

Mars vs. Project A.D.A. — The Hidden Cost of Colonization

Collaborative proposal of ideas. Original text by Alejandro Díaz Aldana. November 2025

This document compares Mars colonization with Project A.D.A. on Earth. It is not a scientific study, but a creative and provocative vision. Costs based on 2025 technology; Starship could reduce them 100x. Timelines assume current logistics.

1. Introduction: Earth Priority

We deeply admire and support the exploration and colonization of Mars as a historic achievement for humanity. However, we will not begin sending materials or building cities there until we secure our existence on Earth. The worst scenario is not just the loss of expensive materials or ships; the real risk is losing humanity's last chance by wasting critical resources on a premature project, depleting reserves of talent, technology, and capital needed to protect life on our home planet.

The idea of colonizing Mars and creating self-sustaining cities for millions is fascinating. However, behind the fantasy of traveling to the "new world" lies a reality of astronomical costs, extreme risks, and massive technological complications. Comparing these cities to those proposed by Project A.D.A. on Earth shows why saving all of humanity on Earth is far more viable, safe, and economical.

2. Transportation and Logistics Costs

One-way/round-trip travel per person: In optimistic scenarios, a ticket could cost \$100,000 to \$500,000 USD. Considering tons of materials per person and all life support systems, the real cost could reach \$50–200 million per person.

Cargo and materials transport: Sending 1 kg to Mars currently costs \$270,000 USD. A self-sustaining city for 1 million inhabitants would require 50,000–200,000 kg per person, including housing, hospitals, parks, labs, factories, and artificial gravity. This makes a single city cost between \$100–500 trillion, and 10 cities (10 million inhabitants) exceed \$500–5,000 trillion USD.

3. Critical Infrastructure

For a Martian city to function like an Earth city, it needs:

- **Artificial gravity systems:** Rotating rooms to simulate Earth gravity; massive engineering and constant maintenance. Estimated cost: \$50–500 billion per city.
- **Water and oxygen:** Oxygen production plants and CO₂ scrubbing; extraction, purification, and water recycling systems.

- **Food and agriculture:** Enclosed greenhouses with LED lighting, temperature control, and nutrients; seed banks and artificial pollination systems.
- **Nuclear energy and heating:** Modular nuclear plants + solar/battery backup to keep cities warm; estimated consumption: 10–15 GW per city; cost: \$35–80 billion USD.
- **Internal transportation and logistics:** Pressurized trains, pods, airports/spaceports; bridges, roads, hangars, and vehicle maintenance systems.
- **Health, education, and leisure:** Hospitals, labs, universities, schools; shopping centers, pools, stadiums, parks, and pressurized theme parks. Includes psychological health: rehabilitation centers, constant monitoring, and acoustic/visual isolation systems.
- **Safety and contingency:** Emergency shelters, specialized brigades, spare parts storage, emergency evacuation.
- **Machinery and spacecraft production/maintenance:** Factories for parts, vehicles, and ships; 3D printers and engineering labs for self-sufficiency.
- **Pressurized structures and dust storm protection:** Glass or advanced material domes; covered area: ~100 km²; initial cost: \$30–50 billion per city; annual maintenance: \$6–25 billion.
- **Extreme redundancy and chemical self-sufficiency:** Critical systems require N+3 redundancy or more, doubling or tripling base costs.
- **Low gravity compensation:** Without artificial gravity, bone/muscle loss occurs, plus child reproduction issues; requires mandatory exercise systems, specialized medical design, and constant monitoring.

4. Risks of Living on Mars and Transportation

- **Launch and transportation accidents:** Catastrophic failure risk: 1–5%; explosions = dozens or hundreds of deaths and multibillion losses.
- **Prolonged interplanetary travel:** 6–9 months one-way; radiation exposure; critical life support failures.
- **Accidents on Mars:** Meteorites, dust storms, pressurized structure failures; severe medical emergencies.
- **Emergency evacuations:** Practically impossible; multibillion costs and risk of more lives lost.
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Cost impact:

- Conservative scenario: 1–3% launch failures → \$1–10 trillion additional per city.
- Intermediate scenario: 5% failures → \$10–50 trillion additional.
- Extreme scenario: Major accidents could double or triple an entire city's costs.

5. Construction Timelines

- One city for 1 million inhabitants: 20–30 years.
- Ten cities (10 million inhabitants): 200–300 years.
- 10 A.D.A. cities on Earth: 15–25 years.

