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SPIRE Public Private Partnership

Preliminary ideas of areas to be covered by NMP in 2014

SPIRE.NMP.2014-1 Breakthrough innovations in recovery technologies: characterisation, separation and pre-processing - RTD, TRL 3-6, SME-targeted

Scope:

Nowadays resources are becoming increasingly scarce. For this reason resource efficiency has become an exceedingly important topic in industry. This is especially true for resource and energy intensive industries such as the process industries. To improve resource utilisation in the process industry it is therefore paramount to valorise industrial waste streams. This would allow the recovery of valuable renewables, which could be re-processed to improve the overall resource efficiency of industrial processes and of the industry as a whole. Valorisation of industrial waste streams requires, due to their complexity, the development of advanced processes for characterisation, along with the development of separation processes insuring efficient recovery of valuable substances. In addition, the conversion of the recovered substances into feed streams suitable for industrial processing is likely to require the development of pre-treatment processes.

Research under this topic should lead to novel processes for waste stream treatment aimed at maximising the overall resource efficiency. The proposed solutions should be able to process industrial waste streams, providing novel technologies for characterisation of waste streams as well as separation and pre-processing technologies (including concentration of substances from water waste streams and separation of different materials from hybrid structures). The recycling processes should yield feed streams suitable for industrial processing. Recoverables from these processes include metals and alloys, nutrients, salts and organic building blocks. The best valorisation of industrial waste streams might require an integrated and cross sectorial approach where waste streams from a certain industrial sector after processing would become a valuable feedstock for other sectors.

The proposed waste treatment processes to be industrially viable should be highly energy-efficient and relatively low cost. They should be conceived to allow for their integration in the current industrial landscape without requiring major capital investments and should be applicable to different industrial sectors.

It is expected that the proposed solutions are demonstrated in an industrial environment and possibly for different industrial sectors.

In order to ensure an efficient implementation and maximum impact of SME-related activities, the leading role of the participating SMEs with R&D capacities is expected. The coordinator does not need to be an SME but the participating SMEs should have the decision making power in the project management; and the output should be for the benefit of the participating SMEs and the targeted SME dominated industrial communities.

Funding scheme: RTD projects.

Expected impact:

The industrial processes proposed should provide impacts related to increased resource efficiency of the industries where they are applied and provide additional business opportunities for such industries by means of the commercialisation of the recovered materials.

Technologies applicable to different industrial sectors and allowing for integration in already existing industrial plants, in an economically viable way.

Significant reduction of materials losses of between 20 - 50% depending on the type of material. Ability of the process industry to recover and recycle materials of scarce supply.

Provide environmental benefits by decreasing the amount of waste produced by industrial processes and the related need for further downstream processing.

Impact on job creation in Europe, with the creation of high technology jobs.

Benefits for the European industries with particular attention to SMEs, allowing them to enjoy a world leading position in recycling technologies.

SPIRE.NMP.2014-2 Adaptable chemical processes allowing the use of renewables as flexible feedstock for chemical and energy applications - RTD, TRL 5-7, Large

Scope:

The increased use of biomass, residues and waste gases as feedstock in industry poses a number of challenges that need to be addressed, such as seasonal and fragmented availability, short harvesting windows, environmental challenges, presumed competition with animal or human food supply, etc. Changing markets and making new links in the value chains will be an added challenge in the future production systems based on cross sectorial integration. These challenges have to be overcome in order to allow increased utilisation of biomass in the industry.

Use of biomass, residues and waste gases as feedstock in industry to produce green chemical building blocks is expected to increase significantly in the coming years. This will play a vital role in the establishment of a more sustainable and low carbon industry, allowing the replacement of part of the fossil energy sources as well as providing an increased supply of sustainable feedstock for further industrial processing. In order to apply biomass, residues and waste gases as feedstock, pre-processing will likely be necessary.

New approaches have demonstrated that small mobile and flexible units with chemical processing and process intensification capabilities could provide several advantages in comparison to fixed facilities, such as operation in a distributed manner and mobility to different locations providing higher flexibility. This could provide convenient business opportunities especially for processes presenting a variable feed supply, fragmented feedstock availability and/or need for mobility to different locations to maximise usage time. It is believed that this novel flexible and possible containerised approach could be suitable for the processing of renewables, especially with respect to the mobility of such units that could cope well with the related challenges.

