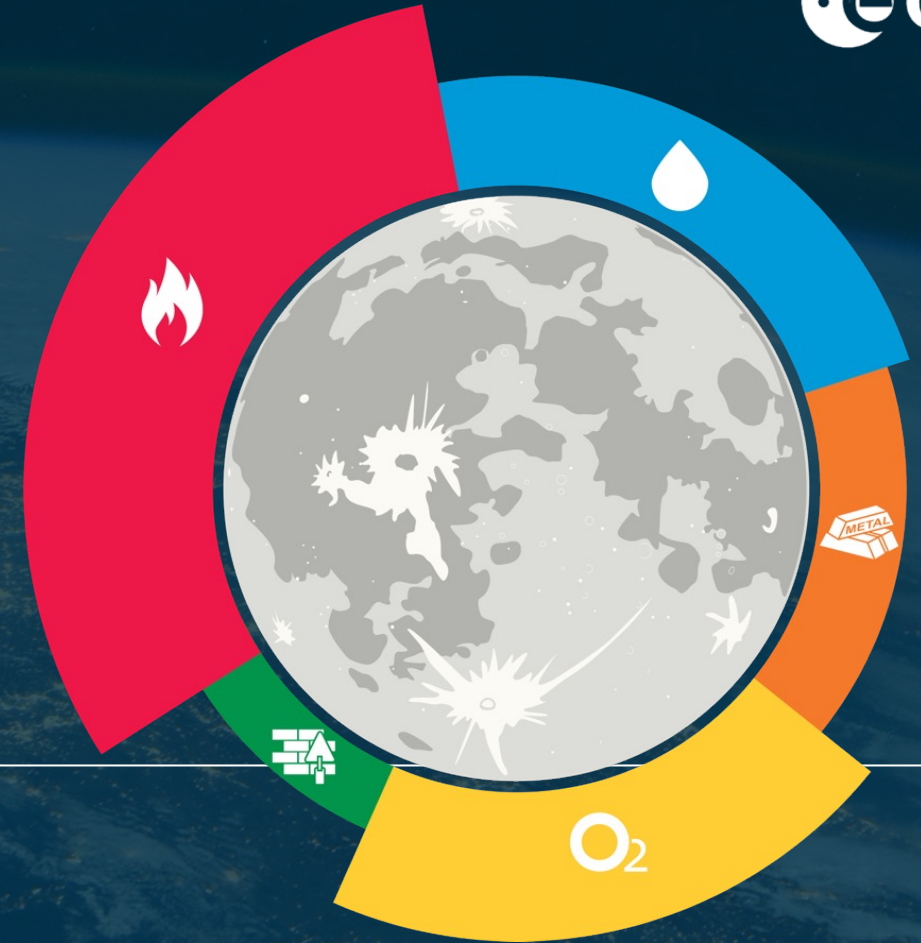


ESA Space Resources Initiative

An overview



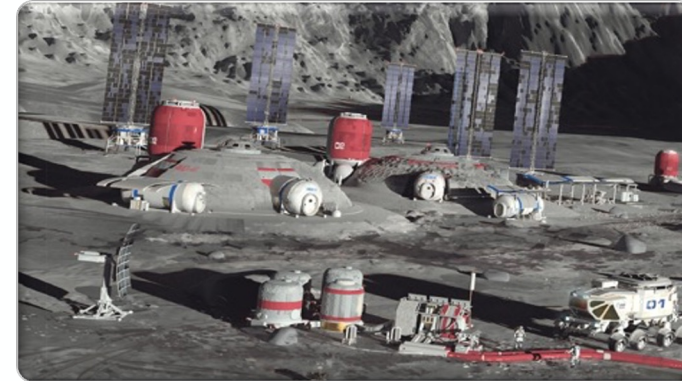
Melchiorre Conti

Space Resources Roundtable

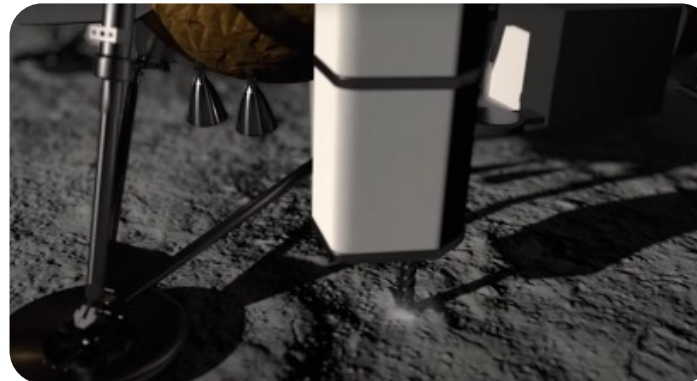
07/06/22

- **Based on the Space Resources Strategy launched in 2019**
- **Space Resources Steering Group**
 - Based on a coordinate multi-directorate approach
- **Three Flagship Goals identified**

