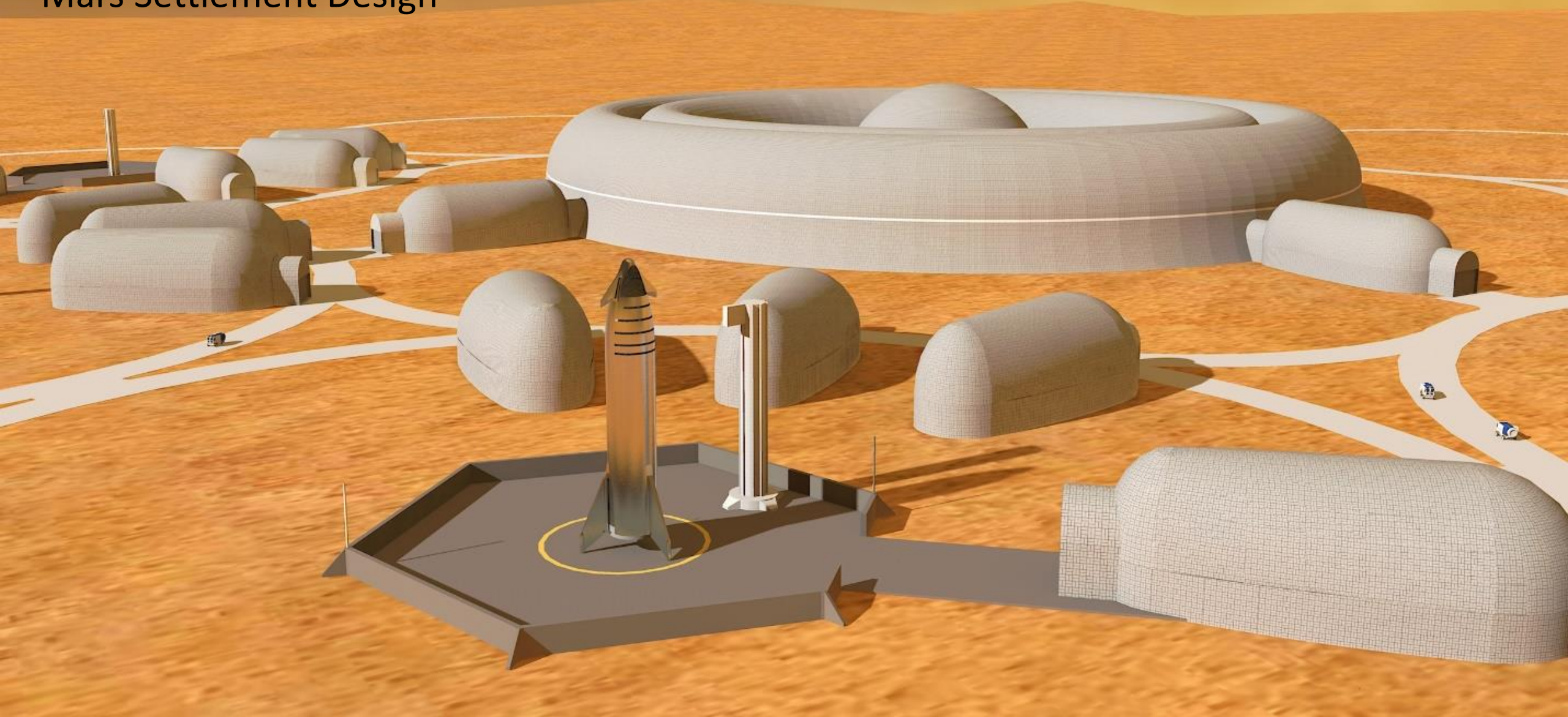


Eureka

Mars Settlement Design



Eureka's Goal: Overcome the “Steelman” Arguments

Answer all reasonable challenges to
Space Settlement in the most cost
effective and low-risk ways possible

- **Technology Issues**
- **Investment Issues**



Technology Revolution Components



Energy

- Higher Density
- Affordable, Consistent, Safe



Invention

- Capacity Envelope Expansion (Superpowers)
- Factorial complexities ($2!=2$, $3!=6$, $4!=24$, $5!=120$, etc.)



Information

- Science Drives Engineering. Vice Versa.
- Communication Drives Factorial Expansion



Affordability and Return on Investment

- Applies to All of the Above



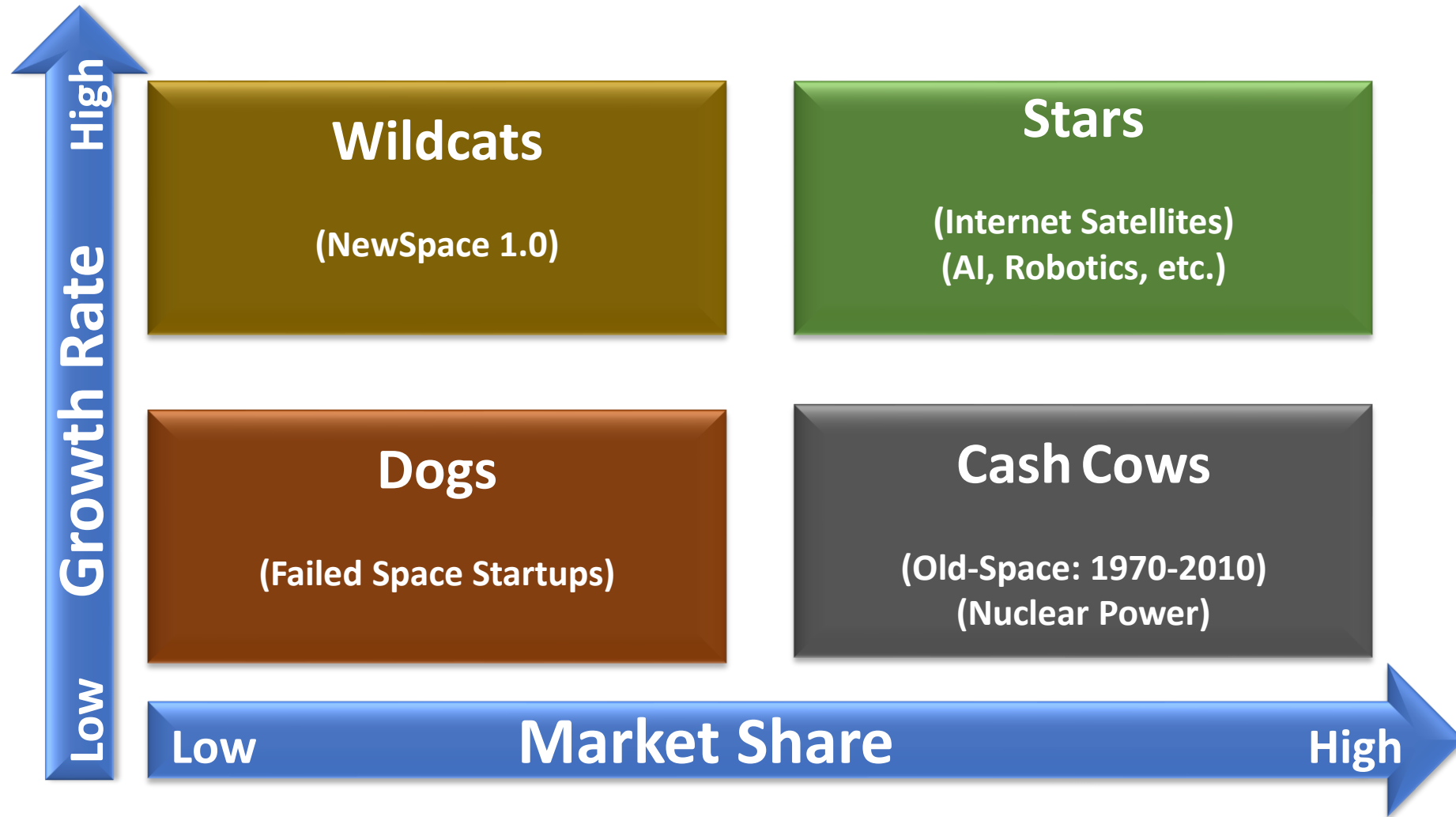
Excitement

- Boring Science and Technology Doesn't Explode Interest
- Superpowers, Comfort, Novelty

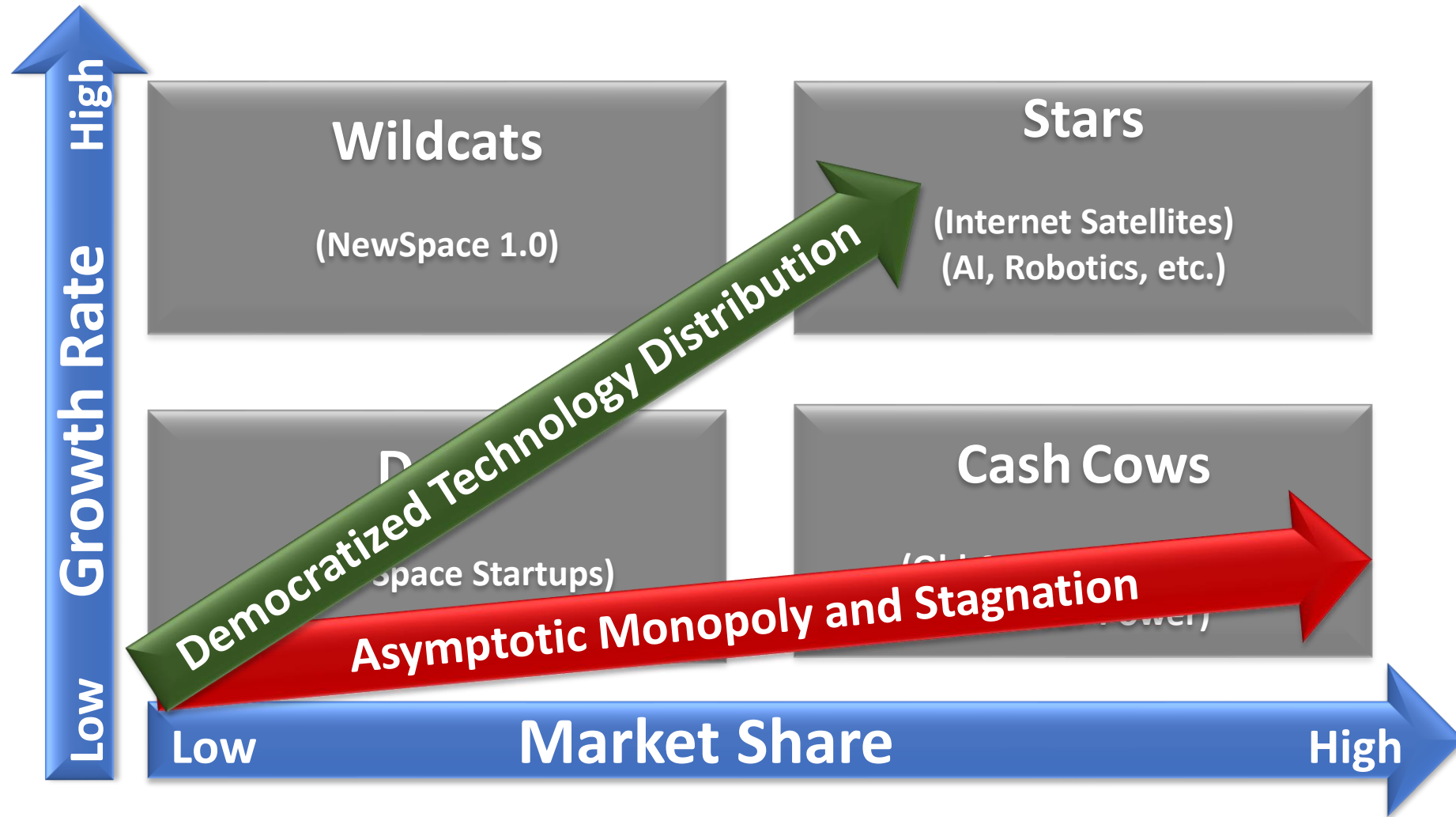
Energy Density, Invention and Information

Energy System	Utilization Inventions	Information
Human Power	Hunting, Gathering, Migration, Villages, Basic Farming, Textiles	Language
Animal Power	Farming, Roads, Cities, Travel, Writing, Trade	Math/Alphabets
Fire	Metallurgy, Basic Chemistry	Metallurgy
Wind Power	Ocean going vessels, Navigation	Navigation
Steam (Wood)	Fast transport on rail/oceans. Paddle-wheels/wood boats.	Telegraph
Steam (Coal)	Ironclad ships with screw propellers. Steel and other alloys.	Fast News
Petroleum (Kerosene)	Indoor lighting, advanced industrial chemistry of petroleum.	Radio
Electricity	Indoor lighting, Distributed mechanical/heat power.	Telephone
Petroleum (Gasoline)	Internal combustion, Cars, Aircraft, early rockets.	Television
Chemical Rockets	Moon landings, Solar system exploration, etc.	Satellites
Nuclear Power	Submarines/Aircraft carriers, NERVA.	Computers

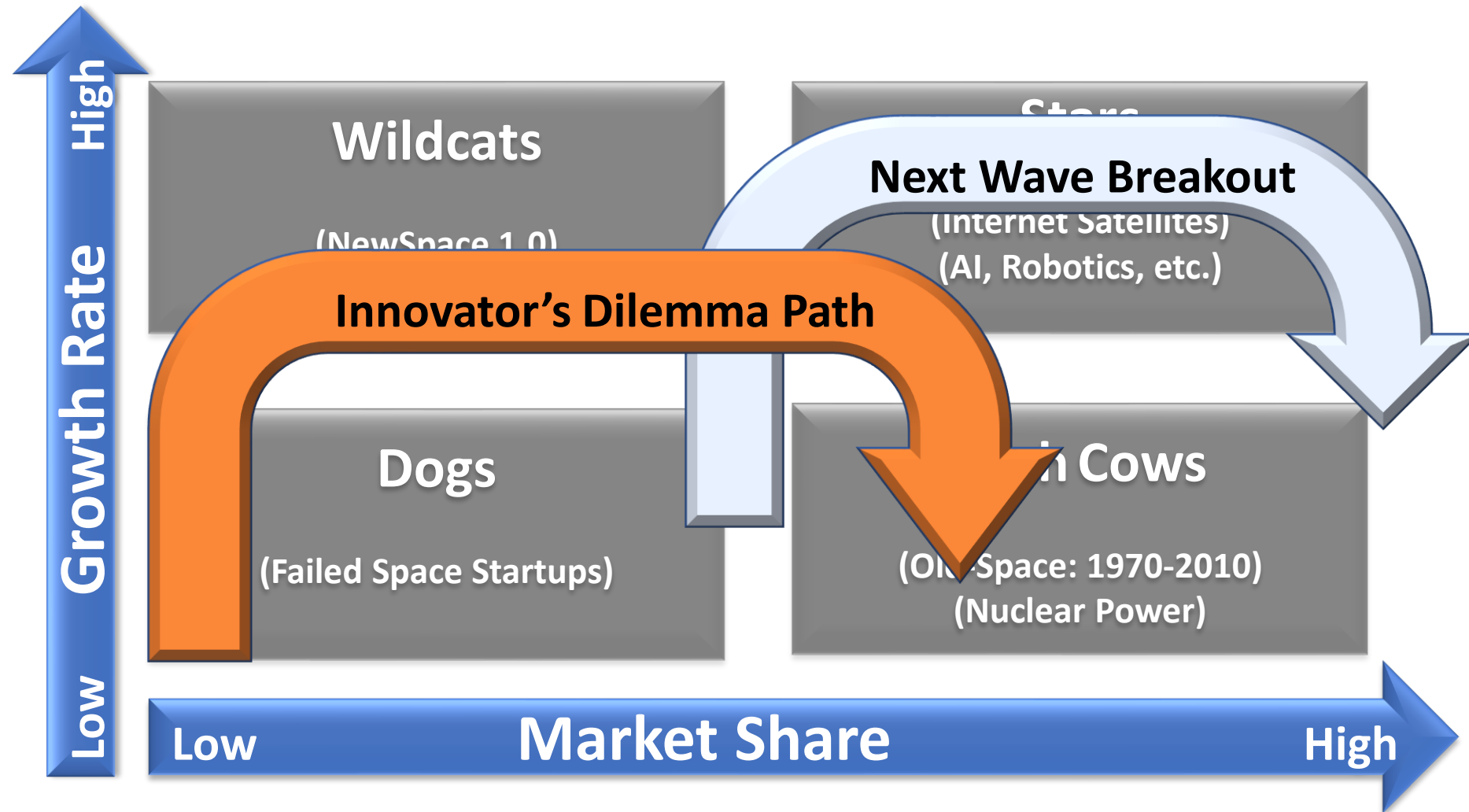
Boston Box and Initial Failure to Democratize



Boston Box and Initial Failure to Democratize



Innovation: Exponential to Asymptotic



Grand Challenges of Space Settlement

Launch/LEO	Deep Space	Moon/Mars	Settlement
Affordable Launch	Solar Flares	Moon Landing	Air/Water
Large Vehicle Launch	GCR: Cell Damage	Mars EDL	Power and Propellant
Orbital Refueling/ Mass Fraction beyond Earth Orbit	Medication/ Food Expiration	Spacesuit Lifespan	Base Construction
Space Junk	Life Support Closed Loop	Dust Issues	Food Growth
Microgravity (health issues)	Medical Entropy	Basic Power/ Propellant Production	Surface Mining and Extraction
	Psychology	Return Flight to Earth (speed, mass, etc.)	Hybrid Manufacturing
	Mechanical Entropy	Planetary Protection	Reproduction

