

NASA Entrepreneurs Challenge 2023



"One Giant Leap for Life: Lunar Demonstration Garden"

Dr. Daniel Tompkins
GrowMars2@gmail.com

MARKET PAIN/PURPOSE

Problem:

Resupply and system services for air, water, and food add cost and risks

Psychological challenges faced by astronauts during extended space missions

Significance:

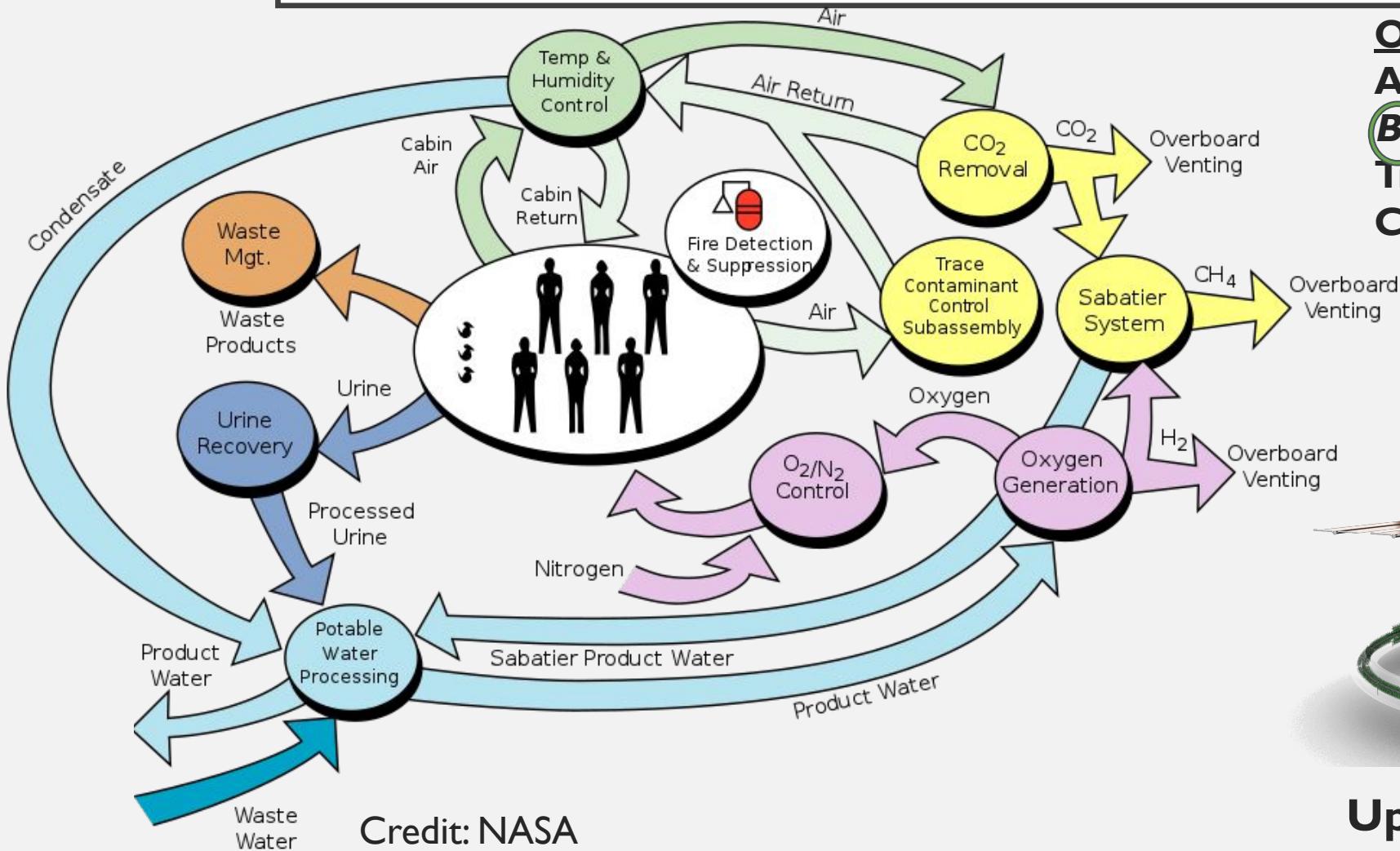
The Lunar Demonstration Garden, “Moon Garden” is a pathway to an **expandable-loop ecosystem** providing sustainable air, water, food, and building material.