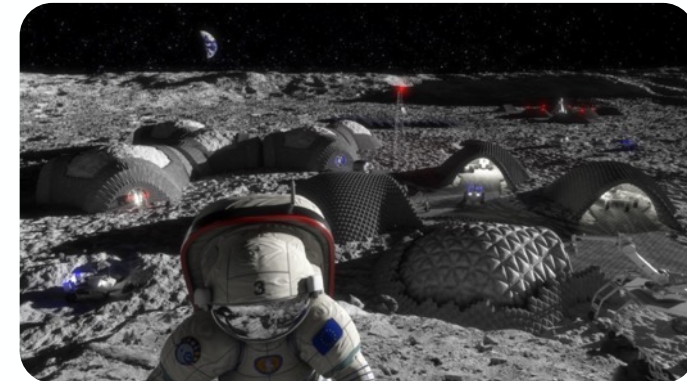
ISRU pilot plant



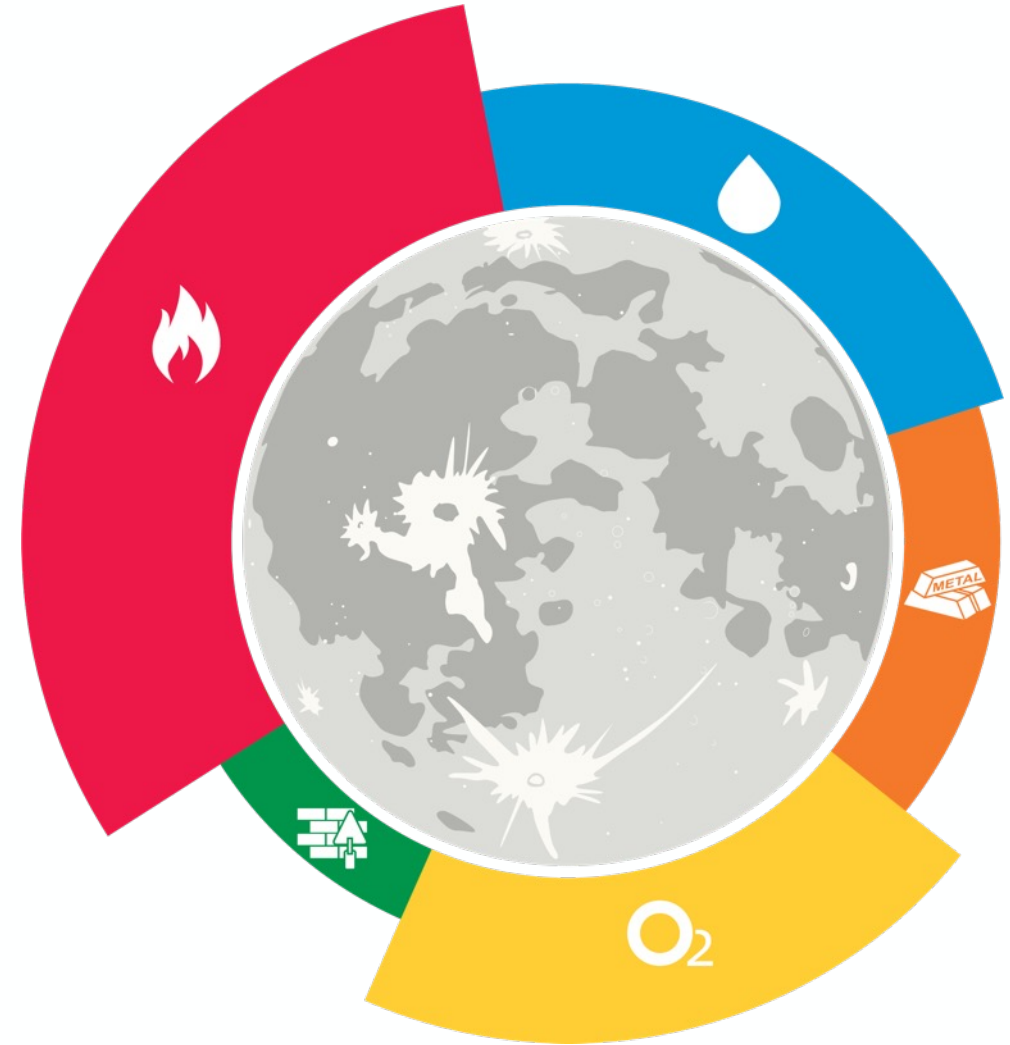
Prospecting



ISRU Applications



Prospecting Activities



International Lunar Polar Prospecting Campaign



Missions from around the world will determine regional distribution, abundance, and accessibility

ESA CONTRIBUTIONS	PARTNER / MISSION	WHAT
EMS-CLPS	NASA CLPS	First flight of European Mass spectrometer (non-polar)
EMS-LUPEX	JAXA/ISRO	contribution to JAXA polar prospecting rover
PROSPECT-CLPS	NASA CLPS	Characterisation of ice and volatiles at a polar location plus ISRU experiments
NILS-Chang'e 6 (TBC)	CNSA	Supporting environment characterisation at the pole

