

A NOVEL SYSTEM FOR TRANSFERRING COMMODITIES ACROSS THE LUNAR SURFACE. S. Ziegler, V. Vuong, and R. Sullivan, Space Kinetic Corporation (2518 60th Ave., Oakland, CA 94605), scottziegler@spacekinetic.com

Introduction: To establish a sustainable human presence on the lunar surface and beyond, NASA has prioritized in-situ research utilization (ISRU) and Excavation, Construction, and Outfitting (ECO) as key components of its “Live” strategic thrust [1]. NASA’s commitment to ISRU and ECO is prompting a strong industry response, as a number of private sector players are focused on excavating and processing lunar resources [2].

Development of the lunar economy will be predicated on a concerted ECO effort from government and industry players. Initial site surveying and resource prospecting will ultimately facilitate large scale ISRU processing and infrastructure construction [3].

Apart from its role in ECO, the emerging ISRU value chain will likely be structured around making and distributing propellant; a robust ISRU propellant market will decrease the cost of accessing fuel for space operations beyond Earth. In fact, PwC predicts that the cumulative market for ISRU-derived propellant will approach \$63 billion by 2040 [4].

Supporting Measurement and Instruments on Polar Ice Data: However, before the ECO & ISRU ecosystems develop on the moon, the scientific community must be able to better understand the moon’s natural resources. Against this backdrop, Space Kinetic is developing a novel system for transferring commodities across the lunar surface. Our system is high speed and highly scalable, allowing the scientific community to access more samples and excavation sites on the lunar surface. Its modular design means that rovers on the lunar surface can tap into our transfer network wherever they are.

Ultimately, this will allow researchers to send samples throughout our network to conduct sample analysis in a centralized location, rather than relying on heavier rovers that perform analysis on-site. A centralized lab will lower operational costs associated with future research while allowing expanded service areas.

Description of the Technology: Our system leverages a series of multi-functional launcher/receiver modules to transport commodities. Each module is equipped with a robotic arm, which launches capsules containing resources (e.g. samples, regolith, propellant, etc.) on a predetermined ballistic flight trajectory toward a receiving module. After the receiving module accepts inbound capsules, they will be released via an automatic unloading system. Our system can load, transfer, and unload different materials that will be useful to the exploratory and scientific

community—including regolith, electronic systems, and samples from the lunar surface.

System Specifications and Capabilities: If configured to meet NASA’s Watts on the Moon or Break the Ice Challenge requirements (three kilometer service range), our system can transfer 60 kilograms of materials per hour (three kilograms transferred every three minutes). Each transfer will take only 50 seconds to travel three kilometers, using a total input of 8kJ per payload. Relying on our system will both reduce the number of rovers needed on the lunar surface and mitigate wear and tear on the rovers that are needed, decreasing operating costs for our partners. Furthermore, our system will be lightweight (each module weighing 50 kilograms), reducing lift costs and making the movement of commodities on the lunar surface affordable for more participants—including smaller research organizations and startups.

Development Goals: Our system has attained TRL 3. We are currently developing our third prototype with the goal of attaining TRL 4 by the end of 2022. We are on pace to complete TRL 6 testing by the end of 2024. Our current trajectory will allow us to be fully operable at scale by 2027. We aim to be ready for limited use by late 2025 to support exploration missions at small scale; these early missions will serve as test beds for future full scale operations. Ultimately, Space Kinetic can help the scientific community spend more time exploring, prospecting, and excavating resources on the lunar surface—and less time transporting the resources that it collects.

References:

- [1] *NASA Strategic Technology Framework: Requests for Information*. NASA. (2022, April 11).
- [2] *NASA Awards \$500,000 in Break the Ice Lunar Challenge*. NASA. (2021, August 18).
- [3] *LIVE: Excavation, Construction, and Outfitting*. NASA STMD. (2022, May).
- [4] Scatteia, L., & Perrot, Y. (2021). Lunar market assessment: market trends and challenges in the development of a lunar economy. *PwC Space*, 30–31.