

DIGS: Deployed Independent Greenhouse Systems

Space Apps Challenge 2013

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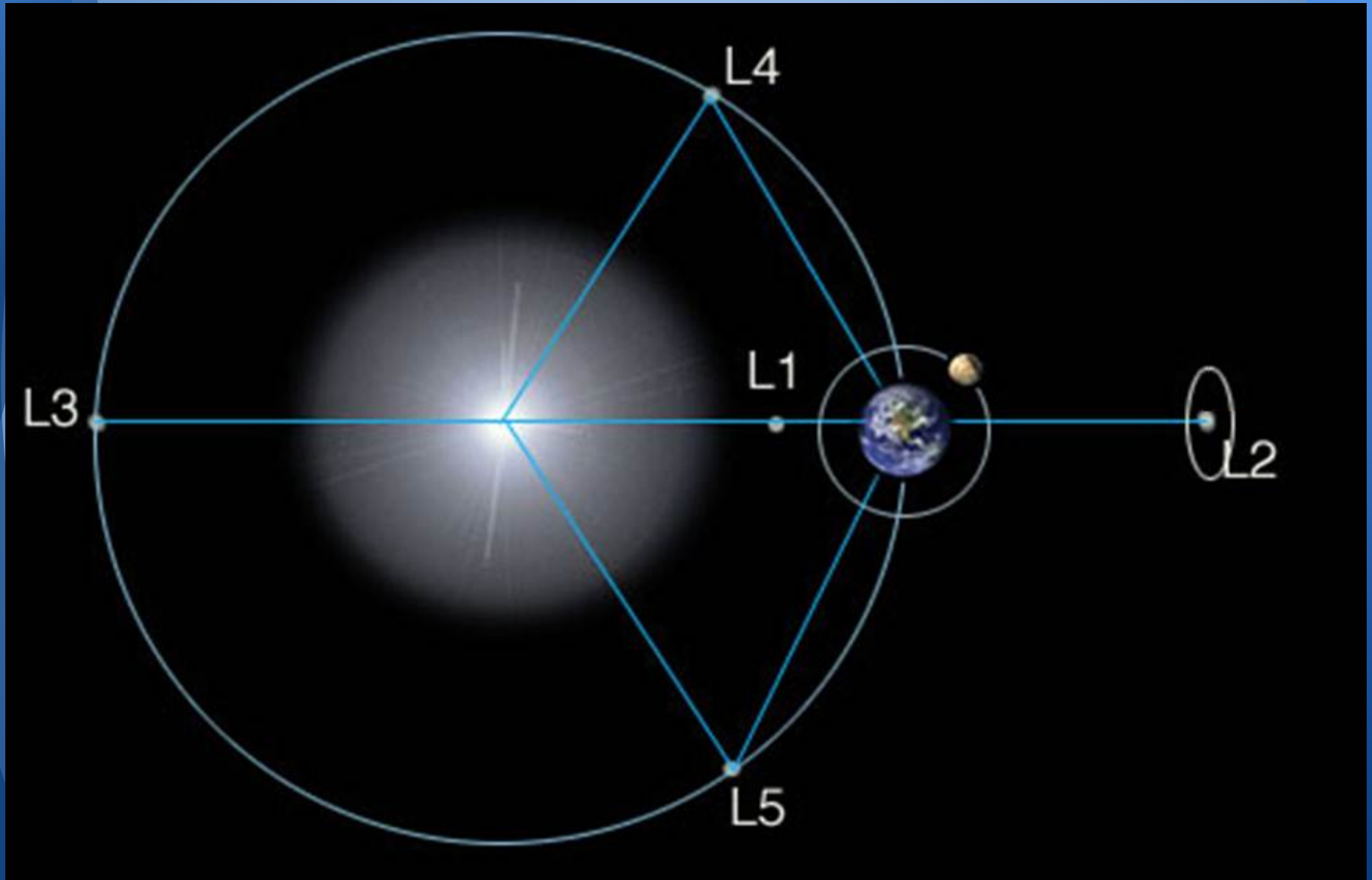
2025

Stepping Stones

Exploring a series of increasingly challenging destinations on the way to Mars...

