Paper ID: 95840
student

IAF BUSINESSES AND INNOVATION SYMPOSIUM (E6)
Interactive Presentations - IAF BUSINESS INNOVATION SYMPOSIUM (IP)

Author: Mr. Sukhjit Singh
Space Generation Advisory Council (SGAC), India

MARS AUTONOMOUS ENERGY GRID: SUSTAINABLE POWER GENERATION THROUGH CARBON-BASED RESOURCE UTILIZATION

Abstract

As humanity aims to establish a sustained presence on Mars, the need for reliable, self-sufficient energy sources becomes critical. Traditional energy supply methods relying on Earth-based resources are neither cost-effective nor logistically feasible for long-term missions. Addressing this challenge, our study introduces an innovative, sustainable energy generation approach that converts Mars' abundant carbon resources into rechargeable power sources to sustain essential equipment like rovers and other mission critical systems. This approach envisions a network of decentralized power stations distributed across key operational zones on Mars, forming a cohesive energy grid. By applying a robust modeling tool, we optimize station placement based on Martian terrain conditions, projected energy needs, and vehicle operational ranges to ensure efficient coverage and minimize energy gaps.

Our proposed energy conversion model specifically utilizes Mars' carbon resources to generate power through a chemical process. By harnessing solar energy with a semiconductor tailored to Mars' conditions, we can excite electron-hole pairs that react with Martian carbon dioxide, producing formic acid and carbon monoxide. Formic acid, in turn, powers fuel cells through its reaction with oxygen, releasing energy, water, and carbon dioxide as by-products. Further, we evaluate a combined Earth-Mars resource strategy, analyzing the cost and practicality of manufacturing components on Mars through in-situ resource utilization (ISRU) versus importing them from Earth. This study emphasizes the logistical and financial benefits of leveraging Martian resources, offering a pathway to a resilient and scalable infrastructure that supports a self-sufficient human presence on Mars through locally sourced energy solutions