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THE STARSHIP REPORT

A comprehensive look into SpaceX's next-generation launch vehicle.

PayloadResearch

TABLE OF CONTENTS

OVERVIEW OF SPACEX 03

OVERVIEW OF STARSHIP 09

INTEGRATED FLIGHT TESTS 18

IMPLICATIONS 22

INDUSTRY COMPS 26

COST ANALYSIS 27

STARLINK AND STARSHIP 32

HUMAN SPACEFLIGHT USE CASES 34

CONCLUDING THOUGHTS 35

OVERVIEW OF SPACEX



Founded by Elon Musk in 2002, SpaceX is a private American space transportation and services company that designs, manufactures, and launches rockets, spacecraft, and satellites. The company made history with the development of the first privately funded, liquid-propellant rocket to reach orbit (Falcon 1 in 2008), and later, the first privately developed spacecraft to dock with the International Space Station (Dragon in 2012).

SpaceX is not one to shy away from bold ambitions, and its overarching mission statement—“to make life multi-planetary”—exemplifies that ethos. By advancing the boundaries of current technology, SpaceX aims to develop the necessary infrastructure to support human life on Mars and further enhance our understanding of the universe. This objective is driven by SpaceX’s conviction that humanity’s long-term survival depends on our ability to colonize other planets and become a spacefaring civilization.

SpaceX’s relentless commitment to cost-cutting is one of the most important keys to its success. SpaceX lowers costs through rapid iteration, deleting all unnecessary components, returning to first principles, and taking advantage of a vertically integrated model that allows it to build most rocket and spacecraft components in-house. The company also pioneered launch reusability, which has reduced the cost per launch dramatically.

SpaceX is on a promising financial trajectory.¹ In 2022, SpaceX’s revenue doubled to \$4.6 billion, helping to reduce the company’s losses to \$559 million from a larger loss of \$968 million in 2021. The company is expected to have hit \$9 billion in revenues in 2023, primarily driven by its expanding Starlink and rocket launch operations. This figure is projected to grow to \$15 billion by 2024, with Starlink set to become the dominant revenue source (estimated to be \$10 billion).