6. Comparison with Project A.D.A.

Concept	Mars (1 city)	Mars (10 cities)	Earth (Project A.D.A., 10 cities)
Approximate cost	\$100–500 trillion	\$500–5,000 trillion	\$1–5 trillion (1,000–5,000 billion)
Construction time	20–30 years	200–300 years	15–25 years
Vital risk	Very high	Very high	Low
Critical infrastructure	Self-built + imported	Self-built + imported	Standard Earth construction
Population capacity	1 million	10 million	Variable, adaptable to real needs

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7. Energy Cost to Keep Cities Habitable on Mars

Estimated consumption per city: 10–15 GW. Technology: Modular nuclear plants + solar and battery backup. Cost per city: \$35–80 billion USD. Total for 10 cities: \$350–800 billion USD. 24/7 energy required for artificial gravity, water, oxygen, and agriculture.

8. Costs of Pressurized Structures and Maintenance Against Dust Storms

Covered area per city: ~100 km². Initial construction cost: \$30–50 billion per city. Annual maintenance: \$6–25 billion per year. Partial material replacement every 5–10 years due to wear and radiation. Reinforces that living on Mars is more expensive, riskier, and complex than on Earth.

9. Communications Network and Internet on Mars

For a Martian city to function at Earth-level connectivity, a complete communications network comparable to Earth's would be needed: low, medium, and high orbit satellites, ground stations in each city, pressurized fiber optic links, and high-speed interplanetary transmission systems. This would include duplicating existing commercial and government satellite networks, servers, data centers, and backups. The estimated cost to build this integral infrastructure could exceed \$50–100 billion USD per city, not counting annual maintenance and continuous tech upgrades. Technical complexity and interplanetary distance would increase costs and failure risks, reinforcing that replicating Earth life on Mars is extremely expensive and technically challenging.

10. Mining and Material Production on Mars

To build even the first city, complete mining and metal processing companies would be needed to extract iron, copper, aluminum, and other essentials directly from Mars, avoiding Earth transport dependency.

- **Mining infrastructure:** Excavators, drills, transport trucks, smelters, and processing plants adapted to low gravity and extreme cold.
- **Safety and training:** Workers need advanced training and maximum protection against radiation, dust storms, low gravity, and pressure failures.
- **Labor and operational costs:** High salaries for extreme risk, specialized insurance, constant health monitoring, and medical contingencies.
- **Energy and maintenance:** All machinery requires energy, lubricants, and specialized maintenance; added to life support systems.

Cost impact: Creating a functional mining industry on Mars could add tens or hundreds of billions per city in initial capital alone, plus recurring multibillion operational costs. Without these companies, dependency on Earth transport would make each additional kilogram cost \$270,000 USD (based on current technology), multiplying the city's total cost several times. However, in the future, SpaceX could considerably lower these costs—potentially to \$10–100 per kg with reusable Starship and massive fleets—making initial imports more viable. Even so, many things would still be cheaper through local Mars mining, as in-situ resource extraction (iron, aluminum, silicon) eliminates interplanetary transport for most construction, reducing long-term expenses and achieving true self-sufficiency.

11. Waste Management and Extreme Recycling

Earth can afford landfills and imperfect recycling systems. On Mars, survival depends on a perfect closed loop.

- **Foresight:** Martian cities need not just purification plants, but advanced waste management and recycling infrastructure reaching near 99.9% rates. This includes processing biological waste, plastics, metals, and electronics.
- **Cost impact:** Developing and implementing these closed-loop systems (essentially "disassembly factories") is already costly on Earth; replicating them on Mars adds another layer of billions in development, transport, and maintenance.

12. Critical Spare Parts Production and Additive Manufacturing

Mining was mentioned, but high-precision part manufacturing is its own industry.

- **Foresight:** Factories for microcomponents, advanced electronics, and tightly tolerated parts are needed. Basic 3D printers aren't enough; metallurgical labs and clean rooms are required to create chips, sensors, or high-pressure valves for Starship or nuclear reactors.
- **Cost impact:** This involves transporting and maintaining extremely sensitive and expensive manufacturing equipment, adding another initial cost spike and operational risk.

13. The Human Talent Dilemma

It's clear that a call to colonize Mars would attract thousands of highly skilled professionals: engineers, architects, doctors, biologists, dentists, and scientists from all fields. Many would sacrifice their Earth careers, motivated by the obsession to make history, the pioneer ideal, or the conviction that humanity must expand beyond the blue planet.

However, the real problem isn't attracting talent, but retaining it long-term. Being a pioneer for months can be exciting, but being a settler for decades—raising children in artificial, hostile conditions—is a radically different psychological challenge. Initial adrenaline turns into monotony, isolation, and emotional burnout. This opens the door to severe depression, extreme anxiety, and high mental dropout risk, even among the brightest and most motivated professionals.

