



PROCESSES4PLANET

ASPIRE

PROCESSES4PLANET RESEARCH ASSOCIATION

**Innovation and Sustainability in the European Process Industries
Processes4Planet Partnership
Projects 2021 and 2022**

Innovate, Transform, Sustain: The EU Process Industries' Journey to 2050



“Process Industries are at the root of all supply chains and hence critical for our society. It is vital that these industries can remain competitive and strive in full harmony with our planet. A.SPIRE, through the projects and initiatives that it fosters via the Processes4Planet Partnership, is therefore definitely engaged in making critical contributions to the climate transition of the European process industries. It is also working to position these industries at the core of a circular economy in communities across Europe. This brochure documents the first fruits of A.SPIRE’s unique cross-sectorial, cross-disciplinary and cross-border collaborations under the European Commission’s Horizon Europe Framework Programme: Processes4Planet. The work described here builds on our learnings from SPIRE’s seven-year partnership and will help to ensure the achievement of a truly sustainable and competitive European process industry sector to the benefit of the whole of society.”

Pierre Joris,
A.SPIRE President



“The Processes4Planet Partnership is, with the full support of the European Commission, making key contributions to develop the vital Process Industry solutions that Europe requires to realise the Green Deal, support a just recovery, and catalyse a sustainable, competitive European industrial strategy. The EU-funded projects described here will help Europe achieve the successful transition to a climate neutral and circular society that we desire.”

Jurgen Tiedje,
Head of Unit Industrial Transformation,
European Commission DG Research & Innovation



“All the projects described in this brochure are the result of a huge collaborative effort that spans energy intensive industry sectors across Europe. I would like to thank everyone who has contributed to and shared the immense workload required to formulate programme input, compile our Strategic Research and Innovation Agenda 2050, and in consortium building and developing successful projects from conception to realisation. On behalf of the A.SPIRE team I look forward to continuing our work together to shape a real sustainable future for all.”

Angels Orduña,
Executive Director A.SPIRE



CONTENT

CHAPTER 1 6

- Introduction 7
-

CHAPTER 2 10

- Processes4Planet Projects 2021 and 2022. 11
-

- **Renewable Energy Integration: electrification, hydrogen use and flexible plants.** 12

- Call HORIZON-CL4-2021-TWIN-TRANSITION-01-21: Design and optimisation of energy flexible industrial processes. . . 14

- Call HORIZON-CL4-2022-TWIN-TRANSITION-01-17: Integration of hydrogen for replacing fossil fuels in industrial applications 19

- Call HORIZON-CL4-2022-TWIN-TRANSITION-01-15: New electrochemical conversion routes for the production of chemicals and materials in process industries. 23

- **Carbon Capture and Utilisation.** 28

- Call HORIZON-CL4-2022-TWIN-TRANSITION-01-11: Valorisation of CO/CO₂ streams into added-value products of market interest 30

- **Materials circularity.** 34

- Call HORIZON-CL4-2021-TWIN-TRANSITION-01-17: Plastic waste as a circular carbon feedstock for industry. 36

- Call HORIZON-CL4-2021-RESILIENCE-01-01 Ensuring circularity of composite materials 41

- **Digitalisation for traceable value chains.** 46

- Call HORIZON-CL4-2022-RESILIENCE-01-01: Circular and low emission value chains through digitalisation. 48

- **Hubs4Circularity, Industrial and Urban-Industrial symbiosis.** 53

- Call HORIZON-CL4-2021-TWIN-TRANSITION-01-14: Deploying industrial-urban symbiosis solutions for the utilisation of energy, water, industrial waste and by-products at regional scale 55

- Call HORIZON-CL4-2021-TWIN-TRANSITION-01-16: Hubs for Circularity European Community of Practice (ECoP) platform 60

- Call HORIZON-CL4-2022-TWIN-TRANSITION-01-10: Circular flows for solid waste in urban environment 63

CHAPTER 3 68

- Testimonials 69
-

CHAPTER 4 72

- Join A.SPIRE! 73
-

CHAPTER 1

Introduction

INTRODUCTION

Welcome to this first compilation of projects funded by the European Union through the Processes4Planet co-programmed partnership (P4Planet).

The 27 projects presented here are the result of successful applications to the first 10 partnership calls in 2021 (five calls) and 2022 (five calls) under the Horizon Europe Framework Programme.



PROCESSES4PLANET

THE P4PLANET PARTNERSHIP

Processes4Planet is a co-programmed partnership under Horizon Europe. It is the successor of the Sustainable Process Industry through Resource and Energy Efficiency Public-Private-Partnership (SPIRE cPPP) between the European process industries and the European Commission that was successfully undertaken under the Horizon 2020 Framework Programme. The current partnership is based on a memorandum of understanding signed by the European Commission, as the public partner, and A.SPIRE aisbl, as the private partner representing the European process industries.

In the memorandum, the Commission engaged EUR 1.3 billion in funds for partnership related calls, over the period from 2021 to 2027, to be matched by EUR 1.3 billion in investments by process industry partners from 2021 to 2030. This funding represents a 27% increase over the funding for the SPIRE cPPP, reflecting its success and the vital importance of the process industries for achieving Europe's Green Deal aspirations, and realising the Circular Economy.

THE EUROPEAN PROCESS INDUSTRIES

The innovative process industries represented within A.SPIRE provide about 8.5 million jobs directly and 20 million indirectly in Europe. These process industries have a turnover of EUR 2 trillion/ year, drive innovation, and develop solutions for societal problems. They play a vital role in the European industrial landscape as they produce the materials that are used by the wider manufacturing industry to make products. They are, mainly, energy intensive industries and therefore have a key role in the journey to industrial decarbonisation and the transformation to a net-zero economy. They are also key enablers for the closure of material loops while minimising or removing substances of concern for human health and the environment in recycled materials and products – the basis for a circular economy that is safe and sustainable by design.



A.SPIRE

A.SPIRE aisbl is the private partner in the Processes4Planet Partnership. It represents 10 European process industry sectors, including cement, ceramics, chemicals, engineering, non-ferrous metals, minerals, pulp and paper, refining, steel and water. With more than 180 members from over 22 countries, ranging from industry players to research and innovation organisations, it coordinates input to the partnership to help guide work programme formulation and works to coordinate, monitor and administer the programme and related projects with the Commission.

THE P4PLANET SRIA AND PARTNERSHIP OBJECTIVES

The P4Planet partnership is based on a comprehensive assessment of the current state of the European process industries and a consensus vision and strategic research and innovation agenda of where it wants to be in 2050.

The assessment and vision are set out in Processes4Planet Strategic Research and Innovation Agenda (SRIA). This identified three major challenges for our industries (and society): Our high impact on climate; The linear use of resources; and Global competitiveness.

In response, a vision of net zero greenhouse gas (GHG) emissions, near zero landfilling and water discharge by 2050, and growing competitiveness through innovation was articulated.

The 2050 Vision is built around the Value Proposition: “An integrated and digital European Process Industry, fostering a “well-below 2 degrees” scenario and a fully circular future for our planet and society.” This encapsulates A.SPIRE’s ambitious vision that the future of Europe lies in strongly enhanced cooperation across sectors and across borders, enabling a meaningful step change in competitiveness and sustainability performance that brings benefits to Europe and all its citizens.

The P4Planet SRIA outlined three general objectives for the partnership:

- Developing and deploying climate neutral solutions
- Closing the energy and feedstock loops
- Achieving a global leadership in climate neutral and circular solutions, accelerating innovation and unlocking public and private investment

To achieve these objectives, the SRIA identifies four key, cross-sector enablers for success: Industrial-urban symbiosis; Process innovation in energy mix, electrification, Carbon Capture and Utilisation (CCU) and resources efficiency; Digitalisation; and Non-technological aspects.

The SRIA also includes two special initiatives. The first is first-of-a-kind plants, or units within a plant, that are essentially large-scale demonstration initiatives that enable the deployment of cutting-edge process technology at TRL9. The second are Hubs4Circularity that aim to establish self-sustaining, regional hubs of industrial and urban symbiosis in which material, energy and data loops are closed.

In terms of specific areas, the SRIA puts forward 14 innovation areas broken down into 36 innovation programmes or fields. Each project described in this brochure has indicated in which SRIA innovation fields they are working (via an Innovation Grid) and to which of the Partnership’s objectives they are aiming to make an impact (via an Impact Grid).

The Processes4Planet SRIA is currently in the process of revision and an updated version is scheduled to be published towards the end of 2023.

HORIZON EUROPE CALLS

Horizon Europe is the EU’s most ambitious research and innovation programme ever with a budget of EUR 95.5 billion for the period from 2021-2027. The budget is divided amongst four pillars and 15 components.

Funding for the P4Planet partnership is under Horizon Europe Pillar 2, Cluster 4 (Digital, Industry and Space) and a total budget of EUR 1.3 billion has been allocated for partnership calls over the period.

The EU sees research and innovation in industrial key enabling technologies as essential to create wellbeing, prosperity and jobs across Europe, while not over exploiting our limited planetary resources. Research and innovation are also vital to accelerate the green and digital transformation of industry, strengthen its resilience and maintain its base in Europe, and is, therefore, at the heart of the EU’s renewed European Industrial Strategy.

To accelerate these transitions the Commission proposed co-created transition pathways that include Horizon Europe Partnerships such as Processes4Planet that also trigger private investments.

Introduction

HORIZON EUROPE, CLUSTER 4, WP21-22 TOPICS IMPLEMENTING P4PLANET PARTNERSHIP-ANALYSIS

The Horizon Europe, Cluster 4, WP21-22, contribution to projects implementing the P4Planet partnership amounted to about EUR 314 million: EUR 154 million allocated to 14 projects from five topics in 2021 and EUR 160 million allocated to 13 projects from five topics in 2022.

Of the 27 projects implementing the P4Planet partnership selected in the 2021 and 2022 calls, the vast majority (20) are coordinated by A.SPIRE members. A total of 549 organisations are participating in these successful P4Planet project consortia of which 120 (22%) are members of A.SPIRE.

SME participation is high with 27% of consortia participants being classed as small or medium-sized enterprises.

The future budget allocation for topics implementing the P4Planet partnership in Horizon Europe Work Programmes for 2023 and 2024 are EUR 180 million and EUR 150 million respectively.



CHAPTER 2

Processes4Planet Projects
2021 and 2022

PROCESSES4PLANET PROJECTS 2021 AND 2022

The following pages present the 27 Processes4Planet Partnership projects that have been successfully evaluated and awarded grants during the first two years (2021 and 2022) of the European Commission's Horizon Europe programme.

THE PROJECT PRESENTATIONS ARE ORGANISED UNDER FIVE THEMES;

- Renewable Energy Integration: electrification, hydrogen use and flexible plants
- Carbon Capture and Utilisation (CCU)
- Materials circularity
- Digitalisation for traceable value chains
- Hubs4Circularity, Industrial and Urban-Industrial symbiosis

Each theme covers a number of 2021 and 2022 Horizon Europe calls and successful projects within the calls are listed alphabetically.

Each call is described via a brief synopsis and the total call budget given.

Information on the innovation areas and fields covered by each project and the P4Planet objectives they are supporting is also provided.