Credit:NASA



MARKET PAIN/PURPOSE

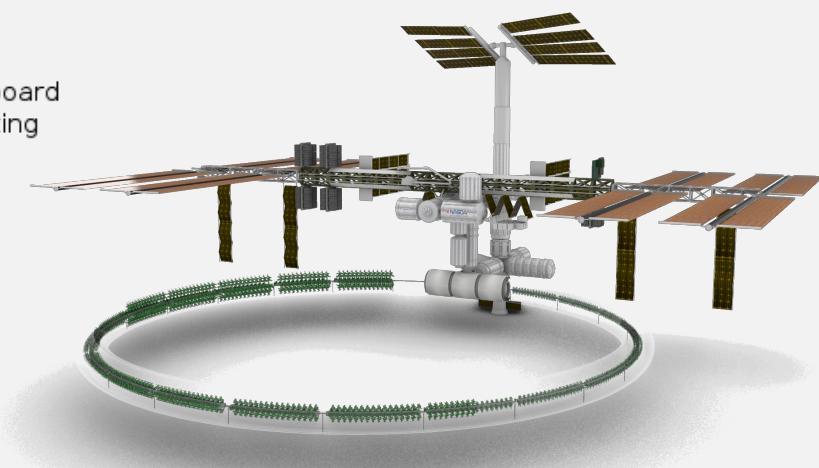


Options

A. Bring more

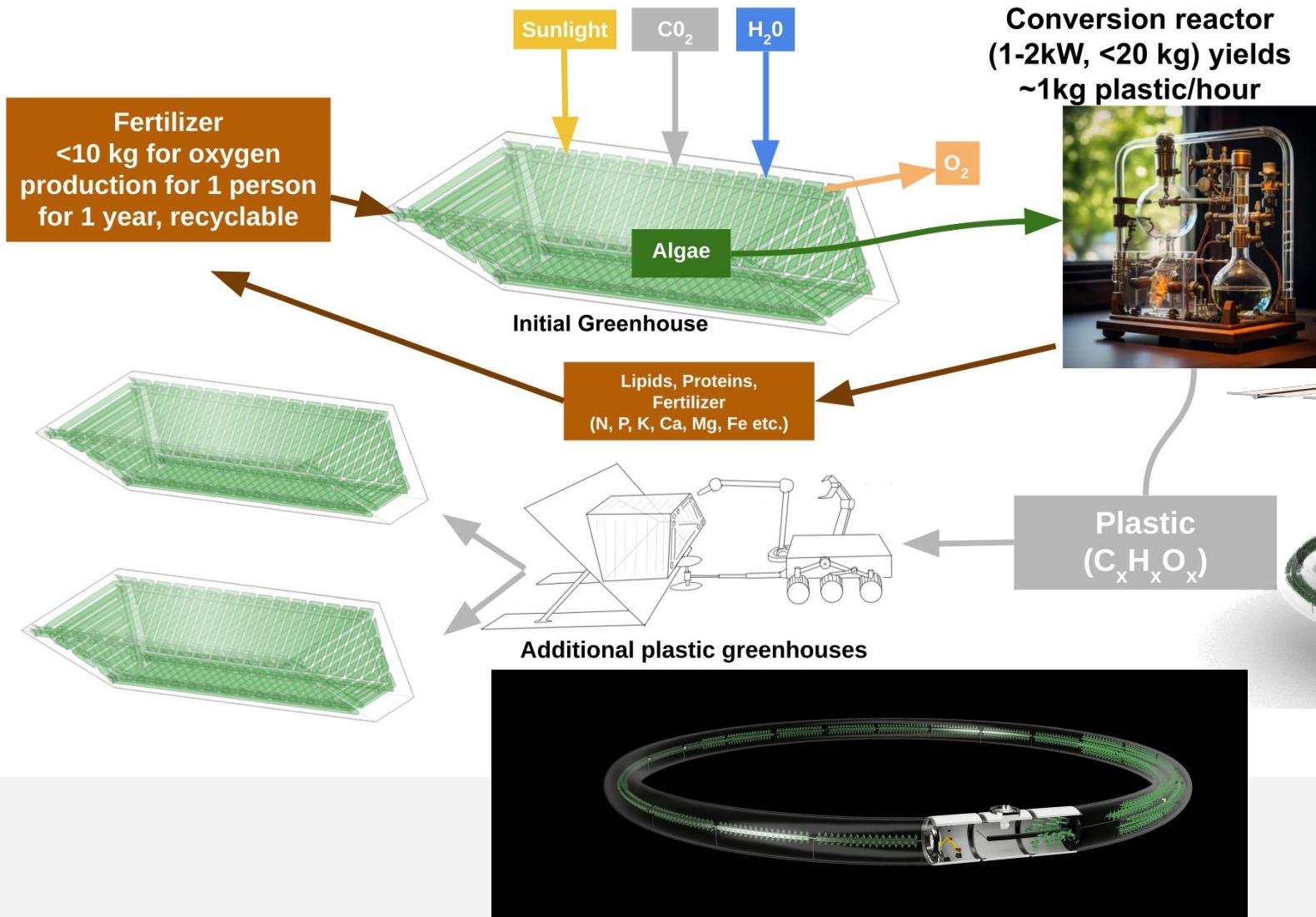
B. Do more, a lot more

Transform current single use
Carbon, Nitrogen, Hydrogen



**Upcycle waste carbon into
4,000 kg plastic /year**

TECHNICAL SOLUTION

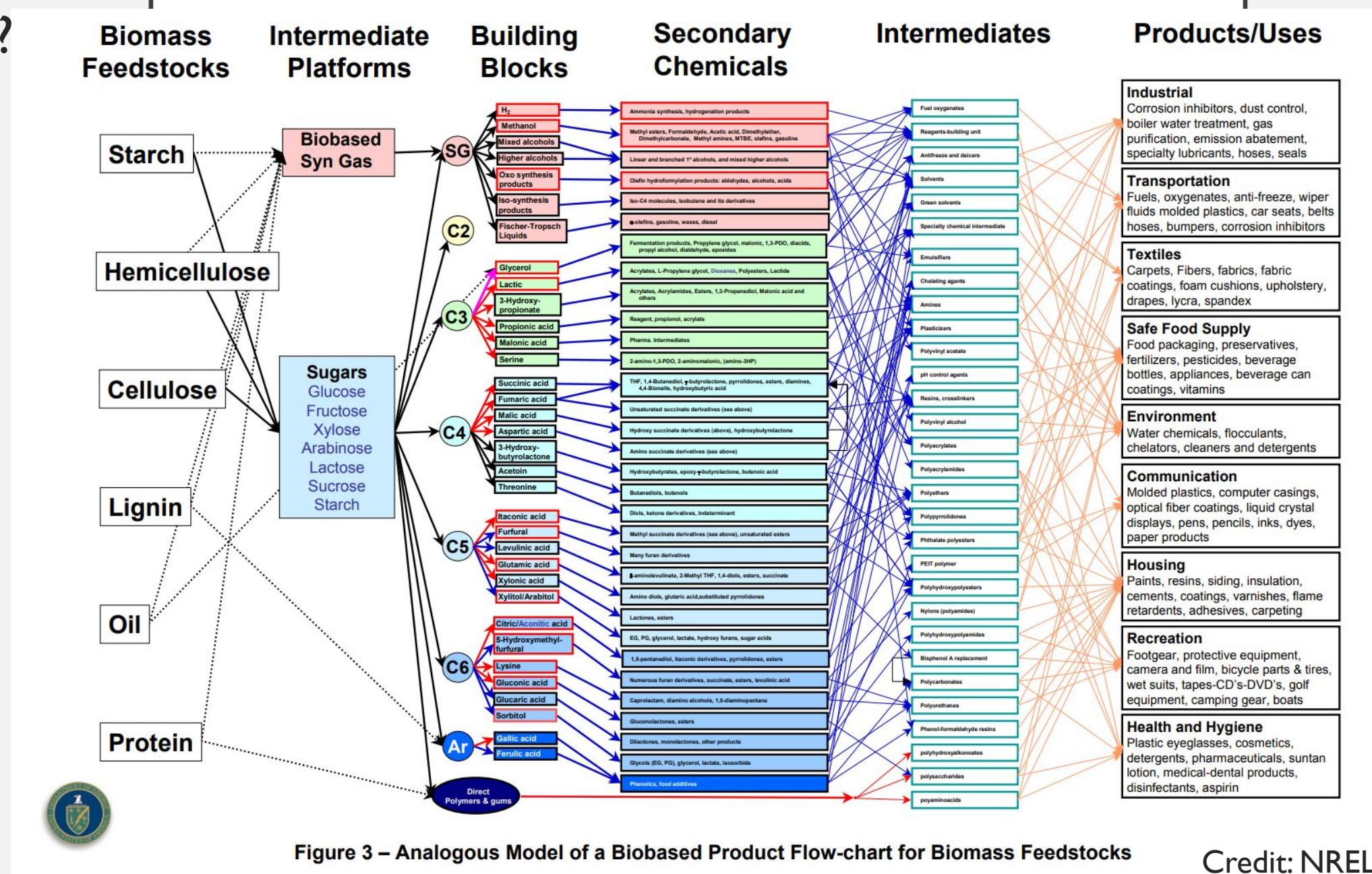


US patent issued 2021

**Upcycle waste carbon into
4,000 kg plastic /year**

Why Massive Biomass?

TECHNICAL SOLUTION



TECHNICAL SOLUTION

Technology Description

Moon Garden utilizes **biological processes** and **deeptech to sustain life** in space indefinitely, providing fresh food, oxygen, and cognitive enhancement for astronauts.

Response to Market Pain

The technology addresses the high cost and **logistical challenges** of space habitation beyond Earth by reducing resupply missions, upcycling waste, and improving astronauts' quality of life.

