Mars as Breadbasket of the Outer Solar System
11:00 AM, Saturday 1 Oct 2022

ARCHON 45

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Why can Mars be a Breadbasket?

- Plentiful CO_2 and H_2O
  - $CO_2+H_2O \rightarrow$ photosynthesis = food: Critical for Agriculture
  - $H_2O \rightarrow H_2 + O_2$ = Rocket fuel
  - CO_2+H_2O for hydrocarbon fuels
- Lava Tubes, other locations for farms
- Further out from Solar Gravity Well than Earth, Moon
- Lower Gravity (1/3g)
  - Allows for simplified space elevator concepts
  - Allows for lower fuel costs to Mars orbit using rockets

Space Farm 101

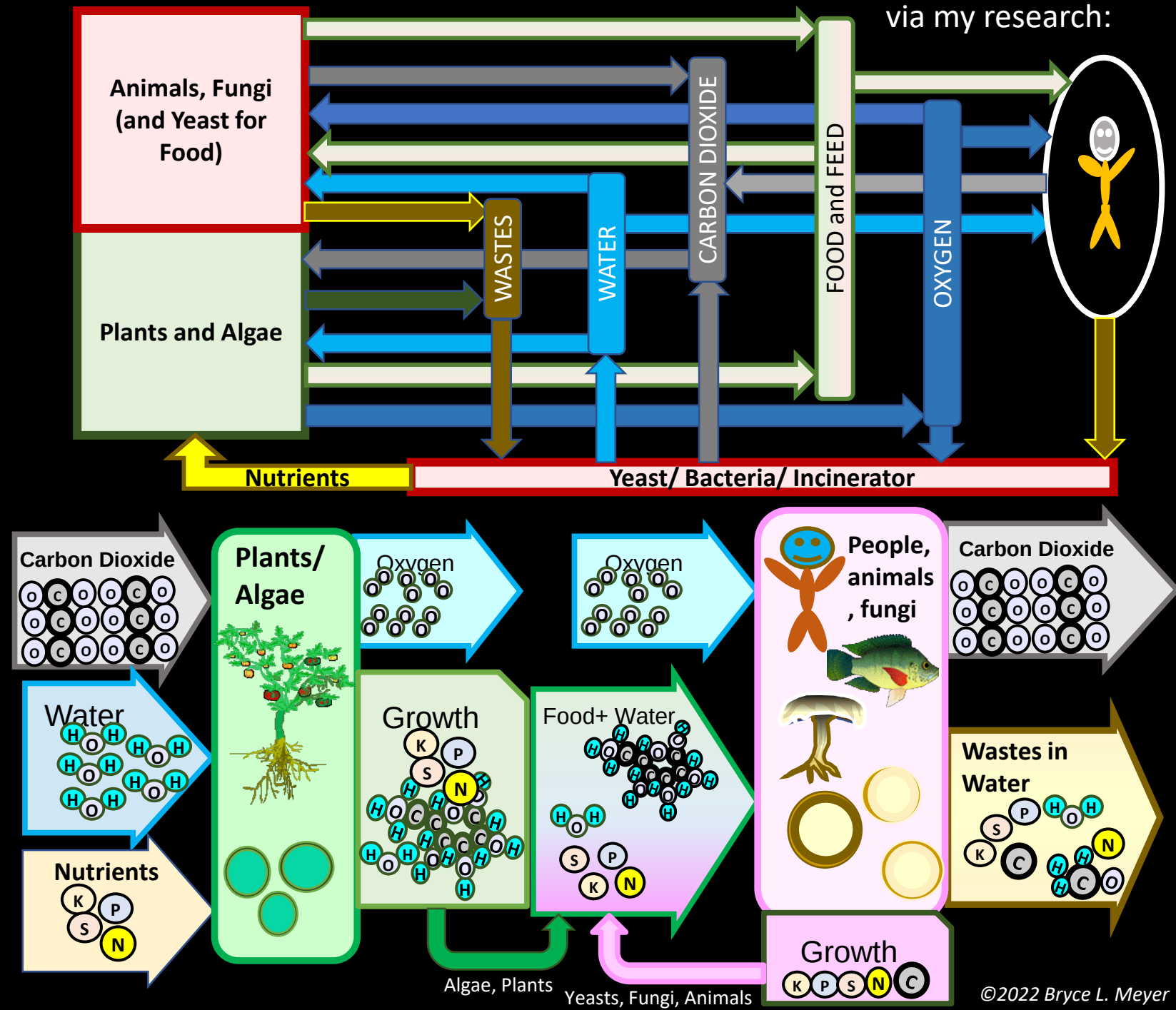
For Most Crops (kg inputs per kg **wet edible mass** produced, *rough*):