Research under this topic should lead to the development of new processes that would provide efficient biomass, residue and waste gas conversion (or biomass pre-treatment for further refining). These processes should allow an increased utilisation of renewables (not competing with food production) as feedstock for the production of chemicals (including intermediates) and/or fuels as part of an integrated approach to optimise energy efficiency. Such processes should be presented with a containerised, flexible and scalable chemistry approach allowing for (pre-)processing of biomass at locations closer to the supply. The proposed solutions should be able to cope with the seasonal or even daily fluctuations of the renewable source to be used. In this respect the unit should also be able to process feedstock from different sources in order to guarantee the level of supply.

The proposed solutions should provide economically viable alternatives to current practise in biomass processing and demonstrate business feasibility. Moreover, new innovative technologies and approaches are expected to substitute the current fossil fuels by renewables as feedstock. LCA and LCC analysis for the proposed processes is needed in order to prove the sustainability of the solutions. Overall, it is desirable to develop and demonstrate a multi-sectorial and replicable methodology for increasing the renewable resources integration in industrial processing. It is expected that high amounts of residues from will be further used in energy intensive industries, enhancing the efficiency in the use of these resources. Substantial demo activities in conjunction with the development of solution-adapted equipment are expected.

Funding scheme: RTD projects.

Expected impacts:

Economically viable solutions and technologies allowing a reduction in fossil resources intensity of at least 30%, compared to current practices (for already optimal processes the savings could also come from reduction in fossil energy for feedstock transportation). It should lead to increased utilisation of renewables in the industry as feedstock for the production of chemicals (and/or intermediates) and/or fuels as part of an integrated approach to optimise energy efficiency with a proven sustainability, taking into account environmental issues and competition with food.

The technologies developed should integrate well in the current industrial landscape providing finished products and/or intermediate and building blocks that could be processed in already existing industries.

It is expected that the proposed solutions show an impact on job creation in Europe, with the creation of high technology jobs. They could also show a direct or indirect impact on rural areas, arising from the increased use of biomass and residues production locally.

SPIRE.NMP.2014-3 Improved downstream processing of mixtures in process industries - RTD TRL 4-7, LARGE

Scope:

Currently, operations for separation and fractionation of gas and liquid mixtures represent on average 20-70% of the total capital and operating costs for most of the current plants in the process industry. These operations are also very energy-consuming, as they account for up to 45% of all the process energy used, for example, by the chemical and petroleum refining industries. Major improvements of these processes leading to more efficient and cost effective solutions are paramount to achieve a more sustainable European industry.

In this respect, hybrid technologies combining different techniques, such as distillation, membrane permeation, adsorption, extraction, etc. have already been applied successfully to a number of industrial processes. They can provide a cost effective solution to achieve major improvements in separation and fractionation operations, leading to waste reduction, lowering greenhouse gas emissions, and improved energy efficiency.

To realise the full potential of these technologies, further investigation and a deeper understanding of hybrid separation techniques is required, in particular leading to a better understanding of how the different components interact with each other. This may also facilitate the transition from batch to continuous processes in the next generation of plants, increasing yield, purity and quality of products while improving productivity.

To enable the deployment of innovative highly-efficient separation and fractionation technologies in industry, the development of new approaches for the design and scale up of the overall production processes might also be required. If possible, these innovative approaches should regard the primary process and the downstream separation as one single, integrated process.

The aim is to provide innovative solutions for downstream processing, advance in the integration of different separation techniques into complex hybrid units and provide tools for the design of such units.

The proposals should provide a proof of economic and industrial feasibility for the new technologies. The proposed solutions should also have potential for integration in the current industrial scenario, and should be suitable for different sectors in the process industry. Important aspects that should be taken into considerations are:

- Compatibility with continuous processes and support to the transition from batch processes to more efficient and reliable continuous operations (where relevant).
- Reduction of production costs and time to market by providing tools for process and separation unit design and optimisation.
- Significant improvements in energy and resource efficiency.
- Significant reduction in greenhouse gas emissions.
- Improvement in safety of the work environment.

