Climate action and growing electricity demand

meeting both challenges in the 21st century with space-based solar power delivered by space elevator

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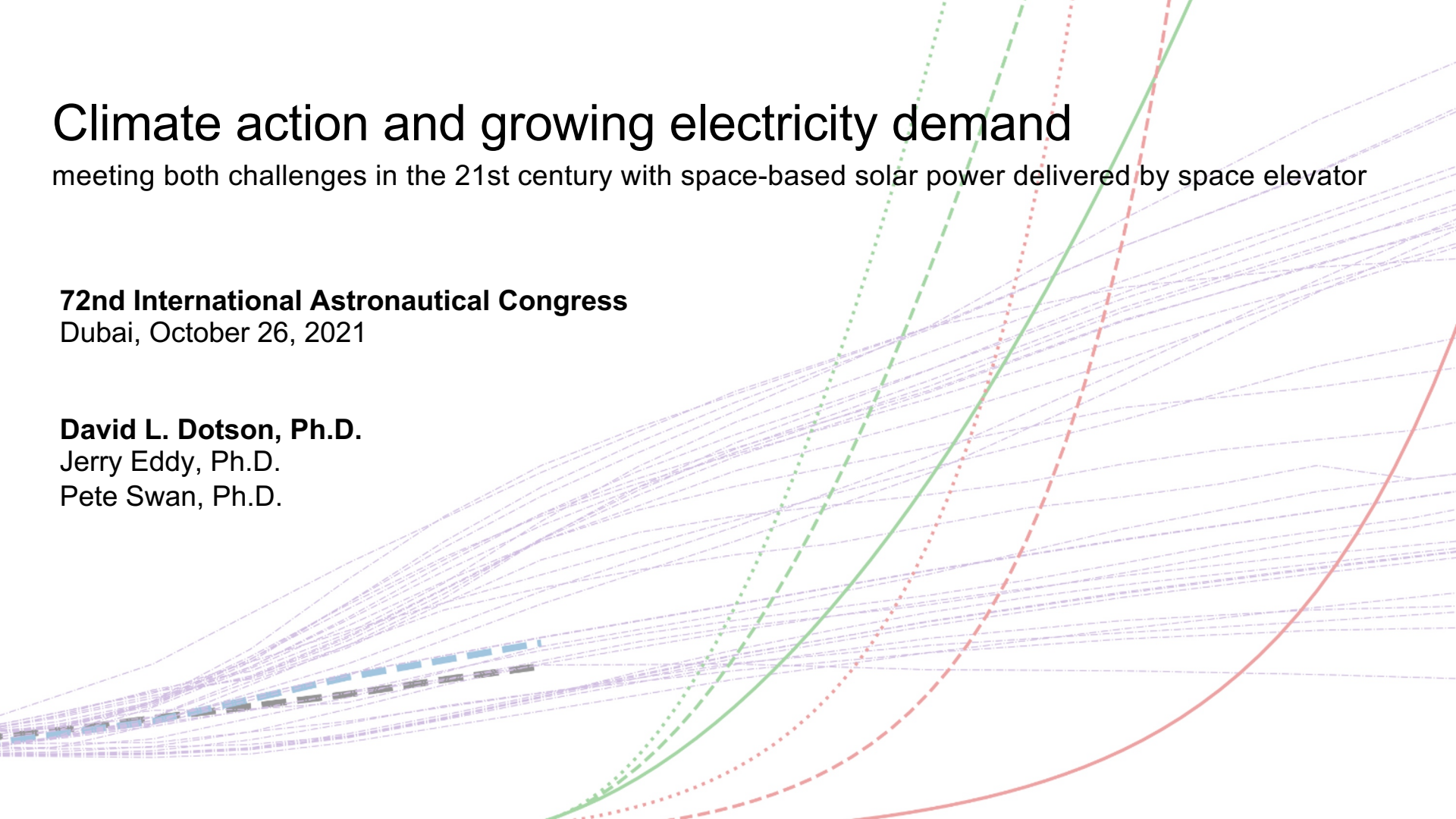