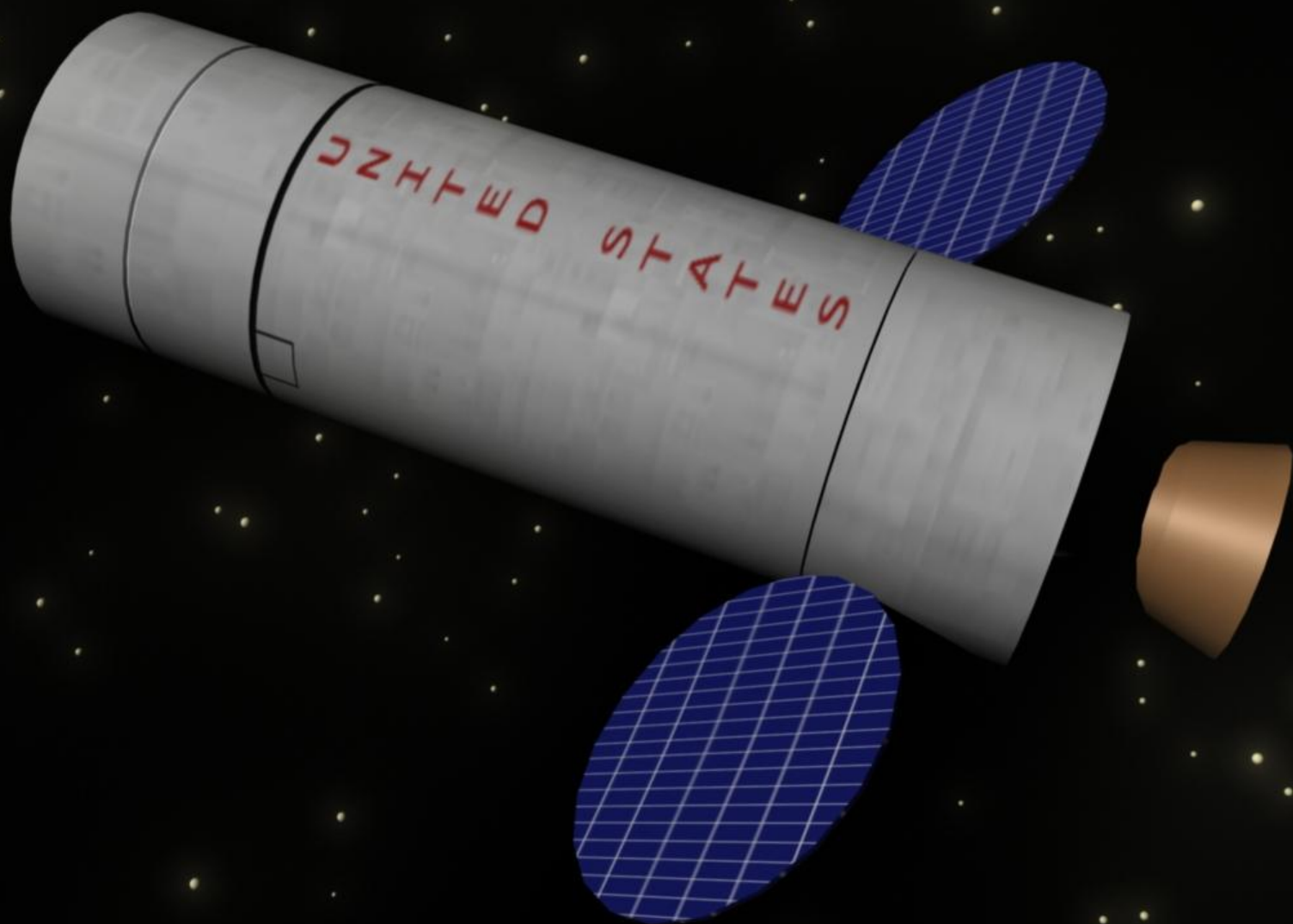


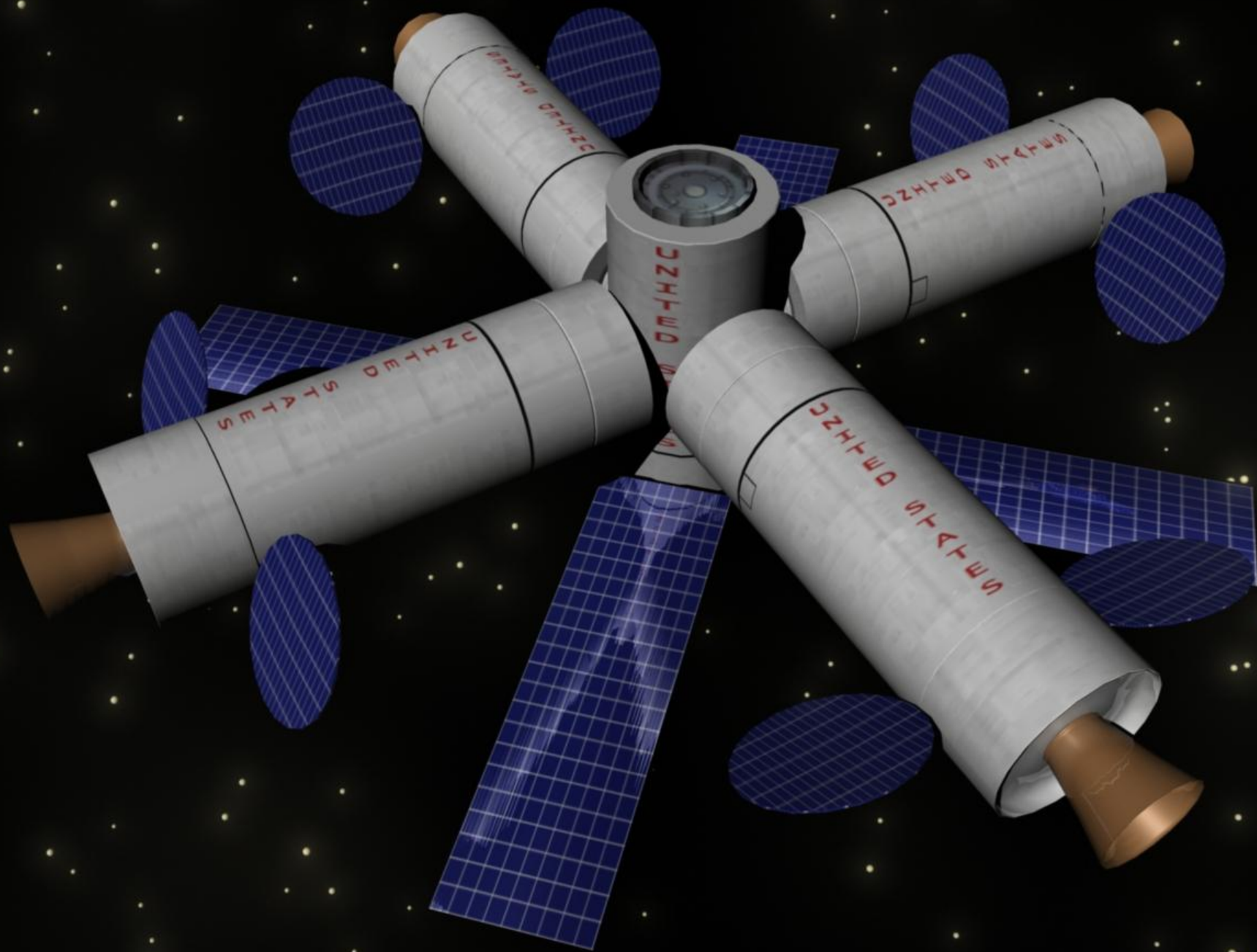
Lagrange Points



Basics

- Modular
- DIGS is center module of rocket
- Circular solar panels expand like Orion
- Thrusters for station keeping - propulsion module
- Docking connectors/airlocks





Basics Cont'd

- Pods launch ready-to-go
- In stasis using chemical agent
- Re-activate on deployment

DIGS Dimensions

- Total DIGS length: 16m
- Total DIGS diameter: 5m
- Storage module length: 2m
- Processing module length: 2m
- Growing module length: 8m
- Propulsion module length: 4m

