

# Integrated System-of-Systems Modeling Tools for Site Selection

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# LUNAR SURFACE ARCHITECTURE ANALYSIS

## Infrastructure Services



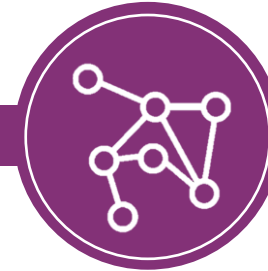
Sustainable Lunar Surface Architecture depends upon complex infrastructure services

## Business Case



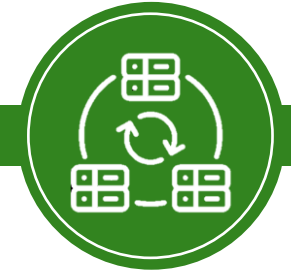
Value Proposition and Cost Analysis require demand forecasting & understanding operational scalability

## End-to-End Models



Models & Tools are necessary to capture end-to-end infrastructure of various mission operations

## Global Optimization

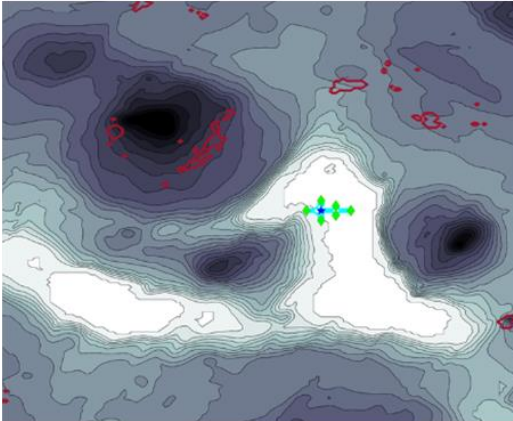


Integrated, model-based framework enables optimization and analysis at the pace of industry development

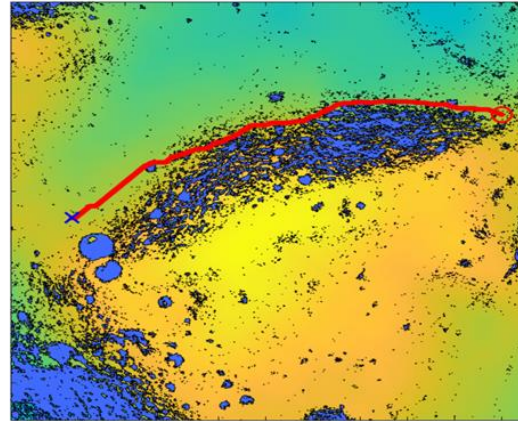
System-of-Systems approach including technical, operational, business, and demand models represents a wholistic infrastructure roadmap

