



Flexible, predictive and Renewable
Electricity powered electrochemical
toolbox For a sustainable transition of the
catalyst-based European chemical industry

General Presentation

Project overview

Grant agreement no: 101091715

Coordinator: VLAAMSE INSTELLING VOOR TECHNOLOGISCH ONDERZOEK N.V. (VITO)

Funding Scheme: RIA-Research and Innovation Action

Participants:

 **16 partners from 7 countries:**

Belgium, France, United Kingdom, Spain, Iceland,
Greece, Norway

 **Duration:** 1st January 2023 to 31st December 2026

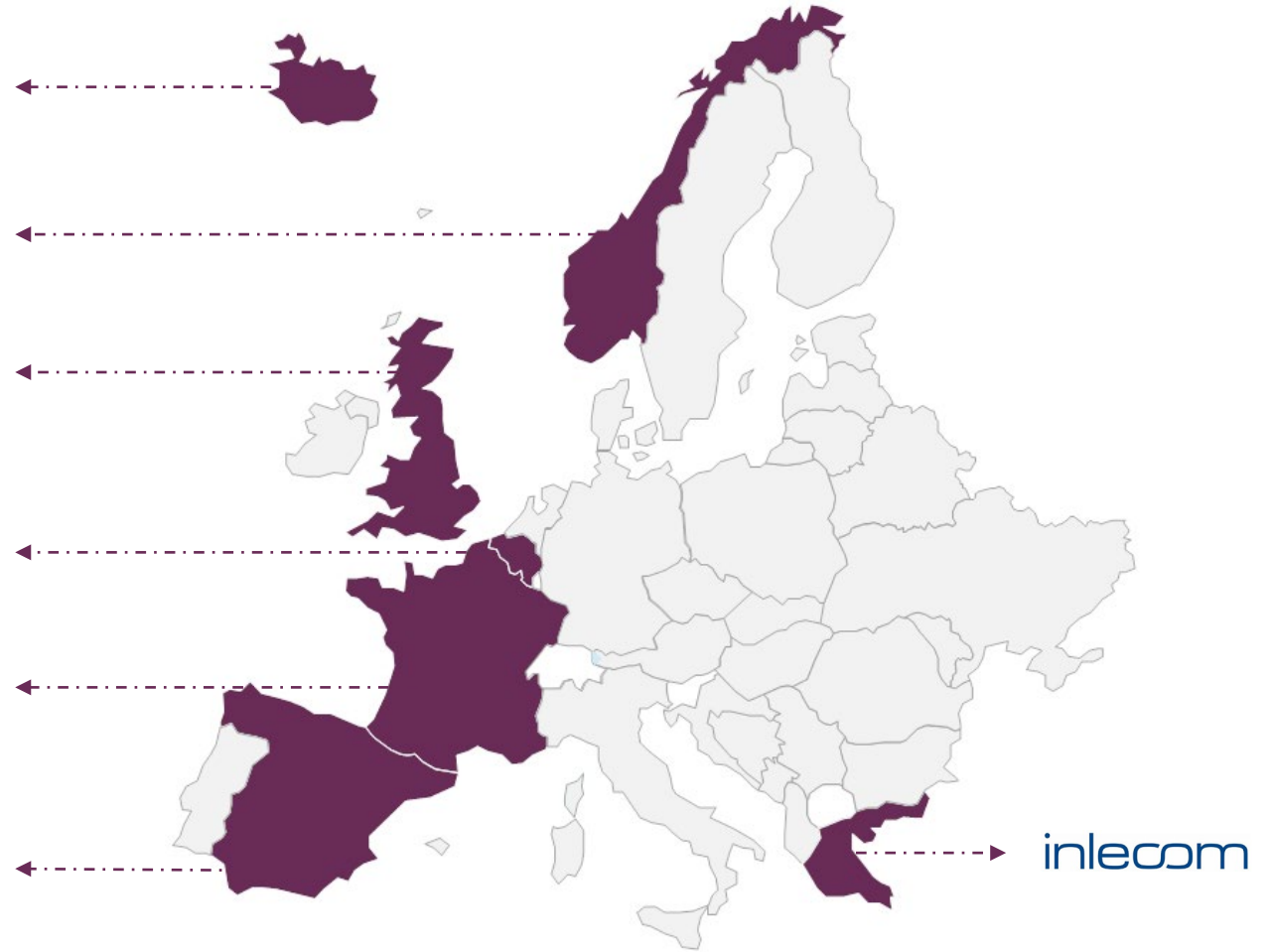
 **Project budget:** EUR 11 Million



 **16 partners**
from **7 countries**

