



Position Paper

Lunar Bases Should Be the Focus of Artemis

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The U.S. has already won the Moon Race

The United States first landed on the Moon in 1969, more than 57 years ago. It may well be that a Chinese spacecraft will land a crew on the Moon for its first time before the U.S. does so for the 7th time, but this achievement will not determine the future of humanity on the Moon or otherwise. What will be decisive is if the Chinese build on an initial crewed landing to systematically and permanently occupy and exploit the Moon as a steppingstone to deep space, while the U.S. engages in sporadic, inefficient, and directionless “lunar exploration.” One way the U.S. can avoid such an outcome lies in refocusing Artemis on the incremental increase of permanent lunar infrastructure that establishes true leadership in the exploration of the Moon and the development of lunar resources.

No repeat of Apollo – go to stay

“Sortie” missions that land here and there have limited value when compared to an on-going lunar base with extensive surface mobility capabilities. The needs of most if not all scientific or resource mapping in diverse locations can be fulfilled by an extension of the existing Commercial Lunar Payload Services (CLPS) program, which is already very cost effective. Artemis sortie missions must include efforts toward the construction of at least one, and preferably more than one, permanently crewed lunar bases that become the focus of U.S. lunar exploration. What is most important is not that a base is constructed quickly, but that the main thrust of the Artemis program is toward a base on the lunar surface.

A tendency exists in certain circles to avoid any construction of lasting infrastructure on the Moon based on the misguided notion that it will anchor NASA to the Moon and delay future expeditions to Mars. An attractive direction lies with competing, commercially owned and operated lunar infrastructure in which NASA participates as an anchor tenant. These commercial lunar bases could be targeted for different areas of the Moon with different key exploration and resource development objectives just as commercial space stations in low Earth orbit (LEO) are being designed for different applications and markets. As an anchor tenant, NASA can purchase the lunar services needed to support its lunar ambitions as well as its Mars program without the burden of owning and operating a lunar base.

A Base is more than just a Base

For a lunar base to be effective at exploration and resource development, it must be more than a fixed infrastructure. Mobility is a fundamental part of lunar base operations. The Artemis program is currently engaged with three suppliers of unpressurized rovers, which the National Space Society (NSS) endorses. However, the Japan Aerospace Exploration Agency (JAXA) is being relied on as the single source of a long-range pressurized rover. At least one, and preferably two additional pressurized vehicles should be added to the Artemis program.

Additionally, longer range mobility requires a “hopper” which is currently not part of the Artemis program. A “hopper” is a short-range rocket powered reusable vehicle capable of short “hops” from and back to a lunar base. Regardless of exactly where a lunar base is sited, there will be limits to how far explorers can travel in a pressurized vehicle. These limits can be overcome with a “hopper” that enables more distant locations to be reached without mounting an expedition that comes from the Earth. To operate cost-effectively in the long run such a vehicle must be reusable and should probably use the same fuel as the Artemis lunar landers. The development of such a vehicle should be added to the Artemis program as soon as possible.

Finally, to the extent possible, key lunar infrastructure such as power sources, location services like life support, and communications equipment should be designed to support multiple bases in different locations. A robust network for lunar Position, Navigation, and Timing (PNT) and telecommunications will be foundational to both lunar exploration and resource extraction.

Discussion of lunar base sites

Current thinking with regard to lunar bases appears almost exclusively focused on the lunar south pole. The NSS acknowledges the importance of the U.S. establishing operations at the lunar south pole but believes that consideration should be given to accomplishing this goal with automated equipment focused on resource exploration and extraction. A wider view

should be taken with regard to siting lunar bases that considers the lunar south pole as one option among many. It should be noted that there are other resources of value on the Moon than lunar south pole water ice, and these resources are associated with sites where the construction of a base may be easier than at the lunar south pole, if an alternative to solar energy is utilized.

It should be noted that it is relatively difficult to explore from a lunar south pole base due to the rugged conditions and deep shadows that characterize that part of the Moon. There appear to be many locations on the Moon that could function much better as exploration hubs than the lunar south pole. As one example, a path exists from a possible base in Clavius Crater to the south pole that allows an easy traverse in a pressurized rover taking about one week.

In fact, the utilization of fission nuclear reactors on the Moon, as currently envisioned by NASA, could open numerous interesting sites for consideration. It is likely that the placement of such high and continuous sources of power could be determinative in selecting the location, sustainability and growth of future lunar bases. This is true not only because solar power solutions, other than at a few polar sites, only generate power for roughly two weeks out of each four-week lunar cycle, but because they must be constantly protected from damage from regolith plumes from take-offs and landings.