Invention/Investment Convergence Engines



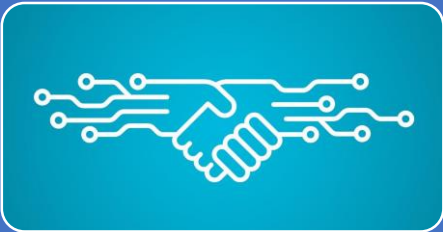
MarsSpec

- Robust systems
- Democratization of Space Innovations to All Markets



Certification Seals

- Investment (Corporate Bond Equivalent)
- Space-Flown Collectables
- Sponsorship of Early Flight Articles

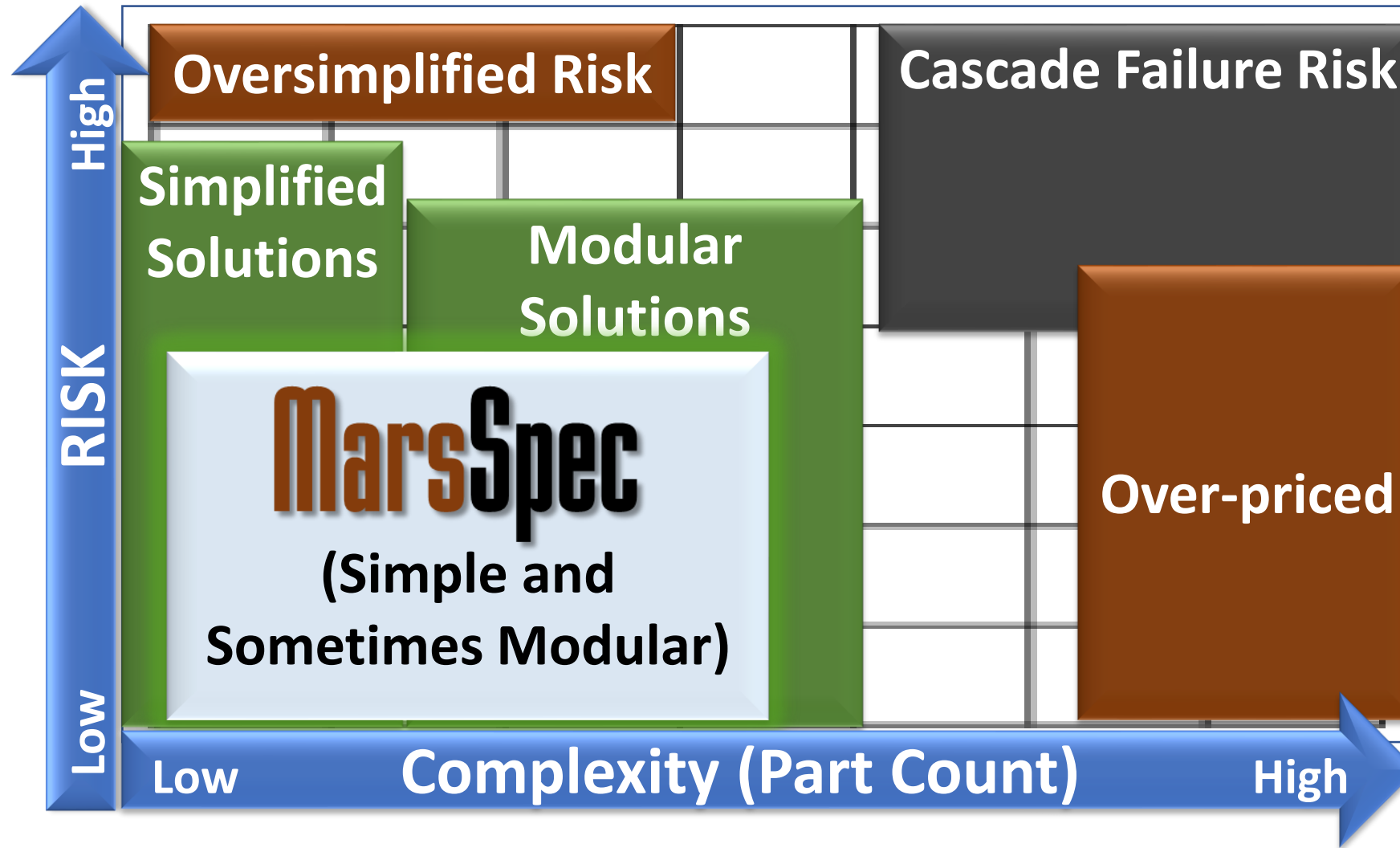


Intellectual Property Smart Contracts

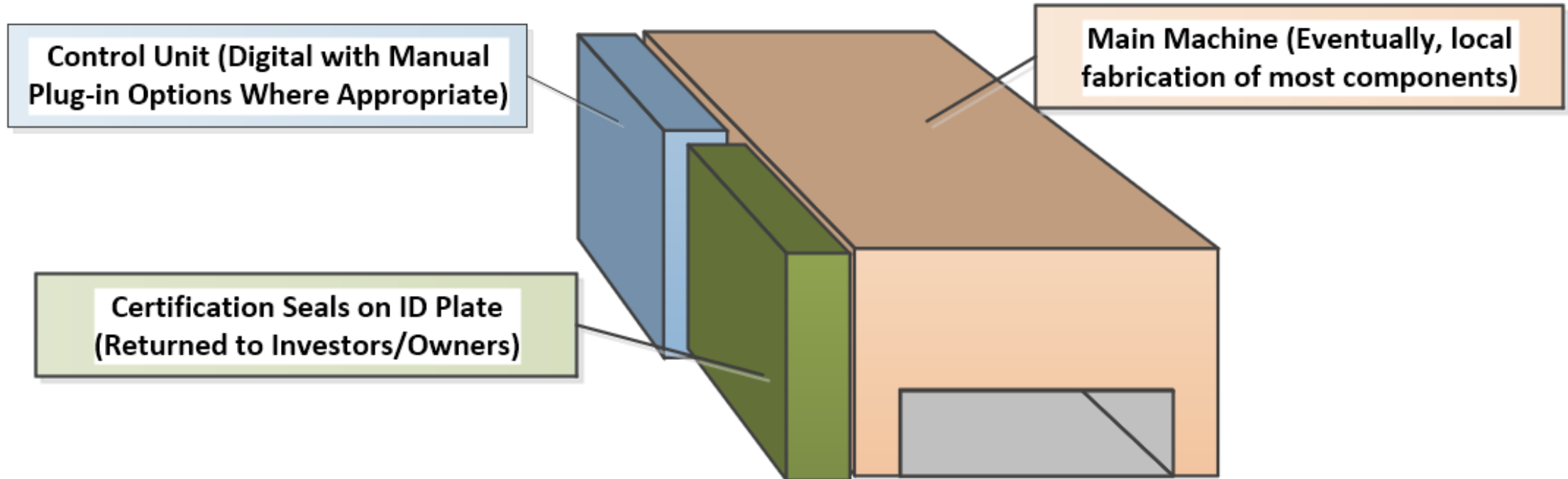
- Fast, Fair Patent protection and Primary Research Funding
- AI Accelerated Literature Searches
- External interfaces via Foundation to isolate in-house innovation