Renewable Energy Integration:
electrification, hydrogen use
and flexible plants



H₂ ZERO EM
CLEAN ENERGY O

Call HORIZON-CL4-2021-TWIN-
TRANSITION-01-21: Design and
optimisation of energy flexible
industrial processes

THREE PROJECTS WERE FUNDED:

FLEX4FACT

FLEXINDUSTRIES

TRINEFLEX

CALL HORIZON-CL4-2021-TWIN-TRANSITION-01-21: DESIGN AND OPTIMISATION OF ENERGY FLEXIBLE INDUSTRIAL PROCESSES

SCOPE

Flexibility solutions are key to achieve a renewable energy share to deliver the EU Green Deal objectives. EU industries will need to adapt to increased fluctuations in energy supply caused by the higher penetration of variable (renewable) energy sources. The increased value of flexibility will offer competitive opportunities for process industries and enable a leaner energy system. Process flexibility and efficient energy storage are essential to enable variable renewable energy production. A fast response rate, i.e.,

a swift increase or decrease of process energy consumption, is key in the shift to dynamic operating processes and will require adaptation for many processes along with increased energy efficiency. Digital tools and process control systems that optimise the process while accounting for the value of flexibility will need to be implemented. Powerful digital twin models based on suitable combinations of analytical models, physics-based Artificial Intelligence (AI) or pure AI solutions need to be designed and applied.

This call on the Twin Green and Digital Transition was for Innovation Actions (IAs). It was a single-stage call that opened on 22 June 2021 with a deadline for applications of 23 September 2021.

CALL BUDGET

EUR 57,602,503

PROCESSES4PLANET THEMES AND GOALS		Energy		
		HORIZON-CL4-2021-TWIN-TRANSITION-01-21		
Theme	Goals	FLEX4FACT	FLEXIndustries*	TRINEFLEX
Climate neutrality	Develop new electrified processes and Energy efficiency, ensuring process flexibility and capturing the full potential of renewable energies	✓		✓
	Replace fossil fuels and feedstock by Renewable H ₂ and biomass in processes	✓		

* No data.



Industrial flexibility platform
for sustainable factories

AIM

FLEX4FACT aims to make industrial sites and processes more flexible through digitisation, automation, and smart control systems. It will support industrial stakeholders to integrate more renewable sources into their industrial energy systems and provide flexibility to power transmission systems via demand response measures. FLEX4FACT will develop an end-to-end solution including: tools supporting the definition of pathways for increased renewable penetration in industrial sites; digital twins for five different industrial use cases; a module for manufacturing process planning and control; and a cloud-based platform allowing industrial

DISCLAIMER

This project has received funding from the European Union's Horizon Europe research and innovation programme under Grant Agreement No. 101058657.



sites to participate in the ancillary energy market. All solutions will be developed in a modular way to allow for easy replication and upscaling across the EU.

CONCEPTS AND INNOVATIONS

FLEX4FACT builds on a modular and multi-level architecture that leverages the provision of flexibility from the industry through digital process twinning, machine learning techniques and novel algorithms supporting modern manufacturing planning and scheduling. The developed industrial flexibility platform will include modelling and simulation tools for industries and manufacturing processes and their energy requirements, software for optimising and scheduling manufacturing processes, methodology and tools for introducing flexibility into manufacturing processes, digital twins of the industrial processes to achieve greater energy flexibility during the manufacturing process, and results of techno-economic and life cycle assessments. With the help of these results, FLEX4FACT will leverage energy flexibility from industrial sites by offering demand response services to external agents through an Industrial Cluster Flexible Platform. The developed digital tools will be demonstrated and validated within five industrial settings.

RELEVANT FIELDS OF INNOVATION

Integration of renewable heat and electricity; and Flexibility and demand response.

P4PLANET LONG-TERM IMPACTS

Develop new electrified processes and Energy efficiency, ensuring process flexibility and capturing the full potential of renewable energies; and Replace fossil fuels and feedstock by Renewable H₂ and biomass in processes.

COORDINATOR CONTACTS

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AIM

The FLEXIndustries project builds upon a holistic multi-disciplinary (device, process and value-chain) and multi-scale (operating, tactical and strategic) approach to help enterprises in seven (automotive, biofuels, polymers, steel, pulp & paper, pharmaceuticals, and cement) energy intensive industry sectors design and deploy the most suitable Energy Efficiency Measures and Process Flexibility Methods for their industrial environments. The project also aims to ensure these solutions connect seamlessly with electrical and heating networks.

DISCLAIMER

This project has received funding from the European Union's Horizon Europe research and innovation programme under Grant Agreement No. 101058453.



CONCEPTS AND INNOVATIONS

FLEXIndustries will develop and demonstrate a Dynamic Energy and Process Management Platform to monitor, analyse and optimise energy-intensive industrial processes, by effectively managing emerging demand response mechanisms and providing plant and process flexibility as well as offering power grid services. The unique premise of FLEXIndustries is the optimal integration of innovative energy generation, storage and conversion assets, such as Battery Energy Storage Systems (BESS) and waste heat recovery solutions based on novel Heat Pumps, Organic Rankine Cycle (ORC) and thermoelectric systems, combined with smart and digital tools for optimised operation and control, all supported by novel business models and market mechanisms for enhanced industrial flexibility. Overall, FLEXIndustries has the potential to save a total of over 159 GWh per year of Primary Energy, over EUR 6 million per year in Life Cycle Costs at demonstration scale and over 33 111 tonnes of CO₂eq per year in emissions at project level. Demonstration activities will take place in seven industrial facilities in six reference countries (Turkey, Greece, Poland, Bulgaria, Germany and Italy) and will feature energy efficiency and operational flexibility along with process redesign/ modification,

increased levels of electrification, digitalisation and automation, enhanced user satisfaction and grid flexibility services, and decreased environmental footprint.

COORDINATOR CONTACTS

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AIM

TRINEFLEX aims to support the transformation of energy-intensive industrial processes through the integration of energy flexibility and the supply of raw materials. Today energy consumption is a critical economic and environmental issue for companies, and it is necessary to combine energy-intensive industrial processes with low carbon dioxide emission systems, which encourage the use of renewable energies, in a flexible way, and without compromising productivity. TRINEFLEX will develop a toolkit for Energy Intensive Industries that will function as a service managing the digital aspects and the flexibility and sustainability transition of industrial processes.

DISCLAIMER

This project has received funding from the European Union's Horizon Europe research and innovation programme under Grant Agreement No. 101058174.



CONCEPTS AND INNOVATIONS

The project will develop a series of digital services for the collection, management and real-time analysis of relevant Big Data: data containing a greater variety, arriving in increasing volumes and with more velocity produced by the most energy-intensive industrial processes considered within the TRINEFLEX project. This approach is the starting point for the implementation of process analysis and models and the development of Digital Twins of selected industrial processes. TRINEFLEX will be implemented in five demonstration sites in four energy intensive industrial sectors: glass, copper, aluminium and water treatment. The implementation is supported through the integration of different innovative technologies (energy efficiency, renewable energy, sustainable fuels and feedstocks and Carbon Capture, utilisation and storage), that will synergise with powerful digital solutions to demonstrate flexibility measures to achieve energy neutrality. The project will involve local stakeholders and communities and will be designed for rapid replicability across the project's selected sectors and high transferability to other sectors with the aim of increasing industrial process energy flexibility and developing industrial symbiosis.

RELEVANT FIELDS OF INNOVATION

Integration of renewable heat and electricity; Flexibility and demand response; Advanced heat reuse; Heat pumps; Electricity-based heating technologies; Alternative hydrogen production routes; Flexible CO₂ capture and purification technologies; Demonstration of Industrial-Urban Symbiosis; Digital plant operation; Intelligent material and equipment monitoring; and Digitalisation of industrial-urban symbiosis.

P4PLANET LONG-TERM IMPACTS

Develop new electrified processes and Energy efficiency, ensuring process flexibility and capturing the full potential of renewable energies.

COORDINATOR CONTACTS

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Call HORIZON-CL4-2022-TWIN-
TRANSITION-01-17: Integration of
hydrogen for replacing fossil fuels in
industrial applications

TWO PROJECTS WERE FUNDED:

H₂GLASS

HYINHEAT

CALL HORIZON-CL4-2022-TWIN-TRANSITION-01-17: INTEGRATION OF HYDROGEN FOR REPLACING FOSSIL FUELS IN INDUSTRIAL APPLICATIONS

SCOPE

Hydrogen offers a solution to decarbonise industrial processes and help meet the 2050 climate neutrality goal of the European Green Deal and the EU's clean energy transition. Hydrogen can be used as feedstock and energy carrier in energy-intensive industry sectors. The integration of hydrogen into new production routes, the direct use of hydrogen for heating and the use and production of GHG emission-free hydrogen instead of

carbon-intensive hydrogen will be fundamental to decarbonise EU industry across a number of sectors. It can replace fossil fuels to generate high temperature heat but burns differently so will require adaptation of heating processes. Any (re)-design of burners must include aspects that minimise NOx formation. In addition, large demand for green hydrogen will lead to large-scale oxygen production via water electrolysis. Use of oxygen instead of air in combustion reactions can increase combustion and heating system efficiency.

This call on the Twin Green and Digital Transition was for Innovation Actions (IAs). It was a single-stage call that opened on 12 October 2021 with a deadline for applications of 30 March 2022.

CALL BUDGET

EUR 55,826,660

PROCESSES4PLANET THEMES AND GOALS		Energy	
		HORIZON-CL4-2022-TWIN-TRANSITION-01-17	
Theme	Goals	H ₂ GLASS	HyInHeat
Climate neutrality	Develop new electrified processes and Energy efficiency, ensuring process flexibility and capturing the full potential of renewable energies		✓
	Replace fossil fuels and feedstock by Renewable H ₂ and biomass in processes	✓	✓



AIM

The Glass industry is searching for sustainable alternatives. Carbon emissions related to the production of glass stem mainly from the combustion of natural gas. The H₂GLASS project brings together 23 partners from around Europe to create the technology portfolio that glass and aluminium manufacturers need to convert to 100% hydrogen combustion. H₂GLASS will address the challenges related to emissions of nitrogen oxides and high flame propagation speed, process efficiency and the supply of hydrogen for on-site demonstrations. Digital twin techniques will be used to assess risk-based predictive maintenance. The project will also demonstrate the transferability of its underlying models to similar energy-intensive industries.

DISCLAIMER

This project has received funding from the European Union's Horizon Europe research and innovation programme under Grant Agreement No. 101092153.



CONCEPTS AND INNOVATIONS

H₂GLASS will create the technology portfolio that glass manufacturers need to realise 100% H₂ combustion in their production facilities, while ensuring the required product quality, and manage this transition safely. Digital Twin techniques will be critical for risk-based predictive maintenance, optimised production control, and combustion system control. Hydrogen will be supplied by a portable electrolyser and the oxygen produced will be reused in the process. The H₂GLASS technologies and design solutions will be validated up to TRL 7 with five industrial demonstrators from three segments (container glass, flat glass and glass fibre), which together represent 98% of the current EU glass production. A demonstrator for the aluminium industry will prove the transferability of the basic solutions and underlying models to other energy-intensive industries with similar processes, thus strengthening the impact of the project. The innovations generated by H₂GLASS will potentially create 10 000 new jobs and unlock between EUR 1 to 5 billion of revenues for glass technology deployment, and more than EUR 17 billion in investments and 200 000 new jobs for green hydrogen. Emissions in the sector could be cut by up to 80%.

RELEVANT FIELDS OF INNOVATION

Integration of renewable heat and electricity; Flexibility and demand response; Using hydrogen in industrial processes; Digital process development and engineering; and Intelligent material and equipment monitoring.

P4PLANET LONG-TERM IMPACTS

Replace fossil fuels and feedstock by Renewable H₂ and biomass in processes.