# Lunar Economy Analysis Platform

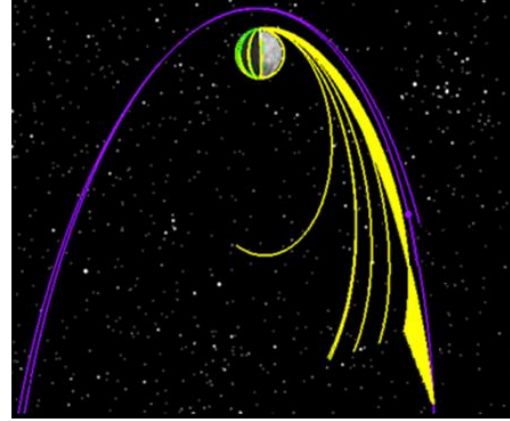
Optimize Power Grid Architecture



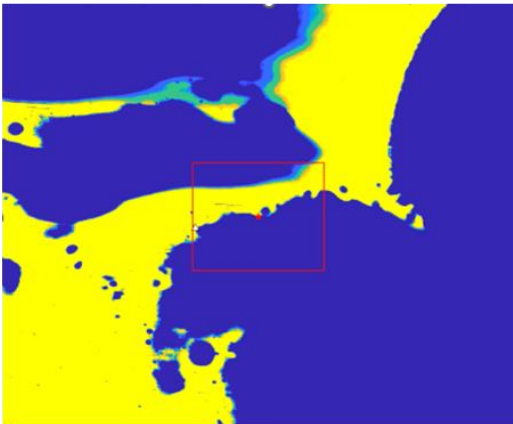
Multivariate Lunar Path Planning



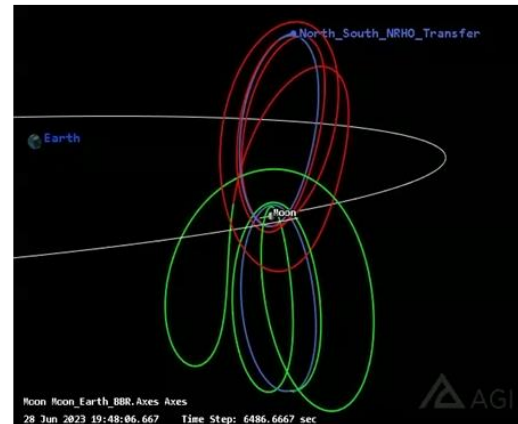
Model Mission Prop Consumption



Analyze Illumination vs Height, Time



Refueling Logistics & CONOPS



Calculate ISRU Infrastructure Needs



Integrated lunar infrastructure system-of-systems analyses

Modular tools in a common environment

Object-oriented modeling

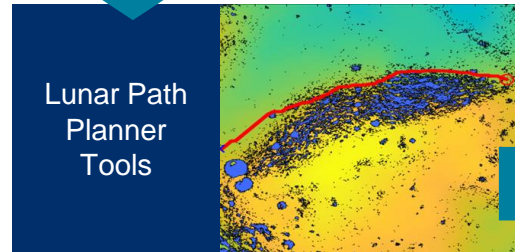
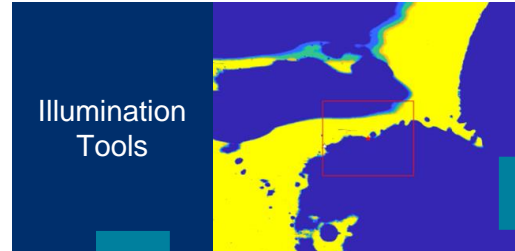
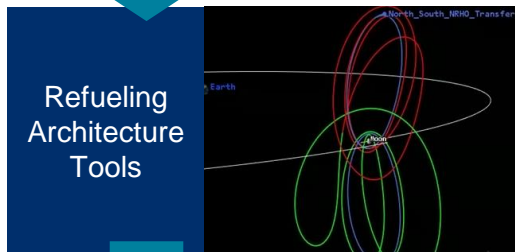
Common data structure

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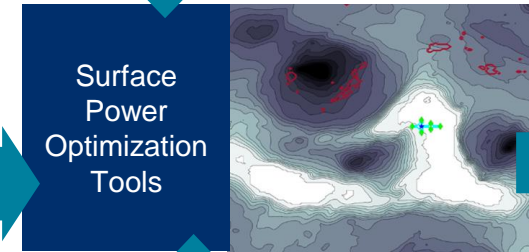
## Design Features