Crop	CO_2	H_2O*	N,S,P,K, etc.
Grains	2.6	1.6	0.05
Beans	3.4	1.8	0.1
Veggies (Fruit)	0.3	2.2	0.01
Tubers	0.5	1.3	0.02
Spirulina	0.15	1	0.02

* = excluding transpiration which is cycled inside farm

Energy: ~60 kWh/day/kg food produced (rough)

via my research:



Mars Has .....

- Atmosphere: **Carbon Dioxide (CO_2) (95%),** molecular nitrogen (2.8%), and argon (2%) @ 1% of Earth's Sea Level pressure
  - Fog at some times of year at some spots, maybe
- Ice Caps: **Water (H_2O), Dry Ice (CO_2)**
  - **Water may be under the crust in many places too.**
- Regolith:
  - First few feet have **perchlorates = bad**
  - But: also has **nutrients**! (maybe Nitrogen compounds too ????)
- Lava Tubes: Great locations to grow crops, reduced radiation
- Mars Concrete could work too!

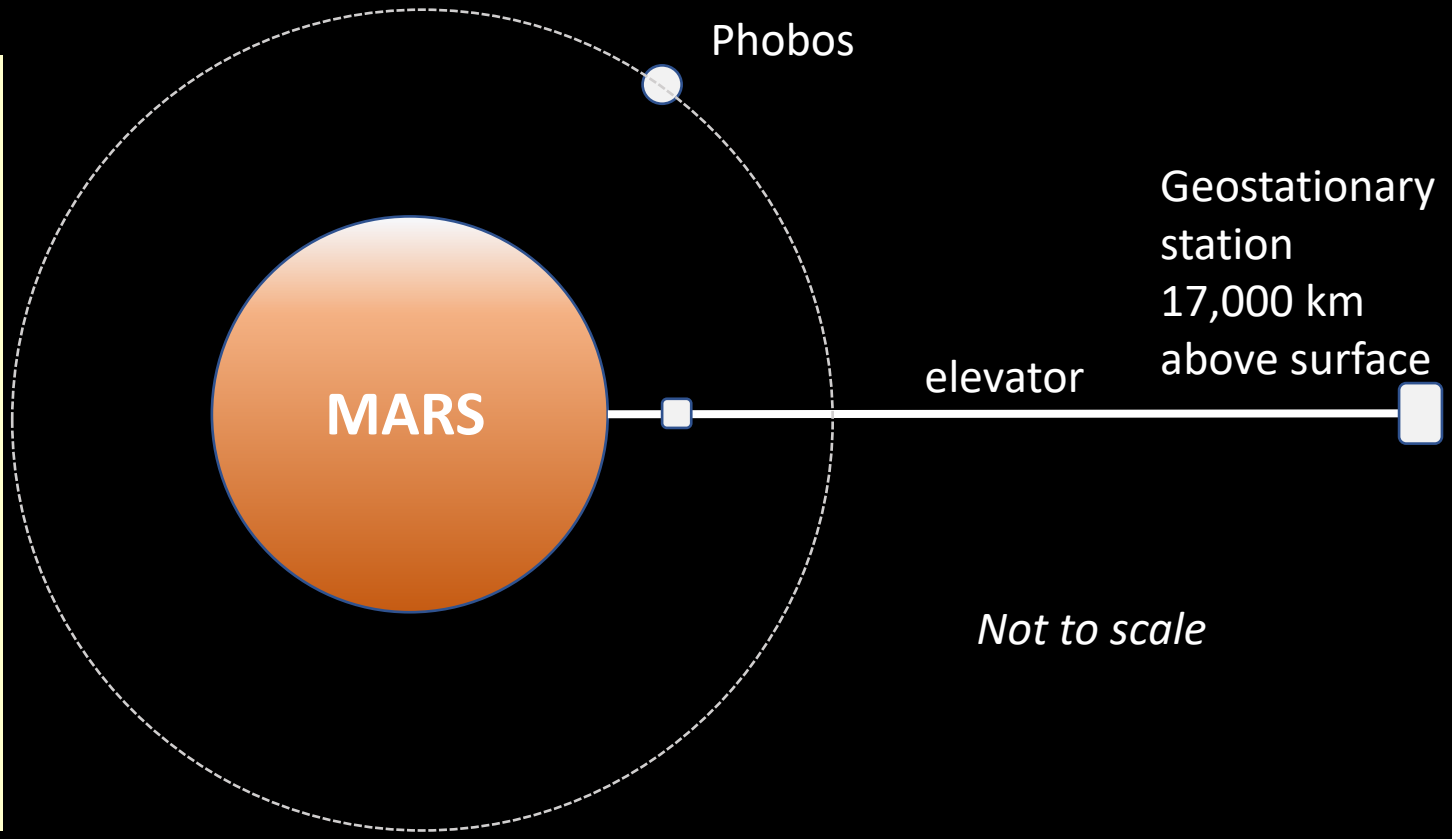
NET RESULT: ALL THE INPUTS AND SPOTS FOR CROPS!

