

Space Resources (10)  
Space Resources (1) (1)

Author: Mr. Pascal Barbier  
Air Liquide, France, pascal.barbier@airliquide.com

Mr. Pierre-Alexis Joumel  
Airbus Defence and Space, Germany, pierre-alexis.joumel@airbus.com

Mr. yannick juanico  
Air Liquide, France, yannick.juanico@airliquide.com

AIRBUS - AIR LIQUIDE: COMMON VISION AND ROADMAP FOR A LUNAR INDUSTRIAL  
ECOSYSTEM

**Abstract**

For more than 50 years now, humans have not come back on the moon but remained in LEO thanks to international orbital stations. However, new programs have been raised recently for targeting a return of humans on the moon in the 2020s with an ambitious goal of having a permanent presence. Based on ISS experience, it will require a sustainable approach of operations in space. This trend already began with the development of private launchers that lower the cost for accessing space. From now on, a new step must be overcome to unlock permanent human presence on the moon. According to AIAA 5 technical challenges have been identified:

- Space transportation: reliable and affordable space transportation between earth and moon. It also includes the mobility on the moon with rovers for instance
- ISRU: possibility of using resources present on the moon such O<sub>2</sub>, H<sub>2</sub>O, metal
- Long-term habitation: habitat for allowing permanent life of humans. It especially addresses the challenge of life support and virtuous closed cycle operations
- Power generation Energy management: production and storage of energy to sustain lunar night and provide power for operations on the moon
- Human health: monitoring of human health and limiting effects of radiations, microgravity, ...

To overcome those challenges, many capabilities from space and non-space actors will need to be put together. Airbus and Air Liquide are taking the initiative to create an industrial movement leading the lunar resource value chain based on complementarity capabilities.

Airbus, with its wide space competencies and experience, and Air Liquide, with its long standing experience on gas management (cryogenics, energy, ...) pooled their expertises to tackle these challenges by focusing on the end to end value chain of oxygen and H<sub>2</sub>O (that could form H<sub>2</sub> and O<sub>2</sub>) on the moon. Indeed, the water and oxygen molecules are key for many challenges : space transportation (propellant and mobility), ISRU (water recovery), Long term habitation (life support) and energy management (FC and Electrolyzer). Airbus and Air Liquide identified a roadmap for providing water and/or oxygen molecules on the moon before the end of 2030. Airbus and Air Liquide can contribute to solving some technological challenges but others remains to be addressed.

Airbus and Air Liquide will present this common ambition and vision detailing technological gaps to be tackled.