Use this data to identify where to find the reserves



European Large Lunar Lander and Polar Explorer



Mission study for a **rover mission** to explore a **polar ice deposit**

Delivered with ESA's **European Large Logistics Lander**

Rover with instrumentation to **map ice** and provide **geological context**

Candidate for a mission in the **2030s**

Community Engagement - Space Resources Challenge



A CHALLENGE TO IDENTIFY NEW AND DISRUPTIVE COMPANIES AND TECHNOLOGIES

13 teams selected

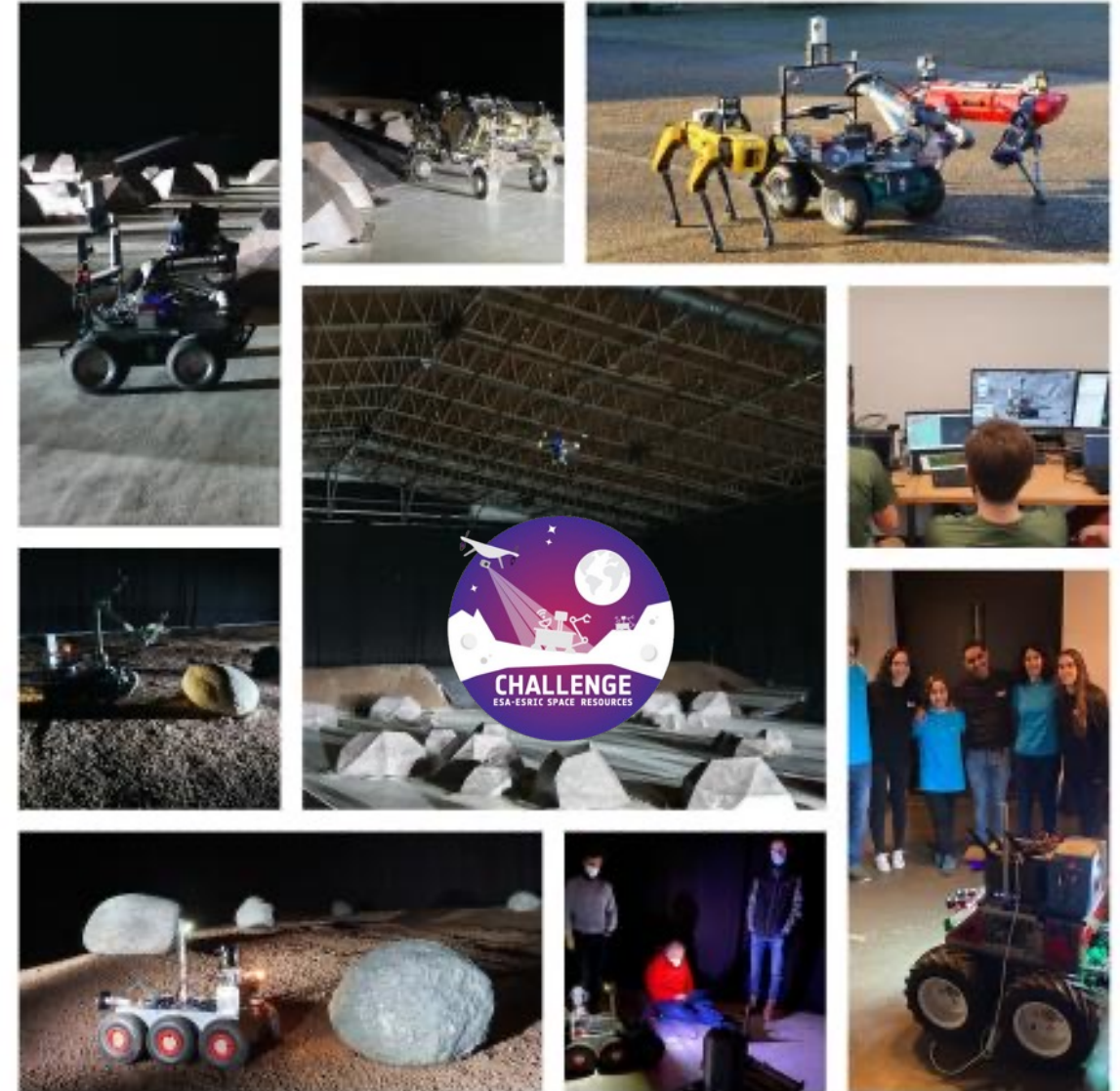
1 field test

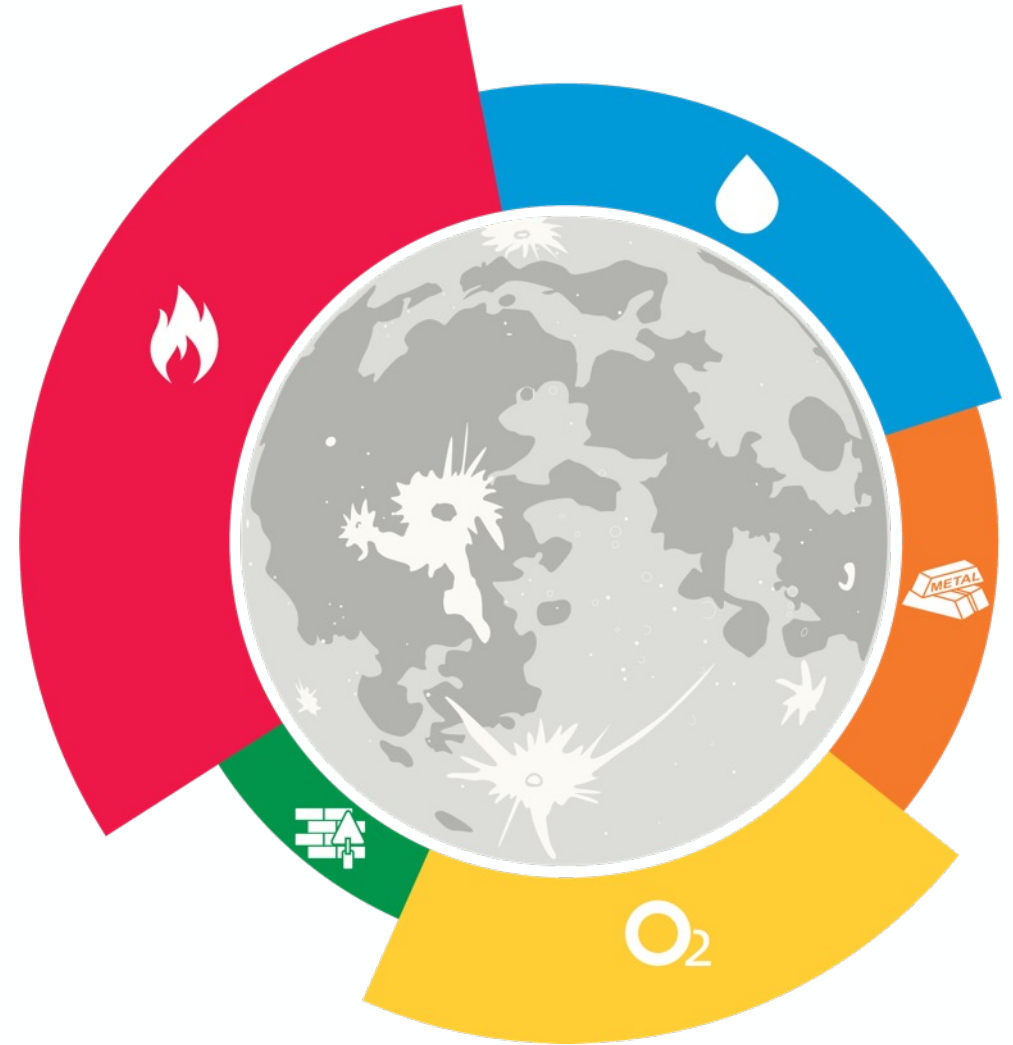
2500 m² of simulated lunar landscape mapped

5 winners

5 development contracts

The five teams will undergo the second part of the Challenge in Luxemburg (September 2022), the winner will be awarded an ESA-ESRIC funded development contract.



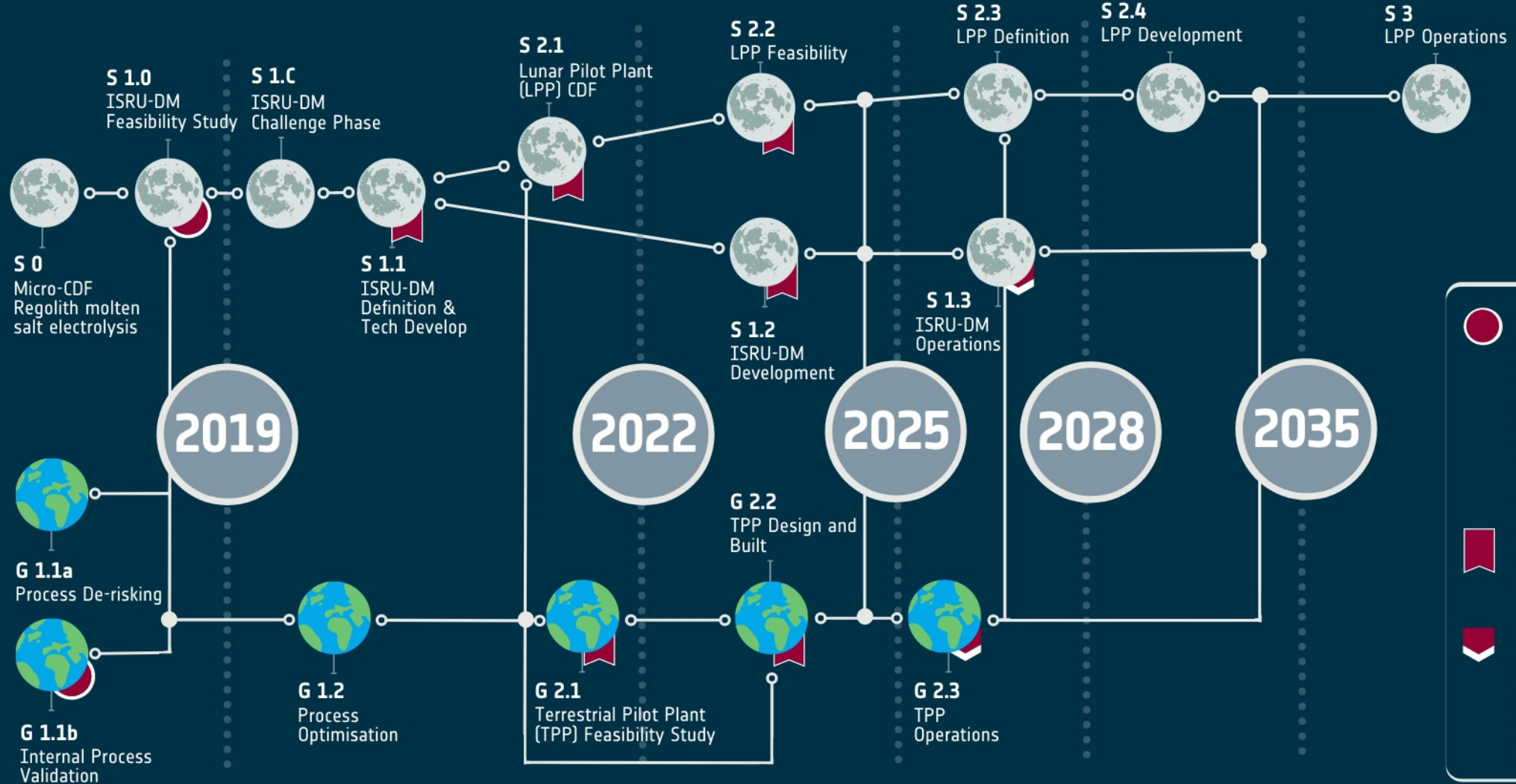


A PILOT PLANT ON THE MOON: PILOT PLANT R&D ROADMAP FOR OXYGEN AND METAL EXTRACTION



SPACE

GROUND



Early exchange of information that has benefited terrestrial and payload design development.