Mars colonization thus faces not a talent shortage willing to risk life, but the risk of losing that talent in an environment that can break the human mind. And every engineer, doctor, or scientist lost to psychological failure or accident represents a critical resource that could have been invested in saving humanity on Earth. Project A.D.A. reminds us that the true dilemma isn't "who wants to go," but "who can truly stay."

Beyond pioneers' personal sacrifice, a deeper ethical question arises: Who is willing to condemn their children to life on Mars? Adults can choose, driven by glory, obsession, or scientific curiosity, but children don't choose to be born in a hostile world, confined in domes, without oceans or open skies, with constant risk of a technical failure ending their lives. The human cost of Mars colonization isn't measured just in dollars, but in entire generations growing up in unnatural conditions, paying the price for their parents' dreams.

After two years of extreme training in the South Pole, the number of professionals willing to move to Mars would drop drastically. Engineers, doctors, architects, and scientists might initially be motivated by excitement, research, or pioneer glory. However, after experiencing extreme routine, absolute isolation, and the challenge of raising children in a hostile, critical-system-dependent environment, most would decide not to continue. Only a very small group with exceptional psychological tolerance and ideological conviction would be willing to take the risk

of permanent residence on Mars, ensuring that truly prepared colonists are the ones who finally arrive on the red planet.

14. Critical Shortage of Nuclear Engineers

A Martian colony's survival depends on a tiny, exceptionally qualified group of nuclear engineers responsible for operating, maintaining, and repairing modular plants that supply vital energy for artificial gravity, heating, oxygen, water, and agriculture. This personnel shortage brings enormous risks:

- **Catastrophic failure:** Incapacity of one or more experts could compromise the entire colony's life.
- **Extreme psychological load:** Two-year hostile simulations show engineers facing isolation, constant pressure, and dust storms, knowing every failure could be fatal.
- **Irreplaceability:** The combination of high specialization, mental preparation, and risk willingness makes these engineers nearly impossible to replace quickly, increasing mission vulnerability.

In conclusion, the most critical limitation isn't technology, but the human resource to sustain it, reinforcing the need for redundancy plans, extreme training, and psychological support for any interplanetary survival.

15. Candidates and Operational Strategies

Ideal candidates for the first Martian colonies include people accustomed to extreme challenges: ultramarathoners, endurance athletes, climbers, fighters, and martial arts practitioners. Beyond physical and mental demands, they must be scientists and multi-disciplinary experts with near-infinite resilience and tenacity. Their extreme physical and mental strength prepares them for prolonged isolation, pain, fatigue, and harsh conditions. Discipline and self-control from constant training allow maintaining critical routines in hostile, repetitive environments, while calculated risk adaptation enables sound judgment in potentially fatal failures. They would likely pass resilience and overcoming habits to their children, who must also learn to tolerate and adapt to an extreme environment. Finally, experience in extreme sports and martial arts fosters cooperation and mutual trust—essential skills for a colonist team depending on each other for survival. However, even these individuals face extraordinary challenges: extreme cold, dust storms, absolute dependence on critical systems for oxygen, energy, water, and food, and the pressure of raising children in the same hostile conditions, making colonization an immense human sacrifice requiring uncommon determination.

It is recommended that every engineer traveling to Mars have redundant training in multiple disciplines—hydraulics, electronics, electrical, civil, and nuclear—so that colonists can support

each other and solve the numerous technical problems that will inevitably arise in such a hostile environment. For extremely complex issues exceeding colony resources, a communication protocol with Earth will be established, where a team of engineers and specialists analyzes the situation and sends critical solutions back to Mars.

15.1 Comprehensive Health and Resilience Strategy

Long-term survival of a Martian colony critically depends on a complete team of health professionals whose role goes beyond emergency medicine. Specialists like psychologists, psychiatrists, physiotherapists, doctors, nurses, and child health experts will be indispensable to maintain mission operability.

Their work will be mainly preventive. The team will implement exercise routines, design resilience programs, and establish continuous adaptation strategies to handle extreme stress and prevent emotional or physical breakdowns. They will constantly assess inhabitants' physical and mental state and design safe, functional spaces to minimize conflict or severe health risks. Without these professionals, even the most advanced technology (like artificial gravity or life support systems) could fail to sustain human life and colony cohesion in the Martian environment.

