Power to your know-how

"2019 has been another prolific year for SPIRE and its contributions to the resource and energy efficiency of our process industries. It is exciting to see how this cross-sectoral initiative continues to bear fruit, while also evolving its strategy towards a renewed and wider Partnership under Horizon Europe: Processes4Planet. I and my colleagues on the A.SPIRE Board are looking forward with great enthusiasm to this opportunity to build on the learnings of SPIRE's unprecedented seven year partnership experience to rise to the next level of ambition and, with the support of the European Commission, develop the key Process Industry solutions required for a successful transition to a climate-neutral and truly circular society."

Pierre Joris,
Chair of the A.SPIRE Board

CONTENT

CHAPTER 1

Building the Next Generation of European Process Industries

1.1: ABOUT A.SPIRE

From its initial 28 founding members in 2012, A.SPIRE has grown continuously and expanded its activities. Today, in 2020, A.SPIRE is a diverse community of 169 members including large industries, SMEs, sector bodies, research organisations, academia and many other stakeholders.

Since the SPIRE Public-Private-Partnership (cPPP) launched in December 2013, it has inspired and initiated nearly 50 programme calls under Horizon 2020. Between 2014 and 2020 these calls have covered topics including efficient processes, the circular economy, and the development of technologies and innovations that enable sustainable industrial development. In total, 125 SPIRE projects have been supported through Horizon 2020. With more to come!

SPIRE cPPP's greater asset is the unceasing dialogue it has inspired among A.SPIRE members. SPIRE's strategies are broadly based, inclusive and its results are implementation-ready thanks to this unique ability to organise across multiple world-leading industrial sectors operating throughout Europe and globally, and to include large and small businesses, research and innovation organisations.

A.SPIRE is continuing to expand its expertise to provide the solutions required to holistically address the ambitions under the European Green Deal: already, in 2020, **the Refining** and **the Pulp and Paper** sectors have joined its community!

The objective is to ensure that A.SPIRE can help achieve EU policy objectives such as climate-neutrality and increasing a circular economy in Europe. These challenges cannot be tackled without the commitment and expertise of the industry – and the process industries in particular.

With new objectives at hand and greater ambition, A.SPIRE is ready to take on the next steps and start a new, more ambitious partnership relevant to the goals of Horizon Europe: Processes4Planet.

Collaboration with the European Commission is already underway during 2020 to shape the first Processes4Planet calls under Horizon Europe. These calls will address the priority Innovation Programmes outlined in the Processes4Planet 2050 roadmap, including the innovative Hubs for Circularity concept. A.SPIRE looks forward to continuing collaboration and contributions to these programmes from all A.SPIRE sectors and members whether they are old hands, new participants, or yet to join us!

1.2: PROCESSES4PLANET 2050

The European Green Deal is a game-changer for our society and more specifically for the process industries. The process industries produce materials which directly contribute to the quality of life of citizens and are essential to most of the value chains in our economy. Their presence on European territory is of strategic importance for the resilience of our society.

The SPIRE projects under Horizon 2020 are already delivering results that are improving European competitiveness, jobs and growth, action on climate change and environmental protection.
But A.SPIRE wants to do more. In the medium- to long-term, the innovations developed through the SPIRE cPPP can enable the emergence of a truly sustainable European economic system in which economic growth is permanently decoupled from environmental impact and leading to an industrial infrastructure that can deliver a climate-neutral continent.

Emerged from intense consultation and dialogue between A.SPIRE stakeholders on their shared research and innovation requirements, their joint challenges and wider societal needs, the ambitious SPIRE Vision 2050 foresaw "An integrated and digital European Process Industry, fostering a 'well below 2° C' scenario and fully circular economy."

The Vision 2050 has been transformed into the Processes4Planet 2050 Roadmap that builds on the experience and results gained in SPIRE's Horizon 2020 projects and looks to develop the next generation of process technologies that can realise our ambitions for the Process Industries in 2050. Implementing the Processes4Planet 2050 Roadmap will be a key element in realising Europe's collective ambition under the Green Deal to become the first climate-neutral continent.

Transforming the European Process Industry for a sustainable society.

PROCESSES4 PLANET

Processes4Planet will be the unique cross-sectorial research and innovation partnership required to develop and deploy the innovations needed for a profound transformation of the European process industries to achieve overall climate neutrality at EU level while enhancing Europe's global competitiveness and taking resource and energy efficiency to the next level. It will work on new technologies and on the scaling up of technologies already developed to deliver significant CO2 emission reductions by 2030 and to achieve full impact by 2050.

Through cross-sectorial technological and non-technological innovation efforts, three key objectives will be achieved:

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

14 Innovation Areas and 36 Innovation Programmes moving from Technology Readiness Level (TRL) 1 to 9 (or from Symbiosis Readiness Level (SRL) 1 to 9 for Industrial-Urban Symbiosis) have been identified in the Processes4Planet Roadmap. These core technologies will lead the sustainable reindustrialisation of the European Process Industry with multiplier effects generated across the economy.

Processes4Planet will implement the 2050 Roadmap initiated under SPIRE through four transformation levers:

- Process innovation with four core drivers - energy mix (including H2), energy and resources flexibility/ efficiency, electrification of industrial processes, and Carbon Capture and Use (CO2);
- Industrial-urban symbiosis;
- Digitalisation;
- Non-technological innovation.

A special focus of the partnership will be to foster local innovation initiatives through 'Hubs for Circularity' where local public authorities, process industries and other private actors will together design and implement integrated business models maximising the circularity of resources and minimising the impact on climate.
The partnership will also scale-up innovations to practical industrial dimensions through "first-of-a-kind" plants, de-risking investment decisions for subsequent widescale roll-out.

1.3: SHAPE YOUR FUTURE, JOIN A.SPIRE TODAY!

