European Innovation Partnership on Raw Materials

Application for a Raw Materials Commitment

**Recycling Of Secondary raw materials for a sustainable optimization of construction processes in civil Engineering**

Acronym:
ROSE

Links to the Strategic Implementation Plan:
- **I. Technology Pillar**
  - **I.A Priority Area: Raw materials research and innovation coordination**
    - Action area n° I.1 Improving R&D&I coordination in the EU
      - 3) Collaboration between Raw materials community and society
      - 4) Research and innovation platforms
  - **I.B Priority Area: Technologies for primary and secondary raw materials’ production**
    - Action area n° I.4: Processing and refining of raw materials
      - 1) Innovative and flexible processing
      - 3) Paper waste processing
    - Action area n° I.5: Recycling of raw materials from products
      - 3) Construction and demolition (C&D) waste recycling
- **II. Non-Technology Pillar**
  - **II.A Priority Area: Improving Europe's raw materials framework conditions**
    - Action area n° II.1: Minerals Policy Framework
      - 4) Explore how to manage mining waste as a resource
      - 6) Encourage to translate policy/information into appropriate language(s)
  - **II.B Priority Area: Improving Europe's waste management framework conditions and excellence**
    - Action area n° II.5: Optimised waste flows for increased recycling
      - 2) Landfill ban for recyclable waste and incineration ban for certain waste
  - **II.C Priority Area: Knowledge**
    - Action area n° II.8: EU Raw Materials Knowledge Base
      - 2) Data input and EU / global standards for interoperability with national databases and other relevant databases
    - Action area n° II.10: Optimised raw materials flows along value chains
      - 1) Raw material partnerships

Objectives of the commitment:
The goal is to increase the use of Secondary Raw Materials (SRM) in construction engineering processes. The SRM the commitment intends to work on are: mining and quarrying tailings, construction and demolition waste, fly ash, paper mill waste, yarn mill waste, textile fibre waste, plastic waste. A proper combination of these SRM will be treated and processed to develop innovative solutions with added economic value for geotechnical, structural and functional applications. Most of the proposed activities have already been studied and tested at a research level (lab or small scale models). The objective is to foster a virtuous process of industrial application at EU scale, putting together multidisciplinary academicians, waste producers, recycling companies, socioeconomic researchers and stakeholders to prepare and test new environmentally compatible products to be introduced into market.

**Description of the activities:**

The activities will be focused on the development of new materials and technologies for geotechnical, structural and functional applications. Particular attention will be paid towards the valorisation of SRM through chemical and physical treatments of inorganic and organic components. The combination of different typologies of SRM will be considered with the aim of taking advantage of specific properties of the individual components through a multidisciplinary approach. As a result of the activities, pilot plants will be realized in specific Working Areas (WA) focusing on TRL6-7. The 6 WAs will be the following:

- **WA1:** Mining and Quarrying tailings (Actions: I.1.1, I.1.3, I.1.4, I.4.1, II.1.4, II.1.6, II.5.2, II.8.2, II.10.1). These tailings are currently landfilled for the largest part (it accounts for about 25% of all waste generated in EU). Treatment and stabilization (according to Directive 2006/21/EC) with traditional techniques (for instance with lime) or with the innovative ones will be implemented (with recycled fibrous raw materials, fly ash and geopolymers) by means of laboratory and site applications.
- **WA2:** Construction and demolition waste (Actions: all those specified above in WA1 + I.5.3). It accounts for about 30% of all waste generated in Europe. Consists of numerous materials such as concrete, asphalt, bricks, gypsum, wood, glass, metals, plastic, soil and dredged spoil. Many of them can be recycled, but separation at source is a critical issue. Novel technologies and procedures will be developed to optimize the recycling/re-use procedures. Specific construction components will be manufactured with construction and demolition waste (chemically modified or not), e.g. barriers, pavements, panels.
- **WA3:** Fly ash produced in coal burning factories (Actions: all those specified above in WA1). This production is close to 40 Mtons/year in EU, only partly reused. Use of fly ashes as binder in soil improvement techniques or in other civil engineering applications, to partially replace traditional binders (Portland cement or lime), will be implemented. Tuning of chemical composition, lab and in situ tests.
- **WA4:** Paper mill waste (Actions: all those specified above in WA1 + I.4.3). In the paper recycling process, a recycle paper mill waste is produced, usually landfilled or incinerated. The goal is to obtain a breakthrough by modifying the wastes with precursors of inorganic phases, in order to obtain organic-inorganic adducts or hybrid systems to be used in the formation of compact or foamed organic-inorganic products with enhanced mechanical and functional properties (i.e. thermal, acoustical insulation).
- **WA5:** Yarn Mill Waste or Textile Fibre Waste (Actions: all those specified above in WA1). The residual or secondary textile fibre waste (TFW) in the yarn production have little value and are difficult to dispose. The objective is to recycle TFW to make structural elements (bricks, panels), or to reinforce soil embankments or slopes in a compatible way. This can be done either by using dispersed fibres into the soil or by creating planar reinforcements with the fibres (e.g. geogrid, geotextiles).
WA6: Plastic waste (Actions: all those specified above in WA1). The idea is to implement innovative technological and sustainable approaches to make different plastics compatible for the production of fibre and sand shape materials, to be used to produce structural elements (bricks, panels) and, when environmentally compatible, to reinforce soil embankments.