COORDINATOR CONTACTS

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AIM

HyInHeat aims to integrate hydrogen (H₂) as a fuel for high temperature heating processes in the energy intensive industries, particularly in the aluminium and steel sectors. While some equipment is already presented as H₂-ready, the integration of H₂ combustion in heating processes still needs adoption and redesign of infrastructure, equipment and the process itself. The project will implement efficient H₂ combustion systems to decarbonise heating and melting processes in the aluminium and steel sectors, covering almost their complete process chains leading to reduced carbon dioxide emissions, increased energy efficiency, and cost competitiveness.

DISCLAIMER

This project has received funding from the European Union's Horizon Europe research and innovation programme under Grant Agreement No. 101091456.



CONCEPTS AND INNOVATIONS

HyInHeat will follow a systemic approach towards the decarbonisation of process industries through the integration of H₂-based heating technologies. It will implement eight demonstrators to redesign combustion systems for H₂ firing and to optimise burner technology to minimise NOx emissions. It will modify and optimise four burners for cross-sectorial application for H₂ operation and develop measurement equipment for fuel supply and combustion control. H₂ compatible fuel supply lines will also be implemented, and refractory degradation and consumption will be monitored. Seven of the demonstrators will use pure oxygen instead of air, with the potential for energy savings up to 40% through optimised combustion control systems. HyInHeat will use two measurement technologies for fuel quality determination and implement them at lab-scale and also in two demonstrators to address fuel gas characteristics and flows. Combustion control and NOx emission measurement technologies for H₂/air and H₂/O₂ fired processes will be developed, and data analysis and data-based digital process control algorithms developed to promote digitalisation of production processes. The project will compare the developed technologies with fossil fuel alternatives to evaluate their economic viability and

develop individual business cases. Insights into systemic decarbonisation strategies based on H₂ for EU process industries will be provided. HyInHeat hopes to revolutionize the energy-intensive industries by demonstrating sustainable H₂ heating technologies and pave the way for a greener, more sustainable future for these sectors.

RELEVANT FIELDS OF INNOVATION

Integration of renewable heat and electricity; and Using hydrogen in industrial processes.

P4PLANET LONG-TERM IMPACTS

Develop new electrified processes and Energy efficiency, ensuring process flexibility and capturing the full potential of renewable energies; and Replace fossil fuels and feedstock by Renewable H₂ and biomass in processes.

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Call HORIZON-CL4-2022-TWIN-
TRANSITION-01-15: New electrochemical
conversion routes for the production of
chemicals and materials in process
industries

THREE PROJECTS WERE FUNDED:

FIREFLY

HYPER

POWER2HYPE

CALL HORIZON-CL4-2022-TWIN-TRANSITION-01-15: NEW ELECTROCHEMICAL CONVERSION ROUTES FOR THE PRODUCTION OF CHEMICALS AND MATERIALS IN PROCESS INDUSTRIES

SCOPE

The production of chemicals, bulk materials and metals through the direct use of renewable electricity and energy sources can be realised by electrochemical conversion in photo- and/or electro-catalytic processes. As well as reducing CO₂ emissions, other advantages of electrochemical conversion with renewable electricity could be higher product selectivity, process flexibility, or the

possibility of accessing chemical pathways unattainable via conventional reactors. Photoelectrocatalysis (PEC) directly uses solar radiation to drive the electrochemical reaction, potentially enabling higher efficiencies and lower costs. All novel electrochemical paths need to integrate process design and optimisation with the development of advanced materials and reactor/cell components as well as low-energy separation processes.

This call on the Twin Green and Digital Transition was for Research and Innovation Actions (RIAs). It was a single-stage call that opened on 12 October 2021 with a deadline for applications of 30 March 2022.

CALL BUDGET

EUR 28,506,534

PROCESSES4PLANET THEMES AND GOALS		Energy		
		HORIZON-CL4-2022-TWIN-TRANSITION-01-15		
Theme	Goals	FIREFLY	HYPER	Power2Hype
Climate neutrality	Develop new electrified processes and Energy efficiency, ensuring process flexibility and capturing the full potential of renewable energies	✓	✓	✓
Circularity	Design processes for maximum resource efficiency, including the development of materials for circularity	✓		✓
	Develop new processes for circularity of secondary materials from wastes/residues for all industrial processes	✓		
Leadership in climate neutral and circular solutions	Drive the innovation portfolio to first of a kind plants (or units) in order to de-risk investment (CAPEX/OPEX reduction, competitiveness)	✓	✓	✓
	Foster new framework conditions to generate a market for climate neutral and circular solutions	✓		
	Foster new skills and types of jobs and business development, including SMEs	✓	✓	

FLEXIBLE, PREDICTIVE AND RENEWABLE ELECTRICITY-POWERED ELECTROCHEMICAL TOOLBOX FOR A SUSTAINABLE TRANSITION OF THE CATALYST-BASED EUROPEAN CHEMICAL INDUSTRY

FIREFLY



AIM

The FIREFLY project aims to electrify a large part of the chemicals value chain in a sustainable way through power-to-catalyst and chemicals fostered via electrochemical catalyst recycling. By leveraging downstream synthesis of strategic metal-based (electro) catalysts, the project aims to develop a sustainable process for the flexible, renewable energy source (RES)-powered electro-driven recycling of metals to TRL 6, placing the project in a prime position to set the foundations of an electrified chemical industry.

CONCEPTS AND INNOVATIONS

The FIREFLY project aims to drive the catalyst-based chemical industry towards

electrification and to reduce external reliance on metals and fossil fuels. The FIREFLY concept uses renewable electricity to manufacture (electro)catalysts from secondary resources in a new sustainable approach that will significantly reduce production costs. The initiative continues the path to circularity, introducing more profitable routes for the chemical industry by development of electro-driven technologies for metal recycling from spent, waste, and off-specification catalysts sourced from different industrial applications. This includes a modelling, optimisation, and engineering approach together with the efficient integration of renewable electricity and the development of a digital tool for predictive decision-making using Artificial intelligence/ Machine Learning (AI/ML) algorithms. The production of (electro)catalysts for innovative (electro)chemical processes will overcome traditional production associated with high (temperature/ pressure) operating conditions, greenhouse gas (GHG) emissions, and lack of circularity for materials.

improvement; Upgrading secondary resources; Digital process development and engineering; and Autonomous integrated supply chain management.

P4PLANET LONG-TERM IMPACTS

Develop new electrified processes and Energy efficiency, ensuring process flexibility and capturing the full potential of renewable energies; Design processes for maximum resource efficiency, including the development of materials for circularity; Develop new processes for circularity of secondary materials from wastes/residues for all industrial processes; Drive the innovation portfolio to first of a kind plants (or units) in order to de-risk investment (CAPEX/OPEX reduction, competitiveness); Foster new framework conditions to generate a market for climate neutral and circular solutions; and Foster new skills and types of jobs and business development, including SMEs.

DISCLAIMER

This project has received funding from the European Union's Horizon Europe research and innovation programme under Grant Agreement No. 101091715.



RELEVANT FIELDS OF INNOVATION

Integration of renewable heat and electricity; Electrochemical conversion; Electrically driven separation; Alternative hydrogen production routes; Catalytic conversion of CO₂ to chemicals/fuels; Utilisation of CO₂ and CO as a building block in polymers; Next-gen catalysis; Breakthrough efficiency

COORDINATOR CONTACTS

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AIM

HYPER aims to transform hydrogen peroxide (H_2O_2) production from a large-scale, energy intensive chemical process to a smaller-scale, robust, modular, sustainable, electrochemical process, providing substantial economic and environmental benefits. The expected outcomes will revolutionise the production of H_2O_2 from its traditional centralised energy intensive production, which has a significant CO_2 footprint, into a modular, robust, on-site production, allowing for on-demand H_2O_2 , decreasing CO_2 emissions both directly and indirectly, as well as reducing the consumption of critical raw materials and the generation of hazardous waste.

DISCLAIMER

This project has received funding from the European Union's Horizon Europe research and innovation programme under Grant Agreement No. 101091554.



CONCEPTS AND INNOVATIONS

HYPER will focus on the development of a unique electrochemical process to produce H_2O_2 via persulfate, a compound that has higher oxidation potential and is more stable than H_2O_2 . This flexible and modular electrified process can advantageously replace the current fossil fuel-based auto-oxidation (AO) production process and provide improved energy and material efficiency that will result in GHG emissions savings. The anodic oxidation will be paired with useful cathodic reductions, such as H_2 production and material recovery/emissions (NO_x/SO_x) reductions, in a low waste and circular economy approach. HYPER's electrified process will be able to work using intermittent and unpredictable renewable energy sources (RES). Indeed, HYPER will develop a digital twin, to simulate dynamic operation with intermittent renewable power and to analyse how a full-sized system would be able to function as a grid balancing service. This data will feed into the identification of routes for improved commercial viability and help ensure the efficient integration of RES to drive the conversion process in a reliable manner.

RELEVANT FIELDS OF INNOVATION

Electrochemical conversion; and Breakthrough efficiency improvement.

P4PLANET LONG-TERM IMPACTS

Develop new electrified processes and Energy efficiency, ensuring process flexibility and capturing the full potential of renewable energies; Drive the innovation portfolio to first of a kind plants (or units) in order to de-risk investment (CAPEX/OPEX reduction, competitiveness); and Foster new skills and types of jobs and business development, including SMEs.

COORDINATOR CONTACTS

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WWW.HYPERHORIZON.EU



AIM

Power2Hype aims to establish a sustainable route for hydrogen peroxide (H_2O_2) production based on air and water as the only feedstocks and renewable energy sources. Hydrogen peroxide will be synthesised by paired electrolysis at both the cathode and anode using an innovative custom-made 200% electrolyser. Aiming for the electrification and decentralisation of the chemical industry, Power2Hype will demonstrate electrolytic hydrogen peroxide production at TRL 5-6 for any given concentration (from 20 to 99%) at the point of use, for example for sanitation purposes, bleaching applications or even as a propulsion fuel.

DISCLAIMER

This project has received funding from the European Union's Horizon Europe research and innovation programme under Grant Agreement No. 101091934.



CONCEPTS AND INNOVATIONS

Power2Hype will work on a set of interlinked activities structured in three project phases. The first phase will address the fundamental aspects of the electrochemical H_2O_2 production. Partners will work on the design, synthesis, and characterisation of advanced component materials, such as electrocatalysts, gas diffusion layers, anode materials and membranes. The second phase will focus on the cell design and scale-up for the electrochemical process and on integration with downstream processing of the product mixtures. The final phase will concentrate on the demonstration of the integrated electrochemical process at TRL 5-6, including the downstream processing of the generated aqueous hydrogen peroxide solutions to yield concentrated H_2O_2 of commercial value. Furthermore, the experimental work will be accompanied and supported by the implementation of a virtual demonstrator, enabling extensive modelling and predictive process integration and scale-up. The virtual demonstrator will provide the ability to follow the dynamics of fluctuating renewable power supplies. Based on experimental data and system modelling, the economic, environmental and societal performance and impact potential of the developed Power2Hype technology will be critically assessed.

RELEVANT FIELDS OF INNOVATION

Flexibility and demand response; Electrochemical conversion; Next-gen catalysis; Breakthrough efficiency improvement; Innovative materials of the process industries; and Digital process development and engineering.

