SPIRE
Sustainable Process Industry through Resource and Energy Efficiency

# *Portugal InfoDay Circular Economy*

## Strategies and R&I Opportunities for the Circular Economy within the Sustainable Process Industry

## SPIRE 2018-2020 calls

Vladimir CID-BOURIE
A.SPIRE Programme Manager

# Outline

- SPIRE cPPP in H2020
- Current SPIRE projects and members
- NMBP – SPIRE 2018-2020 calls

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Sustainable Process Industry through Resource and Energy Efficiency

- SPIRE cPPP in H2020
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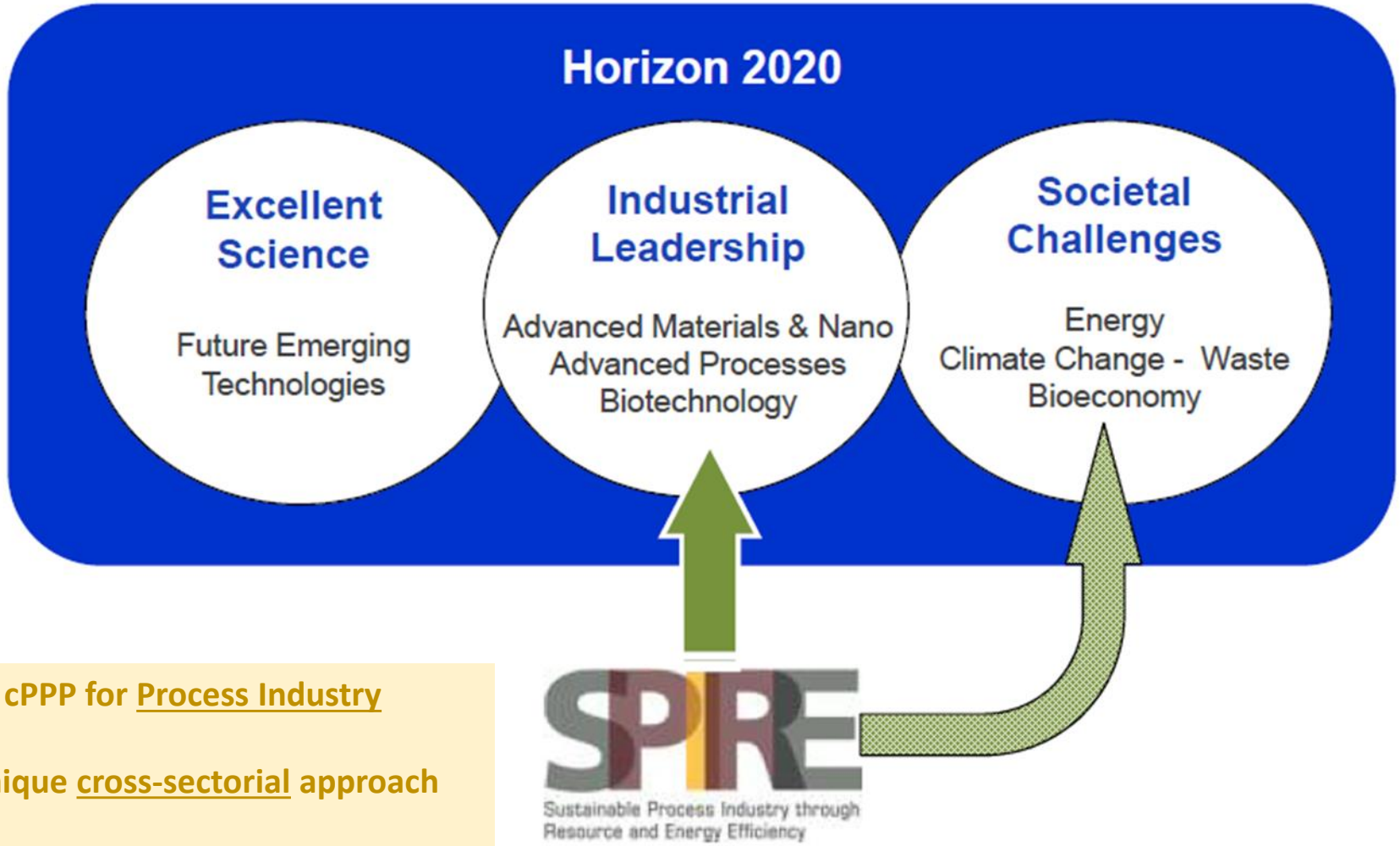
# SPIRE cPPP

- Contractual Public-Private Partnership between European Commission & A.SPIRE supporting R&I for **Process industries**
- SPIRE Budget: €850M (DG RTD) + €50M (DG ENER)= **€900M**
- Participation under **Horizon 2020 rules**