The terrestrial pilot plant will be fundamental to understand scale up and operational issues that may arise. It will be based as much as possible on the lunar design.

Close cooperation between the ground based activities and space activities will help identify potential issues, resolve them and overall de-risking the processes providing testing opportunities for technology development.

In relation to ancillary systems, such as cryogenic and metal storage post production are not displayed however they will be instrumental to the efficient and meaningful functioning of the LPP and should have dedicated work streams assigned.

- A Concurrent Design Facility study is planned for the fall 2022
- In the period 2023-25 the following activities are under consideration to be proposed
 - For Pilot Plant Feasibility Phase A\B1 including a rover excavator and end-to-end concept of operations.
 - Critical Technology Developments for the lunar Pilot Plant to TRL5

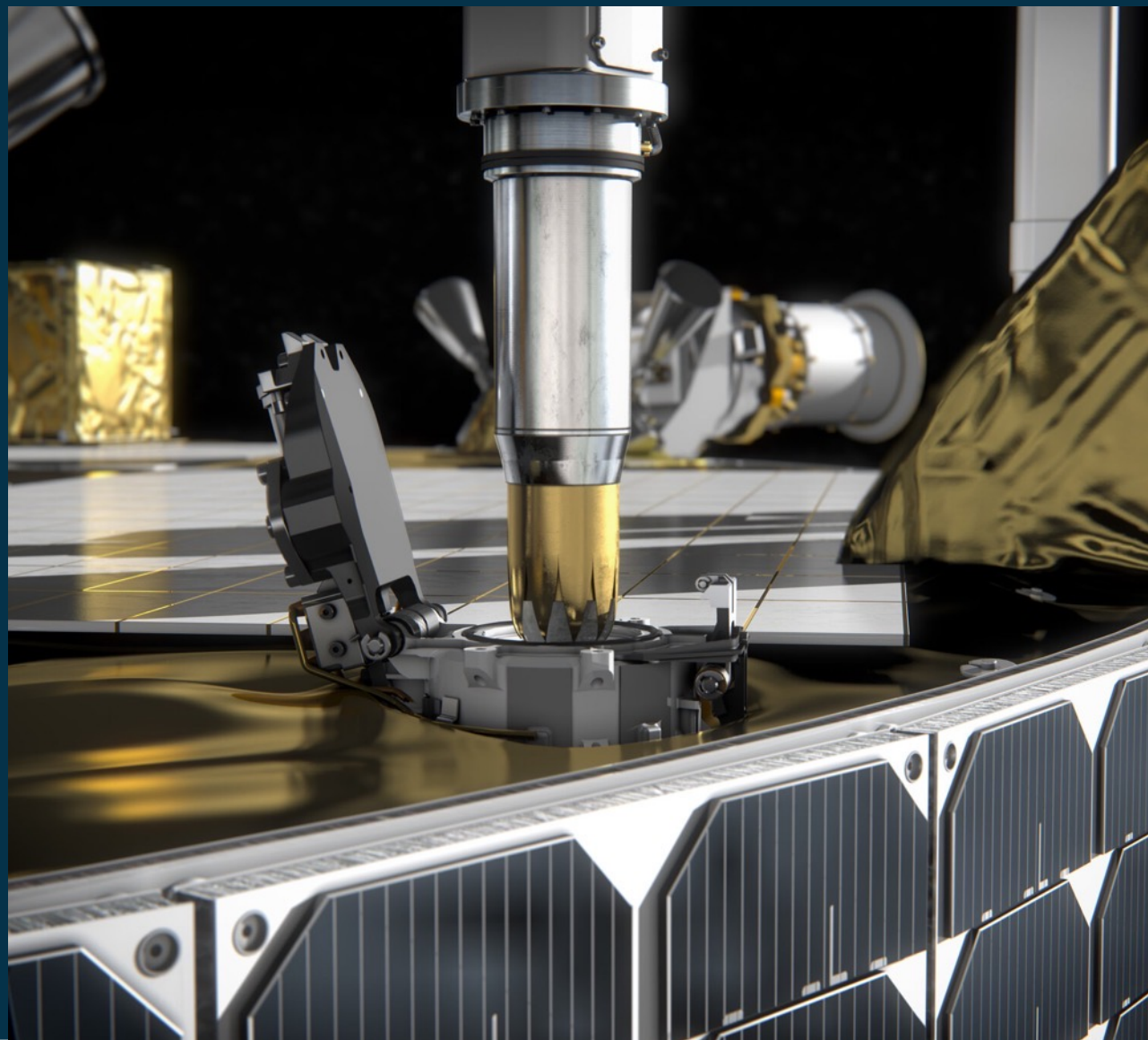


ISRU DEMONSTRATOR PAYLOAD STUDY

- Challenge driven procurement approach
- Flight model to be built in three years
- Oxygen extraction from regolith demonstrator
- Aiming to extract 50-100g of oxygen during the mission

More on this:

https://www.esa.int/Enabling_Support/Space_Engineering_Technology/Team_chosen_to_make_first_oxygen_on_the_Moon



Procurement of state of the art molten salt electrolysis reactors and gas purification unit