A.SPIRE members are now preparing to implement the Processes4Planet Roadmap 2050 through the expanded Processes4Planet partnership in the forthcoming Horizon Europe programme.

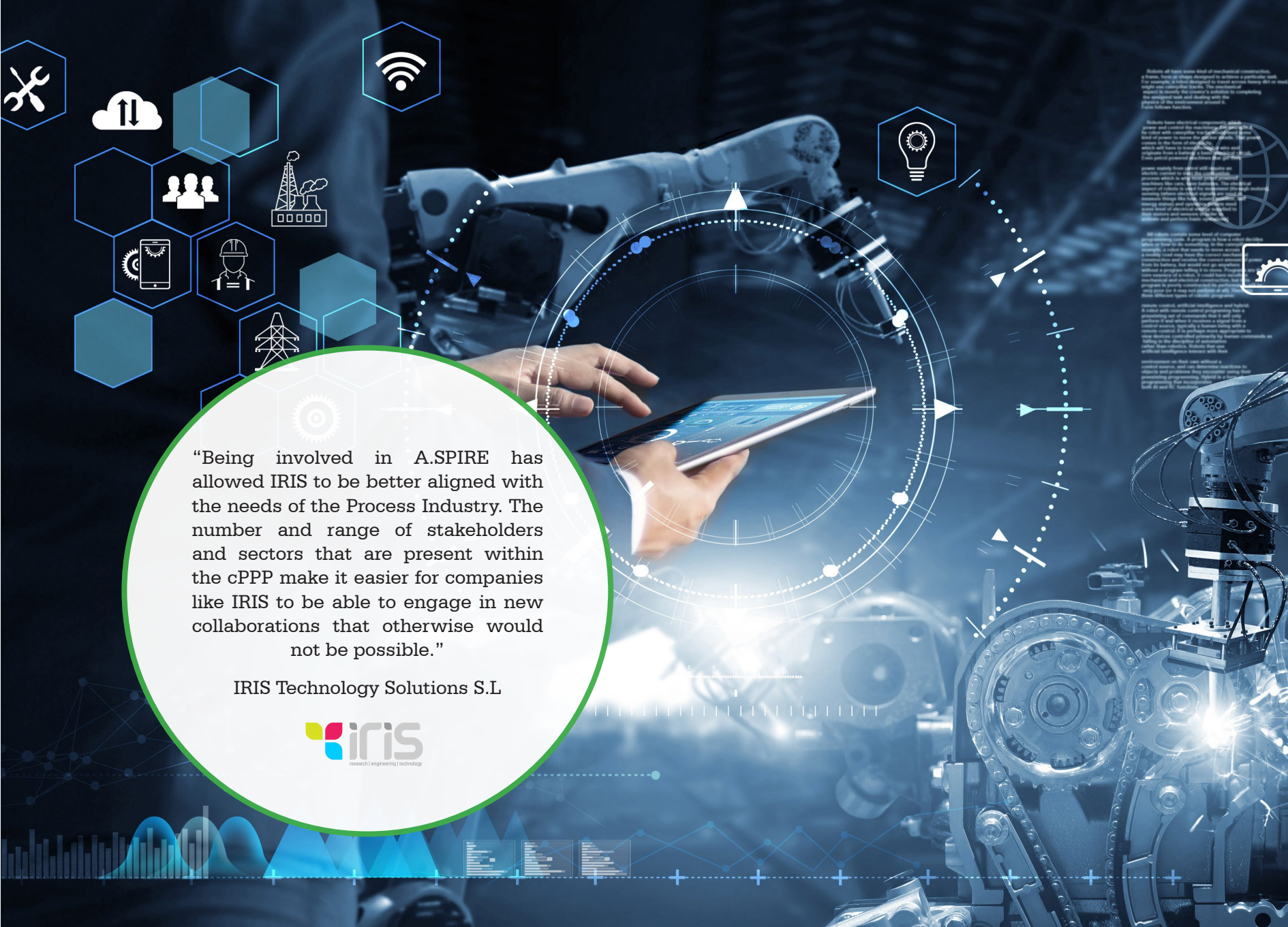
With over 160 industrial and research industry members, in A. SPIRE you can team-up to address the challenges of Climate Change, the Circular Economy and sustainable competitiveness by:

- Helping to shape the future of the process industry and addressing its research and innovation needs by contributing to the successful definition and implementation of the Processes4Planet partnership.
- Joining the current and new sectors to co-define the business opportunities triggered by research and innovation outcomes such as the proposed Hubs for Circularity.
- Networking across major industry sectors to find new partners and opportunities through member-only brokerage activities and other targeted workshops and benefiting from synergies among different sectors.
- Getting access to knowledge on technological and non-technological developments in the A.SPIRE community, sharing best practices and having direct access to SME providers, applied innovation, growth opportunities and new markets.
- Improving your visibility across diverse sectors and players by contributing to the resource efficiency policy debate, getting publicity through the A.SPIRE website, events, and publications at European and national levels.

Three types of A.SPIRE membership are available: Industry Membership (open to relevant industrial and commercial companies and trade associations); Research Membership (open to research institutes and universities); and Associate Membership (a non-voting category open to non-governmental organisations and other stakeholders).

Membership of A.SPIRE is only open to legal entities established in European countries and all applications must be approved by the A.SPIRE Board.
Together, we can enable Europe to lead the next generation of process industry globally, and become the first climate-neutral continent.

Be part of your future, apply today!



"Being involved in A.SPIRE has allowed IRIS to be better aligned with the needs of the Process Industry. The number and range of stakeholders and sectors that are present within the cPPP make it easier for companies like IRIS to be able to engage in new collaborations that otherwise would not be possible."