15.2 Bioengineering Strategy for Self-Sufficiency on Mars

To ensure self-sufficiency in greenhouses and artificial habitats, closed ecosystems must be established through strategic species selection. This biological planning is crucial for food production and habitat stability. It must include:

1. **Production Support (Pollinators):** A variety of natural pollinators, such as honeybees and solitary bees, bumblebees, butterflies, moths, and beetles, adapted to controlled environments. Supplemented with artificial or robotic pollinators as backup for biological failures.
2. **Nutrient Recycling (Decomposers):** Resistant insects and arthropods, such as cockroaches and crickets, along with soil organisms like earthworms, essential for organic matter recycling, plant residue decomposition, and substrate fertility. Decomposer fungi are included to accelerate the process and produce additional food (edible mushrooms).
3. **Companionship and Biological Balance:** A limited selection of domestic and farm animals, such as chickens (eggs and meat), guinea pigs (fast-reproducing protein), goats (efficient milk), tilapia (in aquaponics systems), cats and dogs (psychological support, pest control), and microalgae (oxygen, water purification, and protein food).

Note: Cows were eliminated due to high resource consumption. Compact, fast-cycle, multifunctional species are prioritized. In advanced phases, pigs or sheep could be included.

The careful selection of these species ensures artificial ecosystem stability, recreating a functional and sustainable Earth-like environment. This strategy is holistic, considering the full life cycle (pollination → harvest → waste → decomposition → soil), has dual purpose (biological and psychological), and offers contingency via artificial pollinators combining engineering and biology for long-term survival.

15.3 Robotic Preparation and Safe Colonization

A fundamental strategy for Mars colonization is that the first 50 to 100 ships transport exclusively materials and equipment. The first arrivals will be advanced robots tasked with building initial biospheres and leaving all essential systems operational. These automata will handle critical tasks like assembling and activating nuclear reactors, erecting habitats, and starting life support systems: food production, water, air, and functional ecosystem seeding (plants, pollinators, and other species needed for self-sufficiency).

Only when infrastructure is optimally functioning and redundant biospheres exist will the first humans be sent. This robotic pre-deployment approach mitigates the risk of colonists arriving in inhuman conditions. Finding prepared, operational environments with stable essential resources makes adaptation much safer and more habitable, ensuring mission success from day one. This process must be tested and adjusted beforehand on Earth (e.g., in extreme environments like the South Pole) to minimize errors and risks before Mars implementation.

15.4 Colonist Selection and Multidisciplinary Capacity

Ideal candidates include people with extreme physical and mental resilience, accustomed to prolonged stress, pain, fatigue, and harsh conditions. Extreme athletes, ultramarathoners, climbers, and martial artists would be optimal profiles. Additionally, they must be scientists or engineers in multiple disciplines: hydraulics, electrical, electronics, civil, nuclear. This ensures the team can solve the many technical problems arising in the colony.

Each engineer should have redundant studies and cross-capabilities, with a protocol to send extremely complex problems to Earth for specialized solutions. Generational adaptation commitment is required: those going to Mars must be willing for their children to live under the same conditions, teaching them resilience, discipline, and overcoming mindset.

15.5 Energy: The Martian Power Grid Architecture

- **Distributed Energy Network (Microgrids):** Multiple isolated microgrids using small modular nuclear reactors (SMRs) so local failures don't compromise the colony.

- **Regolith Thermal Storage:** Harnessing heat stored in Martian soil as a stable base energy source, complementing nuclear and solar, especially during prolonged dust storms.
- **Energy Interface Standardization:** All equipment, habitats, robots, and vehicles must use standard connectors, voltage, and protocols to simplify maintenance and repair.

15.6 Governance and Culture: The Long-Term Human Factor

- **The “Mars Charter”:** Before departure, colonists will draft an adaptive basic legal framework operating without immediate Earth authority, defining property, conflict resolution, and human rights.
- **Reserve of “Lost” Skills:** Ensure essential knowledge (manual farming, non-tech water purification) is preserved and taught to future generations as a final lifeline.
- **“Earth Memory” Programs:** Massive Digital Library with art, music, literature, and history, plus Earth event celebrations to maintain cultural connection to the home planet.

16. Conclusion

Mars colonization is admirable and visionary, but ensuring millions live comfortably and safely there is extremely expensive, slow, and risky, even for companies like SpaceX.

Project A.D.A., in contrast, allows saving and protecting millions on Earth faster, cheaper, and safer, while developing Mars as a second stage—only after guaranteeing our species' survival on our home planet. Incorporating extreme redundancy, low gravity compensation, and psychological health shows Mars' hidden costs are colossal, reinforcing the priority of focusing efforts on Earth before venturing into space.

For More Information (Real Links)

These ideas align with real projects you can explore:

- [NASA: Mars and Artemis Plans](#)
- [SpaceX: Starship and Mars Colonization Vision](#)
- [Biosphere 2: Closed Ecosystem Experiments](#)
- [ESA: Aquaponics and Space Food](#)

End of document *Original text and coordinated by Alejandro Díaz Aldana. November 2025 Open collaboration: Have ideas to improve this vision? Contact us on the website! Humansp.org*