- 8 research centres
- 6 SMEs
- 2 large enterprises

Consortium



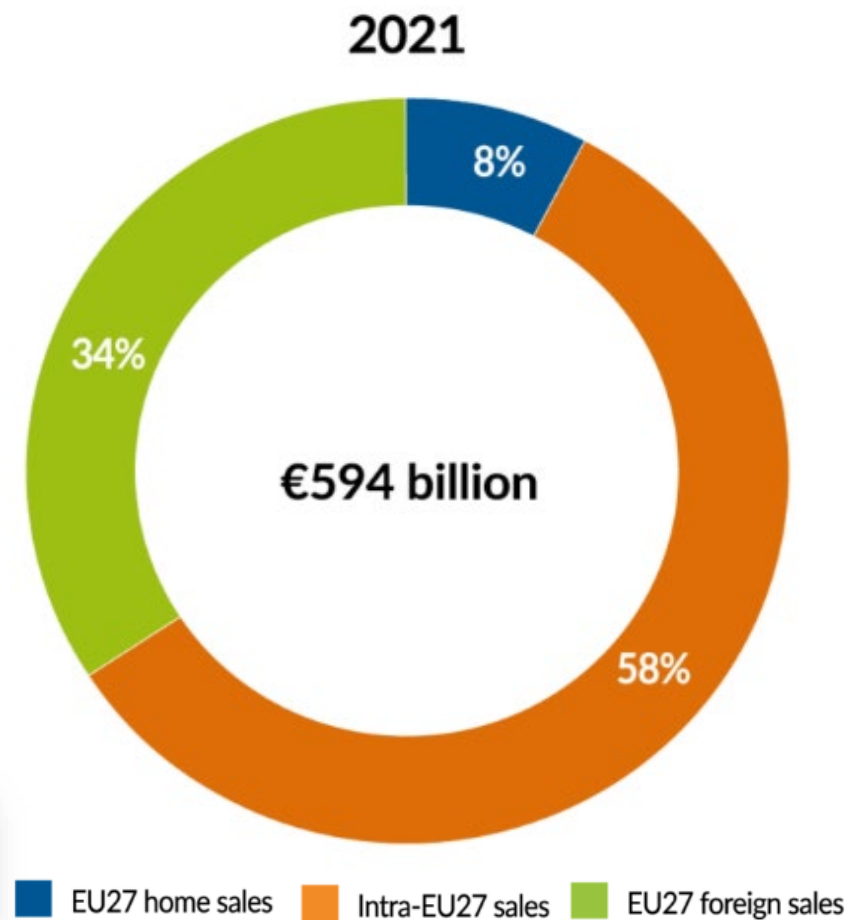
Motivation

- EU-27 chemical industry ranks world second in total sales, generating EUR 594 billion in year 2021.
- Chemical industry is highly dependent on catalyst, around 90% of all chemical processes and 60% of all industrial products use catalysts.
- The catalyst market in Europe is expected to reach ~ EUR 10 billion by 2030.
- Market growth is hindered by socio-political issues, supply risk and strategic importance of the targeted *Critical Raw Material* (CRM) and economically important materials in catalyst.