P4PLANET LONG-TERM IMPACTS

Develop new electrified processes and Energy efficiency, ensuring process flexibility and capturing the full potential of renewable energies; Design processes for maximum resource efficiency, including the development of materials for circularity; and Drive the innovation portfolio to first of a kind plants (or units) in order to de-risk investment (CAPEX/OPEX reduction, competitiveness).

COORDINATOR CONTACTS

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Carbon Capture and Utilisation



Call HORIZON-CL4-2022-TWIN-
TRANSITION-01-11: Valorisation of
CO/CO₂ streams into added-value
products of market interest

TWO PROJECTS WERE FUNDED:

CARBON4MINERALS

THREADING-CO₂

CALL HORIZON-CL4-2022-TWIN-TRANSITION-01-11: VALORISATION OF CO/CO₂ STREAMS INTO ADDED-VALUE PRODUCTS OF MARKET INTEREST

SCOPE

Project proposals should provide concepts for utilisation of CO/CO₂ streams from point sources, such as large industrial installations like steel, cement and chemical plants, and convert them into added value products and/or intermediates and chemicals of wide interest, for example plastics, resins, composites, or chemicals.

This topic excluded projects aiming to produce fuels and renewable energy storage concepts. The technologies proposed should support cross-sectorial concepts and sector integration paradigms. They should also be able to work efficiently in a renewable based energy system and cope with potential fluctuations in the energy supply.

This call on the Twin Green and Digital Transition was for Innovation Actions (IAs). It was a single-stage call that opened on 12 October 2021 with a deadline for applications of 30 March 2022.

CALL BUDGET

EUR 42,786,213

PROCESSES4PLANET THEMES AND GOALS		Materials Circularity	
		HORIZON-CL4-2022-TWIN-TRANSITION-01-11	
Theme	Goals	Carbon4Minerals	THREADING-CO ₂
Climate neutrality	Develop new electrified processes and Energy efficiency, ensuring process flexibility and capturing the full potential of renewable energies		✓
	Replace fossil fuels and feedstock by Renewable H ₂ and biomass in processes		✓
	Develop new efficient CO/CO ₂ Capture and purification technologies	✓	
	Develop efficient CO ₂ valorisation routes to chemicals, minerals and fuels	✓	✓
Circularity	Design processes for maximum resource efficiency, including the development of materials for circularity	✓	✓
	Develop new processes for circularity of secondary materials from wastes/residues for all industrial processes	✓	✓
Leadership in climate neutral and circular solutions	Drive the innovation portfolio to first of a kind plants (or units) in order to de-risk investment (CAPEX/OPEX reduction, competitiveness)		✓
	Foster new skills and types of jobs and business development, including SMEs	✓	



AIM

The core concept of Carbon4Minerals addresses the simultaneous use of CO₂ from industrial flue gases with current and future waste streams to unlock a vast stock of resources for innovative low carbon binders and construction materials (80-135% lower CO₂-emissions than reference cement-based materials). Apart from lowering CO₂ emissions, these technologies offer a solution for the dwindling supplies of conventional cement replacements, as a result of the energy transition.

DISCLAIMER

This project has received funding from the European Union's Horizon Europe research and innovation programme under Grant Agreement No. 101091870.



CONCEPTS AND INNOVATIONS

A total of eight industrial pilots will be built and operated across the process value chain from CO₂ capture to cement production and low carbon construction products on the site of cement, steel and brick plants. Specific technologies to be deployed include liquid amine and solid sorption CO₂ capture, carbonation clinker, supplementary cementing material (SCM) production by CO₂-mediated mechanical activation and carbonation, pressed and precast carbonation products. A consortium of technology providers, producers and research partners will develop, test and demonstrate the processes. Technical, environmental and economic feasibility will be validated by an integrated assessment, in combination with the development of a service life test package tailored to these new products. Co-learning modules are to be developed to support industrial implementation and market introduction.

RELEVANT FIELDS OF INNOVATION

Flexible CO₂ capture and purification technologies; CO₂ utilisation in concrete production; CO₂ and CO mineralisation to produce building materials; Upgrading secondary resources; and Human resources, skills, and labour market.

P4PLANET LONG-TERM IMPACTS

Develop new efficient CO/CO₂ Capture and purification technologies; Develop efficient CO₂ valorisation routes to chemicals, minerals and fuels; Design processes for maximum resource efficiency, including the development of materials for circularity; Develop new processes for circularity of secondary materials from wastes/residues for all industrial processes; and Foster new skills and types of jobs and business development, including SMEs.

COORDINATOR CONTACTS

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WWW.CARBON4MINERALS.EU



THREADING-CO₂

AIM

The THREADING-CO₂ project aims to significantly reduce the carbon footprint of the textile industry by demonstrating and bringing to the market high-quality polyester textile products from the valorisation of CO₂ waste streams through a circular manufacturing approach.

DISCLAIMER

This project has received funding from the European Union's Horizon Europe research and innovation programme under Grant Agreement No. 101092257.



CONCEPTS AND INNOVATIONS

THREADING-CO₂ aims to scale-up and demonstrate its first-of-its-kind technology producing high-quality, commercially viable sustainable PET textile products from CO₂ waste streams at industrial scale (TRL7) via a monoethylene glycol (MEG) synthesis process using a circular manufacturing approach and running on renewable energy sources (RES). The overall outcome of the THREADING-CO₂ project will be a 70% GHG emissions reduction compared to existing PET manufacturing processes. In addition, THREADING-CO₂ will enable the creation of a European value chain for sustainable PET textiles, from feedstock to final textile products in the clothing, automotive and sports/outdoor industries.

RELEVANT FIELDS OF INNOVATION

Integration of renewable heat and electricity; Using hydrogen in industrial processes; Catalytic conversion of CO₂ to chemicals/fuels; Utilisation of CO₂ and CO as a building block in polymers; Innovative materials of the process industries; and Inherent recyclability of materials.

P4PLANET LONG-TERM IMPACTS

Develop new electrified processes and Energy efficiency, ensuring process flexibility and capturing the full potential of renewable energies; Replace fossil fuels and feedstock by Renewable H₂ and biomass in processes; Develop efficient CO₂ valorisation routes to chemicals, minerals and fuels; Design processes for maximum resource efficiency, including the development of materials for circularity; Develop new processes for circularity of secondary materials from wastes/residues for all industrial processes; and Drive the innovation portfolio to first of a kind plants (or units) in order to de-risk investment (CAPEX/OPEX reduction, competitiveness).

COORDINATOR CONTACTS

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Materials circularity



Call HORIZON-CL4-2021-TWIN-
TRANSITION-01-17: Plastic waste
as a circular carbon feedstock for
industry

THREE PROJECTS WERE FUNDED:

ELECTRO

PLASTICE

PLASTICS2OLEFINS

CALL HORIZON-CL4-2021-TWIN-TRANSITION-01-17: PLASTIC WASTE AS A CIRCULAR CARBON FEEDSTOCK FOR INDUSTRY

SCOPE

Plastic (and other) waste, such as packaging and textiles, could potentially represent a sustainable alternative to imported fossil fuel feedstock. The waste contains high amounts of carbon, is widely available, and its valorisation could also provide environmental and societal benefits avoiding disposal in landfill.

Project concepts should utilise unsorted plastic (and other) waste in cracking applications for the production of material streams of wide industrial interest (for example hydrocarbons, olefins, syngas, or hydrogen). The technologies proposed should be electrified to work efficiently in a renewable based energy system and able to cope with potential fluctuations in energy supply.

This call on the Twin Green and Digital Transition was for Innovation Actions (IAs). It was a single-stage call that opened on 22 June 2021 with a deadline for applications of 23 September 2021.

CALL BUDGET

EUR 69,670,842

PROCESSES4PLANET THEMES AND GOALS		Materials circularity		
		HORIZON-CL4-2021-TWIN-TRANSITION-01-17		
Theme	Goals	ELECTRO	PLASTICE	Plastics2Olefins
Climate neutrality	Develop new electrified processes and Energy efficiency, ensuring process flexibility and capturing the full potential of renewable energies	✓	✓	✓
Circularity	Design processes for maximum resource efficiency, including the development of materials for circularity	✓	✓	✓
	Develop new processes for circularity of secondary materials from wastes/residues for all industrial processes	✓	✓	✓



AIM

ELECTRO will demonstrate a revolutionary technology concept that links the waste and the petrochemical industries and provides them with a sustainable, low GHG footprint and scalable circular solution for olefin and polyolefin production. The priority for ELECTRO is the plastic waste streams that are currently not recycled but rather incinerated or dumped to landfill – these include multilayer plastics, mixed polyethylene (PE)/ polypropylene (PP) / polystyrene (PS) and waste PS. This hugely scalable concept will enable strong industrial symbiosis and potentially reduce Greenhouse Gas emissions by 90% compared to today's best available technology through full (renewable) electrification.

DISCLAIMER

This project has received funding from the European Union's Horizon Europe research and innovation programme under Grant Agreement No. 101058412.



CONCEPTS AND INNOVATIONS

ELECTRO will deliver a new disruptive, electrically driven reactor technology at TRL 7 for the conversion of plastic waste by catalytic pyrolysis connected to an innovative modular extruder for optimal pre-treatment, all demonstrated and bench-marked to the current state of the art. The main product from the conversion of the plastic waste, namely plastic waste pyrolysis oil, will be fed into a novel electrified steam cracking technology. Steam cracking will be electrified in a Roto Dynamic Reactor (RDR). In the RDR, the need to transfer heat from fired heaters to reactant gas flowing in tubular coils is eliminated. RDR's high-velocity rotor blades create thermal energy to heat the reactant gas directly, quickly and much more efficiently. Therefore, the RDR has a substantially higher selectivity towards light olefins and improved process efficiency. These light olefin products will be further processed into PE and PP, demonstrating the technical feasibility of chemical recycling and the use of plastic waste as a circular carbon feed. Given the amount of plastic waste that can be converted and the market demand for the compounds produced, the impact of ELECTRO could be profound.

RELEVANT FIELDS OF INNOVATION

Integration of renewable heat and electricity; Integrating circular carbon into energy applications; Electricity-based heating technologies; Breakthrough efficiency improvement; Innovative materials of the process industries; Inherent recyclability of materials; and Upgrading secondary resources.

P4PLANET LONG-TERM IMPACTS

Develop new electrified processes and Energy efficiency, ensuring process flexibility and capturing the full potential of renewable energies; Design processes for maximum resource efficiency, including the development of materials for circularity; and Develop new processes for circularity of secondary materials from wastes/residues for all industrial processes.

COORDINATOR CONTACTS

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AIM

In 2019, only 9% of the world plastics produced were recycled, highlighting a pressing concern: the ever-growing plastic pollution and the various challenges related to managing and recycling plastic wastes. Accordingly, difficulties in the current recycling processes include the presence of complex fractions in the waste streams such as contaminants, multilayer materials, complex mixes of plastics, and other types of waste that cannot be sorted in an economically feasible way. This leads to large amounts of plastic waste being incinerated or landfilled, causing serious environmental impacts. The PLASTICE project aims to tackle this issue by developing and designing four

innovative technologies (cascade enzymatic hydrolysis; combined gasification and chemical post-treatment; hydrothermal liquefaction; and microwave assisted pyrolysis) to assess the valorisation processes which will be further evaluated in industrial environments. This will help bring about a sustainable closed-loop value chain for plastics.