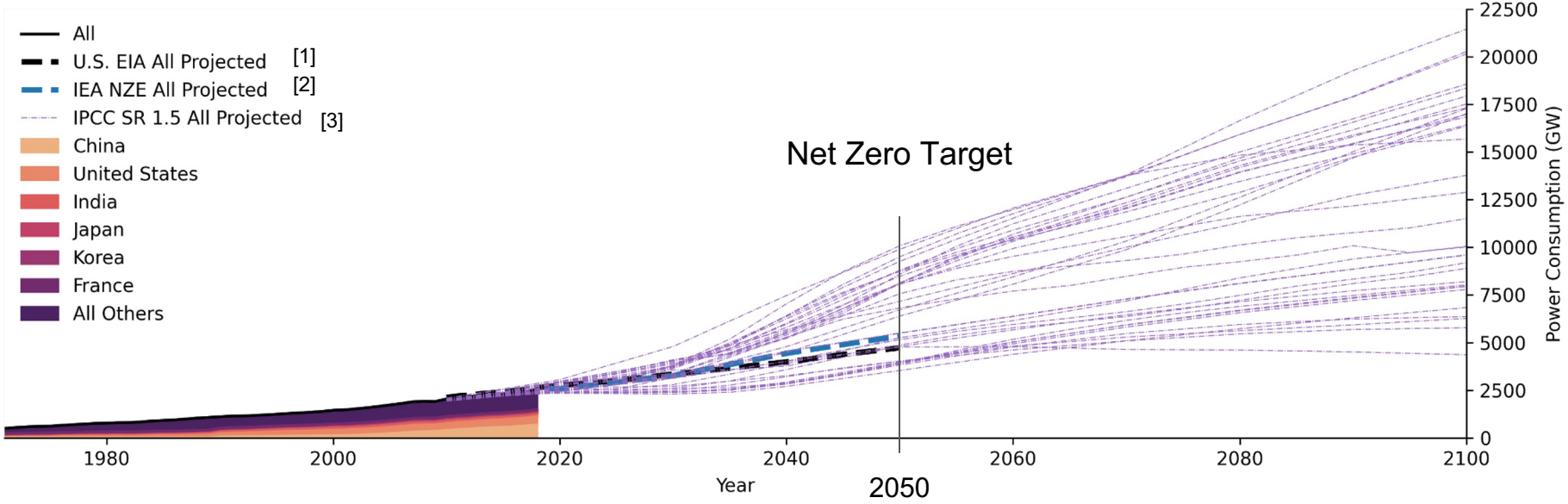
Renewables and electrification are key components for climate action

“Renewable energy technologies like solar and wind are the key to reducing emissions in the electricity sector, which is today the single largest source of CO2 emissions.”

“As electricity generation becomes progressively cleaner, electrification of areas previously dominated by fossil fuels emerges as a crucial economy-wide tool for reducing emissions. This takes place through technologies like electric cars, buses and trucks on the roads, heat pumps in buildings, and electric furnaces for steel production.”

International Energy Agency, “Net Zero by 2050”, Special Report, Paris, May 2021. https://www.iea.org/reports/net-zero-by-2050