The projects selected under this topic are also expected to carry out demonstration activities in industrial environments aimed at proving the industrial relevance and feasibility of the proposed technologies, the technologies should also clearly show potential integration into current plants.

Funding scheme: RTD projects

Expected impact:

Novel and cost effective separation and fractionation technologies applicable to the process industry. The proposed technologies should aim at increasing the resource and energy efficiency for the process industries by at least 20 % while leading to a significant decrease in greenhouse gas emission. The proposed technologies should strengthen the competitiveness of the European industry developing both engineering know-how as well as economically sustainable industrial processes leading to shorter time to process/market, and higher production capacity. Overall, the activities should support retention and creation of jobs for the European process industry.

SPIRE.NMP.2014-4 Methodologies, tools and indicators for cross-sectorial sustainability assessment of energy and resource efficient solutions in the process industry - Support action

Scope:

The capacity of the process industry to address societal needs through resource and energy efficiency depends on the development of innovative technologies and synergistic optimisation, which require a consistent sustainability assessment across sectors and along the value chains.

In order to further develop appropriate tools, there is a need to increase the European knowledge base related to applied sustainability assessment tools, methodologies, indicators and to overcome the bottlenecks for cross-sectorial take-up and further development in the process industry.

The support action should involve a study across multiple sectors in the process industries considering all aspects of sustainability assessment along the whole product life cycles with regard to resource and energy efficiency. The outcome of the study should incorporate:

- a comparative overview of currently used methodologies, tools, indicators and practices in different sectors,
- a selection of the most appropriate solutions, based on their demonstrated robustness and their ability to provide simplified and easily communicated data,
- an overview of the related opportunities as well as the bottlenecks towards further development and cross-sectorial replication/transfer of these approaches,
- definitions of the required steps to accelerate further uptake of resource efficiency indicators over the value chains, and
- recommendations on the most suitable tools for management and decision making at research lab, plant, company, sector and multi-sectorial level.

The study should allow for the customisation and development of sector-specific tools, for example regarding boundaries of the system, and including technical aspects for each industry.

Strategies should be proposed to value chain partners, public authorities and final users, in particular to meet expectations in terms of relevant sustainability assessment (e.g. standards, labeling), and create a broad range of options to raise awareness levels and understanding of sustainability. The study should produce recommendations as input for further research and development projects in the field of sustainability assessment.

Collaboration with standardisation bodies should be addressed**.**

The methodology should also address the needs of companies operating in data lean environments.

Funding scheme: Coordination and Support Action

Expected impact:

Identification of best practices over different sectors for environmental and economic sustainability indicators to facilitate cross-sectorial deployment.

Identification of the research needs in this area to achieve a set of environmental and economic sustainability indicators suitable for the process industry.

Identification across the different sectors of the process industry of a set of tools for management and decision making at research lab, plant, company, sector and multi-sectorial level of the process industry.

Preliminary ideas of areas to be covered by NMP in 2015

SPIRE.NMP.2015-1 New adaptable catalytic reactor methodologies for Process Intensification - RTD, TRL 3-5, SMALL

Scope:

The reduction of the number of steps and unit operations in industrial processes is a key factor to achieve process intensification, improve the efficiency in the use of resources, and reduce the impact on the environment. Continuous scalable processes using intensified equipment are key to enable flexible and decentralised production at high process performance.

The research focus should be on the development of new adaptable reactor concepts to reduce the number of process steps and unit operations for industrially relevant processes by the redesign and merging of critical reaction steps and subsequent process steps such as separation and work-up or by allowing new operating windows, which are not accessible using conventional equipment. The design of the corresponding reactor equipment, in close co-operation of the engineering and equipment manufacturing sector with process industries, should be included.

Application areas targeted include new adaptable catalytic schemes for chemical production, which intelligently combine catalytic reactions and separation operations, by using catalytic membrane reactors or catalyst immobilisation strategies to significantly reduce subsequent downstream operations, thereby improving process efficiency. Another area would be the design of reactors and processes allowing for operation at high pressure and/or temperature for a substantially increased space time yield.