MarsSpec

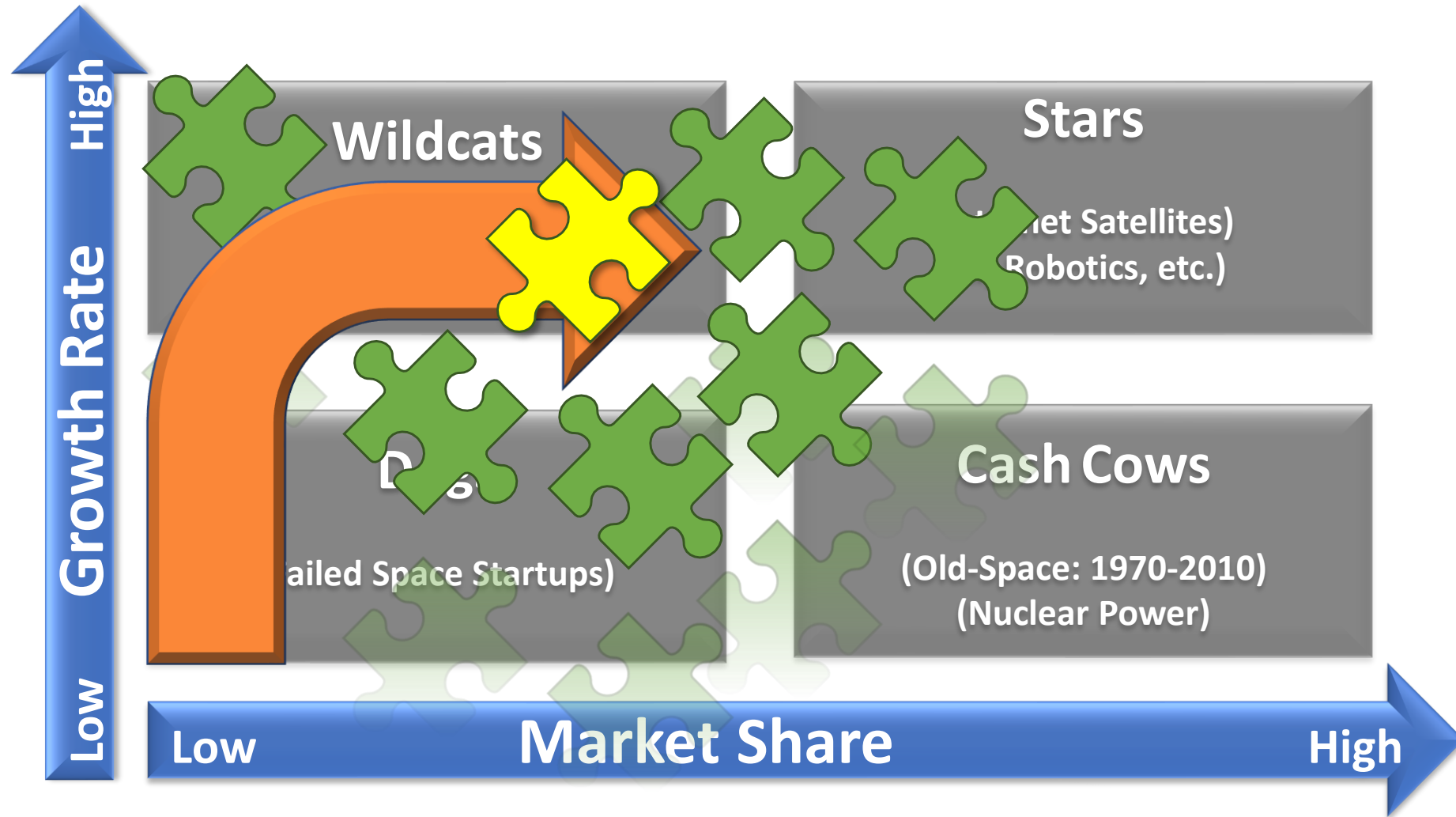
Fast, Safe, Standard, Adaptable



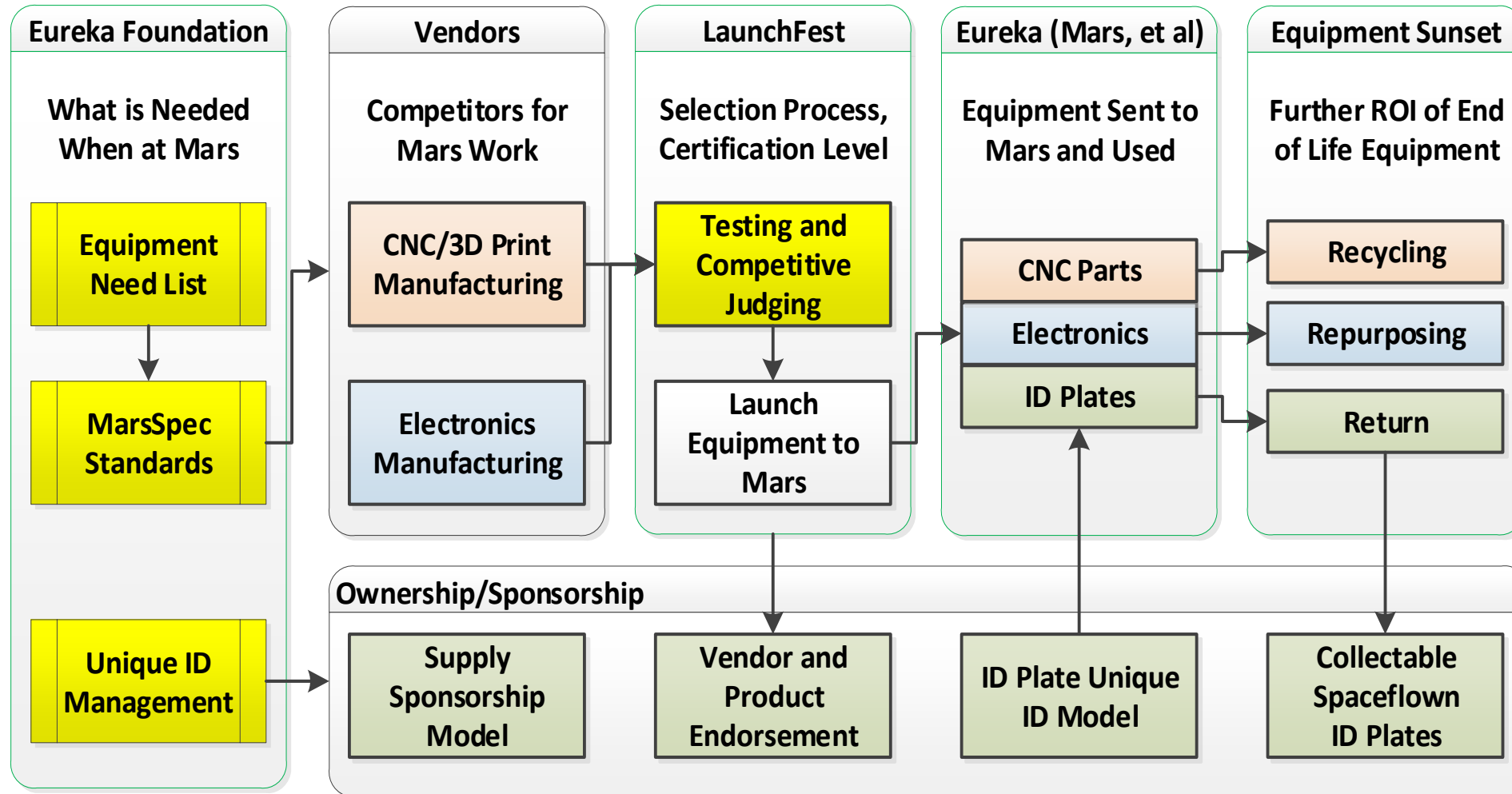
Certification Seals



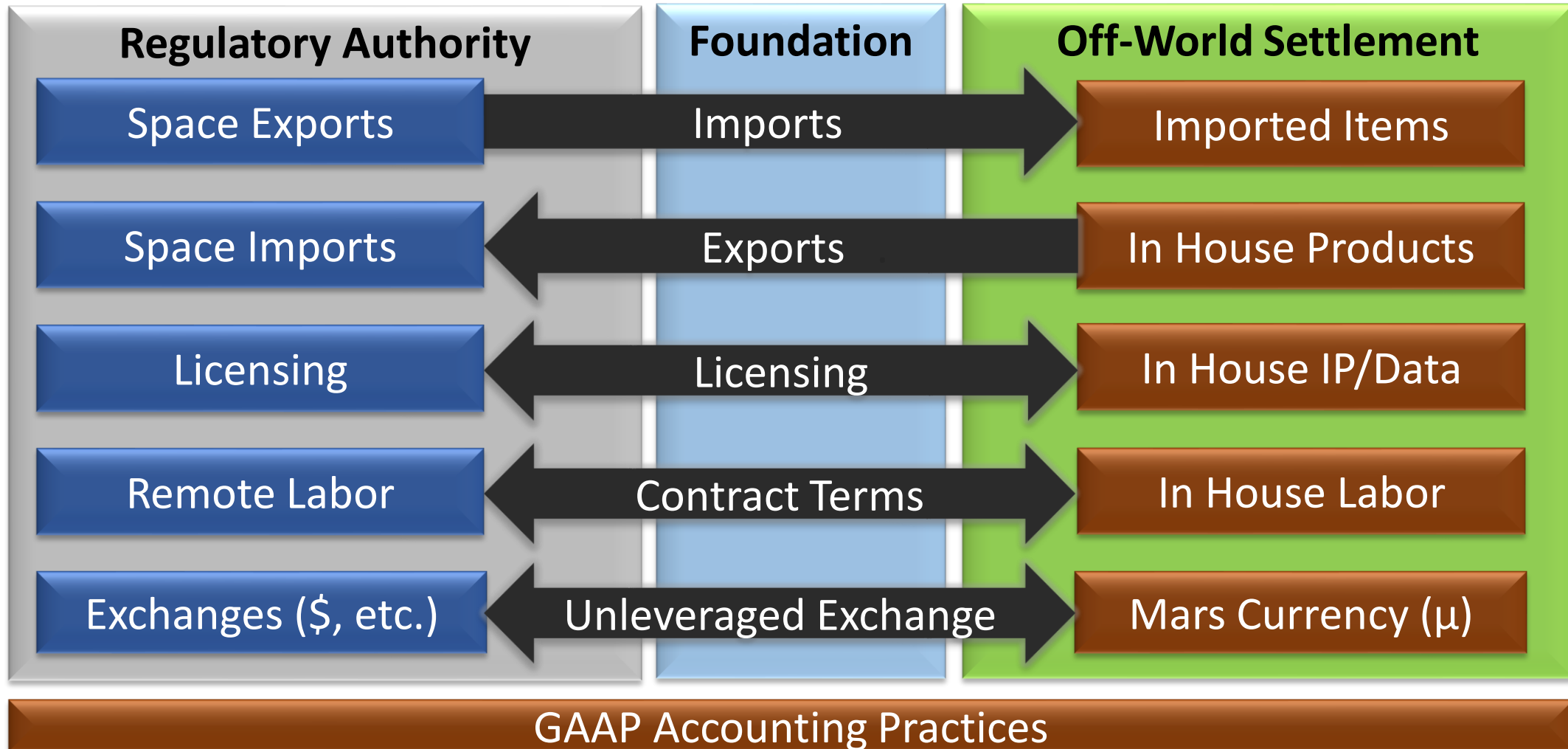
Smart IP: Making Innovation Permanent



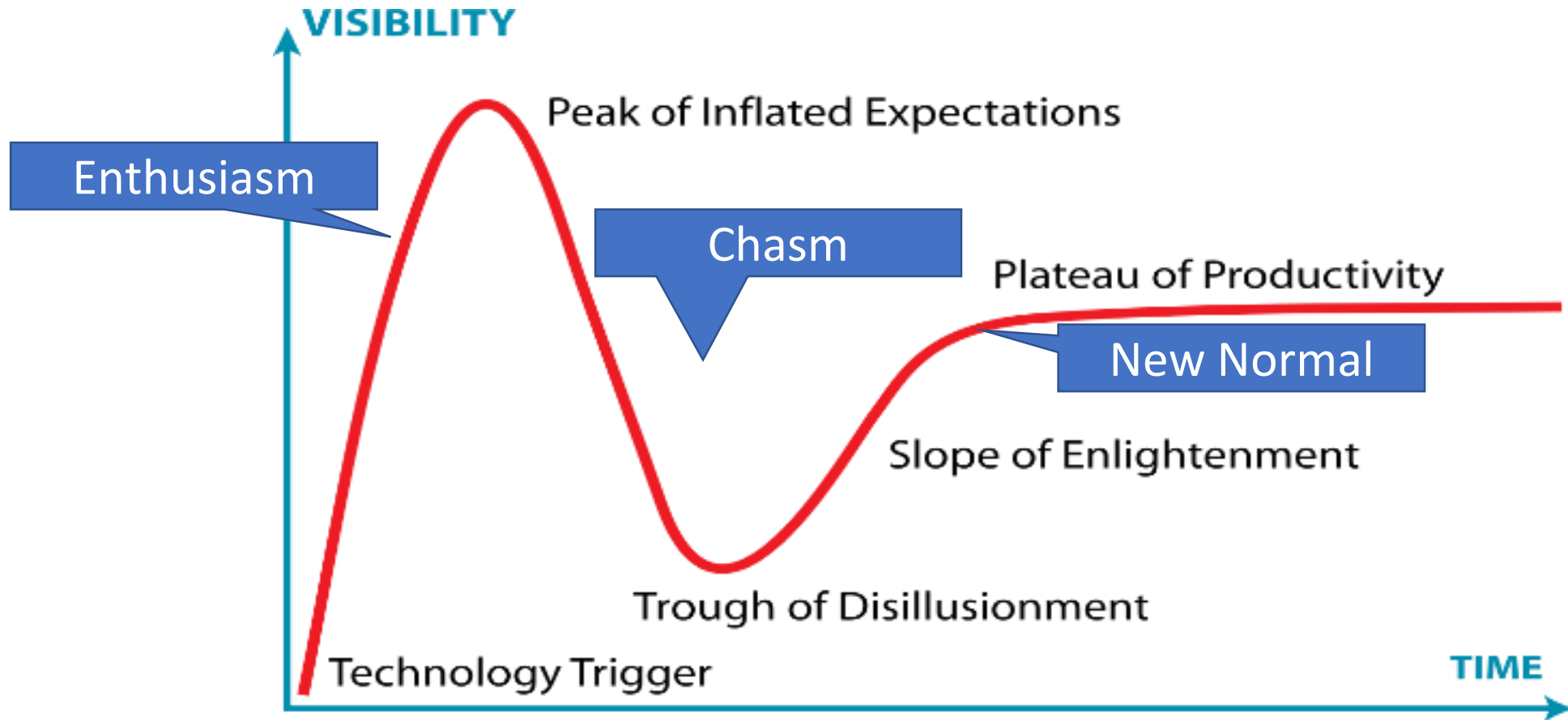
Disrupting Development Costs



Economic Independence



Business Model – Three Environments



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Phases of Economic Development



Exploration Phase

- Mars Rocks to science community
- Commissioned Studies



Collector Phase

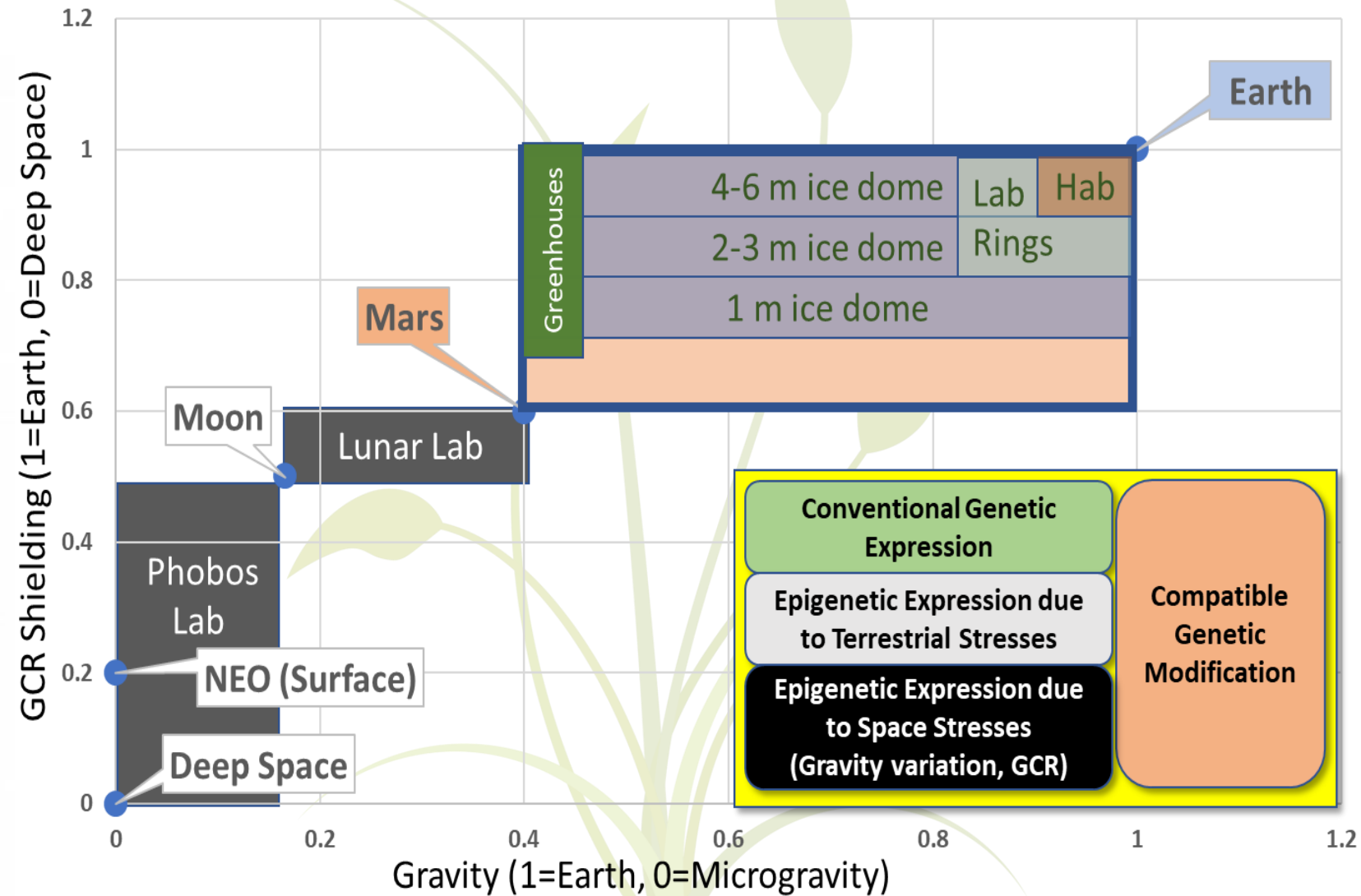
- Rock Samples, Grown on Mars, Made on Mars collector's items
- Intellectual Property Rights (Patents, etc.)



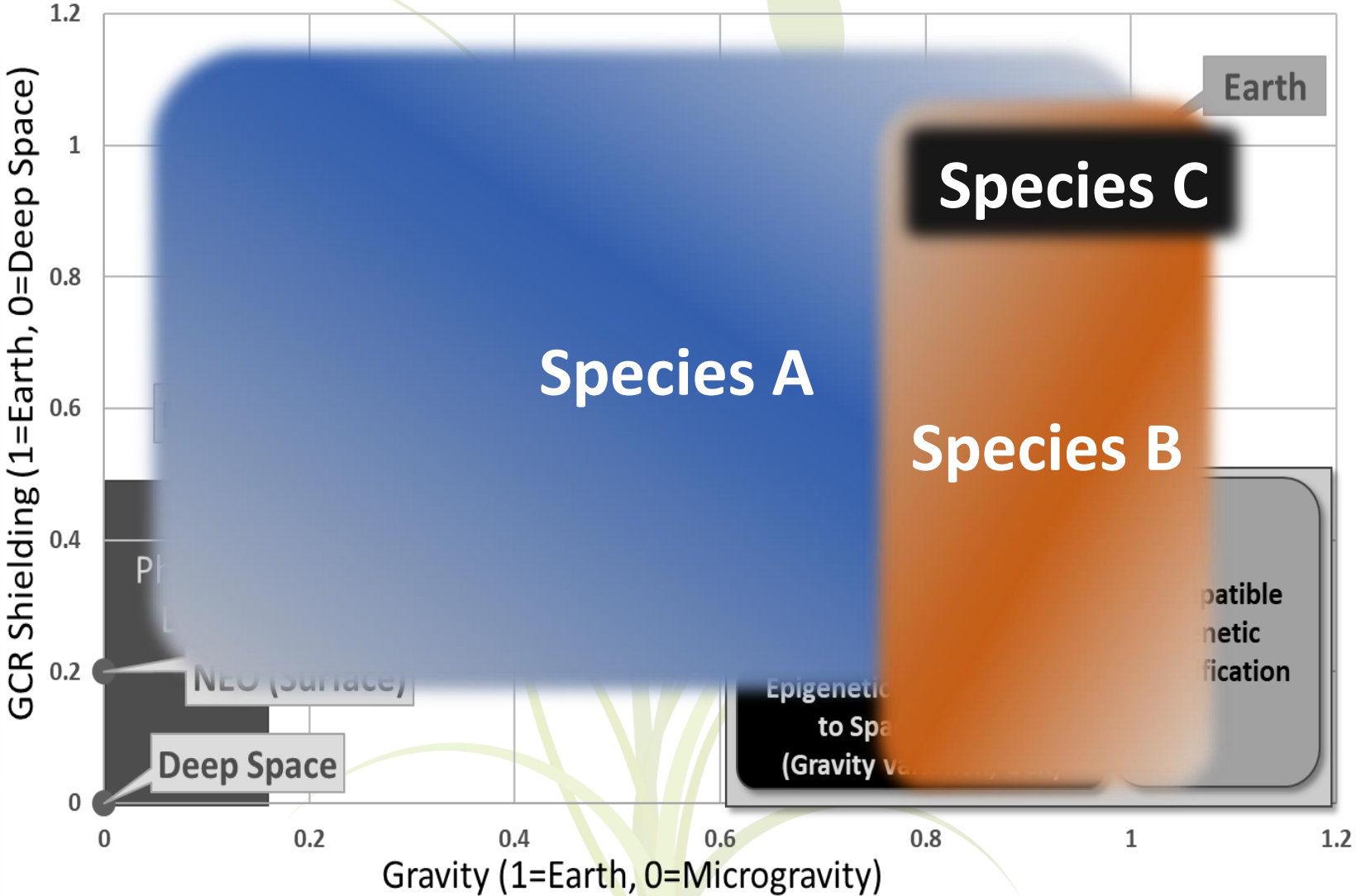
Science City Phase

- Direct Biological Exports, Pharma and agricultural work
- Possible Lunar Base Outsourcing for Short Lifetime Biologicals