Delivery of hydrogen reduction technology demo

ISRU dedicated Thermal Vacuum Chamber feasibility study ongoing

Industrial Plant

Scalability Challenges

Operational Knowledge

De-Risking Space Systems

Multi-Process Collaborative Platform

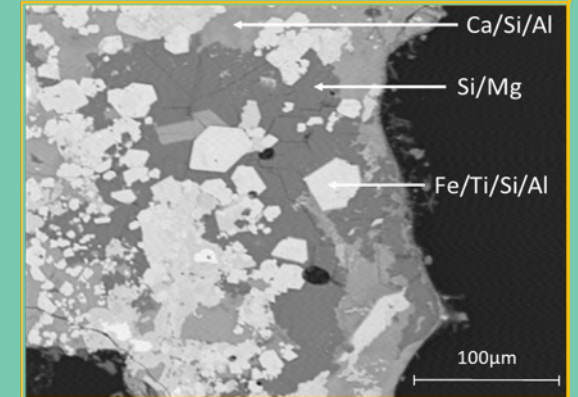
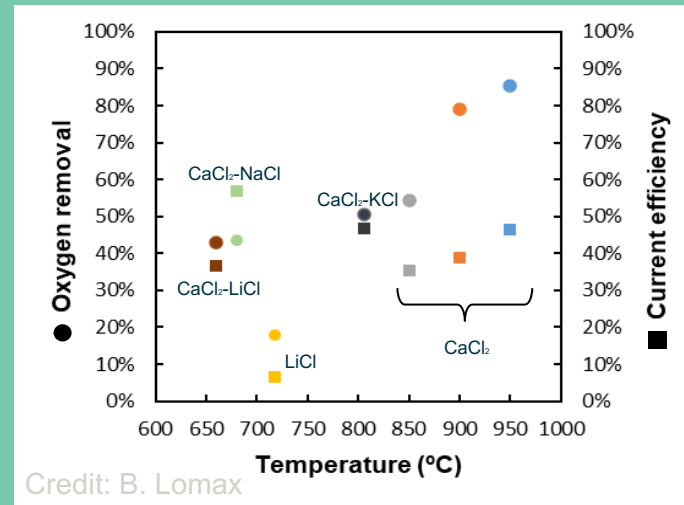
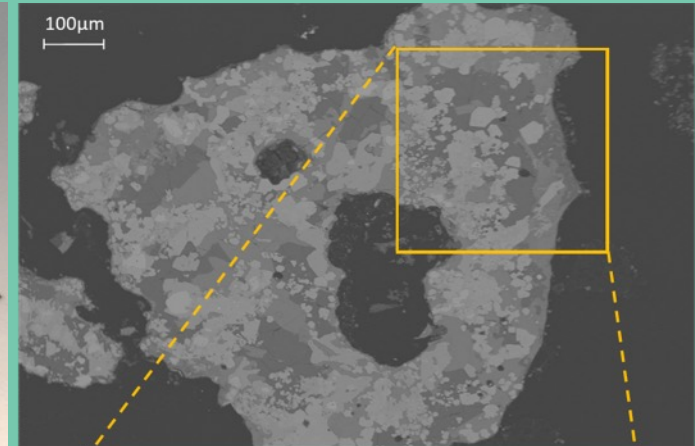
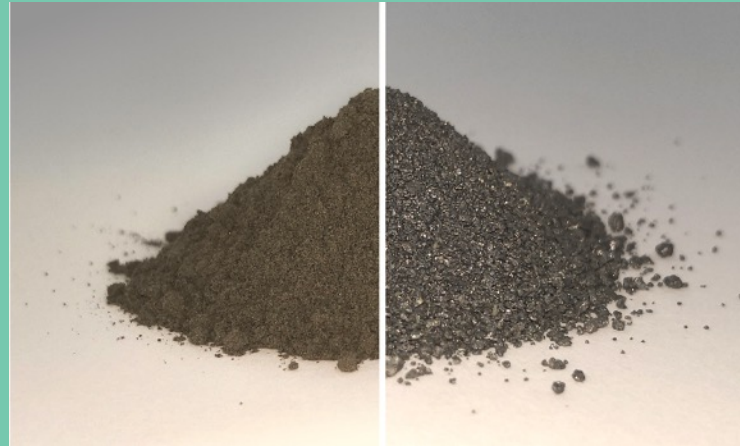
Long Term Operation