Global electricity demand is expected to rise substantially this century

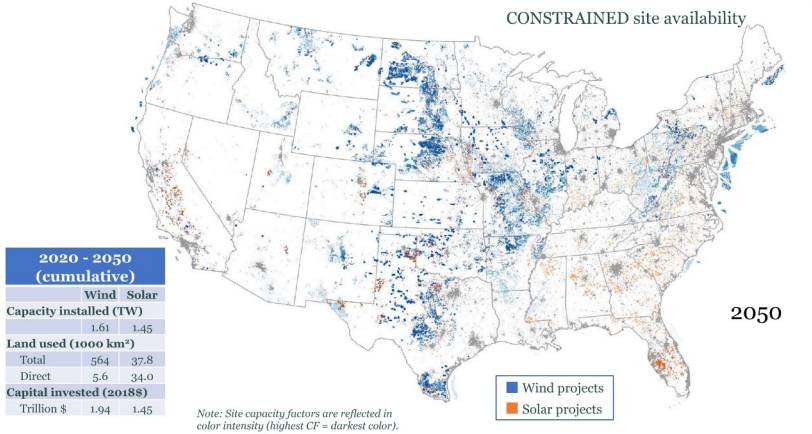


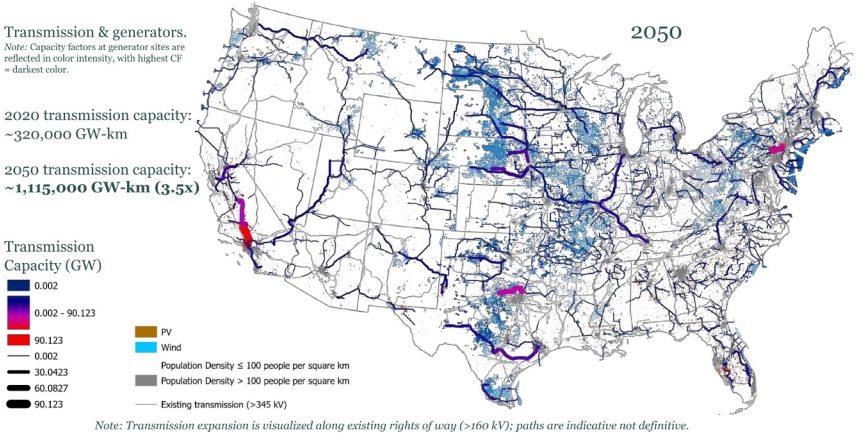
[1] Office of Energy Analysis, “International Energy Outlook 2019,” U.S. Department of Energy, Energy Information Administration, Sep. 2019. https://www.eia.gov/ieo

[2] International Energy Agency, “Net Zero by 2050”, Special Report, Paris, May 2021. https://www.iea.org/reports/net-zero-by-2050

[3] Joeri Rogelj, Drew Shindell, Kejun Jiang, et al. Mitigation pathways compatible with 1.5°C in the context of sustainable development, in "Special Report on Global Warming of 1.5°C (SR15)". Intergovernmental Panel on Climate Change, Geneva, 2018. url: http://www.ipcc.ch/report/sr15/

High deployment of renewables and electrification in the U.S.





"Total area spanned by onshore wind and solar farms is ~590,000 sq-km, ***an area roughly equal to the size of IL, IN, OH, KY, TN, MA, CT and RI put together****. Offshore wind farms span 33,000 sq-km."*

3.5x transmission capacity increase to deliver power from where it is generated to where it is needed.

J. Drossman et al., "Net-Zero America: Potential Pathways, Infrastructure, and Impacts." Princeton University. Dec. 2020. https://netzeroamerica.princeton.edu

SSP is a renewable energy source suitable for high electrification

Efforts underway in the U.S., U.K., China, Japan, Korea, and Australia in pursuit of SSP, with widely varying levels of activity.

Recent policy and timeline drives:

- Space Energy Initiative in the U.K.
- NSS and Beyond Earth legislative push in the U.S.
- Solar Space Technologies in Australia

SSP addresses the concerns of **intermittency**, **land use**, and **transmission** presented by terrestrial solar and wind.

