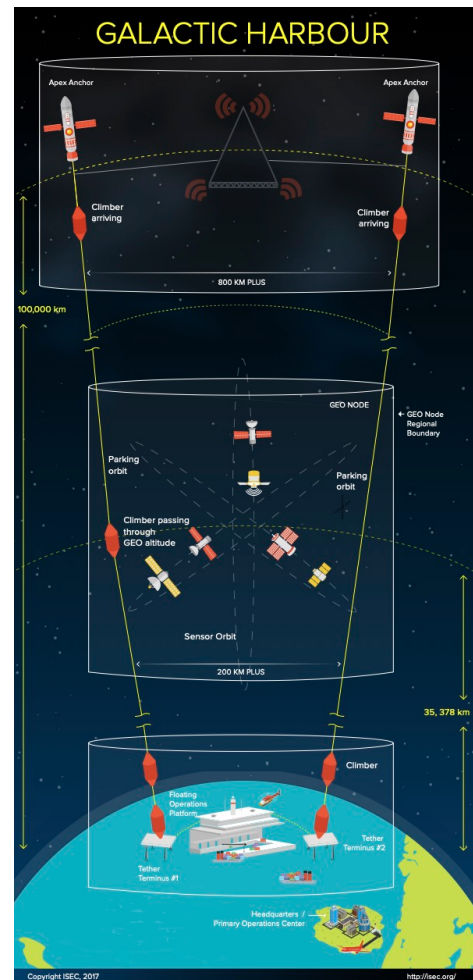


## *Galactic Harbour Recognition – Humanity Demands Space Elevators, NOW!*

From Climate Crisis to the desire to move off planet, future demands are extraordinary. To stop Global Warming and ensure humanity has sufficient energy for future generations, Space Solar Power must be immediately initiated – approximately five hundred 3,000 tonne satellites at Geosynchronous Orbit to support 12% of the global baseline electrical need by 2050 (replacing coal burning plants). In addition, communities off-planet need 1,000,000 tonnes beyond GEO. To reach these numbers using rockets (at less than 2% delivery statistics – and 20 to 50 tonnes capability to GEO) something like three launches a day is expected. This exorbitant demand for rockets – burning fuel in our atmosphere – would be hazardous to the environment. When putting this all together, Space Elevators’ capabilities will be mandatory for the next step into the future. We must build upon the concept of dual space access strategy combining the strengths of both advanced rockets and space elevators.

A first step into our future must be to build Space Elevators. A leap into this bright future for humanity by using individual launches alone is counterproductive. There must be a permanent transportation infrastructure that can move massive logistics to GEO and beyond with environmentally-friendly operations. This can be accomplished by starting with the Initial Operational Capability of Space Elevators at 30,000 tonnes per year to GEO and beyond (estimate 2037) growing to the Full Operational Capability of 170,000 tonnes per year (estimate 2047). Rockets cannot grow to this capability without damaging our atmosphere. The rocket equation is a killer – even with reusability, frequent launches, and low costs.



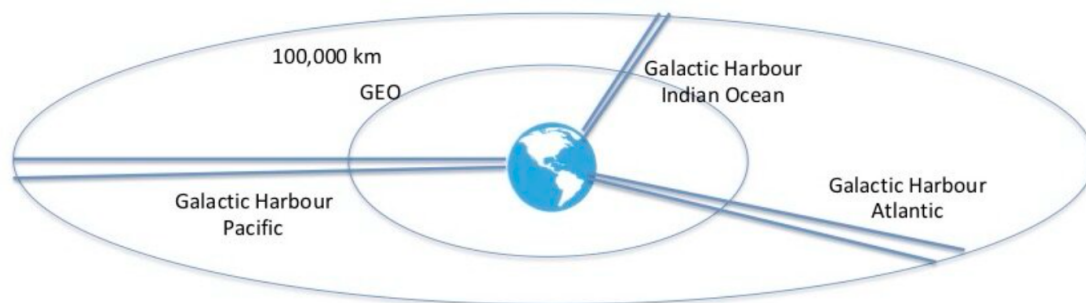
Space Elevators will open up the heavens for humanity while saving the planet from global warming. If our Space Elevator Community is to progress aggressively, we must all present these concepts in a way that is convincing – we must believe in these strengths of Space Elevators and develop these concepts up front in our presentations and discussions. Our future is in the hands of Space Elevator enthusiasts.