Technical Credibility

The approach builds on established principles of life growth and reproduction, with adaptations for the unique conditions of space. It considers **power and hardware** requirements for a sustainable operation on the lunar surface.

Innovation

Moon Garden innovates by:

- 1) **Scaleable** biological life support in space
- 2) Waste **utilization** Carbon, Nitrogen, Hydrogen
- 3) Platform technology for in-space manufacturing, **transforming how we approach space exploration and sustainment.**

MARKET POTENTIAL

Market Potential Lunar

Market positioned to generate \$105 billion over the next decade [1].



Impact on the Market

Pathway to reduce the cost of living (researching) in space from \$500 million[2] to \$500k per person per year.

Platform for biology, biomanufacturing, green chemistry



References:

[1] Article Title: Moon Markets Analysis – MVA Moon Markets. - Link: <https://moonmarkets.moonvillageassociation.org/moon-markets-analysis/>

[2] Article Title: PwC's 'Lunar market assessment: market trends and challenges in the - Link: <https://space-economy.esa.int/article/119/pwcs-lunar-market-assessment-market-trends-and-challenges-in-the-development-of-a-lunar-economy>

BUSINESS MODEL AND TRACTION

NETFLIX

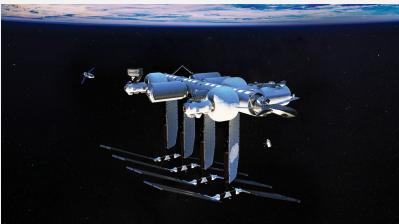
prime video

Disney+

REVELATIONS
ENTERTAINMENTIMAGINE
ENTERTAINMENT

Prospecting proposals

Streaming platforms, Broadcasters, Production companies

Qualified Xprize
team April 2022

B 2 C- Educational/Entertainment

Science data and documentary showcasing the first tree, flower, egg, bee, on the Moon.