The north pole of the Moon as a lunar base location

Some have suggested that since the lunar north pole appears to have less water than the lunar south pole, that exploration and mining be initially concentrated in the lunar south pole region. The NSS endorses this direction on a short to medium term basis but urges that the exploration of the lunar north pole is not completely neglected. At least one CLPS lunar lander mission should be targeted at the lunar north pole.

Artemis and CLPS site selection

The NSS holds that the primary driver for the selection of both Artemis landing sites and CLPS landing sites should be the determination of a preferred location of a lunar base. Once one or more lunar base sites are identified, they should become the major target areas for exploration, in addition to the lunar south pole region. This suggests that pure scientific criteria for site selection should be secondary to supporting the selection of lunar bases and associated resource development.

Lunar economic development

The NSS suggests that although the exploration of lunar resources should be a priority, another important initial lunar industry will be tourism, including sovereign astronaut visits. A lunar base with a strong infrastructure fits well with this economic direction, as

well as with resource extraction activities. The NSS cautions against excessive enthusiasm for mining Helium-3 and instead urges that early resource exploration and development focus on water, oxygen, and fundamental building materials such as silicon, aluminum, and iron. Sulfur and titanium might be secondary targets.

Lunar property rights

The NSS supports the Space Act of 2015, which endorse the right of commercial entities to extract and utilize lunar resources for commercial purposes in the context of the 1967 Outer Space Treaty, which forbids national appropriation. Under this treaty, any lunar base built by the U.S. and its Artemis Accords partners, whether government or commercial, will be the property of the constructing entities, and operated under the laws of the constructing entities without creating a claim to the lunar surface per se. The NSS supports efforts (so far unsuccessful) by NASA's CLPS program to operationalize the rights of commercial entities to extract lunar resources and sell them to other entities, both commercial and governmental.

Reusable/economic Concept of Operations

U.S. cislunar infrastructure, both for transportation to and from the Moon, and for supporting crews on the Moon, including robotic and telerobotic operations, must be fully reusable and capable of economic operation using in-situ lunar resources (e.g. refueling). A foundational lunar industry is the production of oxygen from lunar regolith for both breathing and for rocket fuel oxidizer. Both methane and hydrogen rocket engines will benefit from being able to refuel with oxygen on the lunar surface.

With the recent success of Blue Origin in replicating SpaceX's achievement in landing the first stage of a large launch vehicle, the justification for the continued use of expendable vehicles in the Artemis CONOPS (CONcept of OPerationS) has been greatly diminished. The importance of reusability has also been adopted by both SpaceX and Blue Origin for their lunar landers (Starship and Blue Moon).

Changes in the Artemis Program are welcome

The NSS endorses the recently announced modification to the Artemis program to transform Artemis 3 from a lunar landing to a low Earth orbit test of all the systems involved, while Artemis 4 becomes the first lunar landing. This programmatic change makes good engineering sense and will significantly de-risk the program.

Limit Investment in the Space Launch System (SLS)

Additionally, the NSS endorses the cancellation by NASA of the Exploration Upper Stage (EUS), and the presumptive cancellation of the taller gantry system needed to support the EUS. The money saved should be redirected toward a lunar base. In the past the NSS has

[endorsed the cancellation](#) of the enhanced Solid Rocket Boosters (SRBs) for the SLS system. In the context of the rapid development of commercial heavy lift systems, it has become increasingly clear that the long-term operation of the extremely expensive SLS system is not a viable forward direction, but that at the same time, SLS flights are a crucial short to medium term part of the Artemis program.

A commercial approach is foundational to long term success

NASA should seek commercial partners that exhibit a genuine interest in commercial lunar operations by not asking for “cost-plus” contracts but rather sharing a large portion of development costs themselves. At the same time, NASA must avoid the over-specification and constant changes of direction that drive up costs and make economic space operations impossible.

One way to avoid a long period in which commercial endeavors on the Moon are inhibited by government regulations and management is by moving directly to commercially owned and operated lunar bases at which NASA rents space and buys services. NASA should not be in a position where it “gatekeeps” lunar business plans.

Firms that prefer not to operate under any kind of contract other than a cost-plus contract might be directed by NASA toward projects such as nuclear-electric in-space transportation where the near/medium term prospects for commercial operations are limited.

Accept that there will be failures on the path to success

NASA should consider that the path to commercial success on the Moon probably will not be based on the kind of highly system-engineered, elaborately tested, and extremely expensive programs that have typified NASA in the past. Instead, the CLPS model with many competing vendors providing a service with limited requirements provides an established model for long term success based on real-in space operational success at modest cost.