# Horizon 2020 & SPIRE cPPP



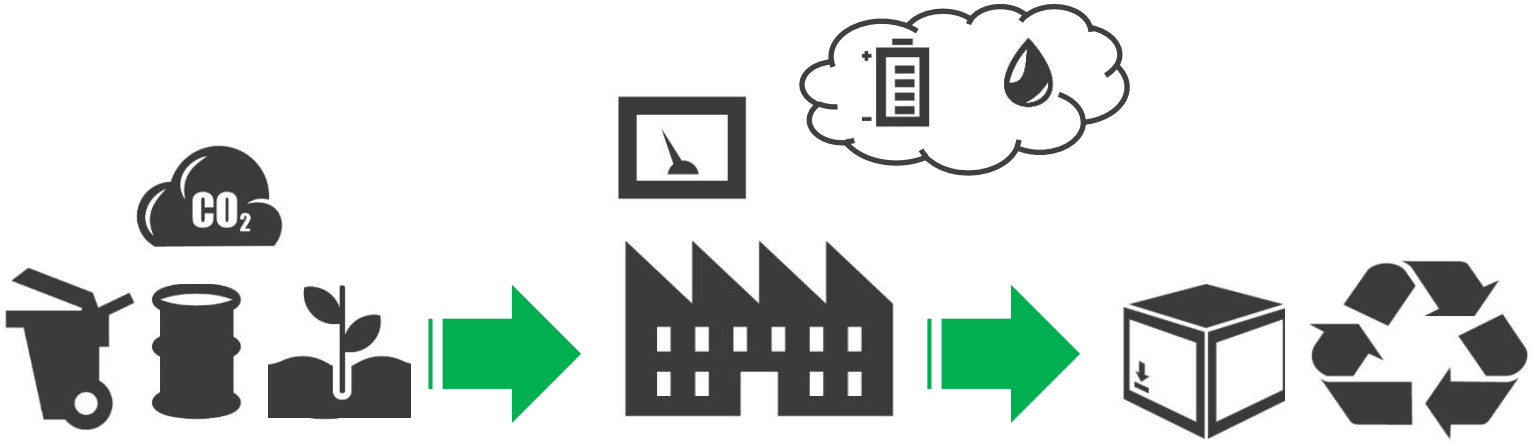

1st cPPP for Process Industry

Unique cross-sectorial approach

# SPIRE 2030 roadmap

Sustainable Process Industry through Resource and Energy Efficiency

## TO TOMORROW's SCENARIO:




- **(Re)invent** feedstock (waste, bio, $CO_2$)
- **Reduce** emissions; **(re)invent** energy & resource management concepts, incl. industrial symbiosis
- **Introduce** digital devices for better monitoring and control
- **(Re)invent** materials for optimised processes
- **(Re)invent** processes & materials with a significantly increased impact on resource & energy efficiency down the value chain: transport, housing
- **Reduce** waste & **(re)invent** technologies for valorisation of waste streams within and across sectors

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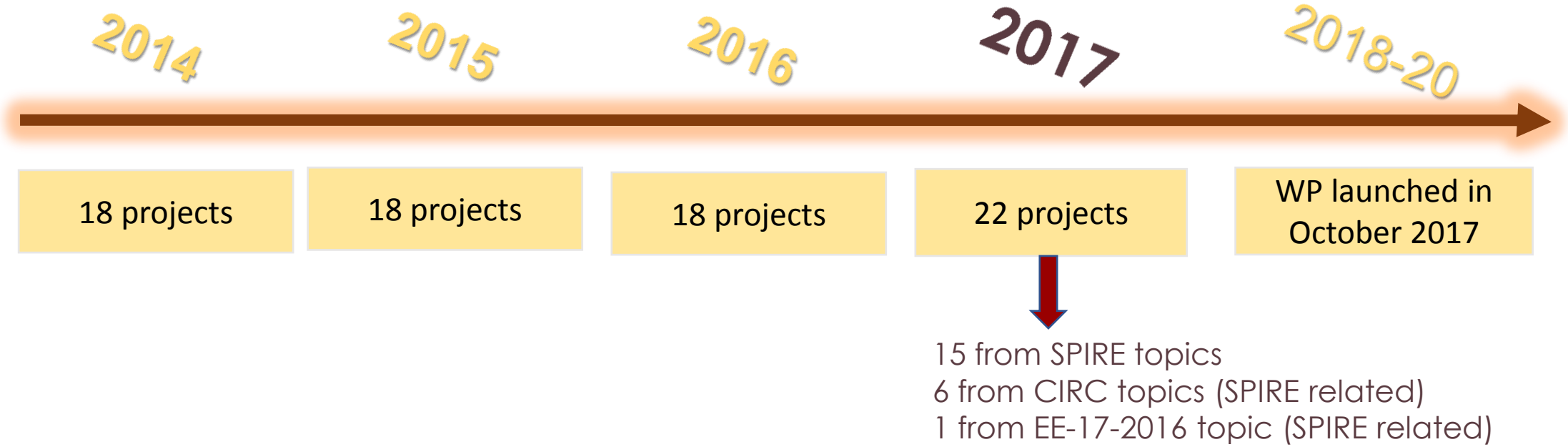
# SPIRE Projects overview

