Mining the moon for a nuclear future

The Chinese, as they have announced, will do it first

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The race to return to the moon is on. Earlier this month NASA unveiled its mission statement to revisit earth's satellite and create a permanent base there. While it may become the jumping off point for further exploration of our solar system and beyond, there are more earthly prizes in sight, with some scientists believing that it has the potential to solve the world's dependence on fossil fuels.

Mining the moon for fuel used in nuclear fusion reactors is among NASA's 200-plus set of mission goals and could precipitate another reason for other countries and private investors to join future lunar exploration.

The substance that has such large potential is an isotope called helium-3, a form of helium but with only one neutron instead of two.

It is extremely rare on earth as it is created during very active nuclear reactions, most commonly found on the surface of the sun, but here can only be found as a by-product of the maintenance of nuclear weapons.

Experts have estimated that the moon is a rich depository of the isotope with possible reserves that stretch meters down into the lunar soil that have been carried there by solar winds.

What makes helium-3 so attractive as an alternative future fuel source is its environmentally friendly credentials, as it does not produce radioactive waste.

However, while mining helium-3 from the moon will be one challenge, extracting energy from it is another, as it relies on nuclear fusion, rather than fission used in today's nuclear reactors.

Scientists have been working to prove nuclear fusion works but much of it still remains theoretical. It is thought to be at least 50 years from being proven to work on a large scale.

The potential, though, is enormous. It has been estimated that about 25 tons of helium-3, equal to just one payload of a space shuttle, would provide enough energy for the U.S. for a year at current consumption levels.

While NASA aim to have a moon base by 2025 other space agencies and companies have expressed an interest in the moon and its potential energy reserves.

"We are planning to build a permanent base on the moon by 2015 and by 2020 we can begin the industrial-scale delivery... of the rare isotope helium-3," said Nikolai Sevastianov, head of Russian space vehicle manufacturer Energia, at a seminar in Moscow in January.

His bold statement might have been more of a publicity drive for Energia rather than a clear commitment to a program, but China, which has committed itself to a space program to land men on the moon by 2017 has also stated its interest in helium-3.

"China's lunar project can incorporate the mining of helium-3 (HE-3) as a new, clean, efficient, safe and cheap nuclear fusion fuel. The foreign sales and internal uses of HE-3 will help offset the high price of maintaining a lunar base," wrote Stacey Solomone from the University of Hawaii in an article in Futures Research Quarterly.

With the three large powers racing to moon it will be interesting to see if the spirit of cooperation will pervade if such a revolutionary and potentially lucrative prize is up for grabs.

NASA has refuted any charges of national interest. Its Global Exploration Strategy canvassed 13 of the world's space agencies and the NASA maintains that it does not present a domestic agenda to win the moon for the U.S.

It is the high costs involved that will be the main reason for cooperation rather than competition. Building and running a permanently manned lunar base alone will be incredibly expensive.

The Government Accountability Office, the independent auditing arm of U.S. Congress, puts the price of NASA's lunar program to 2025 at $230 billion. "Typically a habitat is less than the cost of large rocketry," Michael Griffin of NASA told AP, and successfully utilizing the native materials on the moon will be a crucial to creating a viable base there.

Research at the Fusion Technology Institute at the University of Wisconsin has also suggested that the process of mining helium-3 would produce other minerals to support space settlements. Nitrogen, methane, helium, water, carbon-oxygen compounds and hydrogen produced from mining, could permit food growth and development of a water supply for lunar inhabitants.

Professor Manuel Grande of University of Aberystwyth led the British involvement of the European Space Agency's Smart-1 mission to observe the moon. He believes that focusing on mining self-sustaining minerals would be more beneficial than trying to harvest and then transport helium-3.

"It is dubious whether it will ever be economically viable even if nuclear fusion works commercially or if helium-3 is a better option than other elements available on earth," he told CNN.

"There are plenty of other minerals on the moon that would be easier to get at and help provide resources for a self-sustaining base. Oxygen could be derived from ilmanite reserves there and water could be extracted to make rocket fuel or sustain life on a base.

"Put it this way, I wouldn't buy shares in the moon for the economic return. Lunar tourism will be the first money maker there," Manuel Grande told CNN.