IRIS Technology Solutions S.L

CHAPTER 2

CE-SPIRE-04-2019

INCITE

IMPRESS

MACBETH

INNOVATIVE CHEMOENZYMATIC INTEGRATED PROCESSES

CHEMO-ENZYMATIC PROCESSES
incite

AIM

INCITE aims to showcase two chemo-enzymatic processes at demonstration scale and show their clear environmental gains, cost-effectiveness and contribution to increased safety in the work environment. One process is the esterase-catalysation of an important precursor in the production of insecticides, and the other is the solvent-free synthesis of oleochemical esters using lipase enzymes.

WWW.PROJECT-INCITE.EU

CONCEPT

The INCITE project aims to demonstrate novel integrated upstream and downstream processing paths involving flow chemistry and membrane technology in chemo-enzymatic processes. Chemo-enzymatic conversion presents immense opportunities for developing sustainable processes. Enzymatic processes are particularly interesting to produce chiral molecules because of their high regio- and enantio-selectivity, which greatly simplifies downstream processing compared to traditional chemical synthesis. In addition, their compatibility with ambient pressures and temperature conditions is a bonus for reducing the environmental footprint of the product molecules.

During the project, processes will be demonstrated in real industrial settings and both should show the clear advantages of greater efficiency, higher product quality, higher safety and a smaller environmental footprint.

The project estimates reaching a minimum of 20 % decrease in greenhouse gas emissions and a minimum of 40 % resource and energy efficiency gains compared to traditional chemical synthesis and will demonstrate this assumption using state of the art Life Cycle Assessment methods.

DISCLAIMER

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement N° 870023.

SPIRE PROJECT

INTEGRATION OF EFFICIENT DOWNSTREAM PROCESSES FOR SUGARS AND SUGAR ALCOHOLS

AIM

IMPRESS is here to impress! We are heading towards a fossil-free future with European know-how. IMPRESS will integrate selected key technologies to refine plant-based material into multiple sustainable chemicals and materials that can replace fossil-based products. Related technologies will be substantially improved to provide a better future for us and the generations to come.

CONCEPT

IMPRESS is a novel concept that aims to assess multiple purification and separation technologies to develop plant-based products with improved environmental footprint.
The concept will be thoroughly evaluated from techno-economic and environmental perspectives, by means of executing a life cycle assessment and conceptual process designs, to demonstrate the positive impact on the circular economy. The generated know-how will also be circulated to future experts and employees through a lifelong learning e-platform.
The biorefinery concept is based on efficient integration of proven purification and separation technologies such as crystallization, membrane filtration and simulated moving bed (SMB) to optimise the quality of all product streams. The key conversion processes included in the concept are Dawn Technology™, Ray Technology™ and xylitol fermentation technology. The Dawn Technology™ enables the conversion of plant-based biomass into industrial sugars and lignin. The industrial sugars can be used by the Ray Technology™ for production of plant-based mono-ethylene glycol (MEG - key component for the production of plastics) and plant-based mono-propylene glycol (MPG) as well as for the production of xylitol.

WWW.SPIRE2030.EU/IMPRESS

DISCLAIMER

This project has received funding from the European Union's Horizon 2020 research and innovation programme under Grant Agreement N° 869993.

MEMBRANES AND CATALYSTS BEYOND ECONOMIC AND TECHNOLOGICAL HURDLES

MACBETH
Membranes And Catalysts Beyond Economic and Technological Hurdles

AIM

The MACBETH breakthrough technology combines catalytic synthesis with the corresponding separation units in a single highly efficient catalytic membrane reactor (CMR). It can reduce greenhouse gas (GHG) emissions from large volume industrial processes by up to 35 %. In addition, resource and energy efficiency can be increased by up to 70 %, while CAPEX is decreased by up to 50 % and OPEX by up to 80 %.

WWW.MACBETH-PROJECT.EU

CONCEPT

Previous EU-funded projects ROMEO, BIONICO and CARENA have laid a strong basis by showing the proof of concept for CMRs at TRL 5 for highly relevant and three large-scale processes: hydroformylation, hydrogen production, and propane dehydrogenation. Key members of these consortiums have joined forces in MACBETH to bring CMR up to TRL 7 and build the basis to move forward to commercialisation of the technology.

To demonstrate the exploitation potential, MACBETH will extend the CMR technology to the field of biotechnology. Based on a large variety of already established building blocks (such as catalysts, membranes, support materials and reactor concepts) a demonstration plant for bio-catalytical oil cleavage will be developed, showing the commercial applicability of CMR in biotechnology for the first time.

To take a further step forward and to extend the benefits of CMR technology to other sectors, the European Competence Centre 'Lighthouse Catalytic Membrane Reactors' will be established.

DISCLAIMER

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement N° 869896.

SPIRE PROJECT

CHAPTER 3

CE-SPIRE-05-2019

RETROFEED

IMPLEMENTATION OF SMART RETROFITTING FRAMEWORK IN THE PROCESS INDUSTRY TOWARDS ITS OPERATION WITH VARIABLE, BIOBASED AND CIRCULAR FEEDSTOCK

Retrofeed
smart retrofitting in process industry

AIM

RETROFEED's main objective is to enable the use of an increasingly variable, bio-based and circular feedstock in process industries through the retrofitting of core equipment and the implementation of an advanced monitoring and control system, and providing support to the plant operators by means of a Decision Support System (DSS) covering the entire production chain.

This approach will be demonstrated in five Resources and Energy Intensive Industries (REII) - ceramic, cement, aluminium, steel, and agrochemical - with the potential to reach on average an increase of 22 % in resource efficiency and 19 % in energy efficiency, with a consequent reduction in costs and GHG emissions of €9.3 million and 135 ktonCO$_2$, respectively.

WWW.RETROFEED.EU

CONCEPT

RETROFEED activities are focussed on the furnaces and reactors of energy intensive process industries, which are usually the core equipment of one or several processes within the plant and, therefore, represent one of the highest resource and energy consumption elements.