B 2 B- Commercial Low Earth Orbit Destinations

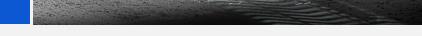
Revenue model commercial orbital and lunar service provider

B 2 G- Deepspace and deeptech gigatonne carbon sequestration

Earth-based applications of Moon Garden data, such as improving supply chain resiliency for space operations (DoD) and advancing carbon sequestration efforts, contributing to global sustainability.



BUSINESS MODEL AND TRACTION

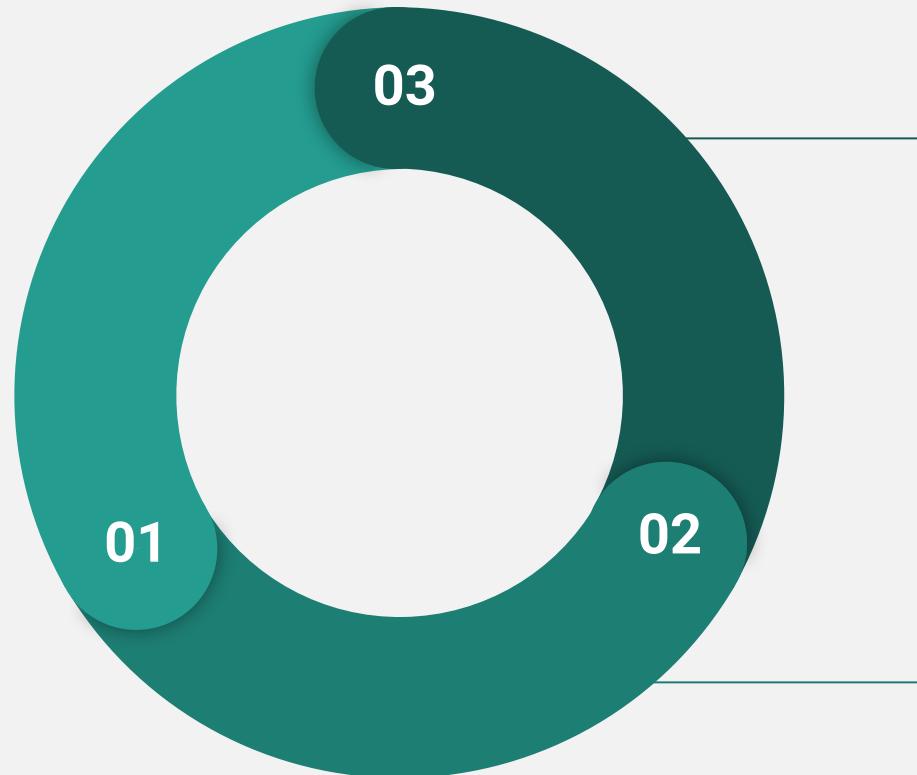
Accomplishments	DONE	TO -DO	Future Growth	
1 Successful design and test of Moon Garden prototype in Thermal- vacuum chamber	✗	✓	Commercial lunar payload services and solutions for LEO customers	
2 Space talent agreement (25+pp)	✗	✓	Earth-based applications of Moon Garden data for supply chain resiliency and carbon sequestration	
3 Strategic letter of intent and support with Lockheed Martin	✗	✓	Anticipated new revenue and growth opportunities with Moon Garden evolution	 
4 PARSEC Network agreement	✗	✓	Educational revenue streams through science documentaries	

