
BECOMING A MULTIPLANET SPECIES
SPACEX

“You want to wake up in the morning and think the future is going to be great - and that's what being a spacefaring civilization is all about. It's about believing in the future and thinking that the future will be better than the past. And I can't think of anything more exciting than going out there and being among the stars.”

Elon Musk, CEO and Lead Designer, SpaceX

PROGRESS

DEEP CRYO LIQUID OXYGEN TANK TESTING

Pressure tested to 2.3 atmospheres

Carbon fiber matrix

Volume 1000m^3

Holds 1200 tons of liquid oxygen

ENGINE TESTING

Over 1200 seconds of firing across 42 main engine tests

Longest test 100 seconds; 40 seconds typical for Mars landing

Test engine operates at up to 200 atmospheres

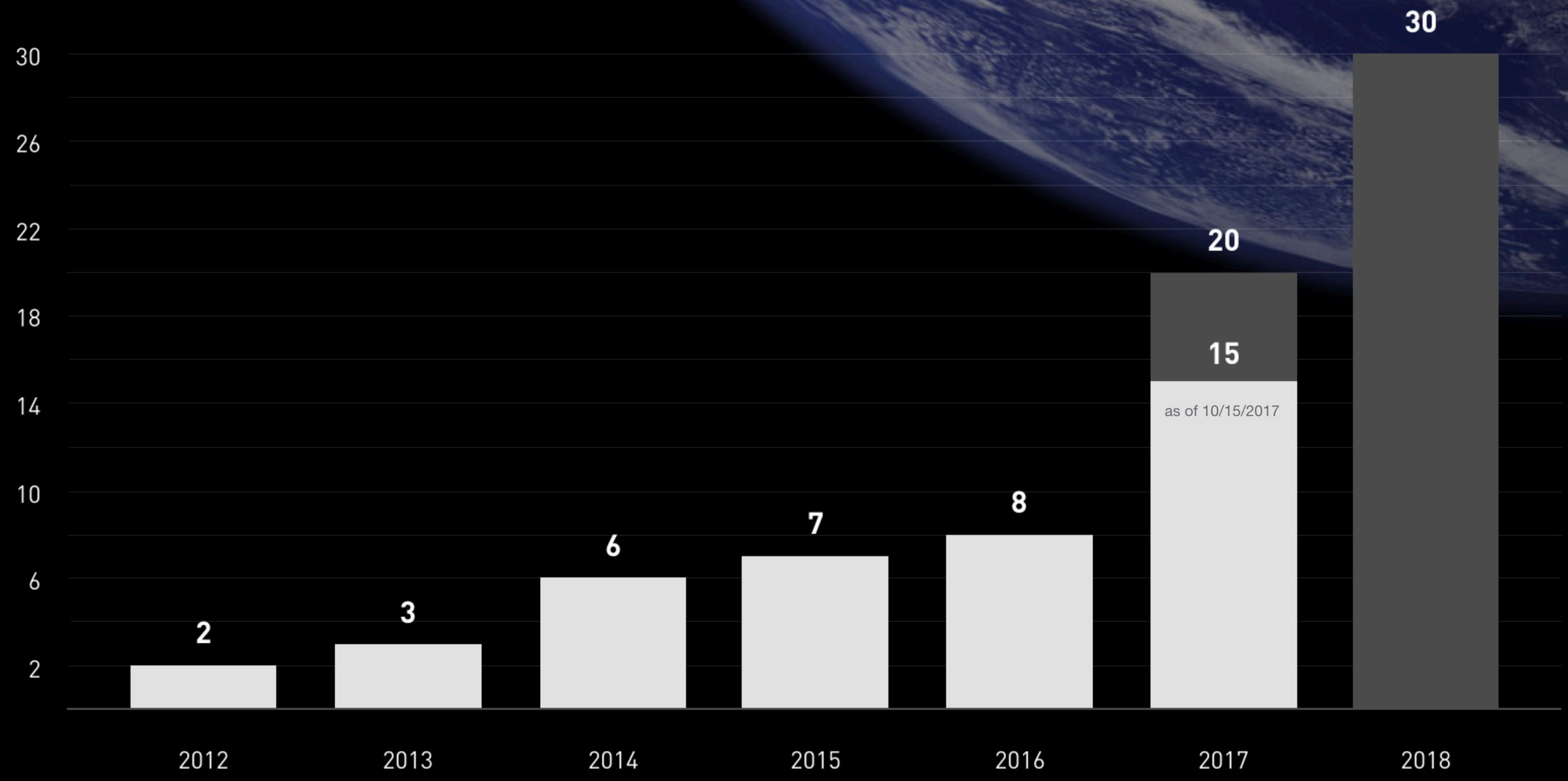
PERFECTING PROPULSIVE LANDING

18 successful Falcon 9 landings as of 10/15/2017

Very high reliability demonstrated with single engine landings

Precision landing will allow for return to launch mount, no landing legs needed

LAUNCH RATE


30
26
22
18
14
10
6
2
2
3
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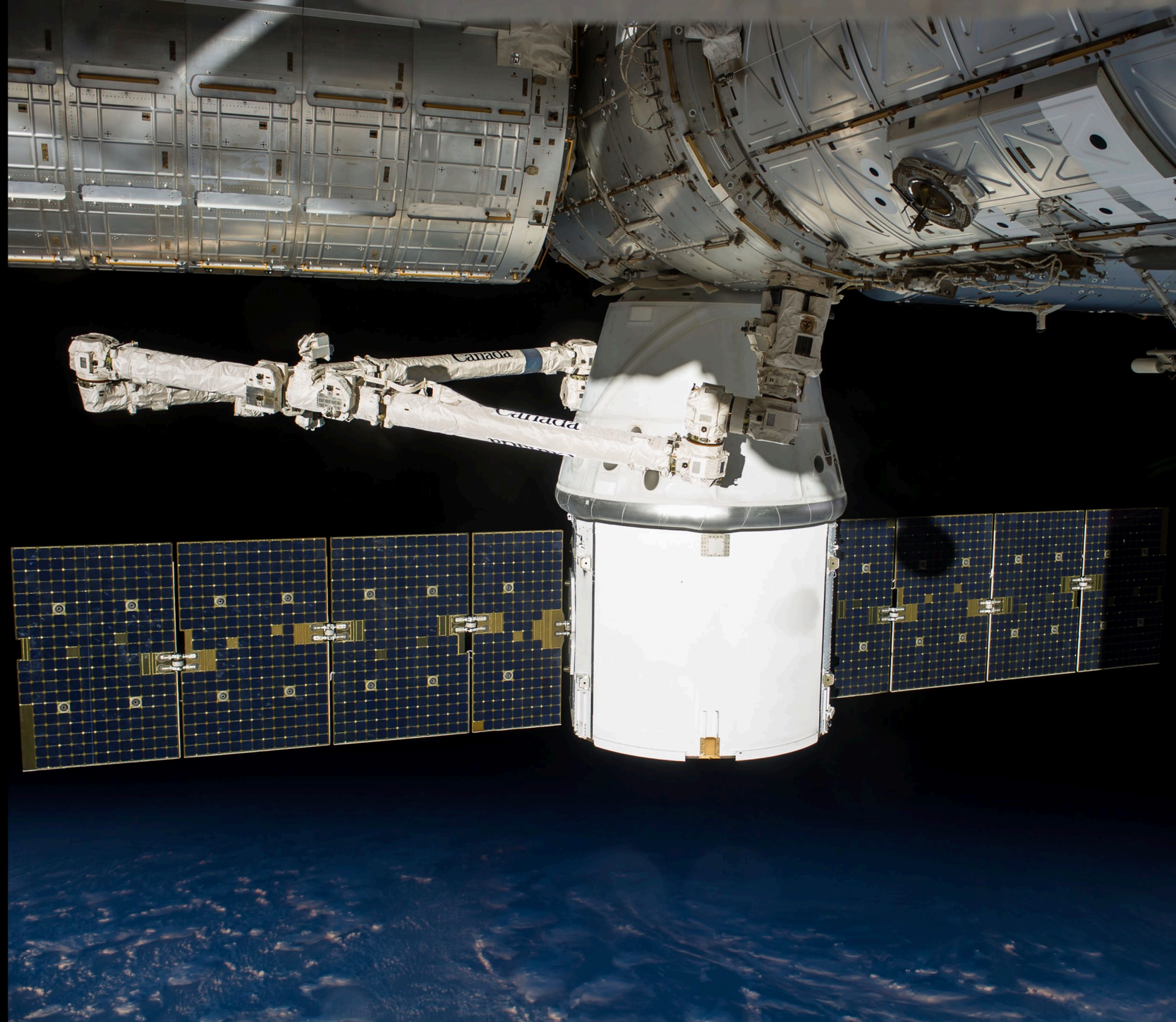
7
8
20
15
as of 10/15/2017
30
2012
2013
2014
2015
2016
2017
2018

DRAGON UPDATES

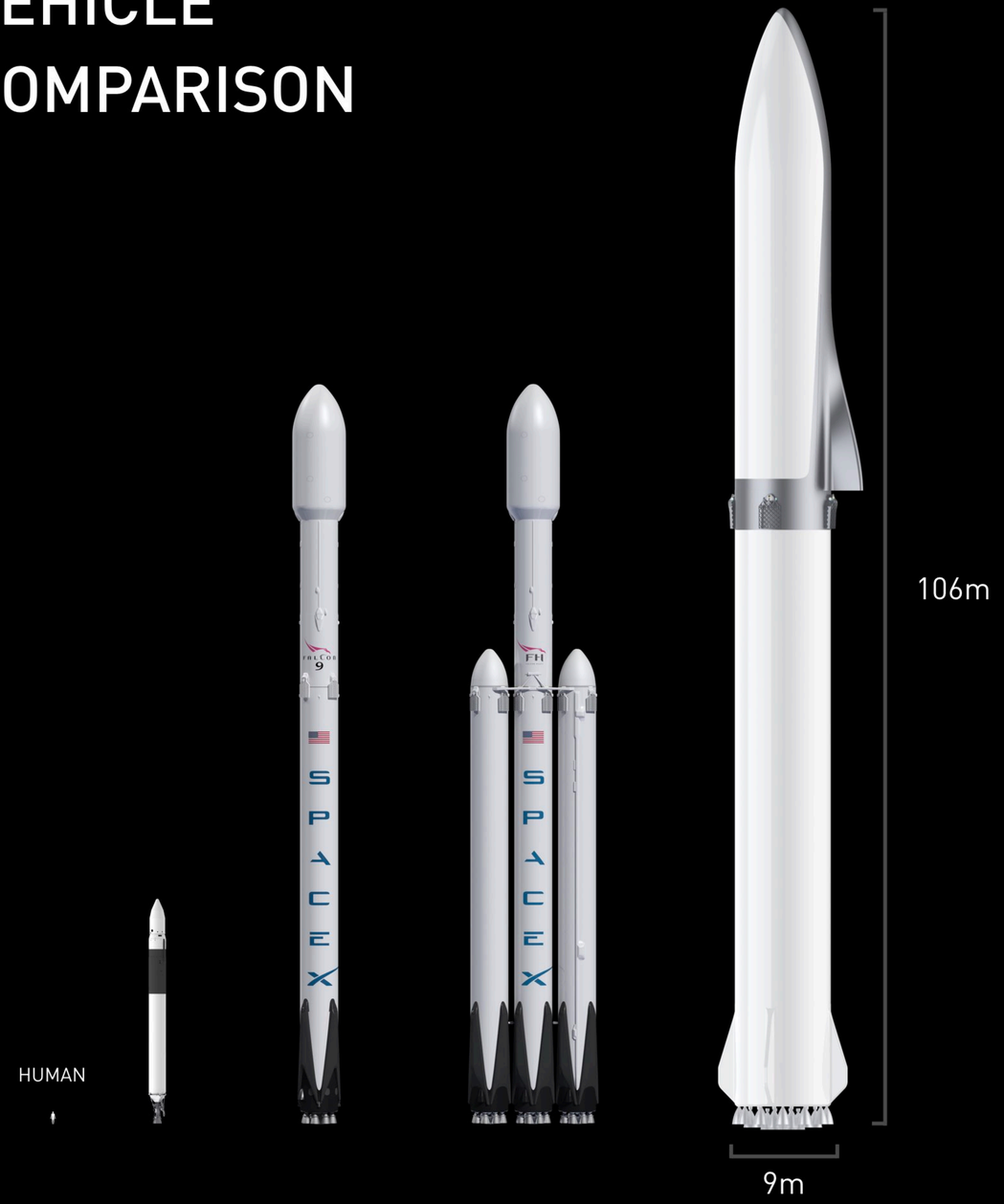
Demonstrated automated rendezvous and docking to space station with Dragon 1