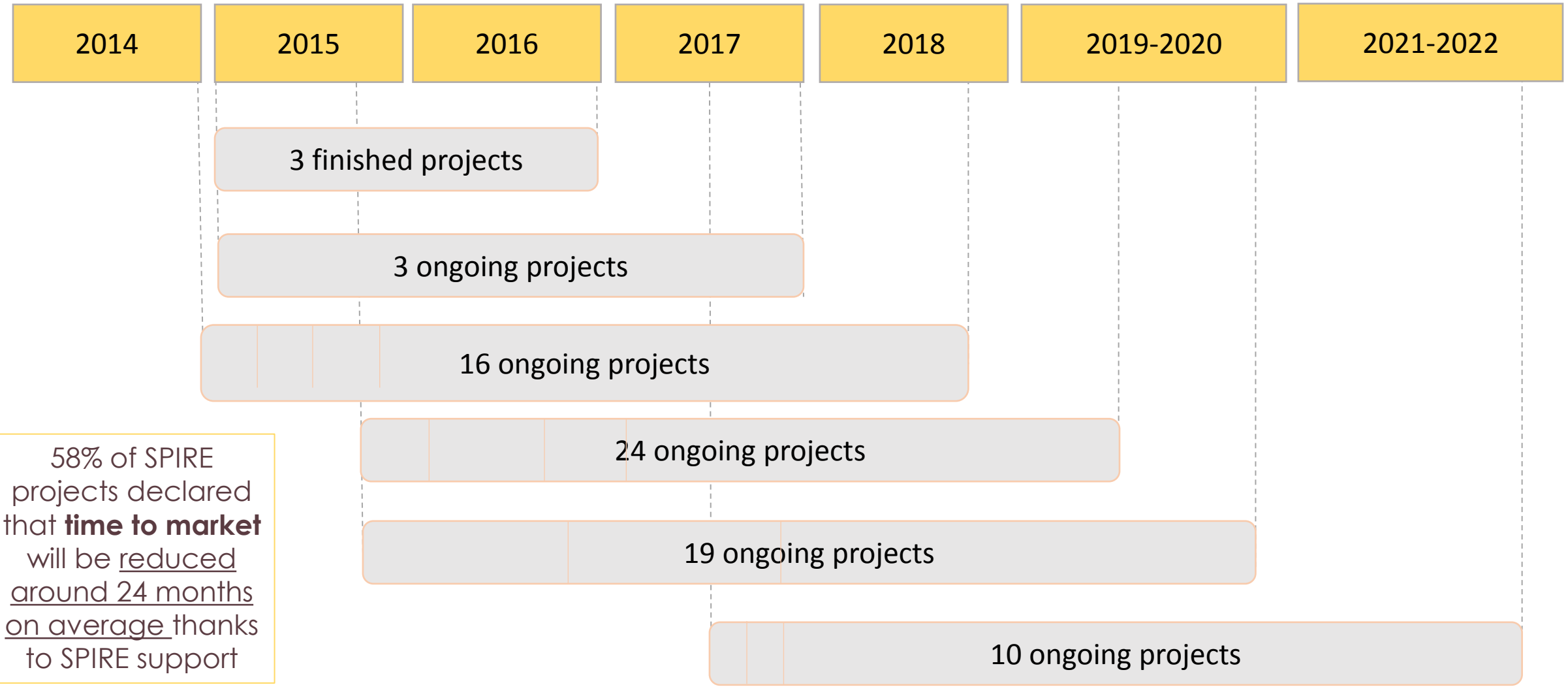
Sustainable Process Industry through Resource and Energy Efficiency




**73 ongoing projects + 3 finished = 76 SPIRE Projects**

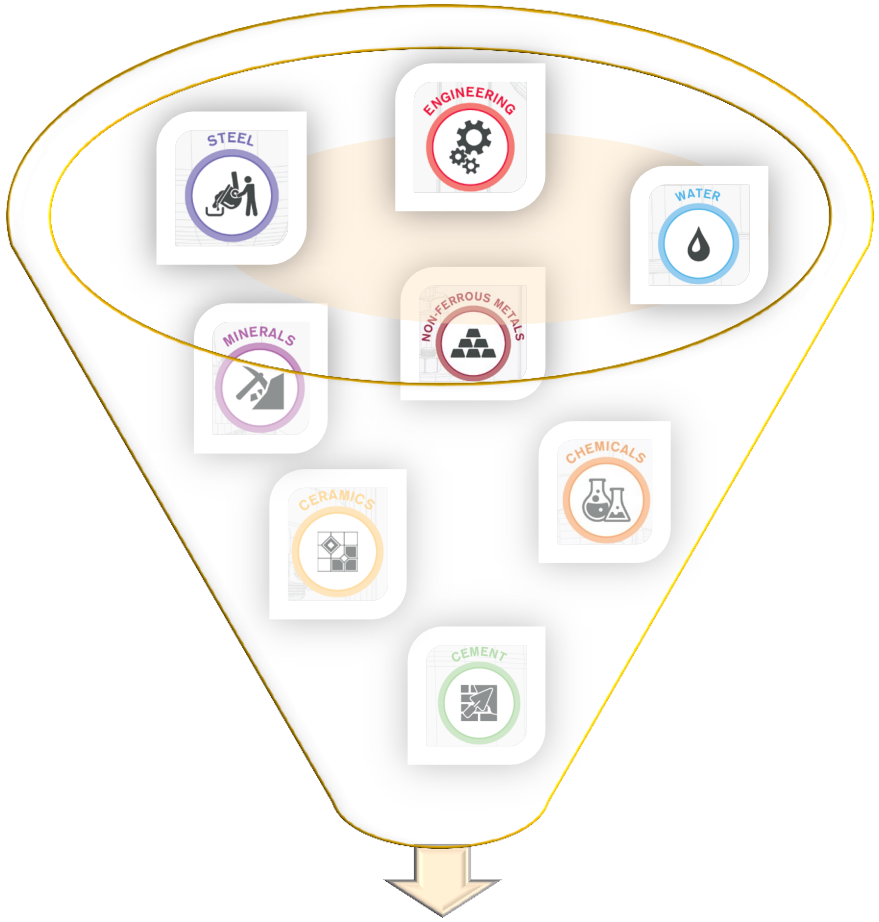
34 RIAs / 34 IAs / 8 CSAs

# SPIRE Projects overview




58% of SPIRE projects declared that **time to market** will be reduced around 24 months on average thanks to SPIRE support