# Example Integrated System-of-Systems Model

**INPUT:** Artemis Surface Missions Over Time



Height-Varying Illumination Data

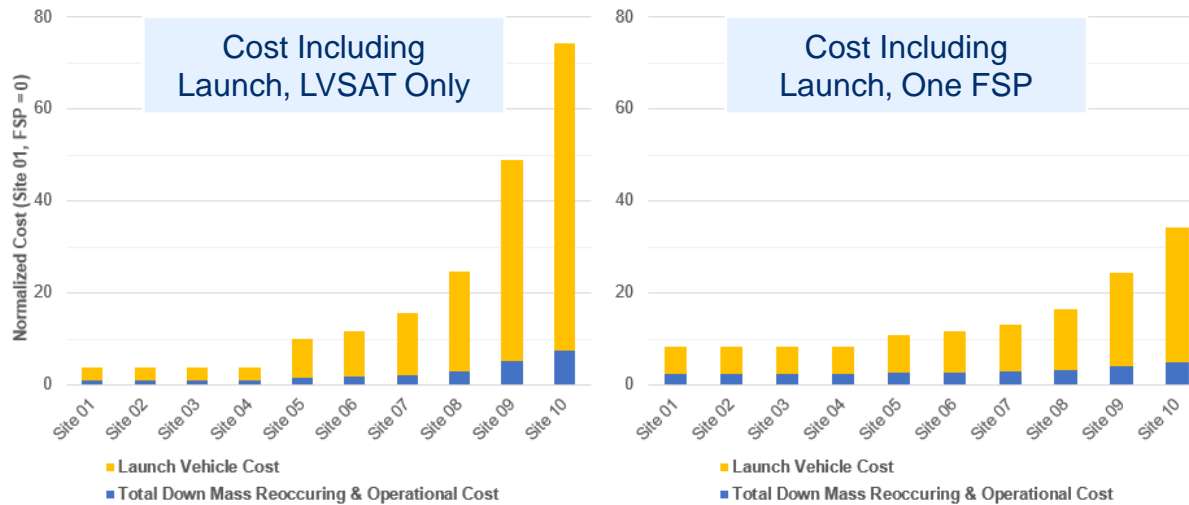
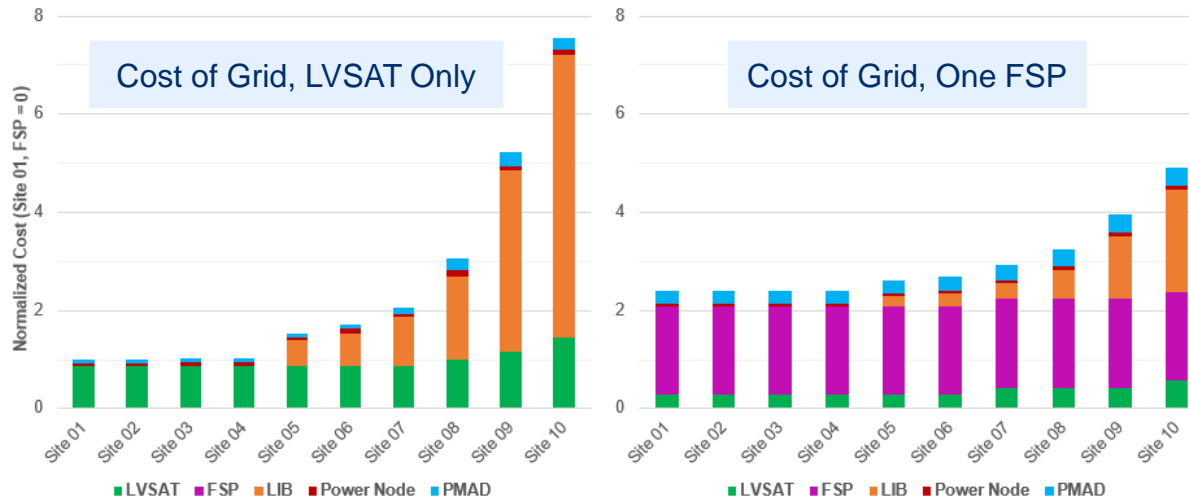