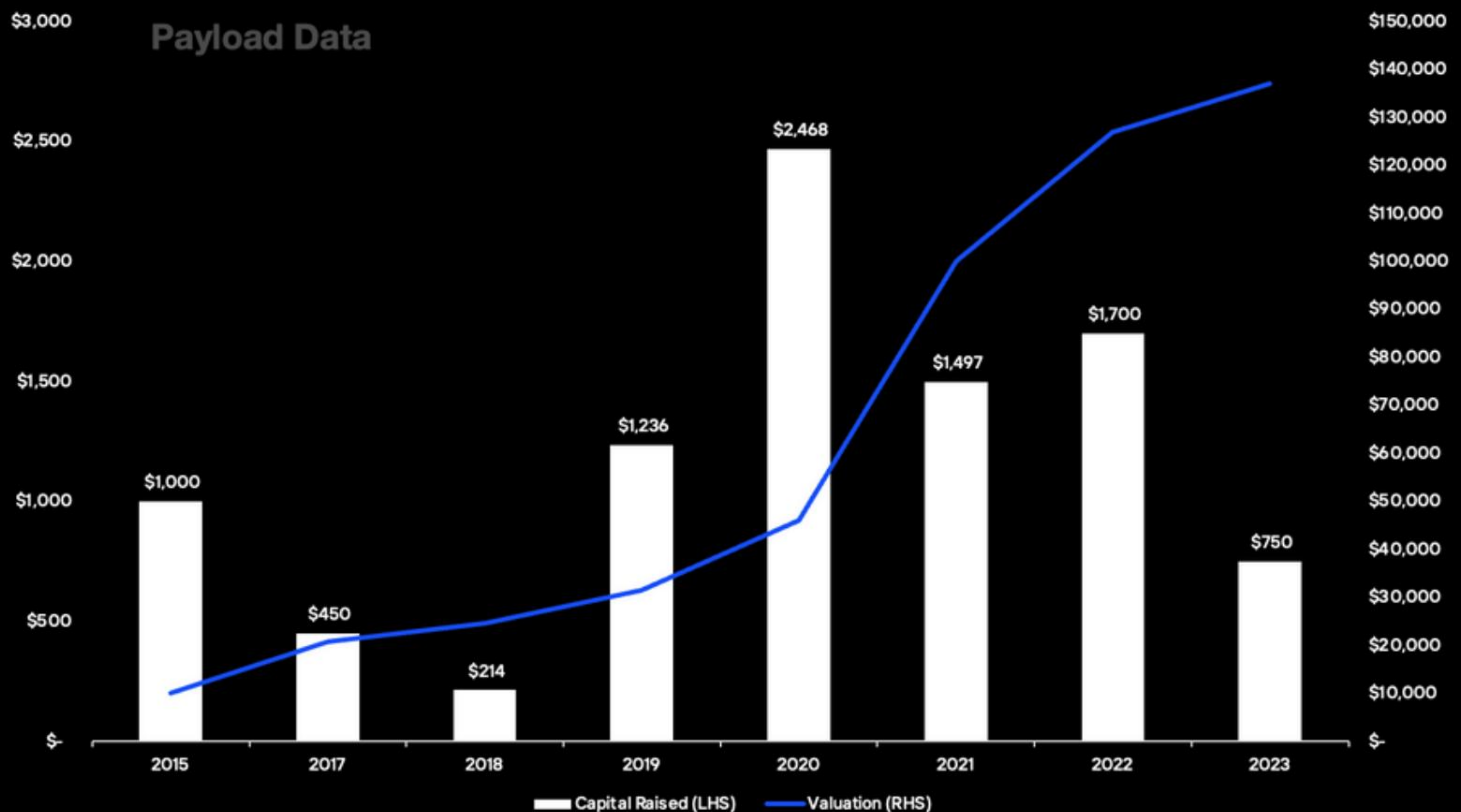
FUNDING

The early days of SpaceX were funded primarily through Elon Musk's personal fortune, amassed from the sale of his previous venture, PayPal. Musk invested approximately \$100 million into developing the Falcon 1 rocket.² SpaceX's first institutional funding round occurred in 2008, with Founders Fund investing \$20 million.

After its first successful launch in 2008, which followed three failures that nearly led to bankruptcy, SpaceX received its first Commercial Resupply Services (CRS) contract from NASA, a pivotal moment for the company. Subsequently, SpaceX shifted its focus to the Falcon 9 rocket, which first flew in 2010 and set the company on the path to commercial viability.

To date, SpaceX has raised over \$9B, according to Pitchbook, and is currently the second most valuable private company in the world, after China's ByteDance, the owner of the social media platform TikTok. SpaceX's most recent secondary transaction reportedly values the company at \$180B.³

SpaceX Annual Fundraise History Since 2015 (\$M)



Source: Pitchbook | 01.2024

Price is reflective of YE valuation based on primary rounds. This chart does not capture data prior to 2015 or valuations related to secondary transactions. SpaceX's first funding round took place in 2002.

BUSINESS LINES

SpaceX's three business lines: **Launch, Human Spaceflight, Starlink**

Launch Services

SpaceX is the leading launch service provider in the world, pioneering rapid flight cadence and reusable rockets. Since its first orbital launch success in September 2008, the company has launched nearly 300 successful missions.

The company offers various launch services, including dedicated launches, rideshare launches, crewed launches, and commercial resupply missions to the ISS via its Falcon family of rockets.