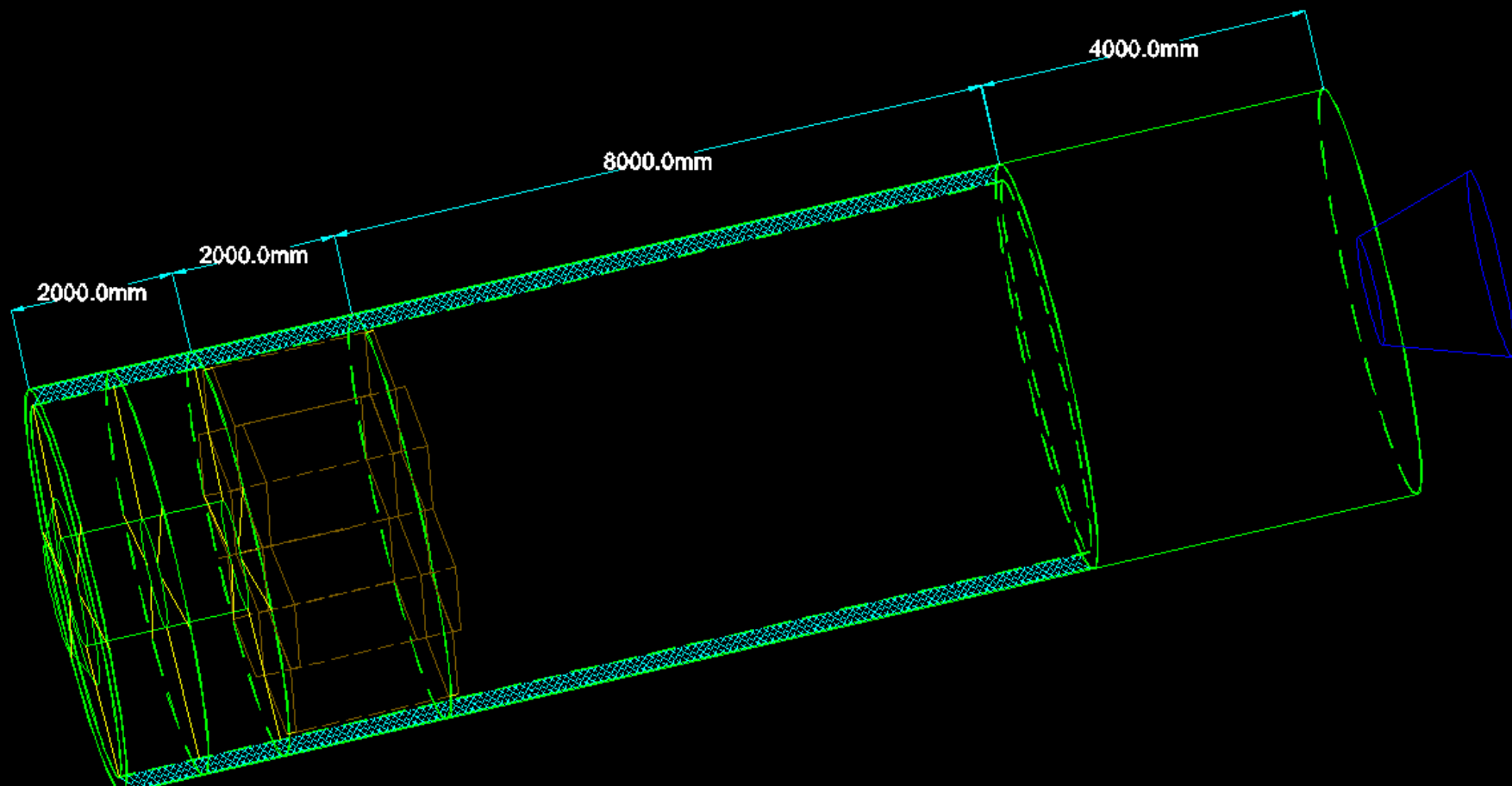
Possible Launch Vehicle Dimensions

- Delta IV Heavy fairing: 19.8m x 5m
- Falcon Heavy fairing: 6.6m x 5.2m (can be requested/ordered longer)
- SLS Heavy-Lift fairing*: 10m x 7m