# Cross-sectorial approach




**SPIRE PROJECTS**

## Cross-sectorial collaboration is cornerstone for SPIRE projects:

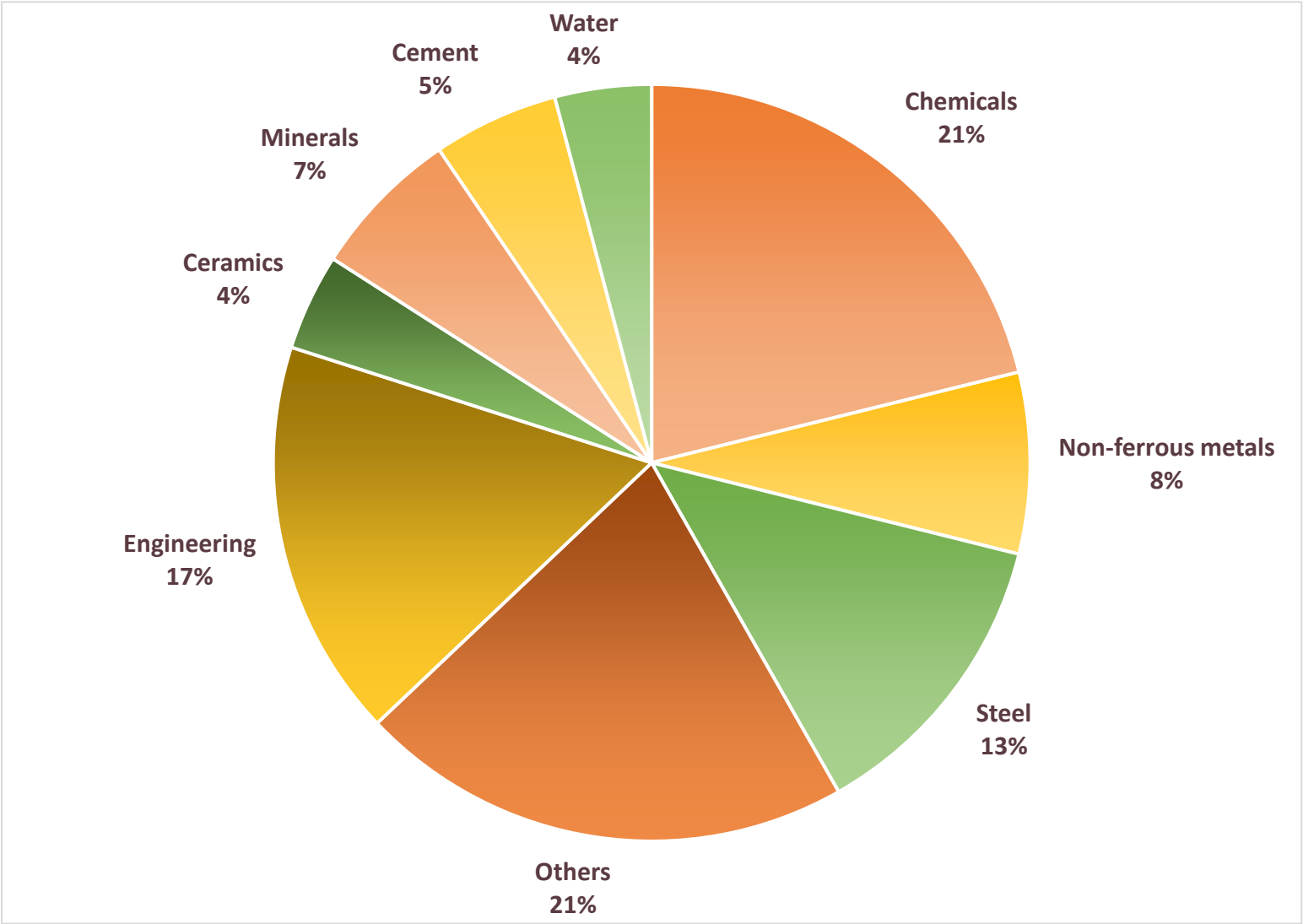
- **Minimum: 2 sectors/project**
- **7 or 8 sectors together are collaborating in various projects**
- **Average: 2.67 sectors/per project**

# Cross-sectorial approach

Sustainable Process Industry through Resource and Energy Efficiency

Global sectors participation in SPIRE projects:

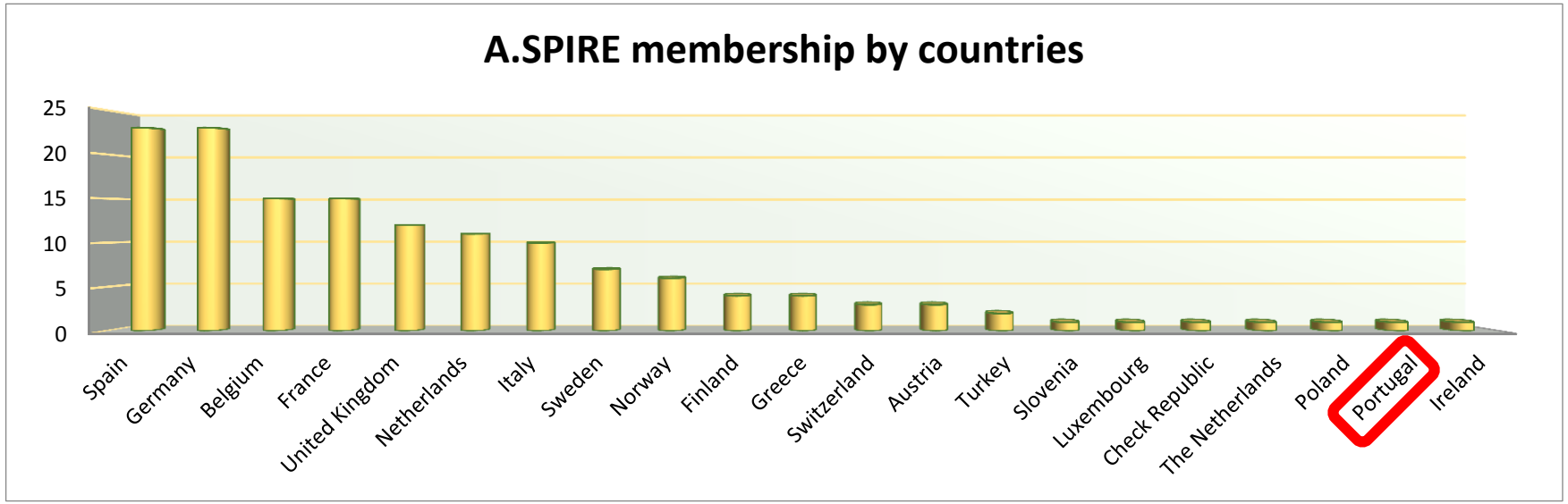
**All sectors benefit**



# Membership

| Membership type | |
|---|---|
| Associate member | 11 |
| Associations | 15 |
| | |
| Industry member (intermediate) | 2 |
| Industry member (large) | 29 |
| Industry member (medium) | 3 |
| Industry member (small) | 13 |
| Research member (large) | 41 |
| Research member (small) | 33 |
| **Total** | **147** |





# Membership


SPIRE
Sustainable Process Industry through Resource and Energy Efficiency

# Outline

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# NMBP – SPIRE calls for 2018-2020

Sustainable Process Industry through Resource and Energy Efficiency

- **+196 M€ in calls from NMBP** to provide major momentum to Research & Innovation across the process industry sectors
- Build on the positive results achieved so far, aiming at **large scale demos to enable prompt industrial deployment**
- Target breakthrough gains in **resource and energy efficiency** across the process industry, through **Industrial Symbiosis** and **cross-sectorial integration**, **recycling and recovery technologies**
- Support the development of **smart retrofitting** concepts to improve performance of existing large scale installations
- Enable the shift to **renewable electricity**
- **International cooperation** may be particularly appropriate in some areas of the Sustainable Process Industry, in particular with Eastern Partnership countries (Ukraine, Moldova, Georgia, Armenia, Azerbaijan and Belarus)

# SPIRE topics

Sustainable Process Industry through Resource and Energy Efficiency

- **CE-SPIRE-02-2018**: Processing of material feedstock using non-conventional energy sources (IA)
- **CE-SPIRE-03-2018**: Energy and resource flexibility in highly energy intensive industries (IA 50%)
- **CE-SPIRE-10-2018**: Efficient recycling processes for plastic containing materials (IA)
- **CE-SPIRE-04-2019**: Efficient integrated downstream processes (IA)
- **CE-SPIRE-05-2019**: Adaptation to variable feedstock through retrofitting (IA 50%)
- **DT-SPIRE-06-2019**: Digital technologies for improved performance in cognitive production plants (IA)

# SPIRE topics

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# CE-SPIRE-02-2018: Processing of material feedstock using non-conventional energy sources (IA)

Sustainable Process Industry through Resource and Energy Efficiency

**Specific Challenge:**

- Non-conventional energy sources, such as microwave, plasma, ultrasound and laser, as well as electrochemical and photochemical processes, have already been applied in process intensification, mainly at lab scale, showing significant improvements in process performance (e.g. improved selectivity, crystal nucleation, reaction speed easing raw material demand) for the benefit of energy efficiency.
- The processes powered by non-conventional energy sources are suitable for connection to the electricity grid.
- They allow variable throughputs to better follow market demand and enable leaner production paradigms (e.g. decreased stock, production on demand).
- Such technologies are suitable for downscaling and continuous processing, where they can also be coupled with real time monitoring allowing a finer control of the transformations.

***TRL 4 to 6***

# CE-SPIRE-02-2018: Processing of material feedstock using non-conventional energy sources (IA)

Sustainable Process Industry through Resource and Energy Efficiency

**Scope:**

Proposals are expected to develop technologies applying non-conventional energy sources to processes of high industrial interest. The concepts proposed should:

- Show potential for integration in a renewable electricity grid, and consider the relevant limitations (fluctuating nature of the electricity stream);
- Provide significant advantages in terms of resource and energy efficiency, compared to the current state of the art processes (or similar ones, as relevant);
- Provide improved flexibility, working at variable throughputs without major losses in the overall process performance;
- Be applicable to continuous processes and/or show potential enabling the replacement of current batch ones;
- Consider, where relevant, the possibility for containerised and/or mobile (e.g. biomass in situ processing) technologies;
- Consider Life Cycle Assessment proving a reduced environmental footprint;
- Consider replicability and scalability of the proposed concepts.

# CE-SPIRE-02-2018: Processing of material feedstock using non-conventional energy sources (IA)

Sustainable Process Industry through Resource and Energy Efficiency

**Expected impact:**

- Allowing for a -30% to +30% energy input within RES fluctuations timeframes, without significant losses in specific energy efficiency;
- Improvement in energy efficiency of 30%;
- Improvement in resource efficiency of 30%;
- Decrease in CO2 emissions by 40% (without considering the electricity generation and at steady state);
- Decreased OPEX and CAPEX by 15%;
- Effective dissemination of major innovation outcomes to the current and the next generation of employees of the SPIRE sectors, through the development of learning resources with flexible usability. These should be ready to be easily integrated in existing curricula and modules for undergraduate level and lifelong learning programs.

Relevant indicators and metrics, with baseline values, should be clearly stated in the proposal.