https://en.wikipedia.org/wiki/Martian_soil
https://en.wikipedia.org/wiki/Atmosphere_of_Mars

Mars Elevator and Rockets to Lift Crops

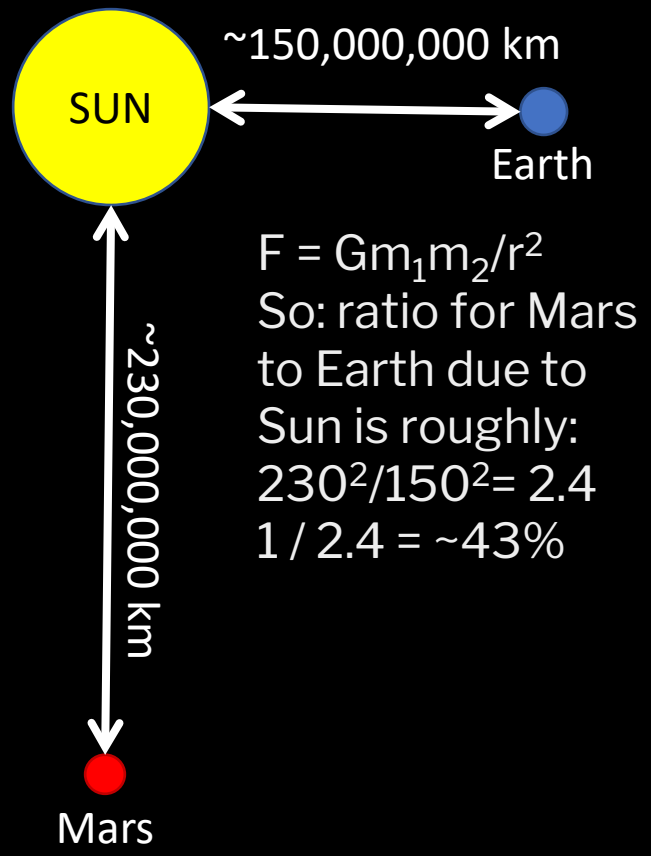
- Elevators:
  - Many well-developed concepts in literature, experiments
  - Cheap access to lift high mass items (like crops) to orbit to send outward
  - Must deal with low orbit moon Phobos

Due to lower gravity, it takes 1/3 the fuel to get off the surface to the same altitude versus Earth,
So instead of 3kg fuel/1kg payload Earth to GTO, around 1kg fuel/1kg payload (or less) to Mars GTO