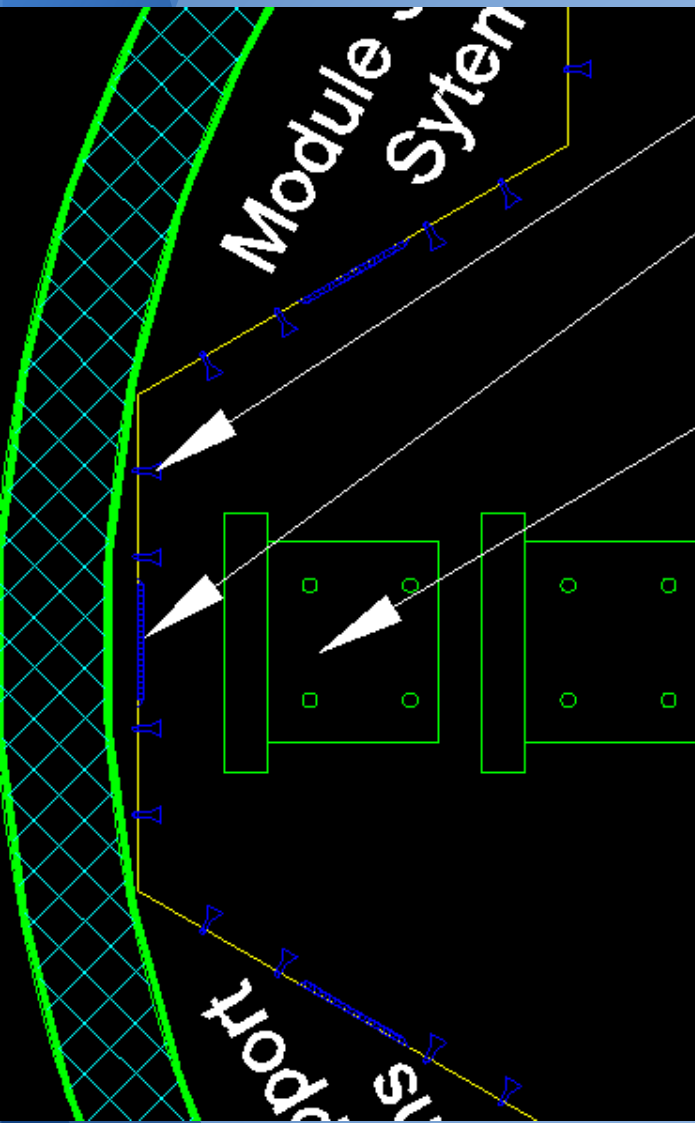
* Proposed

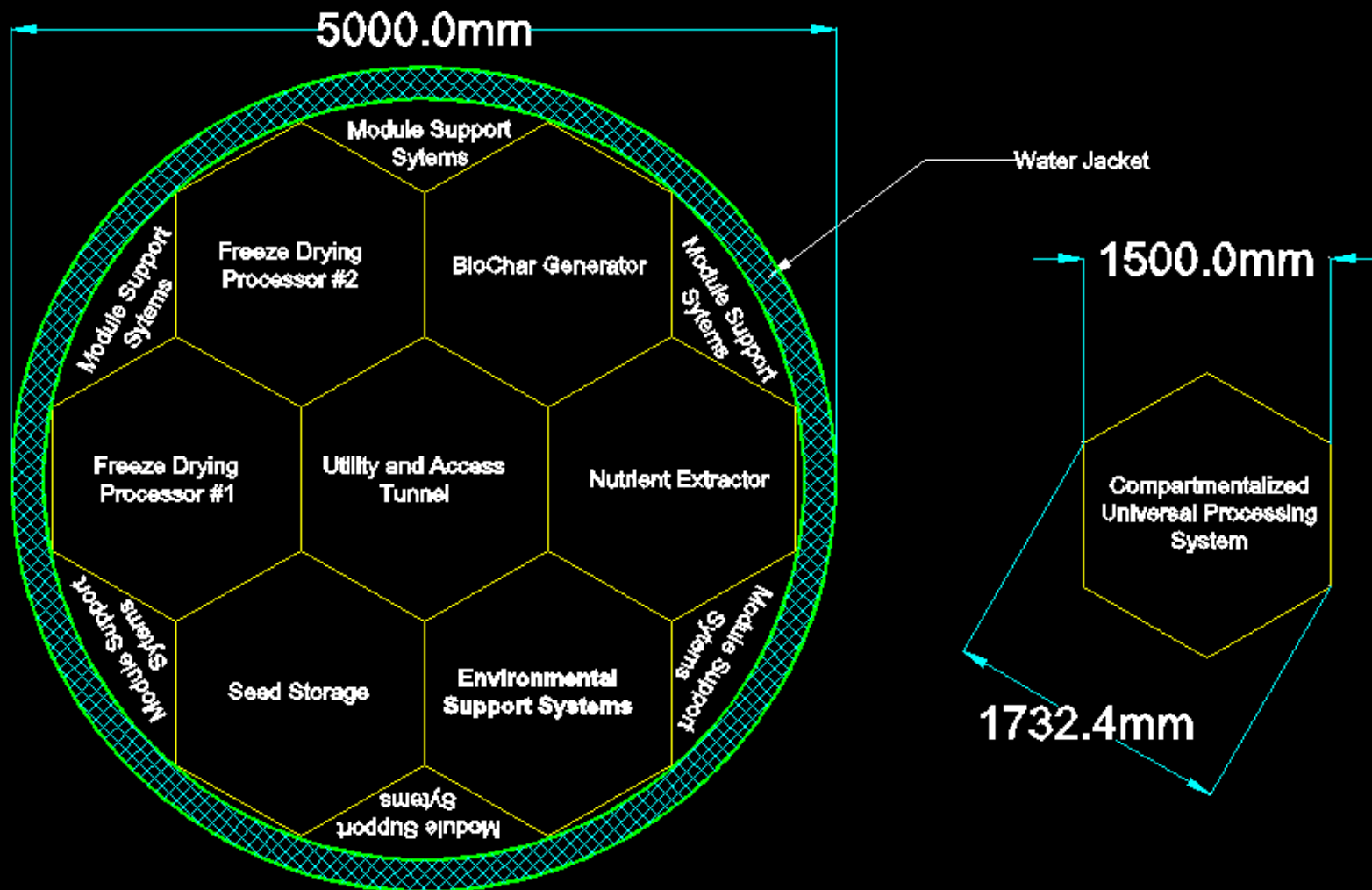
Pod Interior

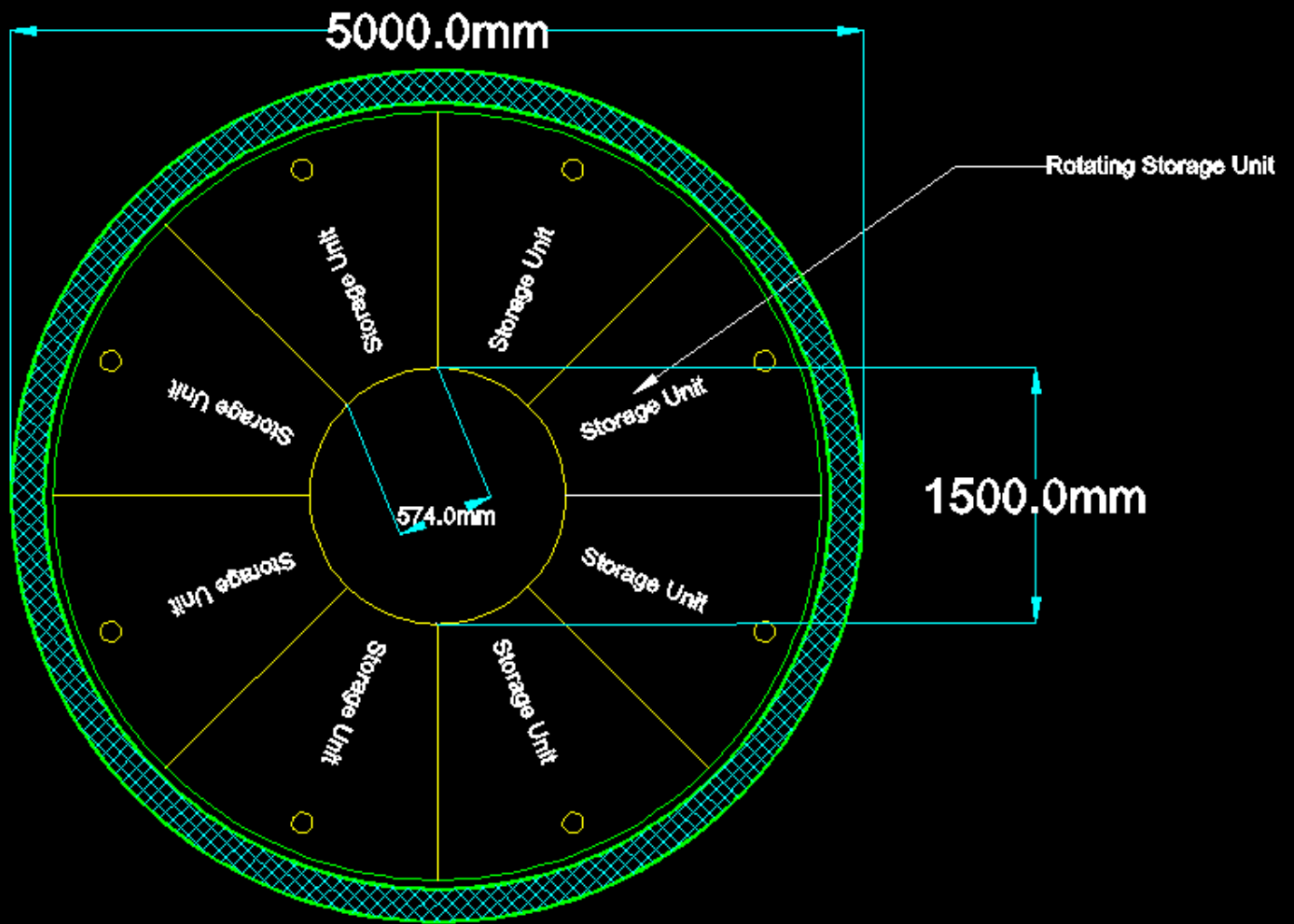
- Aeroponics on conveyer system
 - multiple layers of conveyors
 - multiple stationary robots
 - enclosed sprayer with water/nutrients