**Description of the expected impacts:**

Construction, mining, quarrying and manufacturing activities are, in order of importance according to quantity, the major sources of waste (about 60%) in the European Union. About half of the total amount of waste produced in the EU-28 is disposed (either land filled, land treated or released into water bodies). Furthermore cement production has severe environmental impacts, using vast amounts of fuel (usually fossil fuels) and being responsible for the emission of as much as 5% of all CO2 worldwide. The expected impacts of the activities of the proposed commitment are:

- Environmental impacts: 1) Reduction of waste disposal; 2) Reduction of the cement used in some structural and geotechnical application; 3) Increasing recycling rate.
- Economical impacts: 1) Recovery of secondary raw materials needed in the civil applications from industrial, building and manufacturing activities; 2) Reduce the waste produced by enterprises and/or increase their business by reusing wastes in different civil engineering application. 3) Creation of new innovative products to widen enterprises’ business.
- Social impacts: 1) Create new job opportunities; 2) Increase environmental and health protection; 2) Improve the collaboration in EU in the raw material community (academia and enterprises), authorities and stakeholders; 3) Facilitate the transfer of the best research and innovation practices to different regions of the EU with the essential help of the involved stakeholders.

**Expected innovation outcomes:**

- New products to the market
- New processes
- New technologies
- New ideas to the market

**Comments:**

The academic and research partners (from 7 different countries) have skills in geotechnical, structural, chemical engineering and in materials science and technology. Their theoretical and experimental expertise will constitute the basis of different innovative processes. The non academic partners are:

- 7 large companies (KGHM POLSKA MIEDŹ S.A., ENEL, Greenbet Polska S.A., Mota Engil, Katowicki holding, Teixeira Duarte, Keltbray);
- 6 SME (AGS, RC Vedelago, Technital, I.P.S, FORMIT, LOTUS);
- 6 stakeholders (Campania Region, Veneto Region, Legambiente, CCDR-N, APA, Katowicki holding).

**Name of the coordinating organisation:**

STRESS scarl

**Country:**

Italy

**Entity profile:**

Other

**Other:**

SMRO (Consortium among private companies and public research institutions including: University of Naples Federico II, CNR, AMRA)

**Role within the commitment:**
STRESS is involved in all the 6 Working Areas (WAs). It will play a role in developing the solutions from the laboratory testing of prototype processes to verification of integrated prototype systems (TRL 4-7) developed by the industrial patners. STRESS will also coordinate network activities among all the partners and will contribute to the industrial application of the new products and to the realization of the pilot plants.

Other partners:

Name of partner: A.G.S. - Advanced Geotechnical Solutions
Country: Italy
Entity profile: Other
Other: Private sector – SME; Spin-Off University of Cassino and Southern Lazio
Role within the commitment: AGS will enhance and verify advanced techniques for the reuse of dredged sediments, by desiccation and stabilization with quicklime and fly ashes. Projects will be developed with the other partners to integrate the soil treatment methodologies in standard construction processes, controlling their effectiveness by means of laboratory investigations and in situ tests (WA2, WA3).

Name of partner: Centro Riciclo Vedelago Srl
Country: Italy
Entity profile: Private sector - SME
Role within the commitment: The center will participate in the definition of the general strategies of Commitment to transform waste in second raw material. Following the Research Centre’s indications the industrial plant will be used to produce new polymers aggregates generated from plastic waste. The secondary raw material will be analyzed and tested in pilot applications to evaluate the potential outcomes in the market (WA5, WA6).

Name of partner: Technital S.p.A.
Country: Italy
Entity profile: Private sector - SME
Role within the commitment: The company is an engineering consultancy firm, involved in design of ports, roads, hydraulic works, tunnels as well as environmental impact assessment services. The company has been involved in design of large port infrastructures with major dredging and reclamation volume balances. The company will cooperate in the commitment ensuring connection with construction
Name of partner: I.P.S. s.r.l.
Country: Italy
Entity profile: Private sector - SME
Role within the commitment: I.P.S. will operate in the recovery and recycling of materials from demolition, excavation, and asphalt milling. The company is equipped with an up-to-date plant (ISO 14001 and ISO 9001 certified). The new products that the commitments aims to obtain from C&D waste will be verified and eventually subjected to CE marking according to EN13242 standard (WA2).

