Electronic Design

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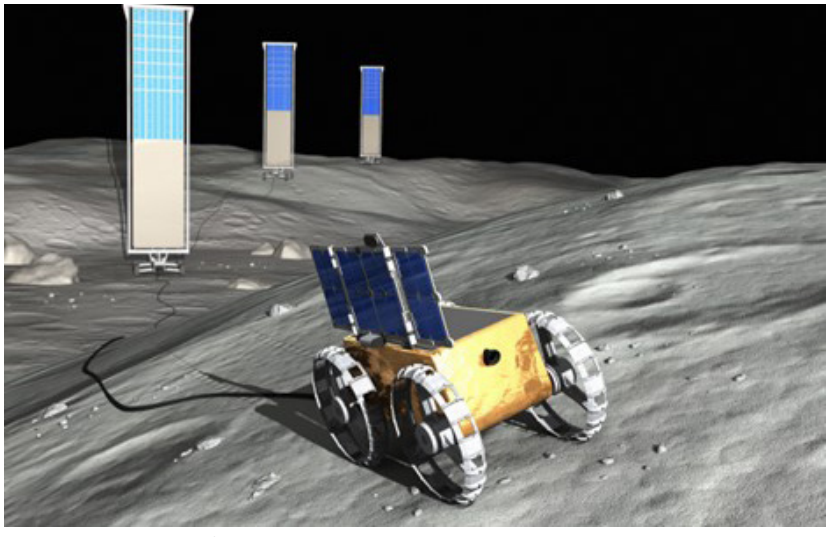
# Moon Mission: Powering the Lunar Surface

**We're going back to the moon, but more electrical power is needed to live there. NASA and selected companies will develop technologies to enable long-term exploration.**

NASA took "a second giant step for man," on July 25, 2023, opening the door for humans to "live off the land" on the Moon. It's awarding several contracts toward the construction of landing pads, habitats, and roads on the lunar surface, using nuclear power for energy.

The moon that NASA is striving to visit isn't the same moon that Neil Armstrong and other Apollo astronauts left behind some 50 years ago. Journeying to the Moon and returning to Earth was the first effort achieved during the Apollo era in the 1960s and early 1970s. Now, during the next phase, it intends to build a sustainable presence that will focus on the Lunar South Pole, where water exists in the form of ice.



**1. Here, Astrobotic's CubeRover unspools a cable to construct a power grid, initially by tying together solar-power towers and connecting those towers to power-hungry lunar equipment. (Image courtesy of John MacNeill)**

NASA selected 11 U.S. companies to develop technologies that would support long-term exploration on the lunar surface, as well as in outer space for the benefit of mankind. The technologies will range from lunar-surface power systems to tools for 3D printing in outer space. This will expand industry capabilities to sustain a human presence on the Moon via Artemis, along with other NASA, government, and commercial missions.

In addition, NASA will lay a high-voltage power line that extends over a half mile across the lunar landscape.

**Participating Companies in the Lunar Power Project**

NASA has named some of the key technology companies related to providing power for the Moon. Two of those selected companies that will help provide power on the Moon are:

***Astrobotic Technology**, Pittsburgh, Pa., $34.6 million—LunaGrid-Lite: Demonstration of Tethered, Scalable Lunar Power Transmission.*

Astrobotic's proposal, selected by NASA, will employ advanced technology that can distribute power from devices on the lunar surface. This will be tested on a future lunar mission. The company's CubeRover will provide more than a half-mile (one kilometer) of high-voltage power line that can transfer power from a production system to a habitat/work area on the lunar surface *(Fig. 1)*.

Astrobotic was also selected to deliver the VIPER to a lunar landing site close to the Nobile Crater (a 45-mile-wide [73 km] impact basin at the Lunar South Pole). The company chose SpaceX's Falcon Heavy rocket, a workhorse, to launch its Griffin lander that will carry the VIPER to the

**2. This is an artist's concept of the VIPER rover working in the lunar darkness. (Image courtesy of NASA/Daniel Rutter)**

lunar surface *(Fig. 2)*.

The approximately $200 million commercial delivery arrangement enables Astrobotic to design and build the lander that will carry VIPER to the Moon. NASA would have developed this system for the original Resource Prospector mission, but it would have come at a much greater cost.

NASA also presented Astrobotic with a $34.6 million Tipping Point award for the development technology for its LunarGrid project that will produce energy via solar power.

***Blue Origin*** *of Kent, Washington, $34.7 million—In-Situ Resource Utilization (ISRU)-Based Power on the Moon.*

This company's technology may also make use of local lunar resources by extracting elements from lunar regolith to produce solar cells and wire that would be used to power work on the lunar surface.