CRMs

PGMS	27 3d ⁷ 4s ² Co Cobalt 58.933	22 3d ² 4s ² Ti Titanium 47.867	74 4f ¹⁴ 5d ⁴ 6s ² W Tungsten 183.84	42 95.94 Mo MOLYBDENUM	29 63.546 Cu COPPER	30 65.39 Zn ZINC	28 58.693 Ni NICKEL	47 107.87 Ag SILVER	79 196.97 Au GOLD
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EU27 chemical sales structure (%)



Cefic report-A pillar of European Economy ([URL](#))

Challenges and Opportunity

Catalyst production:

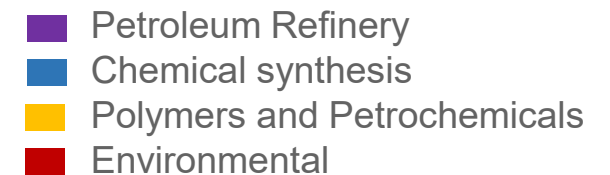
- Europe has a large share of the global catalyst manufacturing market (~25%).
- *Heterogeneous catalyst* is dominating the market, taking 72% of global market divided into four segments **petroleum refining**, **chemical synthesis**, **polymers** and **petrochemicals**, and **environmental**, whereas *homogeneous catalysts* represent the remaining 28%.
- The current catalyst production processes are not sustainable, they require intensive operational conditions with high utilization of chemicals and energy demand.

Production of chemicals using catalytic processes:

- For instance, the production of ammonia alone consumes 1.5% of the world's energy production and accounts for ~1% of global CO₂ emissions with demanding operating conditions.
- The chemical and petrochemical industries are among the largest energy consumers, with 1078 Mtoe in 2016 and a 2% annual increase rate.

These challenges will be tackled by FIREFLY project to develop sustainable metal recovery technologies for catalyst recycling and the integrated green production of (electro)catalysts for an electrifiable chemical value chain.

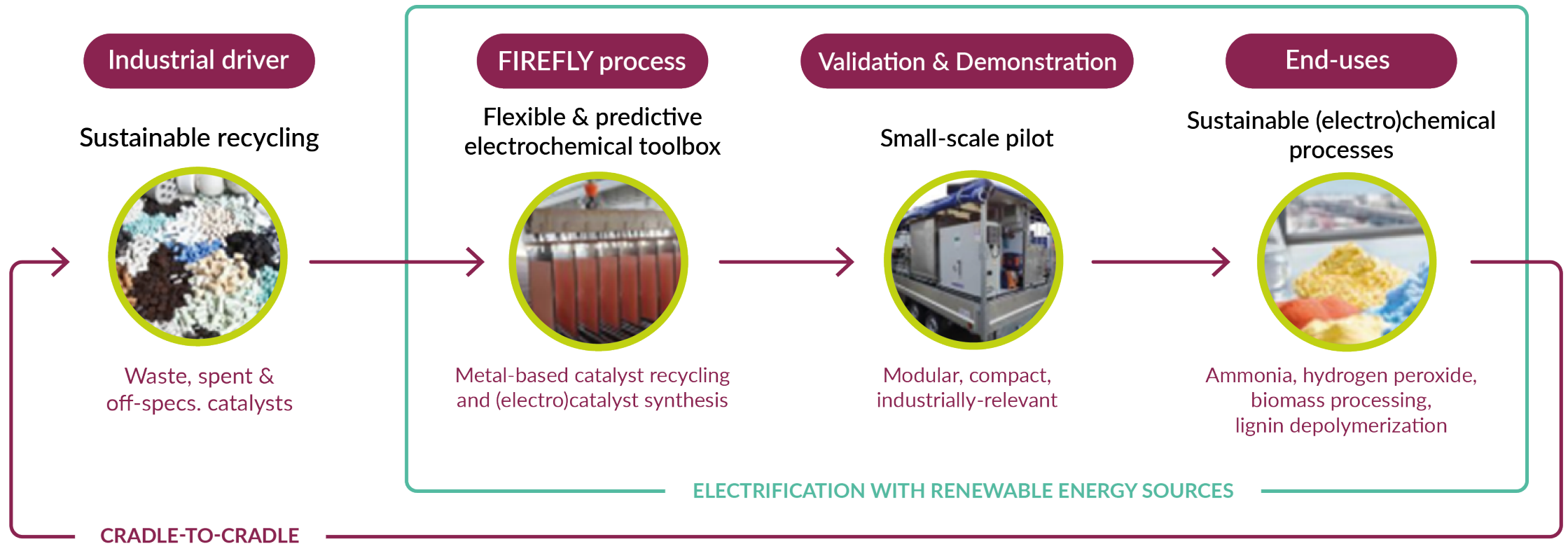
Catalyst Market Share by Application (%)



EMR – Global industrial catalyst market outlook ([URL](#))

Vision

The FIREFLY project aims to electrify a large part of the chemicals value chain in a sustainable way (environmental, economic, social): **POWER-TO-CATALYSTS AND CHEMICALS FOSTERED VIA ELECTROCHEMICAL RECYCLING.**



Specific Objectives

SO1: To develop innovative and sustainable **electrified technologies for recycling** metal-based catalysts and the downstream (electro)chemical synthesis of strategic (electro)catalysts.

