

IAF SPACE EXPLORATION SYMPOSIUM (A3)
Moon Exploration – Part 2 (2B)

Author: Mr. David Binns
European Space Agency (ESA), The Netherlands, david.binns@esa.int

Mr. Bernhard Hufenbach
European Space Agency (ESA), The Netherlands, Bernhard.Hufenbach@esa.int

Dr. Andreas Borggräfe
European Space Agency (ESA), The Netherlands, andreas.borggraefe@esa.int

Dr. James Carpenter
European Space Agency (ESA), The Netherlands, james.carpenter@esa.int

Mr. Robert Lindner
European Space Agency (ESA), The Netherlands, robert.lindner@esa.int

Ms. Ana Cipriano
European Space Agency (ESA), The Netherlands, ana.cipriano@esa.int

Dr. Markus Landgraf
European Space Agency (ESA), The Netherlands, Markus.Landgraf@esa.int

Mr. Rogier Schonenborg
The Netherlands, Rogier.Schonenborg@esa.int

LUNAR IN-SITU RESOURCE UTILISATION (ISRU) DEMONSTRATION MISSION ACTIVITIES IN
ESA'S EXPLORATION ENVELOPE PROGRAMME (E3P)**Abstract**

The Earth's moon is a key destination for human and robotic exploration beyond Low Earth Orbit in the next decades. Findings from early science-driven missions characterising the lunar soil have led to a good understanding of the resources that can be found in-situ on the Moon surface. An affordable and, hence, sustainable human presence on the Moon would require the utilisation of local oxygen and/or potentially present water based volatiles. Furthermore, if the focus is placed on oxygen, then the options of refuelling landers on the surface and spacecraft in cis-lunar space could become possible. This could eliminate the recurring transportation costs of consumables from Earth, replaced by one-off investment in lunar production infrastructure, exploring the paradigm "living off the land".

To these ends, the European Space Agency (ESA) has investigated a demonstration mission of technologies for ISRU, supported a ground based demonstrator activity and developed a concept for a pilot plant. The focus of this paper is the feasibility of an ISRU Demonstration Mission to de-risk key technologies by landing an ISRU based payload to produce water on the Moon by 2025. It is the first step towards enabling lunar ISRU for sustainable exploration. The mission is to be realised through private-sector developed key capabilities for payload delivery, communications and operations, which are planned to exist by the mid-2020s. ESA aims to procure these lunar services from commercial providers in order to realise the mission. For this purpose, the Agency engages also new industrial sectors through innovative partnerships to support the mission development.

The paper describes the key objectives and technical challenges for ISRU payloads, presents initial conclusions on the selection of the ISRU chemical process, provides an overview of the overall mission architecture, and updates on the current development status and related ESA activities in order to mature the end-to-end mission together with the European private sector.