European Innovation Partnership on Raw Materials

Application for a Raw Materials Commitment

**Recycled Carbon Fibres Substitute for Natural Graphite & Industrial Applications**

Acronym: CARBOCYCLE

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
      1) Coordination of industrial initiatives
      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
    - Action area n° I.5: Recycling of raw materials from products
      1) End-of-life products recycling
  - I.C Priority Area: Substitution of raw materials
    - Action area n° I.6: Materials for green technologies
      2) Substitution of CRM in batteries
      3) Substitution of CRM in catalysts
    - Action area n° I.8: Materials under extreme conditions
      2) Substitution of CRM in hard materials

- **II. Non-Technology Pillar**
  - II.A Priority Area: Improving Europe's raw materials framework conditions
    - Action area n° II.1: Minerals Policy Framework
      8) Develop EU guidance on the streamlined application of the EU environmental legislation
  - II.B Priority Area: Improving Europe's waste management framework conditions and excellence
    - Action area n° II.4: Product design for optimised use of (critical) raw materials and increased quality of recycling
      1) Eco-design Directive
      2) Product life extension strategies and development of sustainable circular
business models

3) Critical Raw Materials in product and waste flows

- Action area n° II.5: Optimised waste flows for increased recycling
  1) Qualitative targets
  2) Landfill ban for recyclable waste and incineration ban for certain waste
  3) Waste collection systems and Extended Producer Responsibility (EPR) Schemes
  4) Innovative approaches and infrastructures for reuse and recovery of end-of-life consumer products

II.C Priority Area: Knowledge

- Action area n° II.8: EU Raw Materials Knowledge Base
  1) Appropriate conditions for the development of the EU Raw Materials Knowledge Base (EURMKB)
  2) Data input and EU / global standards for interoperability with national databases and other relevant databases
  3) Raw materials intelligence - methods, tools and analysis
  4) Public data reporting and related expertise and skills
  5) Collaboration with the rest of the world on raw materials information
  6) Improvement of data collection

- Action area n° II.9: Possible EIT Knowledge and Innovation Community
  1) Coverage of network
  2) SME network

- Action area n° II.10: Optimised raw materials flows along value chains
  1) Raw material partnerships

III. International Cooperation Pillar

- Action area n° III.1: Technology
  1) Exploit synergies in R&D with regard to exploration, extraction and processing
  3) Cooperation and best practice sharing in the area of Critical Raw Materials (CRM)
  4) Develop ore metallurgy and processing techniques
  5) Dialogue with technologically advanced countries

- Action area n° III.2: Global Raw Materials Governance and Dialogues
  1) Pursue dialogue with trading partners from an economic point of view
  2) Dialogues with International Study Groups, UNEP International Resource Panel and G20

- Action area n° III.4: Skills, Education and Knowledge
  2) Provide support to establishment of African Mineral Development Centre

- Action area n° III.5: Investment activities
  2) Develop further series of ‘partnership agreements’ related to raw materials

Objectives of the commitment:

Main objective is to define, industrialize and bring to market a Recycling Process for CFRP (Carbon Fibres Reinforced Plastic) at diverse stages of life cycle (Scrap & End-of-Life parts) that represent a resource to substitute Industrial applications and Natural Graphite (NG), a Critical Raw Material currently imported for a portion exceeding 70%, (from a single Country: China), while CFRP Products are just disposed in Landfill.

This objective counts on intermediate targets, namely the screening of NG properties required by current applications, agreements with NG industry, detailed analysis of all applications in Transport, Energy and Retail sectors and finally the development of a recycling business model for CFRP waste at the most relevant sources, sorting for quality and supply availability.
The project includes the development of a production plant to satisfy the full EU needs of NG.

**Description of the activities:**

The Project covers a period of seven years and the detailed description is focused on first two years of commitment. High level of Innovation will be achieved by ensuring the production at industrial scale of a substitute for Natural Graphite from recycled CFRP.

The first set of activities is to establish a consolidated but flexible project management organization for the whole life of the project to ensure consistency and accomplishment of the objectives.

The Engineering Systems approach, matured in the Aerospace Industry, will be transferred to Recycling, hence allowing to define methodologies for the best processes, with the final target to guarantee that the resulting graphite substitute achieves the expected characteristics, including quality and availability of supply.

Same approach will ensure the best pilot and production plant design, ensuring flexibility during construction and in operation, through the set up of a modular design flexible enough to be escalated from lab-scale up to production plant size. Consortium will guarantee to the market the required quantities depending on demand forecast and criticality of supply, taking into account the market evolution to be absorbed through the modular design, so to minimize the risk.

The Consortium will engineer, manage and optimize the entire recycling logistic and supply chain for the input CFRP material. The success on this critical activity will allow achieving a sustainable and successful innovation, bringing the technological developments from the realm of research to the market. This activity requires a deep understanding of the logistics needed together with the skills and expertise to set up the supply chain, that the Consortium posses.

A preliminary assessment and mapping has already been carried out to ensure feasibility.

Furthermore, a deep understanding of the input material characteristics is mandatory. Consortium will carry out laboratory tests based on a wide selection of samples from potential suppliers to determine the physical, chemical and macroscopic characteristics of the materials, as input for the subsequent processing phases. Consortium incorporates actual manufacturer of Natural Graphite in order to define and standardize specification(s) for the desired output product(s) to meet current needs and to improve performance of existing materials.