**OUTPUT:**

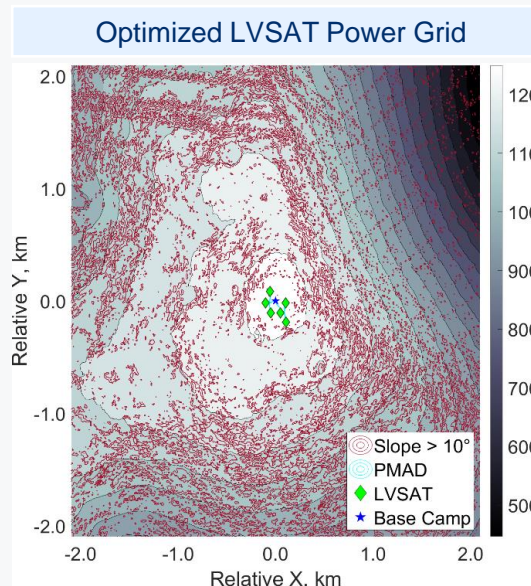
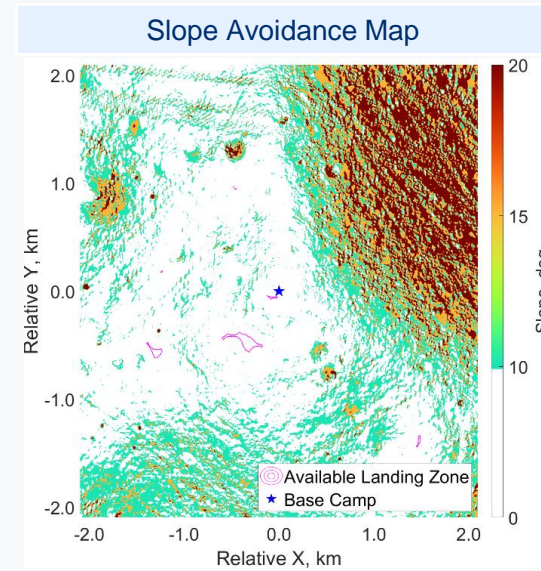
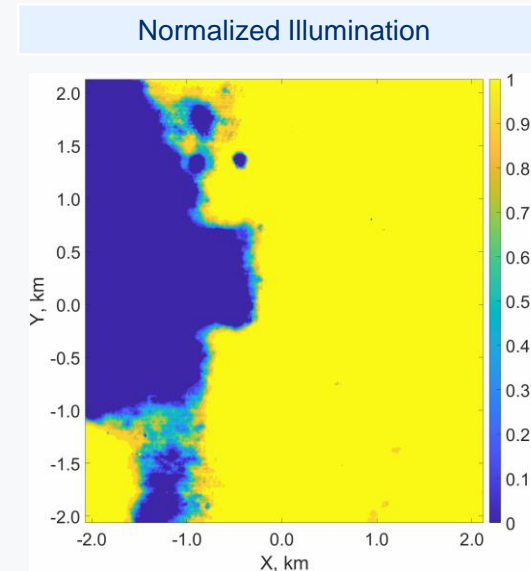
Optimized Architecture for Propellant Refueling, ISRU Commodity Production, & Surface Power Grid

Includes catalog of all elements required, total mass, total power usage, and recurring cost estimate

