

EXPRESSION OF INTEREST FOR A HORIZON 2020 PROJECT

**Title of the targeted call for proposals and Topic of interest**

Name of the call: Green Deal – area 8- Zero-pollution, toxic free environment

Topic: LC-GD-8-1-2020 Innovative, systemic zero-pollution solutions to protect health, environment and natural resources from persistent and mobile chemicals

**Contact details**

Country	France
Name of the organisation	Aix-Marseille University (AMU)
Laboratory	Institute of Microbiology, Bioenergies, and Biotechnology (IM2B)
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**Short description of AMU**

Created in 2012, Aix-Marseille University (AMU) is the largest multidisciplinary French-speaking university, resulting from the merger of the University of Provence, University of the Mediterranean and Paul Cézanne University. It welcomes nearly 80,000 students, including 10,000 international students, and 8,000 staff on 5 large campuses of international standards. It has undertaken the HRS4R labelling process since June 2019. AMU is an intensive research university, accounting 121 research structures and 132 research facilities, recognised by its success in several national (labex, equipex, Instituts convergences, RHU, EUR...) or European calls for projects of the H2020 type (AMU is thus the third French institution raising funds under this programme). Since 2019, it has created 15 thematic institutes that are at the crossroads of research and education and in tight interactions with industrial partners and local authorities. The Institute of Microbiology, Bioenergies, and Biotechnology (IM2B) is one of them.

**Laboratories involved**

Four laboratories of the Institute are interested by this area:

- 1) The Bioenergetic and Protein Engineering laboratory (BIP) develops research in the field of bioenergetics of microorganisms, from the molecular to the cellular level. To this end, BIP members study both the catalytic mechanisms that develop within metalloproteins, key actors in cellular bioenergetics, and the evolution of energy conversion systems and microbial strategies for acclimatization and adaptation to environmental changes.
- 2) The Mediterranean Institute of Oceanography (MIO) laboratory develops research whose goal is to

better understand the oceanic system and its evolution in response to global changes. The MIO constitutes a center of expertise in marine biology, ecology, biodiversity, microbiology, halieutics, physics, chemistry, biogeochemistry and sedimentology. Its working environment is the world ocean, alongside its continental, atmospheric and sediment interfaces.

- 3) Biosciences and Biotechnology Institute of Aix-Marseille (BIAM) is interested in the living responses to environmental constraints, the bio-conversion mechanisms of energy and the production of energy-rich molecules (bio-energy). It develops biotechnology to safeguard the quality of the environment and health (biosensing & bioremediation) or to produce biofuels.
- 4) The Laboratory of Bacterial Chemistry (LCB) is specialized in the study of the functioning of the prokaryotic cell taken either as a cellular model or as a testimony to the evolutionary and adaptive richness of the living. Very diverse aspects are explored such as environmental adaptation, metabolism, genetics, evolution, cells communities, biotechnologies.

### **Areas of potential contribution**

#### Ecotoxicology of microorganisms:

The MIO laboratory has experiences in assessing the impact of contaminants on microorganisms using both field and laboratory approaches at the population scale and the community scale. The impact of contaminants on biota (on the first level of the trophic web) are assessed by taking into account the complexity of contamination observed in the environment characterized by mixture of different contaminants (organic and inorganic) often detected at low dose.

BIP, BIAM and LCB laboratories have experiences in assessing the impact of contaminants on metabolism and how microorganisms adapt to their environment. In particular, the BIAM laboratory analyses the response of environmental bacteria to the exposure to radionuclides, in particular Uranium. Studied environmental bacteria are soil's bacteria from uranium-rich environments.

#### Detection of pollutants:

The MIO Laboratory has extensive experience in the identification of microorganisms and microbial ecology studies in marine environments, and has therefore the expertise to identify specific microorganisms for the presence of certain pollutants in marine environments. These microorganisms could then be used as a "biomarker" of a given pollution. Rapid and specific tests based on the detection of these "biomarkers" in biotopes could be used to detect the presence of the considered pollutants.

Regarding toxic metals, the BIAM laboratory has developed expertise to detect bioavailable fraction of toxic metals using protein engineering, protein evolution, and development of ratiometric biosensors.

#### Bioremediation and bioprocesses to remove toxic molecules:

Toward bioremediation strategies, the BIAM laboratory develops mechanistic approaches to understand and predict toxic metal transfer into ecosystems: analysis of the influence of (radioactive)metal speciation in metal uptake into water and in ecosystems, role of microorganisms in metal bioavailability, identification of proteins involved in metal trafficking and chelation. In the same way, the BIP laboratory studies the metabolic pathways related to pollutant uptake, like arsenic, chromium...

The bioprocesses developed by MIO at laboratory scale use aerobic and anaerobic marine microorganisms (including extremophilic microorganisms) and in particular microbial consortia (microalgae and bacteria) to get benefit of the cometabolism that favors biodegradation of recalcitrant toxic molecules. In addition, the BIAM laboratory has developed know-how to exploit the diversity of cyanobacteria for the bio-mineralisation of toxic metals and radionuclides

**Keywords:** Microorganisms, bioremediation, ecotoxicology, inorganic and organic contaminants, metal, aquatic ecosystems, bioprocesses, biosensor

**Involved persons:**

- Barbara Schoepp-Cothenet: bioenergetics, metabolic pathway
- Olivier Pringault: Ecology, Microorganisms, Aquatic systems
- Yannick Combet-Blanc: Marine microorganisms, Bioenergy, Electromicrobiology
- Benjamin Misson: relationships microorganism / contaminant
- Catherine Berthomieu: Bioremediation, Interactions proteins-metal
- Virginie Chapon: Ecotoxicology