
LUNAR ECONOMY: THE NEW FRONTIER IS MOON MINING



In the hectic rush towards the space conquest, a new challenge has been profiling on the horizon over the last few years: moon mining. The discovery through geological surveys of the impressive number of valuable resources on the moon has largely fascinated governments and private entities and expeditiously settled as the new frontier of the space sector. Water, helium, and rare earth metals (REMs) are only few of the resources that lately have fueled investments and partnerships to mine the moon, paving the way for unprecedented uses of the outer space assets and bringing Mars colonization closer.

In fact, helium-3 is a rare isotope that could be used for innovations in the energy sector, as for nuclear fusion, whereas water could support life and agriculture in space and be converted into rocket fuel to propel mankind further into the cosmos. Moreover, the satellite has become a new battlefield for the competition USA-China. In fact, more than 90% of the current world's production of REMs needed for electronics is held by the Asian superpower. Nowadays, not only these reserves have few years of expected endurance, and recycling alone will not be able to meet future demand, but the US are largely attracted by the possibility of competing on a level playing field with China for the rare earth metals control. The Moon Rush is therefore getting tainted by political intrigues and relevant economic implications.

In 2015, the US Commercial Space Launch Competitiveness Act was passed, supporting the private sector's right to mine the Moon, thus, spurring the pace of efforts. Only three years later, NASA presented to the world the Artemis program which aims at returning astronauts to the Moon by 2024, paving the way for eventual journeys to Mars in conjunction with private companies. Finally, in April 2020, during Trump mandate, an executive order was signed to incentivize mining of the Moon and other celestial bodies for resources. An "innovative and sustainable" US-led project was advocated to allow for long-term exploration and utilization which would eventually lay the ground for both building a lunar economy and starting Mars missions.

Furthermore, besides enlarging Nasa budget, the Tycoon also promoted two different actions in order to sustain the supremacy of his nation. On one hand, he instituted a new armed force, the so-called Space Force, mandated to protect the US and their allies' interests; on the other, he urged a renovation and revitalization of NASA administration, thus, intervening from an economic, strategic, but also political point of view. First, Russian space agency, Roscosmos, compared Trump's actions to those pursued during colonialism; subsequently, the Kremlin criticized the USA and admitted that any form of colonialization in space would be inadmissible at this stage.

The latest events in the space sector have therefore disregarded the 1979 Moon Treaty, a document stipulating countries would not mine resources in outer space, and the 1967 United Nations Outer Space Treaty stating that no nation can claim ownership of the Moon. According to Trump's executive order, space is not regarded as a "global common" by the United States, potentially opening an era of mining activities off the Earth without an international treaty allowing for it or possibly leading to a colossal legal battle with unexpected outcomes. Although mining our satellite is not expected to have significant effects on our lives¹, concerns have risen related to the environmental damage and related ethical issues, including the impact on future generations, the visual effect from Earth, and the cruciality of the Moon in human culture and heritage.

¹ The Moon has a mass of 73 quadrillion tons, even if we removed one metric ton from the Moon every day, it would take 220 million years to deplete 1% of the Moon's mass. Even that wouldn't be enough to cause a change of orbit or affect the gravitation that causes tides.

However, the question that comes spontaneous is how close we are to mining the Moon and it results that we are still in a taxiing phase, where the first challenge to overcome relates to the cost barrier. SpaceX, one of the private partners selected by NASA to reach the Artemis targets, is tackling this aspect by investing in research and development of reusable rockets with its Dragon craft which, according to the founder and CEO Elon Musk, "would revolutionize access to space". The outcome of such an intensive activity of research is Starship, a fully reusable transportation system designed to carry both crew and cargo to Earth orbit, the Moon, Mars and beyond. Starship is expected to be the world's most powerful launch vehicle ever developed, with the ability to carry in excess of 100 metric tons to Earth orbit.

Nevertheless, for mining to occur, existing infrastructure is required to be present on the lunar surface. At this stage, 3D printing could be the key to manufacture material and equipment on site. The challenges are also physical: crews working in the hostile environment of the Moon will have to endure temperatures varying from 123 °C to -233°C and will be exposed to hard radiation and abrasive dust grains. Additionally, the absence of gravity, with respect to the terrestrial one, is likely to complicate mining activities and the subsequent manufacturing processes. Finally, a further critical point is related to transferring lunar resources back to our planet.

In conclusion, if successful, the Artemis program will represent the first crewed lunar landing mission since Apollo 17 in 1972, the last lunar flight of the Apollo program. However, all the issues needed to be addressed to permit a fortunate moon mining process and a sustainable human presence on the secondary planet are still far from being resolved. Among them, a legal framework to coordinate nations' incursions on the celestial bodies is imperative to prevent a tragedy of commons also in the outer space. Hence, the way to the moon and to exploiting its resources is still remote and lunar mining keeps remaining a frontier, not a feasible opportunity that will concretize in the immediate future.