https://marspedia.org/Space_elevator

Solar Gravity Well and Total Savings



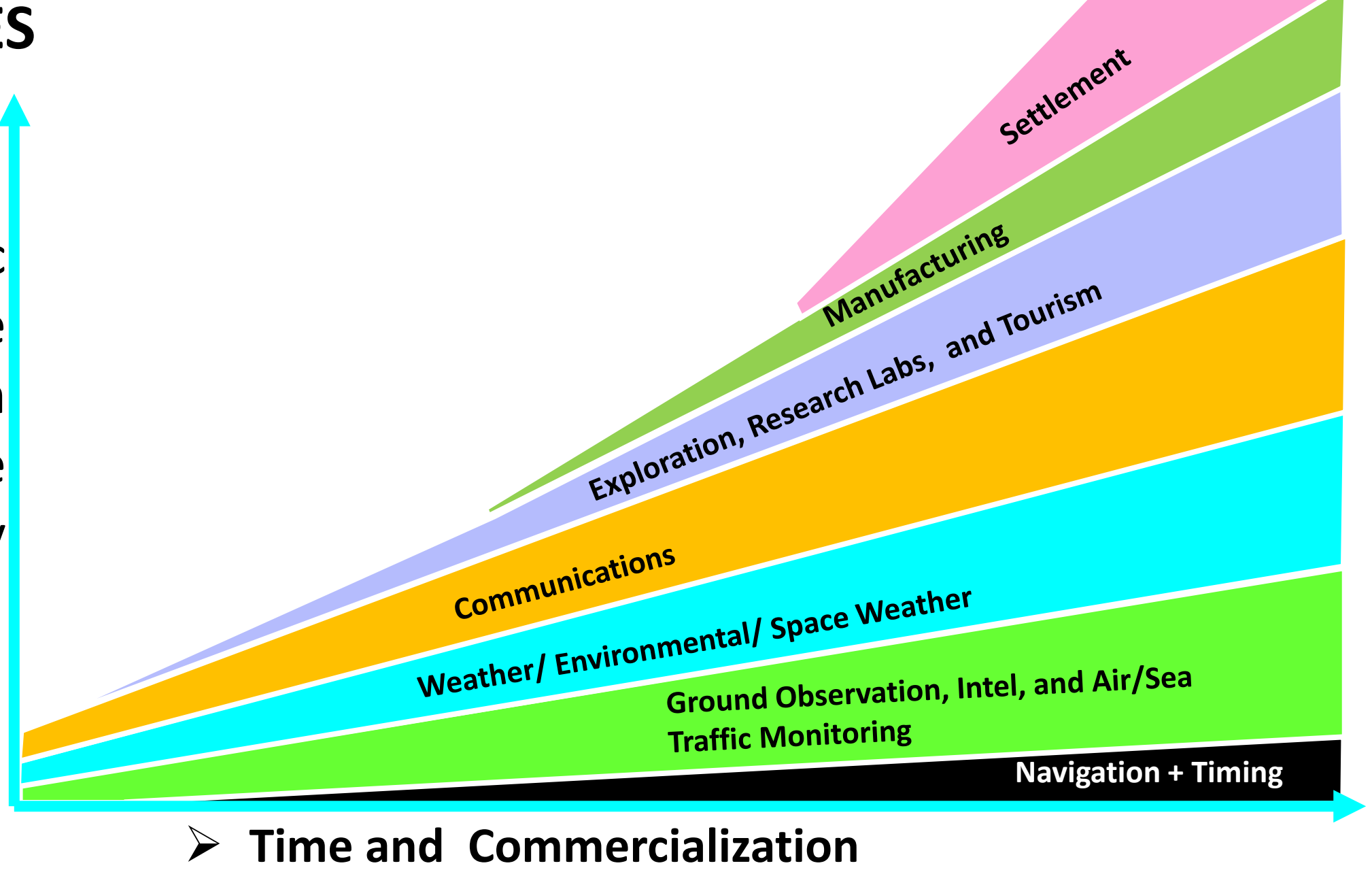
$F = Gm_1m_2/r^2$
So: ratio for Mars to Earth due to Sun is roughly:
$230^2/150^2 = 2.4$
$1 / 2.4 = \sim 43\%$

- Mars sits further from Sun than Earth, so it costs less to send mass to asteroids or further out, than from Earth.
- It takes (VERY ROUGHLY) <43% of the fuel to reach the asteroids or further from Mars than from Earth.
- Combined with savings to Mars Orbit: (1/3)* 43% = 14% of cost, or 86% savings in fuel…
- …assuming I can grow food on Mars as cheap as on Earth…