In particular, four different approaches will be considered when adapting this equipment to variable feedstock: the integration of feedstock mixtures of waste and/or by-products obtained within the plant, the introduction of waste materials from outside the plant to complement the current furnace/reactor feedstock supply, the use of bio-based sources as raw materials, and the combustion of bio-based fuels to reduce the plant's current demand for fossil fuels.

The improvement and exploitation of the plant's flexibility in terms of feedstock will be also enabled by a set of digital retrofitting measures based on monitoring and control systems, which ensure that the overall performance of the process is optimised while the main requirements for production and product quality are maintained.

DISCLAIMER

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement N° 869939.

CHAPTER 4

DT-SPIRE-06-2019

COGNIPLANT

COGNITWIN

FACTLOG

HyperCOG

INEVITABLE

COGNITIVE PLATFORM TO ENHANCE 360⁰ PERFORMANCE AND SUSTAINABILITY OF THE EUROPEAN PROCESS INDUSTRY

AIM

The project will demonstrate an innovative approach for advanced digitisation and intelligent management of process industries. A novel vision for data monitoring and analysis will be developed to make the most of the latest developments in advanced analytics and cognitive reasoning, coupled with a disruptive use of the digital twin concept to improve production plants' operational performance.

CONCEPT

The COGNIPLANT solution will provide a hierarchical monitoring and supervisory control that will give a comprehensive vision of a plant's production performance as well as the energy and resource consumption. Advanced data analytics will be applied to extract valuable information from the data collected about the processes and their effect on the production plant's overall performance enabling the design and simulation of operation plans in digital twin models based on the conclusions. As a result, optimal operation plans will be obtained that will improve the performance of those cognitive production plants. The concept will be implemented by four end-users from four different SPIRE industries: a chemical industry site in Austria, an alumina refinery in Ireland, a lime manufacturing facility in Italy, and a metal industry plant in Spain.

WWW.COGNIPLANT-H2020.EU

DISCLAIMER

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement Nº 869931.

COGNITIVE PLANTS THROUGH PROACTIVE SELF-LEARNING HYBRID DIGITAL TWINS

AIM

Main aim for COGNITWIN is to improve performance in Cognitive Production plants in SPIRE Process Industry sectors Aluminium, Silicon (Non-Ferrous), Steel and Engineering through the use of Hybrid and Cognitive Digital Twins.

The COGNITWIN solution platform will include a sensor network that will continuously monitor and collect data from various plant processes and assets which will be stored in a database. This data will be used to develop a digital twin of the process and models with cognitive capability for self-learning and predictive maintenance which will lead to optimal plant operations.

WWW.SINTEF.NO/PROJECTWEB/COGNITWIN

CONCEPT

Currently the European Process Industry makes extensive use of first principle models, but less use of smart sensors and data. COGNITWIN will develop the use of new data-based models and link to the existing models – presenting both as digital twins. Moreover, combining the digital twins with machine learning and artificial intelligence (hybrid analytics) will secure increased competitiveness and a reduced environmental footprint for the European Process Industry.

COGNITWIN will set a new standard for the design, development and operation of the European process industry by introducing a platform for virtual component-based architecture that integrates models, Internet of Things (IoT), Big data, artificial intelligence (AI), smart sensors, machine learning and communication technologies, all connected to a novel paradigm of self-learning hybrid models with proactive cognitive capabilities.
The project builds on ideas and technologies that have been validated in controlled environments (TRL 5) to arrive at prototype demonstrations in operational environments (TRL 7). Results from COGNITWIN will be implemented by our industrial partners to demonstrate the transition to TRL 7.

DISCLAIMER

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement N° 870130.

ENERGY-AWARE FACTORY ANALYTICS FOR PROCESS INDUSTRIES

FACTLOG

AIM

By incorporating different pipelines of machine learning and analytics tools, FACTLOG enables the realisation of the Cognitive Factory as an ensemble of independent but intertwined Enhanced Cognitive Twins (ECTs) that are able to: self-learn, and thus effectively detect and react to anomalies and disruptions, but also to opportunities that may arise; enjoy a local or global view of operations; and are capable of short- and long-term reasoning and process optimisation.

WWW.FACTLOG.EU

CONCEPT

FACTLOG builds on the cognitive digital twin concept and further advances it by developing and demonstrating a system that applies the innovative concept of the ECT. More specifically, the digital twin technology uses a digital (virtual) model of a real (industrial or other) system (i.e. resources, processes, people, locations, systems, equipment and devices, even software and procedures) enabling monitoring of the system, simulating its behaviour and optimising its operation. To empower the correspondence between virtual and real systems, a connection between the two is established by using an array of Internet of Things (IoT) sensors to generate and feed the digital twin with continuous streams of real-time data. These data, stored across the real system's lifetime, empower a dynamic digital model that changes as its physical counterpart changes, thus enabling understanding, learning and reasoning.

DISCLAIMER

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement N° 869951.

SPIRE PROJECT

HYPER CONNECTED ARCHITECTURE FOR HIGH COGNITIVE PRODUCTION PLANTS

HyperCOG

AIM

The HyperCOG project aims to demonstrate that cyber-physical systems and data analytics can be used to drive transformation within the European process industry, while improving efficiency and competitiveness by harnessing the power of data. HyperCOG will demonstrate the potential of these technologies and will evaluate their replicability and transferability to different industrial sectors.

CONCEPT

Current industrial networks are implemented following a centralised and hierarchical architecture, with different layers at device level, control level and management level. This structure does not normally allow a direct communication between and amongst the separate layers, and this hinders an agile response to changing conditions. The next generation of industrial automation systems is being designed to be networked and with decentralised organisation.
HyperCOG will build a hyperconnected cyber-physical systems (CPS) platform to provide process industries with the basis for faster and better decision-making. The project's smart manufacturing system will be robust in the face of any variable and uncertain scenario. The solution will be designed to allow for real-time monitoring, the analysis of a high volume of data, multilateral communication and interconnectivity between cyber-physical systems and people. This innovative architecture will be validated at three pilot sites in three different sectors: steel, cement and chemicals.