Name of partner: FORMIT, Fondazione per la Ricerca sulla Migrazione e Integrazione delle Tecnologie
Country: Italy
Entity profile: Private sector - SME
Role within the commitment: FORMIT will perform technological, financial and socio-economic evaluations for market foreword of new products. With reference to selected actions, FORMIT will coordinate a Stakeholders Board for supporting the reliability and the exploitation of proposed solutions; perform an assessment of potential market opportunities; carry out studies on models and best practises to give support to public policies definition (all WAs).

Name of partner: ENEL INGEGNERIA E RICERCA S.P.A.
Country: Italy
Entity profile: Private sector - large company
Role within the commitment: ENEL ENGINEERING AND RESEARCH will lead to the development and demonstration of industrial processes of re-use of ash and gypsum obtained from thermal power generation and their application in new products (WA3).

Name of partner: ENEA – Italian National Agency for new technologies, Energy and Sustainable economic development
Country: Italy
Entity profile: Other
Other:
Research institution

**Role within the commitment:**
ENEAA will participate in all activities through: development of materials and composites; modelling and characterization of structural, chemical, physical, mechanical and thermal properties of the considered secondary raw materials; optimization of the recovery and reuse of C&D waste; environmental products certification; recovery of high value added secondary raw materials from fly ashes and tailings (all WAs).

**Name of partner:**
Dipartimento di Ingegneria Civile e Architettura, Università di Pavia

**Country:**
Italy

**Entity profile:**
Academia

**Role within the commitment:**
The University of Pavia will develop numerical models to simulate the response of standard and innovative materials as will come out from the experimental tests carried out also by other partners. The models will be aimed to the simulation of structural behaviors for complex loading conditions. (WA1, WA2, WA3).

**Name of partner:**
Legambiente Campania Onlus

**Country:**
Italy

**Entity profile:**
NGOs

**Role within the commitment:**
Legambiente Campania Onlus will: • carry out benchmarking to identify sustainability best practices that can establish decision-making guidelines for the Raw Materials Commitment; • facilitate interaction between organizations belonging to the sectors of production, research, ong, public administration and the RMC team; • promote the achievements of the RMC and the related opportunities. (all WAs)

**Name of partner:**
Campania Region – Affari internazionali e rapporti con l’Unione Europea

**Country:**
Italy

**Entity profile:**
Governmental/public body

**Role within the commitment:**
Campania Region is a policy maker interested in all the EU initiatives related to reduction of landfilling and promotion of recycling. Campania Region will participate to: the definition of lists under relevant EU legislation of waste categories that are to be banned from landfill and incineration; the definition of common classification of recovered material to facilitate industrial activities; the clarification of the status of used recycled materials as secondary raw
materials in the EU legislation and national standards (all WAs).

**Name of partner:**
Veneto Region - Dipartimento Ambiente  
**Country:**  
Italy  
**Entity profile:**  
Governmental/public body  
**Role within the commitment:**  
Veneto Region (RV), consulting industrial, economic and recycling operators, is a policy maker aimed fostering materials recycling and recovery (present recycling outcomes of RV outmatch the European directives targets). It will sustain all actions related to reduction of landfilling and promotion of recycling, in order to obtain a clearcut technical and legal framework for waste recovery in an environmentally sound and sustainable way especially for C&D and plastic wastes (all WAs).

**Name of partner:**
Belgian Building Research Institute (BBRI)  
**Country:**  
Belgium  
**Entity profile:**  
Private sector - large company  
**Role within the commitment:**  
foster the re-use of waste in manufacturing of materials including testing their properties; working out solutions to be implemented in constructions (reuse in foundations, load transfer platforms, embankments, reinforced soil, soil improvement); development of innovative measurement techniques to monitor new applications (small/real scale); evaluate technical solutions in terms of LCC/LCA; characterize and manage the waste chain (WA1, WA2, WA3, WA4)

**Name of partner:**
Lotus Synthesis SAS  
**Country:**  
France  
**Entity profile:**  
Private sector - SME  
**Role within the commitment:**  
Lotus will cooperate in: surface functionalization of waste materials by nano-particles and addition of novel functionalities with the aim of developing products with added value for the construction sector; development of formulations and of guidelines for the application of nanocomposite/ nanostructured materials in depositing technology (WA3, WA4, WA5).