Pete

# *Leadership Approach for Development of Space Elevators*

## *2023 Perspective of Space Elevators*

- ***View of Future Galactic Harbours:*** The future of Space Elevators will grow through a Galactic Harbour architecture approach. A Galactic Harbour is the combination of Space Elevator Transportation Systems and Space Elevator Enterprise Systems; businesses attracted by the permanent infrastructure. Galactic Harbours will be the volume encompassing an Earth Port while stretching up in a cylindrical shape to include two Space Elevator tethers outwards beyond Apex Anchors. The estimate is for three Galactic Harbours to be deployed during the developmental phase between 2035 and 2043.



- ***Modern Day Space Elevator:*** This term has surfaced as the Space Elevator has matured through eight Space Elevator architectures described by David Raitt in his Quest Magazine article (2021)<sup>1</sup>. As the name implies, the Modern Day Space Elevator has evolved from a dream to a scientific reality that can move us into the second phase of development (Engineering Development). This change in maturity occurred as the limiting factor of the tether material has been identified and seems to be overcome. The latest idea for tether material is Single Crystal Graphene which has been shown to be strong enough and can be manufactured long enough. The five major thrusts for the development of Modern Day Space Elevators focus on the following statements:
  - Space Elevators are ready to enter Engineering Development
  - Space Elevators are the Green Road to Space
  - Space Elevators can join advanced rockets inside a Dual Space Access Architecture
  - Space Elevators' major strength as a permanent transportation infrastructure is its ability to move massive cargo to GEO and beyond daily, safely, inexpensively and accomplish this while being environmentally neutral.
  - Space Elevators inherently have the economic strengths of strategic investment, ubiquitous access, and uninterrupted exchange of resources between the Earth's surface through the GEO region toward CisLunar and Mars.
  - Space Elevators, as transportation core, attract and logistically support future enterprises.

<sup>1</sup> Raitt, David. "Space Elevator Architectures." Quest, The History of Spaceflight, Quarterly, 28, no. 1 (2021): 17-26.

- ***Transformational Characteristics:*** The transformation of space access created by space elevator operations will be similar to moving from small boats crossing a large river to a permanent infrastructure such as a bridge moving traffic daily, routinely, safely, inexpensively, and with little environmental impact. The permanent transportation infrastructures of space elevators will enable missions by leveraging their strengths:
  - Daily, routine, safe, and inexpensive
  - Transforming the economics towards an infrastructure with access to more valuable, lucrative, stable and reliable investments.
  - Massive movement (Initial Operational Capability (IOC) at 30,000 tonnes/yr with Full Operational Capability (FOC) 170,000 tonnes/yr), [Swan, 2020]
  - High velocity (starting at 7.76 km/sec at 100,000 altitude enables rapid transits to the Moon, Mars and beyond)
  - As a Green Road to Space, it ensures environmentally neutral operations
  - Reduction of Rocket Fairing Design limitations
  - Assembly at the Top of the Gravity Well
- ***Permanent Space Transportation Infrastructure – Space Elevators:*** From a historical transportation perspective canals, channels and deep-water ports are infrastructure - the ships are vehicles. Likewise, the interstate highway, bridges, and trans-continental rail systems are infrastructure for ground transportation - trucks and trains are the vehicles that use it. The international airports and related facilities are the infrastructure for air travel, the planes are the vehicles. From this perspective, rockets, no matter how large and reusable they may be in the future, will always be vehicles - not a permanent space infrastructure. In the Galactic Harbour proposal, climbers are the vehicles while tethers, Earth Ports with several termini and operational platforms, GEO construction - repair garages/stations, and Apex Anchor are the permanent, reliable space infrastructure. This permanent transportation infrastructure defines the future space superhighway's main green road to space with collaborating and complementary permanent infrastructures.
- ***Space Elevators are “Massive Green Machines:”*** Recently, ISEC completed an 18 month study<sup>2</sup> that evaluated Space Elevator's environmental factors. This study started critical discussions by showing the additional benefits of Space Elevators being defined as "Massive Green Machines" as they do not burn rocket fuel in the atmosphere, do not leave debris in orbit, and enable environmentally enhancing missions that require massive movement to GEO and beyond. In point of fact, the operations of Space Elevators and Galactic Harbours will be carbon negative. Several of the concepts developed during this study establish the reality that Space Elevators can make the Earth Greener. This net assessment trade study conducted by ISEC showed that:
  - “Space Elevators and Galactic Harbours are Big Green Machines designed to improve the Earth's environment through two significant contributions. The first is the remarkable "zero-emission" lift of cargo to space - reducing environmental impacts from rocket launches. The second is the ability to deploy massive

