NASA’s Mars Sample Return has a new price tag—and it’s colossal

Enlarge / This illustration shows a concept for a proposed NASA Sample Retrieval Lander, about the size of an average two-car garage, that would carry a small rocket called the Mars Ascent Vehicle to the Martian surface.
NASA/JPL-Caltech

reader comments

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During his final months as the chief of NASA’s science programs last year, there was one mission Thomas Zurbuchen fretted about more than any other—the agency’s ambitious plan to return rocks from Mars to Earth. He supported the Mars Sample Return mission and helped get it moving through the agency’s approval process. But the project threatened to devour the agency’s science budget.

“This was the thing that gave me sleepless nights toward the end of my tenure at NASA and even after I left,” said Zurbuchen, who left NASA after seven years leading its Science Mission Directorate at the end of 2022. “I think there’s a crisis going on.”

Now, Ars has learned, the problem may be even worse than Zurbuchen imagined.

According to two sources familiar with the meeting, the Program Manager for the mission at the Jet Propulsion Laboratory, Richard Cook, and the director of the mission at

NASA Headquarters, Jeff Gramling, briefed agency leaders last week on costs. They had some sobering news: the price had doubled. The development cost for the mission was no longer $4.4 billion. Rather, the new estimate put it at $8 to $9 billion.

Moreover, this only represents the cost to build and test the different components of the mission. It does not include launch costs, operating costs over a five-year period, nor construction of a new sample-receiving facility to handle the rocks and soil from Mars. All told, the total cost of the Mars Sample Return mission is now about $10 billion.

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About the mission

NASA and its international partners, including the European Space Agency, have wanted to return material from Mars for decades. It has also been a top priority of the scientific community, both to better understand the geological history of Mars as well as to look for evidence of life—past or present—on Mars.

After several iterations, NASA and its European partners settled on the project's current design last summer. Under this plan, NASA will develop a large "Sample Retriever Lander" that nominally is due to launch in 2028. After this vehicle lands on Mars, the Perseverance rover—which has been collecting and storing samples of Martian dust in 38 titanium tubes, each the size of a large hotdog—will bring its samples to the lander.

However, Perseverance may be a little long in the tooth by the time the lander arrives. Because Perseverance landed on Mars in 2021, NASA has decided it is too risky to count entirely on the rover being operational a decade from now. Accordingly, it plans to send two helicopters much like Ingenuity, which

remains operational on Mars, as a backup plan to retrieve the samples.

Once delivered to the lander, these sample tubes will be placed aboard a rocket called the Mars Ascent Vehicle. This rocket is being developed by Lockheed Martin, and it will be stowed inside the lander. After launching from Mars, this rocket will release the "Orbiting Sample container" into Martian orbit, where it would be picked up by an "Earth return orbiter" built by the European Space Agency. This vehicle would carry the samples back to Earth orbit, where they would be released into a small spacecraft to land on the planet. NASA created a video showing how this might work.

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If NASA manages to develop and launch the Sample Retriever Lander by 2028, the samples could be returned to Earth in 2033. The problem is no one expects the lander to launch in 2028. At this point, even 2030 looks like a stretch goal.

Mistakes were made

There is already a background buzz in the science community about cost overruns for this mission. After the space agency received $822 million in this year's federal budget for Mars Sample Return, it asked for $949 million in the fiscal year 2024 budget. This is far above the appropriations level sought even by the agency's most expensive science mission, the James Webb Space Telescope, on an annual basis. Additionally, in April, NASA administrator Bill Nelson warned of near-term cost growth in the mission.

Around the same time, NASA convened an "Institutional Review Board" to assess the agency's strategy for the mission and to make recommendations for its success. The board is being led by Orlando Figueroa, a retired deputy center director for science and technology at NASA's Goddard Space Flight Center, and the group will publicly release a report in late August.

So what happened to drive these costs up?

Zurbuchen said there were “horrendous” technical mistakes made during the early planning phase at the Jet Propulsion Laboratory. The original concept involved sending everything on a single lander, including a small rover to “fetch” the samples from Perseverance. However, the depth of this analysis was insufficient and included large errors about the mass of the landing legs and other factors. For a time, the plan had to evolve to add a second lander, which increased the cost by more than $1 billion.

Additionally, planning for Mars Sample Return got swept up in the management problems at the Jet Propulsion Laboratory, including staffing issues that led to the delay of the Psyche mission. An independent review found that the California-based field center, which leads many of the space agency’s most prestigious science missions, had undertaken an “unprecedented workload” without possessing the resources needed to complete major projects.

Now it is undertaking its biggest mission ever in Mars Sample Return.

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