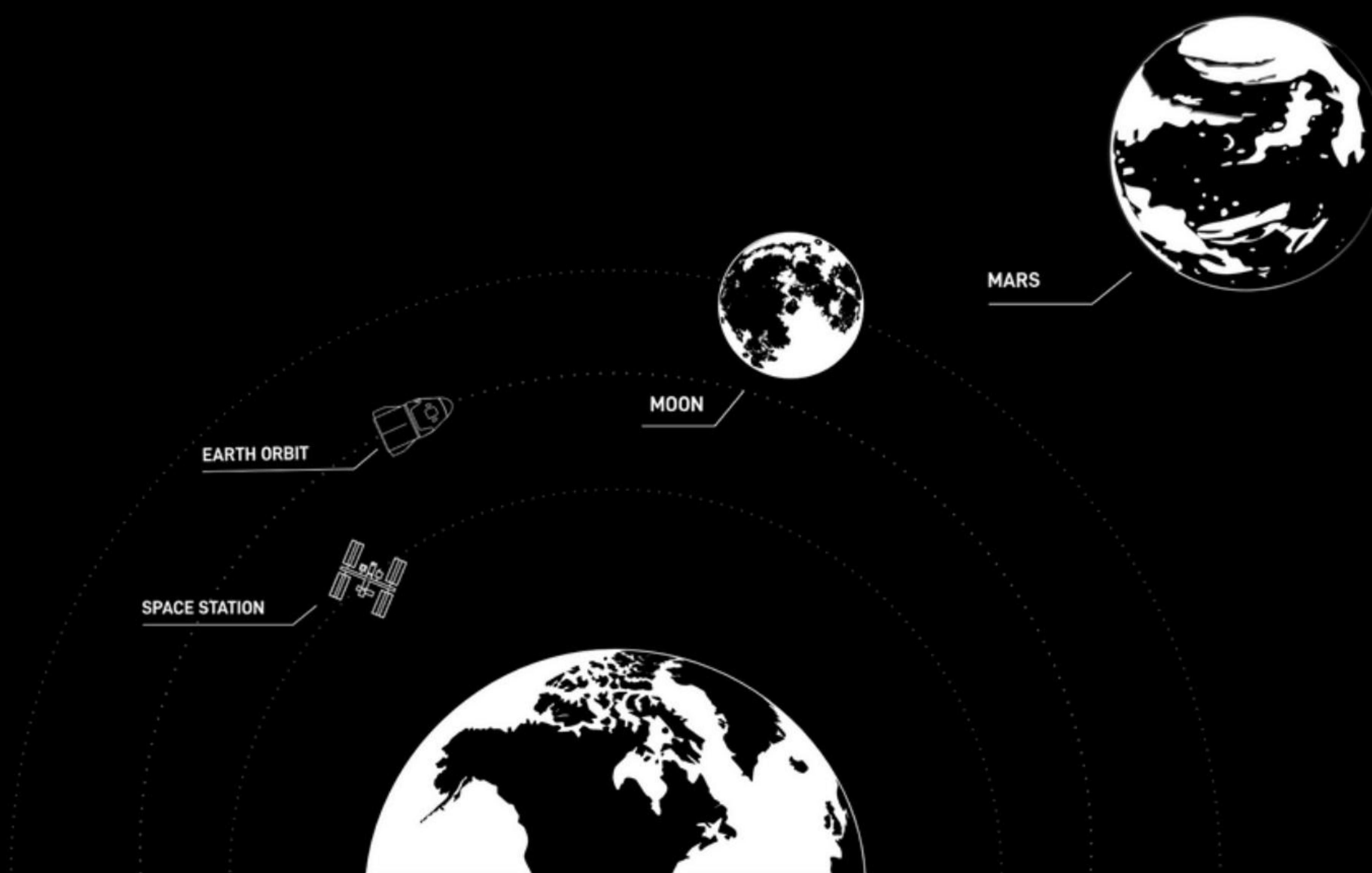
- Falcon 9: Falcon 9, a two-stage orbital-class launch vehicle, is engineered for transporting payloads and people to Earth's orbit and beyond. Notably, in 2015, it achieved a milestone by successfully returning its booster stage to Earth after a mission, setting new standards in rocket reusability and reliability. Powered by nine Merlin engines using rocket-grade kerosene (RP-1) and liquid oxygen (LOX) in a gas-generator cycle, Falcon 9 can lift up to 22,800 kg to Low Earth Orbit (LEO).
- Falcon Heavy: Falcon Heavy consists of three Falcon 9 cores, harnessing the thrust from 27 Merlin engines. As one of the world's most powerful operational rockets, Falcon Heavy can lift up to 63,800kg to LEO.
- Starship: Starship is SpaceX's next-generation launch vehicle. Once operational, Starship will be the most powerful launch vehicle ever developed, capable of carrying between 100 and 150 tons to LEO when the rocket is fully reusable and 250 tons when it's expendable. Starship is powered by 39 Raptor engines, which are fueled by methane-oxygen.

