

Destination Mars: Putting American Boots on the Surface of the Red Planet
United States Senate Committee on Commerce, Science, and Transportation
Subcommittee on Space, Science, and Competitiveness

Testimony of
Chris Carberry
Chief Executive Officer; Explore Mars, Inc
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Thank you, Chairman Cruz, Ranking Member Markey, and the other members of the Subcommittee on Space, Science, and Competitiveness, for your gracious invitation to testify at today's hearing. I am honored to be here to discuss how the United States should lead humanity's efforts to land humans on the surface of Mars by 2033.

Next July we will all be celebrating the 50th anniversary of the historic Apollo 11 Moon landing. Today the United States and our commercial and international partners are at a new and exciting watershed moment in human space exploration, and we are well-positioned to continue where the Apollo Program left off. With new launch capabilities coming online and with the continued support of Congress, the Executive Branch, and the American public, we are now poised to send crews even further into deep space with Americans landing on the surface of Mars in the 2030s.

To further this goal, teams of scientists and engineers from industry, NASA, and academia have come together as a community in a series of recent workshops, and have been developing scenarios for achievable missions to Mars. These workshops, known as the *Achieving Mars Workshops* (<https://www.exploremars.org/affording-mars>), are organized by Explore Mars, Inc., the organization that I am privileged to serve as CEO, in partnership with the American Astronautical Society, and sponsored by major aerospace companies. The scenarios for achievable Mars missions developed by these workshops have four essential characteristics:

1. They are affordable,
2. They are achievable *without* technological miracles,
3. They are sustainable in coordination with our international partners, and,
4. They achieve major and long-standing scientific goals.

Our recent workshops have been motivated to a large extent by the long-standing support of our nation's space program by the United States Congress, including most recently with the passage of the *NASA Transition Authorization Act of 2017*, which states in part that "NASA shall take all necessary steps, . . . to ensure that activities in NASA's human exploration program balance how those activities might also help meet the requirements of future exploration and utilization activities leading to human habitation on the surface of Mars." That Act goes on to say, "NASA shall contract . . . to study the feasibility of the launch of a human space flight mission to Mars in 2033."

If this deadline is to be achieved, however, we can not allow ourselves to postpone critical decisions about specific mission architectures. Many such decisions need to be made in the very near term, otherwise there will be little hope of actually seeing American boots on the surface of Mars in the early to mid-2030s. Fortunately, we do not need to start from scratch. Over the past several years, numerous realistic and efficient concepts to land humans on Mars have been proposed by NASA, industry/commercial stakeholders, and others, and our workshops and the community that they represent have built on and refined those concepts to the point where we as a nation are ready and should be willing to act.

These workshops have revealed the high degree of commonality of the critical elements of a Mars program that exists among different scenarios for exploration of the Red Planet.

There are, of course, additional key technologies and plans that must be developed in order to achieve the goal of human missions to Mars. However, the United States overcame a multitude of such challenges in order to land humans on the Moon in the 1960s, and to build an International Space Station in the decades that followed, and America can overcome whatever challenges lie ahead in order to land humans on Mars in the 2030s.

For many years, the space community has been unable to achieve consensus regarding the scope and long-term goals of initial missions to Mars. However, our most recent workshop – the 5th in the series – was specifically addressed to that situation. Workshop participants outlined three architectures that span the range of likely options for human missions to Mars, with each of these missions leading eventually to crews that would be away from Earth for roughly 1000 days:

1. The first scenario involves ‘sortie-like’ missions, with a two-week stay on the surface, analogous to the Apollo Program.
2. The second concept is a semi-permanent base or “field camp” on the surface, with a stay of a year and a half, and is analogous to early Antarctic exploration.
3. The third concept is a sustained, permanent habitation analogous to current Antarctic exploration, setting the stage for potential settlements.

Our series of workshops have also found that in order to succeed, any plan to send humans to Mars must encompass, in the decision-making process by NASA, policy-makers, and our partners, the following:

1. Science precursor missions in the 2020s are critical for human exploration in the 2030s. The 2020 Rover is the last robotic mission to Mars that the United States has funded. This rover *must not* be the end of our robotic missions. In advance of humans to Mars, we will need new reconnaissance capabilities around Mars, and more robust deep-space communication. If we achieve a sample return mission, which is considered a top priority, we should consider a “heavy” sample return mission that not only collects a significant amount of Martian samples, but can also provide an intermediate test for Entry, Descent, and Landing capabilities as well as employ robust experiments for in-situ resource utilization and other essential technologies needed for a sustainable human presence on Mars.
2. Lunar operations should be planned with Mars as the ultimate goal: Missions to the vicinity of the Moon should be designed and executed in a manner that will create a clear path to Mars and stimulate commercial and international participation.
3. Common ‘Long-Pole’ Capabilities: During the 4th Achieving Mars Workshop in 2016, over a dozen ‘long-poles’ – that is, capabilities that need to be developed and such work needs to begin immediately to accomplish humans Mars landings in the 2030s – were identified and designated. As plans for the Moon and Mars proceed, experts should determine which ‘long-poles’ are vital for both the Moon and Mars.
4. Integration is essential: Missions should be designed and conducted with unprecedented coordination among the directorates of NASA, industrial/commercial entities, and our international partners, the latter of which look to us to lead these efforts.

Regardless of which approach is chosen, and that choice must be made soon, the United States is well-positioned to move ahead now. As we all know, NASA and its industry partners are developing launch and crew capabilities well beyond any existing or previous systems, commercial entities are also advancing impressive technologies, and there is unprecedented international interest and activity in space exploration.

In addition, and also importantly, there remains strong public support for human space exploration - particularly Mars. The nature and extent of this support becomes even clearer when the public is given precise information. For example, as evidenced by the findings of the 2013 *Mars Generation National Opinion Poll* (<https://www.exploremars.org/wp-content/uploads/2013/03/Mars-Generation-Survey-full-report-March-7-2013.pdf>), when informed that NASA accounts for less than half of one percent of the federal budget, the public tends to overwhelmingly support ambitious plans for space exploration.

The entertainment industry – whose profits are based on understanding the appetites and passions of the public – understands this national Mars enthusiasm exceedingly well. As highlighted in the 2018 *Humans to Mars Report* (<https://www.exploremars.org/the-humans-to-mars-report>), there are innumerable television and film projects underway depicting Mars exploration and settlement. While policy should certainly not be decided based solely on the current Hollywood movie trend, the continuing profitability of Mars related film projects is clear evidence of the sustained enthusiasm that the public has for Mars exploration.

With this overwhelming bi-partisan support in Congress, clear support from the current and previous administrations, and unwavering public support, many of us in the space community wonder why our nation seems unable to commit to the decisions that will finally enable human missions to Mars. As this Committee well knows, many larger federally funded projects –

projects with far less broad-based support - have been able to move forward with fewer delays, despite far less unity in Congress and among American voters.

Once again, definitive decisions are needed soon. We do not want to squander the support we now have and in twenty years in the future find ourselves looking back to realize that we were unable to return to the surface the Moon or send humanity to Mars in spite of the broad support for such missions.

Mr. Chairman and Members of the Committee, my organization, Explore Mars, Inc., and I, would like to thank you for taking the time to hold this important hearing. I would like to conclude by saying that while we should never be reckless with the lives of our astronauts, we need to take calculated risks and be bold, once again, as we were in the '60s, in order to achieve something truly extraordinary for the United States and the world. We are well past due for 'the next giant leap...'