Process core development will follow, with the final objective of delivering a full scale industrial plant (targeted to 50 K tons/yr).

A description of the first 2 years main activities includes:

a) Recycling Processes State of the Art assessment, currently ongoing;
b) Process parameters identification in order to apply the proven Selection Methodology and ensure the most suitable process in terms of performance, reliability, quality, output, energetic efficiency and environmental integration;
c) Lab-scale testing of the most promising technologies;
d) Pilot plant design.

Final achievement will be the Industrial Plant development and building, as well as process
optimization, with focus on innovation and target to reach the market at Project deadline or in advance, as requested by investors and market itself.

The urgency to reach the market is suggested by the exponentially growth of CFRP demand, the increasing public repulsion to landfill, the actual economic dependency from import of Natural Graphite and the supply risk, requiring immediate action.

Business Plan is available and object of successful presentations and current negotiations with Private and Public Investors, proving the Business Model validity.

**Description of the expected impacts:**

Security of supply of critical raw material for European industry:
European Graphite Consumption is around 70,000 tons per year. 70% of which is imported from China.
The Industrial Plant development targeted by the Project will be able to satisfy the EU needs of Natural Graphite, reducing or nullifying European Import Dependency of a Critical Raw Material.

Enhance Industry environmental sustainability:
the analysis of the whole CFRP products life cycle will allow to move from the actual non-sustainable practices (i.e.: landfilling of the manufacturing scrap) to the conversion of waste into a resource substituting graphite and bringing to market a performance-competitive recycled material for several other applications.
End-of Life Complex products will be converted into eco-designed products.

The Project will target Zero Waste by 2020 for CFRP products setting standards for Waste Management Industry and providing alternative to Landfill for end-of-life Materials

Improve EU competitiveness through development of industrial technologies related to recycling of complex materials and products leading to European jobs creation:
Creating an innovative industrial process for the extraction of graphite from the CFRP waste through the transnational cooperation between the Industry, Research Centers, SME’s, Universities and clients.
This will result in the creation of technological knowledge, value, competitiveness and job development pushing Europe to the forefront in raw materials.

The Project will increase the integration between Consortium Partners, the transnational and cross-sectorial cooperation allowing a very high TRL; a matter of fact, Consortium target is clearly the Market.

The Business Model is fully scalable to every industry sector.

**Expected innovation outcomes:**

New products to the market
New processes
New services
New technologies
New business models
New ideas to the market
Societal innovation
Other

**Comments:**
The Project will allow the improvement of actual recycling practice, targeting Zero Waste by 2020 for Carbon Fiber Reinforced Plastic and providing alternative to Landfill for end-of-life CFRP Materials. The recycled Carbon Fibers will serve both as substitute of natural Graphite and as new application on existing products in Energy and Transport Industries, with unlimited option on every Industry Sector, guaranteeing Scalability.

**Name of the coordinating organisation:**
ITRB
**Country:**
Cyprus
**Entity profile:**
Private sector - SME
**Role within the commitment:**
- Project management and Systems Engineering
- Operations
- Supply chain
- Quality
- Plant Engineering
- Product Manufacturing Engineering
- Integration of activities among partners and follow up of the overall program as well as major role in supply chain set up, plant design and operations and marketing of resulting products.

**Other partners:**

**Name of partner:**
Fraunhofer Institute for Chemical Technology (ICT)
**Country:**
Germany
**Entity profile:**
Other
**Other:**
Research and Development
**Role within the commitment:**
As core partner Fraunhofer ICT (FhG) will contribute to project management work and Dissemination activities. Furthermore FhG will support the market survey and will be responsible for CFRP-treatment technology evaluation and develop the technology selection methodology. Furthermore FhG will incorporate natural graphite substitute into different applications such as composites or graphite electrodes energy for storage systems.

**Name of partner:**
CIDAUT
**Country:**
Spain
**Entity profile:**
Other
**Other:**
FOUNDATION Research CENTRE
**Role within the**
commitment:
Along the project CIDAUT will contribute to Management and Dissemination task, although mainly it will be focused on materials characterization and processing. The expertise in the field of Recycling will allow CIDAUT give support in the next activities of the project • Fiber, Subproducts and component Characterization • Subproduct Valorisation analysis and design of new applications • Sampling and Composites/Products Manufacturing and its Characterization

Name of partner:
PBLH
Country:
Belgium
Entity profile:
Private sector - SME
Role within the commitment:
PBLH will be the main entity working on Dissemination Work Packages 4 and 5. It is a well-established Brussels based consulting company specialised in providing technical support in different fields to the European Commission. PBLH International Consulting SPRL will be responsible of securing the communication both internally and externally of the Consortium. Different means are put in place to make benefit the project from its previous experience managing + EUR Million projects with important budgets in Communication. Besides the communication WP, PBLH will ensure the appropriate dissemination to third parties including the European Commission, private sector and academic.

Name of partner:
Universidad Europea de Madrid
Country:
Spain
Entity profile:
Academia
Role within the commitment:
Valorisation of recycled Short Carbon Fibers and Powders with appropriate high added value matrices both ceramic and metallic, as well as polymeric, for high temperature and noble applications.

Existing EU contribution:
No

Period to implement the commitment:
Monday, 14 April, 2014 to Thursday, 31 December, 2020