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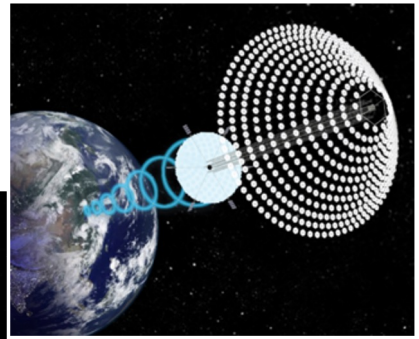

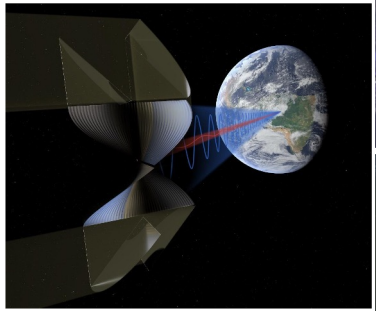

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[1] J. C. Mankins, “New Developments in Space Solar Power,” *NSS Space Settlement*, no. 3, Dec. 2017, Accessed: Mar. 12, 2020. [Online]. Available: https://space.nss.org/media/NSS-JOURNAL-New-Developments-in-Space-Solar-Power.pdf

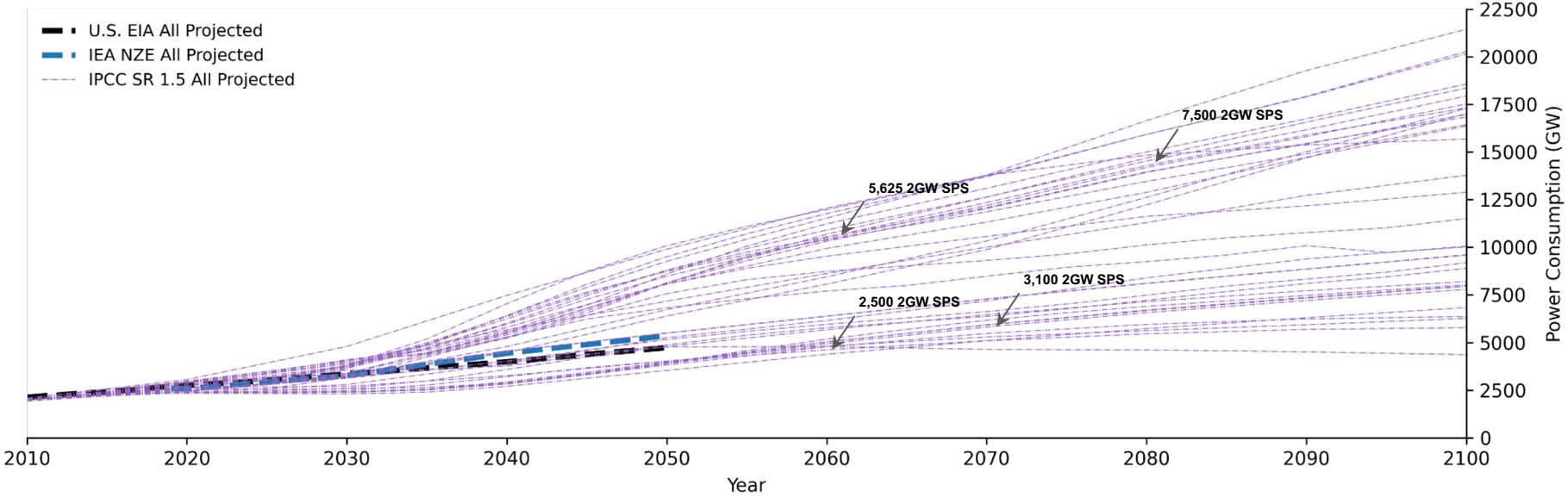
[2] I. Cash, “CASSIOPeiA – A new paradigm for space solar power,” *Acta Astronautica*, vol. 159, pp. 170–178, Jun. 2019, doi: 10.1016/j.actaastro.2019.03.063.

[3] H. Xinbin *et al.*, “Multi-Rotary Joints SPS,” *Online Journal of Space Communication*, vol. 2016, no. 18, 2016.