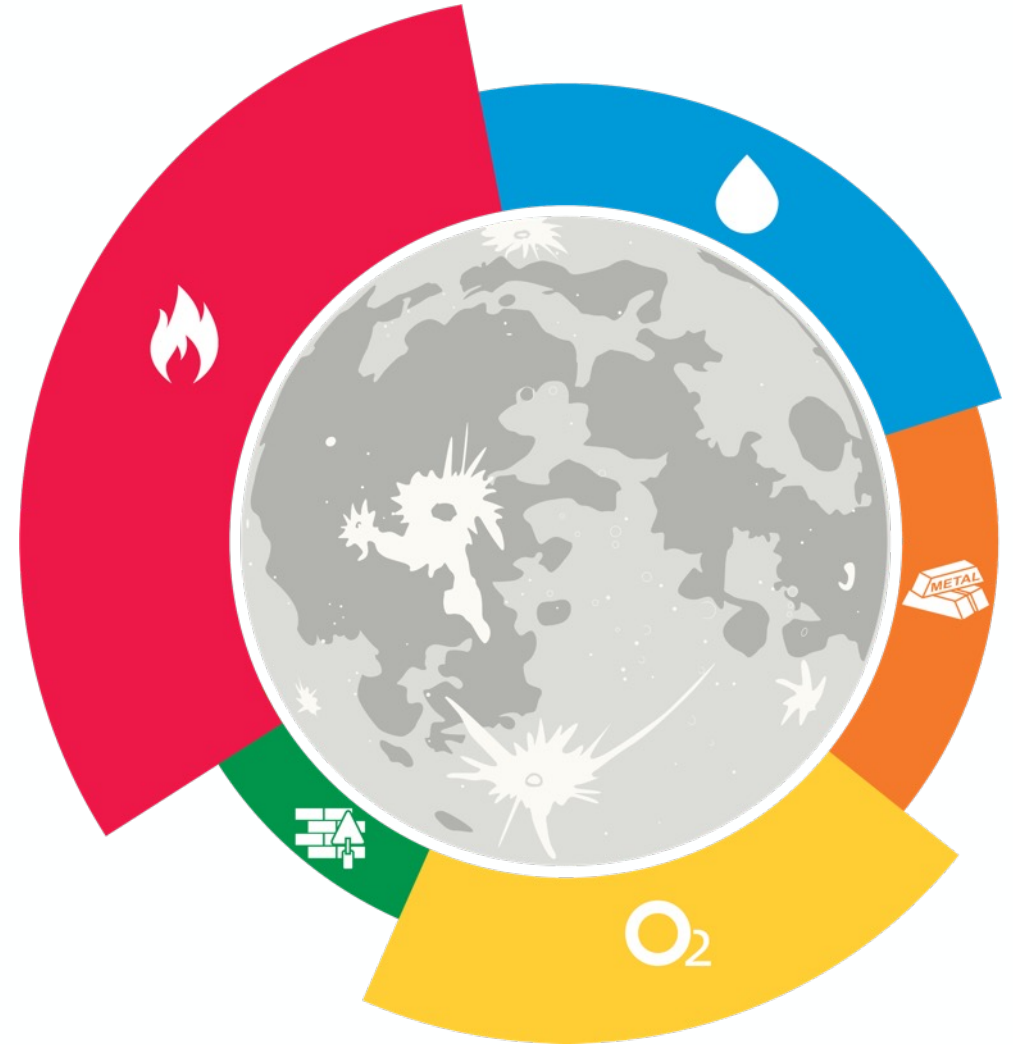


Focus on understanding and optimising the FFC process for lunar application

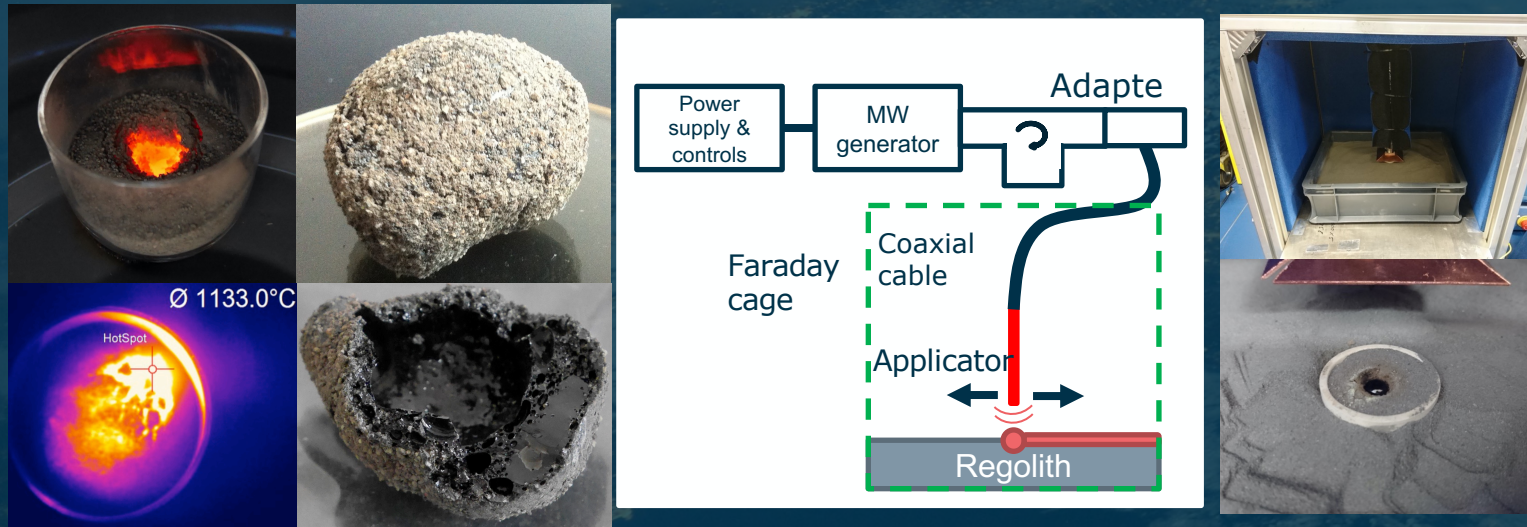
Research areas include:

- Lowering the baseline temperature of the process
- Oxygen extraction rate over time
- Solid product phase analysis for possible applications
- Salt contamination and reusability
- Process monitoring
- Expected delta to real lunar regolith and the lunar environment





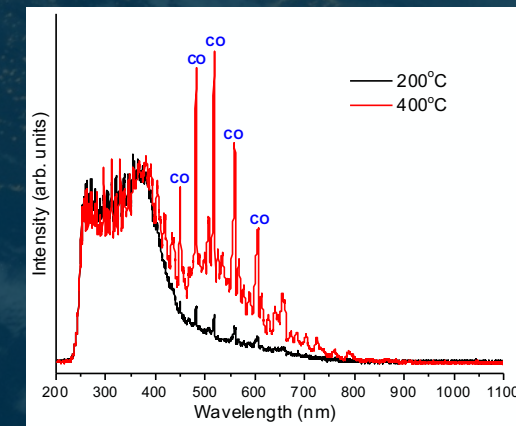
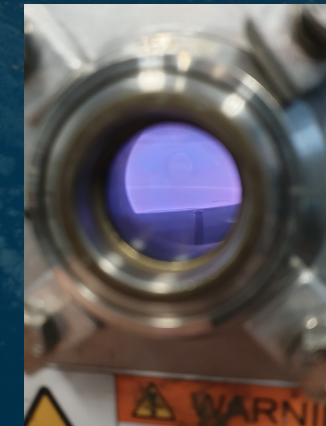
Microwave (MW) Processing of Regolith

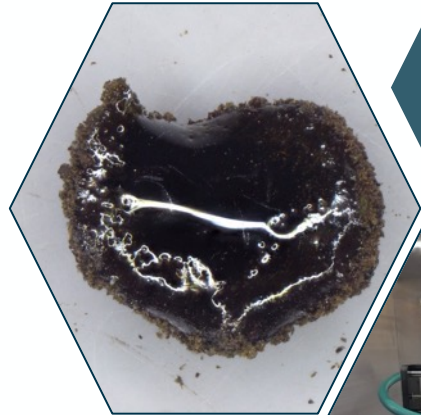


Novel Regolith/Thermoplastic Composites

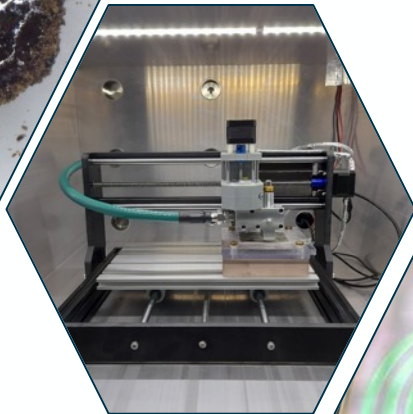


Plasma Processing of Regolith for Oxygen

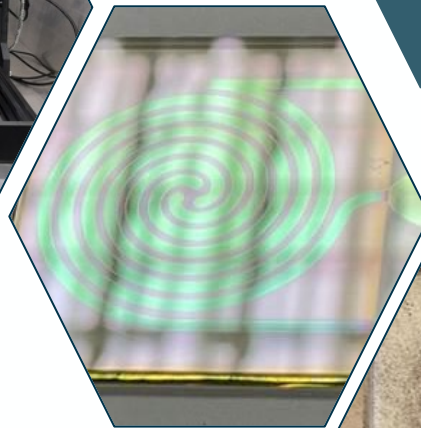




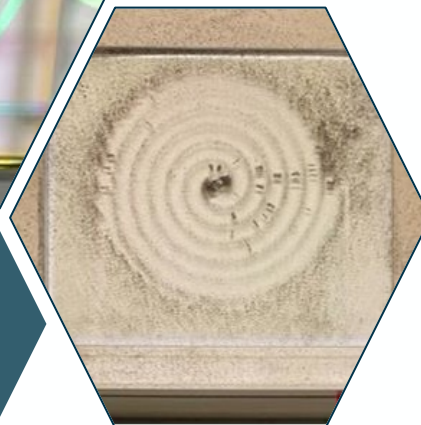
Microwave Heating/Sintering of lunar regolith for additive manufacturing



