

Opinion: As space exploration and colonization expand, off-Earth resources will create a booming market

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The drive to explore deeper into space and establish colonies on other planets has intensified over the last decade, and with it the importance of space resources extraction.

Obtaining valuable resources and minerals, even in [extreme environments](#), has long been attractive to humans. We have a history of facing hazards in search of valuable resources. From the [gold rush](#) in the 1800s to the recent surge in space resources, humans have been willing to take risks to find and collect scarce and profitable materials.

With advances in [space technology](#), we're on the edge of the next gold rush—but not on Earth. Based on recent scientific and engineering breakthroughs and commercial interests, off-Earth mining is expected to begin in the next decade.

Potential mining sites include the moon, Mars and its moons, asteroids and even comets. Market predictions for lunar mining, particularly lunar water, project a multibillion-dollar industry by 2050. Although theoretical, these forecasts signal a worthwhile market, with Australia as a potential leader.

The motivation for off-Earth mining is multifaceted: access to an unlimited wealth of valuable space resources, the spirit of discovering new planets and the development of spin-off technologies to be used back on Earth.

NASA's Artemis program, which Australia supports via its signing of the Artemis Accords, is aiming for a lunar colony and eventually one on Mars. The only way to reduce the enormous costs of transporting resources from Earth will be through the establishment of self-sustaining infrastructure.

Water is an essential starting point. When converted to oxygen and

hydrogen, it can be used as a propellant for rockets for further space missions. Given the vast reserves of lunar ice, it's a sustainable and economical source compared with Earthly transport.

The Australian Center for Space Engineering Research, based at the University of New South Wales, is at the forefront of this endeavor, merging terrestrial mining engineering expertise with space research. The Off-Earth Mining Forum was founded in Sydney in 2013. Since then, it has run every two years. In August the year, the first non-Sydney-based event took place in Perth, Western Australia.

Its primary objective is to position Australia as a global leader in in-situ resource utilization by harnessing space resources to reduce potential risks of off-Earth mining. This encompasses using lunar regolith (soil) for construction or mineral extraction, focusing on lunar water.

However, off-Earth mining has many challenges: there are geological uncertainties—we don't know exactly where the water is and how much there is; infrastructural needs such as landing pads; social considerations—people have a strong emotional attachment to the moon; and financial constraints, with high risk but high potential return.

Mining is a challenging industry that constantly confronts extreme conditions and volatile markets. Despite these obstacles, mining has continued to attract businesses due to the potential for high financial returns. In many cases, mining operations have been a driving force behind the settlement of new territories.

Looking toward the future, the mining industry is working towards zero-entry mines (with no human access required) and invisible mines (low-impact, reduced-footprint mining sites) to reduce the effect on the environment, improve energy efficiency and achieve decarbonization.

Improved [social acceptance](#) and reputation are also critical for the mining industry's future. The space resources industry is motivated by colonization and creating a market for its product.

The mining and space sectors both thrive in challenging environments, making collaboration essential. They can mutually benefit, with the mining sector gaining from [systems engineering](#) and autonomous technology, while space can leverage operational experience and market creation.

The path ahead is loaded with uncertainties, but merging [mining](#) knowledge with space exploration will be paramount in the years ahead.

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