SO2: To develop environmental friendliness and cost-efficiency electrified technologies powered by **Renewable Energy Sources (RES)**

SO3: To develop a **digital tool** for prescriptive and predictive decision-making of the optimised metal recycling and catalyst synthesis processes.

SO4: To develop the **modelling and simulation-based engineering framework** to support the optimisation of the design, operation, validation, and demonstration of the FIREFLY process.

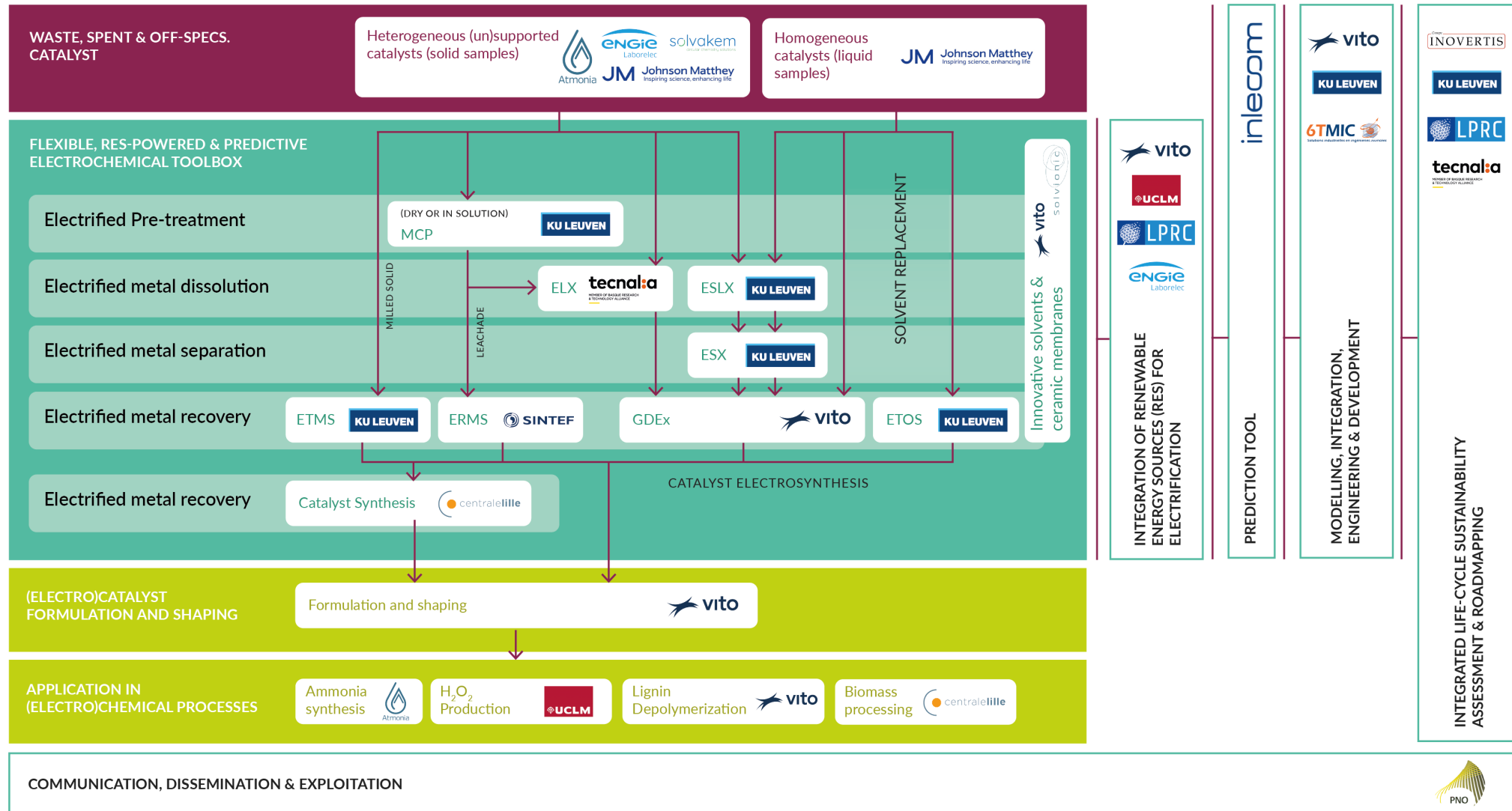
SO5: To **demonstrate the TRL6 electrified FIREFLY process** for the recycling of metal-based catalysts, simultaneous production of (electro)catalysts, and validation of the latter in selected (electro)chemical applications.