# Basecamp: Site Power Study

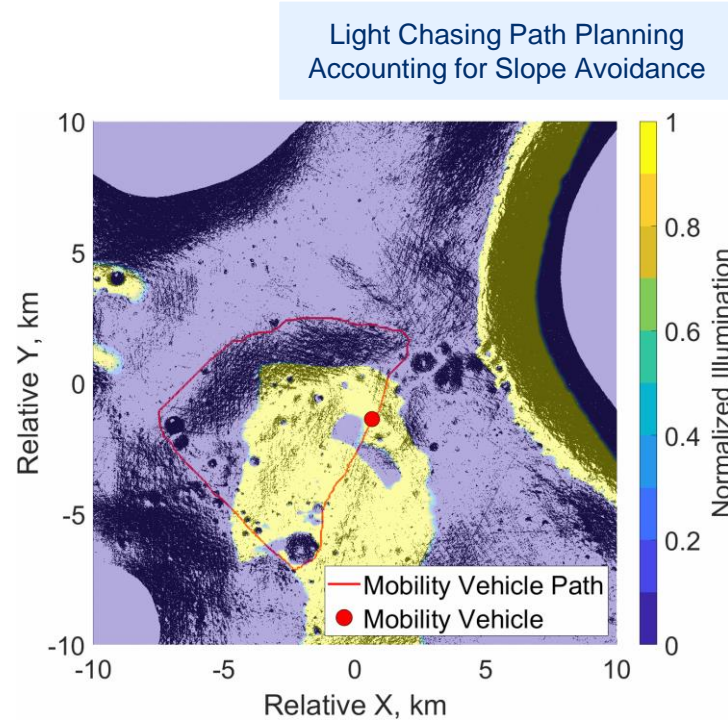
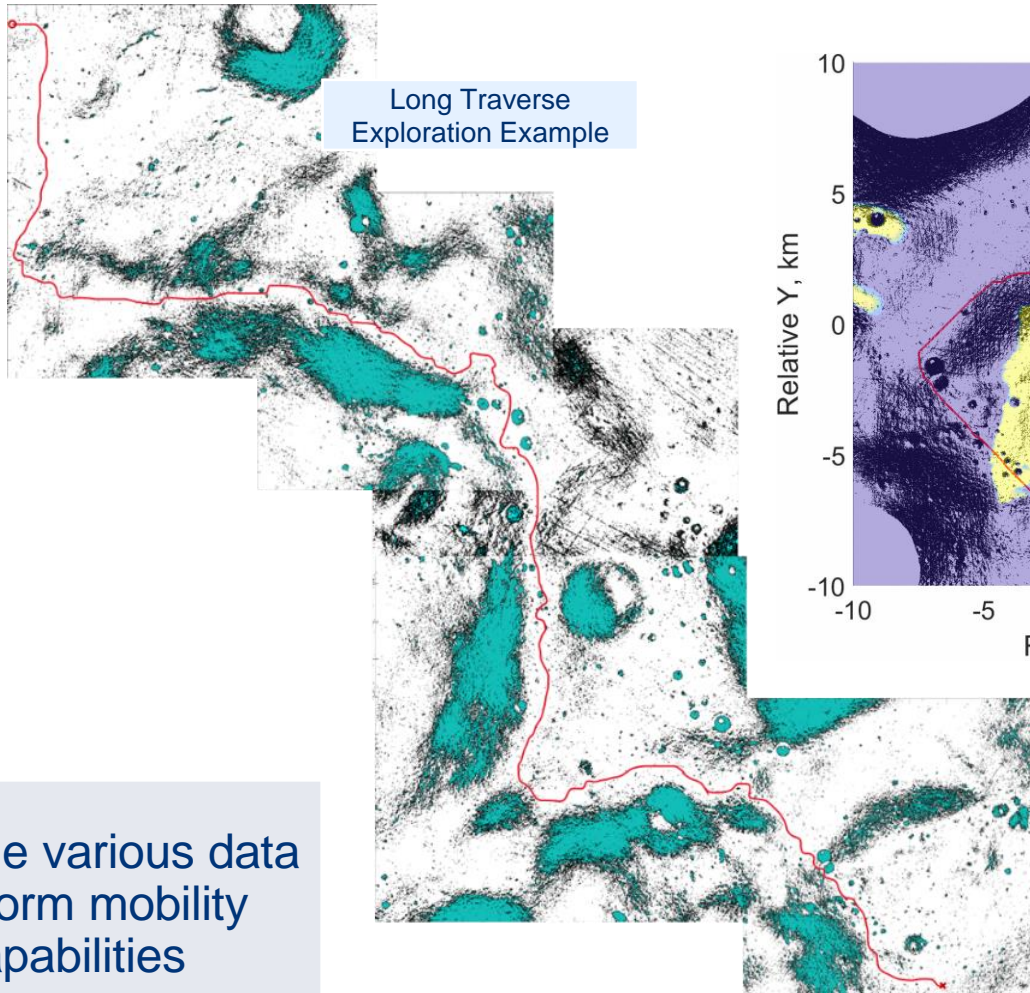


