

ESA Space Resources initiative – An Overview. M. Conti¹, J. Alves¹, D. Binns¹, J. Carpenter¹, A. Cowley¹, B. Lamboray², B. Lamaze¹, R. Lindner¹, B. Lomax¹, A. Makaya¹, A. Meurisse¹, B. Hufenbach¹.

Melchiorre.Conti@esa.int,

¹ European Space Agency
Keplerlaan 1,
2201 AZ Noordwijk,
The Netherlands

² Luxembourg Space Agency
19-21, boulevard Royal
L-2449 Luxembourg
Luxembourg

Introduction: Following the publication in 2019 of the ESA Space Resources Strategy^[1] and with Space Resources gathering momentum in the arena of International Human and Robotic Exploration, and noting the involvement of several actors public and private interested in the development of In-Situ Resources Utilization, this paper aims to give the conference an overview of some of the activities on going at ESA. Furthermore it hints to the planning of future activities aiming to delivering an oxygen and metal pilot plant on the Lunar surface to enable sustainable exploration of our solar system.

This paper will give a flavor of the multi-directorate approach to Space Resources, involving not just the Human and Robotic Exploration Directorate, but also the technology, commercialization and legal departments within ESA, in the quest to deliver a holistic approach to the implementation of space resources that brings together Institutions, Academia and Industrial partners to deliver technical excellence made in Europe.

A roadmap will be presented on how the Agency intends to combine space segment research and development opportunities alongside the terrestrial research to generate benefits that go further than the one linked to exploration by creating opportunities for up and coming technologies that could benefit from ISRU in space and that could benefit terrestrial markets by transferring technologies to similar problems.

The talk may feature the following topics.

Coordination and internal communication: Space Resources Steering Group where the stakeholders from various directorate come to discuss issues and update each other on ISRU related activities on going on the respective areas. Charting the way forward for Space Resources within ESA.

ISRU-DM Status: following a successful Phase A study in 2020, the Phase B1 has been assigned to the contractor following a Challenge approach; four chal-

lengers proposed payload design with one concept selected as the way forward. Furthermore a workshop with the European Space Resources science community is in the planning to maximise any scientific return associated with this payload.

The European Space Resources Innovation Centre Strategic Partnership: following the establishment of ESRIC in August 2020, several activities have been initiated in the four pillars:

Research. Several procurements initiated with the goal of creating in ESRIC a state of the art ISRU laboratory in the heart of Europe, with some equipment already delivered to the facility in November 2021. The intent to cater for various research platforms including molten salt electrolysis, gas management and others.

Community Management. Engaging and nurturing the European and International ISRU Community with the organising the increasingly popular Space Resources Week and the first ESA-ESRIC ISRU Challenge.

Knowledge Management. Aiming to build a database of ISRU activities to be used by the ISRU community, with the goal to develop a tool that will serve the scientific community, the agencies and the commercial community.

Business Support. A multi year Start up Support Programme providing technical and business support has been put in place focused in stimulating the growth of companies in the Space Resources market which have both long and short term milestones. In 2022, the first five companies have been selected for pre-Incubation phase.

Spaceship Activities: several projects on going for the low TRL particle demonstration of ISRU technologies in relation to various aspect of regolith utilization for construction (Microwaves and other sintering techniques) and oxygen extraction from regolith (Plasma reduction and pyrolysis).

Open Space Innovation Platform Campaigns:

the OSIP platform is a website that enables the submission of novel ideas for space technology and applications.

Off-Earth Manufacturing. The campaign was launched in October 2019, with the mission statement of “We are seeking innovative ideas on enabling technologies for in-situ construction, manufacturing and maintenance of infrastructure and hardware, to support long-term human exploration of a planetary body”, 69 ideas were submitted, 23 of which have been founded according to their novelty and maturity.

Call for Ideas on Applications using Space Resources. In February 2021 a call for idea was launched to invite the European ISRU community to put forward their ideas for novel applications of space resources, of the 34 ideas , 5 have been selected for Co-Sponsored research.

Lunar Pilot Plant: preliminary studies are scheduled for 2022 to look at a Lunar Pilot Plant targeting a potential operation on the Moon surface, this will create the base for related activities in the period 2023-25.

Technology Development activities: Several Technology Development Element programs are ongoing covering dust handling research, alongside other uses of regolith by means of Microwave sintering for construction material or feedstock for other ISRU processes. Future activities in this area will also include process de-risking for various electrochemical processes and efforts in the area of water purification for various uses.

Internal research: The current internal research at ESTEC focuses on the characterization and optimization of the Fray-Frathing-Chen (FFC) process , to be applied to the extraction of oxygen and metal alloys from Lunar regolith.

Resource Exploration:

Polar Resources Exploration. Discussions are progressing to secure two flight opportunities to fly similar payloads to PROSPECT, a mission with CLPS (NASA) to fly in 2025 and one mission with EMS on Lupex Rover for 2024 with JAXA

Commercially Enabled Resources Exploration. The call has been open to any E3P Member States based companies who are capable of accommodating a range Lunar Payloads that ESA has identified as potential candidates for Lunar, in which priority for the potential candidates will be given to prospecting payloads for ISRU ground truthing with links to definition of the Lunar Pilot Plant site selection.

References:

- [1] ESA Space Resources Strategy (2019)