DEVELOPMENTS DURING THE SPACE AGE

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28th November 2024

“Examining the factors that contribute to fast technological developments during the space age”

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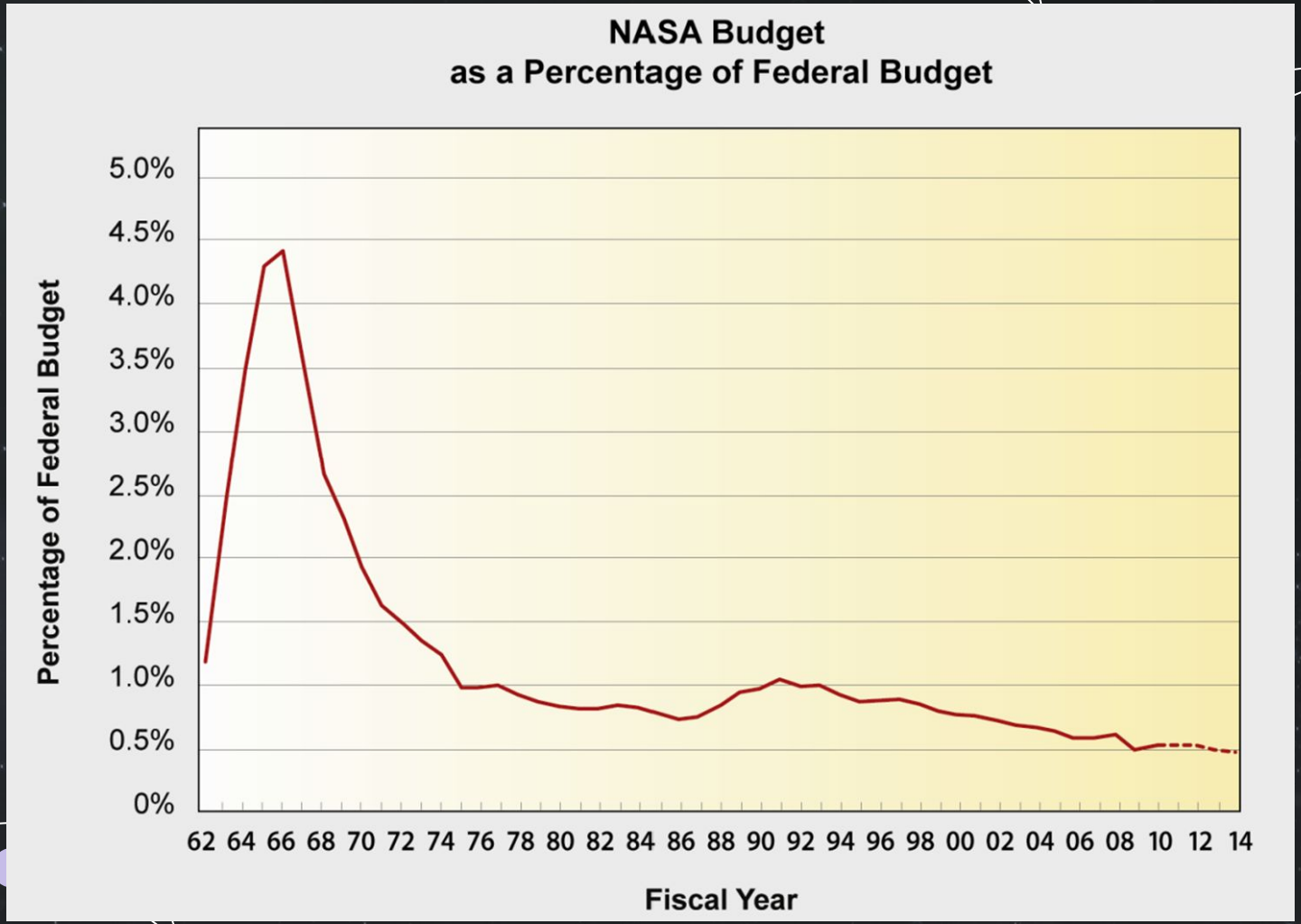
01

