20th IAA SYMPOSIUM ON BUILDING BLOCKS FOR FUTURE SPACE EXPLORATION AND DEVELOPMENT (D3)
Systems and Infrastructures to Implement Sustainable Space Development and Settlement - Systems (2A)

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NASA ENVISIONED FUTURE PRIORITIES PLAN FOR IN SITU RESOURCE UTILIZATION (ISRU)

Abstract

Introduction: The National Aeronautics and Space Administration (NASA) of the United States of America (US) has initiated the Artemis Moon to Mars program to send astronauts (the first woman and person of color) back to the lunar surface, create a sustainable human lunar exploration program, and lead the first human exploration mission to the Mars surface in the 2030's [1]. A major objective of this program is to characterize the resources that exist on the Moon and Mars, and learn how to utilize them for sustained and affordable exploration. Commonly known as In Situ Resource Utilization (ISRU), the search for, acquisition, and processing of resources in space has the potential to greatly reduce the dependency on transporting mission consumables and infrastructure from Earth, thereby reducing mission costs, risks, and dependency on Earth.

ISRU is Enabling: Through the extraction and processing of resources into mission commodities such as rocket propellants, life support consumables, and fuel cell reactants, ISRU enhances and evolves the cis-lunar, lander, and surface transportation systems required for human exploration; expanding and ehancing HOW humans get to explore and return from the Moon. Through the extraction and processing of resources into metals, silicon, and other manufacturing and construction feedstock, ISRU enhances and allows for the expansion of critical infrastructure through in situ manufacturing and construction capabilities needed for WHAT humans do on the Moon and in cis-lunar space. Because of this, ISRU supports and enables commercial involvement beyond NASA and governmental agencies by both lowering the cost of sustained transportation to/from/on the Moon as well as supporting the market required for needing these transportation systems.

Strategic Vision: To achieve this vision, NASA's Space Technology Mission Directorate (STMD) ensures the coordinated development of ISRU and other critical space and surface infrastructure elements such as propulsion, power, manufacturing, construction, and robotics through the Strategic Technology Architecture Roundtable (STAR) process. Through STAR, an integrated framework and process has been created allowing for capabilities and technologies to be linked and assessed, gaps to be identified, specifications and metrics to be established, and provide a means to prioritize and implement technology development and missions. For lunar ISRU, three primary areas of development have been initiated, (1) understanding, mapping, extracting, and processing water and other volatiles found in polar permanently shadowed regions (PSRs), (2) methods, technologies to extract oxygen from regolith, and (3) methods, technologies, and use cases for metals, silicon, and other feedstock commodities extracted and produced from lunar resources. This presentation will briefly discuss the STAR process and elaborate on the current status and future plans for ISRU development, demonstration, and architecture implementation of NASA's Envisioned Future Priorities plan for ISRU.

References: [1] NASA's Plan for Sustained Lunar Exploration and Development (2020) https://www.nasa.gov/sites/defa