CONCEPTS AND INNOVATIONS

PLASTICE will develop a set of new valorisation processes aligned with roadmaps for chemical recycling technologies at European level. In collaboration with EU waste managers it will design, develop and demonstrate under real-world conditions four valorisation technologies: Microwave-assisted pyrolysis; Hydrothermal liquefaction; Combined gasification and chemical post-treatment; and Cascade enzymatic hydrolysis. The project's overall approach will deploy innovative elements along the whole value chain with the objective of integrating green technologies for the new processes to become sustainable and closing the loop to deliver circular value chains around plastics including textiles with plastic content. PLASTICE works both upstream and downstream in the valorisation processes, integrating new sorting systems,

technologies, digitalisation tools and eco-design principles together with new business models linked to each step of the circular value chains. This can make a significant impact on the amount of landfilled plastics and GHG emissions linked to process operation and fossil fuel-based feedstock. Replication of the project results will be supported by contributions to the development of new standards and regulations, and by creating a community supported by PLASTICE's tools and consortium.

P4PLANET LONG-TERM IMPACTS

Develop new electrified processes and Energy efficiency, ensuring process flexibility and capturing the full potential of renewable energies; Design processes for maximum resource efficiency, including the development of materials for circularity; and Develop new processes for circularity of secondary materials from wastes/residues for all industrial processes.

COORDINATOR CONTACTS

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WWW.PLASTICE.EU

DISCLAIMER

This project has received funding from the European Union's Horizon Europe research and innovation programme under Grant Agreement No. 101058540.





AIM

The project aims to develop and validate at TRL 7 a novel plastics recycling process based on high temperature pyrolysis reducing the lifecycle GHG emissions by more than 70% compared to existing plastics recycling processes for unsorted plastic waste, and by more than 80% compared to current end of life options for these wastes. It will optimise the pyrolysis downstream process to achieve the required quality of final products in order to valorise the outputs across a number of selected markets (syngas, oils and char).

DISCLAIMER

This project has received funding from the European Union's Horizon Europe research and innovation programme under Grant Agreement No. 101058032.



CONCEPTS AND INNOVATIONS

Plastics2Olefins takes a two-step approach: first by adapting and testing a pilot plant at the Repsol Technology Lab to optimise the process conditions of the chemical recycling technology and the downstream processes, and secondly a full-scale industrial demonstration plant at Repsol's Puertollano plant, which will be operated for a six-month validation campaign. Industrial and technological partners from different steps in the value chain are involved in the project contributing their technical knowledge to develop and optimise the technology including pretreatment of the plastic waste, pyrolysis technology, condensation and finally upgrading of the pyrolysis oil and pyrolysis gas. Plastic2Olefins will demonstrate a new pathway, in an industrial environment, to produce circular olefins that could be converted to recycled plastics, using plastic waste as a feedstock.

RELEVANT FIELDS OF INNOVATION

Inherent recyclability of materials.

P4PLANET LONG-TERM IMPACTS

Develop new electrified processes and Energy efficiency, ensuring process flexibility and capturing the full potential of renewable energies; Design processes for maximum resource efficiency, including the development of materials for circularity; and Develop new processes for circularity of secondary materials from wastes/residues for all industrial processes.

COORDINATOR CONTACTS

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WWW.PLASTICS2OLEFINS.EU

Call HORIZON-CL4-2021-
RESILIENCE-01-01: Ensuring
circularity of composite materials

THREE PROJECTS WERE FUNDED:

EURECOMP

MC4

RECREATE

CALL HORIZON-CL4-2021-RESILIENCE-01-01: ENSURING CIRCULARITY OF COMPOSITE MATERIALS

SCOPE

The European composites market is substantial and growing due to increasing demand for lightweight materials in various energy intensive value chains such as wind energy and transport. However, composites are difficult to reuse or recycle as available technologies, such as high-temperature pyrolysis or grinding, are either environment unfriendly or economically unattractive. In

addition, environmental legislation on recycling of end-of-life components and structures will mean that from 2025 considerable amounts of composite materials will have to be recycled every year in Europe. Technologies are required to enable reuse and recycle of these materials in a useful and sustainable manner. New solutions should also allow recycling of composite materials with few, or no, separation steps without a compromise to downcycling of materials.

This call on the Twin Green and Digital Transition was for Research and Innovation Actions (RIAs). It was a single-stage call that opened on 22 June 2021 with a deadline for applications of 23 September 2021.

CALL BUDGET

EUR 24,266,854

PROCESSES4PLANET THEMES AND GOALS		Materials circularity		
		HORIZON-CL4-2021-RESILIENCE-01-01		
Theme	Goals	EuReComp	MC4	RECREATE
Climate neutrality	Develop new efficient CO/CO ₂ Capture and purification technologies	✓		
Circularity	Design processes for maximum resource efficiency, including the development of materials for circularity	✓	✓	✓
	Develop new processes for circularity of secondary materials from wastes/residues for all industrial processes	✓	✓	✓
	Seed H4C's to foster circularity within and beyond process industries			✓
Leadership in climate neutral and circular solutions	Drive the innovation portfolio to first of a kind plants (or units) in order to de-risk investment (CAPEX/OPEX reduction, competitiveness)	✓		
	Foster new framework conditions to generate a market for climate neutral and circular solutions	✓	✓	
	Foster new skills and types of jobs and business development, including SMEs	✓	✓	✓



AIM

EuReComp aims to provide sustainable methods for recycling and reuse of composites coming from components used in various industries such as aerospace and wind energy. Its main objectives are to propose innovative dismantling and sorting systems enabling reuse and recycling of complex composite materials, develop and integrate novel solutions for a higher reuse of whole products and components, demonstrate at pilot scale reuse/recycling approaches of composites and secondary raw materials, develop tools demonstrating the circularity and the environmental benefits of the solutions, and consider the co-design of learning resources with educational organisations for current and future generations.

DISCLAIMER

This project has received funding from the European Union's Horizon Europe research and innovation programme under Grant Agreement No. 101058089.



CONCEPTS AND INNOVATIONS

EuReComp will enable material circularity through repairing, repurposing and redesigning parts from end-of-life large scale products, and recycling and reclamation of the materials used in these parts, accomplishing reduction of waste and transformation to high-added value products. The methodologies developed will be further tested and validated by developing five demonstrators using novel manufacturing methodologies and incorporating recycled materials obtained from different recycling processes leading to a range of new circular composites. The five EuReComp pilot demonstrators will be a Continuous fibre reclamation (from pilot scale to industrial scale), an Optimised Pilot scale chemical solvolysis with solvent and monomer separation-reuse, a Naval and Construction Demo Case introducing recycled fibres with an infusion process, Closed Loop Recycling using a Filament Winding Demo with recycled fibres, and an Automotive Demonstration Case combining a range of techniques.

RELEVANT FIELDS OF INNOVATION

Integrating circular carbon into energy applications; Flexibility and demand response; Flexible CO₂ capture and purification technologies; CO₂ and CO mineralisation to produce building materials;

Breakthrough efficiency improvement; Innovative materials of the process industries; Inherent recyclability of materials; Upgrading secondary resources; European Community of Practice (H4C); Development of Hubs for Circularity; and Human resources, skills, and labour market.

P4PLANET LONG-TERM IMPACTS

Develop new efficient CO/CO₂ Capture and purification technologies; Design processes for maximum resource efficiency, including the development of materials for circularity; Develop new processes for circularity of secondary materials from wastes/residues for all industrial processes; Drive the innovation portfolio to first of a kind plants (or units) in order to de-risk investment (CAPEX/OPEX reduction, competitiveness); Foster new framework conditions to generate a market for climate neutral and circular solutions; and Foster new skills and types of jobs and business development, including SMEs.

COORDINATOR CONTACTS

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AIM

MC4 aims to establish circular approaches for carbon and glass fibre composites. These materials are essential in numerous technical applications, for which their lightweight properties and high performances are especially valued. However, 98% of the end-of-life materials end up in landfill, while the current competitive position of Europe in these value chains needs to be improved in order to be less dependent on foreign sources. MC4 will develop processes that will allow carbon and glass fibre composites to be recycled, making the composites industry more sustainable, and the EU more resilient.

DISCLAIMER

This project has received funding from the European Union's Horizon Europe research and innovation programme under Grant Agreement No. 101057394.



CONCEPTS AND INNOVATIONS

Carbon fibres (CF) and glass fibres (GF) have substantially different costs and this needs to be considered when developing economically feasible recycling procedures for the two materials. Therefore, MC4 will design four pathways for recycling CF and GF composites. For CF, in the short term, uncured CF scrap materials will be directly re-used in the production line to reduce the amount of scrap generated during manufacturing. As a long-term solution, chemical recycling will be developed to regain valuable CF from end-of life parts and convert them into yarns, fabric and nonwoven material for new production. For GF, in the short-term, GF composites will be shredded and re-used in new parts, which will reduce the amount of virgin material required. Eventually, the application of a new dynamic resin enabling the reshaping of parts at their end of life will provide a long-term solution. In addition to developing the recycling processes, additional evolutions will be addressed to better sort end-of-life parts, to enhance quality control methods, and to foster industrial-sized installations.

RELEVANT FIELDS OF INNOVATION

Innovative materials of the process industries; Inherent recyclability of materials; and Upgrading secondary resources.

P4PLANET LONG-TERM IMPACTS

Design processes for maximum resource efficiency, including the development of materials for circularity; Develop new processes for circularity of secondary materials from wastes/residues for all industrial processes; and Foster new framework conditions to generate a market for climate neutral and circular solutions; Foster new skills and types of jobs and business development, including SMEs.

COORDINATOR CONTACTS

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WWW.MC4-PROJECT.EU



AIM

RECREATE aims to develop a set of innovative technologies for profitable reuse, recycling, and remanufacturing of end-of-life fibre-reinforced composite materials. The project will introduce new systemic approaches for utilising complex composite waste as feedstock for new materials and parts for a variety of industrial sectors, setting up the necessary tools and strategies to make these approaches efficient and sustainable, and exploiting the full circularity potential of end-of-life fibre-reinforced composite waste.

DISCLAIMER

This project has received funding from the European Union's Horizon Europe research and innovation programme under Grant Agreement No. 101058756.



CONCEPTS AND INNOVATIONS

The EU composites market size is forecast to grow steadily over the next few years, leading to an estimated 80 000 tonnes or more of composite waste requiring recycling and reuse by 2025. In parallel, the market is increasingly demanding high-performance fibre materials at affordable costs for the lightweight-design field. New recycling technologies, as an alternative to current mechanical grinding and pyrolysis processes, are therefore needed to allow recovery and reuse of composite materials and components without downcycling and with convincing environmental sustainability and viable economic business cases. RECREATE will develop novel reuse strategies for current generation, end-of-life composite parts, develop innovative physico-chemical upcycling technologies allowing simultaneous recovery of high quality, integer, clean fibres and of a reusable organic resin fraction, and develop smart, green reversible thermoset resins for the next generation of recyclable-by-design fibre-reinforced composite materials and structures. RECREATE will also develop new digital tools for the quantitative evaluation of the environmental and economic performance of the new technologies as well as their circularity assessment, and the co-design of innovative digital learning resources, including the realisation of

massive online open courses (MOOCs), serious games and digital twins of the specialty technologies developed.

RELEVANT FIELDS OF INNOVATION

Innovative materials of the process industries; Inherent recyclability of materials; and Upgrading secondary resources.

P4PLANET LONG-TERM IMPACTS

Design processes for maximum resource efficiency, including the development of materials for circularity; Develop new processes for circularity of secondary materials from wastes/residues for all industrial processes; Seed Hubs4Circularity to foster circularity within and beyond process industries; and Foster new skills and types of jobs and business development, including SMEs.