Foundations

Politics

- *"States as Actors with Strategic Interests"*
- Cold War Rivalry
- National Prestige
- Military Interests


NASA Budget
as a Percentage of Federal Budget
Percentage of Federal Budget
5.0%
4.5%
4.0%
3.5%
3.0%
2.5%
2.0%
1.5%
1.0%
0.5%
0%
62 64 66 68 70 72 74 76 78 80 82 84 86 88 90 92 94 96 98 00 02 04 06 08 10 12 14
Fiscal Year

Benefits Stemming from Space Exploration

Clicker Question:

"Benefits Stemming from Space Exploration"

a.) The (level of) financial investments make sense and the research has a big impact on earth

b.) The research is still important but has little impact on our daily lives

c.) The space exploration doesn't take us any further and the money can be better invested elsewhere

d.) I don't know

Benefits Stemming from Space Exploration

- Website dedicated to spinoffs of NASA technology: https://spinoff.nasa.gov

1. Innovation: Contributions to everyday life: Solar panels, heart monitors, lightweight materials, water purification
2. Culture and Inspiration
3. New Means to Address Global Challenges

Space as International Domain

- Actors
- United Nations for Outer Space Affairs (UNOOSA): https://www.unoosa.org
- International *Space Law*

  - Outer Space Treaty 1967

- Legal Frameworks

Space as International Domain

- Challenges
  - Space Debris
  - Militarization
  - New Space Race
  - Commercialization

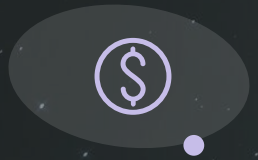
02

SHIFT TO PRIVATE ACTORS

INTEREST OF PRIVATE ACTORS

#1

Deepen humanity's understanding of the universe



#2

Money.

#3

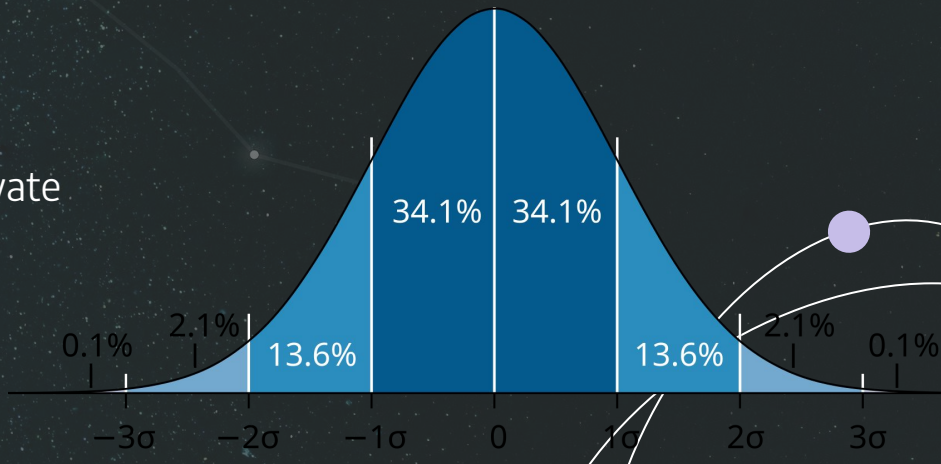
Market Control

COMMERCIALISATION

The Commercial Space Launch Act was enacted into law in 1984 by the Reagan administration.

- Expected casualty analysis
- System Safety Process
- Operating restrictions

Mandates NASA to encourage the entry of private enterprise into space launch.



SPACEX

Founded in 2002 multi-billionaire Elon Musk with a vision to put human colonies on Mars.

They were the first to innovate a partially reusable rocket which reduced the cost of spaceflight dramatically.

Leading launch provider in the world with 84% of spacecraft launches performed by SpaceX.

