

**Restructuring:** Since the initiation of the United States (US) Artemis program to send astronauts back to the lunar surface, create a sustainable human lunar exploration program, and lead the first human exploration mission to the Mars surface, the National Aeronautics and Space Administration's (NASA) Space Technology Mission Directorate (STMD) has performed a series of initiatives to better plan, focus, and coordinate technology and flight development activities. This started with the Strategic Technology Architecture Roundtable (STAR) process that created an integrated framework and process to allow capabilities and technologies to be linked and assessed, gaps to be identified, specifications and metrics to be established, and to provide a means to prioritize and implement technology development and missions. A critical part of the STAR effort was the establishment of a Strategic Framework that organizes all work under four major Thrusts (Go, Land, Live, and Explore). In this framework, all STMD work can be categorized and linked between Capability Areas, and technology gaps can be identified and addressed. To further guide development of ISRU technologies and systems on the ground and demonstrate these capabilities on the Moon and Mars, STMD created and released the ISRU Envisioned Future Priorities (EFP) strategic plan in 2022 and updated it in 2023. While lunar ISRU technology development had already started, these publicly released strategic plans have been used to guide and prioritize technology development and assess the progress in achieving the vision. Since the release of the ISRU EFPs, there have been several significant activities/events that have occurred with respect to human lunar and Mars exploration that requires NASA STMD to restructure and reprioritize its organization and work. One has been the release of the Artemis Architecture Definition Document (ADD) Revisions 1 and 2. While these documents included ISRU as a sub-architecture, the ADD focuses primarily on the Human Lunar Return (HLR) and Foundational Exploration (FE) stages of human lunar exploration where ISRU products are not utilized, and the Mars ascent propellant strategy for the initial human Mars mission concept does not utilize ISRU-derived propellants. This has now led to the initiation in 2025 of joint human exploration/STMD studies and tasks to better define what, when, and how ISRU will be incorporated into the Artemis Moon to Mars campaign. The second activity/event has been the effort to reprioritize all STMD work around customer priorities. At the Lunar Surface Innovation Consortium (LSIC) Spring Meeting in 2024, STMD

released the results of the Shortfall Priority Review and Ranking process with the goal of utilizing the results to support future technology development and funding decisions. The establishment, review, and ranking of the 187 STMD Shortfalls has now led to a further focusing of all the Shortfalls into Capability Goals to address the Shortfalls, and from these Roadmaps to close the Shortfalls. At the same time, STMD management initiated a reorganization of the mission directorate and its work from an organization centered around Technology Readiness Level (TRL)-based solicitations and programs, to an organization centered around Domains and Capabilities. Finally, NASA and particularly STMD has faced a series of budgetary shortfalls for the last several years, leading to the need to reassess development and flight mission plans. Because these activities are going on at the time of abstract submission, the presentation at the Space Resources Roundtable will provide an overview of these recent activities and how ISRU technology and flight development efforts are being restructured and refocused.

**Progress:** In 2017, the United States National Aeronautics and Space Administration (NASA) initiated the Artemis program to send astronauts back to the lunar surface, create a sustainable human lunar exploration program, and lead the first human exploration mission to the Mars surface. In 2018, NASA began transitioning the focus of In Situ Resource Utilization (ISRU) development from Mars to the Moon. In 2019 NASA started to outline the main goals and objectives for lunar ISRU development, refocus Mars ISRU work where possible, and began to implement the Leader/Follower strategy for lunar polar water mining and oxygen from regolith ground development and flight demonstrations leading to a Pilot plant system demonstration. These development and flight strategic plans have been presented in various forums starting in 2019 with a presentation at the Space Resources Roundtable titled "Current NASA *In Situ* Resource Utilization (ISRU) Strategic Vision" and at the 2<sup>nd</sup> Mining Space Summit in Luxembourg titled "What's Next for Space Resource Utilization?". Since 2019, NASA has been funding a significant amount of technology development work to advance lunar ISRU within NASA and with industry and academia though numerous solicitations and challenges. NASA also initiated technology demonstration and flight missions associated with ISRU as well as missions to advance capabilities needed to support ISRU resource assessment, extraction, and processing through

Artemis, the Space Technology Mission Directorate (STMD) Flight Opportunities (FO) and Technology Demonstration Mission (TDM) programs, and the Science Mission Directorate (SMD) Commercial Lunar Payload Services (CLPS) program. Because missions and development activities are currently going on, the presentation at the Space Resources Roundtable will provide an overview of the progress that has been made since 2019 on NASA's ISRU technology development and flight implementation plans and objectives.