



Hydrogen & Hangs

June 17, 2020

Neal Bloom & Caitlin Wege

Background

Graduated UCSD in 2008 with a B.S. Mechanical Engineering

Started at Pratt & Whitney Rocketdyne in September 2008 as a Systems Engineer

Assigned to the Space Shuttle Main Engine from 2008-2011 and SLS from 2011-2013 as a Test & Launch Performance Engineer

Involved in 12 Space Shuttle launches & ~130 rocket engine tests

With Space Shuttle shutdown and layoffs in 2011-2012, co-founded Portfolium to help engineers



The Space Shuttle Main Engine

14 feet long, 8 feet diameter, and 8000 lbs in weight

500,000 lbs of thrust x3 engines and throttable (w/ SRBs - 7k lb thrust)

Liquid hydrogen (-420 deg F) & liquid oxygen (-340 deg F) combusts at 6000 deg F

Creates water vapor exhaust

Staged combustion, “two rocket engines” power the turbopumps

with hydrogen cooled nozzle

[Engine Startup Video](#)



Manned Space History

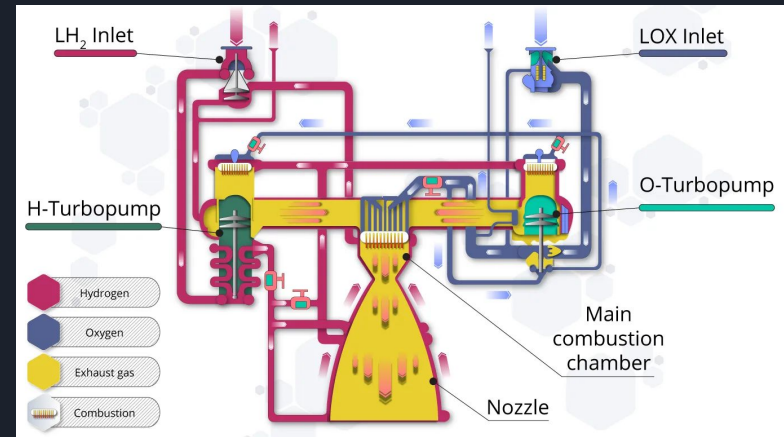
First Shuttle developed - 1969 and first manned launch 1981

SpaceX founded - 2002 and first manned launch 2020

First launch Falcon 1 - 2006, Falcon 9 - 2010

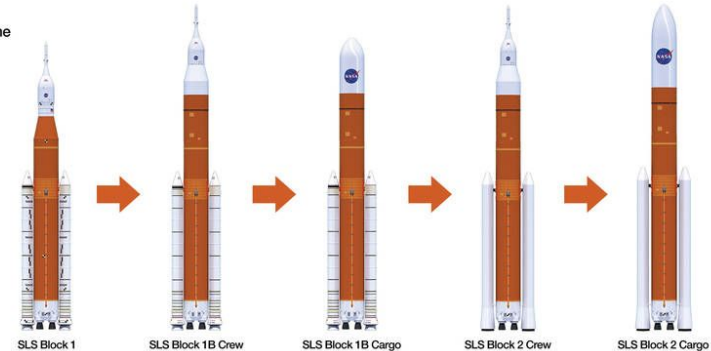
[Artemis Program](#) - Goal of landing first woman and next man on the moon by 2024

[RS-25 Test Video](#)



Payload to TLI/Moon	> 26 t (57k lbs)	34-37 t (74k-81k lbs)	37-40 t (81k-88k lbs)	> 45 t (99k lbs)	> 45 t (99k lbs)
Payload Volume	N/A*	10,100 ft ³ (286m ³)*	18,970 ft ³ (537 m ³)	10,100 ft ³ (286 m ³)*	31,950 ft ³ (905 m ³)

* Not including Orion/ Service Module volume



Maximum Thrust	8.8M lbs	8.8M lbs	8.8M lbs	11.9M lbs	11.9M lbs
----------------	----------	----------	----------	-----------	-----------

Politics of Space

NASA's budget ~\$20 billion

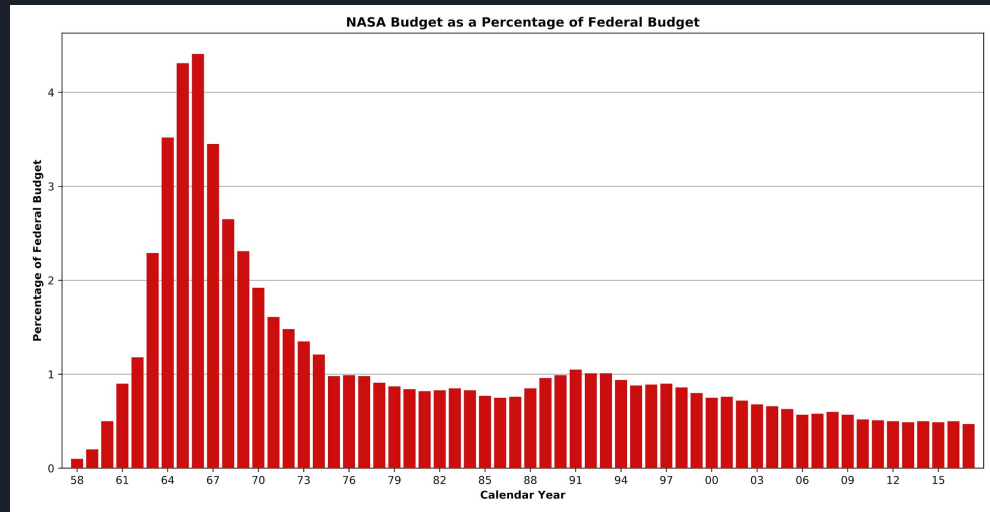
Change of mission - 10+ year development

Reusability - Complexity/versatility

Contractors & subcontractors vs. sole sourced

Geolocation of manufacturing

Impact of space program - tech transfer, education



NASA Dollars Boost the Economies of Every State in the U. S.



- All 50 states and the District of Columbia participated in NASA procurements in FY '03
- Grants and awards went to various educational institutions and non-profit organizations in 50 states and the District of Columbia

Investing in Space

TAM increasing from government only-focused to commercial economy, \$400 B now to \$10 T by 2040

SpaceX funding - \$3.2 B for \$33 B valuation, 1st raise was \$60 M in 2002, outside of Musk's capital

Rocket Lab - \$215 M in funding



Today/tomorrow's space challenges to invest in:

Satellites, refueling, etc

Orbital debris removal/cleanup

In space propulsion

In space GPS

Radiation protection

Questions?

Contact

Neal@freshbrewedtech.com

