THE LUNAR SURFACE INNOVATION CONSORTIUM IN-SITU RESOURCE UTILIZATION GROUP: STATUS UPDATE AND PATH FORWARD. J. Berdis, C. A. Hibbitts, M. Nord, R. Miller, P. Burke, A. Coburger, Johns Hopkins Applied Physics Laboratory, 11100 Johns Hopkins Rd., Laurel, MD, 20723 (Jodi.Berdis@jhuapl.edu).

Introduction: The Lunar Surface Innovation Consortium (LSIC) was established by NASA's Space Technology Mission Directorate and is managed by the Johns Hopkins Applied Physics Laboratory. The primary goal of the LSIC is to bring together universities, non-profit institutions, commercial companies, NASA, and other government agencies to identify the technical capabilities and challenges involved in establishing a sustained presence on the Moon. LSIC consists of four Focus Groups, and the goal of the In-Situ Resource Utilization (ISRU) Focus Group is to facilitate the development of ISRU-related technology to enable a sustained presence on the surface of the Moon, including fostering communication within and between members of the community.

Past Achievements: Achieving this goal requires the ISRU Focus Group to be active on multiple fronts. We identify gaps in the technologies that are needed for a sustained presence in order to enable industry's development of ISRU technologies. We have hosted approximately one workshop per year since inception, which has included, but is not limited to, the "Supply and Demand Workshop" in 2020, which led to the determination that the approximate amount of O_2 usage will be on the order of 10s to 100 metric tons/year.

Building off of interest from the community to further investigate O_2 extraction from regolith in lunar gravity, we have conducted research on preliminary computational Fluid Dynamic (CFD) models of electrolytically-produced O_2 bubbles growing and detaching from an electrode. We have modeled water electrolysis (as a control), molten regolith electrolysis (MRE), and molten salt electrolysis (MSE) in Earth's gravity, lunar gravity, and martian gravity. Different electrode orien-tations with respect to the g-vector have also been test-ed. Results were used to develop more detailed models and techniques to mitigate decreased electrolytic efficiency in lunar gravity, and have been approved for publication in Frontiers in Space Technologies [1].

Furthermore, we are working torward understanding and defining the needs for a Lunar Proving Grounds (LPG), at which technology developers could achieve system-of-systems testing to prepare for system-level and system of systems operations on the lunar surface. We led the organization of an LSIC-wide workshop on LPG Definition, and started the conversation for defining the needs of the users. Several needs identified include a focus on integration, validation, lifecycle testing, humans-in-the-loop, digital engineering tools, and international and small business accessibility.

This Next Year: Over this next year, the ISRU Focus Group will direct its efforts into three specific areas. These include (1) a focus on system integration, (2) integrating our efforts with those of other focus groups, Surface Power, Excavation & Construction, and the newly formed Crosscutting Capabilities, and (3) identifying gaps and paths forward for O_2 from regolith ISRU systems to be deployed on the lunar surface.

Toward the end of 2023, the ISRU Focus Group conducted an "End-Of-Year" Survey to assess what aspects worked, what did not work, and what the community would like to see in 2024. On a question regarding telecon meeting styles, a majority of respondents indicated they appreciate the seminar style, and many are interested in working-style meetings with plenty of time for networking. As a result of these survey findings, we intend to substitute in several "working" monthly meetings intermixed throughout the traditional seminar monthly meetings dedicated to addressing open technical and knowledge gaps in ISRU, especially system-level gaps.

The LSIC Oxygen From Regolith (O_2fR) systems study aims to examine the interconnectedness of various subsystems including regolith handling, oxygen production, oxygen cleanup, oxygen storage, power, communications, thermal management, and others. The objective is not to establish interface standards, but rather, to enhanced community understanding of system-level concerns. We look forward to reporting out to the community (pending NASA approval) on our progress and findings throughout this study, and we welcome any inputs from the community.

Conclusion: We continue to invite participation in these activities through active involvement with the Focus Group, and are excited to continue engaging with the lunar ISRU community in 2024.

References:

[1] Paul A. Burke, et al., 2024. "Modeling Electroly-sis in Reduced Gravity: Producing Oxygen from In-Situ Resources at the Moon and Beyond." *Front. Space Technol. Sec. Space Exploration*, Volume 5.

doi: 10.3389/frspt.2024.1304579