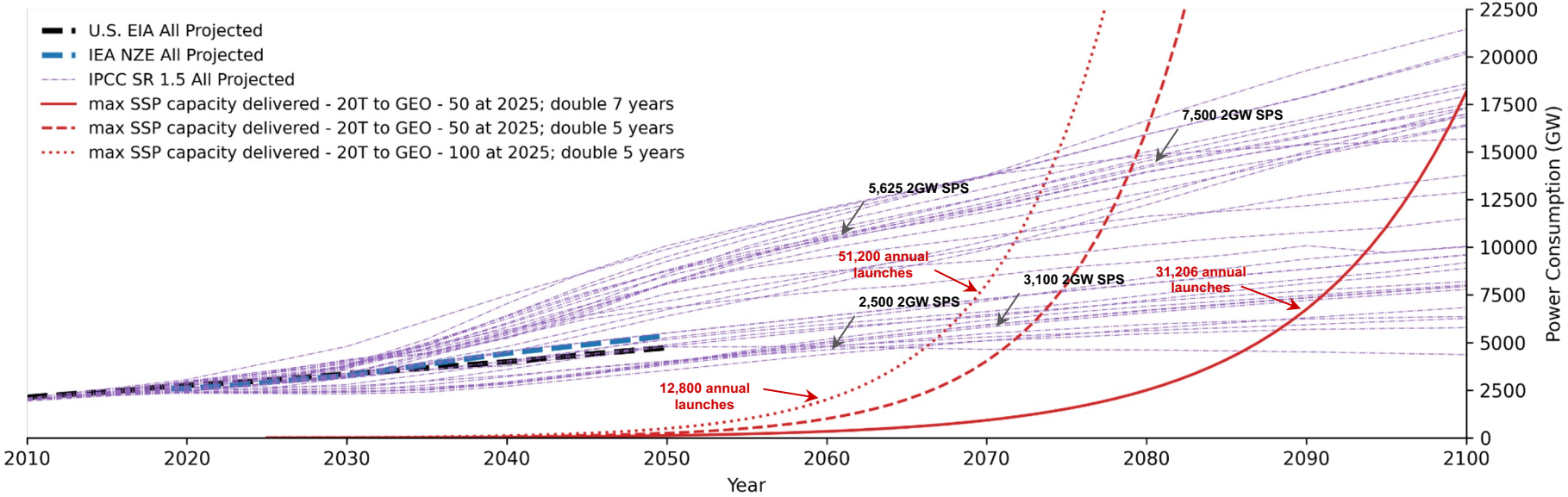
Can SSP be part of the solution to climate action, electricity demand?

Yes, but **throughput** is key.

Scale is required to meet electricity demand beyond 2050



Rockets can deliver the first SSP systems, but may struggle to scale

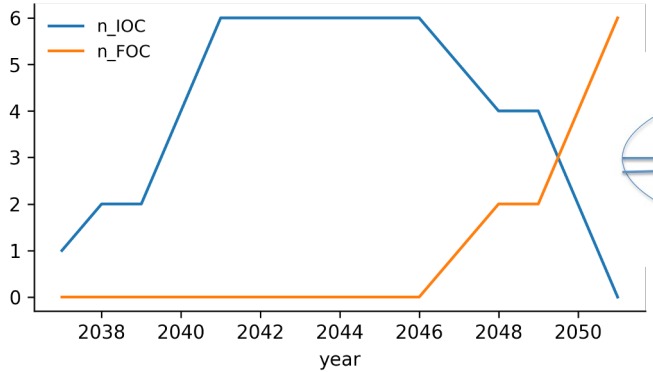


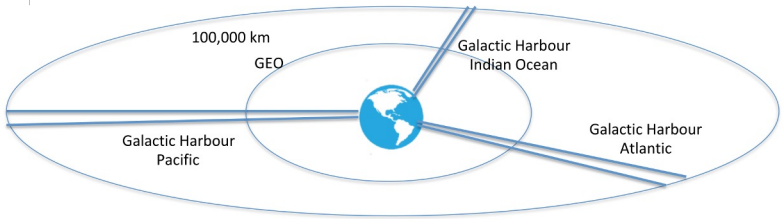
Space elevators offer an enticing alternative to rockets for SSP scale

Proposals from the **International Space Elevator Consortium (ISEC)** and **Obayashi Corporation**, aiming for production systems in place by 2050.