**Name of partner:**
Institut des Matériaux de Nantes Jean Rouxel - CNRS  
**Country:**  
France
The center will promote the use of natural material in Civil Engineering with a coupled approach between physico-chemical investigations and macroscopic measurements in order to understand how the reactivity at lower scale (silicon or aluminium environment in clay layers) modifies the microstructure and the mechanical resistance of materials (natural soils, sediments, steel slags, stabilized or not with lime and/or cement) (WA1, WA3).

LEMTA is specialised in the field of geomechanics and geoenvironmental engineering, with strong experiences in coupled multiphysics issues. LEMTA will study the very long term behaviour of new materials when treated with lime, cement, fly ash submitted to cyclic wetting/drying, thermal cycles. It will participate/lead projects promoting use of raw materials in construction through advanced experimental testing and constitutive modelling (WA1, WA3).

Keltbray is a leading provider of demolition and groundworks services. We will cooperate to the development and use of innovative products obtained with recycled raw materials reducing waste to landfill. Keltbray are already collaborating with City University London on the reuse of demolition waste in working platforms for tracked plant and this work could be expanded to enable use in more permanent applications. (WA1, WA2).

City University will explore uses for demolition waste in geotechnical structures and in
concrete. We are already investigating the use of demolition waste for working platforms for tracked plant, although this work currently has a safety focus. We will develop this work to encompass sustainability aspects. We will look at characterising, enhancing and optimising material properties of demolition waste and large scale testing both in the laboratory and on site (WA2).

Name of partner: University of Bristol  
Country: United Kingdom  
Entity profile: Academia  
Role within the commitment: Because of the previous extensive research experience in reinforced soils, the University of Bristol will guide the selection, testing and design of raw materials for being reused as fibres and/or geotextiles for civil engineering applications, through a knowledge transfer process from academia to industrial partners. (WA5, WA6).

Name of partner: University of Cambridge  
Country: United Kingdom  
Entity profile: Academia  
Role within the commitment: Collaborative research and knowledge transfer between the participating organisations on raw materials as they relate to civil engineering applications and in particular geotechnical, environmental and construction engineering: resources, carbon footprint, applications, sustainability, performance, field applications, commercialisation and innovation (WA3, WA5, WA6).

Name of partner: Imperial College London  
Country: United Kingdom  
Entity profile: Academia  
Role within the commitment: Provision of materials processing expertise to transform waste materials into value added products in the fields of low carbon construction, sustainable materials, supplementary cementitious materials, lightweight aggregate, cenospheres and geopolymers. This will include developing reuse applications for residues from combustion, including incinerator bottom ash, paper sludge ash, sewage sludge ash, construction and demolition waste, tunnel spoil and silt (WA2, WA3, WA4, WA5, WA6).

Name of partner:
KGHM POLSKA MIEDŹ S.A., Oddział Zakład Hydrotechniczny (Hydrotechnical department)

**Country:**
Poland

**Entity profile:**
Private sector - large company

**Role within the commitment:**
- Production of mining waste and processing to select the appropriate fractions to be recycled
- Cooperation in research and investigations on waste mechanical and chemical characterization
- Analysis and realization of documentation as well as organization of meetings on the Zelazny Most tailings pond (WA1).

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**Name of partner:**
KATOWICKI HOLDING WĘGLOWY S.A.

**Country:**
Poland

**Entity profile:**
Private sector - large company

**Role within the commitment:**
Katowicki Holding Węglowy S.A. is interested in the environmental problems and willing to enhance the reuse of secondary raw materials (all WAs).

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**Name of partner:**
GREENBET POLSKA S.A.

**Country:**
Poland

**Entity profile:**
Private sector - large company

**Role within the commitment:**
- Developing recipes based on combustion by-products, preparation of test samples
- Design of installation for the production of materials based on combustion by-products
- Certification of compliance with standards for materials based on combustion by-products (WA3).

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**Name of partner:**
The Silesian University of Technology, Faculty of Civil Engineering, Department of Geotechnics and Roads

**Country:**
Poland

**Entity profile:**
Academia

**Role within the commitment:**
- Geotechnical/chemical and structural analysis of micro- and macrostructure of soil-fly ash mixtures and soil-fly ash-lime mixtures
- Recommended guidelines to develop acceptable solutions and required engineering properties for mixture groups
- Creating techniques for validating the selection of the stabilizer through mixture design and testing
- Preparing needed information for stabilizer selection (fly ash, tailings) and validation of that selection through
mixture design and field testing (WP1, WP3).