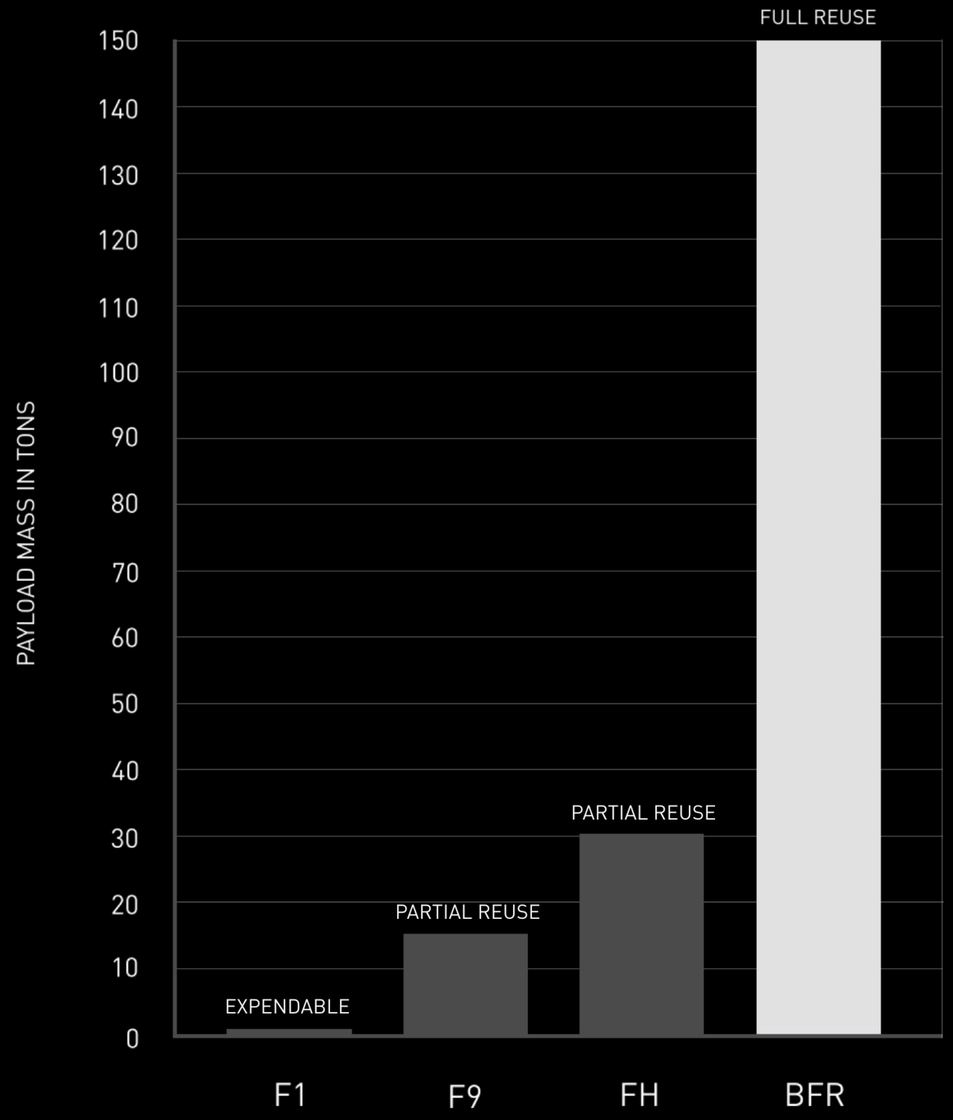
Dragon 2 will dock directly, not needing use of Canadarm

Perfected heat shield technology to withstand extremely high reentry temperatures



VEHICLE COMPARISON

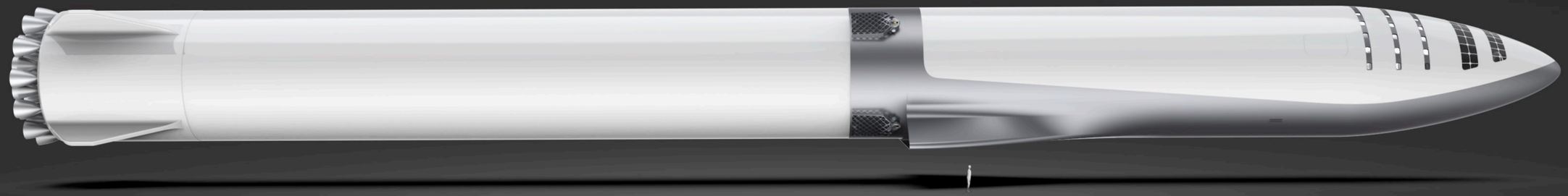




BFR OVERVIEW

By creating a single system that can service a variety of needs, we can redirect resources from Falcon 9, Falcon Heavy and Dragon to this system—which is fundamental in making BFR affordable.