SO6: **Sustainability assessment** and benchmarking it *versus* the State of the Art (SoA) recycling, production of catalysts and selected chemical manufacturing applications.

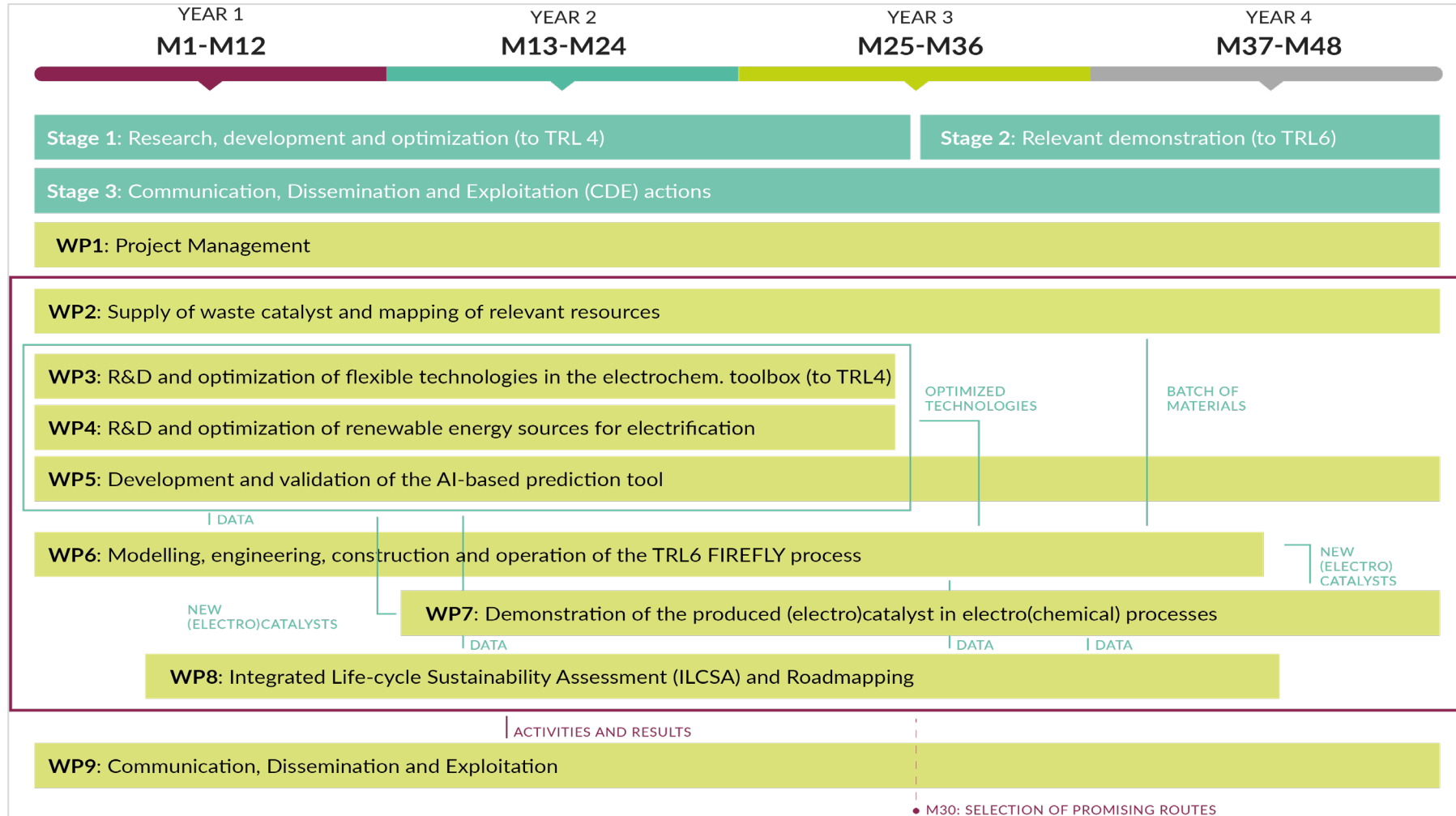
SO7: To effectively **communicate, disseminate and exploit** the activities and results of the project to interested stakeholders in the chemical value chain.