BUSINESS MODEL AND TRACTION

**Expertise in space
Living Systems
Design and Build**

- 2018 AWS aerospace accelerator
- 2019 Joint NASA publication
- 2021 US patent issued
- 2022 Top 108 US qualified teams for Xprize carbon removal challenge
- 2022 Won AirbnbOMG100k prize

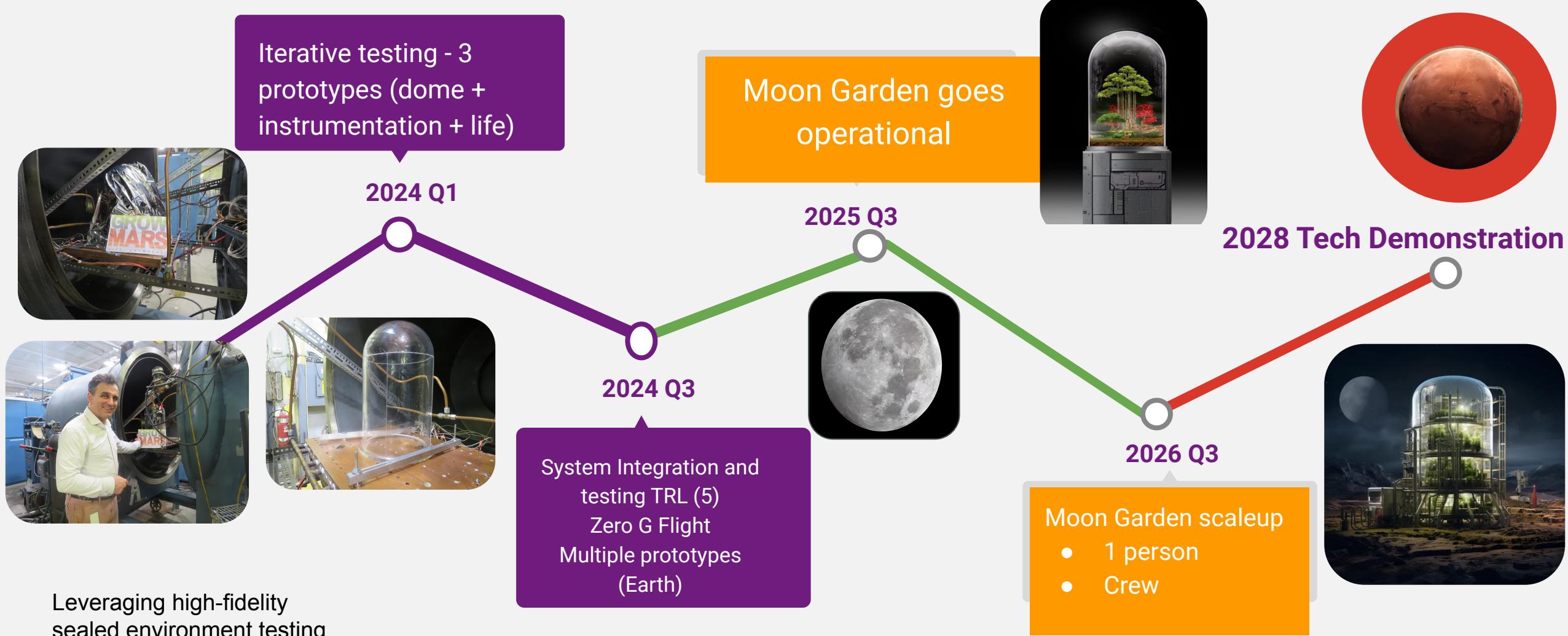
...



**Operations
Management and
Manufacturing**

**Data (Science and
Consumer)
Analytics**

FUTURE VISION



500+ years of experience

“Dream” TEAM



Leadership Collaboration

Technology, Engineering, Math (7)



Art (7)



Business (3) Director, Strategy, Marketing



Biology (7) Space Soil Science, Hydroponics, Astrobotany, Astrobiology, Bioremediation



Strengths: Multidisciplinary collaboration with a roadmap for technology development and commercialization.

