15th IAA SYMPOSIUM ON BUILDING BLOCKS FOR FUTURE SPACE EXPLORATION AND DEVELOPMENT (D3)
Systems and Infrastructures to Implement Future Building Blocks in Space Exploration and Development (2)

Author: Mr. Mansoor Shar
International Space University (ISU), France

Mr. Michael Klas
UNSW Australia, Australia

ENERGY CONSIDERATIONS FOR IN-SITU RESOURCE UTILISATION IN A FUTURE SPACE-BASED ECONOMY

Abstract

Energy considerations play a vital part in the development of any economy. Space is becoming cheaper and more accessible partly due to the increased commercialisation of the LEO environment through better transport infrastructure. This is likely to extend further out into the solar-system in the coming decades and will necessitate sustainable energy resource utilisation in order to accelerate a space-based economy. To be fully effective, ISRU requires self-sustaining groups of systems independent from the resources, and ultimately the control, of Earth. This paper will discuss the tradeoffs of different self-sustaining systems of varying size and complexity to address the energy considerations of a developing space-based economy. The level of a systems self-sustainability can be measured by the system's capacity to sustain itself without external influence and by the timeframe this self-sustainability can be maintained. On a small scale biotechnological resource extraction methods such as biomining and biomethanation could help fill the requirements for ISRU in self-sustaining biospheres. Passive solar radiation for thermoregulation, solar photovoltaics for power and microbial metabolic heat generation could work together to create a self-sufficient robotic plant. This paper further seeks to address the gap between in-space energy production and potential impact of sustainable in-space energy infrastructure on a space-based economy. On a larger scale a space-based economic model would include aspects of resource extraction, space manufacturing, transportation, trade and construction to ultimately serve the expansion of humanity and development beyond Earth. A return on investment analysis is considered as part of a wider ecosystem enabling productive utilisation of such groups of systems, while factoring in potential implications on the wider terrestrial and space economy.

Keywords: Space Economy, Biotechnology, Asteroid Mining, In-Situ Resource Utilisation, Sustainable Energy