

Lunar Outpost Oceania leads Australia's Moon to Mars Trailblazer Rover Lunar Mission. A.J. Gerner¹, J. Kenrick¹, J. Cyrus¹, ¹Lunar Outpost, Inc. (12555 W. 52nd Ave, Arvada, CO 80002, AJ@lunaroutpost.com).

Overview: The Australian Space Agency (ASA) has launched the Trailblazer initiative under its Moon to Mars program to develop new capabilities in the Australian space sector, including foundation services for lunar exploration missions [1]. The initiative aims to demonstrate and progress Australian exploration capabilities with remotely operated and autonomous Australian robotic lunar assets, contributing to NASA's Artemis program. The Consortium led by Lunar Outpost Oceania has been selected for Stage 1 of the initiative, which includes the development of a foundation services rover platform capable of collecting lunar regolith and delivering it to a NASA in-situ resource utilization facility. Lunar Outpost Oceania will be working with a consortium that includes EPE, BHP, Northrop Grumman Australia, RMIT University, the University of Melbourne's Space Laboratory and others to develop the rover platform.

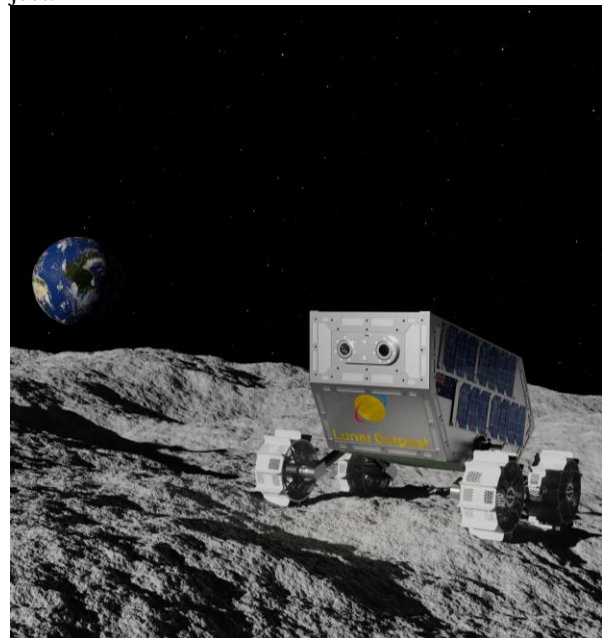
Mission: The primary objective of the lunar rover is to deliver lunar regolith to the ISRU facility on the surface of the moon. This will require the rover to survey the environment, locate and acquire the regolith, transport it to the designated delivery zone, and deposit it at the ISRU facility. The rover will repeat this process until the required amount of regolith is delivered. The rover is expected to become more autonomous and learn from its environment through these repetitions. Additional tasks that can be performed by the rover include loading and unloading regolith, constructing regolith stores, conducting remote asset inspection, performing surface preparation, and carrying out end-of-life tasks.

Lunar Outpost Oceania: Expanding its presence from the U.S. and EU, Lunar Outpost announced the formation of Melbourne-based Lunar Outpost Oceania (LOOC), a wholly owned subsidiary established to support and accelerate the Australian aerospace industry. LOOC will leverage the knowledge from prior missions while building local Australian expertise to drive a successful Moon to Mars Trailblazer mission and invigorate Australia's emerging space industry.

LOOC and the Consortium will utilise an Australian-built evolution of the Lunar Outpost MAPP Rover platform for the Trailblazer mission, modelled after Lunar Outpost's South Pole M1-MAPP lunar rover. M1-MAPP is the premier commercial Lunar Surface Mobility Platform, with extensive capabilities for lunar surface operations. MAPP has the capability to traverse 2+km with payloads onboard, at an average speed of 1.7 cm/s and a max speed of 10 cm/s. MAPP has also performed integration compliance checks with all the CLPS lander providers, allowing great flexibility and

rapid integration with the as-yet unselected Trailblazer lander.