Name of partner:
University of Life Sciences in Poznan - Dept. of Geotechnics at the Institute of Construction and Geoengineering
Country:
Poland
Entity profile:
Academia
Role within the commitment:
In situ and laboratory tests on tailings • Bearing capacity research and observation of tailings behaviour under load in natural scale on the functioning pond • Formulating proposals for changes in depositing technology • All investigations conducted on the Zelazny Most tailings pond with the approval of KGHM PolskaMiedz • Construction of embankments, roads and secondary use of closed ponds of non-ferrous metals, copper and zinc ore (WP1).

Name of partner:
Mota-Engil Engenharia S.A.
Country:
Portugal
Entity profile:
Private sector - large company
Role within the commitment:
Mota-Engil is the leader of the construction industry in Portugal (in the ranking of the 50 largest European construction groups). The company generates large amounts of waste usually landfilled, while it consumes large quantities of raw materials every year. We will contribute to the development/testing of alternative materials in order to achieve technical, economic and environmental benefits (WA1, WA2, WA3, WA4, WA5).

Name of partner:
Teixeira Duarte Engenharia e Construções S.A.
Country:
Portugal
Entity profile:
Private sector - large company
Role within the commitment:
Teixeira Duarte is a construction company and its role in the RMC is targeted to the construction industry, particularly to the geotechnical and foundations sector and focused on the application of new products derived from recycle/reuse of natural aggregates and industrial by-products. Thus, Teixeira Duarte’s commitment goes toward construction waste for geotechnical systems identification, associated with the use of industrial by-products as a binder replacement as well as demonstration activities for the implementation of these systems (WA1, WA2, WA3, WA4, WA5).

Name of partner:
National Laboratory of Civil Engineering (LNEC – Laboratório Nacional de Engenharia Civil)
Country: Portugal

Entity profile: Other

Other: Public organization - Research Laboratory

Role within the commitment:
LNEC will study environmental and hydraulic properties of materials. In the area of environmental properties it will perform leaching, diffusion and pollutant transport tests and determining the content of inorganic chemical species in material. Concerning physical and mechanical properties it will perform, respectively, durability tests and deformability tests at high-pressure oedometer cells. It will develop guidelines for the application of material (WA1, WA2, WA3).

Name of partner:
University of Porto – Faculty of Engineering (FEUP)

Country: Portugal

Entity profile: Academia

Role within the commitment:
FEUP is currently working on the following types of waste: tailings, construction and demolition, fly ash and paper mill. The geotechnical characterization of tailings for safety analysis will be performed. Design for eco-efficient concrete by using several types of waste such as paper mill and demolition materials will be improved. The alkaline activation of fly ash for soil improvement will be tested, to create a new eco-friendly soil binder (WA1, WA2, WA3, WA4).

Name of partner:
UNIVERSIDADE DO MINHO

Country: Portugal

Entity profile: Academia

Role within the commitment:
The Civil Engineering staff of UMinho (geotechnics and structures) has expertise to contribute to the development of the proposal, which also includes experts from other fields of knowledge (textile, polymers and biology), pivoting around Profs. AG Correia (Tailings), PB Lourenço (Construction and demolition), J Barros (Fly ash), C Lucas (Paper Mill), R Fangueiro (Fibres) and C Bernardo (Plastics). (all WAs).

Name of partner:
North Region Development and Coordination Commission (CCDR-N)

Country: Portugal

Entity profile: Governmental/public body
Role within the commitment:
The North Regional Development and Coordination Commission (CCDR-N) is the Portuguese government agency in charge of coordinating economic development, territorial and environmental policies in North region, being also in charge of the regional innovation strategy specialization (RIS3), the preparation of the Regional Operation Program and its management in the 2014-2020 framework.

Name of partner:
Portuguese Environment Agency, Public Institute (APA, I.P)
Country:
Portugal
Entity profile:
Governmental/public body
Role within the commitment:
Within the initiative Raw Materials Commitment, APA, IP in its role of National Waste Authority, and namely in what concerns the fulfillment of management targets foreseen in the waste framework directive for the construction and demolition waste stream for 2020, is very interested in being involved in this process and have the opportunity to contribute to its main goals (all WAs).

Name of partner:
SIK – The Swedish Institute for Food and Biotechnology
Country:
Sweden
Entity profile:
Governmental/public body
Role within the commitment:

Name of partner:
Chalmers University of Technology
Country:
Sweden
Entity profile:
Academia
Role within the commitment:
Upgrading of waste streams from paper-mills industry into biomaterials. Analysis of biomaterial microstructure and functional properties (WA4).

Existing EU contribution:
No

Period to implement the commitment:
Monday, 3 March, 2014 to Thursday, 31 December, 2020