Application for a Raw Materials Commitment

**Breakthrough Solutions for the Sustainable Harvesting and Processing of Deep Sea Polymetallic Nodules**

*Acronym:*  
Blue Nodules

**Abstract / executive summary:**

The strategic aim of Project Blue Nodules is to provide breakthrough solutions that will bring to reality an industrially viable and sustainable deep sea mining value chain for raw materials contained in polymetallic nodules. To achieve this, Blue Nodules will develop and prove concept and feasibility.

This technological capability will open the way to the next steps, i.e. system prototype demonstration in real environment (TRL7) and system completed and qualified (TRL8).

**Links to the Strategic Implementation Plan:**

- **I. Technology Pillar**
  - I.B Priority Area: Technologies for primary and secondary raw materials’ production
    - Action area n° I.3: Innovative extraction of raw materials
      - 1) Automated mining
      - 4) Deep-sea mining
  - III. International Cooperation Pillar
    - III. International Cooperation Pillar
      - Action area n° III.1: Technology
        - 1) Exploit synergies in R&D with regard to exploration, extraction and processing

**Coverage of the Action Areas referred to above:**

I.B.I.3.1 & I.B.I.3.4  
Blue Nodules will develop a new highly-automated and technologically sustainable deep sea mining system for harvesting of polymetallic nodules in the seabed at water depths 3,000 – 6,000 metres. Project features are amongst others the in-situ processing of the nodules, i.e. sediment separation and crushing/sizing and excellent, intrinsic safe working conditions. Special attention will be paid to a minimum environmental impact and compliance with the relevant policies and regulations. The project aims will demonstrate TRL 6 sea-bed operation of autonomous system for nodules harvesting...
and Sea-bed sediment separation.

III.1.1
The project consortium with key stakeholders covering the value chain, hereby matching obtained solutions with market conditions. Blue Nodules addresses the interlinked technological, economic and environmental issues related to deep sea mining. Core members of the Blue Nodules consortium have already dealt in part with these issues within in-company, national and the on-going EU projects Blue Mining and MIDAS and JPI Oceans Pilot Action “Ecological Aspects of Deep-Sea Mining”.

**Objectives of the commitment:**

Blue Nodules specific research/technological objectives, main innovations and key results are:

1. The knowledge, advanced models, design methodologies and technologies (TRL6) for a full scale deep sea mining system for polymetallic nodules consisting of the nodule collector, umbilical and jumper hose;
2. The knowledge and advanced models for building and assessing of business cases representing the entire value chain of polymetallic nodules;
3. The knowledge and advanced models and methodologies for determining the overall environmental impact of the deep sea mining of polymetallic nodules in water depths up to 6,000 metres.

**Description of the activities:**

1) Set the functional requirements and assess the performance of the developed deep sea mining system for polymetallic nodules within the context of a realistic and technical, economic and environmental balanced business case.

2) Development and testing of the essential components for the harvesting of polymetallic nodules to a TRL4 to TRL6.

3) Determination of the properties and characteristics of the mined material in every stage of the process flow and the development of near-situ separation, measurement and comminution systems.

4) Design and development of reliable and sufficient sea surface facilities, offshore and onshore operations for the processing and storage of the polymetallic nodules, the process water and the tailings.

5) Identification, quantification and evaluation of environmental pressures of deep-sea polymetallic nodule harvesting, processing, and transport

**Description of the expected impacts:**

1) Blue Nodules develops the technological capabilities up to TRL6 for industrially-viable and sustainable mining and (in situ) mineral processing of polymetallic nodules in European and international waters from 3,000 to 6,000 m WD and up to sea state 6 conditions. This opens the way to system prototype demonstration in real environment (TRL7) and system complete and qualified (TRL8). Successful completion of these steps leads to technology leadership, improved competitiveness of the EU mining sector and access to (critical) raw materials. Envisaging to become a global player within 5-10 years;

2) Blue Nodules contributes to environmental and socially important impacts by opening up the possibilities for a) new mineral resources (polymetallic nodules) with significantly low severe
ecological impact, b) sustainable highly automated technology for remote and efficient operations that can be retrieved and moved to other mining locations and c) the creation of numerous attractive jobs with excellent working conditions in deep sea mining and equipment manufacturing industries.