Credit: RINA

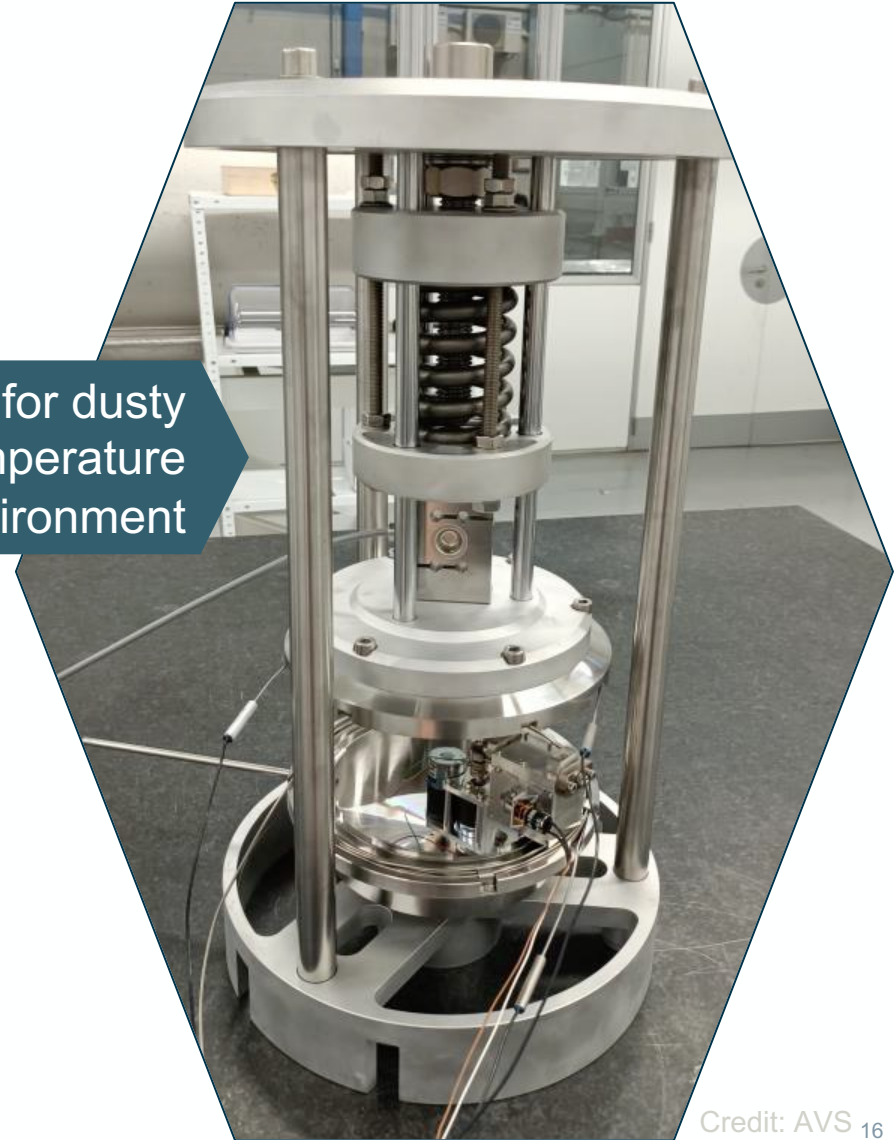


Sealing mechanisms for dusty and high temperature environment

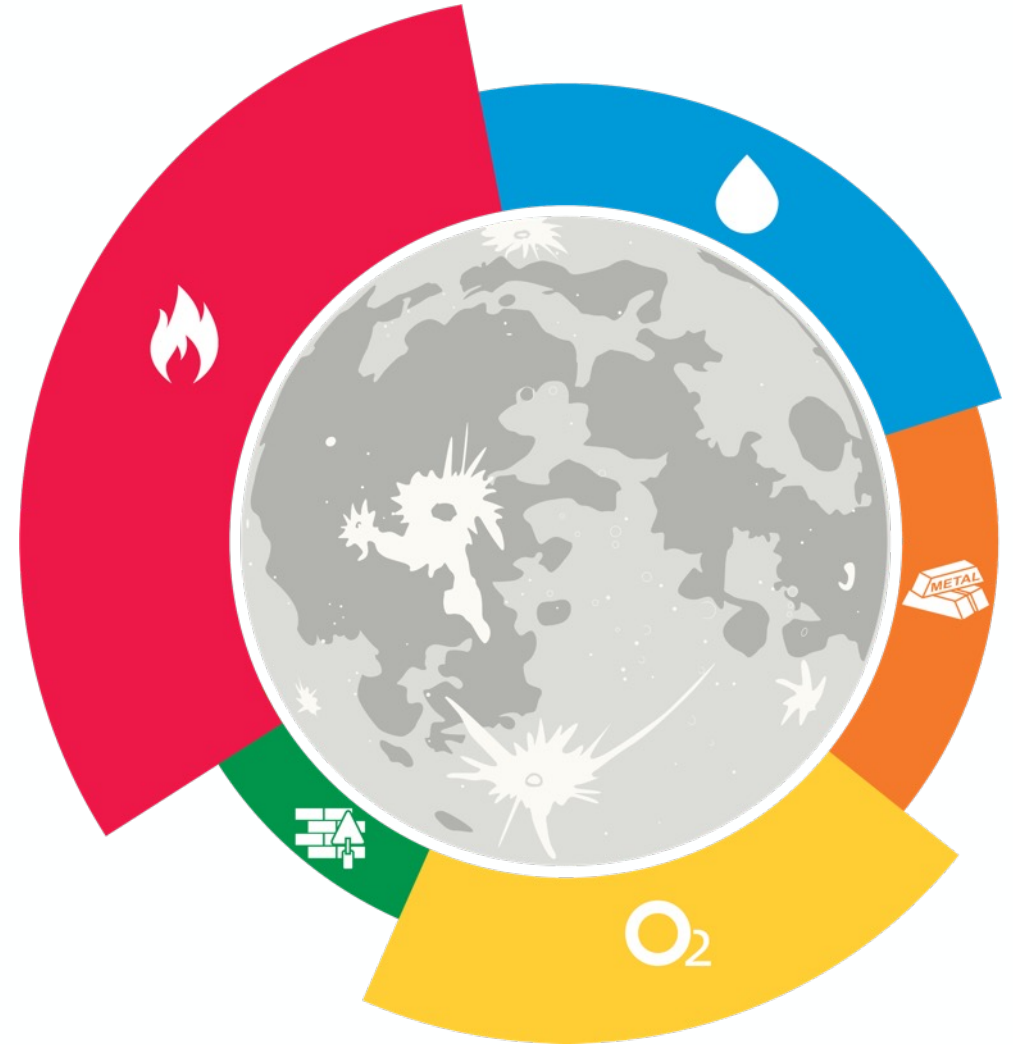


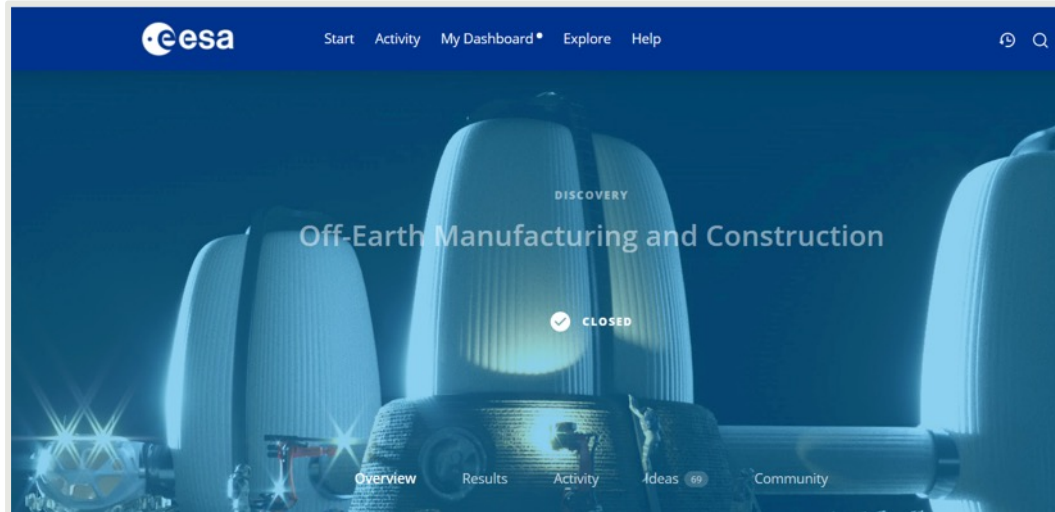
Credit: COMAT

Dust removal and cleaning of Optical surfaces



Credit: AVS 16





Open Space Innovation Platform: *ideas.esa.int*

Campaign launched on OSIP in October 2019

Scope : “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”