***EUR from 6 to 10 million***

# SPIRE topics

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# CE-SPIRE-03-2018: Energy and resource flexibility in highly energy intensive industries (IA 50%)

Sustainable Process Industry through Resource and Energy Efficiency

**Specific Challenge:**

- Energy intensive industries should adapt their production processes and unit operations to increasingly sustainable, but highly fluctuating energy supply.
- To this end, energy and resource flexibility in the European process industry can be improved through the development of novel processes utilising more efficiently energy streams, heat recovery and raw materials flows with variable properties (including new or modified materials as well as secondary raw materials and by-products).
- The challenge is to establish synergistic integration at a regional level among different production sectors leading to optimisation of production system as a whole and logistics, especially in terms of the supply of energy and raw materials. This should reduce emissions and environmental impact, while maintaining competitiveness and job security.

***TRL***
***5 to 7***

# CE-SPIRE-03-2018: Energy and resource flexibility in highly energy intensive industries (IA 50%)

Sustainable Process Industry through Resource and Energy Efficiency

**Scope (1/2):**

Solutions are needed for value chain optimisation through energy efficiency considerations in the design phase of manufacturing equipment and processes, collective demand side strategies, and potential integration of the nearby renewable energy sources.

In particular, proposals are expected to develop:

- Innovative production technologies allowing flexibility in terms of raw material, including new, modified or secondary raw materials, and intermediate or final products are expected to be developed. They have, at the same time, to consider quality of the main products and by-products in view of their valorisation through re-use and recycle;
- Novel advanced energy systems, could include new combustion and gasification techniques applied to the highly resource and energy intensive industries have to be developed;
- New developments should clearly indicate how the use of sustainable electrical energy sources, or heat recovery, could enhance energy efficiency and cope with a fluctuating energy input. These actions have to bring a significant impact on the sustainability profile of the process and/or the final products.

# CE-SPIRE-03-2018: Energy and resource flexibility in highly energy intensive industries (IA 50%)

Sustainable Process Industry through Resource and Energy Efficiency

**Scope (2/2):**

Proposals need to consider the following elements:

- Treatment technologies and process integration solutions allowing a significant reduction as well as the valorisation, re-use and recycling of by-products and waste streams (solid, liquids and gaseous);
- System, process modelling and integration (up and down-stream) within the plant operation terms or symbiosis concepts, improving energy and raw materials efficiency and flexibility, and minimising the impact on the environment of the whole value chain. Taking also into consideration optimisation at a plant/system level. The activities have to be supported by a quantitative Life Cycle Assessment.

Proposals should include multiple demonstrators, including retrofitting of industrial installations, in a highly energy and resource intensive industry-relevant environment. The whole value chain should be considered, as well as relevant regulations which support the recycling of waste materials in Europe. Exploitation of structural and regional funds in connection with smart specialisation strategies is strongly encouraged.

# CE-SPIRE-03-2018: Energy and resource flexibility in highly energy intensive industries (IA 50%)

Sustainable Process Industry through Resource and Energy Efficiency

**Expected impact:**

- Cost reduction of the process of at least 10% through the implementation of a flexible scheme in raw materials, including secondary raw materials, process and product quality specifications;
- Improved process efficiency through re-utilisation of energy and/or material process streams by at least 15%;
- CO2 emissions reduction by at least 5% and reduction of the environmental impact in terms of the main key performance indicators by at least 15%;
- Effective dissemination of major innovation outcomes to the current and next generation of employees, through the development, by education/training experts, of learning resources with flexible usability. These should be ready to be easily integrated in existing curricula and modules for undergraduate level and lifelong learning programmes.

Relevant indicators and metrics, with baseline values, should be clearly stated in the proposal.

***EUR from 8 to 12 million***

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# CE-SPIRE-10-2018: Efficient recycling processes for plastic containing materials (IA)

Sustainable Process Industry through Resource and Energy Efficiency

**Specific Challenge:**

- Plastics materials are produced mainly from raw materials of fossil origin (e.g. PE, PP, and PET). A variety of bio-based plastic materials are increasingly available. Plastic materials are used in a wide range of applications because of their properties, versatility, lightweight and price, for example for making lightweight polymer composites to substitute metals and in more traditional applications, such as packaging. The wide use of these materials results in a huge amount of plastic waste.
- Recycling and redesign of plastics are essential in reusing plastic waste material and avoiding landfill. This also allows utilising plastics as carbon sinks in an optimal way, before using them for energy recovery at the end of life.
- A major challenge lies in the development of process technologies, utilising plastic waste as starting material (at least in part). A better use of underexploited resource (plastic waste) for the production of added value products (not restricted to plastics but excluding fuels) and process streams would support the circular economy.

***TRL***
***5 to 7***

# CE-SPIRE-10-2018: Efficient recycling processes for plastic containing materials (IA)

**Scope (1/2):**

Proposals submitted under this topic are expected to cover processes for the production of recyclable materials containing plastics. Aspects to be considered are:

- Improved energy and resource efficiency. The processes proposed are expected to have a lower environmental footprint compared to the current state of the art for the production of added value products; this should be proved by Life Cycle Assessment as well as Life Cycle Cost to prove the economic viability of the proposed technology;
- Integration with the relevant value chains, ensuring the secure supply of the raw material streams. In this respect, a clear strategy to involve the relevant actors along the value chain is expected;
- Process flexibility and ability to utilise waste heterogeneous plastic materials, including plastic composites, as input to allow the recycling and the re-processing of this widely available resource into added value products (excluding fuels). Sustainable raw materials, such as bio-based raw materials and organic waste could also be considered;

# CE-SPIRE-10-2018: Efficient recycling processes for plastic containing materials (IA)

Sustainable Process Industry through Resource and Energy Efficiency

**Scope (2/2):**

- Key issues related to the quality of the raw (including secondary) material streams should be covered, and in particular the heterogeneity of the waste plastic material, as well as the wide variety of substances contained in plastic materials (e.g. plasticisers, anti-oxidants, etc.). The valorisation of fillers or fibres from composites should also be covered;
- Quality/specifications of the yielded streams ensuring their usability by downstream industries;
- Non-technological hurdles, such as regulations and standards, to enable the prompt deployment in industry of the developed concepts and economic indicators (e.g. CAPEX and OPEX).