WATCH ANIMATION

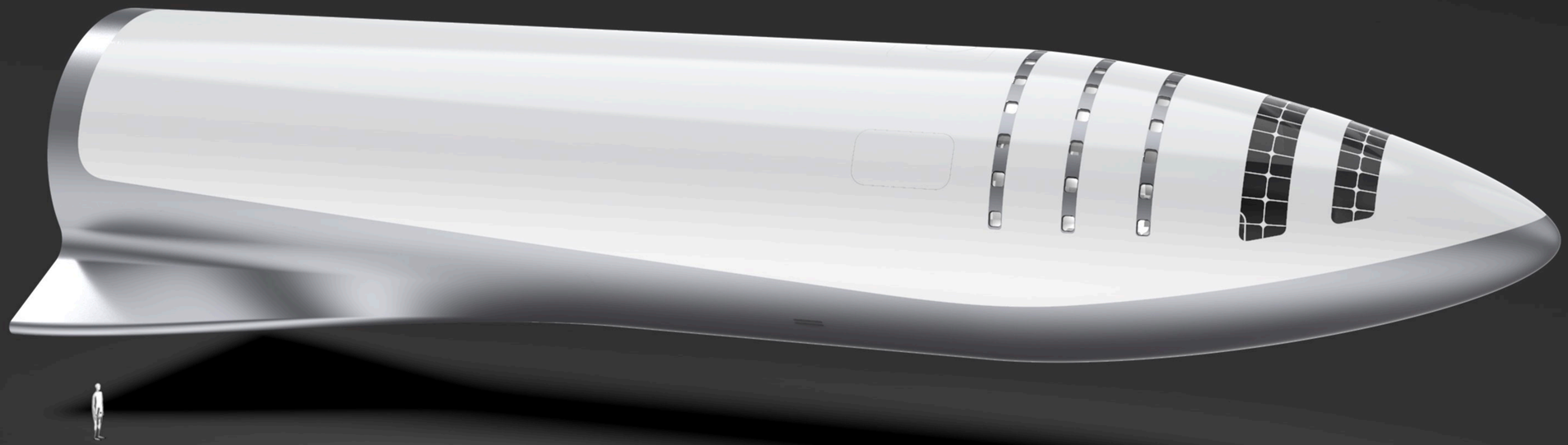


Vehicle Length: 106 m

Booster Length: 58 m

Booster Thrust: 52,700 kN

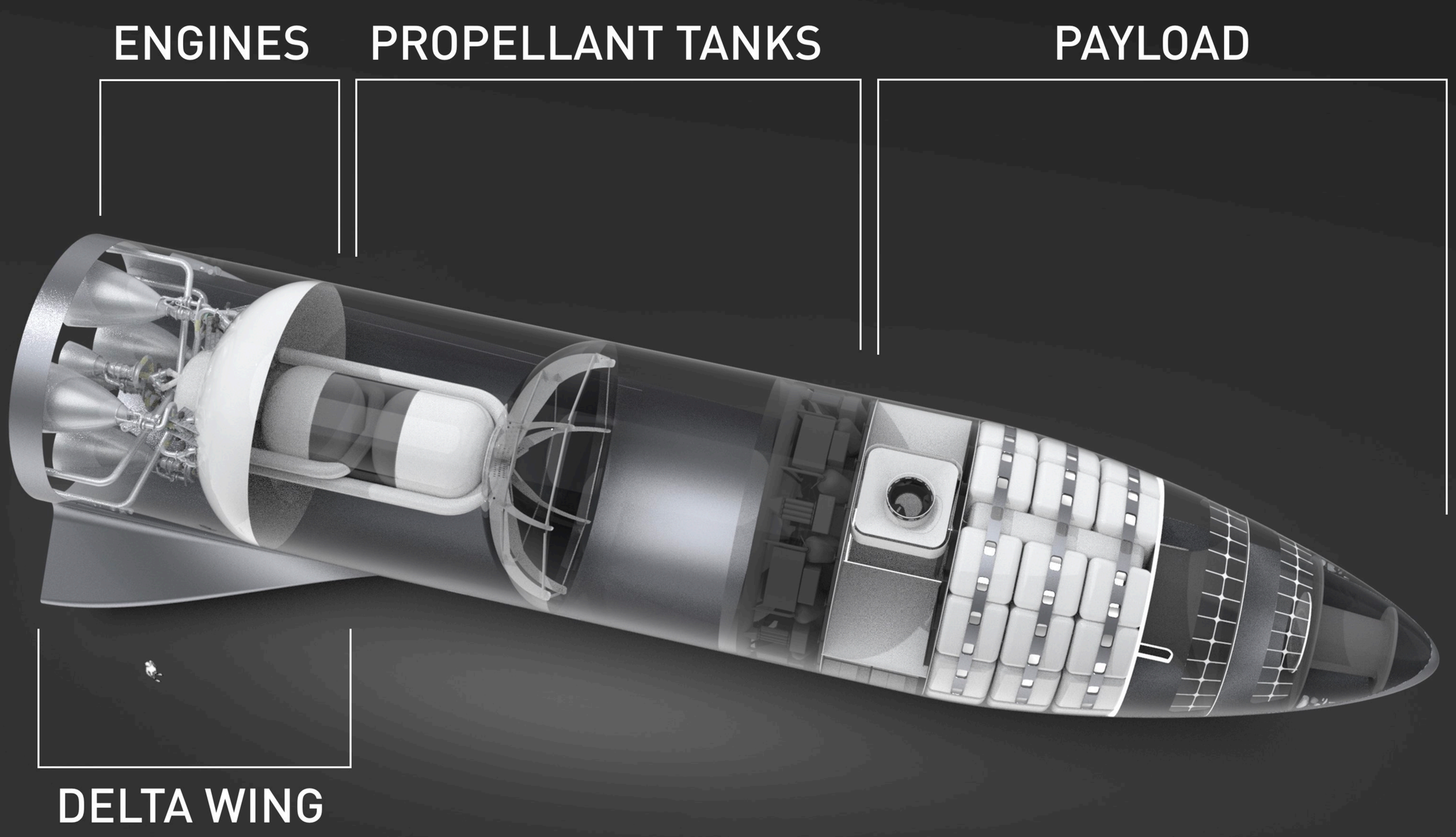
BFR

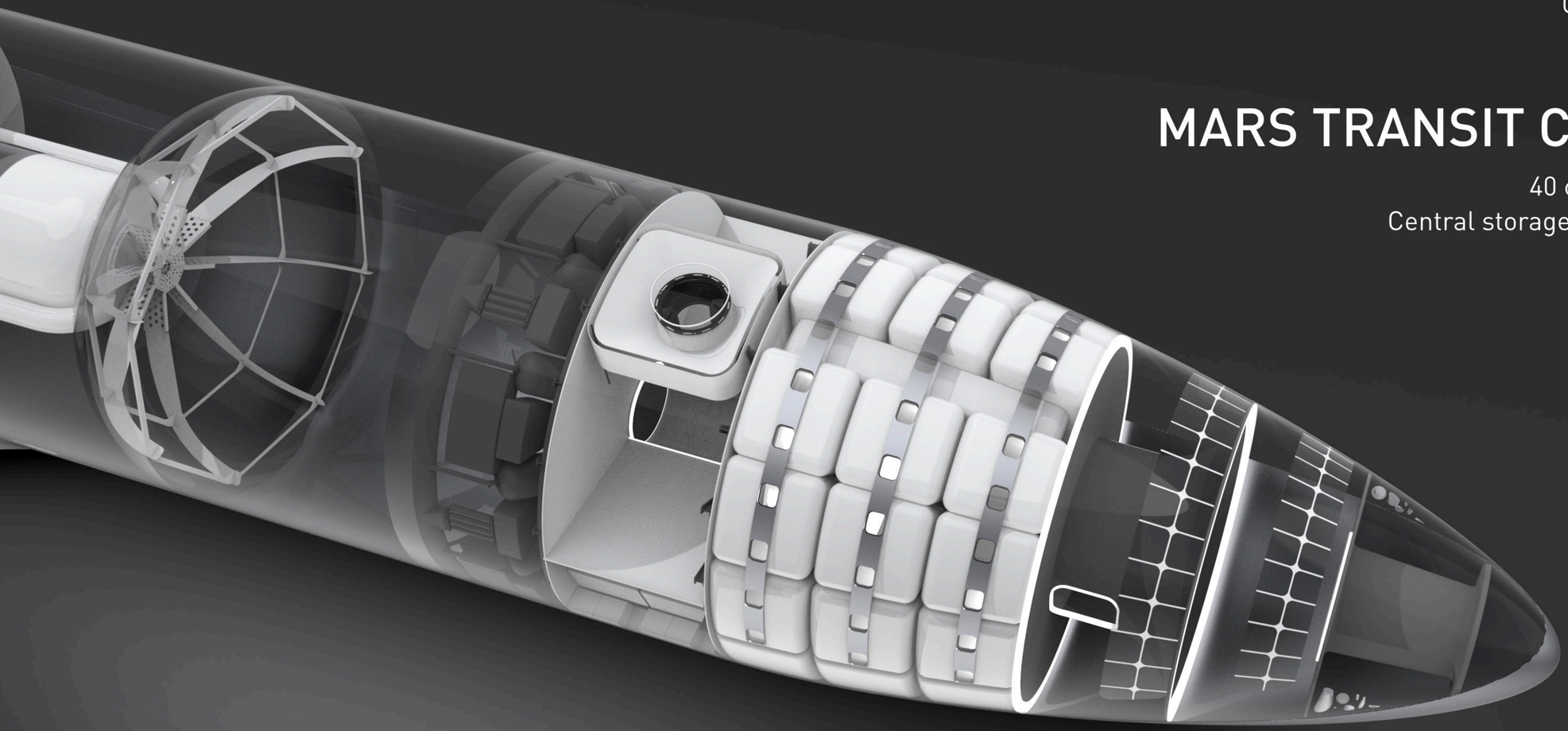


Ship Length 48 m
Body Diameter 9 m

Ship Dry Mass 85 t
Propellant Mass 1,100 t

Max Ascent Payload 150t
Typical Return Payload 50 t


ENGINES
PROPELLANT TANKS
PAYLOAD
DELTA WING



PRESSURIZED VOLUME 825 m^3

Greater than an A380 main deck

MARS TRANSIT CONFIGURATION

40 cabins and large common areas

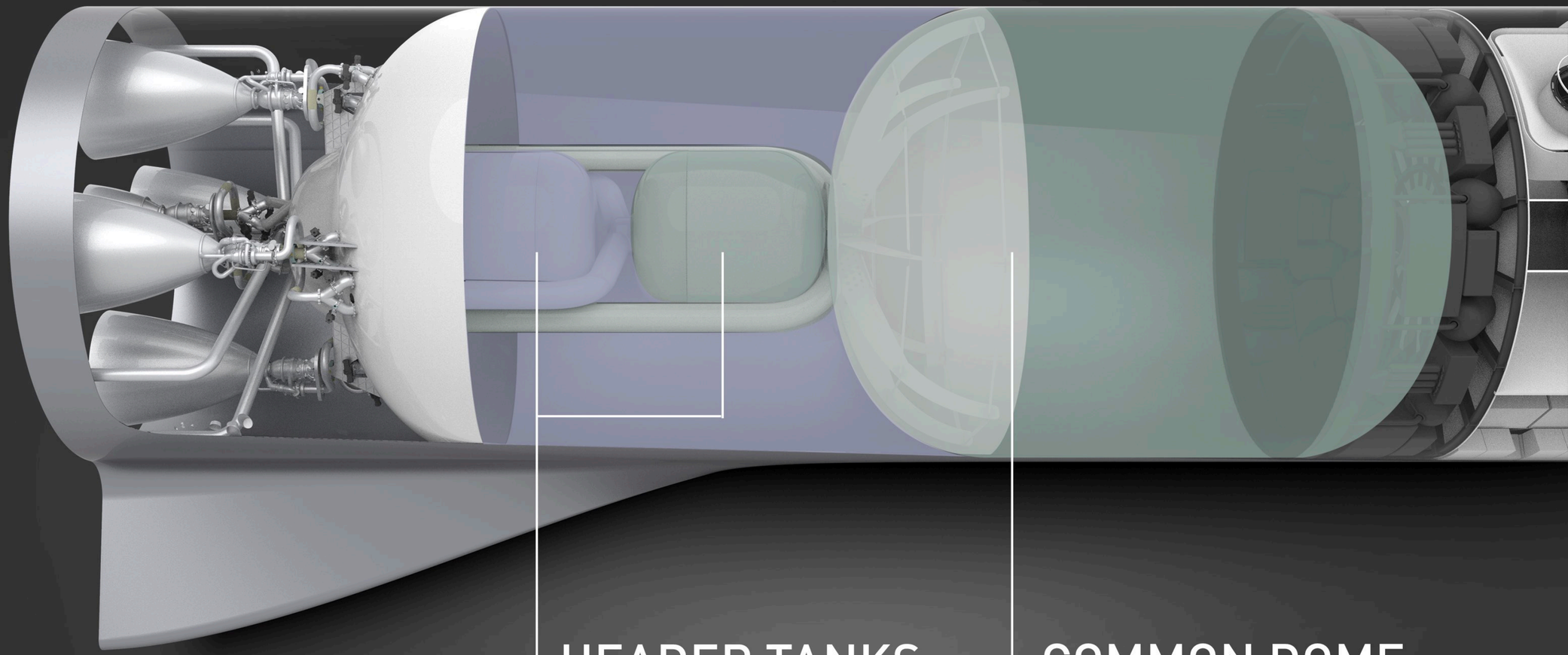
Central storage, galley and solar storm shelter

FUEL TANK

Holds 240 tons of CH_4

OXYGEN TANK

Holds 860 tons of liquid O_2



HEADER TANKS

Hold landing propellant during transit

COMMON DOME

Separates CH_4 and O_2

RAPTOR ENGINES

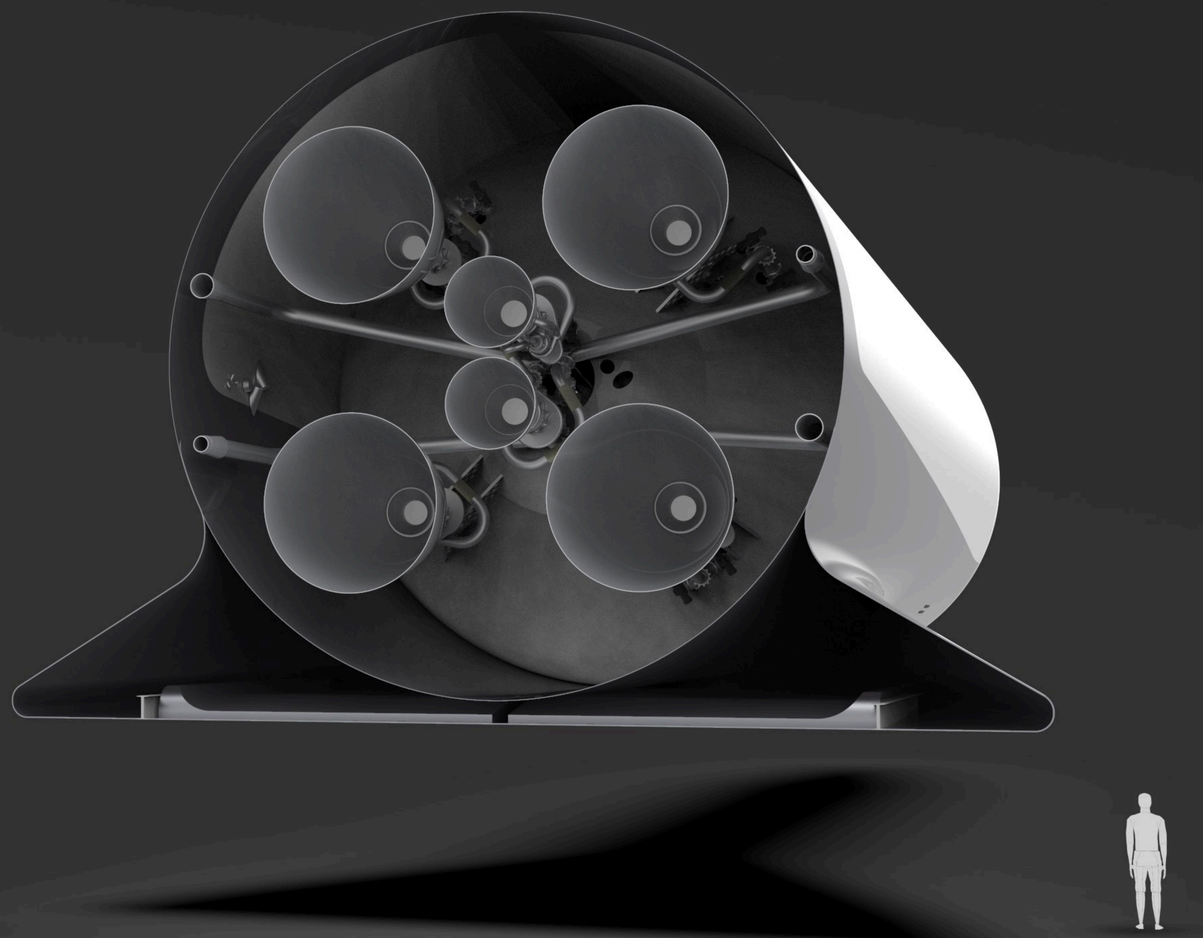
Chamber pressure 250 bar
Throttle 20% to 100% thrust