GrowMars Lunar Demonstration Garden
Letter of Intent for Collaboration



"One Giant Leap for Life: Lunar Demonstration Garden"

GrowMars is in development of a "Lunar Demonstration Garden" on Lockheed Martin's Lunar Mobility Vehicle (LMV). We are excited to extend an invitation to collaborate on subsystems, design, scientific experimentation, and technological demonstrations for this and additional lunar payloads. Join us on this journey together to lay the cornerstone for life indefinitely off Earth!

For critical early-stage funding, GrowMars recently won the Phase 1 NASA Entrepreneurs Challenge in August of 2023. As we advance to Phase 2 of the challenge your intent to collaborate will support this effort and be greatly appreciated.

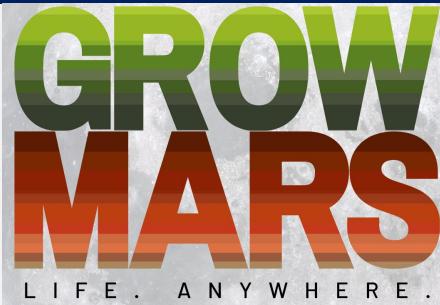
Daniel Tompkins

Dr. Daniel Tompkins
Founder of GrowMars

<u>Janet Ivey-Duensing</u>	<u>David Cheuvront</u>	<u>Morgan Gendel</u>
<u>Graham Lau</u>	<u>Richard Barker</u>	<u>R. H.</u>
<u>Colin Lennox</u>	<u>Kai Staats, MSc</u>	<u>Bryan Versteeg</u>
<u>Patrick Grubbs</u>	<u>D. Marshall Porterfield</u>	<u>Moraan Irons</u>
<u>Gonçalo Esteves</u>	<u>Bruce MacKenzie</u>	<u>R-W~</u>
<u>Beth</u>	<u>Fiona J. Haber</u>	<u>J. Taylor</u>



CONTACT



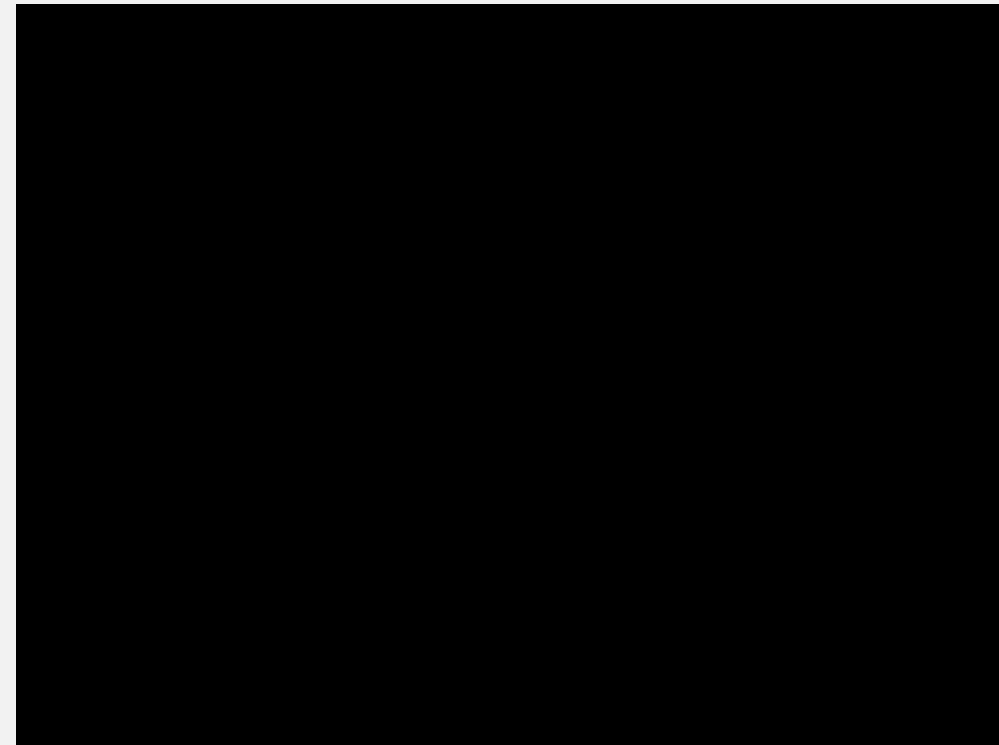
Dr. Daniel Tompkins
GrowMars2@gmail.com
www.GrowMars.space