Estimated by Sacra to generate $8.7 billion in revenue. Reportedly made a profit of $55 million in Q1 of 2023.

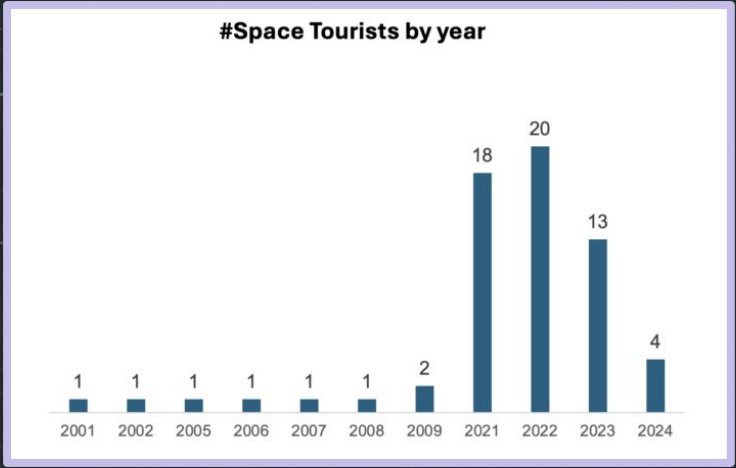
Starlink, a satellite internet company and subsidiary of SpaceX broke even in 2023, and likely is profitable in 2024.

SPACE TOURISM

An amendment to the Commercial Space Launch Act in 2004 allowed paying passengers onto suborbital space vehicles at their own risk.

In 2001, Dennis Tito became the first space tourist aboard the Russian Soyuz-TM32.

Since then there have been 63 others like him, experiencing space flight as a tourist.



BLUE ORIGIN

Founded in 2000 by another multi-billionaire Jeff Bezos. Sustained by his private investment fund up until 2015.

Recently sent 6 individuals to space, totalling 47 by Blue Origin. Accounts for ~77% of space tourists in modern years.

The New Shepard, their suborbital launch vehicle designed for space tourism is 99% reusable.

More secretive about their work, harder to make estimates on their revenue.

Competing unsuccessfully against SpaceX as a space launch provider.

Space tourism lacks demand due to its high price even with nearly full reusability.