2 SEA-LEVEL ENGINES

Exit Diameter 1.3 m
Thrust (SL) 1,700 kN
Isp (SL) 330 s
Isp (Vac) 356 s

4 VACUUM ENGINES

Exit Diameter 2.4 m
Thrust 1,900 kN
Isp 375 s



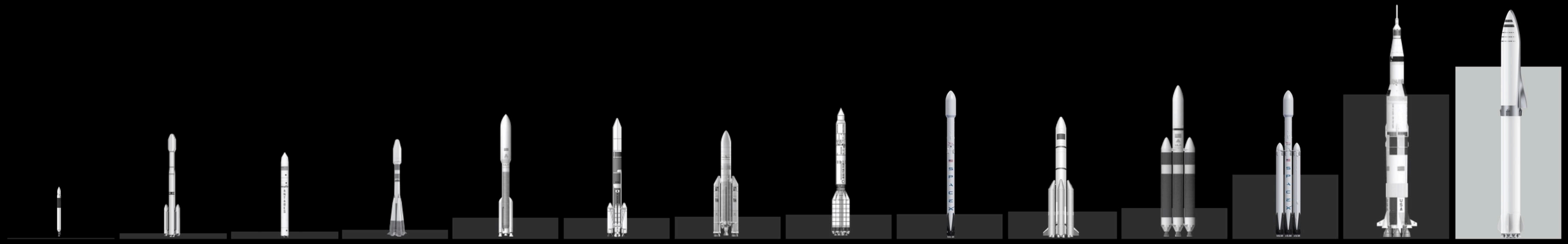
REFILLING

Propellant settled by milli-g acceleration using control thrusters

ROCKET CAPABILITY

PAYLOAD TO LOW EARTH ORBIT IN TONS

BFR has larger payload capacity than a Saturn V, while being fully reusable

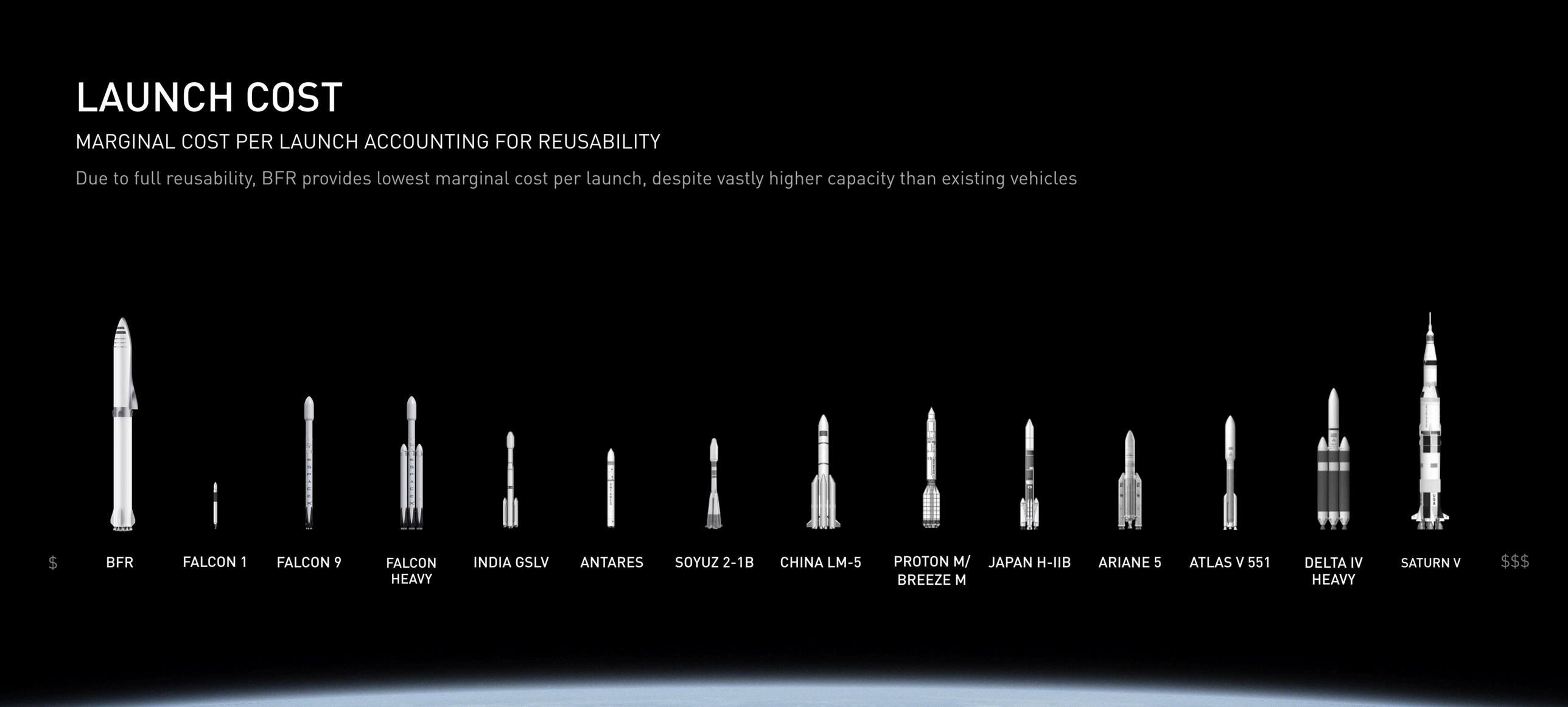


FALCON 1	INDIA GSLV	ANTARES	SOYUZ 2-1B	ATLAS V 551	JAPAN H-IIB	ARIANE 5	PROTON M/ BREEZE M	FALCON 9	CHINA LM-5	DELTA IV HEAVY	FALCON HEAVY	SATURN V	BFR
0.7	5.0	7.0	8.2	18.8	19	20	22	22.8	23	28.3	54.4	135	150

LAUNCH COST

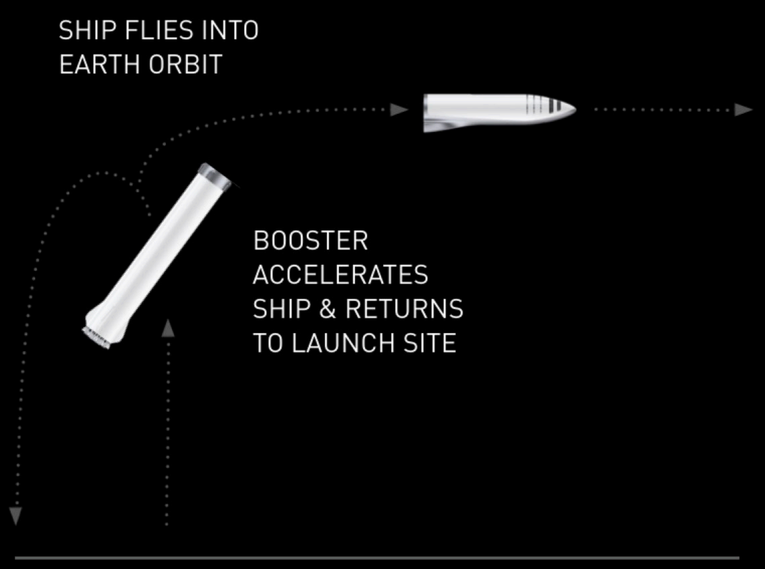
MARGINAL COST PER LAUNCH ACCOUNTING FOR REUSABILITY

Due to full reusability, BFR provides lowest marginal cost per launch, despite vastly higher capacity than existing vehicles