Comparative Cost of Basecamp Options

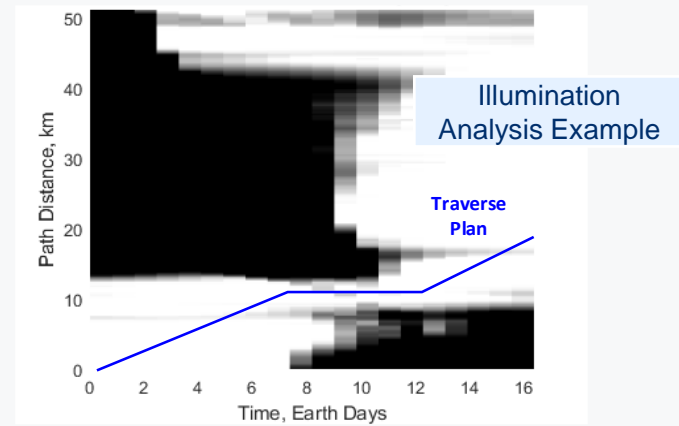
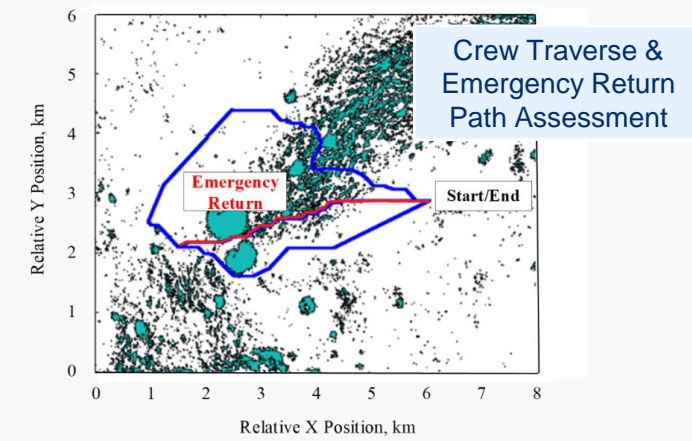
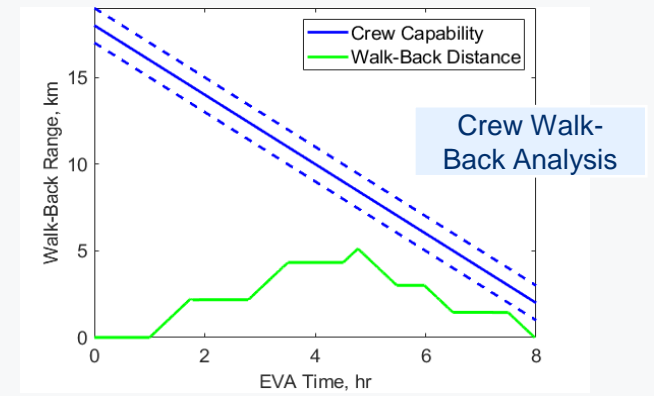


Value proposition analysis drives site selection

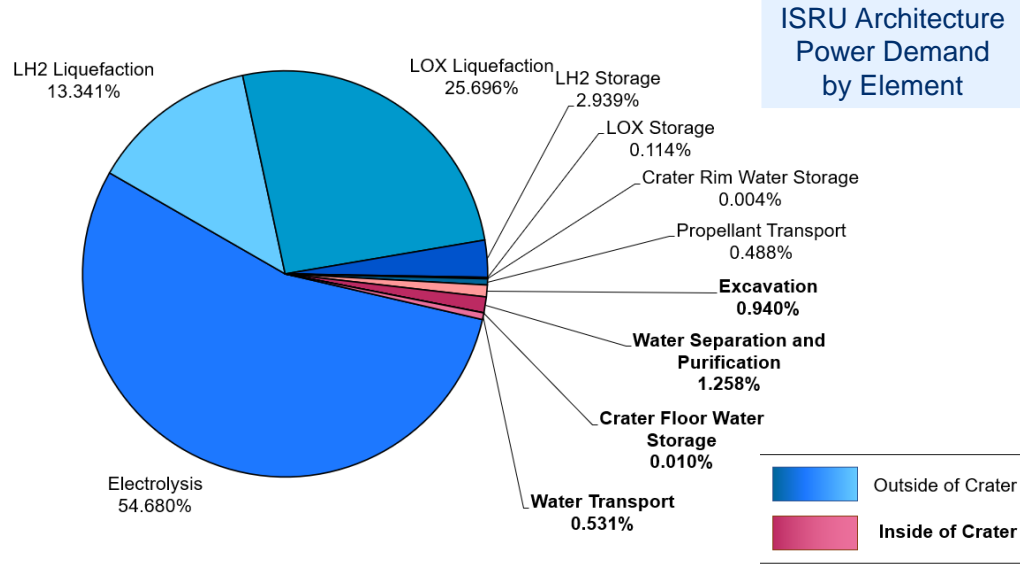
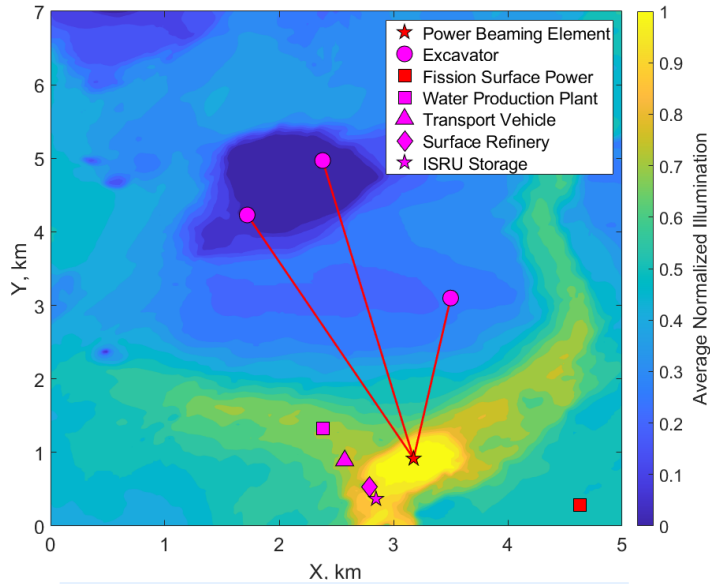
# Exploration & Mobility