Human Spaceflight

In addition to these core revenue streams, SpaceX has secured contracts from NASA for crew missions to the International Space Station (ISS) and SpaceX has already sold a number of missions to space to private customers, including the Polaris Program to LEO and the dearMoon mission to travel around the Moon.

Until Starship becomes operational, SpaceX will rely on its Dragon spacecraft for human spaceflight missions. Dragon boasts the accolade of being the first privately-developed spacecraft to ferry humans to the space station.

Human Spaceflight Destinations (Current and Planned)



Starlink: Starlink provides low-latency broadband internet access with high data rates, utilizing Ka and Ku-band frequencies. The constellation offers persistent global coverage supported by optical laser crosslinks between each of the individual satellites to accelerate the downlink speeds to ground stations. Starlink has launched over 5,000 Starlinks to orbit.

SpaceX intends to deploy 12,000 Starlinks, potentially expanding to 42,000. As of Dec. 2023, the service boasted over 2.3M customers. Its user growth depends on the manufacturing cadence of user terminals, capacity per satellite, number of satellites launched, and market size.

- Starlink serves multiple customer segments, including Residential, RV, Business, Aviation, and Maritime. Pricing varies according to the customer segment, with upfront hardware costs ranging from \$599 (Residential) to \$150,000 (Aviation). US monthly subscription fees start at \$90-\$120 (Residential) and go up to \$12,500-\$25,000 (Aviation).
- SpaceX has stated that it intends to use the cash flow from the Starlink business to fund rocket development and broader human space exploration goals.

Starshield leverages SpaceX's Starlink technology and launch capability to support national security comms and intelligence efforts. In Sept. 2023, SpaceX nabbed a \$70M Space Force contract for Starshield services.

FACILITIES**Build Facility (Hawthorne, CA)**

SpaceX, which is vertically integrated, designs and assembles its Falcon 9 reusable rockets at its facility in Hawthorne, California.

Engine Testing Facility (McGregor, TX)

SpaceX operates its rocket development and testing site in McGregor, Texas. The 4,000-acre facility, equipped with 16 specialized test stands, is primarily used for engine testing.

Falcon 9 Launch Facilities

SpaceX conducts Falcon-family launches from Cape Canaveral/Kennedy Space Center, Florida, and Vandenberg Space Force Base, California.

- Kennedy Space Center LC-39A: The historic Launch Complex 39A was the home of the Apollo and Space Shuttle programs. LC-39A supports commercial satellite launches, space station resupply missions, and crew launches of the Dragon spacecraft. SpaceX is also in the process of building its Starship launch tower at this site. When Starship development and testing are complete, SpaceX will move some Starship launch capacity to this facility.

- Cape Canaveral SLC-40: Cape Canaveral allows access to low and medium inclination orbits. LC-40 supports geostationary orbits and lunar and interplanetary departures.
- Vandenberg SLC-4 East: LC-4 East, on the California coast, provides access to high inclination and polar orbits.



Starbase (Boca Chica, TX)

Most relevant to our report is Starbase, located in Boca Chica, TX. Starbase serves as SpaceX's primary site for developing and test-launching Starship. SpaceX broke ground on the facility in 2014 and had it up and running by 2019. In total, SpaceX has invested \$3B in the site infrastructure.⁴

Currently, all Starship test flights occur at Starbase. SpaceX is in the process of building a second pad to support a higher cadence.

Unlike other spaceports, Starbase neighbors a bustling commercial and touristic city. The launch pad is located near protected lands, 100 yards away from a publicly accessible beach,

and just four miles away from one of Texas' most popular tourist destinations, South Padre Island.

The proximity to populated areas and protected lands has posed a challenge for SpaceX and has led to increased regulatory oversight and community pushback. The long-term goal will be to split launch capacity with its Kennedy Space Center facility.

Mechazilla: Starbase's launch tower, dubbed Mechazilla, features two chopstick-like arms that lift the two rocket stages when they arrive at the pad. In the future, Mechazilla's arms will also catch the booster when it returns to the pad post-mission.