Blue Origin is also proposing "Blue Alchemist," an end-to-end, autonomous, scalable, and commercial solution that will be able to produce solar cells from the lunar regolith. The regolith is made up of dust and crushed rock on the Moon's surface.

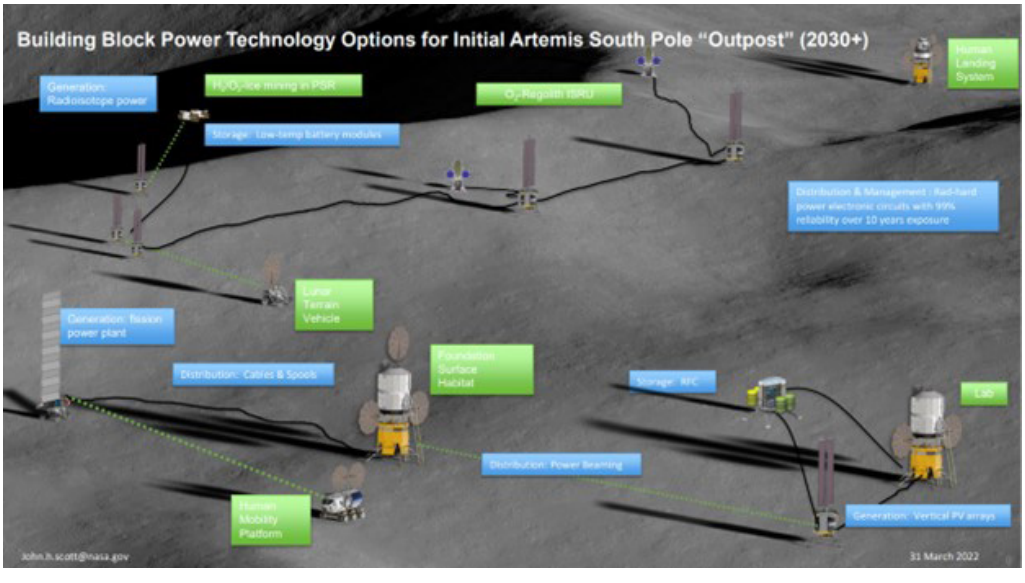
This effort is based on a process known as "molten regolith electrolysis." This amazing breakthrough will be able to create unlimited electricity and power transmission cables anywhere on the lunar surface. The process will also produce oxygen as a byproduct for rocket propulsion and life support.

**Power at the Moon's South Pole**

After two Artemis test missions, two NASA astronauts—the first woman and the first person of color—will journey to the lunar surface in December 2025, beginning with the Artemis III mission. They will land where no humans have ever been before—the Lunar South Pole. This will be the ideal location for a future base camp thanks to its potential access to ice and mineral resources.

On the first few missions, the human landing system will double as a lunar habitat, offering life-support systems to support a brief crew stay on the Moon. Looking toward the future, NASA envisions a fixed habitat at the Artemis Base Camp, which will be capable of housing as many as four astronauts for a month-long stay *(Fig. 3)*.

The Moon's polar regions, especially at the South Pole, are areas that possibly contain water or ice. This discovery of polar water and ice could help provide both air and fuel as




**3. These are some of the power technology options for the Artemis Lunar South Pole "Outpost" post-2030. (Image courtesy of https://www.linkedin.com/in/john-scott-6339368/)**

well as water for astronauts to drink. Once the water is processed, the oxygen may be able to produce vapor that could be used to supply a necessary part of the astronauts' breathable atmosphere. Water, once separated into hydrogen and oxygen components, might even be used as rocket fuel.

Landing at a location such as the South Pole site could help astronauts' long-term survival on the moon, and it may even lay the groundwork for boosting future teams farther out in the solar system.

Debra Needham, a planetary scientist at NASA's Marshall Space Flight Center in Huntsville, Ala., believes that the resources, when mined from the moon, could possibly reduce the need to launch resources from Earth. In turn, it would significantly reduce the cost of deep space exploration.

**Summary**

U.S. companies selected by NASA have the talent and resources to return astronauts to the Moon as a first step in developing sustainable exploration. Such scenarios would safely enable astronauts to escape from Earth's gravity, travel to the Moon, leave the Lunar orbit to travel down to the Moon's surface, and, most importantly, return home safely. All of this effort will lead to the ability to mine lunar water and other possible minerals, ultimately providing power for a sustainable, long-term lunar presence—and for man to explore not just the Moon, but Mars and beyond.

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