COORDINATOR CONTACTS

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WWW.RECREATECOMPOSITES.EU

Digitalisation for traceable value chains



Call HORIZON-CL4-2022-
RESILIENCE-01-01: Circular and
low emission value chains through
digitalisation

THREE PROJECTS WERE FUNDED:

CE-RISE

DIGINTRACE

PLOOTO

CALL HORIZON-CL4-2022-RESILIENCE-01-01: CIRCULAR AND LOW EMISSION VALUE CHAINS THROUGH DIGITALISATION

SCOPE

Circularity is an essential part of a wider transformation of industry towards climate neutrality and long-term competitiveness. It can deliver substantial material savings throughout value chains and production processes, generate extra value and unlock economic opportunities. While circularity is essentially addressed by waste from one

process becoming secondary materials for others, an efficient use in the value chain in order to close the loop or reuse in other industries, can only be ensured through a transparent information system. The design and piloting of an information system for raw materials and components in products throughout the whole value chain of the process industries is required.

This call on the Twin Green and Digital Transition was for Research and Innovation Actions (RIAs). It was a single-stage call that opened on 12 October 2021 with a deadline for applications of 30 March 2022.

CALL BUDGET

EUR 22,949,773

PROCESSES4PLANET THEMES AND GOALS		Digitalisation		
		HORIZON-CL4-2022-RESILIENCE-01-01		
Theme	Goals	CE-RISE	DigInTracCE	Ploto
Circularity	Design processes for maximum resource efficiency, including the development of materials for circularity	✓	✓	✓
	Develop new processes for circularity of secondary materials from wastes/residues for all industrial processes	✓	✓	✓
	Seed H4C's to foster circularity within and beyond process industries		✓	
Leadership in climate neutral and circular solutions	Foster new framework conditions to generate a market for climate neutral and circular solutions	✓	✓	✓
	Foster new skills and types of jobs and business development, including SMEs		✓	



AIM

CE-RISE aims to address limited supply and increasing demand for critical raw materials by minimising material loss and optimising reuse across value chains. It proposes an integrated framework and resource information system to identify effective solutions for material reuse, recovery, and recycling. This will involve defining criteria for evaluating reuse potential and incorporating them into a Digital Product Passport (DPP) for supply chain traceability. The project enhances DPP with environmental footprint information, socio-economic and environmental impacts, and enables confidential information sharing and tracing through a Blockchain-based data storage platform.

DISCLAIMER

This project has received funding from the European Union's Horizon Europe research and innovation programme under Grant Agreement No. 101092281.



CONCEPTS AND INNOVATIONS

CE-RISE will achieve its objectives by developing an integrated framework and a resource information system to identify effective solutions for the reuse, recovery, and recycling of materials. These criteria will be integrated into a Digital Product Passport (DPP), which enables traceability of materials in the supply chain. The framework incorporates information on the environmental footprint of products, as well as socio-economic and environmental impacts of reuse processes. The project will develop a comprehensive conceptual framework and methodology as the foundation for the CE-RISE Information System (CIS). The CIS will facilitate the flow of information, enhancing the reusability and recyclability of products by tracking their life cycles and materials throughout value chains. By providing open-access software applications, the project aims to disseminate and integrate information about reuse criteria, environmental footprints, and product impacts to stakeholders, including consumers and policymakers.

RELEVANT FIELDS OF INNOVATION

Breakthrough efficiency improvement; Upgrading secondary resources; Digital process development and engineering; and Autonomous integrated supply chain management.

P4PLANET LONG-TERM IMPACTS

Design processes for maximum resource efficiency, including the development of materials for circularity; Develop new processes for circularity of secondary materials from wastes/residues for all industrial processes; and Foster new framework conditions to generate a market for climate neutral and circular solutions.

COORDINATOR CONTACTS

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WWW.CE-RISE.EU

A DIGITAL VALUE CHAIN INTEGRATION TRACEABILITY FRAMEWORK FOR PROCESS INDUSTRIES FOR CIRCULARITY AND LOW EMISSIONS BY WASTE REDUCTION AND USE OF SECONDARY RAW MATERIALS



DigInTraCE

AIM

DigInTraCE is guided by six main objectives, each driving specific outcomes. These objectives include optimising the use of secondary raw materials and minimising waste in circular value chains, developing a decentralised digital platform for material tracing and certification, creating real-time sensing and sorting mechanisms supported by a dynamic Digital Product Passport (DPP), improving accessibility to material data through smart technologies, validating DigInTraCE technologies across multiple value chains, and empowering local entities in educational resource development. This comprehensive approach promotes sustainability, enhances material traceability,

DISCLAIMER

This project has received funding from the European Union's Horizon Europe research and innovation programme under Grant Agreement No. 101091801.



and fosters knowledge transfer, maximising the project's impact on circular economy practices.

CONCEPTS AND INNOVATIONS

DigInTraCE will develop a transparent and interoperable decentralised traceability platform using innovative tracking, sensing, and sorting techniques. This platform will primarily focus on the pulp & paper and chemicals sectors. In addition, the project will establish dynamically updated DPP schemes to support certification, quality validation, AI-based decision-making mechanisms for process and life cycle optimisation, as well as upcycling, reuse, and upgrade technologies to enhance the utilisation of secondary raw materials. DigInTraCE will concentrate on composite wood and furniture, wood and pulp and paper, plastic parts from ICT equipment and the automotive market, and polymers and textiles.

RELEVANT FIELDS OF INNOVATION

Flexibility and demand response; Breakthrough efficiency improvement; Innovative materials of the process industries; Inherent recyclability of materials; Development of Hubs for

DIGINTRACE

Circularity; Digital materials design; Digital process development and engineering; Digital plant operation; Intelligent material and equipment monitoring; Autonomous integrated supply chain management; Digitalisation of industrial-urban symbiosis; and Human resources, skills, and labour market.

P4PLANET LONG-TERM IMPACTS

Design processes for maximum resource efficiency, including the development of materials for circularity; Develop new processes for circularity of secondary materials from wastes/residues for all industrial processes; Seed Hubs4Circularity to foster circularity within and beyond process industries; Foster new framework conditions to generate a market for climate neutral and circular solutions; and Foster new skills and types of jobs and business development, including SMEs.

COORDINATOR CONTACTS

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WWW.DIGINTRACE.EU



Product Passport through Twinning of Circular Value Chains

AIM

Plooto aims to deliver a Circular and Resilient Information System (CRIS) to support manufacturers in their green, digital and circular transition. CRIS enables waste reduction and end-to-end traceability of Secondary Raw Materials (SRM) through interconnected digital services for real-time decision-making, monitoring and certification of materials and products. The solution will be piloted in three different circular supply chains (Citrus waste, carbon fibre-reinforced plastic (CFRP) for drones and waste electrical and electronic equipment (WEEE) for magnets) demonstrating waste reduction, reusability of scrap and production by-products, and operational improvement.

DISCLAIMER

This project has received funding from the European Union's Horizon Europe research and innovation programme under Grant Agreement No. 101092008.



CONCEPTS AND INNOVATIONS

Thanks to the multidisciplinary expertise within its consortium, the Plooto CRIS system will offer a variety of services enabling circularity of SRM in industrial settings. These services will relate to Digital Product Passports (DPPs) holding circularity related information for the raw material and produced products, advanced analytics and optimisation for enabling the use of the SRM in new products, as well as a holistic Governance framework and Scorecard that will guide stakeholders through the different processes from receiving the SRM to the production of new products in an efficient and circular manner.

RELEVANT FIELDS OF INNOVATION

Inherent recyclability of materials; Upgrading secondary resources; Digital plant operation; and Intelligent material and equipment monitoring.

P4PLANET LONG-TERM IMPACTS

Design processes for maximum resource efficiency, including the development of materials for circularity; Develop new processes for circularity of secondary materials from wastes/residues for all industrial processes; and Foster new framework conditions to generate a market for climate neutral and circular solutions.

COORDINATOR CONTACTS

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WWW.PLOOTO-PROJECT.EU



CALL HORIZON-CL4-2021-TWIN-TRANSITION-01-14: DEPLOYING INDUSTRIAL-URBAN SYMBIOSIS SOLUTIONS FOR THE UTILISATION OF ENERGY, WATER, INDUSTRIAL WASTE AND BY-PRODUCTS AT REGIONAL SCALE

SCOPE

To accelerate the transition to a circular economy, exemplary pilot solutions integrating industrial urban symbiosis need to be exploited. Solutions could cover the reduction of waste, virgin raw materials and energy and water consumption, mainly by transforming underused waste materials into feedstock

for the process industries. To support a wide implementation of industrial urban symbiosis for waste utilisation, a regional dimension is important to connect with local energy and utility networks, adjacent industrial infrastructures and available by-products.

This call on the Twin Green and Digital Transition was for Research and Innovation

Actions (RIAs). It was a single-stage call that opened on 22 June 2021 with a deadline for applications of 23 September 2021.

CALL BUDGET

EUR 31,935,387

PROCESSES4PLANET THEMES AND GOALS		Hubs4Circularity and Urban-Industrial symbiosis		
		HORIZON-CL4-2021-TWIN-TRANSITION-01-14		
Theme	Goals	AshCycle	SYMSITES	Waterproof
Climate neutrality	Develop efficient CO ₂ valorisation routes to chemicals, minerals and fuels	✓		✓
Circularity	Design processes for maximum resource efficiency, including the development of materials for circularity	✓	✓	✓
	Develop new processes for circularity of secondary materials from wastes/residues for all industrial processes	✓		
	Develop new processes to ensure full valorisation of waste water, recycled water, energy and solutes recovery	✓	✓	✓
	Seed H4C's to foster circularity within and beyond process industries	✓		
Leadership in climate neutral and circular solutions	Drive the innovation portfolio to first of a kind plants (or units) in order to de-risk investment (CAPEX/OPEX reduction, competitiveness)		✓	✓
	Foster new framework conditions to generate a market for climate neutral and circular solutions		✓	
	Foster new skills and types of jobs and business development, including SMEs		✓	



AIM

The overall objective of AshCycle is to develop and demonstrate regional industry-urban symbiosis (I-US) concepts for utilisation of incineration residues by extracting metals, nutrients, and rare earth elements (REEs). The project will also use mineral residues as secondary resources in construction and wastewater treatment products. Demonstrations will be implemented by regional real-scale pilots, virtual or bench-scale replication cases, and digital tools to evaluate the potential for wider replication. Pilots and replication demonstrations will be carried out in Denmark, Finland, Belgium, The Netherlands, Croatia, Slovenia, Switzerland, and South Africa.

DISCLAIMER

This project has received funding from the European Union's Horizon Europe research and innovation programme under Grant Agreement No. 101058162.



CONCEPTS AND INNOVATIONS

AshCycle will characterise ashes from each regional pilot to determine quantities, chemical, physical, and mineralogical properties. Based on the characterisation, ashes will be categorised into groups in terms of their critical properties (such as chemical composition, undesired elements, and reactivity). The groups will be rated where a lower level indicates more efforts needed for pre-treatment before utilisation. Optimised pre-treatment methods for different ash groups will be selected to improve the ash quality and enable economically viable recovery of valuable elements and subsequent utilisation of the remaining mineral residue in low-carbon circular construction materials, adsorbents, or carbon sequestration materials.

The ash characterisation and pre-treatment data, together with existing databases and available scientific information, will be used as an input for the development of a cloud-based digital tool - the Ash Modelling Application - enabling the use of AI-based modelling to evaluate the utilisation potential integrated with a life cycle assessment tool. Finally, AshCycle will also evaluate the I-US concept from economic, environmental and social points of view.