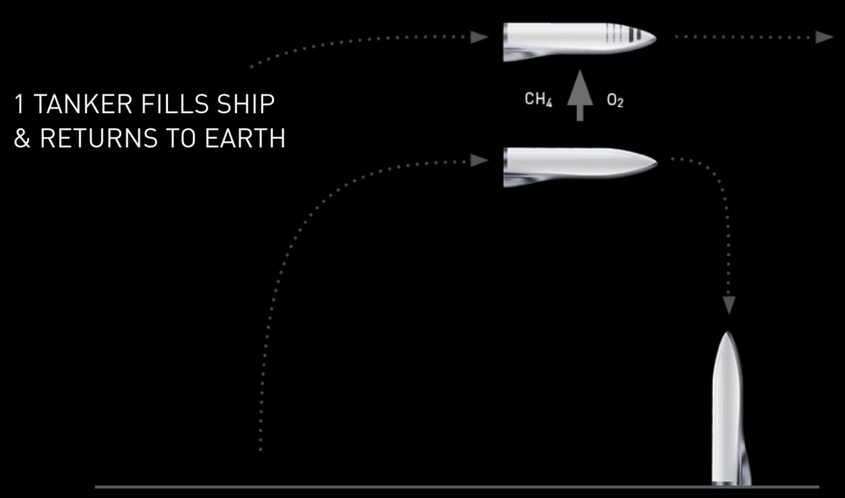
VALUE OF REFILLING

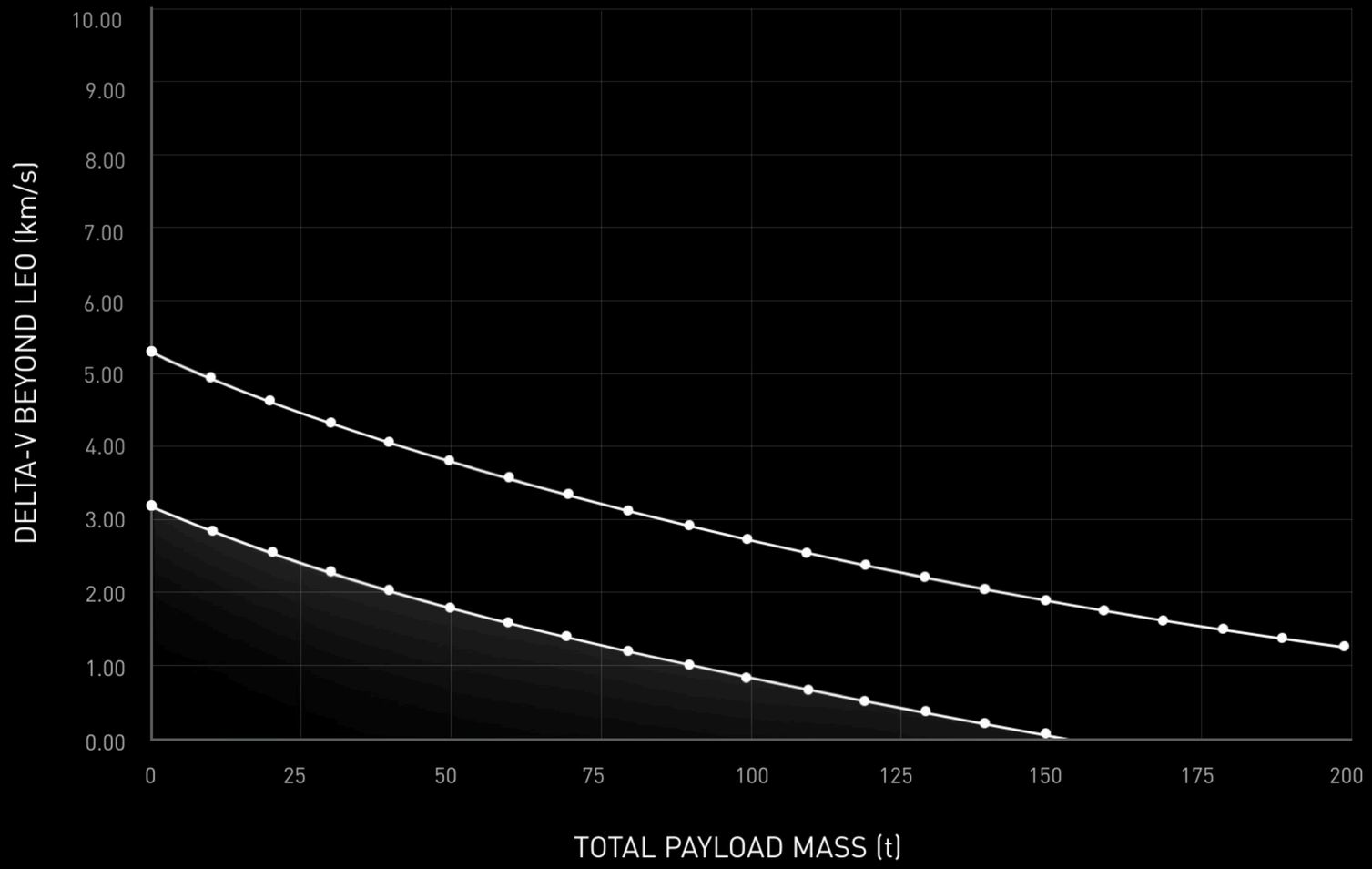
SINGLE LAUNCH CAPABILITY FROM EARTH ORBIT



VALUE OF REFILLING

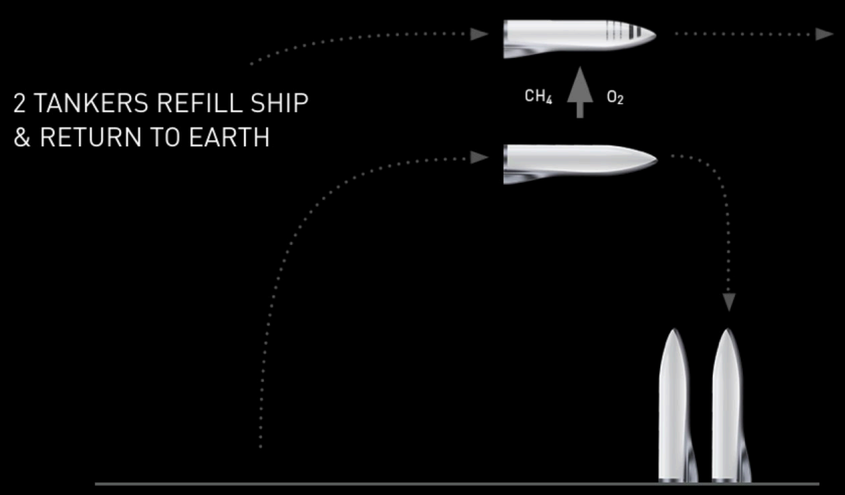
ONE TANKER

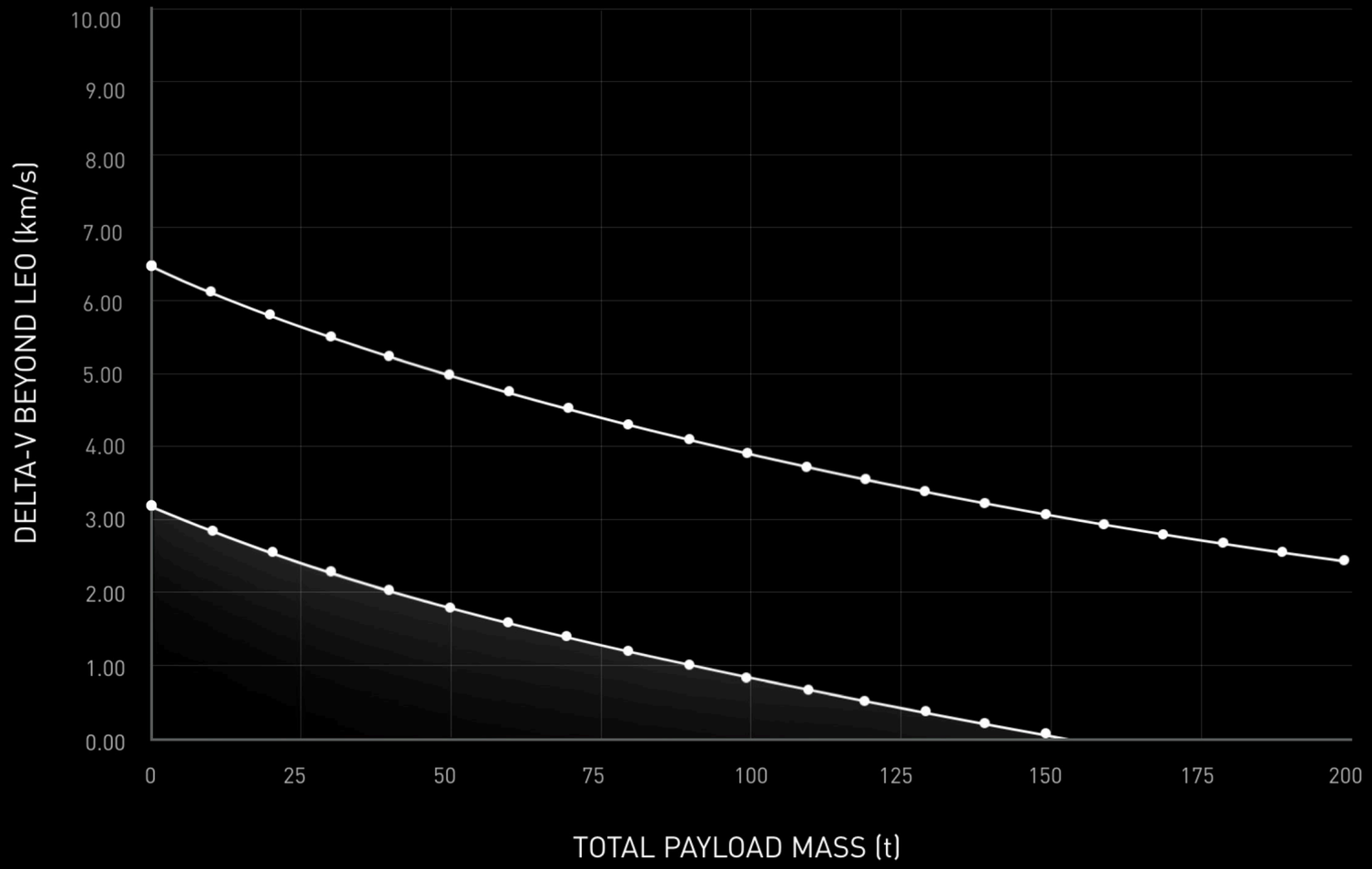




VALUE OF REFILLING

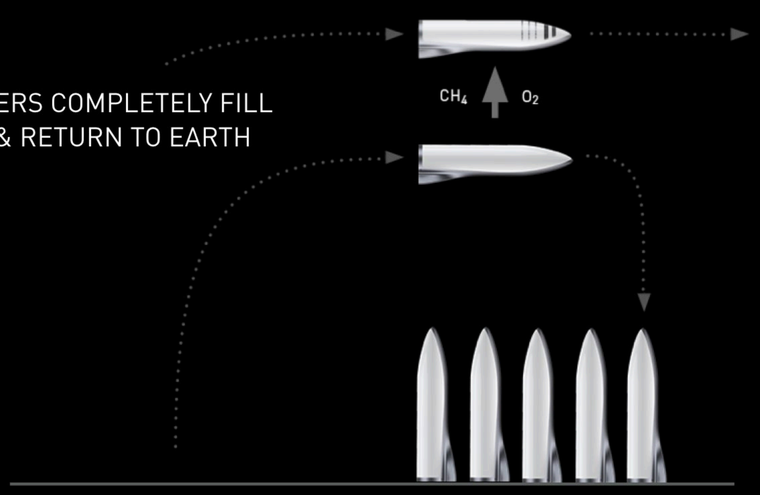