The Purpose



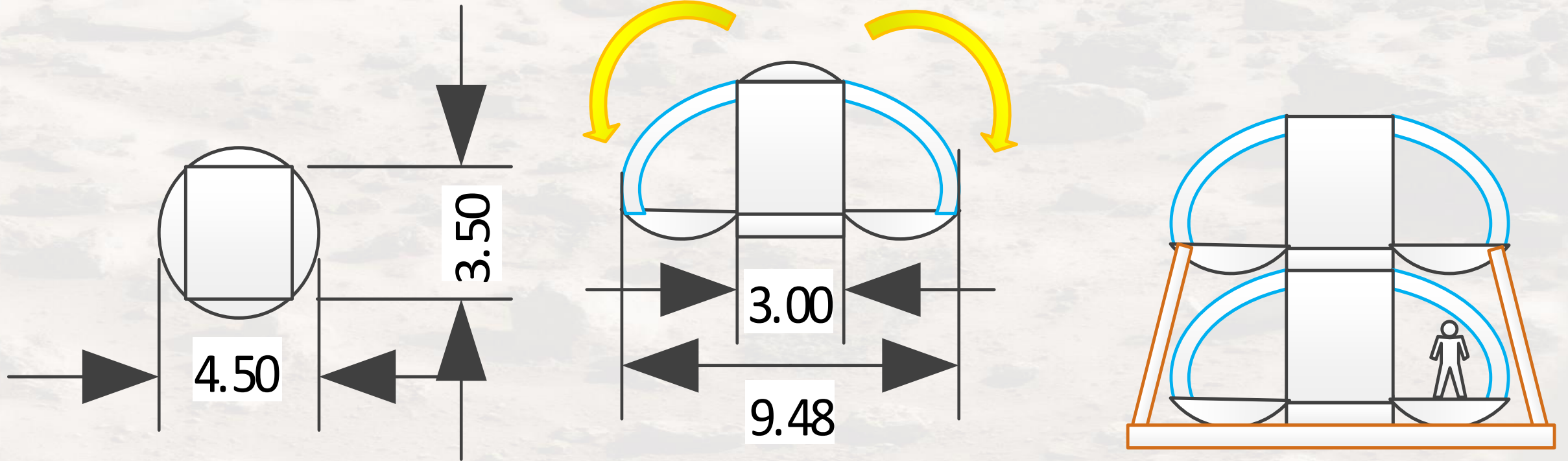
The Purpose



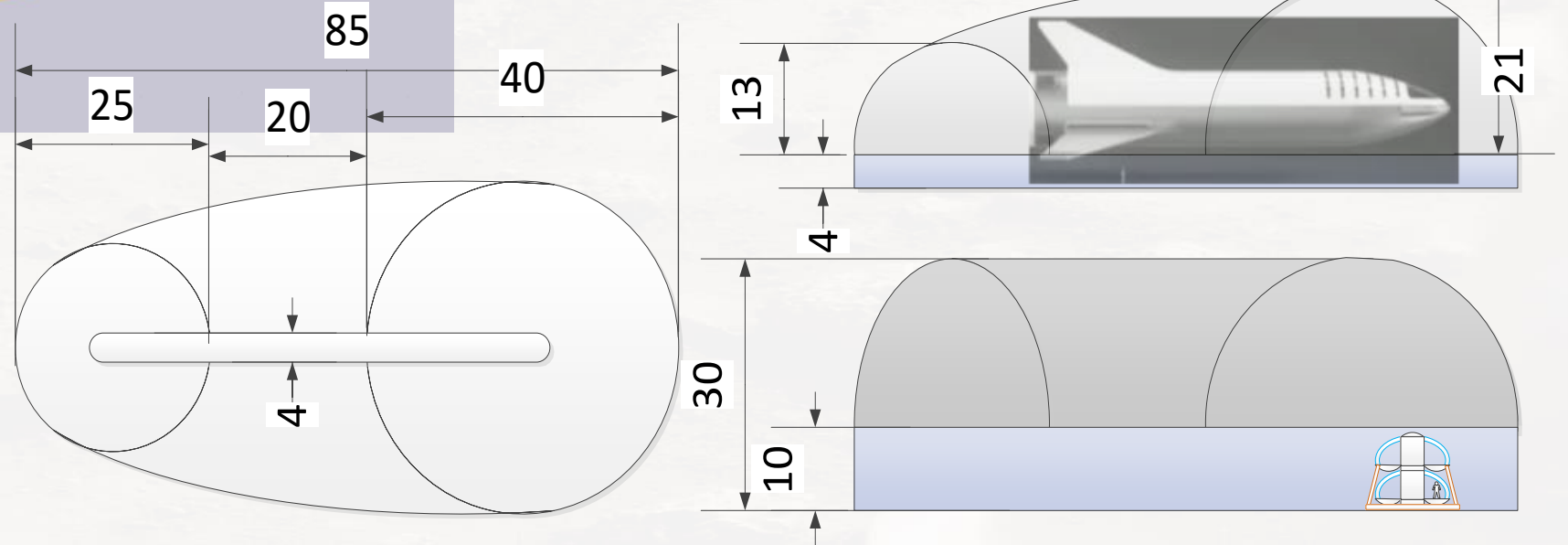
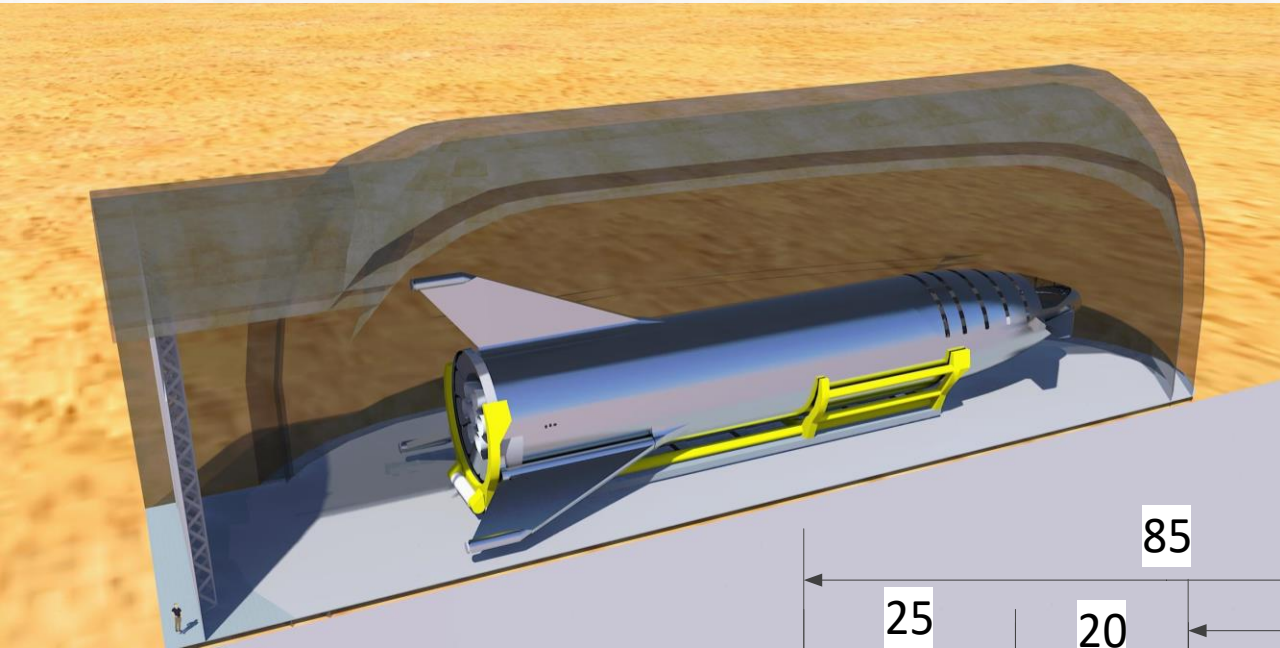


Building Eureka

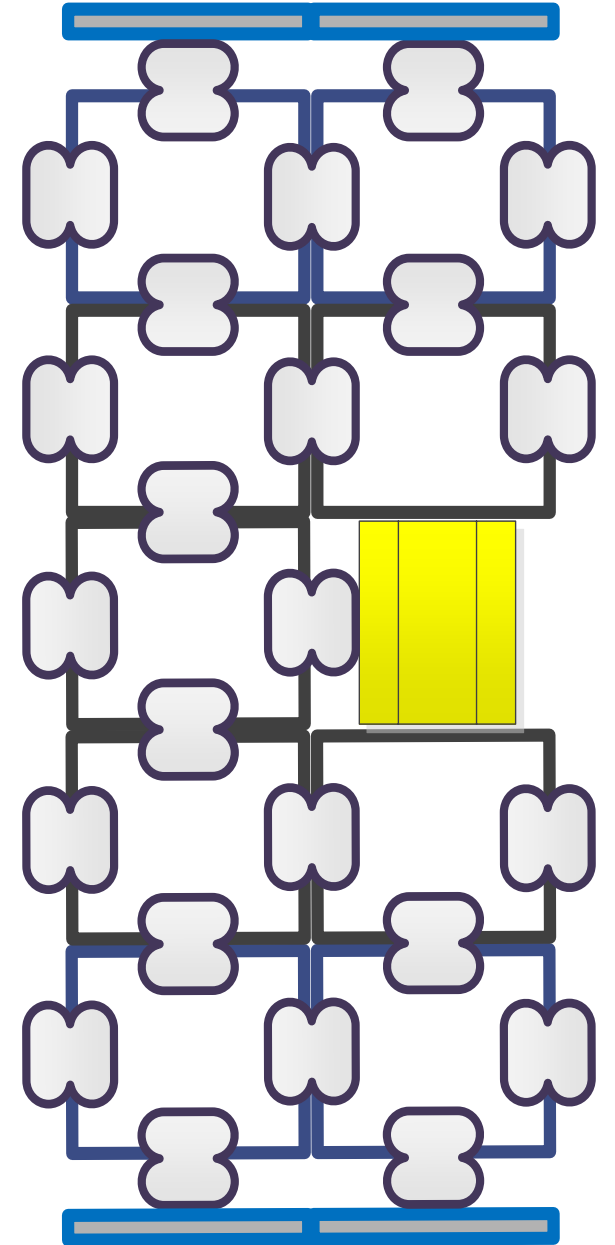
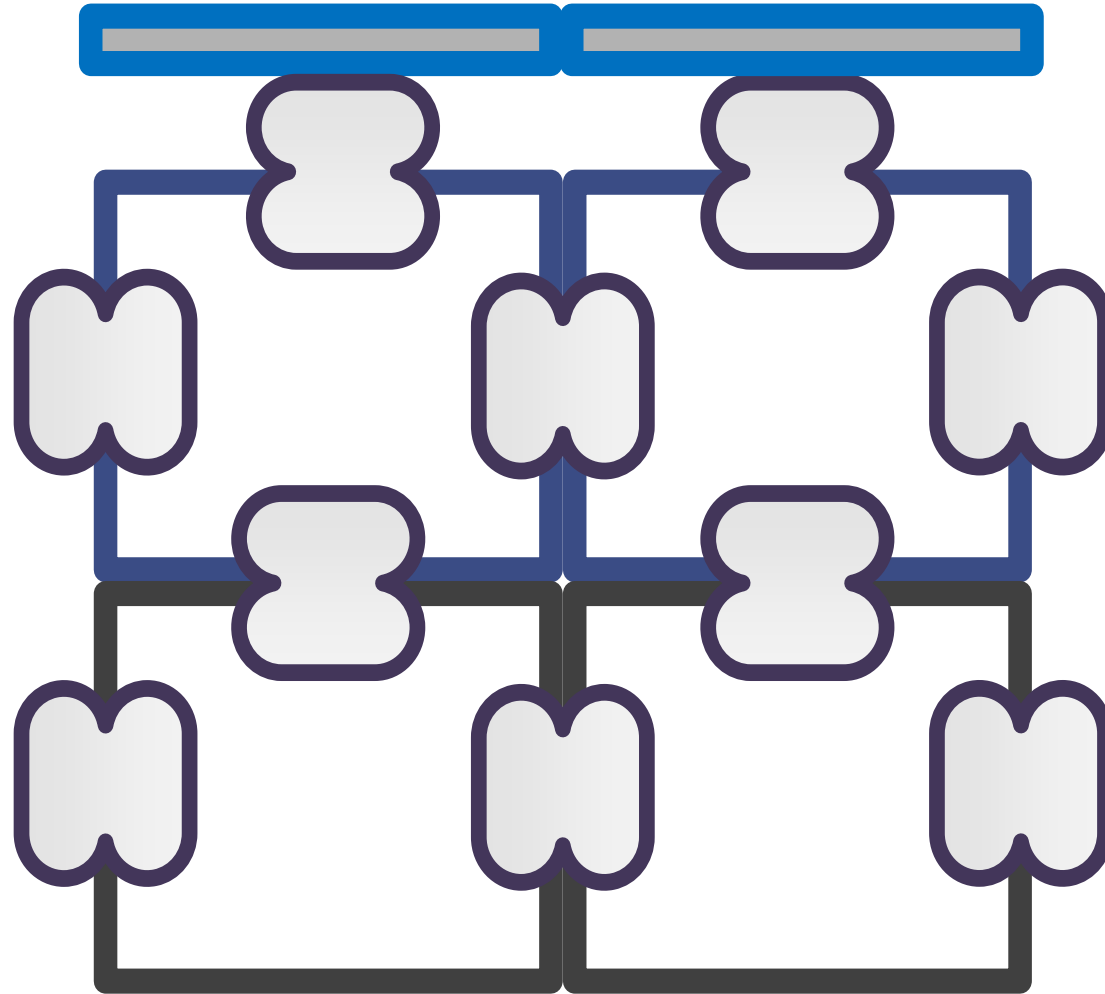
Construction Shack Phase



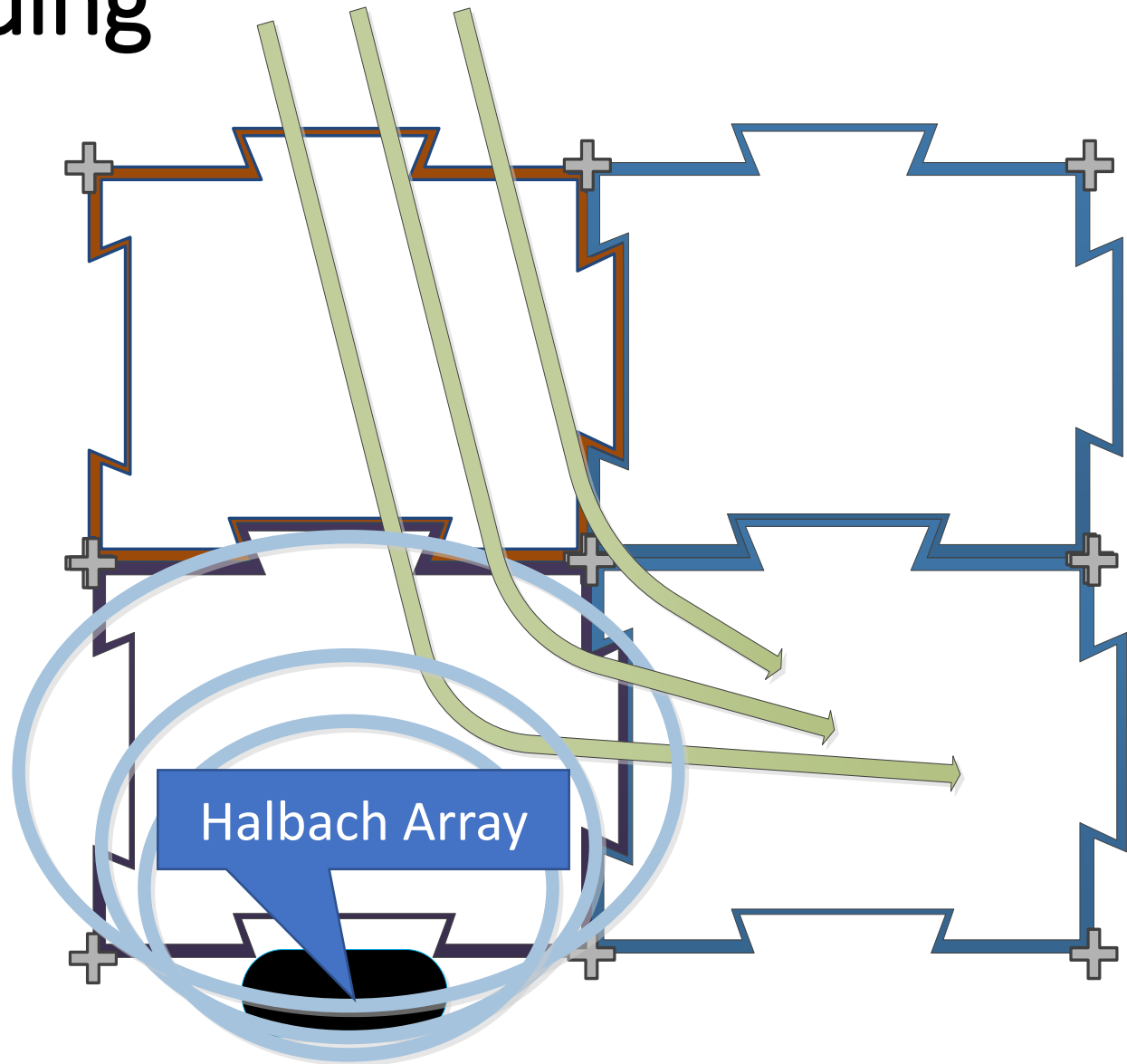
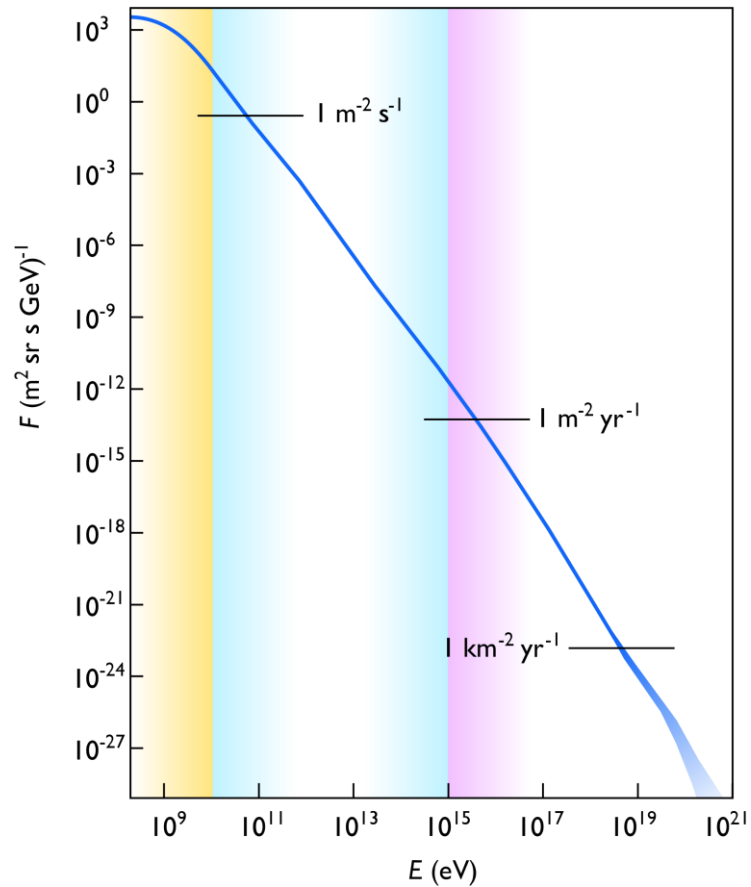
Long Dome Construction