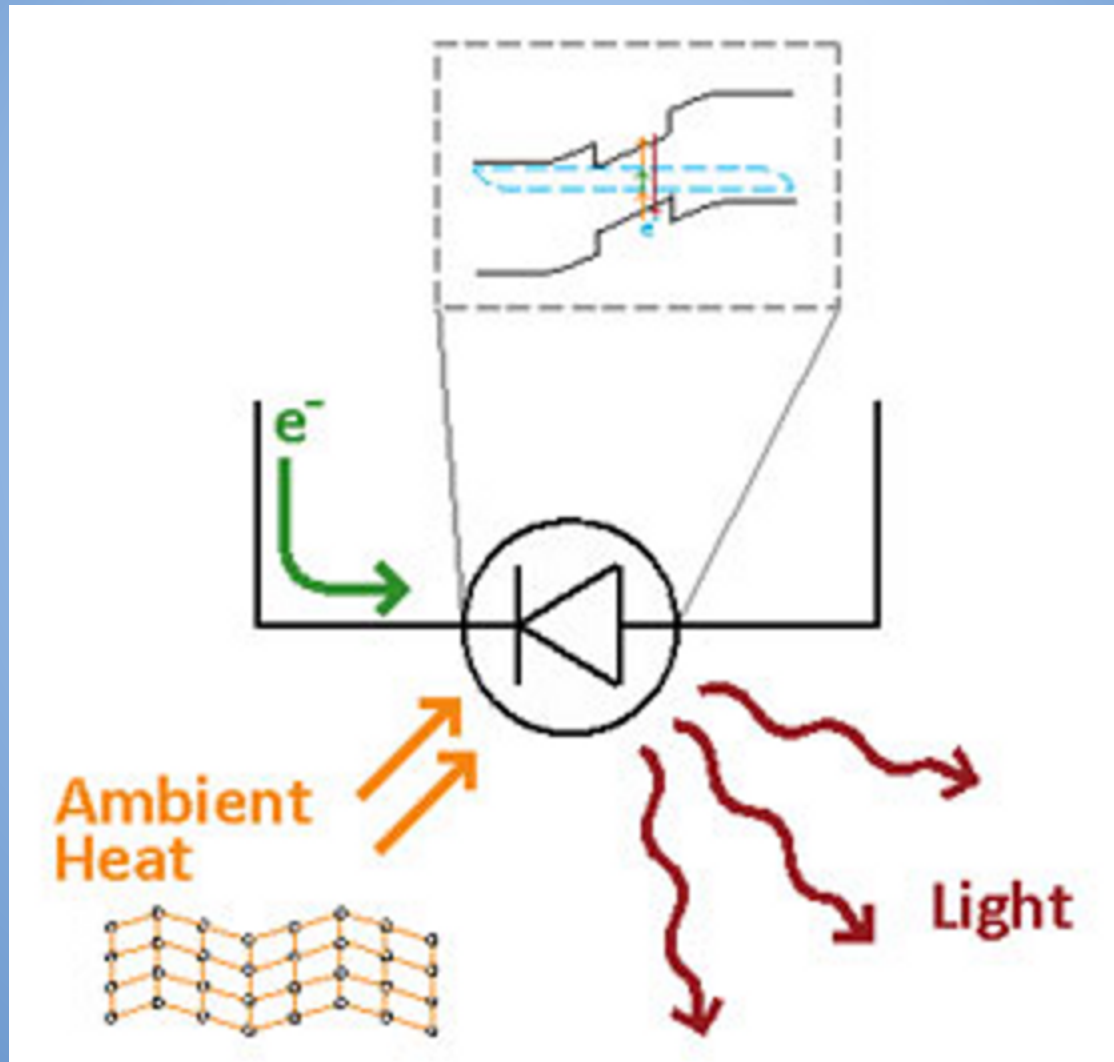
Plant Conveyor



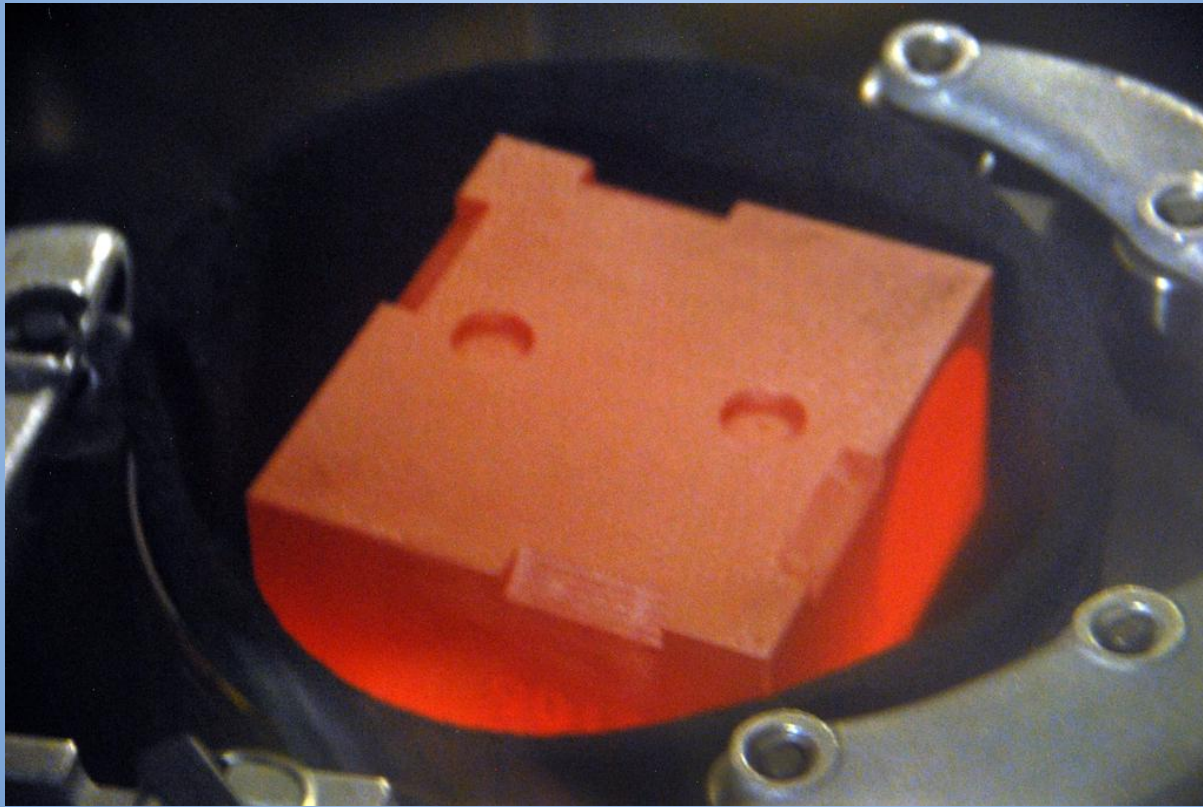




Illumination and Energy



Radioisotope Thermoelectric Generator (RTG)



Normal Operations

- Optical/Infrared sensors for ripeness
- Freeze-dry edibles
- Override for storage of fresh produce orders