WWW.ASHCYCLE.EU

RELEVANT FIELDS OF INNOVATION

CO₂ utilisation in concrete production; CO₂ and CO mineralisation to produce building materials; Innovative materials of the process industries; Inherent recyclability of materials; Upgrading secondary resources; Wastewater valorisation; Demonstration of Industrial-Urban Symbiosis; European Community of Practice (H4C); Development of Hubs for Circularity; Digital materials design; and Digitalisation of industrial-urban symbiosis.

P4PLANET LONG-TERM IMPACTS

Develop efficient CO₂ valorisation routes to chemicals, minerals and fuels; Design processes for maximum resource efficiency, including the development of materials for circularity; Develop new processes for circularity of secondary materials from wastes/residues for all industrial processes; Develop new processes to ensure full valorisation of wastewater, recycled water, energy and solutes recovery; and Seed Hubs4Circularity to foster circularity within and beyond process industries.

COORDINATOR CONTACTS

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AIM

SYMSITES aims to develop new technologies and solutions for wastewater treatment and reuse while applying the Industrial - Urban Symbiosis (I-US) concept, with local and regional collaborations among diverse actors (Citizens, Municipalities and Enterprises) thus improving sustainability and the environment. The project applies a twin green and digital approach to implement the circular use of water.

DISCLAIMER

This project has received funding from the European Union's Horizon Europe research and innovation programme under Grant Agreement No. 101058426.



CONCEPTS AND INNOVATIONS

SYMSITES' main asset lies in the implementation of regional industrial-urban symbiosis (I-US) in four European regions, differing in geographic, socioeconomic, and environmental aspects, from the north of Denmark, through the centre of Austria, and to the south of Spain and Greece. The co-treatment of wastewater and other urban and industrial waste in each of the four EcoSites will allow the recovery of energy, water, and high-value-added products.

A number of technologies will be developed and deployed: an advanced anaerobic membrane bioreactor for the co-treatment of waste and wastewater with each of the four Ecosites developing and testing different configurations; a tertiary treatment based on an adsorption column with antibacterial and antiviral activities; a pyrolysis system to convert non-recyclable wastes into platform molecules and activated carbon for the adsorption column; and a newly developed IT-based Regional Management Platform including novel Internet of Things (IoT) systems, artificial intelligence and a Social Decision Support System to efficiently manage the overall I-US process.

RELEVANT FIELDS OF INNOVATION

Wastewater valorisation; Demonstration of Industrial-Urban Symbiosis; Digital plant operation; and Digitalisation of industrial-urban symbiosis.

P4PLANET LONG-TERM IMPACTS

Design processes for maximum resource efficiency, including the development of materials for circularity; Develop new processes to ensure full valorisation of wastewater, recycled water, energy and solutes recovery; Drive the innovation portfolio to first of a kind plants (or units) in order to de-risk investment (CAPEX/OPEX reduction, competitiveness); Foster new framework conditions to generate a market for climate neutral and circular solutions; and Foster new skills and types of jobs and business development, including SMEs.

COORDINATOR CONTACTS

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WWW.SYMSITES.EU

URBAN WASTE AND WATER TREATMENT EMISSION REDUCTION BY UTILISING CO₂ FOR THE PRODUCTION OF FORMATE DERIVED CHEMICALS

WATERPROOF



AIM

The WaterProof project will close the wastewater carbon loop by creating a novel biorefinery concept to convert CO₂ emissions, originating from waste incineration and wastewater processing, to formic acid that can be used to produce green consumer products. The project will demonstrate the creation of competitive and profitable business opportunities by turning CO₂ emissions into value-adding products on-site at wastewater treatment facilities on a demonstration scale. Technology will be developed that results in reduced GHG emissions based on CO₂ utilisation, replacement of fossil feedstock, industrial electrification, and increased circularity by making use of all by-products of the process.

DISCLAIMER

This project has received funding from the European Union's Horizon Europe research and innovation programme under Grant Agreement No. 101058578.



CONCEPTS AND INNOVATIONS

The conversion of CO₂ to formic acid will be done via electrochemistry using renewable electricity sources. In electrochemistry, two electrodes (oxidation + reduction) work together using the same energy source and provides the opportunity to add a second reaction (oxidation) running in synergy with the CO₂-conversion (reduction) reaction without requiring additional energy. For WaterProof this second reaction is the formation of H₂O₂ from H₂O, which can be used in water treatment facilities and increases the circularity of the project. The process will first be developed at lab-scale and then scaled-up to demonstration size. A demonstration unit, built within a shipping container, will be developed and will convert the CO₂, which is produced during wastewater treatment activities, on-site at treatment facilities. The formic acid produced in this process will be tested and used in consumer goods and processes such as toilet cleaner and leather tanning processes.

RELEVANT FIELDS OF INNOVATION

Integrating circular carbon into energy applications; Electrochemical conversion; Catalytic conversion of CO₂ to chemicals/fuels; Wastewater valorisation; and Demonstration of Industrial-Urban Symbiosis.

P4PLANET LONG-TERM IMPACTS

Develop efficient CO₂ valorisation routes to chemicals, minerals and fuels; Design processes for maximum resource efficiency, including the development of materials for circularity; and Develop new processes to ensure full valorisation of wastewater, recycled water, energy and solutes recovery; Drive the innovation portfolio to first of a kind plants (or units) in order to de-risk investment (CAPEX/OPEX reduction, competitiveness).

COORDINATOR CONTACTS

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WWW.WATERPROOF-PROJECT.EU

CALL HORIZON-CL4-2021-TWIN-TRANSITION-01-16: HUBS FOR CIRCULARITY EUROPEAN COMMUNITY OF PRACTICE (ECOP) PLATFORM

SCOPE

Circularity is an essential part of the industry transformation towards climate-neutrality and long-term competitiveness. Hubs for Circularity (H4C) are defined as first-of-a-kind, lighthouse demonstrator plants of commercial size implementing industrial symbiosis or urban industrial symbiosis with the aim of achieving a step change in circular utilisation of resources and GHG emission reductions, within a given region. H4C have strong technological focus and industrial dimension, but their implementation leverages wider elements. Specific implementation (including funding) strategies will have to be designed,

ensuring the participation of all stakeholders (Industry, SMEs, local authorities, educational institutions and civil society). The common target is to collectively achieve and demonstrate at scale a leap towards circularity and carbon neutrality in the use of resources (feedstock, energy and water) in a profitable way. The ECoP is a tool for connecting the Hubs and the community of interest into a network for exchanging tools and knowledge across regions. It will look to embrace all existing H4C and circular systemic activities and strongly link with the activities of other relevant European Partnerships. This call on the Twin Green and Digital Transition was for Coordination and

Support Actions (CSAs). It was a single-stage call that opened on 22 June 2021 with a deadline for applications of 23 September 2021.

CALL BUDGET

EUR 3,658,017

PROCESSES4PLANET THEMES AND GOALS		Hubs4Circularity and Urban-Industrial-Symbiosis	
		HORIZON-CL4-2021-TWIN-TRANSITION-01-16	
Theme	Goals	H4C ECoP	H4C EUROPE
Circularity	Seed H4C's to foster circularity within and beyond process industries	✓	✓
Leadership in climate neutral and circular solutions	Foster new framework conditions to generate a market for climate neutral and circular solutions	✓	✓
	Foster new skills and types of jobs and business development, including SMEs	✓	✓



AIM

The Hubs4Circularity Community of Practice is a network of public and private stakeholders from industries, regions, and cities to facilitate the building, scaling up and replicating of ecosystems of industrial and industrial-urban symbiosis, as well as the circular economy. Hubs for Circularity (H4C) are to be the European lighthouses of resource efficiency through implementing best practice in industrial and urban symbiosis (I-US).

DISCLAIMER

This project has received funding from the European Union's Horizon Europe research and innovation programme under Grant Agreements No. 101058656 (H4C ECop) and No. 101058416. (H4C)



CONCEPTS AND INNOVATIONS

Through a digital knowledge platform, this initiative curates knowledge, tools, models, and solutions, making them accessible to the Community of Practice. As part of the initiative, expert groups and advisory panels analyse challenges and solutions, exchange best practices, provide policy recommendations, and develop metrics to assess the maturity of regional initiatives in collaboration with Hubs4Circularity demonstration sites.

Working closely together these two projects will deliver a vibrant Community of Practice and H4C platform that will achieve the target of greater circularity and carbon neutrality through profitable actions that also benefit communities and civil society.

RELEVANT FIELDS OF INNOVATION

European Community of Practice (H4C); and Development of Hubs for Circularity.

P4PLANET LONG-TERM IMPACTS

Seed Hubs4Circularity to foster circularity within and beyond process industries; Foster new framework conditions to generate a market for climate neutral and circular solutions; and Foster new skills and types of jobs and business development, including SMEs.

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WWW.H4C-COMMUNITY.EU

CALL HORIZON-CL4-2022-TWIN-TRANSITION-01-10: CIRCULAR FLOWS FOR SOLID WASTE IN URBAN ENVIRONMENT

SCOPE

Hubs for circularity for solid waste in urban environments tackle a fundamental issue of end-of-life materials representing a huge amount and variety of solid wastes and one of the largest waste streams in Europe. Re-using and re-cycling most of this waste stream could cut significantly the emissions caused

by mining and manufacturing to produce virgin materials and as such represents an important decarbonisation potential. Innovative solutions are required to engage waste management actors in novel value chains to valorise a significant part of those wastes, bringing full attention to upcycling back to secondary materials instead of downcycling of low re-use.

This call on the Twin Green and Digital Transition was for Innovation Actions (IAs). It was a single-stage call that opened on 12 October 2021 with a deadline for applications of 30 March 2022.

CALL BUDGET

EUR 45,097,826

PROCESSES4PLANET THEMES AND GOALS		Hubs4Circularity and Urban-Industrial symbiosis		
		HORIZON-CL4-2022-TWIN-TRANSITION-01-10		
Theme	Goals	MOBICCON-PRO	REDOL	tExtended
Circularity	Design processes for maximum resource efficiency, including the development of materials for circularity	✓	✓	✓
	Develop new processes for circularity of secondary materials from wastes/residues for all industrial processes	✓	✓	✓
	Seed H4C's to foster circularity within and beyond process industries	✓	✓	✓
Leadership in climate neutral and circular solutions	Foster new framework conditions to generate a market for climate neutral and circular solutions	✓	✓	✓
	Foster new skills and types of jobs and business development, including SMEs		✓	✓



AIM

The project will introduce and demonstrate a systemic, circular and mobile solution in the South-East Europe (SEE) region to improve the recovery and recycling of Construction and Demolition Waste (CDW). The project will combine physical solutions (a mobile CDW treatment plant) with innovative selective separation and deconstruction technologies to scale up the treatment of CDW and the production and use of recycled construction materials. This will go hand in hand with developing promising Life Cycle Assessment (LCA) / Life Cycle Costing (LCC) tools, and digitalising the management of CDW and recycled products. The project will establish a

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This project has received funding from the European Union's Horizon Europe research and innovation programme under Grant Agreement No. 101091679.



territorial hub for CDW through which key stakeholders will cooperate to bring circularity to the construction ecosystem in the region.