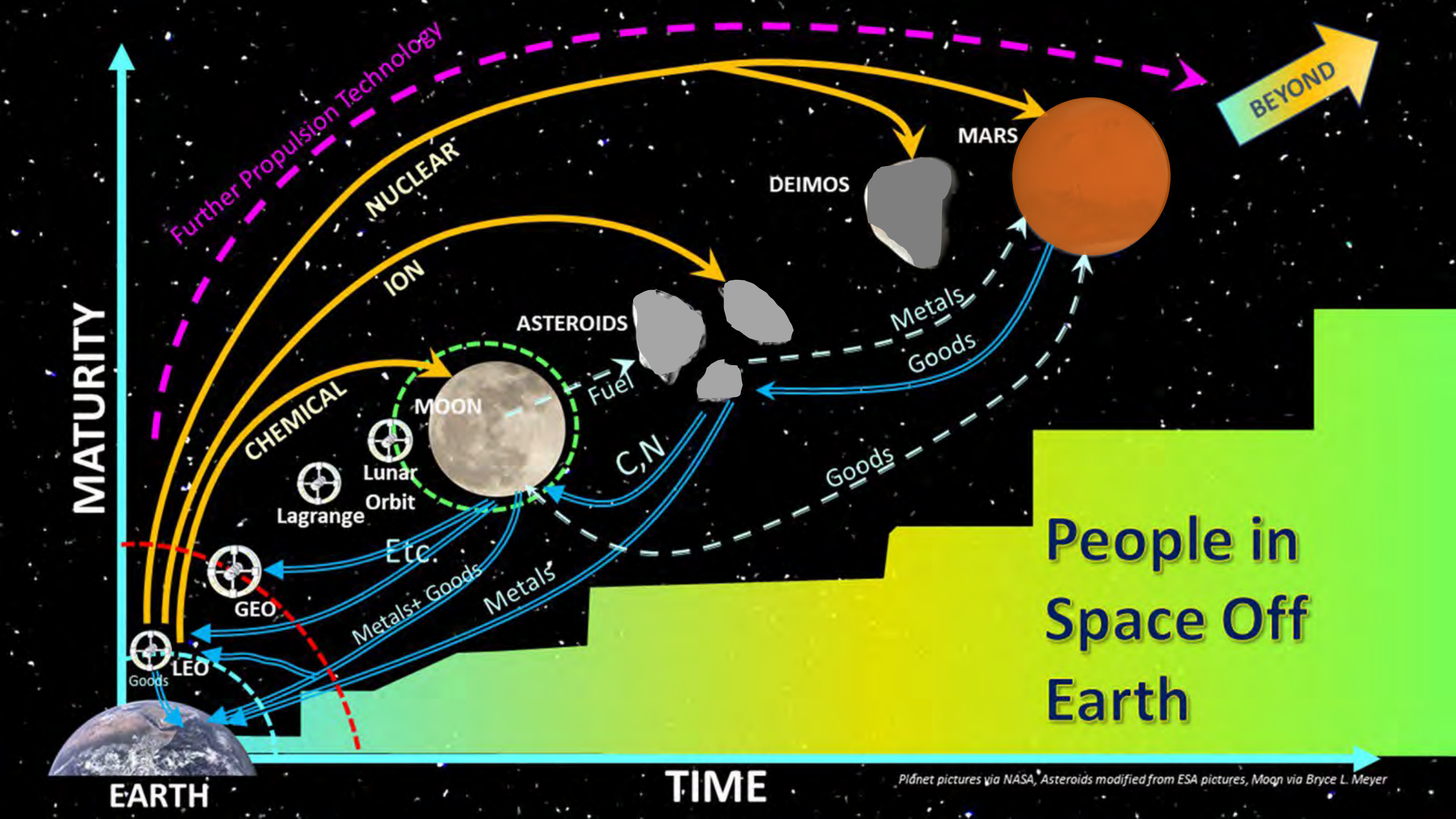
- BACKUPS

SPACE USES

- Economic Value
- People in Space
- Criticality



- **Time and Commercialization**


MATURITY
TIME
EARTH
Further Propulsion Technology
NUCLEAR
ION
CHEMICAL
BEYOND
MARS
DEIMOS
ASTEROIDS
MOON
Fuel
Metals
Goods
C,N
Goods
Lunar Orbit
Lagrange
GEO
LEO
Goods
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