WWW.HYPERCOG.EU

DISCLAIMER

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement N° 869886.

SPIRE PROJECT

OPTIMISATION AND PERFORMANCE IMPROVING IN METAL INDUSTRY BY DIGITAL TECHNOLOGIES

INEVITABLE

AIM

The INEVITABLE project aims to improve key performance indicators in the steel and nonferrous metals sectors by retrofitting existing production sites with digitalisation and innovative control technologies. The main ambition is to exceed the level and functionality of traditional process automation and control systems using the functionalities of Digital Factories and Industry 4.0 concepts.

WWW.INEVITABLE-PROJECT.EU

CONCEPT

The project is targeting at resource and energy intensive sectors of the process industry, with a focus on the steel and nonferrous metals sector. Since these industries have an enormous impact on energy and resource consumption, and consequently on the environmental footprint, improvements in energy and material efficiency represent major results for the project with positive impacts on both process sustainability and the environment. The focus is to develop high-level supervisory control systems for different production plants and to demonstrate them in operational environments to enable autonomous operation of the processes based on embedded cognitive reasoning. The project approach is based on three enabling technological areas: data collection and sensor technologies; tools for data analysis, control and optimisation; and digitalisation infrastructure. Their application will be an important step towards digital transformation and optimisation in the selected production processes.

DISCLAIMER

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement N° 869815.

SPIRE PROJECT

CHAPTER 5

CE-SC3-NZE-2-2018

C2FUEL

COZMOS

ECOCO2

CARBON CAPTURED FUEL AND ENERGY CARRIERS FOR AN INTENSIFIED STEEL OFF-GASES BASED ELECTRICITY GENERATION IN A SMARTER INDUSTRIAL ECOSYSTEM

C2FUEL

AIM

The C2FUEL project aims to develop energy-efficient, economically and environmentally viable CO2 conversion technologies for the displacement of fossils fuels emission through a concept of industrial symbiosis between carbon intensive industries, power production, and local economies.

HTTP://C2FUEL-PROJECT.EU

CONCEPT

The carbon dioxide present in the blast furnace gas of an integrated steel industry will be selectively removed and combined with green hydrogen generated by electrolysis fed with renewable electricity to produce two promising energy carriers: formic acid and dimethoxyethane (DME). These can be used for mobility applications with the ability to displace fossil fuels consumption. C2FUEL's unique concept will be demonstrated at Dunkirk between the DK6 combined cycle power plant, the Arcelor Mittal steel factory and one of Europe's major harbours providing a showcase for future replication.
The project will allow the simultaneous reuse of CO2 emissions from the steel-making factory, use of electricity surplus in the Dunkirk area and the improvement of the operational and environmental performance of the DK6 combined cycle power plant. C2FUEL's unique circular approach could contribute to mitigate up to 2.4 million tonnes of CO2 per year while converting up to 11 TWh of renewable electricity into green energy carriers.

DISCLAIMER

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement N° 838014.

SPIRE PROJECT

EFFICIENT CO2 CONVERSION OVER MULTISITE ZEOLITE-METAL NANOCATALYSTS TO FUEL AND OLEFINS

AIM

COZMOS will develop an energy-efficient and environmentally and economically viable conversion of CO2 to fuels and high added value chemicals via innovative catalyst, reactor and process technologies. By enabling the combination of two sequential reactions in a single reactor, COZMOS will overcome the thermodynamic limitations inherent in the use of CO_2 as a sustainable carbon feedstock.

WWW.SPIRE2030.EU/COZMOS

CONCEPT

CO2 can be a sustainable carbon source and replace fossil fuels for energy consumption and chemicals production, but its transformation to useful products is hampered by its low energy content. The COZMOS technology will combine two reactions into one reactor, reducing energy consumption and increasing the conversion of CO2. Thus, CO2 and hydrogen sourced from renewable, carbon-neutral energy will be transformed into the C3 hydrocarbons propane and propene. Propane can be used as a heating, cooking and transportation fuel, and propene is a valuable chemical building block for lightweight polymers and other chemical intermediates. The technology will be adaptable, such that the primary product can be varied depending on the amount of renewable energy available, the industrial infrastructure and the economic requirements. COZMOS will develop, optimise and scale-up bifunctional catalysts, determine the optimal process conditions and provide overall integration and validation at TRL 5.

DISCLAIMER

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement N° 837733.

DIRECT ELECTROCATALYTIC CONVERSION OF CO2 INTO CHEMICAL ENERGY CARRIERS IN A CO-IONIC MEMBRANE REACTOR

AIM

eCOCO$_2$ combines smart molecular catalysis and process intensification to bring out a novel efficient, flexible and scalable carbon capture and utilisation (CCU) technology. The project aims to set up a CO_2 conversion process using renewable electricity and steam to directly produce synthetic jet fuels with balanced hydrocarbon distribution (paraffin, olefins and aromatics) to meet the stringent specifications of the aviation sector.

HTTP://ECOCOO.EU

CONCEPT

eCOCO$_2$ will provide a new and effective solution for the conversion of captured CO_2 into carbon-neutral synthetic fuels using renewable electricity. The CO_2 converter consists of a tailor-made multifunctional catalyst integrated in a co-ionic electrochemical cell that enables in-situ electrolysis and water removal from the hydrocarbon synthesis reaction. This intensified process can lead to breakthrough product yield and efficiency for chemical energy storage from electricity. The process is compact, quickly scalable and flexible. As a result, this technology will enable the storage of more energy per processed CO_2 molecule and therefore a reduction in greenhouse gas (GHG) emissions per tonne of jet fuel produced. eCOCO$_2$ will demonstrate the technology by producing over 250 g/day of jet fuel in a modular prototype rig that integrates 18 tubular electrochemical reactors. Studies on societal perceptions and acceptance will also be carried out across several European regions.