The MAPP Rover is largely designed using flight-heritage high-TRL (Technology Readiness Level), COTS (Commercial Off The Shelf) components to reduce development cycle time and buy down both development and schedule risks; many mission-critical components have already been spaceflight-qualified and flight-proven on prior missions. MAPP provides the ASA with a fully prototyped, functionally tested, Protoflight-qualified baseline solution, requiring only minor, non-mission-critical adaptation to meet the Trailblazer requirements. Lunar Outpost also has a second mission, supported by NASA's PRISM program, to the equatorial Reiner Gamma lunar region; this 2024 Mission 2 will also be completed ahead of Trailblazer, further de-risking key MAPP rover technologies. MAPP's flight heritage on NASA missions will also provide an abundance of opportunities to the ASA through this project.



Trailblazer: The primary objectives of the Trailblazer program are to develop a rover capable of collecting lunar regolith and delivering it to a NASA science ISRU facility, demonstrate the ability of Australian capability to support international missions, and inspire the Australian public. The intended outcomes of the Trailblazer program include Australia being recognized as a provider of exploration services, an Australian asset operated on the Moon, improved collaboration with international space agencies including NASA, stimulated investment in the foundation services capability, growth

in Australian space capability, increased interest in STEM and related highly skilled careers, galvanization of national pride in Australia's space activities, and increased community engagement in space activities.

The Trailblazer outcomes include recognition of Australia as a provider of exploration foundation services capability with remotely operated and autonomous Australian robotic lunar assets, Australia's foundation services automation capability on the lunar surface is demonstrated, and Australia's ability to safely and effectively manage interoperability between assets deployed on the lunar surface is proven.

Australian Space Agency: The ASA's recognition of Australia's world-leading remote operations skills and experience is based on the country's strong track record in the mining and resources sector. Australia has a long history of remote operations in the mining industry, where companies have been using advanced robotics and automation technologies to increase efficiency and safety while reducing costs. This experience has enabled the country to develop a skilled workforce and a range of advanced technologies that are well-suited to support space exploration missions.

In addition to this, the ASA is also taking advantage of Australia's unique geographic location to provide remote operations support to space missions. Australia is well-positioned to provide support to space missions in the Asia-Pacific region and beyond, due to its proximity to the equator and its extensive network of ground stations and communication facilities. This provides an ideal location for remote operations, as it allows for real-time monitoring and control of space assets, as well as rapid communication with other mission partners.

By leveraging these strengths, the ASA is seeking to develop capabilities that will support the emerging space exploration markets. These foundation services are critical for building a sustained off-earth presence and supporting permanent outposts. They encompass a wide range of operational activities, including monitoring and inspection, planning and logistics, civil construction, materials transport and cargo handling, remote maintenance, and component manufacture and assembly.

NASA Partnership: Australia has formed a partnership with NASA to give Australian businesses and researchers the opportunity to showcase their knowledge and capabilities in a project that can support NASA's Artemis program. NASA has offered a flight to the lunar surface in 2026 for an Australian foundation services rover that can pick up and transfer lunar regolith to a NASA-operated in-situ resource utilization unit (ISRU). The Agency has signed an agreement with NASA to enable discussions leading up to a mission concept review (MCR), followed by system

requirements review (SRR) and preliminary design review (PDR) for the foundation services rover. These responsibilities must be met for NASA to transport the foundation services rover to the lunar surface no earlier than 2026.

Consortium: Lunar Outpost Oceania and fellow co-lead EPE have put together a consortium fortified with depth and expertise. Lead organisations include BHP, Northrop Grumman Australia, RMIT University's Space Industry Hub, and University of Melbourne's Space Laboratory. University of Adelaide, Inovor, Australian National University, and Element Robotics. Colorado School of Mines and Saber Astronautics will provide specialist contributions, and Australian Industry Collaborators include Titomic, One Giant Leap, VIPAC and CD3D.



References: [1] <https://business.gov.au/grants-and-programs/moon-to-mars-trailblazer>