Example Industrial Freeze-Dryer

Heto PowerDry LL1500 Freeze Dryer Specifications

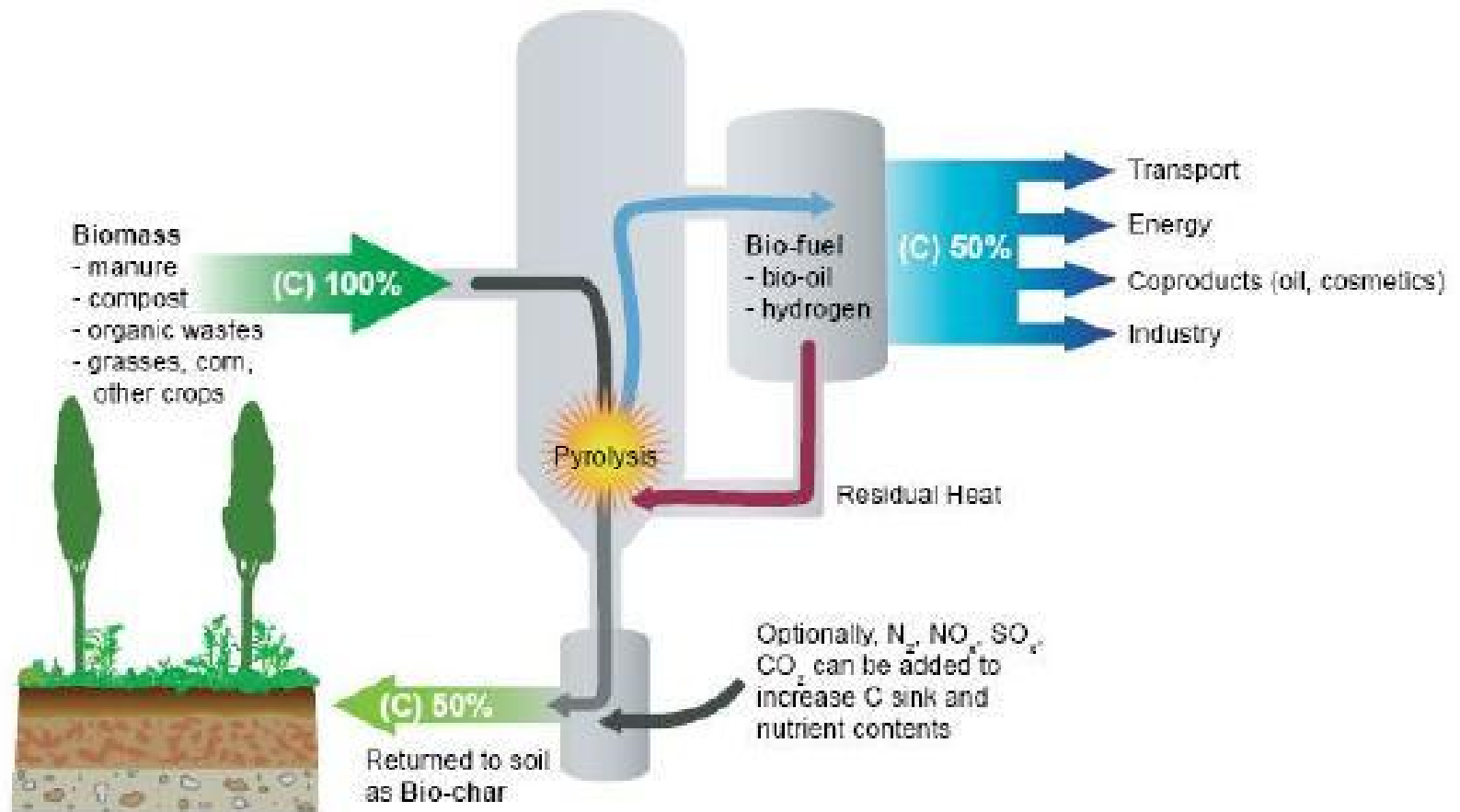
Technical Specifications	Heto PowerDry LL1500 Freeze Dryer
Cat. no. 230V/115V	88001500/88001550
Required power supply	230V/50 Hz or 115V/60 Hz
Condenser capacity/ 24 hours	1.5 kg
Total ice capacity	2.6 kg
Condenser volume	3.8 L
Condenser diameter x height	Ø 160 x 190 mm (6.3 x 7.5")
Lowest condenser temperature	< -110°C
Refrigerants	R507/R1150
Status indicator (Alarm / Wait / Okay)	Yes
RS232-C interface	Yes (when used with HSC500 PLUS controller)
Digital temperature display	Ambient to <-120°C (-184°F)
Ambient temperature	+5 to +32°C (+41 to +89.6°F)
Noise level	<51 dBA
Ice condenser material	AISI 316 Stainless Steel
External dimensions DxWxH	480 x 800 x 335 mm (18.9 x 31.5 x 13.2")
Weight	53 kg (116.8 lbs)



Non-Edible Waste

- Non-edible plant materials have nutrients extracted through enzymatic process
- Remaining material is converted to Biochar
 - Biochar is stored for filtration on module and passing vehicles
 - Biofuels created as by-product of Biochar process

Biochar



Proposed Crops

- Aloe Vera
- Basil
- Berries
- Broccoli
- Carrots
- Grapes
- Mint
- Onions
- Oregano
- Peas
- Peppers
- Radishes
- Rosemary
- Soy & Legumes
- Stevia
- Sugar Beets
- Tomatoes
- Tubers

Aeroponics



Contingency Plans

- Redundancy in multiple robots and conveyors
- Failure Level 1
 - Pause crops using chemical similar to existing tech for tissue samples, but on large scale
- Failure Level 2
 - Freeze-dry whole pod

Pre-Launch Test Sites



Future Locations

- Moon
- Mars
- International Space Station
 - DIGS are removable- can be picked up and tugged to another location
- Space Tourism

Future Pods

- Larger Crops
 - Bamboo
 - Rubber
 - Rice
 - Wheat
 - Algae
- Animals
 - Tilapia
 - Chickens
 - Ducks



Future Work

- Chemical to "pause" plants on larger scale
- Chemical to reactivate "paused" plants
- Robotic harvesters
- Satellite communication to L2
- Advances in solar panel technology
- Advances in LED technology

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