03

Current and Future Space Missions

A FEW CURRENT MISSIONS

JUPITER

- JUICE
- JUNO

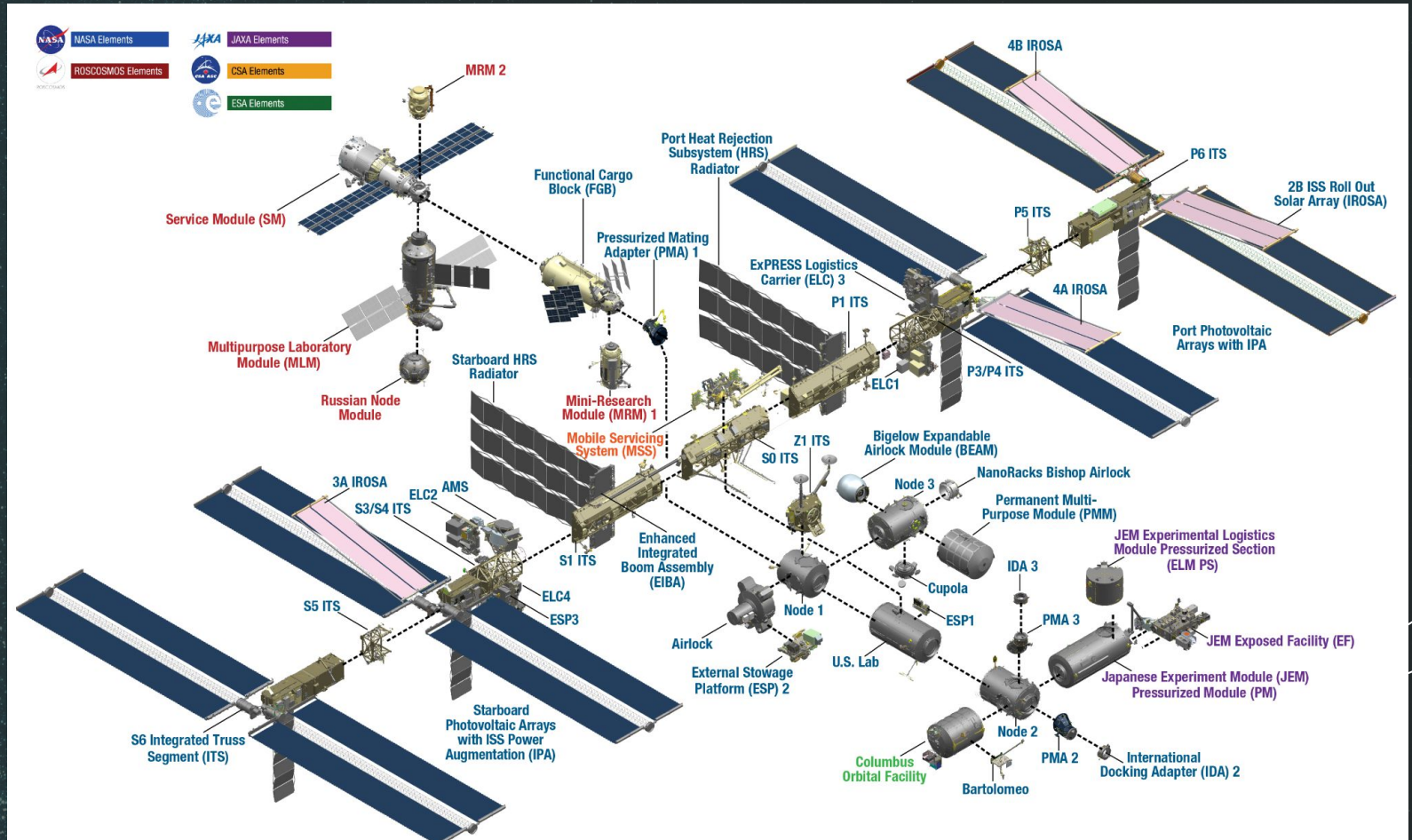
MARS

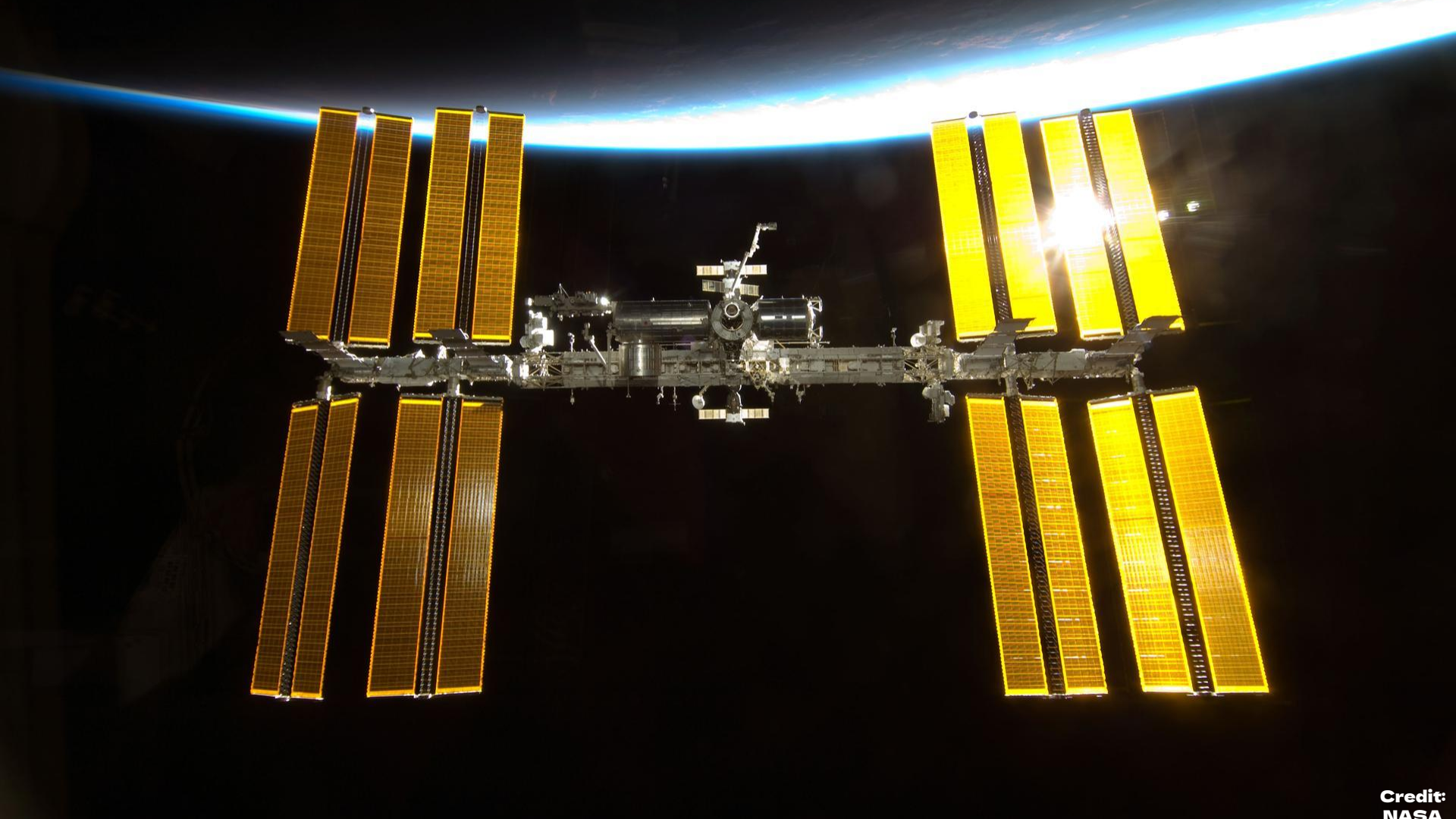
- 2001 Mars Odyssey
- Emirates Mars Mission

MERCURY

- BepiColombo

ASSEMBLY OF THE ISS



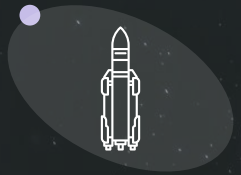


Credit: NASA

Privatization: What's the incentive?

Space Tourism

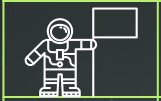
Is it viable yet?



Cargo Transportation

Private contracts
Already seen in current missions

FUTURE MISSIONS

	Artemis II and III (2025 and 2026): Landing on south pole of moon
	VERITAS (2031): Study interior evolution and surface of Venus
	Comet Interceptor (2029): 3D renders of as-yet undiscovered comets
	DAVINCI (2029): Deep atmosphere investigation on Venus
	Dragonfly (2027): Landing on Titan for habitability testing
	EnVision (2030s): Deep core exploration of Venus

Conclusion

- Politics
- Benefits
- Private Actors
- Commercialisation
- Mission
- The Future

Thank you for your attention

Do you have any question?

References

Aglietti, G. S. (2020). Current Challenges and Opportunities for Space Technologies. *Frontiers in Space Technologies*, *1*. https://doi.org/10.3389/frspt.2020.00001

AS 2100. (n.d.). Retrieved 8 December 2024, from http://www.astronautix.com/a/as2100.html

Ben-Itzhak, S. (2022). *The Future of Space Technology and How It May Benefit Humanity*.

