online application that helps partners predict and optimise how different electrochemical processes perform. Built by [Inlecom Innovation](#) using specialised Artificial Intelligence models, [the tool](#) predicts energy use and outputs for individual technologies, identifies the optimal parameters for complete recycling routes based on user-defined criteria, and visualises where catalyst stocks are located on an interactive map. This empowers companies to plan recovery strategies based on real data rather than trial and error.

Catalyst recycling is often energy-intensive and uneconomic. By combining renewable-powered processes with digital decision-making, FIREFLY aims to make recycling more practical for industry and reduce Europe's dependence on imported raw materials.

The coordinator of the FIREFLY project, Savitha Thayumanasundaram [VITO], added: *“What is remarkable in FIREFLY is how the pieces connect. We've compared our electrified metal recovery technologies against conventional methods and shown they can cut energy use and chemical waste. The digital tool and sustainability checks guide us in choosing technologies that have potential to work outside the lab. And although still at small scale, the results point to a bigger picture: circular recycling methods powered by renewables. And beyond the technical work, FIREFLY shows Europe can build supply chains that are cleaner, less dependent on imports and mining, and commercially viable.”*

About FIREFLY

FIREFLY is a Horizon Europe research project launched in January 2023 with €11 million in funding. Its goal is to help the catalyst-based chemical industry shift to electrified processes and reduce reliance on imported metals and fossil fuels. The project combines electrochemistry, renewable energy, and modelling with applications in ammonia and hydrogen peroxide production and biomass conversion. Coordinated by the Flemish Institute for Technological Research (VITO), FIREFLY brings together partners across Europe to develop electrified recycling technologies and digital tools that support circular business models for catalysts.

About VLAAMSE INSTELLING VOOR TECHNOLOGISCH ONDERZOEK N.V. (VITO)

VITO (Flemish Institute for Technological Research) is a leading European independent research and consultancy center in the areas of cleantech and sustainable development, elaborating solutions for the large societal challenges of today. Sustainable chemistry, energy, health, materials management and land use: these are the five topics VITO focuses on. These topics have been set out in five research programs. They offer an answer to the challenges that mankind and society are confronted with today and in the future. Each program builds up a strong base of knowledge and skill, with added value for industry and society. The result is new and innovative research and a comprehensive range of scientific services.

Belgium | <https://vito.be/en>

About KU Leuven

KU Leuven is Europe's most innovative university (Reuters) and ranks 43rd in the Times Higher Education World University Rankings. As Belgium's largest university, KU Leuven welcomes 65,000 students from over 140 countries. The University's more than 8,000 researchers are active in a comprehensive range of disciplines. KU Leuven is a founding member of the League of European Research Universities (LERU) and has a strong European and international orientation. University Hospitals Leuven, its network of research hospitals, provides high-quality healthcare and develops new therapeutic and diagnostic insights with an emphasis on translational research.

Belgium | <https://www.kuleuven.be/english/kuleuven/>

About TECNALIA Research & Innovation

TECNALIA is a private, independent, non-profit applied research centre of international excellence and member of the Basque Research and Technology Alliance (BRTA). Legally a Foundation, TECNALIA is the leading private and independent research and technology organisation in Spain (over 777 patents and promoted more than 30 spin-off companies, participates in 352 H2020 projects, coordinating 73 of them, and in 35 HORIZON EUROPE projects under negotiation[1], coordinating 6 of them) and one of the largest in Europe, employing around 1,472 people (266 PhDs) and with income of 113,5 Million € in 2020.

Spain | <https://www.tecnalia.com/en>

About INLECOM INNOVATION ASTIKI MI KERDOSKOPIKI ETAIREIA

INLECOM INNOVATION is a non-profit foundation (SME), based in Athens (Greece), which undertakes innovative research in the areas of information technology and applies it to various verticals, including: raw materials, security, transport/logistics, energy, healthcare, telecoms and other. INLECOM promotes broader adoption and take-up through supporting open architectures and methodological frameworks that are exploited in industry and/or commercialized, and through supporting commercial imperatives such as patent protection, market analyses, feasibility studies and business plans. The research fields of INLECOM INNOVATION range in AI/ML (digital twins, predictive modelling, decision support tools etc.), Distributed Ledgers (smart contracts, digital identities etc.) as well as integration and data assimilation platforms.

Greece | <https://inlecom.gr/>

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Official website → <https://www.firefly-project.eu/>

Cordis factsheet: <https://cordis.europa.eu/project/id/101091715>

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Consortium members