CONCEPTS AND INNOVATIONS

MOBICCON-PRO will develop and demonstrate an innovative circular systemic solution for CDW management, which is economically feasible and boosts the acceptance of recycled materials in the construction sector. Two key elements for success are the Territorial Circularity Centre (TCC) and a mobile waste management scheme based on separate collection technologies and a mobile waste treatment pilot facility. The TCC will incorporate major construction sites and projects as well as support from specific municipalities and includes representatives from along the CDW and construction materials value chain, as well as citizens, to cooperate to bring circularity to regional construction ecosystems. Measures required to improve the overall legislative framework of construction products to facilitate the market uptake of recycled products will be highlighted. The CDW Treatment Mobile Pilot Plant (MPP) will be established in Sofia and then further deployed to other communities within the region in different environments to prove the sustainability, viability and replicability of the concept.

RELEVANT FIELDS OF INNOVATION

Integration of renewable heat and electricity; Inherent recyclability of materials; Upgrading secondary resources; Demonstration of Industrial-Urban Symbiosis; European Community of Practice (H4C); Development of Hubs for Circularity; and Digitalisation of industrial-urban symbiosis.

P4PLANET LONG-TERM IMPACTS

Design processes for maximum resource efficiency, including the development of materials for circularity; Develop new processes for circularity of secondary materials from wastes/residues for all industrial processes; Seed Hubs4Circularity to foster circularity within and beyond process industries; and Foster new framework conditions to generate a market for climate neutral and circular solutions.

COORDINATOR CONTACTS

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WWW.MOBICCON-PRO.EU



AIM

REDOL aims to transform cities into circularity hubs by utilising solid urban waste (SUW) as a valuable resource and promoting industrial-urban symbiosis. REDOL will redesign five value chains (packaging, plastics, CDW, textiles, and waste electrical and electronic equipment (WEEE)) to produce 12 circular products. It focuses on upgrading waste management and recycling procedures, and optimising value chains through digital tools. REDOL will establish organisational procedures, business models, and social innovation actions to facilitate successful interactions and circularity hubs at the local level. The project seeks to contribute to zero residues cities, which will result in significant economic and environmental benefits.

DISCLAIMER

This project has received funding from the European Union's Horizon Europe research and innovation programme under Grant Agreement No. 101091668.



CONCEPTS AND INNOVATIONS

REDOL will focus on upgrading waste management and processing technologies through the implementation of artificial intelligence waste sorting systems and novel waste recycling procedures. The recycled material will be used to produce new circular products (re)defined during the project. Collaboration and knowledge sharing will play a central role, with the open sharing of information through a new digital platform. The project counts on a great multidisciplinary consortium and actively engages with local actors and communities, creating a vibrant ecosystem for circular schemes. REDOL places an emphasis on the managerial and economic aspects of SUW management. It will develop viable models and strategies to enhance industry competitiveness in SUW valorisation. By transforming Zaragoza City and the Aragon Region into a circularity hub, REDOL will facilitate knowledge exchange with other cities, accelerating the adoption of circular economy principles. REDOL will combine technological advancements, digital tools, collaboration, and a focus on managerial and economic aspects to achieve efficient SUW management, effective waste sorting and processing, and the establishment of a thriving circularity hub.

WWW.REDOLPROJECT.EU

RELEVANT FIELDS OF INNOVATION

Inherent recyclability of materials; Upgrading secondary resources; Demonstration of Industrial-Urban Symbiosis; Development of Hubs for Circularity; Digital process development and engineering; Intelligent material and equipment monitoring; and Digitalisation of industrial-urban symbiosis.

P4PLANET LONG-TERM IMPACTS

Design processes for maximum resource efficiency, including the development of materials for circularity; Develop new processes for circularity of secondary materials from wastes/residues for all industrial processes; Seed Hubs4Circularity to foster circularity within and beyond process industries; Foster new framework conditions to generate a market for climate neutral and circular solutions; and Foster new skills and types of jobs and business development, including SMEs.

COORDINATOR CONTACTS

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AIM

The tExtended project will develop a blueprint for a sustainable textile ecosystem where product and material cycles reduce the use of primary raw materials. The basis of the blueprint is a knowledge-based framework determining the optimised utilisation of textile flows. A real-scale demonstrator will be implemented to verify replicability and the potential to reduce textile waste by 80% via reduction of post-industrial waste, extended reuse of textile products, and efficient material recycling of end-of-life textiles. tExtended will also develop a wide range of digital and technological solutions enabling the replicability of tExtended's environmentally and socially sustainable solutions in different European regions.

DISCLAIMER

This project has received funding from the European Union's Horizon Europe research and innovation programme under Grant Agreement No. 101091575.



CONCEPTS AND INNOVATIONS

The project will optimise textile flows by ensuring retention of the value of materials in a safe and sustainable way. A Conceptual Framework will be developed to classify textile waste based on identified material quality and properties, the requirements of the intended industrial end-use, economical aspects, environmental impacts of textile waste valorisation and recycling processes. This Framework will be tested within an Industrial-Urban symbiosis collaborative real scale demonstrator in different European regions. tExtended will provide the whole textile ecosystem with the necessary digital solutions to collect and utilise data and data-driven solutions to support real-time decision-making to improve specific phases of the recycling system. It will also involve local community actors to ensure the feasibility of the model and the continued flow of second-hand textile material. Consumer participation, in pre-sorting and returning used textiles, will raise their awareness on the sustainability and circularity of textiles. tExtended will also test models to realise a high local collection and sale to increase the popularity of second-hand textiles.

WWW.TEXTENDED.EU

RELEVANT FIELDS OF INNOVATION

Upgrading secondary resources; Demonstration of Industrial-Urban Symbiosis; European Community of Practice (H4C); Development of Hubs for Circularity; Digital process development and engineering; and Human resources, skills, and labour market.

P4PLANET LONG-TERM IMPACTS

Develop new processes for circularity of secondary materials from wastes/residues for all industrial processes; Seed Hubs4Circularity to foster circularity within and beyond process industries; Foster new framework conditions to generate a market for climate neutral and circular solutions; and Foster new skills and types of jobs and business development, including SMEs; Design processes for maximum resource efficiency, including the development of materials for circularity.

COORDINATOR CONTACTS

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CHAPTER 3

Testimonials



"The TERRA project was one of the first to explore new electrocatalytic solutions for process intensification. It greatly benefited from the possibility of sharing expertise and knowledge through the events organized within the SPIRE partnership and the long-term vision elaborated by the A.SPIRE association shared by all the companies and SMEs participating in the project."

Gabriele Centi
President, ERIC aisbl



"A.SPIRE helped us to promote the project outcomes through their wide variety of resources, including website, events or brochures. It facilitates the possibility of meeting other related projects and interacting with them. We are very grateful for the support of the partners of the association such as CEPI for their collaboration on contributing to disseminate the project."

Juan José Cepriá
Roads and Environment Research Group Manager,
ACCIONA Technology Centre



"During the FISSAC project our experience with the partnership has been very fruitful enabling the opportunity of collaboration to foster industrial symbiosis in different value chains and set up the foundations to build future opportunities after the project."

Blanca Juez Sánchez
R&D Project Manager, ACCIONA Construcción



"COMPASsCO₂ project would like to acknowledge A.SPIRE for setting up the framework needed to develop new materials at low TRL and with strong focus on performance improvement. We think that developing new components and materials for extreme operating conditions will enable concentrated solar power plants to be coupled to high temperature processes and contribute to the decarbonization of various industrial sectors. We also acknowledge the networking platforms offered by A.SPIRE."

Daniel Benitez
Project Engineer, DLR, Solar Research Institute



"Developing synergies with the alumina sector in Europe is at the core of the Reactiv project. We test and demonstrate how bauxite residue can be converted into an active material for producing a new low-carbon Supplementary Cementitious Materials (SCM). The P4Planet platform is very instrumental to enable such cross sectoral collaboration."

Philippe BENARD
Alternative SCM's R&D Project Manager,
HOLCIM Innovation Centre



"Thanks to A.SPIRE, we have been able to access European funds, technical resources, and dissemination networks that have driven the success of our project. I believe that SPIRE and P4Planet are key initiatives to drive the ecological transition and competitiveness of the European industry."

Álvaro Pecharrmán Ruiz
Project Manager Public Programmes Unit, CIRCE



"The CREAToR consortium greatly appreciated joining the SPIRE partnership. The various events organized by A.SPIRE significantly widened our outreach to the industrial community."

Irma Mikonsaari
Coordinator of CREATOR Fraunhofer Institute
for Chemical Technology



"Being a SPIRE partner became fundamental for the outreach of two of FLEXnCONFU targets due to the great A.SPIRE support: for the enhancement of Combined Cycle Power Plants flexibility by adapting them to the coupling with unconventional fuels like hydrogen and ammonia, and for natural gas consumption reduction by lowering the amount of greenhouse gases emissions."

Antonio Campanale
Project Manager, RINA



"The results of RETROFEED would not have been possible without the collaboration of the SPIRE association, not only with the funding to demonstrate these near-to-market solutions, but also by supporting us with the dissemination or driving the exploitation of the results."

Diego Redondo
Project Manager, CIRCE Research Centre



"The collaboration within the SPIRE network and with A.SPIRE stimulates knowledge exchange between the industry and the water and waste water sector, and contributes to a mutual understanding of the current and upcoming water challenges stimulating the collaborative effort to develop technologies and solutions."

Gerard van den Berg
Coordinator of ULTIMATE, KWR Water
Research Institute



"Through A.SPIRE we found the best partners from the steel domain area. We also got support for our projects via A.SPIRE news, events and web pages."

Dr. Heli Helaakoski
Research Manager, VTT Technical
Research Centre of Finland



"The SPIRE and subsequent P4Planet Partnership's dedication to advancing circularity, climate neutrality, and economic prosperity throughout Europe is undeniably an example of transformative change in industrial water efficiency. My experience within this dynamic ecosystem has been profoundly enlightening and serves as an emblematic example of collaborative progress in the EU Research and Innovation landscape."

Andrea Rubini
Director of Operations, Water Europe



"I am very grateful that MACBETH and its predecessor project ROMEO have benefited so strongly from the support by A.SPIRE. This visionary European program in sustainable process development is essential to bring our revolutionary concept of catalytic membrane reactors to industrial scale."

Prof. Dr. Robert Franke
Project Coordinator MACBETH, Head of
Hydroformylation Innovation at Evonik Oxeno
GmbH & Co. KG



"IRIS, through its membership of the A.SPIRE association, has the opportunity to co-create cutting edge technological solutions with the Process Industries and to work with world class European academics and research institutions in pushing the boundaries of the state-of-the-art towards achieving climate neutrality by 2050. It has been a privilege for us to coordinate the INCUBIS project, which has helped us to position ourselves as a digital solutions provider for energy symbiosis."

Albert Torres
PMO Manager at IRIS Technology Solutions S.L.



"Thanks to our close collaboration with A.SPIRE, we have strengthened our commitment to innovation and sustainability. Through the association, we have gained access to a network of knowledge and resources that has enabled us to expand our impact in technological research and move towards more efficient and sustainable solutions for current challenges. A.SPIRE has been an invaluable partner on our journey towards a more promising and sustainable future. The events promoted by A.SPIRE give us the opportunity to know more about other projects ongoing, and possible new partners for future projects."

Cristina Vega
Project Coordinator (CAPRI), Fundación CARTIF

CHAPTER 4

Join A.SPIRE!

JOIN A.SPIRE!

JOIN A.SPIRE TODAY AND CONNECT WITH OVER 180 OTHER ORGANISATIONS WORKING TOGETHER TO:

- Shape the future of the European process industry and address its research and innovation needs
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