TWO TANKERS

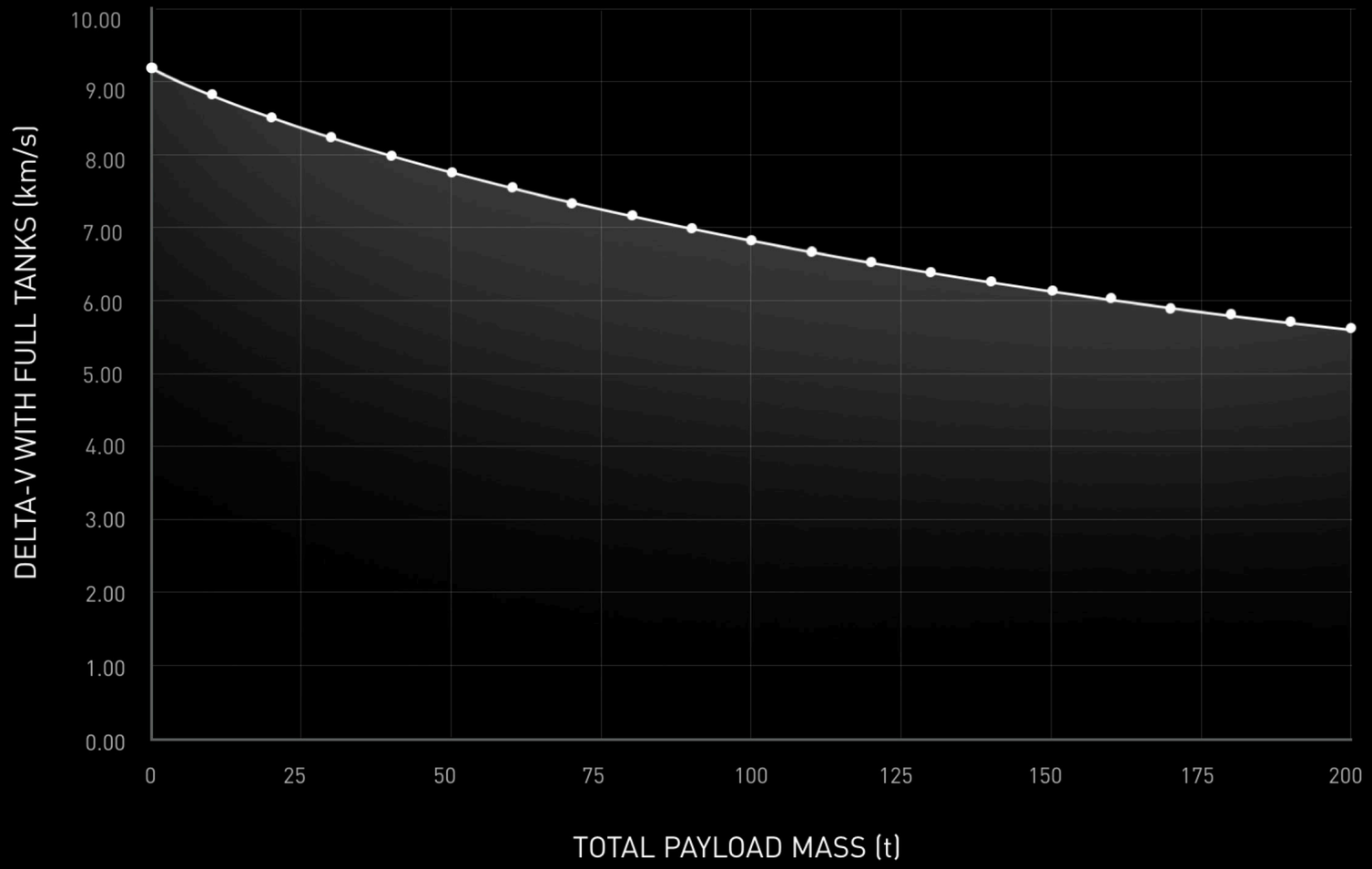


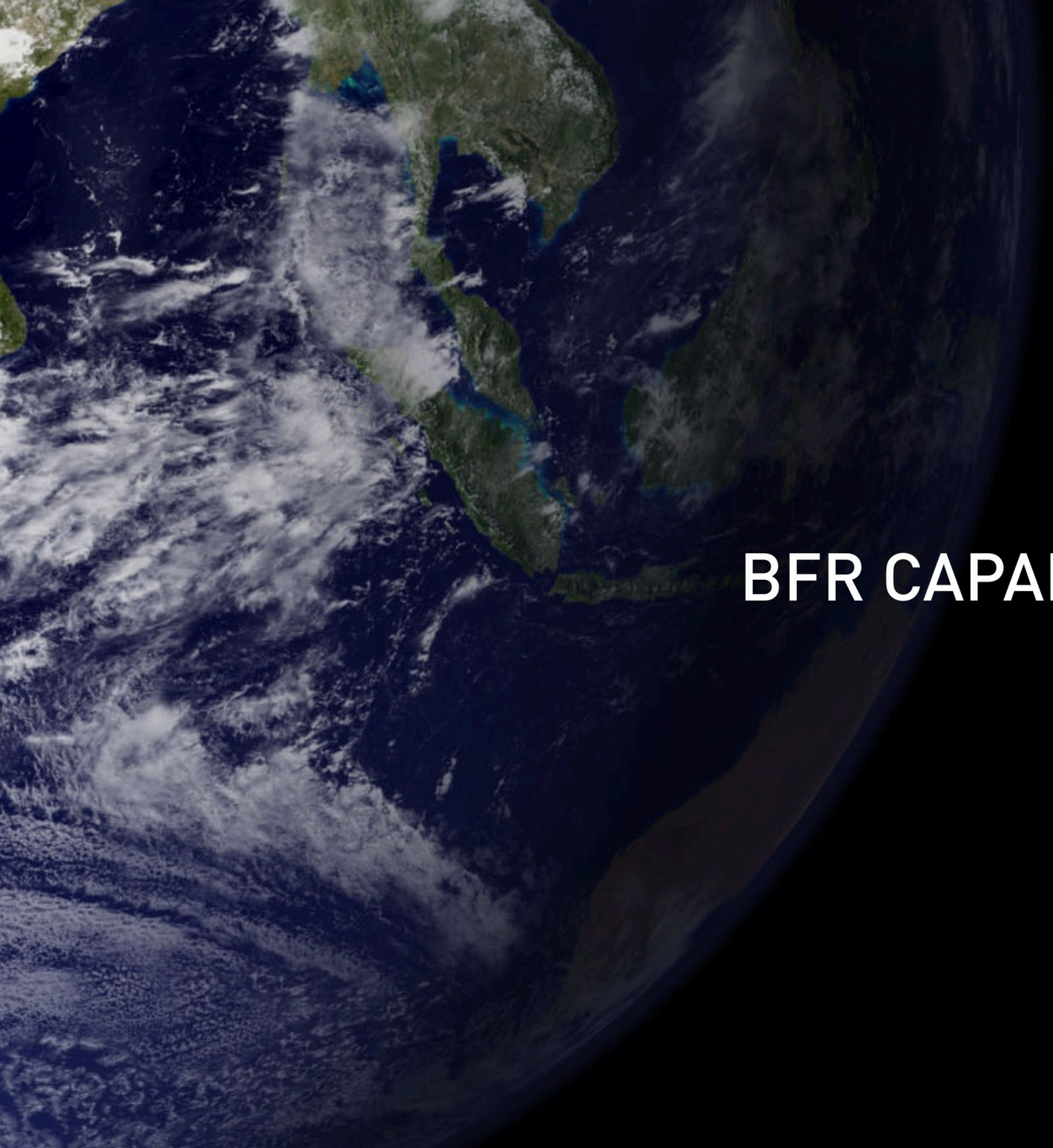


VALUE OF REFILLING

FULL TANKS





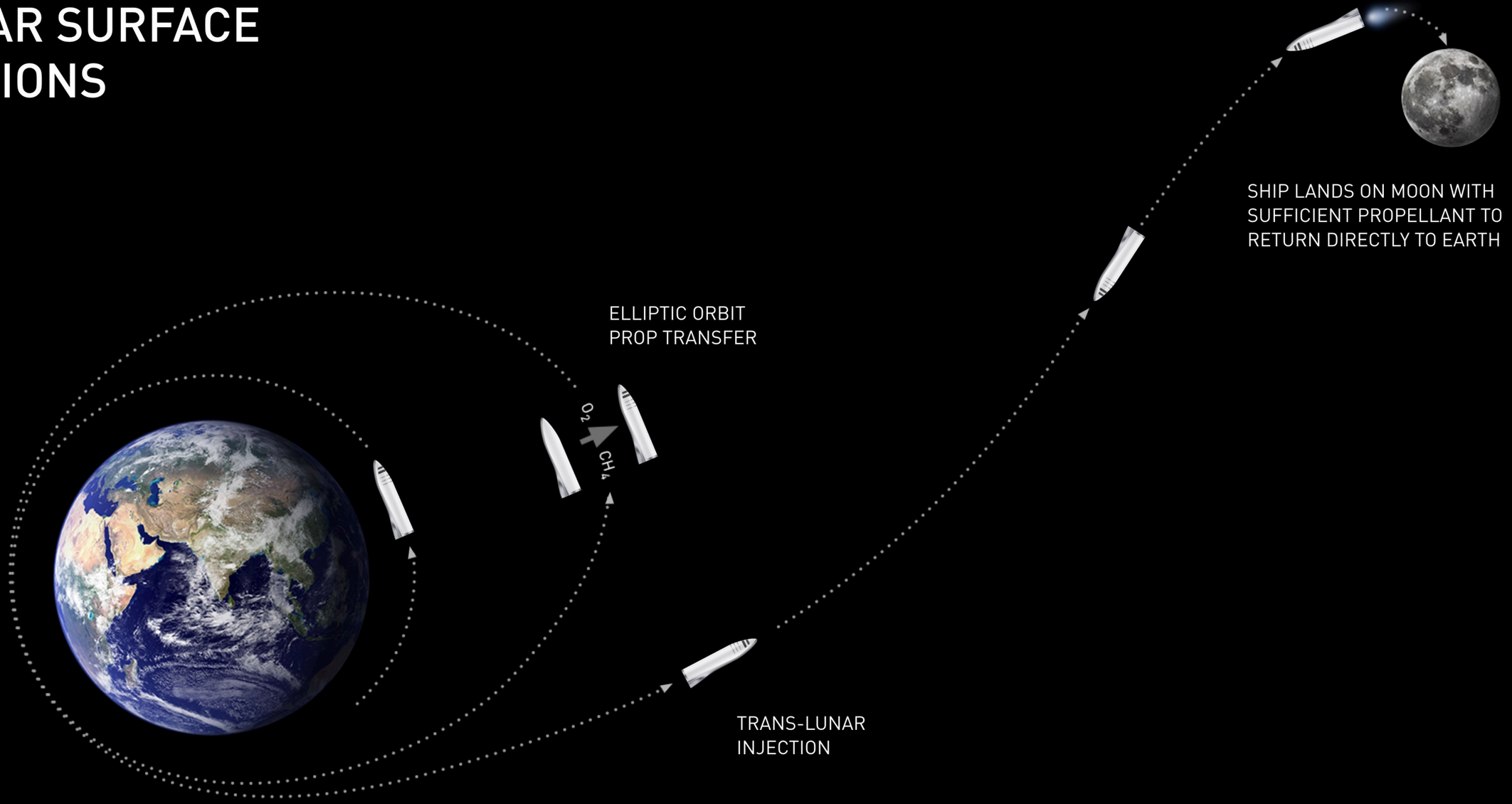


BFR CAPABILITIES

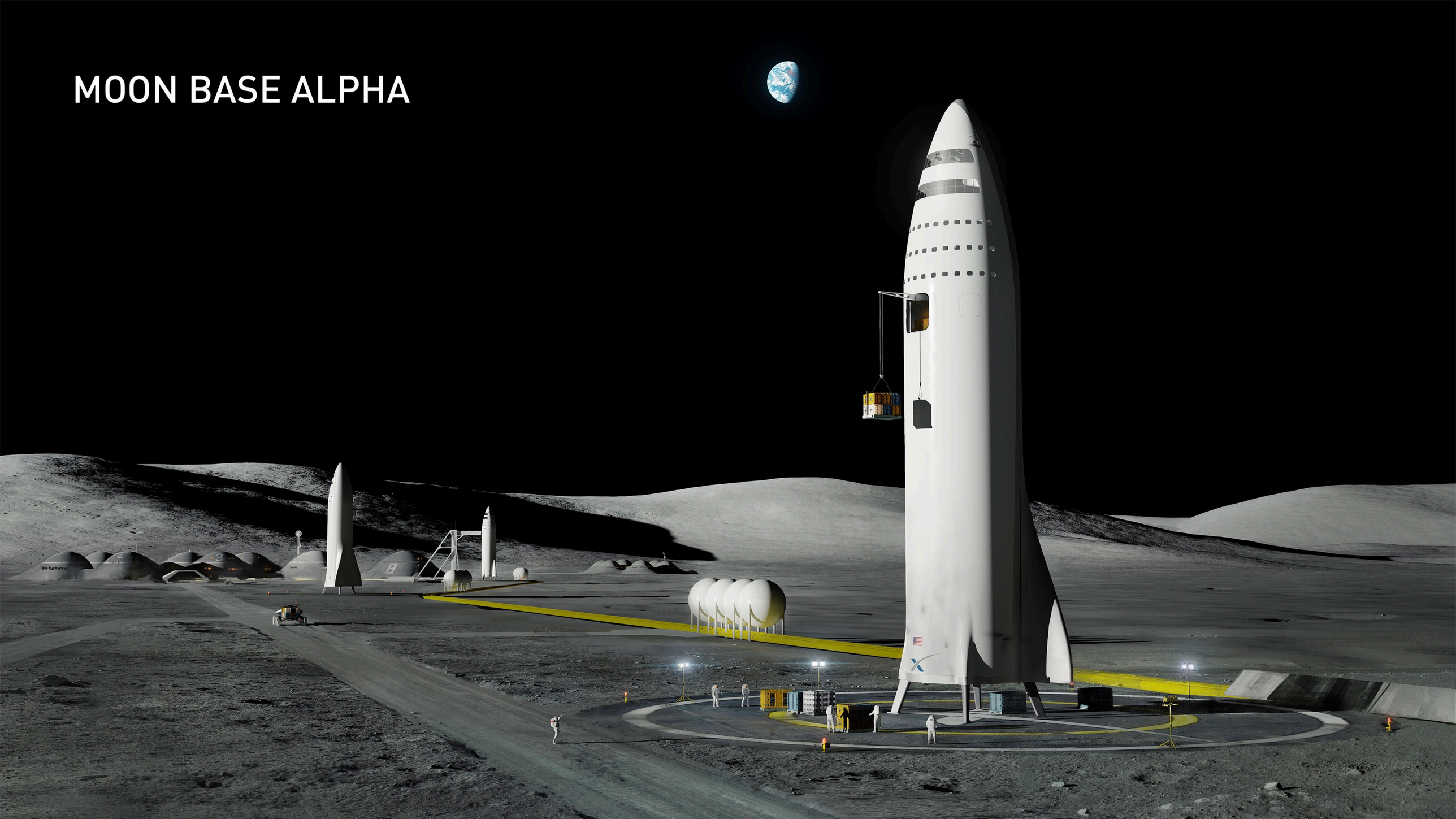
SATELLITES


INTERNATIONAL
SPACE STATION

LUNAR SURFACE MISSIONS