The integration and optimisation in relation to full process engineering assessment should also be explored. The impact of the new process solutions should be proven through proper process modelling and assessment and quantified in terms of resource intensity reduction as well as reduction of emissions. Depending on the scale of the industrial processes included in the project it would be beneficial to consider their implementation within modular or containerised set-ups.

Funding scheme: RTD projects.

Expected Impact: Reduction of at least 15% in process energy intensity and material resource use for relevant large volume industrial processes. Reduction of at least 15% in emissions compared to the present state of the art. Significant improvements in the flexibility and productivity of industrial processes.

SPIRE.NMP.2015-2 Energy and resource management systems for improved efficiency in the process industries - RTD, TRL 3-6, SME-targeted

Scope:

Considerable success has been achieved regarding increased manufacturing sustainability in environmental, economic and social terms by sharing resources (e.g. plants, energy, water and residues) through the integration of multiple production units of a single company or multiple companies on a single industrial production site. Nevertheless, a more general cross-sectorial interaction would be needed in order to enable a major impact within the process industry. This could take a long time to achieve and the aim is to pave the way for future cross-sectorial interactions and potentialities in the development of holistic measurements and activities.

Currently, poor understanding of each other's processes is hindering the development of technical and non-technical interactions and exchanges, which are necessary for industry to properly face the challenges. The target is to enable the implementation of a broad variety of technologies and it needs a wide range of disciplines, encompassing fundamental science but also applied knowledge, such as plant engineering and management. The integration into a single management system of all these environmental, energy and economic factors is key for the improvement in efficiency of the process industries.

The proposed research should focus on the following areas:

- Analysis and optimisation tools for flexible energy use and material flow integration should be developed, aiming at a holistic approach for resource management in process industries, suitable both for small and large scale in a flexible approach. To facilitate a proper dissemination and use, it is expected that standards-based software for measuring critical footprint issues and relevant data used into the daily routine of the plants/clusters will be developed.
- Rapid transfer from lab-scale and conceptual design into testing at demonstration sites, using realistic industrial streams and process conditions. Pilot tests should focus on integrated solutions and tools adapted to the specific conditions in real production units. This will facilitate future industrial symbiosis between different sectors, by integrating energy and material flows within existing industrial parks.
- New approaches that perform cost-saving optimisation of energy and resources supply and demand, in order to reduce the residues and costs in intensive industries, taking into consideration both economical and sustainability constraints.

In order to ensure an efficient implementation and maximum impact of SME-related activities, the leading role of the participating SMEs with R&D capacities is expected. The coordinator does not need to be an SME but the participating SMEs should have the decision making power in the project management; and the output should be for the benefit of the participating SMEs and the targeted SME dominated industrial communities.

Prototypes and pilot implementations in real industrial settings represent a clear added-value.

Funding scheme: RTD projects.

Expected Impact:

- Holistic energy and resource management systems should facilitate significant gains in sustainable processing with regard to several parameters (resource efficiency, energy efficiency and the emission performance).
- Optimisation of interdependencies and the identification of technology components allowing for a breakthrough regarding a cost effective reduction in the use of resources, which overcomes the difficult cross-company collaboration.
- Optimisation of energy and resources supply and demand in selected areas should reduce the overall costs in energy intensive industries by at least 15%, by taking into consideration both economic and sustainability factors.

SPIRE.NMP.2015-3 Recovery technologies for metals and other minerals - DEMO, TRL 6-7

Scope:

Metals and other minerals such as non-ferrous and ferrous metals, ceramics, glass industries, cement and chemicals are utilised in numerous applications in many industrial sectors. Their demand, in particular those used in very specialised applications, will increase in the coming years. Therefore, the development of processes for an effective and efficient recovery of these materials, from primary sources or waste streams of the current industrial processes, has become key due to their increasing scarcity. Development of such novel integrated recovery processes should result in increased resource efficiency and sustainability for the European industry, allowing the recovery of significant amount of metals and other minerals, even from low concentration streams. This should lower the dependency on imports of these materials, sheltering Europe from possible shortages in supply and allowing to reduce the production costs and environmental impacts.

Major improvements in separation processes are needed to achieve an efficient and cost effective recovery from the different streams in the process industries.