Combine various data to inform mobility capabilities



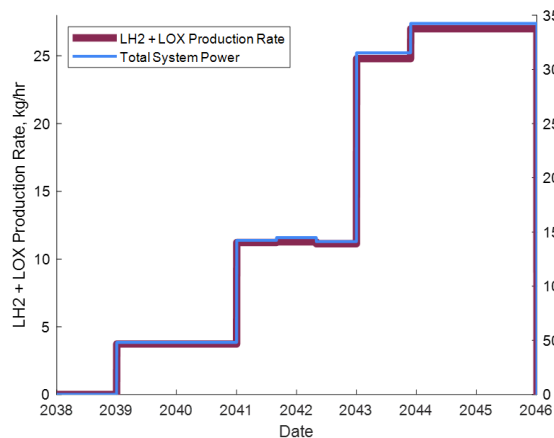
# In-Situ Resource Utilization: System Modeling



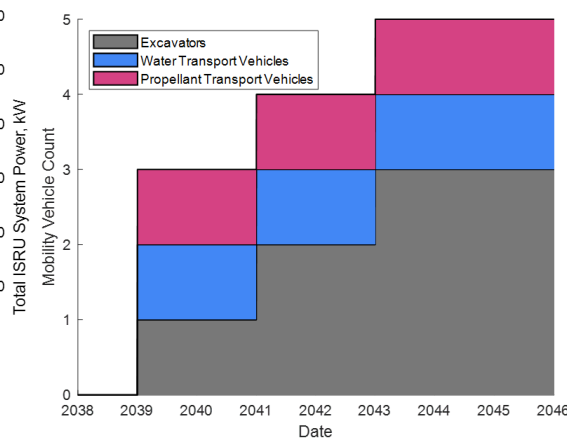
Map technical capabilities to demand forecasting

Determine total infrastructure of interdependent elements

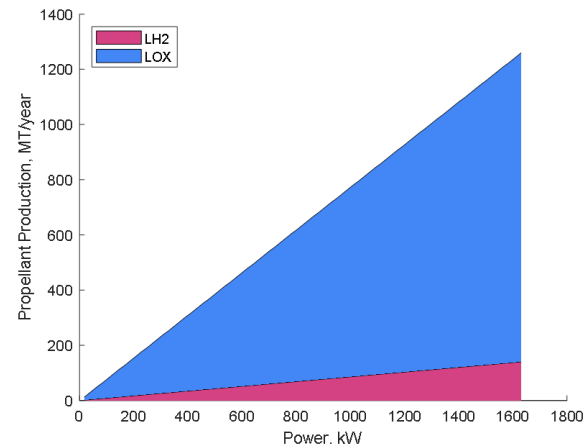
ISRU System and Power Location Model



Production Rate & Power over Time



Mobility Vehicle Count over Time



Production Rate vs. Power

# Closing Remarks

- Lockheed Martin Space has captured a number of relevant perspectives on site selection and lunar infrastructure within the following AIAA ASCEND paper:
- Please reach out if you have comments, questions, or are interested in comparing model-based data artifacts on lunar infrastructure systems



## System-of-Systems Analysis Approach to Establishing Lunar Infrastructure

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