No single suppliers/monopoly suppliers

As a general organizational principle, no major component of the Artemis lunar base program should have a single supplier. A single supplier strategy works best in an unconstrained funding environment, which is no longer characteristic of space operations. A general rule of at least three development options, followed by at least two operational suppliers, must be the gold standard. Some will characterize this approach as wasteful and unnecessary. One needs only look at the case of Kistler Aerospace for ISS commercial cargo and Starliner for ISS commercial Crew to see the contrary argument. Additionally, the recent selection by NASA of Cygnus for the final two ISS cargo flights based on its ability to berth rather than dock with the ISS shows the value of having multiple service providers utilizing different technological approaches.

The logical consequence of this principle is that the current two vendors for Human Landing Services should both be continued. If a third vendor is thought to be needed, that vendor must operate under fixed price contracts that result in a commercially viable long-term transportation solution. Under no circumstances should a replication of the Apollo CONOPS be developed using cost-plus contracts. Such a direction will be expensive, will be a technology dead-end, will lack the competitive dynamic to provide continued innovation, and will be unlikely to deliver the capacity and economic viability to support future commercial lunar bases.

An additional consequence of this principle is that a single supplier for the Artemis pressurized rover is unwise and not in the interests of the U.S. At least one, and preferably two alternative pressurized rovers should be added to the Artemis plan to ensure robust access to wide areas of the Moon from a lunar base.

International collaboration

The last Moon race involved a superpower competition between the U.S. and the Soviet Union and once won created no lasting lunar presence. To repeat that history only replacing the Soviet Union with China would be similarly wasteful. However, China has stated their intentions for a sustained and growing lunar presence beginning at the south pole which will include partners in an International Lunar Research Station (ILRS). Any U.S. lunar efforts should likewise focus on international collaboration to achieve infrastructure cost sharing, reduced development schedules, and to provide for a more resilient and growing lunar presence.

Head-to-head, China has over four times the population of the U.S. and graduates seven times the number of engineers each year. To compete, we must use our more innovative western economic system together with a large group of like-minded international partners. As of today, we have gathered more than 60 international partners under the Artemis Accords. This is an amazing resource which needs to be appropriately included and incentivized in U.S. lunar plans. NASA and the U.S. are the only space agency and country within the Artemis Accords with the resources and expertise to lead this lunar effort, but “winning” the Moon will mean treating all Artemis nations as true partners and not as subcontractors or “second class citizens.” A governance model to accompany the Artemis Accords has not yet been created but may prove to be a critical step in our lunar future. One such concept the NSS believes is worth exploring is the [Lunar Development Cooperative idea](#).

Summary

The National Space Society (NSS) argues that the U.S. already won the original Moon race with Apollo, and future leadership will be determined not by who lands next, but by who builds sustained, permanent lunar infrastructure. The Artemis program should shift from sortie missions toward establishing one or more permanently crewed lunar bases with strong mobility, resource utilization, and commercial participation.

NSS supports commercially owned and operated lunar bases, with NASA acting as an anchor tenant rather than owner-operator. This model would encourage economic development, competition, and long-term sustainability while avoiding costly, government-dominated approaches. Mobility is essential: multiple pressurized rovers and reusable lunar “hopper” vehicles should be added to expand exploration range. Shared infrastructure such as power (including nuclear fission), communications, and positioning systems should support multiple bases.

While the lunar south pole is important, NSS urges broader site consideration, noting other valuable resources beyond water ice and the operational challenges of polar terrain. Site selection for Artemis and CLPS missions should prioritize future base development over purely scientific goals.

Initial resource development should focus on water, oxygen, and construction materials rather than speculative Helium-3 mining. Reusability, in-situ resource utilization (especially oxygen production), and commercial heavy-lift systems are foundational. NSS supports reducing reliance on the costly Space Launch System and canceling certain upgrades, while redirecting the savings toward lunar infrastructure.

Competition and multiple suppliers are essential to avoid monopolies and cost overruns. Fixed-price contracts and commercial risk-sharing are preferred over cost-plus models.

Finally, NSS emphasizes international collaboration through the Artemis Accords, treating partners as valued participants. Long-term success requires commercial leadership and a permanent, growing human presence on the Moon.

About the National Space Society

The National Space Society is the preeminent non-partisan citizens’ voice on space exploration, development, and settlement, reaching millions through its membership, numerous outreach channels, and media activities. The organization was founded in 1987 via a merger of the National Space Institute and the L5 Society. To learn more about NSS and its mission to establish humanity as a spacefaring civilization, visit us on the web at nss.org.