In this respect, new approaches combining several existing techniques (e.g. precipitation, adsorption, and extraction) or new alternative solutions could provide a cost-effective way to achieve major improvements in the efficiency of recovery operations for metals and other minerals, leading to waste reduction and minimising the environmental impact of industrial operations.

The proposed solutions should also have potential for integration in the current industrial scenario, and should be suitable for different sectors in the process industry. Therefore, the compatibility of the technologies with currently existing plants (essential taking into consideration the capital intensive nature of some industrial sectors involved) also needs to be considered.

Demonstration activities should focus in the following research areas:

- Novel and innovative solutions for technologies for minerals and metals recovery from waste solid, gaseous and liquid streams.
- Development of new approaches for the design and scale up of industrial processes. In particular, these innovative approaches should regard the primary process and the downstream separation as one single, integrated process aimed at designs that maximise not only productivity, but also resource efficiency.
- The proposed solutions should be easily integrated with the currently existing plants/technologies, taking into account the capital intensive nature of some relevant industrial sectors, providing tools for the design of such units and their integration with primary processes.

The projects selected under this topic are expected to carry out demonstration activities in industrial environments aimed at proving the industrial relevance and feasibility of the proposed technologies.

Funding scheme: Demonstration projects

Expected impact:

- Proof of economic and industrial feasibility for the proposed technologies in the process industries and showing the real potential for reducing dependency from imports.

- Life Cycle and Cost Assessments for the technologies developed.
- Significant impact on the resource efficiency of industrial sectors leading to a 40% increase in recovery of materials suitable for reprocessing compared to conventional processes.
- Enhanced sustainable industrial processes, shorter time to market and higher production capacity.
- Support to retention and creation of jobs in the European process industries and strengthening of the competitiveness of the European industry.

SPIRE.NMP.2015-4 Novel Technologies for Processing of currently unexploited resources RTD, TRL 4-6, LARGE

Scope:

Europe imports most of the fossil resources (crude oil and natural gas) needed for production of fuels, energy and petrochemical products. The current scenario is becoming highly unsustainable, making it difficult for an increasing number of industrial sectors to operate in Europe, especially for the high energy intensive ones.

The recent technological advances together with the rising price of fossil resources have resulted in renewed interest towards utilisation of previously unexploited and until now non-economically viable resources (e.g. shale gas, gas hydrates, etc.). Currently, a number of initiatives for the development of technologies for the processing of these resources have been launched by several countries (in Europe and beyond).

The criticality of resources and energy prices for the European industry makes it essential to obtain a better understanding of the availability, sustainability and exploitability of such potential resources. Therefore, it is also critical to gain a deeper understanding of the environmental impact of the currently available recovery technologies and the long term impact and sustainability of the utilisation of these "unexploited resources". The development of advanced technologies for processing of such "unexploited" resources could pave the way to their wider sustainable utilisation. This would benefit Europe by ensuring a safe alternative to current fossil fuels and therefore a decreased dependency on imports for Europe, leading to a more stable supply and price stability in the medium-long term.

Proposals submitted under this topic should develop novel technologies for the processing of unexploited resources present in Europe. The proposed technologies should enable economically viable solutions for processing of significant amounts of such resources, contributing to offset Europe's dependency on imports. The outputs generated should be suitable for further processing in existing plants and provide clear advantages over the available technologies in terms of recovery efficiency and environmental impact. The proposals are expected to provide details on the technological and economic feasibility of the technology for full scale plants. They must also provide a thorough assessment of the environmental sustainability of the proposed solutions, as well as of the long term impact of the exploitation of such resources.

The projects selected under this topic are also expected to carry out demonstration activities at pilot plant scale proving the industrial feasibility of the proposed technologies and providing a proof of concept for further up-scaling.

Funding scheme: RTD projects

Impacts:

Novel processing and refining technologies for currently unexploited resources (e.g. shale gas, gas hydrates, etc.) that could lead to the use of significant amounts of such resources as alternative to fossil fuels. Thorough economic and environmental assessment for short and long term effect of exploitation of the resources (greenhouse gases, underground aquifers, etc.). Increased competitiveness of the European industry, through the steady supply and stability of prices. New

engineering know-how in relation to extraction technologies for "novel" resources. Support to the retention and creation of jobs for the European process industries.