FIREFLY Concept



FIREFLY Work Plan





Expected Impacts

The main expected result of the FIREFLY project is a sustainable TRL6 process for the **flexible, predictive and RES-powered electro-driven recycling of metals**, with the concurrent **downstream synthesis of strategic metal-based (electro)catalysts**, able to perform and unlock more-sustainable (electro)chemical processes.

BIOBESTicide



Improved recovery: Optimisation of Eight electrified technologies and developing efficient, greener fully-electrochemical flowsheets for metal recovery and (electro)catalyst synthesis.



Integration of renewable electricity: Effective energy management system driven by software tools to predict energy demand and powering the process with renewable energy system (RES) directly, RES storage and grid energy with minimum environmental impacts.



Energy savings: Significant energy reduction foreseen compared to the primary metal production and electrochemical synthesis processes by using sustainable technologies optimised by modelling tools.



Reduction of CO2 emissions: Developing green processes powered by renewable energy with innovative process design capable of reducing the CO2 emissions, reagent and waste compared to the conventional fossil fuel chemical production.



Competitive cost: Targeting cost-competitive enabling technologies aiming to enhance the competitiveness of the European chemical industry and steering green transition through innovation.



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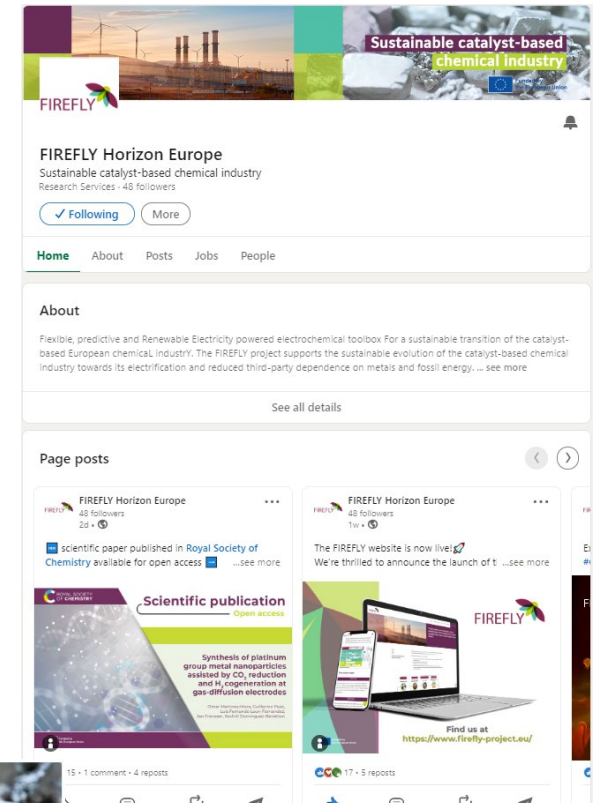
FIREFLY Horizon Europe

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A photograph of an industrial refinery or chemical plant at sunset. The sky is a mix of orange, red, and purple, with some clouds. The refinery structures, including tall distillation columns and complex piping, are silhouetted against the bright sky. In the foreground, there are some trees and a blue-roofed building.

Thank you

Join the #FireflyHorizonEurope journey !