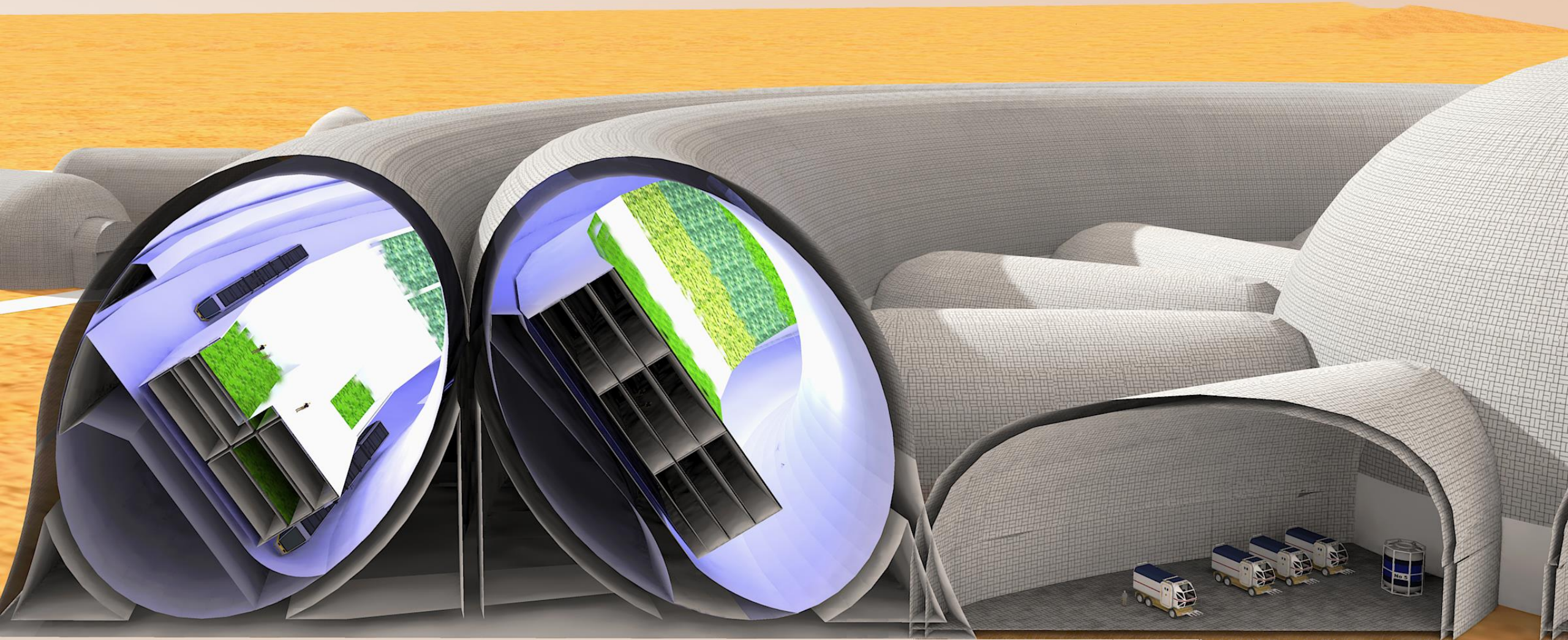
Modular Pykrete Construction



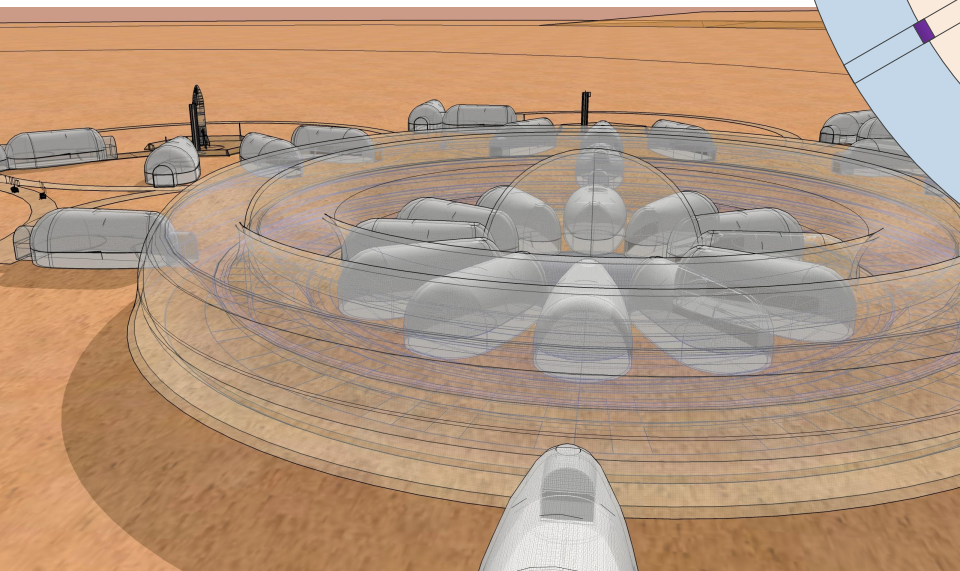
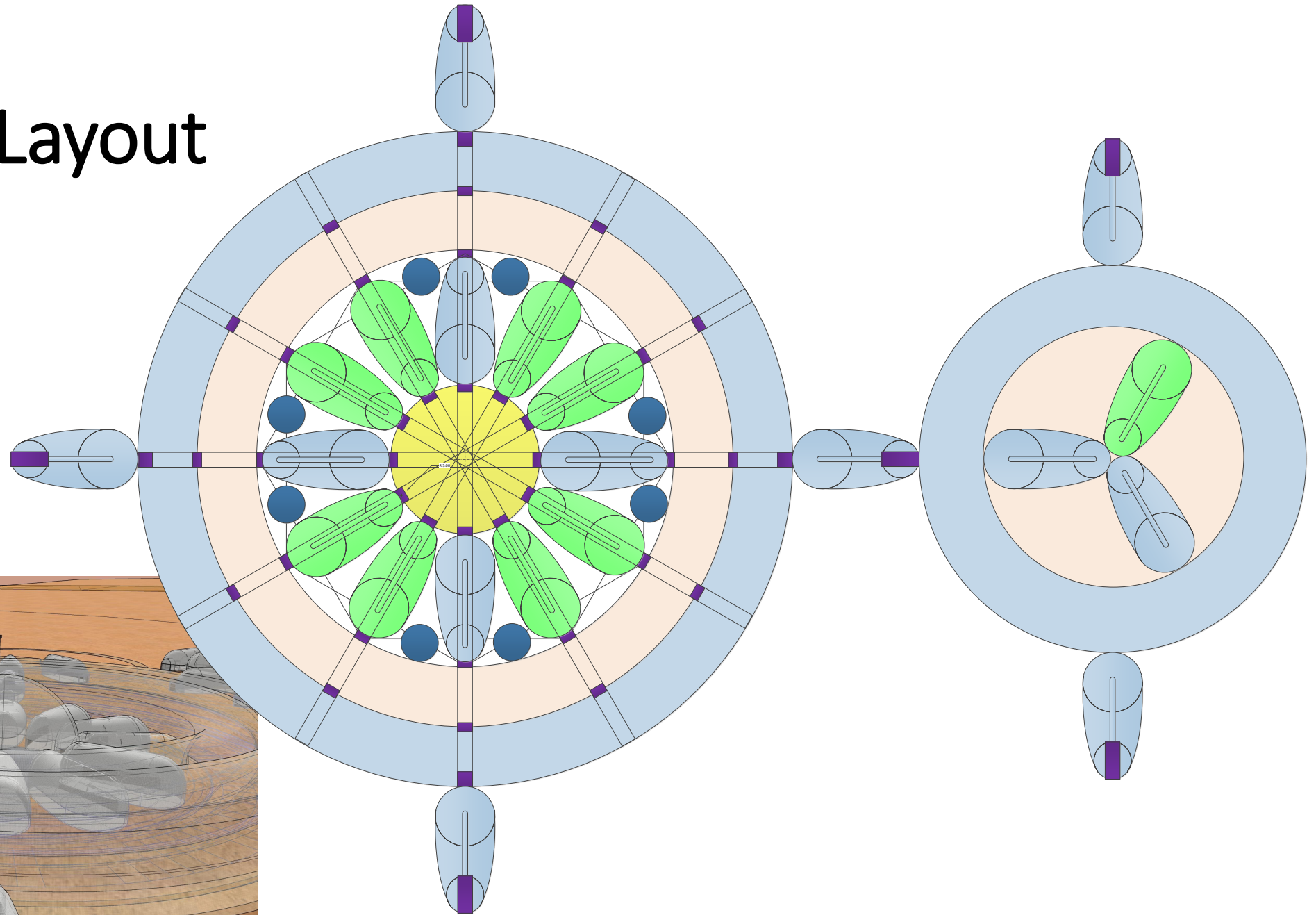
Cosmic Ray Shielding



Main City Construction



Overall Layout

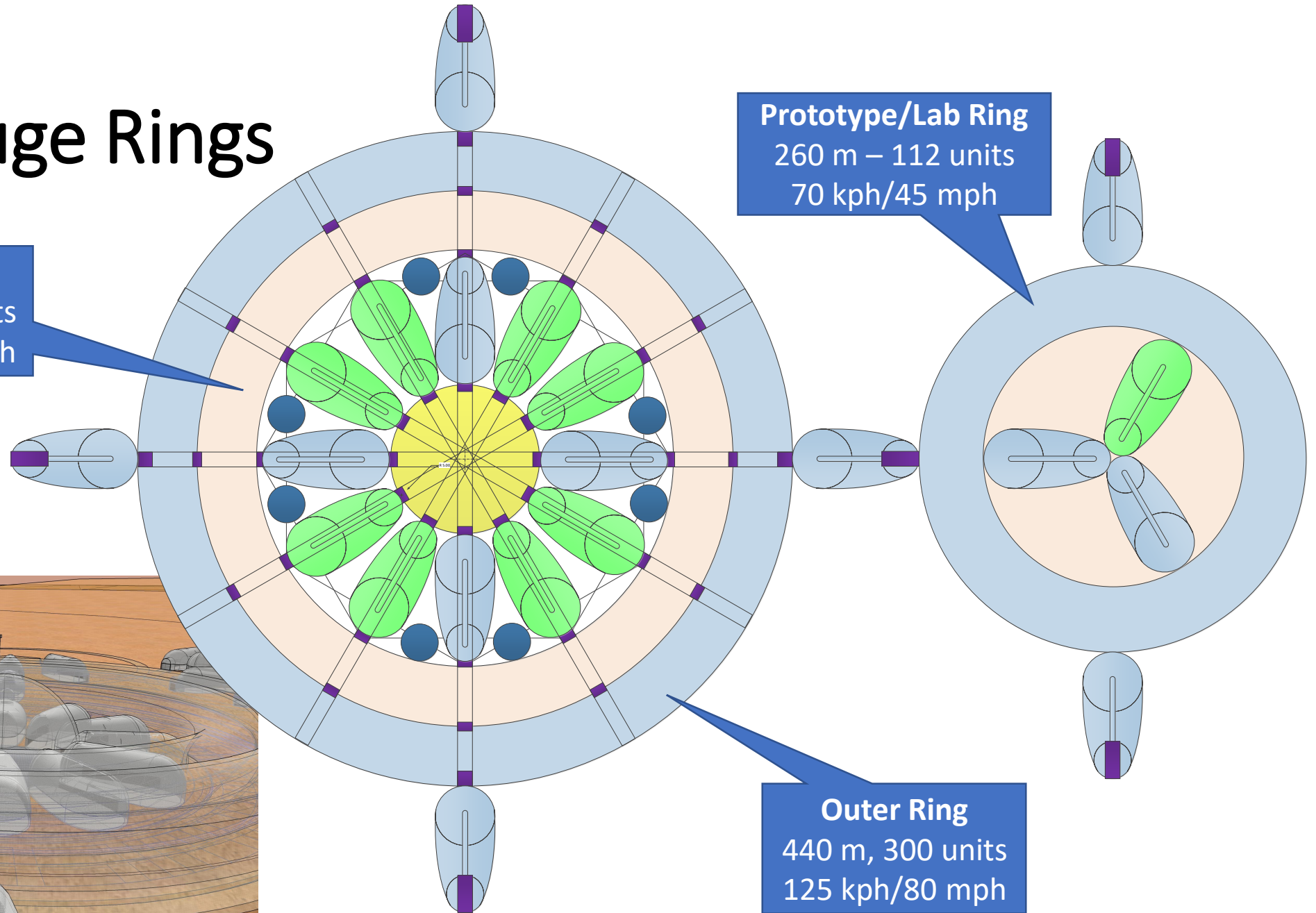
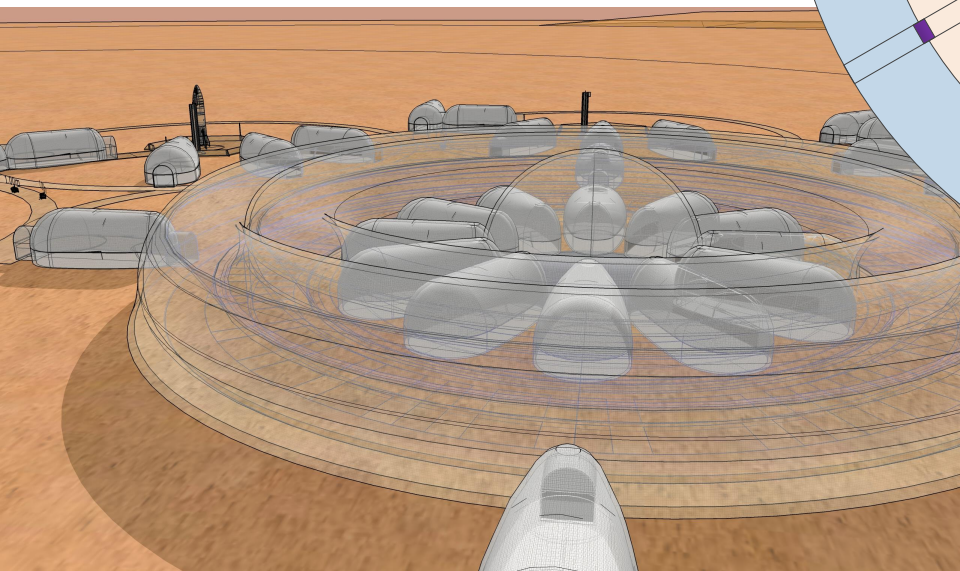


Centrifuge Rings

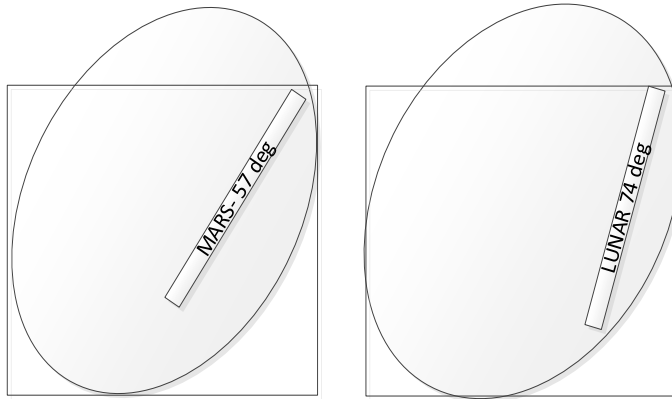
Inner Ring
320 m, 260 units
110 kph/66 mph

Prototype/Lab Ring
260 m – 112 units
70 kph/45 mph

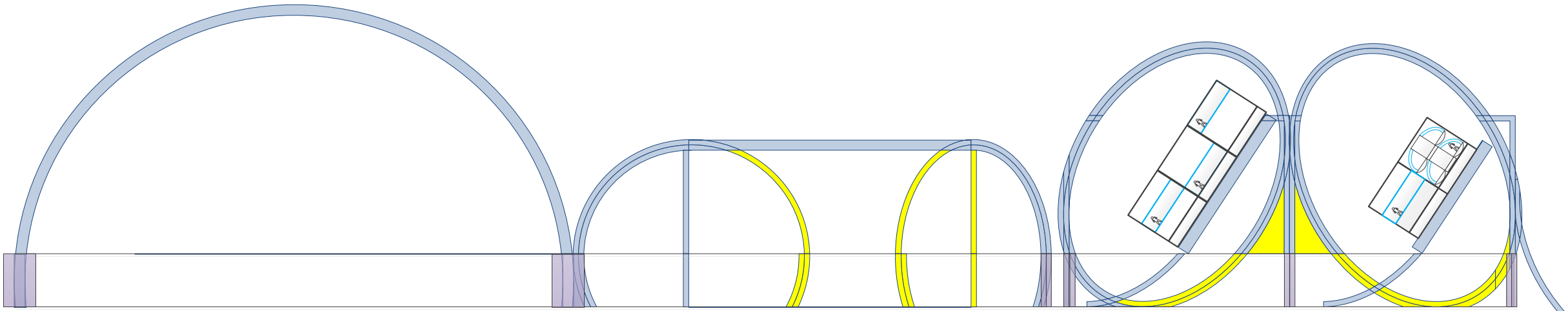
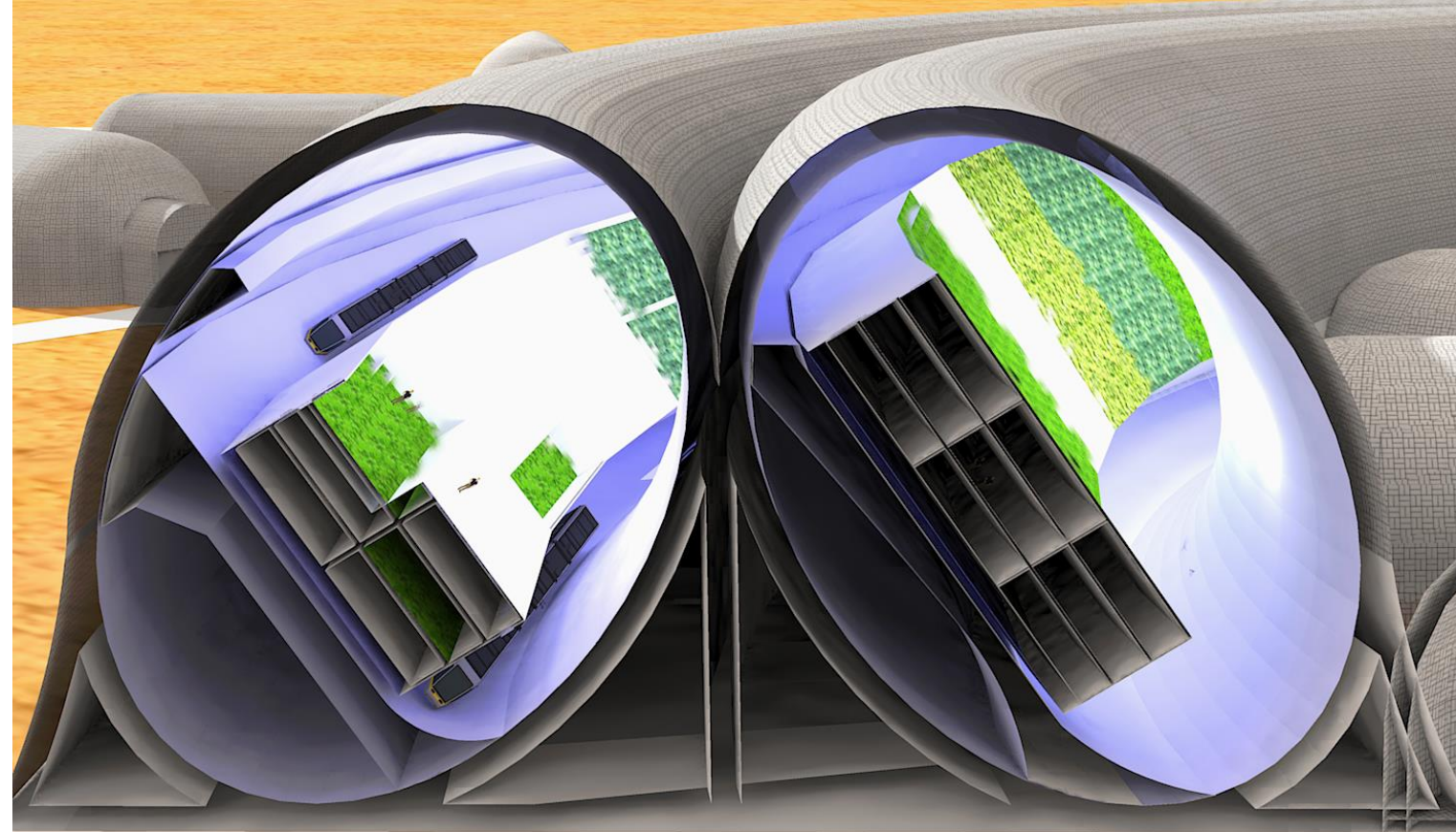
Outer Ring
440 m, 300 units
125 kph/80 mph



Centrifuge Rings



The outer ring has a track that would accommodate a spinning structure for artificial gravity. This is 57 degree slope for Mars gravity or 74 degrees for lunar gravity.