The ISEC proposal gives six (6) elevators by 2050, with the first deployed at initial operating capacity (IOC) by 2037. All elevators are converted to full operating capacity (FOC) by 2050.

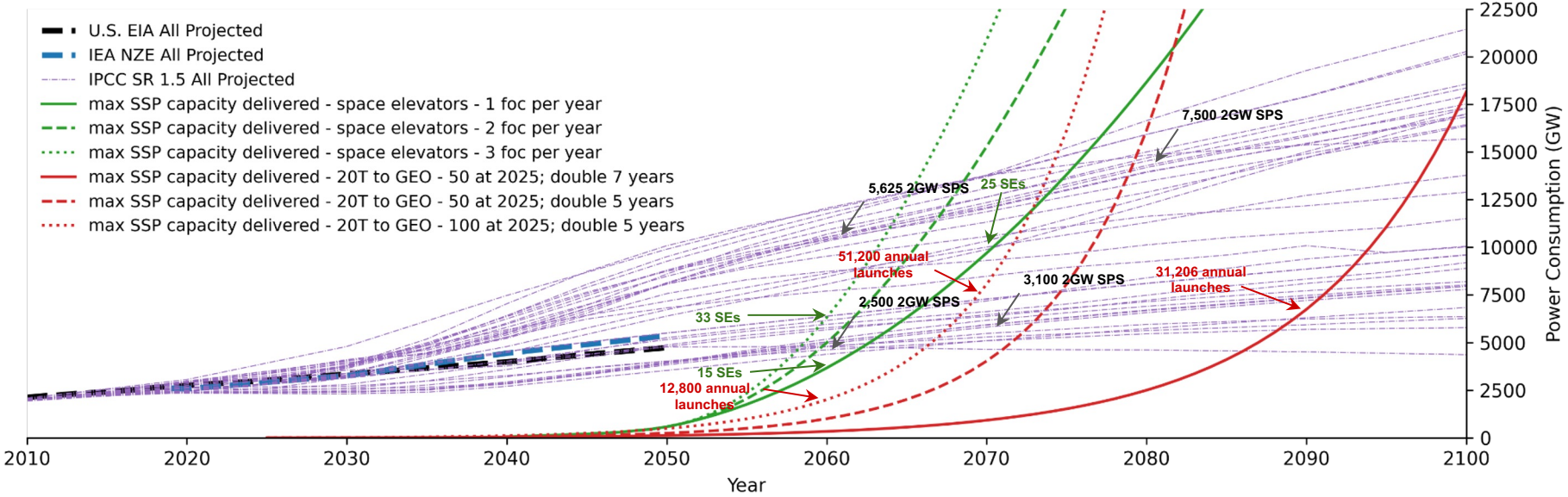
Credit: Obayashi Corporation





Credit: International Space Elevator Consortium (ISEC)

Space elevators are required for SSP at scale this century



Beyond Net Zero, beyond 2050: a dual-space access architecture

1. Deploy SSP demonstrators, initial production systems by 2050 with rockets.

1. In parallel, pursue serious space elevator development and production deployment by 2050.

1. Beyond 2050, to meet rising electricity demands globally and to enable continued electrification of the world economy, deploy SSP at scale primarily with space elevators.

A dual-space access architecture that **takes advantage of the strengths of rockets and space elevators** to enable **massive SSP scale, this century**.

Thank you for your time and attention

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