DISCLAIMER

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement N° 838077.

CHAPTER 6

CE-SC5-01-2018

CIRCULAR FLOORING

CREATOR

NONTOX

PLAST2bCLEANED

REACT

REMADYL

CIRCULAR FLOORING - NEW PRODUCTS FROM WASTE PVC FLOORING AND SAFE END-OF-LIFE TREATMENT OF PLASTICISERS

Circular Flooring
Pioneering Recycling Process for PVC Waste

AIM

This project focuses on the recovery of polyvinylchloride (PVC) from post-consumer PVC floor coverings and the separation of legacy plasticisers in order to create a recycled material for the manufacturing of new PVC floor coverings. The high-quality recovered PVC compound and the plasticisers will be compliant with EU legislation and meet consumer needs with regard to the circular economy.

WWW.CIRCULAR-FLOORING.EU

CONCEPT

To reach the goal, the innovative CreaSolv® plastic recycling process developed by the Fraunhofer Institute for Process Engineering and Packaging IVV and CreaCycle GmbH will be used. This technology has already proven its viability in the lab. As part of the Circular Flooring project, the technical and commercial feasibility of this recycling process for post-consumer PVC floor covering waste will now be demonstrated on a larger technical scale.

To recycle PVC floor coverings, researchers developed selective solvent-based formulations that recover the PVC compound from end-of-life floor coverings and separate it from specific phthalate plasticisers such as Dibutyl phthalate (DBP), Diisobutyl phthalate (DIBP), Benzyl butyl phthalate (BBP), and Bis(2-ethylhexyl) phthalate (DEHP). These phthalate plasticisers are safely transformed into REACH-compliant substances using an additional chemical process. The recycled PVC compound will be ready for re-use as a high-quality secondary raw material with tailor-made additives and stabilisers to contribute to establishing a circular economy for PVC in Europe.

DISCLAIMER

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement N° 821366.

COLLECT, PURIFY, REUSE

CREATOR
COLLECT • PURIFY • REUSE

AIM

The CREAToR project focuses on process development and demonstration activities to remove hazardous, already banned bromine-containing flame-retardants from waste streams using continuous purification technologies. The project will cover the whole value chain, starting with collection of thermoplastic waste streams from the building and construction sector and from waste electrical and electronic equipment.

CONCEPT

The project will implement ways to collect secondary raw materials, identify the presence of hazardous flame retardants, remove these contaminants from the materials and finally reuse the materials, thus creating a circular economy. Waste thermoplastics will be collected from the building/construction, aeronautics and electrical/electronic equipment sectors. The removal of flame retardants will be demonstrated using novel continuous extraction technologies in twin-screw extruders and the purified materials will be reused in applications in the construction, automotive and aerospace markets. The project will also design of a reverse logistics model for the value chain.

WWW.CREATORPROJECT.EU

DISCLAIMER

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement N° 820477.

REMOVING HAZARDOUS SUBSTANCES TO INCREASE RECYCLING RATES OF WEEE, ELV AND CDW PLASTICS

AIM

NONTOX aims to increase the recycling rates of plastics waste containing hazardous substances, such as legacy additives and flame-retardants. To increase recycling rates, NONTOX considers the whole value chain including sorting and pre-treatment techniques, recycling technologies, valorisation of by-products and safe disposal of removed substances.

WWW.NONTOX-PROJECT.EU

CONCEPT

The NONTOX project will develop two different recycling technologies (Extruclean and CreaSolv®) to remove hazardous substances from plastics targeting plastic wastes coming from WEEE (Waste Electrical and Electronics Equipment), C&DW (Construction and Demolition Waste) and ELV (End of Life Vehicles) and removing substances such as flame retardants, stabilizers, and fillers to produce high quality plastics with large market applications. In addition, a novel sensor will be developed to identify hazardous fractions and ensure the maximum value is extracted, thermochemical conversion of non-target plastics and side streams from the main recycling process will also be investigated.

So far the project has mapped the relevant material flows for WEEE, ELV and C&DW in Europe and estimated the material volumes available for processing; collected volumes of mixed plastics from the three streams and characterized them to define the input material for each technology; set-up the recycling of samples of plastics at lab-scale; characterised the input material for the thermochemical conversion process; identified the technical specification of the required plastics and defined solutions for material properties upgrading; and defined the goal and scope of the life cycle assessment (LCA) study that will be performed on the final, optimised NONTOX process scheme.

DISCLAIMER

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No.820895

PLAST2BCLEANED (CE-SC5-01-2018)

PLASTICS TO BE CLEANED BY SORTING AND SEPARATION OF PLASTICS AND SUBSEQUENT RECYCLING OF POLYMERS, BROMINE FLAME RETARDANTS AND ANTIMONY TRIOXIDE

PLAST2bCLEANED

AIM

The overall aim of PLAST2bCLEANED is to develop a human and environmentally safe recycling process for plastics from Waste Electrical and Electronic Equipment (WEEE) in a technically feasible and economically viable manner. Three material loops will be closed: the polymer loop; the bromine fraction and the antimony trioxide fraction.

CONCEPT

PLAST2bCLEANED will develop a circular loop for polystyrene plastics used in Electrical and Electronic equipment in an environmentally friendly and economically viable way. The waste plastics of this segment contain phased out hazardous compounds like flame-retardants, stabilisers and plasticisers. PLAST2bCLEANED will develop new technology to sort plastics with and without these hazardous compounds. This will enable mechanical recycling of the non-hazardous plastic fractions. In addition, PLAST2bCLEANED will add a new recycling step to remove all hazardous substances from the sorted plastics (Acrylonitrile Butadiene Styrene (ABS) and High Impact Polystyrene (HIPS)) using dissolution under superheated conditions and retrieve the bromine and antimony fractions for recycling. This will result in a clean, new ABS or HIPS plastic, ready for (re)use.

