

## Input for the Working Group on Legal Aspects of Space Resource Activities December 2022

### 1. Activities and current practices in the scientific, technological and programmatic developments of space resources exploration, exploitation and utilisation

The resources of space offer a means to enable sustainable exploration, exploitation and utilisation of the Moon and the Solar System beyond. ESA expects that by 2030 key technologies pertaining to lunar resources are likely to have been developed and demonstrated and that space resources will continue to be a major international topic. Against this background, ESA is conducting multiple activities relating to resources exploration, exploitation, and utilisation under its European Exploration Envelope Programme (E3P), such as:

- **PROSPECT:** payload & tools (drilling, analysis and first In-Situ Resource Utilisation (ISRU) experiment) to fly on missions in collaboration with NASA (NASA CLPS), JAXA (LUPEX mission) and CNSA NILS payload on Chang'e 6;
- **Payload study ISRU Demonstration Mission:** study aimed to deliver a demonstrator for oxygen extraction from regolith using Molten Salt Electrolysis (MSE);
- **Concurrent Design Facility (CDF) study for an ISRU Pilot Plant:** study aimed to produce oxygen and metal in line with the International Space Exploration Coordination Group (ISECG) roadmap (completed);
- **European Space Resources Innovation Centre (ESRIC):** ESA supports the development of ESRIC as a centre of excellence for the field of space resources. Here ESA is *inter alia* procuring platforms to further study and develop MSE and ancillary processes;
- **Invitation to Tender (ITT) for a feasibility study for the design and build of a terrestrial Pilot Plant:** study, to be launched at the end of 2022, with the aim of delivering and operating such a pilot plant in the next years (2023/2025);
- **ExPeRT:** (Spaceships) low Technology Readiness Levels (TRL) technology developments are undertaken on a portfolio of teams, from additive manufacturing of regolith to oxygen extraction technology based on very high temperature systems or plasma.

Additionally, ESA programmes are looking into additive manufacturing of regolith and other crucial technical aspects pertaining to space resources, such as high temperature sealing mechanisms and dust resistant apparatuses. ESA's Space Resources Strategy<sup>1</sup> provides the foundation for the above-mentioned programmes with the objective of enabling a strategic approach for sustainable human exploration and reflects the highly interdisciplinary and innovative nature of the domain. The rationale of the Strategy is based on the notion that ISRU offers the potential to locally derive what is needed for living and working in space, especially pertaining to locally sourced water and regolith.

### 2. Types of space resources

ESA's activities relating to space resources currently focus on resources contained within the regolith, with oxygen (as an oxidiser or for life support) and metal alloys (derived from the specific regolith compositions). Regolith is also considered a potential resource in the manufacturing of logistic related capacities (such as landing pads and habitats).

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<sup>1</sup> For ESA's Space Resources Strategy, see here: <https://exploration.esa.int/web/moon/-/61369-esa-space-resources-strategy>.

Another potentially available resource is water ice, which should be prevalent in the permanently shadowed regions, however it is still considered a technologically challenging resource to attain and will require further prospecting missions to understand its availability.

### **3. Relevant factors to be considered in the development of a set of principles on space resource activities**

When developing a set of principles on space resource activities, international cooperation is paramount. Cooperation is ESA's "*raison d'être*" as its purpose is to provide for and promote, for exclusively peaceful purposes, cooperation among European States in space research and technology and their space applications, whether for scientific purposes or operational space application systems (Art. II ESA Convention). Furthermore, it is important to ensure legal clarity on a global level to promote the peaceful and sustainable use of outer space, notably also in the context of space resource activities.

An essential element to consider when developing a set of principles pertaining to space resource activities is to allow for the development of innovative technological solutions, while adhering to and further specifying the existing international legal framework, including the principles set out in the 1967 Outer Space Treaty, to which all of ESA's Member States are State Parties, as well as to internationally recognised guidelines and standards.

The importance of a clear scope of application of a possible set of principles shall be recalled. In this regard, clear definitions, especially pertaining to what should be considered a space resource, would enhance legal certainty for the benefit of future technological developments. A proposal could include a distinction between in-situ space resources and other usages of space resources. This would not only provide clarity for States, but by default also to non-governmental actors. Furthermore, a possible distinction between the use of space resources for sustainable space exploration, exploitation, and utilisation on the one hand, and the use of space resources for terrestrial applications and/or commercial purposes on the other hand could be considered.

### **4. Current practices in the implementation of the existing legal framework**

With regard to space resources utilisation and exploitation, it is recalled that there is no international consensus concerning the legality under international law, nor are there universally accepted international legal norms on the legal status of space resources and their governance beyond the rights and obligations contained in the Outer Space Treaty.

The ESA Executive regularly provides its Member States' delegations with updates and analyses on legal and political developments related to space resources. As an international intergovernmental organisation, ESA is a subject of and acts in accordance with public international law and has moreover declared acceptance of the rights and obligations enshrined in three of the five UN Treaties on Outer Space.<sup>2</sup> ESA has not implemented any specific legal framework regarding space resources. As clarified in its Space Resources Strategy for 2020-2030, published in 2021,<sup>3</sup> ESA cannot assume leadership in interpreting and further developing the legal and regulatory framework applicable to space resources, as this goes beyond its competence. ESA does however play an important role by providing its Member States opportunities to exchange and coordinate positions on international space law, as was just recently reaffirmed in ESA's ministerial council Resolution on "ESA Accelerating the Use of Space in

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<sup>2</sup> Rescue and Return Agreement, Liability Convention and Registration Convention.

<sup>3</sup> For ESA's Space Resources Strategy, see here: [https://sci.esa.int/documents/34161/35992/1567260390250-ESA\\_Space\\_Resources\\_Strategy.pdf](https://sci.esa.int/documents/34161/35992/1567260390250-ESA_Space_Resources_Strategy.pdf).

Europe”.<sup>4</sup> Member States also noted ESA’s support in the establishment and implementation of national space legislation and programmes through both technical and legal advice.

## **5. Benefits of the coordination and collaboration in the development of a space resources framework**

Technological advancements relevant to space resources would benefit from a broad set of principles, as legal certainty encourages investments and restricts political tensions. The challenges of addressing the legal aspects of space resource activities would be best tackled through a coordinated international endeavour. ESA is not only an example of international cooperation, but it continues to offer coordination opportunities among its Member States in *inter alia* matters of space law, including on the topic of space resources.

ESA will maintain monitoring relevant developments at international level and assist in the coordination and identification of legally and non-legally binding requirements and instruments for its own activities and the activities of its Member States. Additionally, as a permanent observer at UN COPUOS, ESA will continue supporting international efforts within its mandate by regularly sharing its expertise and technological advancements within this field.

## **6. Conclusion**

From an operational perspective, ESA’s current technological and programmatic developments are guided by the existing principles enshrined within the international legal framework. To ensure legal clarity and the necessary transparency in going forward planning the next cycle of ESA’s exploration missions, the development of definitions and principles specific to space resources would be beneficial for both the Agency, its Member States, and international partners.

A set of internationally recognised principles conceived through an international cooperation effort would foster the development of new technologies, promote capacity building, and pre-emptively reduce the potential for discord, as well as promote the sustainable use of outer space and its resources.

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<sup>4</sup> For the Resolution on ESA Accelerating the Use of Space in Europe, see here: [https://esamultimedia.esa.int/docs/corporate/Resolution\\_1\\_CM22.pdf](https://esamultimedia.esa.int/docs/corporate/Resolution_1_CM22.pdf).