**Expected innovation outcomes:**
- New products to the market
- New processes
- New services
- New technologies

**Name of the coordinating organisation:**
IHC Mining B.V.

**Country:**
Netherlands

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

**Role within the commitment:**
- Set functional requirements and assessment of the deep sea mining system
- Develop and test collector, propulsion system and tailings and water management systems
- Develop near-situ separation, measurement and comminution systems
- Design and develop sea surface facilities, define mining vessel layout and transfer at sea
- Coordination of the project

**Other partners:**

**Name of partner:**
Dredging International

**Country:**
Belgium

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

**Role within the commitment:**
- Define sea surface and land operations and processes
- Define initial design requirements
- Develop logistics, technology and equipment for minerals handover (ship-to-ship and ship-to-shore)
- Provide relevant operational experience

**Name of partner:**
ContiTech Rubber Industrial Kft

**Country:**
Hungary

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

**Role within the commitment:**
- Specify and develop the flexible subsea risers used to transfer ore/slurry from the crawler to the vertical transport riser, to include development of connector technology
- Specify and develop the flexible hose lines used to transfer ore/slurry from the mining vessel to the transport barge
Name of partner: IHC MTI  
Country: Netherlands  
Entity profile: Private sector - large company  
Role within the commitment:  
- Provide deep sea mining system technical information for the EIA  
- Assist with tests work done and assist with plume source simulation  
- Develop dynamic models

Name of partner: De Regt Marine Cables  
Country: Netherlands  
Entity profile: Private sector - large company  
Role within the commitment:  
- Design and develop the main lift umbilical and tether

Name of partner: Uniresearch B.V.  
Country: Netherlands  
Entity profile: Private sector - SME  
Role within the commitment:  
- Provide management support for planning, monitoring and control, project administration, reporting and milestone reviews, dissemination and exploitation

Name of partner: Global Sea Mineral Resources  
Country: Belgium  
Entity profile: Private sector - large company  
Role within the commitment:  
- Assess overall value chain, including onshore processing methodologies

Name of partner: Bureau Veritas  
Country: France  
Entity profile: Multi-national organization
Role within the commitment:
- Ensure that the overall business case assessment is legally viable taken due consideration for the environment, technological development and regulatory framework

Name of partner:
The Royal Netherlands Institute for Sea Research (NIOZ)
Country: Netherlands
Entity profile: Academia
Role within the commitment:
- Assess and integrate environmental aspects into business case and technology development - Perform cruise to European destination - Assess environmental pressures of deep-sea polymetallic nodule harvesting, processing and transport

Name of partner:
RWTH Aachen University
Country: Germany
Entity profile: Academia
Role within the commitment:
- Develop a subsea processing system, e.g. crushing and screening system - Develop underwater production measurement system - Develop offshore ore and tailings treatment

Name of partner:
NTNU
Country: Norway
Entity profile: Academia
Role within the commitment:
- Define initial design requirements and design parameters for in-situ seabed processing - Process flow overview from pickup to surface delivery to delivery onshore

Name of partner:
Aarhus University
Country: Denmark
Entity profile: Academia
Role within the commitment:
- Assess and quantify sediment plume generation, local and far field dispersal of plumes and sedimentation as part of the Environmental Impact Assessment using state-of-the-art numerical
Name of partner: Universitat Politècnica de Catalunya
Country: Spain
Entity profile: Academia
Role within the commitment:
- Characterize the noise introduced into the sea by the operations
- Analyze effect on the noise introduced by the operations

Name of partner: Seascape Consultants
Country: United Kingdom
Entity profile: Private sector - SME
Role within the commitment:
- Develop a model Environmental Impact Assessment
- Input of environmental considerations

Existing EU contribution: Yes
Source: Horizon 2020
Period to implement the commitment:
Monday, 1 February, 2016 to Saturday, 1 February, 2020