WWW.PLAST2BCLEANED.EU

DISCLAIMER

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement N° 821087.

RECYCLING OF WASTE ACRYLIC TEXTILES

AIM

The REACT proposal will address the management of waste acrylic textiles coming from outdoor awnings and furnishing. The final goal of the project is a fully compatible recycled acrylic textile for reuse and guidelines for the removal of hazardous chemicals from finished textiles with innovative investigation techniques.

WWW.REACT-PROJECT.NET

CONCEPT

The REACT proposal will address the management of waste acrylic textiles coming from outdoor awnings and furnishing. A key issue is the analysis and removal of finishing substances (fluorocarbons, melamine and acrylic resins, and anti-mould agents) that affect the secondary raw material purity and their management. A mechanical recycling process will be implemented to obtain second life fibre and fabrics that will be performance tested to assess the best market application.

A full environment friendly process to remove hazardous finishing materials in waste acrylic textiles will be investigated and developed to enhance their recycling, improve sustainability and reduce environmental and health risks. The removing of finishing products via chemical reactions will involve the combination of many factors and has not previously been studied in this sector.

DISCLAIMER

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement N° 820869.

REMADYL (CE-SC5-01-2018)

REMOVAL OF LEGACY SUBSTANCES FROM POLYVINYLCHLORIDE (PVC) VIA A CONTINUOUS AND SUSTAINABLE EXTRUSION PROCESS

AIM

REMADYL aims at 'rejuvenating' PVC from post-consumer waste (e.g. windows frames; tubes; flooring; cables, etc.) through the removal of hazardous legacy additives, including heavy metals; and demonstrating the circular economy use of the rejuvenated PVC materials. A novel breakthrough extraction technology will be used in combination with novel solvents and melt filtration to turn the post-consumer waste into high purity PVC.

WWW.REMADYL.EU

CONCEPT

The core innovation consists of the removal of LS (legacy substances), currently the main persistent barrier for PVC recycling, using novel solvents and melt filtration. The extracted phthalate plasticisers will be safely disposed of with energy valorisation and the recovered lead will be reused in batteries. REMADYL will deliver a breakthrough support to the Circular Economy Package and resource efficiency targets for EU as increasing recovered PVC will reduce incineration and landfilling. The REMADYL process also has the potential to easily deal with other plastics applications (e.g. removal of halogenated flame retardants).

During the first year of activity a lab-scale synthesis of various samples to allow the testing of the lead removal has been completed. Safety aspects have been studied, leading to best practices, standardisation inputs and policy recommendations. The REMADYL consortium consists of 15 multidisciplinary partners, including nine companies, covering all the expertise to maximise the project's impact.

DISCLAIMER

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement N° 821136.

"Due to the diverse sectors involved, the actual implementation of SPIRE projects enables CIRCE to access knowledge of new technologies and sectors, build a portfolio of success case studies to advertise their expertise, and position themselves to access new markets."

CIRCE

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RESEARCH CENTRE FOR ENERGY RESOURCES AND CONSUMPTION

CHAPTER 7

LC-SC3-EE-6-2018

EMB3Rs

SOWHAT

ENERGY-MATCHING & BUSINESS PROSPECTION TOOL FOR INDUSTRIAL EXCESS HEAT/COLD REDUCTION, RECOVERY AND REDISTRIBUTION

EMB3Rs
Heat and Cold matching platform

AIM

The aim of the EMB3Rs project is to add value to waste heat and help make better use of local energy sources. The project will develop a novel tool that will allow energy-intensive industries and other sectors to explore ways of reusing their excess thermal energy. This will improve their energy performance and contribute to meeting low carbon targets for the industrial sector.

WWW.EMB3RS.EU

CONCEPT

Users of the platform tool, such as industries that generate excess heat and cold, will provide the essential parameters, such as their location and the available excess thermal energy. The EMB3Rs platform will then autonomously assess the feasibility of technical solutions, determine the costs and benefits, and the implementation requirements for the recovery and use of this energy that is otherwise dissipated to the environment.

16 European companies and institutes have joined forces in the project to help energy-intensive processes to improve their energy and environmental performance. Seven case-studies will deliver data for designing and validating the platform. The platform will provide easy matching between sources and sinks for excess heat and cold, explore economically viable business models for the use of excess heat and cold, optimise the techno-economic parameters of proposed solutions, and lower energy costs, improve competitiveness and reduce environmental impacts.

DISCLAIMER

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement N° 847121.

SPIRE PROJECT

SOWHAT (LC-SC3-EE-6-2018)

THE DEVELOPMENT OF A SOFTWARE SUPPORTING INDUSTRIES AND ENERGY UTILITIES BY AUDITING AND MAPPING THEIR ENERGY PROCESSES

AIM

The main objective of the SO WHAT project is to develop and demonstrate an integrated software solution that will support industries and energy utilities in selecting, simulating and comparing alternative Waste Heat and Waste Cold exploitation technologies that could cost-effectively balance the local forecasted Heat & Cold demand including renewable energy source integration.

CONCEPT

The SO WHAT integrated software will be designed to support industries, and energyv utilities in auditing and mapping their energy processes. The project will ensure a maximum prediction error in energy recovery, a reduction of cost and time related to Energy Audits and will progressively increase the number of new projects enabling industrial waste heat and cold recovery. Reaching at least 36 industrial sites across Europe, SO WHAT is expected to trigger the creation of around 2 815 new jobs between 2023 and 2030.

WWW.SOWHATPROJECT.EU

DISCLAIMER

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement N° 847097.

"The multi-sectoral character of A.SPIRE also provides good insights on the challenges emerging in other sectors and stimulates a cross-sectoral fertilization of new ideas and concepts".