Demonstration activities, prototypes and pilot implementations in real industrial settings for the concepts proposed are expected.

Proposals submitted under this topic should include actions designed to facilitate cooperation with other projects; to enhance user involvement; and to ensure the accessibility and reusability of data produced in the course of the project.

# CE-SPIRE-10-2018: Efficient recycling processes for plastic containing materials (IA)

Sustainable Process Industry through Resource and Energy Efficiency

**Expected impact:**

- More efficient and sustainable chemical process and processing technologies utilising plastic waste as starting material for the production of added value products such as recyclable plastic materials (e.g. composites) and chemicals but excluding fuels);
- The technologies proposed should provide a decreased utilisation of primary fossil resources in the process industry of at least 30%;
- The concepts proposed should provide a decrease in CO2 emissions of at least 20%;
- The concept should utilise at least 70% of waste material including at least 40% of plastic waste;
- Effective dissemination of major innovation outcomes to the current next generation of employees of the SPIRE sectors, through the development, by education/training experts, of learning resources with flexible usability. These should be ready to be easily integrated in existing curricula and modules for undergraduate level and lifelong learning programmes.

Relevant indicators and metrics, with baseline values, should be clearly stated in the proposal.

***EUR from 6 to 8 million***

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# CE-SPIRE-04-2019: Efficient integrated downstream processes (IA)

Sustainable Process Industry through Resource and Energy Efficiency

**Specific Challenge:**

- Today, process industry operations for downstream processing represent on average 50-60% of the total capital (CAPEX) and operating costs (OPEX) and they account for up to 45% of the process energy in industrial operations.
- These high costs for downstream processing are often linked to the inefficiencies in the upstream process, due to low conversion and formation of co-products, by-products and/or impurities.
- Hybrid processing technologies (including chemical and biochemical steps) can provide major advantages in terms of primary process selectivity and sustainability. However, they have not been widely deployed in industry so far.
- The development of novel technologies for upstream and downstream unit operations, as well as their better integration, could provide significant resource and energy efficiency gains.

***TRL 5 to 7***

# CE-SPIRE-04-2019: Efficient integrated downstream processes (IA)

Sustainable Process Industry through Resource and Energy Efficiency

**Scope:**

Proposals submitted under this topic are expected to provide novel solutions for a deeper integration of upstream and downstream processing operations. Proposals should consider:

- Intensified process technologies presenting multistep upstream processes, potentially exploiting hybrid chemo and bio catalytic technologies as well as process analytical techniques (PAT), in order to maximise production efficiency, selectivity and mitigation of downstream processing;
- Complex downstream operations, integrating different separation techniques and purification steps;
- Modularity and flexibility of the solutions, as well as, potential for transition from batch to continuous operations;
- The technologies proposed should enable increased productivity, purity and quality of products, while lowering the process environmental footprint and increasing resource and energy efficiency;
- The potential for integration in the current industrial scenario, and the replicability of the concept in different sectors of the process industry;
- Increased safety of the work environment.

Proposals should provide proof of economic and industrial feasibility of the technologies involved; and should consider the potential integration in existing installations, as well as their retrofitting. Reduction of production costs and time to market is also expected.

# CE-SPIRE-04-2019: Efficient integrated downstream processes (IA)

Sustainable Process Industry through Resource and Energy Efficiency

**Expected impact:**

- 20% decrease in greenhouse gas emission;
- Increased in resource and energy efficiency by at least 20%;
- Novel modular and scalable integrated (upstream-downstream) pilot line technologies with 10% decrease in CAPEX and OPEX;
- Effective dissemination of major innovation outcomes to the current and next generation of employees, through the development of learning resources with flexible usability. These should be ready to be easily integrated in existing curricula and modules for undergraduate level and lifelong learning programmes.

Relevant indicators and metrics, with baseline values, should be clearly stated in the proposal.

***EUR from 10 to 14 million***

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# CE-SPIRE-05-2019: Adaptation to variable feedstock through retrofitting (IA 50%)

Sustainable Process Industry through Resource and Energy Efficiency

**Specific Challenge:**

- Process industry plants have to be operated for a long time to make their operations viable. They include equipment such as furnaces, reactors, raw materials handling and storage systems which sometimes have a lifetime beyond 30 years.
- Keeping these facilities up to date from a technological and from regulatory point of view (for instance related to zero waste regulations and to the circular economy) is a major challenge. Even industrial plants which are less than 10 years old, are often not equipped for new or renewable (e.g. biomass) materials and alternative or renewable energy input streams.
- More generally, this increased variety of inputs along with the need for energy efficiency improvements poses a real challenge and requires technological breakthroughs in the process industry.

***TRL 5 to 7***

# CE-SPIRE-05-2019: Adaptation to variable feedstock through retrofitting (IA 50%)

Sustainable Process Industry through Resource and Energy Efficiency

**Scope:**

Proposals need to cover the following:

- Implement simulation models and decision support tools for the production chain in an energy intensive sector, including the detection of inefficiencies, in order to allow flexibility with respect to feedstock of variable composition, while offering energy efficiency and product quality;
- The development of tools and methodologies to streamline and support retrofitting;
- Find the most efficient operational input conditions to optimise the performances;
- Develop indicators to modify input variables and its potential of replication across the industry;
- Facilitate and adapt the equipment towards a larger number and more diverse feedstock in order to be ready for a transition in which variability in quality, quantity and price of feedstock are key to make the production competitive and sustainable;
- Solutions should demonstrate the feasibility and suitability of the concepts of retrofitting at industrial scale.