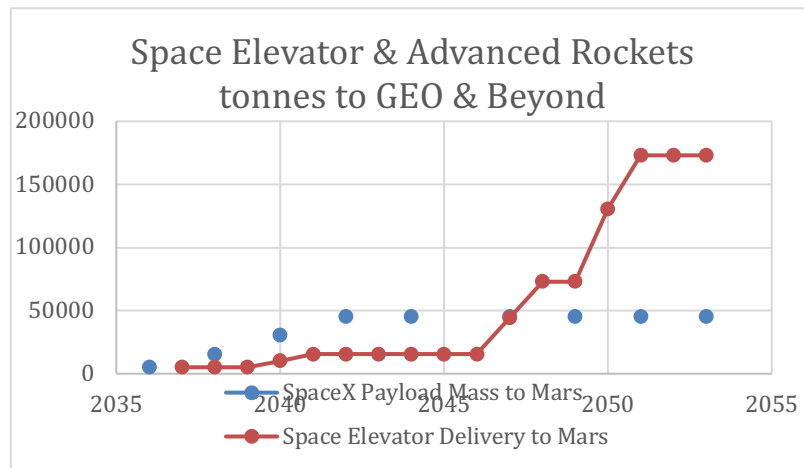
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<sup>2</sup> Eddy, et.al., "Space Elevators are the Green Road to Space," ISEC Report, Lulu Publishers, April 2021.

systems to GEO and beyond that ... minimize... rocket launches by becoming a partner in Dual Space Access Architecture.”<sup>3</sup>

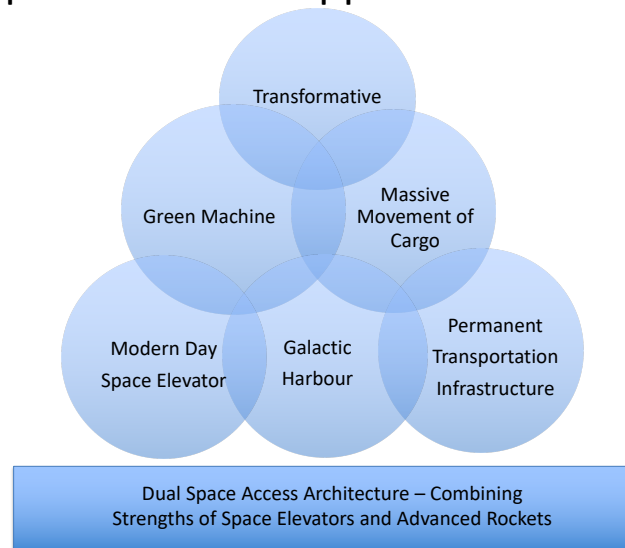
- **Mass to GEO & Beyond<sup>4</sup>:**

The chart compares the mass delivered to GEO & Beyond to reflect movement by advanced rockets and Space Elevators. This estimate is developed for SpaceX with 1,000 launches per year while the estimate for the Space Elevator reflects growth from the Initial Operational Capability



(30,000 tonnes per year) to the Full Operational Capability (170,000 tonnes per year). This capability of Space Elevators dwarfs advanced rockets rapidly because of its efficiency of delivery and environmentally friendly operations.

### Space Elevator Supportive Elements



<sup>3</sup> Eddy, et.al., "Space Elevators are the Green Road to Space," ISEC Report, Lulu Publishers, April 2021.

<sup>4</sup> Calculations conducted inside the ISEC ongoing study "Dual Space Access Architecture" to be published late summer 2023.