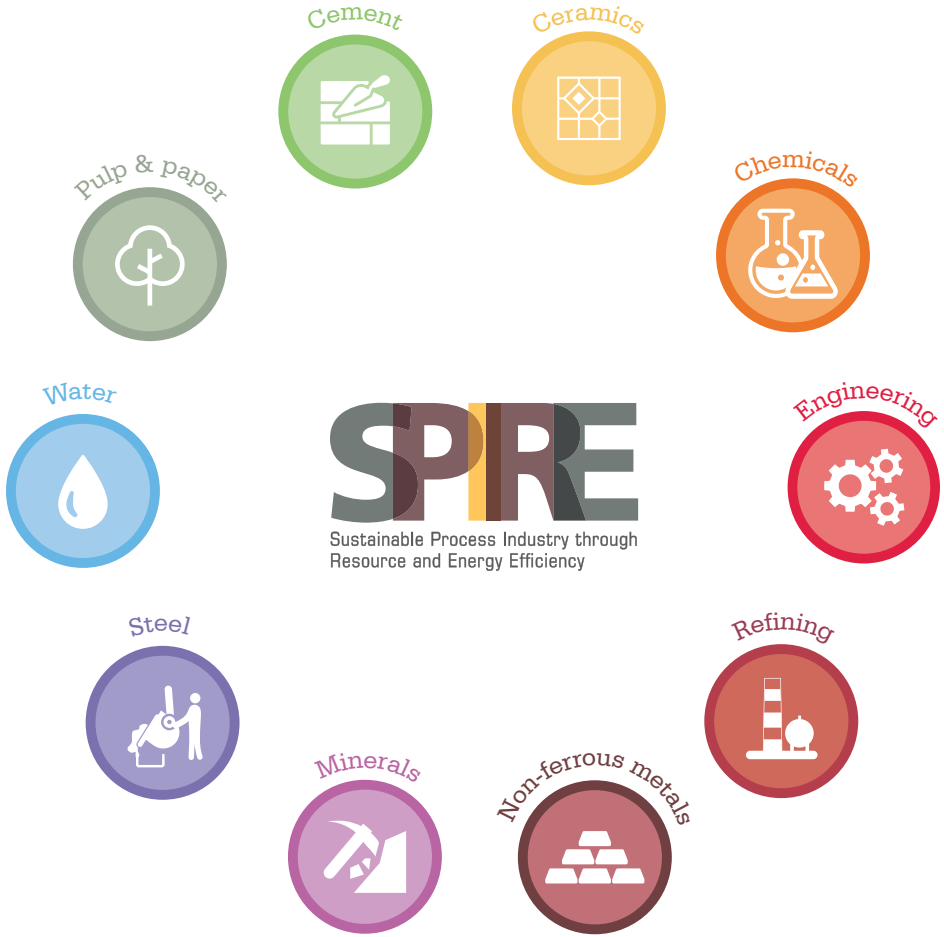
TU Delft

TU Delft Delft University of Technology

PROJECTS ENDED IN 2019

	PROJECT ACRONYM	PROJECT TITLE
EE-17-2016-2017	Smartrec	Developing a standard modularised solution for flexible and adaptive integration of heat recovery and thermal storage capable of recovery and management of waste heat
EE-18-2014	TASIO	Waste heat recovery for power valorisation with organic rankine cycle technology in energy intensive industries
EE-18-2015	SUSPIRE	Sustainable production of industrial recovered energy using energy dissipative and storage technologies
	Indus3Es	Industrial energy and environment efficiency
LCE-02-2015	CHPM2030	Combined heat, power and metal extraction from ultra-deep ore bodies
	SOLPART	High temperature solar-heated reactors for industrial production of reactive Particulates
SPIRE-01-2016	ReWaCEM	Resource recovery from industrial waste water by cutting edge membrane technologies
SPIRE-02-2014	MefCO2	Synthesis of methanol from captured carbon dioxide using surplus electricity
SPIRE-02-2016	MONSOON	Model based control framework for site-wide optmisation of data-intensive processes
SPIRE-03-2016	KARMA2020	Industrial feather waste valorisation for sustainable keratin based materials.
SPIRE-04-2016	DREAM	Design for resource and energy efficiency in ceramic kilns
	VULKANO	Novel integrated refurbishment solution as a key path towards creating eco-efficient and competitive furnaces
SPIRE-05-2015	TERRA	Tandem electrocatalytic reactor for energy/resource efficiency and process intensification

	PROJECT ACRONYM	PROJECT TITLE
	MEMERE	Methane activation via integrated membrane reactors
	ROMEO	Reactor optimisation by membrane enhanced operation
	ADREM	Adaptable reactors for resource- and energy-efficient methane valorisation
SPIRE-06-2015	EPOS	Enhanced energy and resource efficiency and performance in process industry operations via onsite and cross-sectorial symbiosis
	SYMBIOPTIMA	Human-mimetic approach to the integrated monitoring, management and optimization of a symbiotic cluster of smart production units
	MAESTRI	Energy and resource management systems for improved efficiency in the process industries.
	SHAREBOX	Secure management platform for shared process resources
SPIRE-07-2015	ADIR	Next generation urban mining - automated disassembly, separation and recovery of valuable materials from electronic equipment
	REE4EU	REE4EU: integrated high temperature electrolysis (HTE) and Ion Liquid Extraction (ILE) for a strong and independent European Rare Earth Elements Supply Chain
SPIRE-11-2017	SPRING	Setting the framework for the enhanced impact of SPIRE projects
SPIRE-12-2017	HARMONI	Harmonised assessment of regulatory bottlenecks and standardisation needs for the process industry
WASTE-1-2014	RESYNTEX	A new circular economy concept: from textile waste towards chemical and textile industries feedstock
	RESLAG	Turning waste from steel industry into a valuable low-cost feedstock for energy intensive industry
	BAMB	Buildings as Material Banks: integrating materials passports with reversible building design to optimise circular industrial value chains



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