Demonstration of the technology in different process industries should be undertaken, covering both the technology (new 'plug-ins'), as well as the process control (higher variability of the process requires new Monitoring & Control Systems).

Proposals submitted under this topic should include actions designed to facilitate cooperation with other projects; to enhance user involvement; and to ensure the accessibility and reusability of data produced in the course of the project.

# CE-SPIRE-05-2019: Adaptation to variable feedstock through retrofitting (IA 50%)

Sustainable Process Industry through Resource and Energy Efficiency

**Expected impact:**

- Increasing the resource and energy efficiency of the targeted processes by 20%;
- Decrease GHG emissions through retrofitting by at least 30%;
- Decreased utilisation of fossil resources in the process industry of at least 20%;
- Reduced OPEX by 30% and increased productivity by 20%;
- Effective dissemination of major innovation outcomes to the current next generation of employees of the SPIRE sectors, through the development, by education/training experts, of learning resources with flexible usability. These should be ready to be easily integrated in existing curricula and modules for undergraduate level and lifelong learning programs.
- Relevant indicators and metrics, with baseline values, should be clearly stated in the proposal.

***EUR from 8 to 12 million***

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# CE-SPIRE-06-2019: Digital technologies for improved performance in cognitive production plants (IA)

Sustainable Process Industry through Resource and Energy Efficiency

**Specific Challenge:**

- Shortage in raw materials, increased energy prices and environmental constraints require the European process industry to improve its performance and flexibility and there are unexploited opportunities for digitising a large range of enterprises of very different size in the process industry.
- Digitisation endows the production system with capabilities for analysis. This should enable the autonomous operation of the system based on embedded cognitive reasoning, while relying on high-level supervisory control.
- As a consequence, changes in the production process need to be detected and the system needs to be able to respond to these dynamic fluctuations, by adapting the production to stay within the target ranges of production costs and rate, as well as those of and sustainability parameters.
- A fully up-to-date interactive and self-learning process control integrated with management tools is essential to obtain an optimal efficiency, while maintaining adequate flexibility of the system in regard to changing feedstock, energy sources and product demand.

***TRL 5 to 7***

# CE-SPIRE-06-2019: Digital technologies for improved performance in cognitive production plants (IA)

**Scope:**

- Improvement of online monitoring and innovative control technologies in terms of process performance and flexibility, maintenance needs and product quality;
- Digital retrofitting of existing assets, integration towards and holistic optimisation of operations, data-analytics, real-time capability, use role-specific representation of information, feedback control & detect deviations and adjust operations immediately decision support (e.g. advanced process control, reactive scheduling);
- Several among the following concepts: apply low-cost sensors for on-line assessment of product quality and integration into process control; robust optimisation methods to distributed targeted process monitoring; simulation methods for the analysis, characterisation and study of systems for enhanced operations and decision-making combination of various forms of data with cognitive insight to optimise and enhance resources;
- Replicability and scalability of the concepts should be considered appropriately.

# CE-SPIRE-06-2019: Digital technologies for improved performance in cognitive production plants (IA)

Sustainable Process Industry through Resource and Energy Efficiency

**Expected impact:**

- Improved capabilities for valid, reliable and real-time control logics of the properties, efficiency and quality of process streams and final products for existing and for more flexible process operation concepts:
- Show potential for improved performance in cognitive production plants;
- Increased production performance, energy and resource consumption, or waste or by-products production will be significantly improved by more than 20%. The targets should be quantified in the proposal and validated during the execution of the demonstration;
- Project outcomes should demonstrate a positive environmental impact, by reducing CO2 emissions compared to the state of the art and in the scale relevant for the different applications;
- Effective dissemination of major innovation outcomes to the current next generation of employees of the SPIRE sectors, through the development, by education/training experts, of learning resources with flexible usability. These should be ready to be easily integrated in existing curricula and modules for undergraduate level and lifelong learning programmes.
- Relevant indicators and metrics, with baseline values, should be clearly stated in the proposal.

***EUR from 6 to 8 million***

# Indicative Budgets & Deadlines 2018-2019

| Topics (Type of Action) | Budget 2018 (M€) | Budget 2019 (M€) | Deadlines |
|---|---|---|---|
| CE-SPIRE-02-2018 (IA)<br>CE-SPIRE-03-2018 (IA)<br>CE-SPIRE-10-2018 (IA) | Total:<br>97.5 | | 31 Oct.17 - 22 Feb.18 |
| CE-SPIRE-04-2019 (IA)<br>CE-SPIRE-05-2019 (IA) | | Total:<br>65.8 | 16 Oct.18 - 21 Feb.19 |
| DT-SPIRE-06-2019 (IA) | | 32.9 | 16 Oct.18 - 21 Feb.19 |

# SPIRE topics in 2020, still to be written…

- **CE-SPIRE-01-2020**: Industrial symbiosis (IA)
- **CE-SPIRE-07-2020**: Recovery of industrial water, thermal energy and substances contained therein (IA)
- **CE-SPIRE-08-2020**: Improved Industrial Processing using novel high-temperature resistant materials (RIA)
- **CE-SPIRE-09-2020**: Making the most of mineral waste, by-products and recycled material as feed for high volume production (IA)

# Questions?

Sustainable Process Industry through Resource and Energy Efficiency

Muito obrigado !

# Contact the A.SPIRE office

Sustainable Process Industry through Resource and Energy Efficiency

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Sustainable Process Industry through
Resource and Energy Efficiency

# SPIRE believes in the Circular Economy