BepiColombo—NASA Science. (n.d.). Retrieved 27 November 2024, from https://science.nasa.gov/mission/bepicolombo/

Blue Origin launches 6 passengers into space for its ninth tourism flight. (2024, November 22). KSBY News. https://www.ksby.com/blue-origin-launches-6-passengers-into-space-for-its-ninth-tourism-flight

Commercial Lunar Payload Services – Artemis. (2024, February 28). NASA. https://blogs.nasa.gov/artemis/tag/commercial-lunar-payload-services/

FAQs: The International Space Station Transition Plan—NASA. (n.d.). Retrieved 27 November 2024, from https://www.nasa.gov/faqs-the-international-space-station-transition-plan/

Grillo, A. (2024, April 16). *Low Earth Orbit (LEO): An Overview*. Deep InSecurity. https://www.deepinsecurity.com/low-earth-orbit/

History of technology—Perceptions, Impact, Evolution | Britannica. (2024, October 23). https://www.britannica.com/technology/history-of-technology/Perceptions-of-technology

Home | NASA Spinoff. (n.d.). Retrieved 27 November 2024, from https://spinoff.nasa.gov/

International Space Station—NASA. (n.d.). Retrieved 27 November 2024, from https://www.nasa.gov/international-space-station/

Jones, H. W. (2018, July 8). *The Recent Large Reduction in Space Launch Cost*. International Conference On Environmental Systems, Inc., Stafford Springs, CT, United States. https://ntrs.nasa.gov/citations/20200001093

Kring, D. A. (n.d.). *NASA Budget History*. https://www.lpi.usra.edu/exploration/multimedia/NASABudgetHistory.pdf

Lafleur, A. (2024, May 17). The Rise of Space Tourism: From Tito to Bezos and Beyond. *Space Insider*. https://spaceinsider.tech/2024/05/17/the-rise-of-space-tourism-from-tito-to-bezos-and-beyond/

Legislation & Policies, Regulations & Guidance | Federal Aviation Administration. (n.d.). Retrieved 8 December 2024, from https://www.faa.gov/space/legislation_regulation_guidance

NASA's Artemis IV: Building First Lunar Space Station—NASA. (n.d.). Retrieved 27 November 2024, from https://www.nasa.gov/general/nasas-artemis-iv-building-first-lunar-space-station/

NATO. (n.d.). *NATO's approach to space*. NATO. Retrieved 27 November 2024, from https://www.nato.int/cps/en/natohq/topics_175419.htm

New Shepard. (n.d.). Blue Origin. Retrieved 8 December 2024, from https://www.blueorigin.com/new-shepard

Normal distribution: Definition, pdf, properties with applications. (2018, November 18). *Statistical Aid: A School of Statistics*. https://www.statisticalaid.com/normal-distribution-definition-exampleproperties-applications-and-special-cases/

SpaceX - Falcon 9. (n.d.). Retrieved 8 December 2024, from https://www.spacex.com/vehicles/falcon-9/

The New Space Race | Power & Politics in 21st Century. (n.d.). Retrieved 27 November 2024, from https://www.rmg.co.uk/stories/topics/new-space-race-astropolitics-power-21st-century

United Nations Office for Outer Space Affairs. (2018). *International Space Law: United Nations Instruments*. United Nations. https://doi.org/10.18356/014c0e55-en

UNOOSA. (n.d.). Retrieved 27 November 2024, from https://www.unoosa.org/

Image References

International Space Station—NASA. (n.d.). Retrieved 27 November 2024, from https://www.nasa.gov/international-space-station/

Kring, D. A. (n.d.). NASA Budget History. https://www.lpi.usra.edu/exploration/multimedia/NASABudgetHistory.pdf

NASA's Artemis IV: Building First Lunar Space Station—NASA. (n.d.). Retrieved 27 November 2024, from https://www.nasa.gov/general/nasas-artemis-iv-building-first-lunar-space-station/

Normal distribution: Definition, pdf, properties with applications. (2018, November 18). *Statistical Aid: A School of Statistics*. https://www.statisticalaid.com/normal-distribution-definition-exampleproperties-applications-and-special-cases/