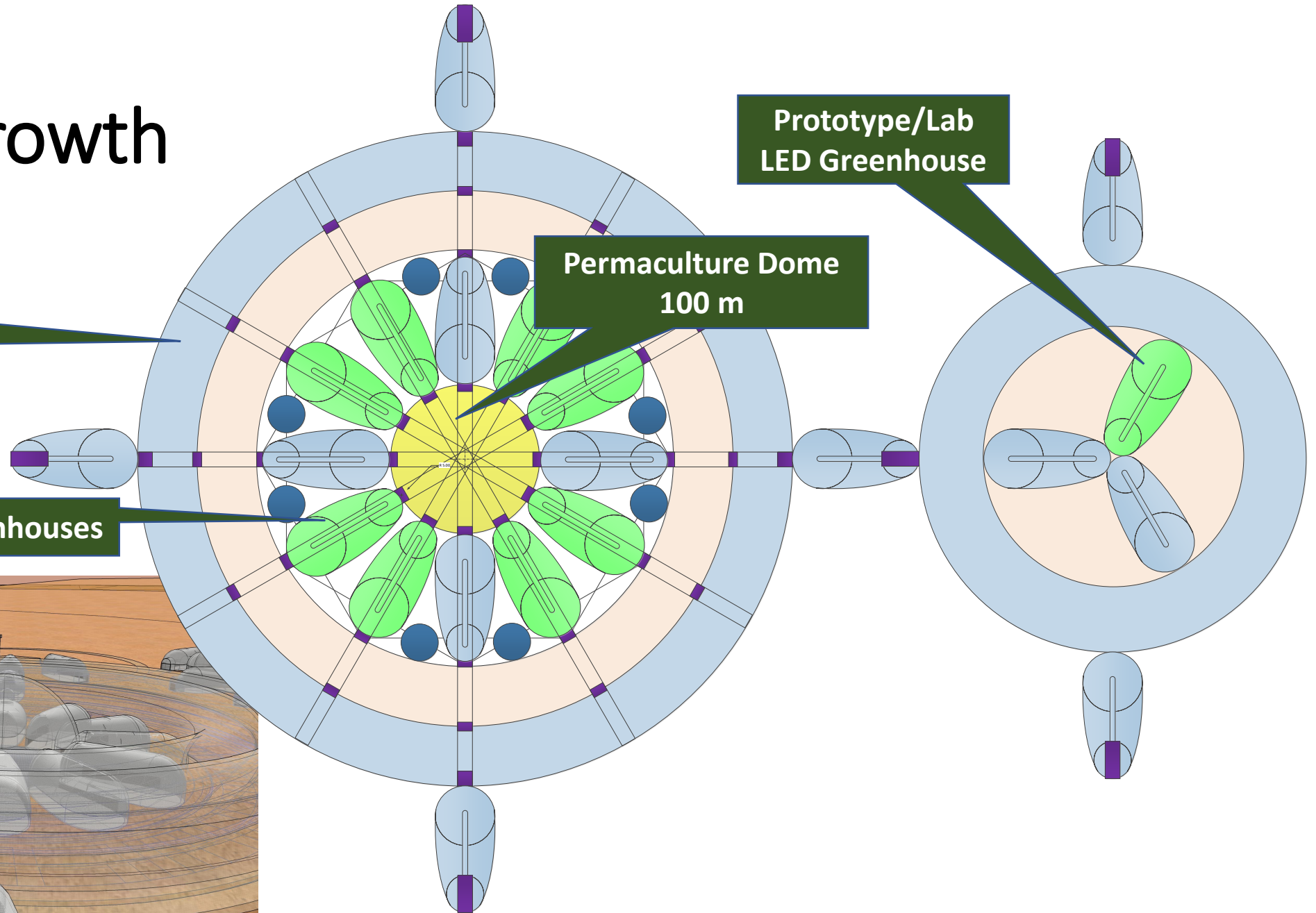
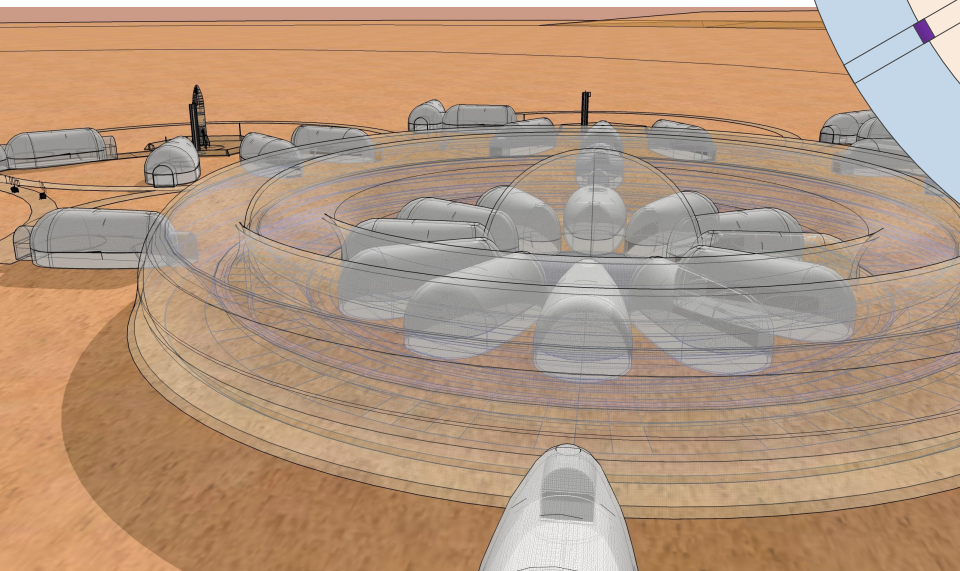
Food Growth

Rooftop Gardens
in Ring Habitats

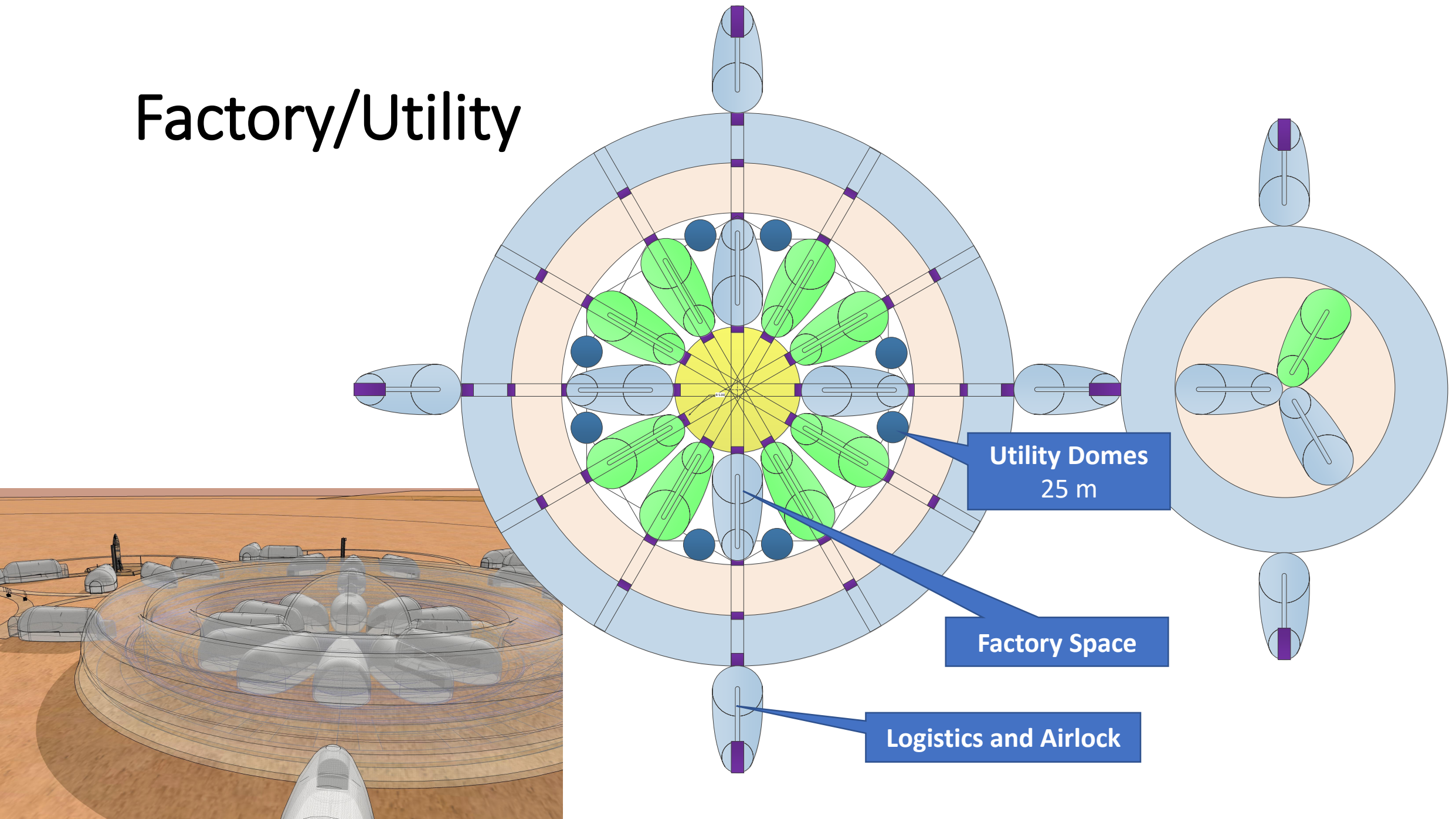
LED Greenhouses

Permaculture Dome
100 m

Prototype/Lab
LED Greenhouse



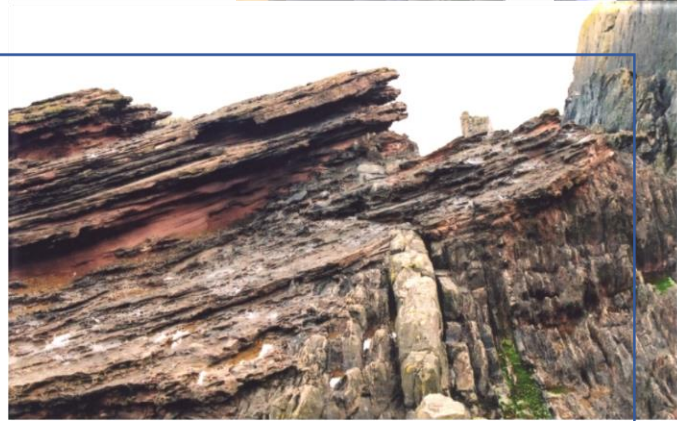
Factory/Utility



Aesthetics



Organic (Roger Dean)



Angular (Syd Mead)



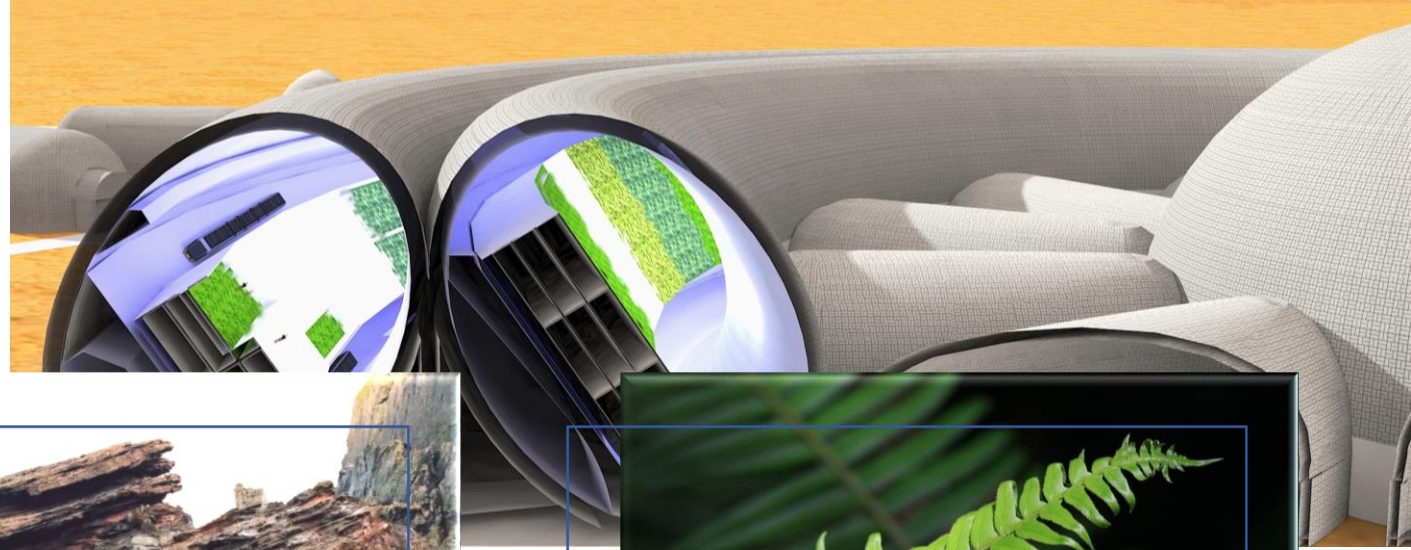
Perpendicular (F. L. Wright)



Derivative (Historic Earth)



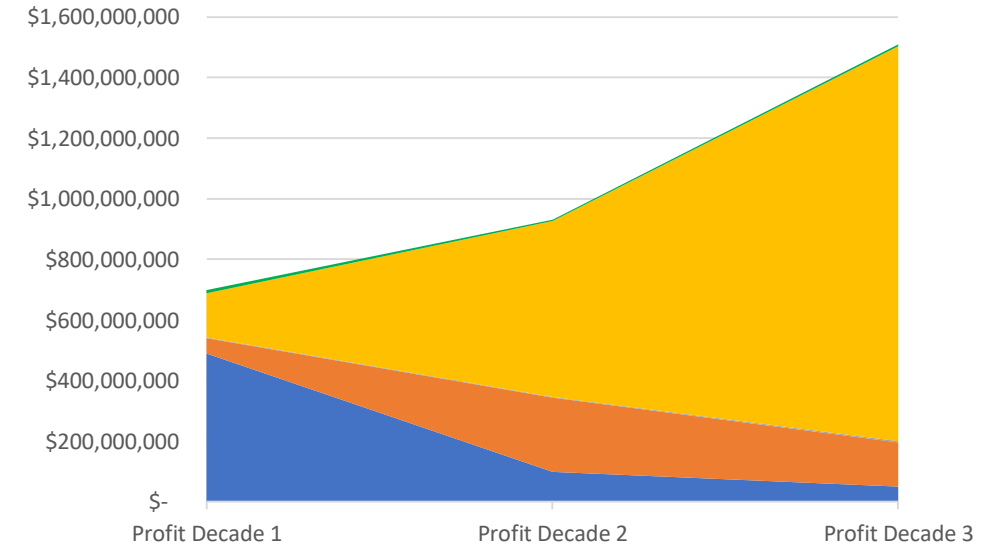
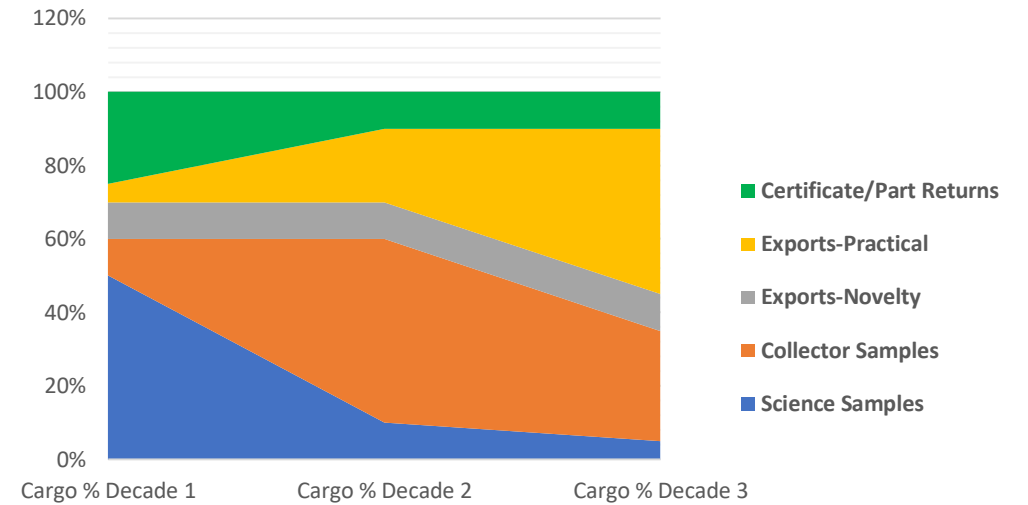
Aspirational (Sci Fi, etc.)