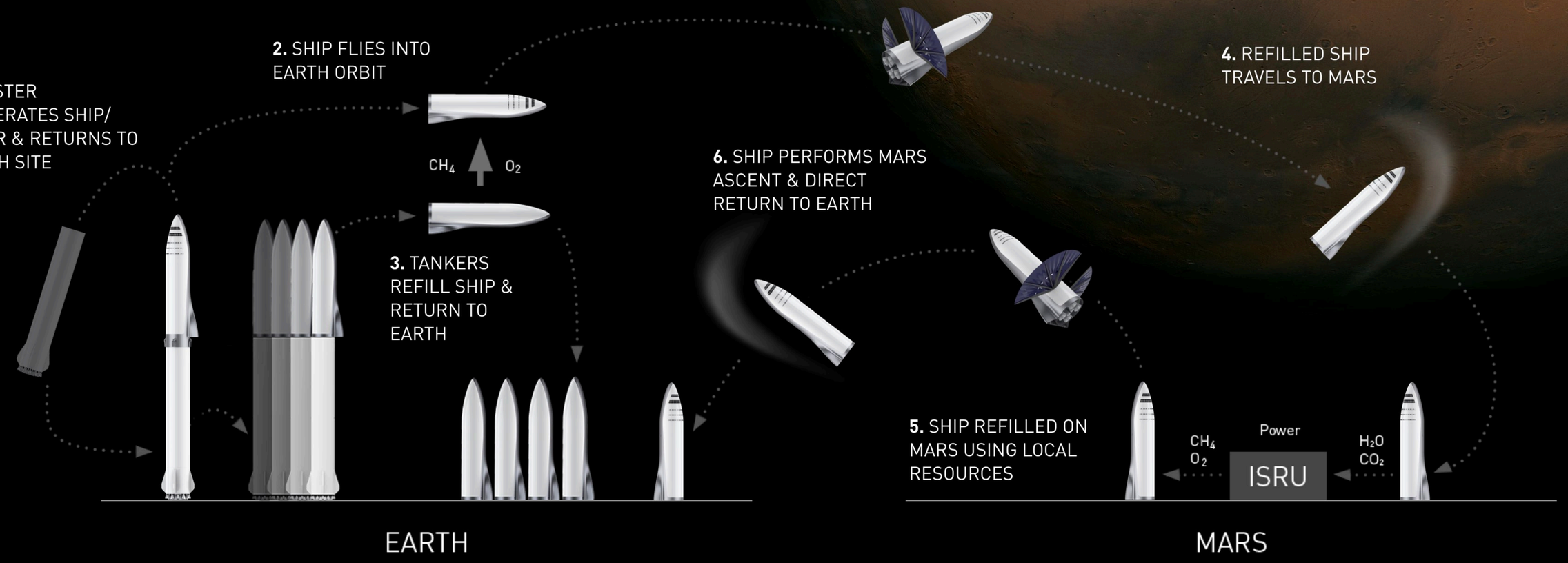


MOON BASE ALPHA



MISSIONS TO MARS

MARS TRANSPORTATION ARCHITECTURE



MARS ENTRY AND LANDING

Hyperbolic entry at up to 7.5 km/s

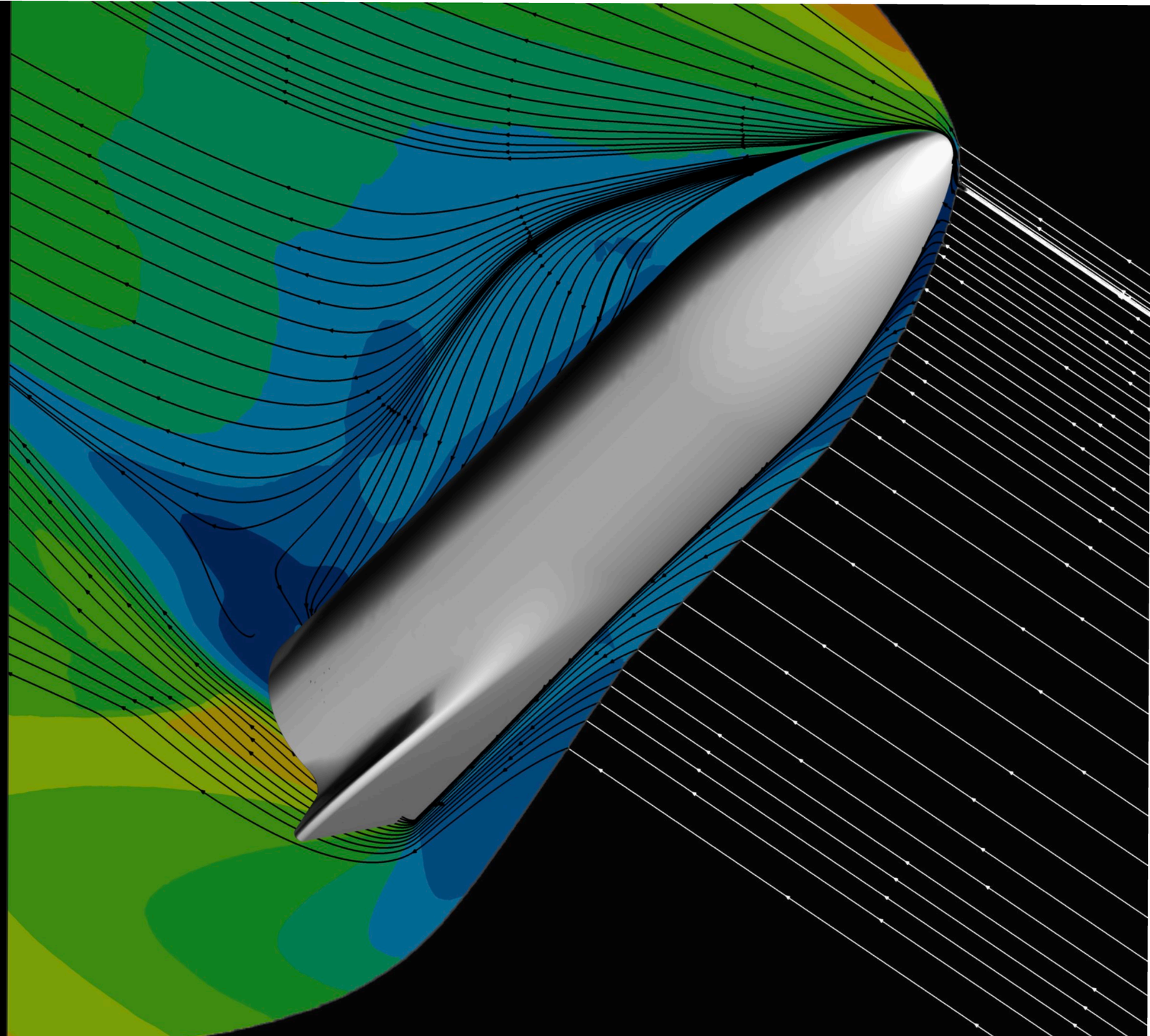
Leverages ablative heat shield materials developed for Dragon vehicles

Peak acceleration of 5 g's (Earth referenced)