Outcome : 23 activities have been selected for funding

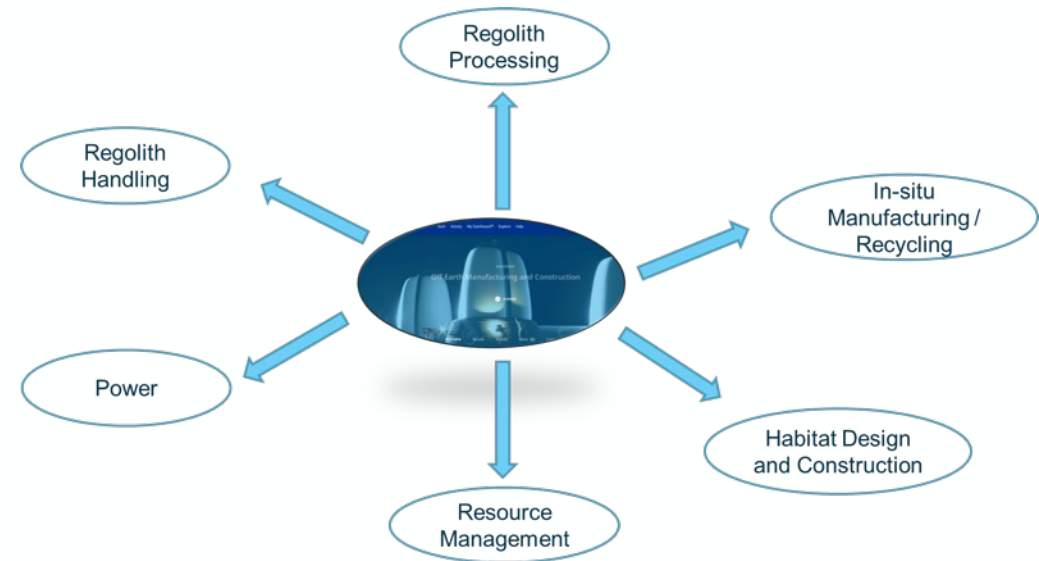
6 Research co-sponsorships

7 Studies

10 Early Technology Developments

"Off-Earth Manufacturing and Construction"
symposium held in November 2021

Presentations are available: https://esamultimedia.esa.int/docs/preparing_for_the_future/Symposium_Programme_v4.pdf



ISRU APPLICATION



CFI “SPACE RESOURCES UTILISATION APPLICATION SCENARIOS”

Launched in February 2021 to identify novel ideas on Resources utilisation

34 ideas submitted of which 5 have been selected for Co-Sponsored research project funding



MarsCat

esric

RISE Regolith
ISRU Sintered
Elements



In-situ
propellants for
electric
propulsion



OHB
SWEDEN



Moon-Comp
project

esric



CORIOLIS



ESRIC Startup Support Programme

Pre incubation

Qualification and validation phase

Incubation

Technical and market validation phase

Post Incubation

Residency Stage

First Call for Selection has identified five Start-ups for 3 months Pre-Incubation Period



April-July 2021
Space Resources Week 2021



October 2021
Workshop with ESRIC



December 2021
ESA Internal workshop



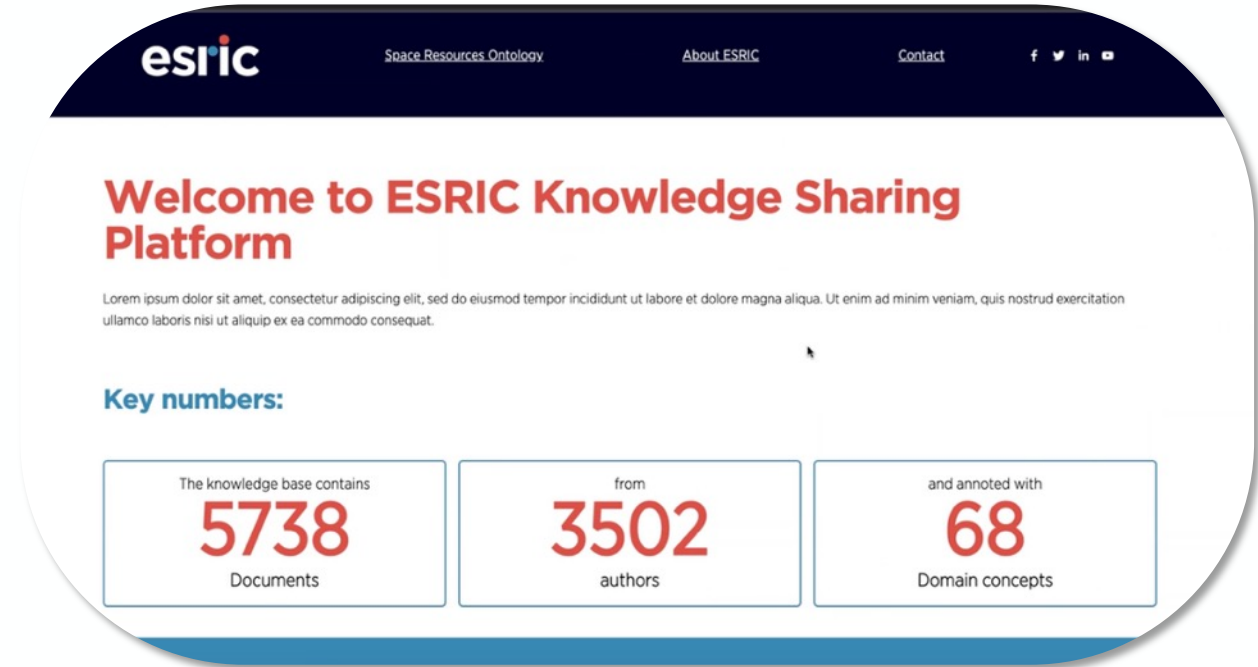
Jan – April 2022
Build use-cases



May 2022
PROTOTYPE

Project Goal

To create of a platform to become the **go to place** for knowledge and expertise of the Space Resources community



Community Engagement: Space Resources Week



2019

2 days event onsite event

348 participants

57 speakers

30 posters



2021

4 days hybrid event with the use of interactive Platform

1001 participants

125 speakers

82 posters

2022

2 and 1/2 days event onsite event

300 participants on site , **672** average online

103 speakers

26 posters



THANK YOU FOR
YOUR ATTENTION

And a special thank you to all the
contributors to this presentation!