Growth and Market Shift

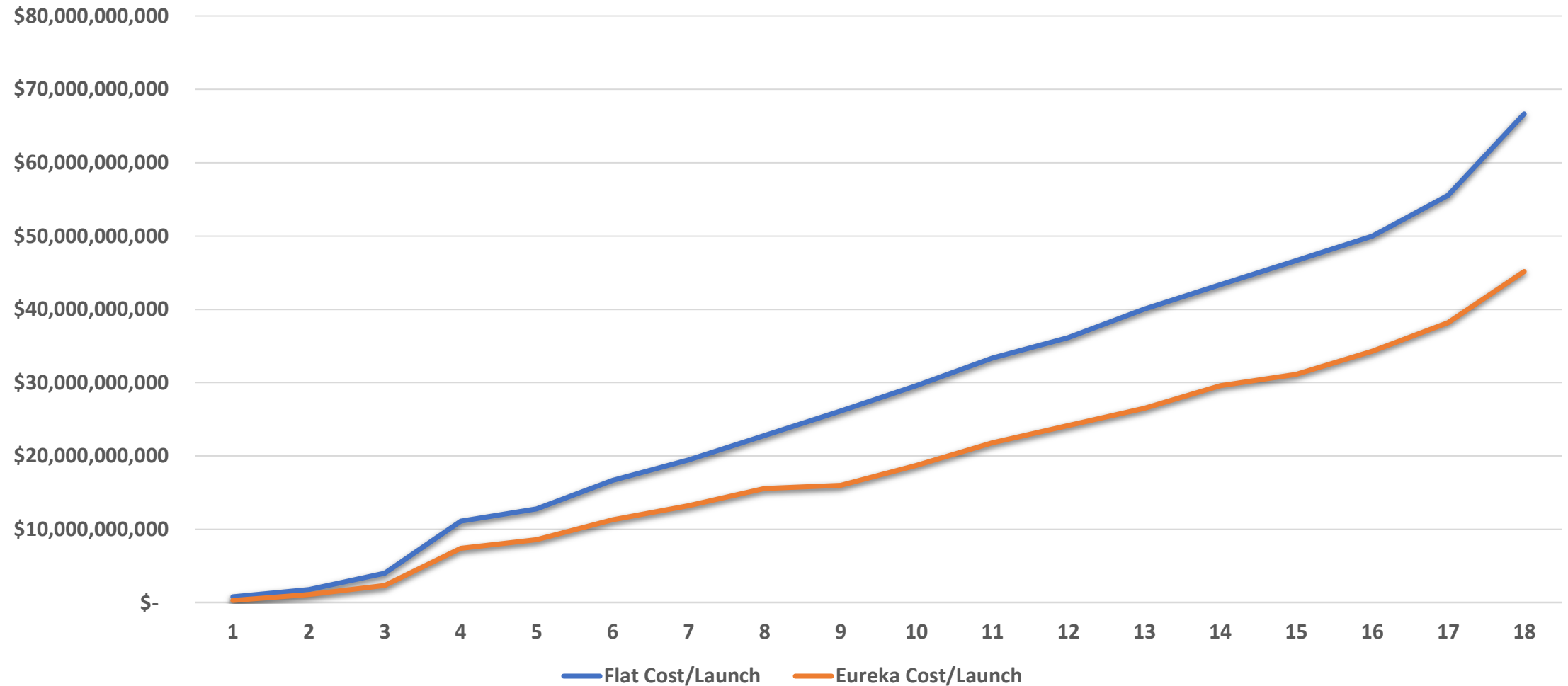
Date	Year	E2M Sorties	M2E Sorties	Population
2031	0	7	4	60
2033	2	16	14	100
2035	4	36	30	300
2037	6	100	95	800
2039	8	115	110	1200
2041	10	150	145	2500
2043	12	175	170	3500
2046	15	205	200	4200
2048	17	235	205	10,000
2050	19	266	240	15,000
2052	21	300	280	18,000
2054	23	325	310	20,000
2056	25	360	340	22,000
2058	27	390	380	24,000
2061	30	420	400	26,000
2063	32	450	440	28,000
2065	34	500	490	30,000
2067	36	600	580	36,000

Cargo Return Mass Ratios by Category



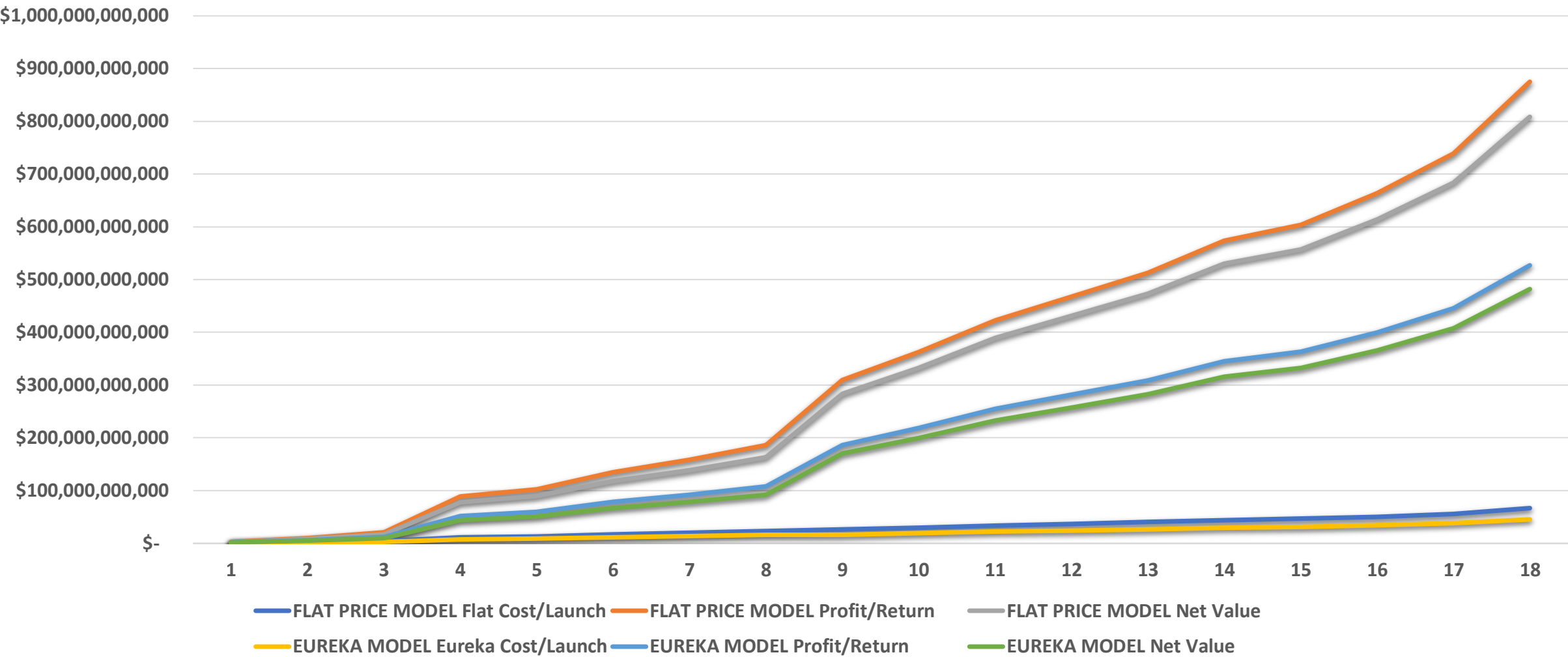
Launch/Payload Cost Model

Total Unfunded Earth-to-Mars Payload/Delivery Costs By Launch Window



Economic Model Summary

Launch Costs, Return Profit, and Net Value By Window



Legal Framework

Authority	Restrictions on Authority
Rights	<ul style="list-style-type: none">• Kept immutable as part of the founding declaration.
Limited Law	<ul style="list-style-type: none">• 1000 pages of basic law. 500 per specialty for regulations.• Review every 7 years and purge obsolete laws.
Regulation	<ul style="list-style-type: none">• Generally Accepted Accounting Principles (GAAP) mandatory for all• Simplified but not diluted GxP
Smart Contracts	<ul style="list-style-type: none">• Use fixed structures with drop-down lists, with counter-sliders to avoid exploitive terms.• Ethereum-type software is used for distribution of profit from inventions to builders, owners, contributing inventors.

Organizational Frameworks

Authority	Restrictions on Authority
Dunbar Limits	Organizations limited to 150 members, or at least two competing entities
Ad Hoc Startups	In house “Kickstarter” style economy for in-house inventions
Guilds	Practical education for new members Covers health insurance, retirement independent of job or state Geographically distributed so skills not at risk from local disruption 7-year membership and sponsorship of new settlers
Distributist Organizations	Credit unions rather than banks, with dividends and open accounting
Minimal Politics	More like jury duty than congress – get send in for six months, part time.
Education	Trivium with STEM and Practical work introduced with pay

Concepts Invented During Eureka Design

Concept	Status	Earth Use?	Market?	Dev Cost?
Certification Seal/ Blockchain System	Prototypes Built, White Paper Planned	Yes	High	Low POC Test, Med Production
Ultra Secure Hardware/ Software/ Network Concept	Design White Paper Started	Yes	Very High	High Entry, High Production
Convergence Economy of Value Transfer	Design White Paper Started	Long Term	High	Regulatory Limited
Holbach/Pykrete Cosmic Ray Shielding	Basic Design included	No	Space Only	Low POC Test, Medium Scale Test
Frame and Block Construction	Basic Design Included	Limited	TBD	Medium POC Test,
Universal Tooling Standard and MarsSpec Design	Basic Design Mentioned, Design White Paper Planned	Yes	High	Low POC Test, Standards Cost High
Large Flat Airlock Doors (Flexible?)	Design White Paper Planned	Limited	TBD	Medium POC Test, High Scale Test

Thank you!

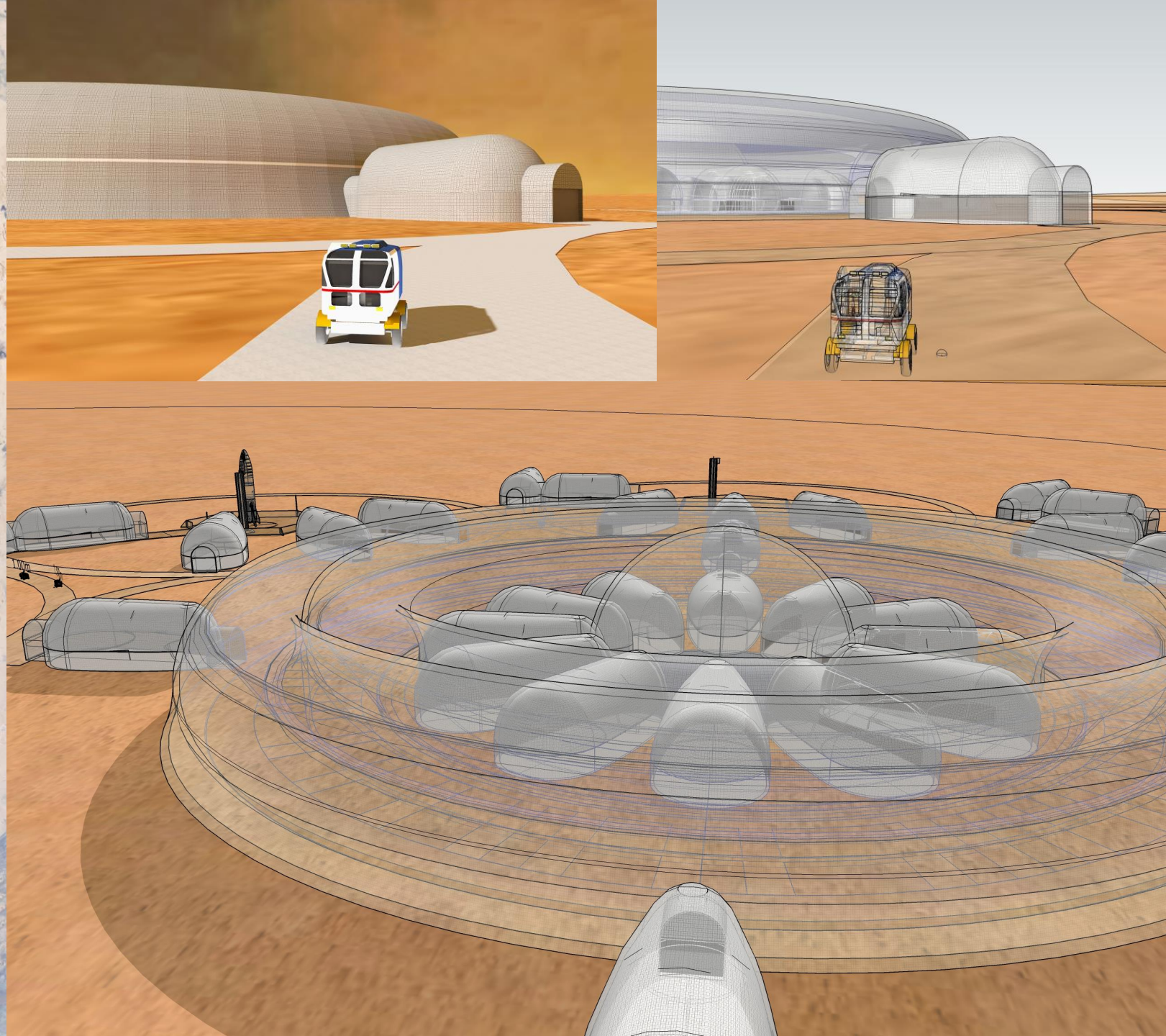
Questions?

Kent Nebergall

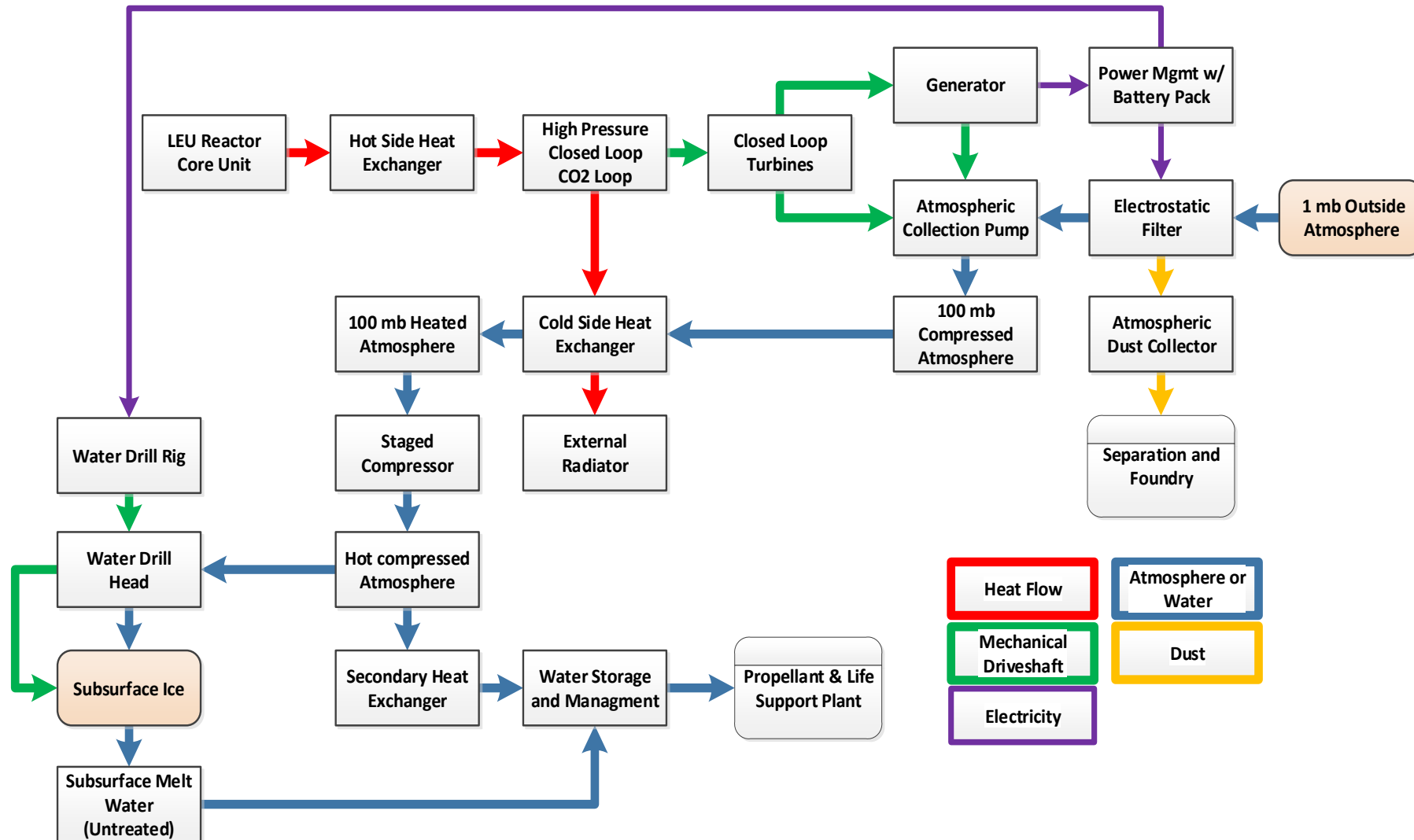
MacroInvent.com

kent@macroinvent.com

3D illustrations:
Michel Lamontagne



Robust, Modular, Buffered Systems



Legal Framework (Detail)

Authority	Restrictions on Authority
Rights	<ul style="list-style-type: none">• Kept immutable as part of the founding declaration.
Limited Law	<ul style="list-style-type: none">• 1000 pages of basic law. 500 per specialty for regulations.• Review every 7 years and purge obsolete laws.
Regulation	<ul style="list-style-type: none">• FAA Model – only fix things that are broken.• Underwriters Labs (UL) model – Commercial certification of products• Generally Accepted Accounting Principles (GAAP) mandatory for all
Smart Contracts	<ul style="list-style-type: none">• Use fixed structures with drop-down lists, with counter-sliders to avoid exploitive terms.• Ethereum-type software is used for distribution of profit from inventions to builders, owners, contributing inventors.
Intellectual Property	<ul style="list-style-type: none">• Smart contracts distribute shared invention credit. Terrestrial licensing through brokerage.• IP locked first 7 years, space economy to 14 years, and open at 21 years.

