# MELiSSA Industrial Actors – Position Paper

The European space industries involved in the Micro-Ecological Life Support System Alternative (MELiSSA) would like to express their strong support to the on-going Program.

MELiSSA now encompasses key technological and scientific activities, including **PFPU, Artemiss, WTUB, WC-MEC, Urinis, Biorat, GWRU and WQA.**

We stress specifically the importance of the ongoing preparation of space missions, in continuity of the on-going activities mentioned above and the new ones such as Phases Separation Units, all of the described in the Annex.

Industry seeks a political support with a long-term planning and adequate funding to:

- Secure the continuity of MELiSSA technology developments for Space exploration Life Support, sustained by a robust roadmap and associated projects in the E3P Programme;
- Improve the European industry technical excellence and competitiveness in this key enabling field for human Space Exploration.

Industry believes that partnerships including the full European ecosystem of industrial and academic actors, within both space and non-space domains, are a key for developing innovation in space as on Earth.

Furthermore MELiSSA projects activities are fully in line with terrestrial challenges and needs, representing a major example of cooperation for developing circular economy capabilities and European non-dependency in space as on Earth, which should be increased to reap the full benefits of these cooperations.

MELiSSA is a perfect example of European excellence, driving innovation in scientific and technological fields, thus enabling human space exploration.

MELiSSA continues to generate economic, political and societal benefits and returns associated to the development of a circular economy, in space as on Earth, as demonstrated by all the developments and the technology transfer projects highlighted in the attached annex.

**Annex**

**Why Industry supports MELiSSA**

For more than 30 years, The European Space Agency has been active in the field of regenerative life support systems. MELiSSA is THE European project of circular life support, known and appreciated worldwide by the scientific and technical community for the advancement of bioregeneration. It has been established to gain knowledge on regenerative systems, achieving the highest degree of autonomy for vital resources, food, water and oxygen, from mission wastes.

MELiSSA is about the development and use of space applications to improve the quality of life for citizens, today and tomorrow. MELiSSA is not only a source of inspiration for the larger public, it represents a credible solution for a human lunar settlement.

Thanks to > 25 years efforts and a long-term commitment, its community has built unique capabilities, demonstrated both on earth and in space.

Key achievements today include:

- **GreenMOSS** (2012 – 2014, coordinated by Thales Alenia Space)
  Study of a Lunar Greenhouse for food production, one of the key building blocks of the “Moon Village”.

- **PFPU** (2014 - 2020, coordinated by Thales Alenia Space)
  Design and development of key technologies for a Precursor of Food Production Unit, for tubers growth in microgravity, targeting demonstration on ISS and cis-lunar space.

- **Artemiss** (2011-2018, coordinated by QinetiQ)
  First photobioreactor that produced oxygen and edible biomass in space.

- **WTUB** (2014-2015, coordinated by University of Ghent with QinetiQ)
  Water treatment unit for producing hygienic water from urine, condensate and grey water proved an efficiency of 95% over 2 months of operation in laboratory.

- **WC-MEC** (2018, coordinated by University of Ghent with QinetiQ)
  Improvement of the Waste Compartment (and Microbial Electrolytic Cell), one of the building blocks of MELISSA. Laboratory tests.

- **Urinis** (2017, coordinated by University of Ghent with QinetiQ, SCK and University of Mons)
  Urine treatment compartment, one of the building blocks of MELISSA. Laboratory tests.

- **Biorat** phase B (2015-2019, coordinated by RUAG with QinetiQ)
  Pre-development and test of a flight experiment composed of a closed gas loop producing O2 (algae photosynthesis) and consuming CO2 of a mice crew.

- **MELiSSA Food Characterization Phase 2** (2015-2016, coordinated by HES-SO Valais and supported by RUAG)
  Hydroponic sub-system studied at scientific and engineering levels, delivery of technical requirements & completion of preliminary testing phase.

- **GWRU** (2006-2008, coordinated by SENER Ingeniería y Sistemas S.A., form. NTE)
  Grey Water Recycling Unit design and analysis activities and technology demonstrator activities.

- **MELISSA adaptation for Space** (2001-2008, coordinated by SENER Ingeniería y Sistemas S.A., formerly NTE)
  Identification of critical technologies for the adaptation, establishment of new control system, study, demonstration of MELISSA techniques for space application.

- **MiDASS** Phase B (2011-2014, coordinated by BioMèrieux with SENER Ingeniería y Sistemas S.A., formerly NTE)
  Preliminary design activities of space instrument for the microbial detection in air, in closed space habitats.

- **WQA, RCW, OLAA** (2011-2017, coordinated by SENER Ingeniería y Sistemas S.A.)
  Removal of specific contaminants in water including metals (Ag, Cu,…) and specifically ammonium analyzer tested by means of laboratory demonstrators.

Key Technology Transfers:

- Algosolis Platform, Algae production, St Nazaire, France
- BioFacades: XTU, Paris, France
- Water quality Control, Kenitra, Marocco
- EZ Col Company, Cholesterol, The Netherlands
- Organic Wastes & Water, La Trappe, Berkel-Enschot, The Netherlands
- Vila Troglodytes, Water, Monaco
- BioStimulant, Mons, Belgium
- Biostyr Nitrification, Veolia, France
- Fermentation Control, Freixenet, Spain
- Urine Treatment Unit, Vuna, Switzerland & Belgium
- ESTEE Spin-off Company, Switzerland
- Grey Water Treatment Unit, Hotel F., Monaco
- Circular Hub, Malaga, Spain.

On-going / future activities of strategic importance to be supported to maintain and increase competitiveness are:

- **PFPU** - flight demonstrator and IOD of a critical subsystems (Nutrient Module), including novel mixed-phase management and separation technologies
- Study of a **Food Production Unit** for demonstration in cis-lunar space
- **Biorat** - flight demonstrator for air recycling demonstration (Carbon capture and Oxygen production), with advanced fluid dynamics based technologies for mass transfer enhancement
- **Phases Separation Units (Gas/Liquid, Solid/Liquid) -** Technology demonstrator enablers
- **Urinis** - flight demonstrator and IOD of a critical subsystems
- **Artemiss** - improvement of flight hardware and continued flight tests
- **WTUB** - IOD of critical subsystems
- **WQA** - IOD of water quality analysis technologies

The Industrial Actors supporting MELiSSA are:

- Qinetiq
- RUAG Space Nyon
- SENER Ingeniería y Sistemas S.A.
- Thales Alenia Space