Over 99% of energy removed aerodynamically

Supersonic retropropulsion for landing burn

WATCH ANIMATION



INITIAL MARS MISSION GOALS

2022: CARGO MISSIONS

Land at least 2 cargo ships on Mars

Confirm water resources and identify hazards

Place power, mining and life support infrastructure for future flights

2024: CARGO & CREW MISSIONS

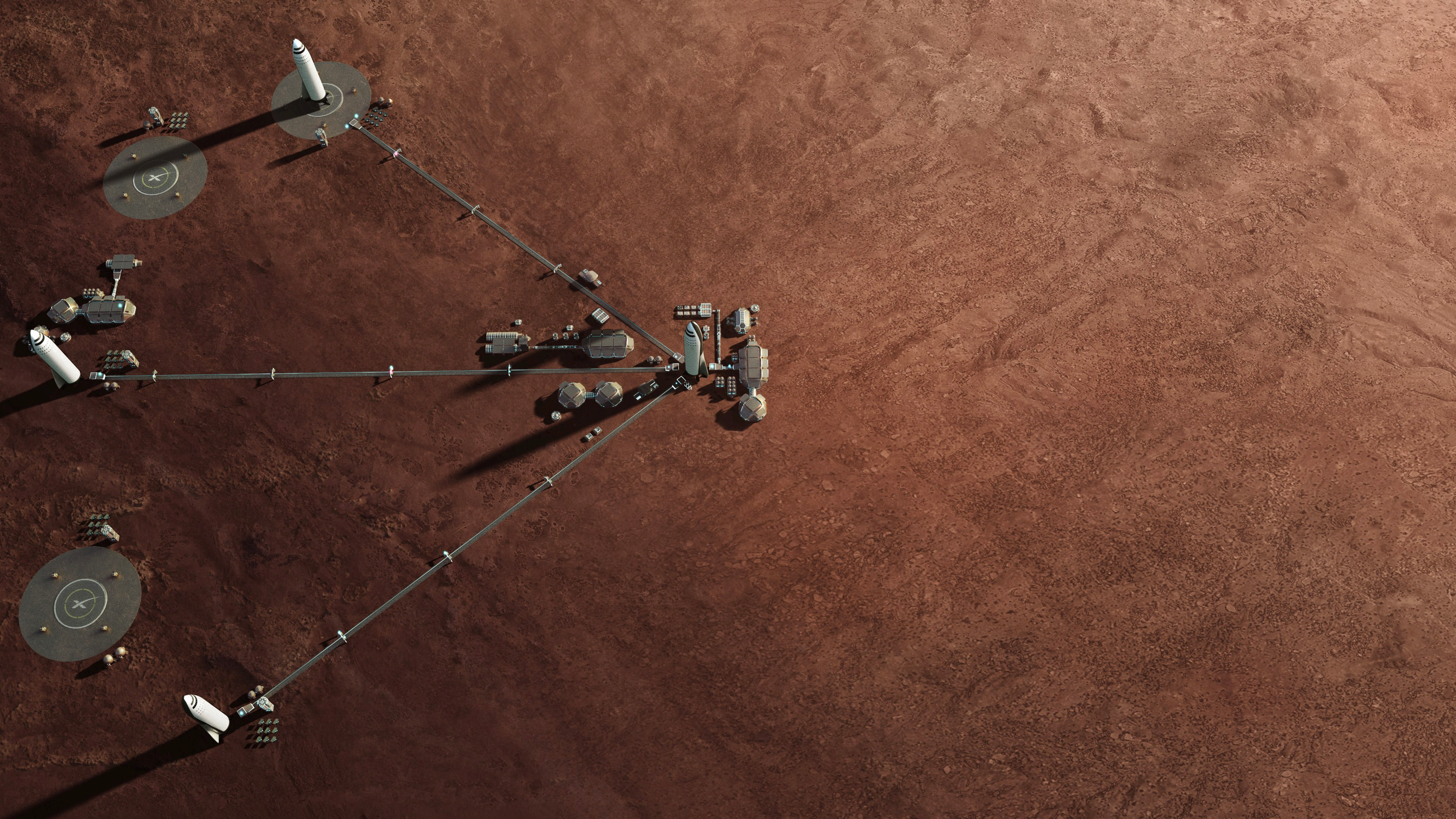
2 crew ships take first people to Mars

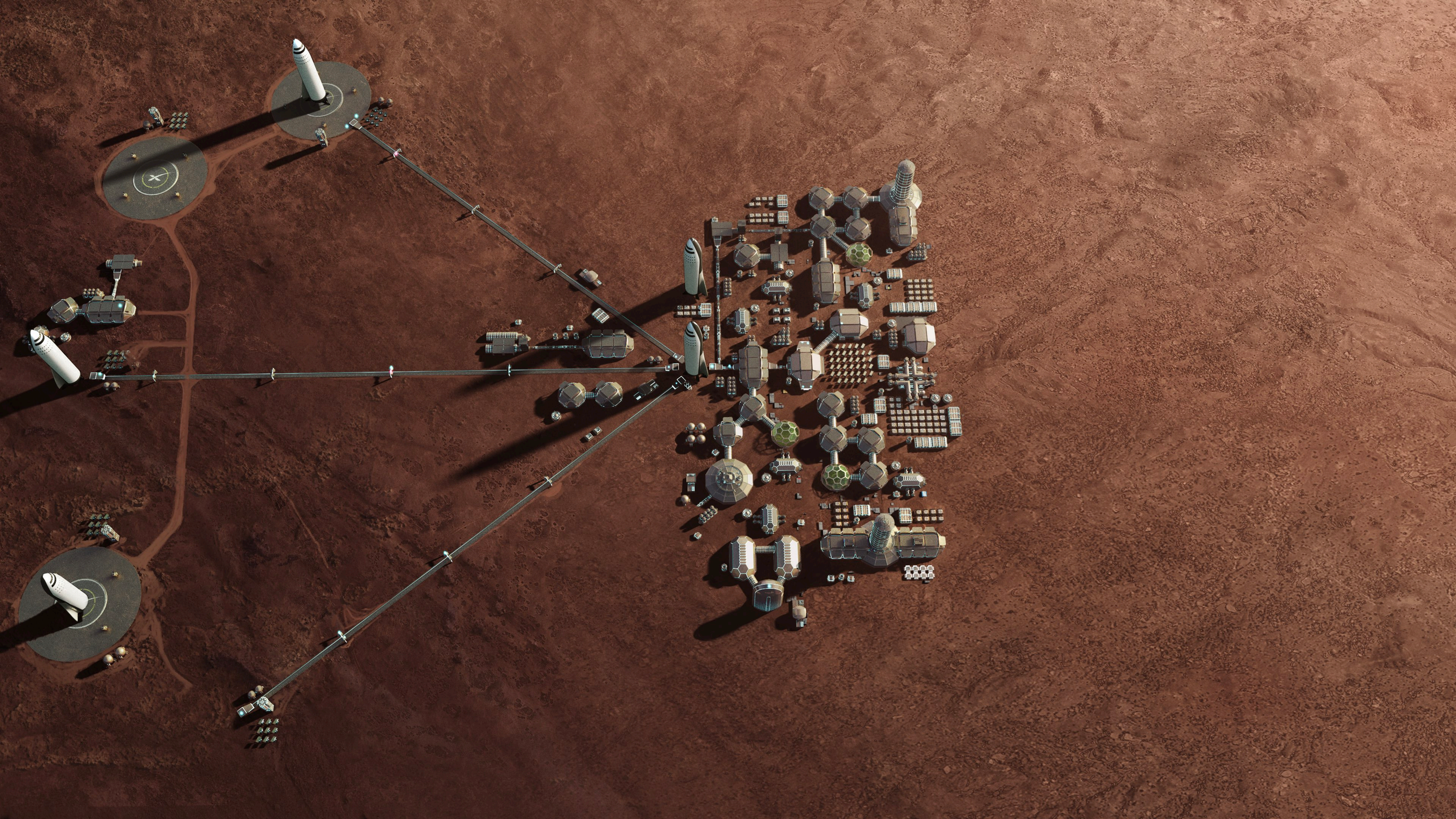
2 cargo ships bring more equipment and supplies

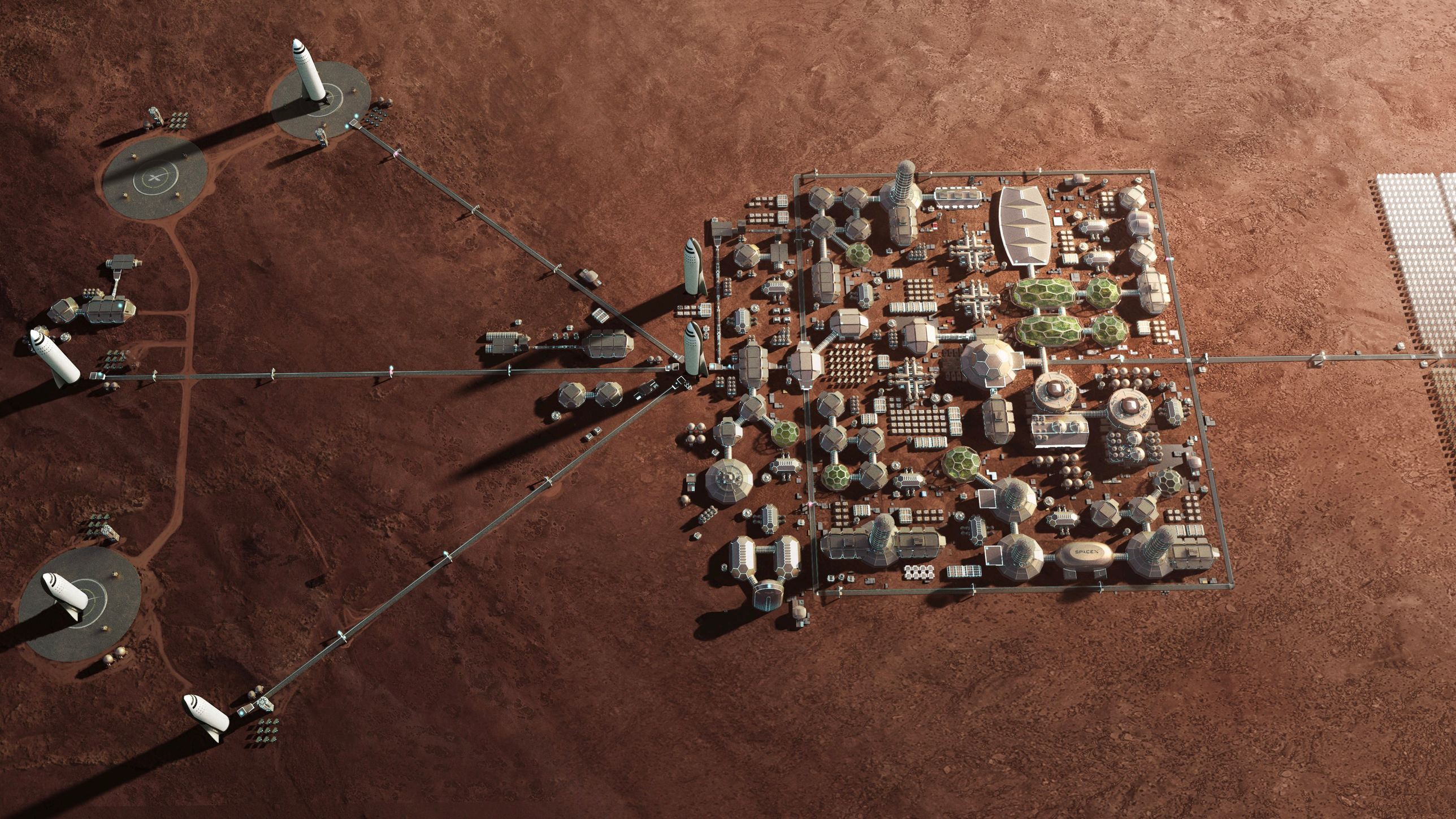
Set up propellant production plant

Build up base to prepare for expansion

BASE BUILDUP



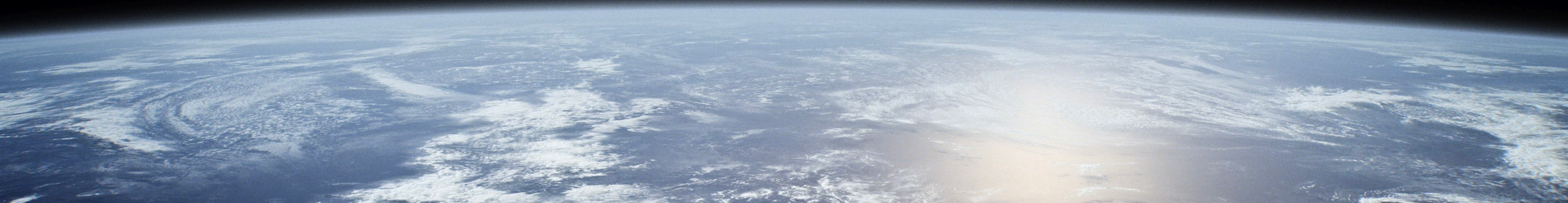



SPACEX

EARTH TO EARTH TRANSPORTATION

BFR has the ability to support Earth to Earth transport, with most of what people consider to be long distance trips being completed in less than half an hour.

Consider how much time we currently spend traveling from one place to another. Now imagine most journeys taking less than 30 minutes, with access to anywhere in the world in an hour or less.




WATCH EARTH TO EARTH FILM