Organizational Principles (Detail)

Guild	Value
Dunbar Limits	Organizations limited to 150 members, or at least two competing entities
Networks	Quantum computing resistant security
Commerce	Micro-transactions and internal currency backed by specific assets and nominal futures, so that practical innovation is the key source of growth
Accounting	GAAP must be practiced by all, including government.
External Government Interfaces	Internal currency and commerce is not subject to external tax/etc. Only interfaces with terrestrial markets in terrestrial currencies are subject to taxation, fees, etc. by those terrestrial entities. All else is internal accounting.
Non-overlap	Guild members must be geographically distributed and politically split by region to avoid both political and economic authority overlap.

Educational, Commercial and Civic

Elementary	Middle School	Teen Education	Work Life	Retirement
Trivium: Grammar	Trivium: Logic, Rhetoric	Quadrivium	Technical Ongoing	Teach
Practicum in STEM	All Guild Foundations	1 Year Guild Internships	Guild Membership Eureka Biologists also guild “reservists”	Craft and Mentor
Hands-on Work with Growing Plants, etc.	Artistic Work	Basic Start-Up Team Practice, Financial Education	Launch ad-hoc start- ups as side jobs or as new businesses.	Steward Resources
	Law Foundations	Civics and Regulation	Electable to Office	Supreme Court Functions

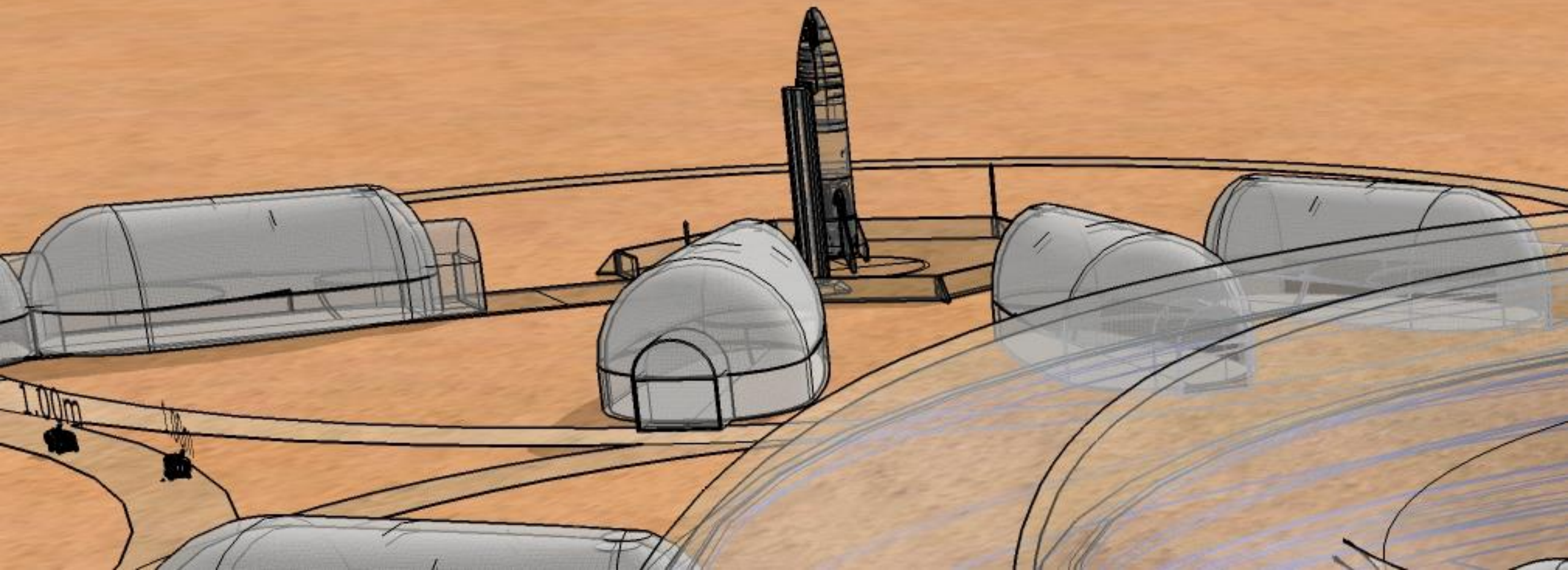
Guild Structure

Guild	Value
Life and Health	Agriculture, Medicine, Pharmaceuticals
Information	Computers, Sensors, Communications, Robotics, Software, Controls
Power and Water	Electricity, Heat, Light, Mechanical, Water
Construction	Habitats, Factories, Industrial
Transportation	Spacecraft, Surface, Roads, Vehicles, Satellites, etc.
Manufacturing	Factory Operations, Mining, Chemistry, etc.
“Reservists”	Work only 1 day/week in guild, but do other tasks the rest of the time.

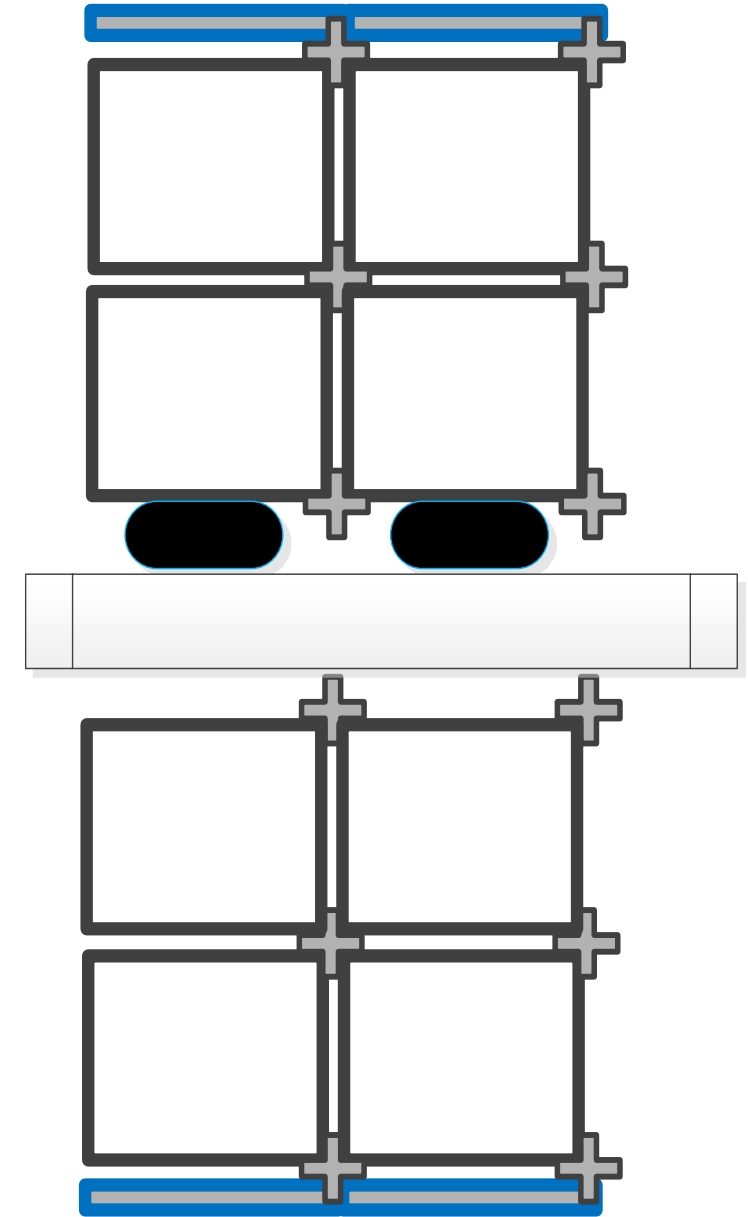
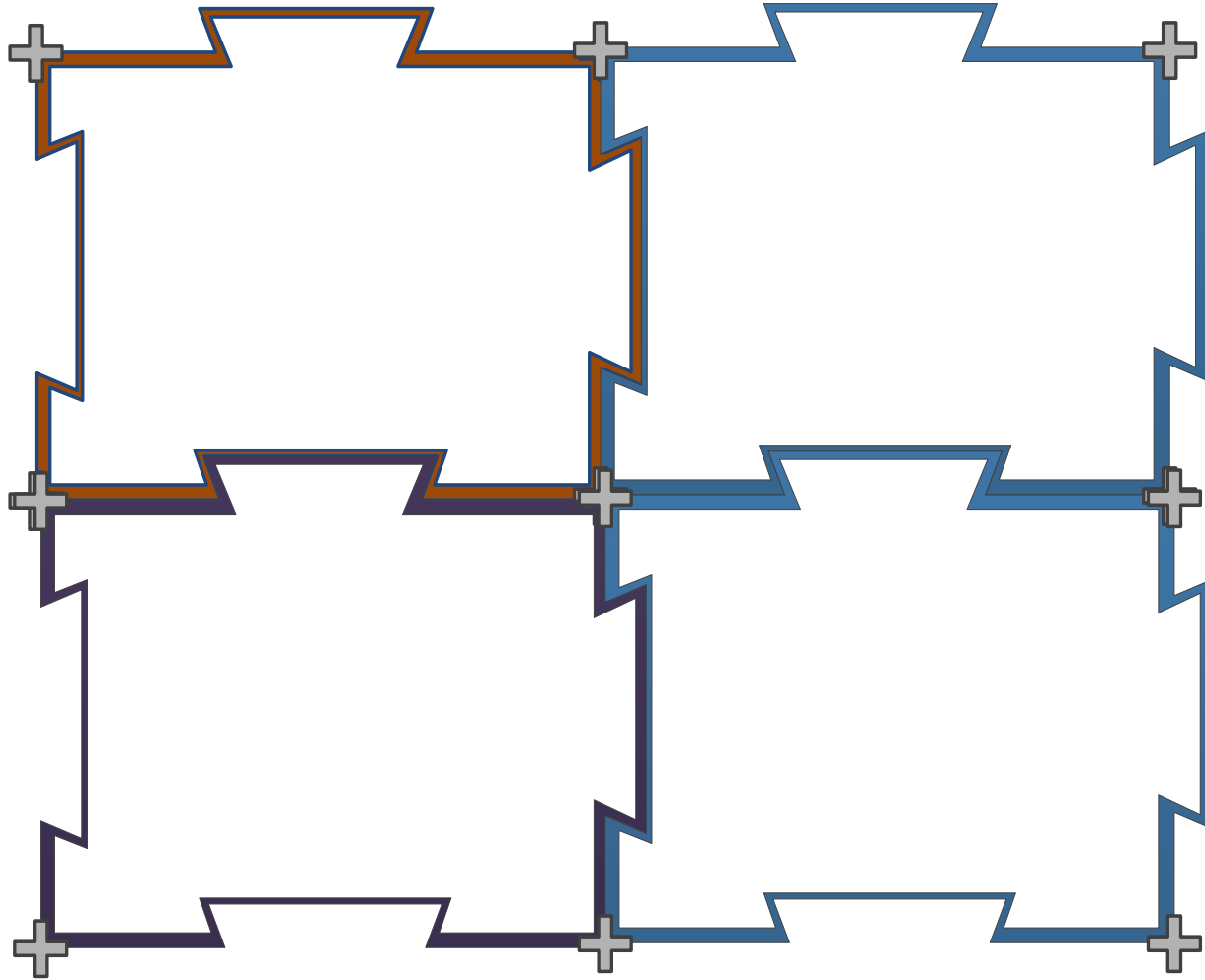
Foundational Principles (Detail)

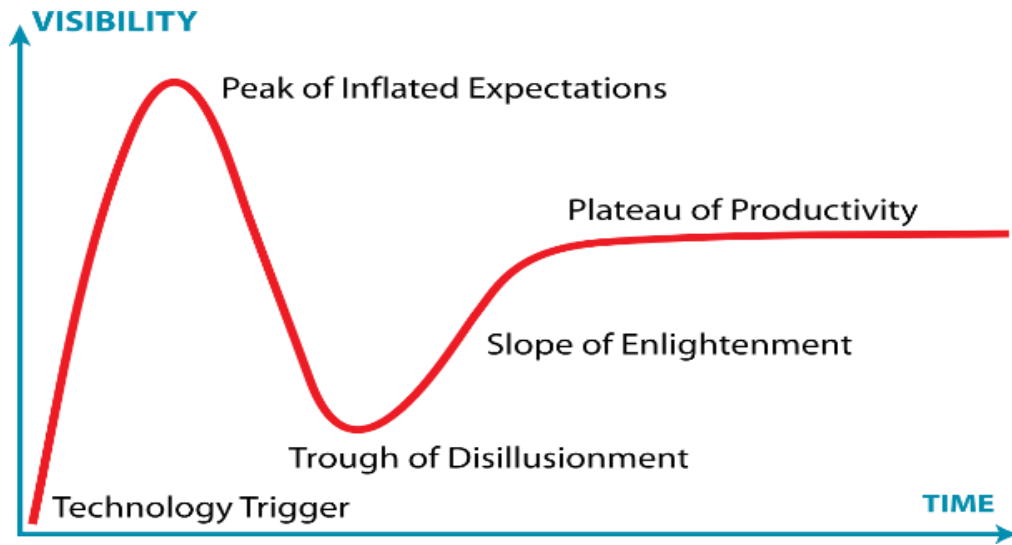
Parameter	Value	
Basis	Distributism (AKA Distributionism): US/UK, 1900-1945	
Summary	“Unbridled capitalism doesn’t produce too many capitalists, but too few.” - <i>G. K. Chesterton</i>	
	Embraced	Avoided
Credit	Credit Unions	Banks
Labor	Training Guilds	Labor Unions
Incorporation	Employee-Owned	Investor-Owned
Economy	Distributed Manufacture	Economy of Scale
Class structure	Middle-Class Stabilized	State & Large Companies Stabilized
Cultural Focus	Productivity + Networked Autonomy	Organizations > Individuals
Education	Trivium + Guild + STEM	Clerical Repetition

Spaceport Layout

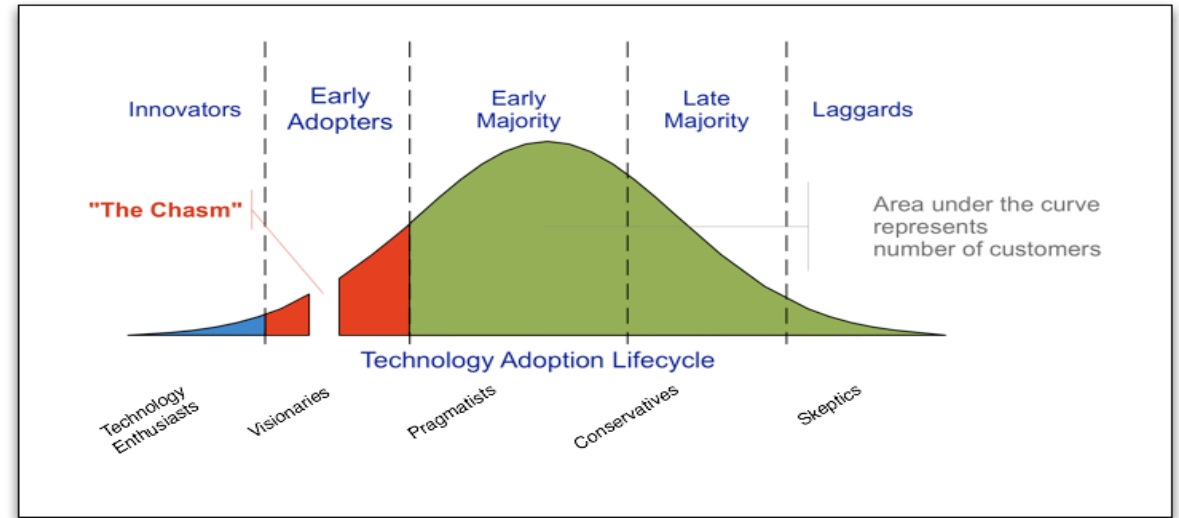


Modular Pykrete Construction





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Economic Model

[illegible]