Gonçalo Esteves
Founder @ Argo Space Technologies | 3x NASA
Award Winner



Daniel Tompkins
Agricultural Scientist, Maker



Breathe Life into Space

Business Roadmap

Garden on the Moon ----- 2025

Life on the Moon -----2027

Life On Mars ----- 2030

Fishbone Diagram - Customer Acquisition

Fishbone Diagram - Fulfillment (Reproducing and
expandability)

BUSINESS MODEL AND TRACTION

- Growth and Commercialization: The Moon Garden aims to serve as a commercial and research platform, offering services to space companies, corporate sponsorships, and nature documentaries. It has secured in-kind support, collaborations, and a signed letter of intent with Lockheed Martin.
- Revenue Streams: Potential revenue streams include service provision to space companies, corporate sponsorships, and nature documentaries, providing a diversified income model.

Fishbone Diagram - Customer Acquisition

MARKET POTENTIAL

Market Potential	Impact on the Market	Differentiation	Establishing a Pipeline for Space Independent from Earth	Space Post the Oil Age
Vast, with a developing moon market positioned to generate \$105 billion over the next decade [4].	Significant, by providing a sustainable solution for life support in space, reducing the cost of living in space from \$0.5 billion to \$500,000 per person per year [2].	Innovative approach to sustaining life in space, utilizing patented fluid-flow mechanisms and a closed-loop system to regulate passive thermal and radiation to sustain plant life in a lunar environment [5].	Aims to create a self-sustaining ecosystem in space, reducing the need for resources from Earth.	Could contribute to a post-oil age in space by demonstrating the feasibility of using in-situ resources for sustainable food production [2].

References:

- [1] Article Title: Moon Markets Analysis – MVA Moon Markets. - Link: <https://moonmarkets.moonvillageassociation.org/moon-markets-analysis/>
- [2] Article Title: PwC's 'Lunar market assessment: market trends and challenges in the - Link: <https://space-economy.esa.int/article/119/pwcs-lunar-market-assessment-market-trends-and-challenges-in-the-development-of-a-lunar-economy>
- [4] Article Title: NSR: Developing Moon Market Propelled by 250+ Missions and - GlobeNewswire. - Link: <https://www.globenewswire.com/en/news-release/2022/04/20/2425653/0/en/NSR-Developing-Moon-Market-Propelled-by-250-Missions-and-105-Billion-in-Revenue-through-Decade.html>
- [5] Article Title: PRODUCT DIFFERENTIATION STRATEGIES BASED ON TRENDS IN THE MARKET - Link: https://www.ishs.org/ishs-article/429_53

MARKET PAIN/PURPOSE

Market Pain/Purpose

High cost and logistical challenges of sustaining human life in space.
Current cost: \$500M per person/year

Problem Addressed

I. Reduce cost of living in space by providing fresh food, oxygen, and cognitive enhancement.

Significance of Solution

2. Increase accessibility of space exploration (Artemis means Sustainable, Presence)

Moon Garden as Manufacturing Platform

Harvest plants and organisms for materials (fibers, biofuels)

MARKET POTENTIAL

- Impact on Market: The Moon Garden has the potential to revolutionize space exploration by reducing the need for Earth-based resources and resupply missions. It addresses critical NASA objectives, including sustainable space exploration, ecological services, and psychological support for astronauts.
- Differentiation: The Moon Garden is a reproducible closed loop ecological system with a unique combination of biological organisms, and its potential to significantly reduce the cost of sustaining life in space.