Dream in Space Development

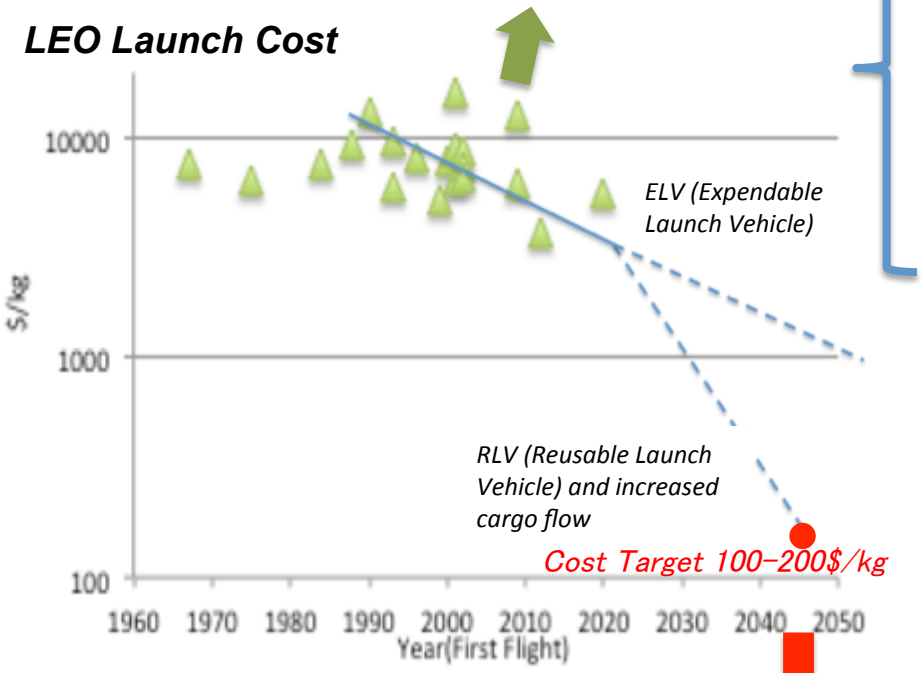
Reusable Launch Vehicle

May 2014

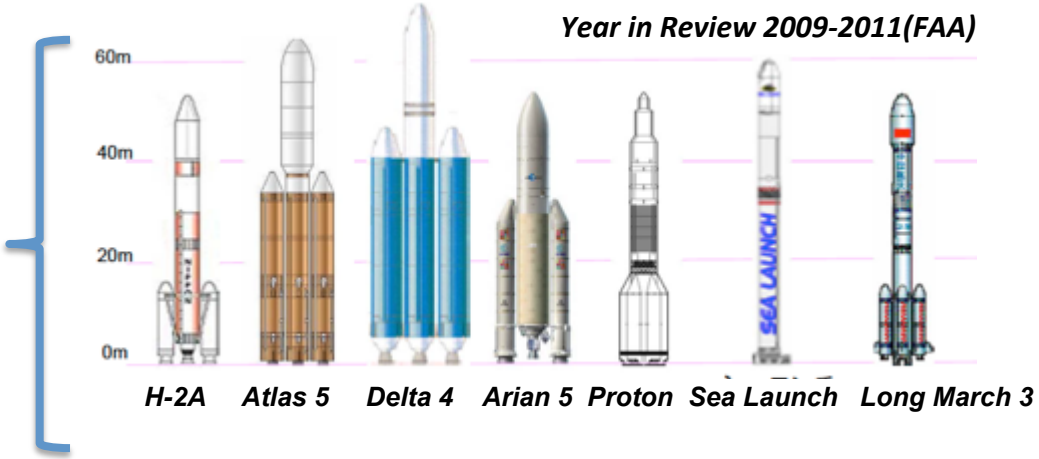
Space Transportation Cost

The transportation cost is very expensive at present as shown below. The high cost has hampered the growth of space activities and commercialization.

250 K$ for space trip
・・・only for special people



10 K$ for space trip
・・・for ordinary people



The reason why the space transportation cost is so high is that the vehicle so far has been designed to be used only once (called as expendable launch vehicle). If we can use the reusable launch vehicle, just like airplanes, the cost will be dramatically reduced. With the transportation cost reduced 1/10 or less, the space activities and space commercialization will be greatly promoted.

History of Reusable Launch Vehicle (1/2)

Space Shuttle

Space plane

The Space Shuttle system, partially reusable, was started to be operated in 1980, as a new space transportation system. From an economic point of view, the system could not reach the initial goal setting. After the 135 flights, the operation was terminated in 2011. Total cost was 150 B$, which corresponds to 1.5 B$ per flight (very expensive).

There was a concept of space plane called "NASP (National Aero-Space Plane)" in the U.S. Since 1980's, the concepts of space plane had been studied extensively in several countries until mid-1990's. Since the technologies in their concepts were so challenging, the studies were all terminated.

History of Reusable Launch Vehicle (2/2)

Two-stage rocket

SpaceShipTwo space plane

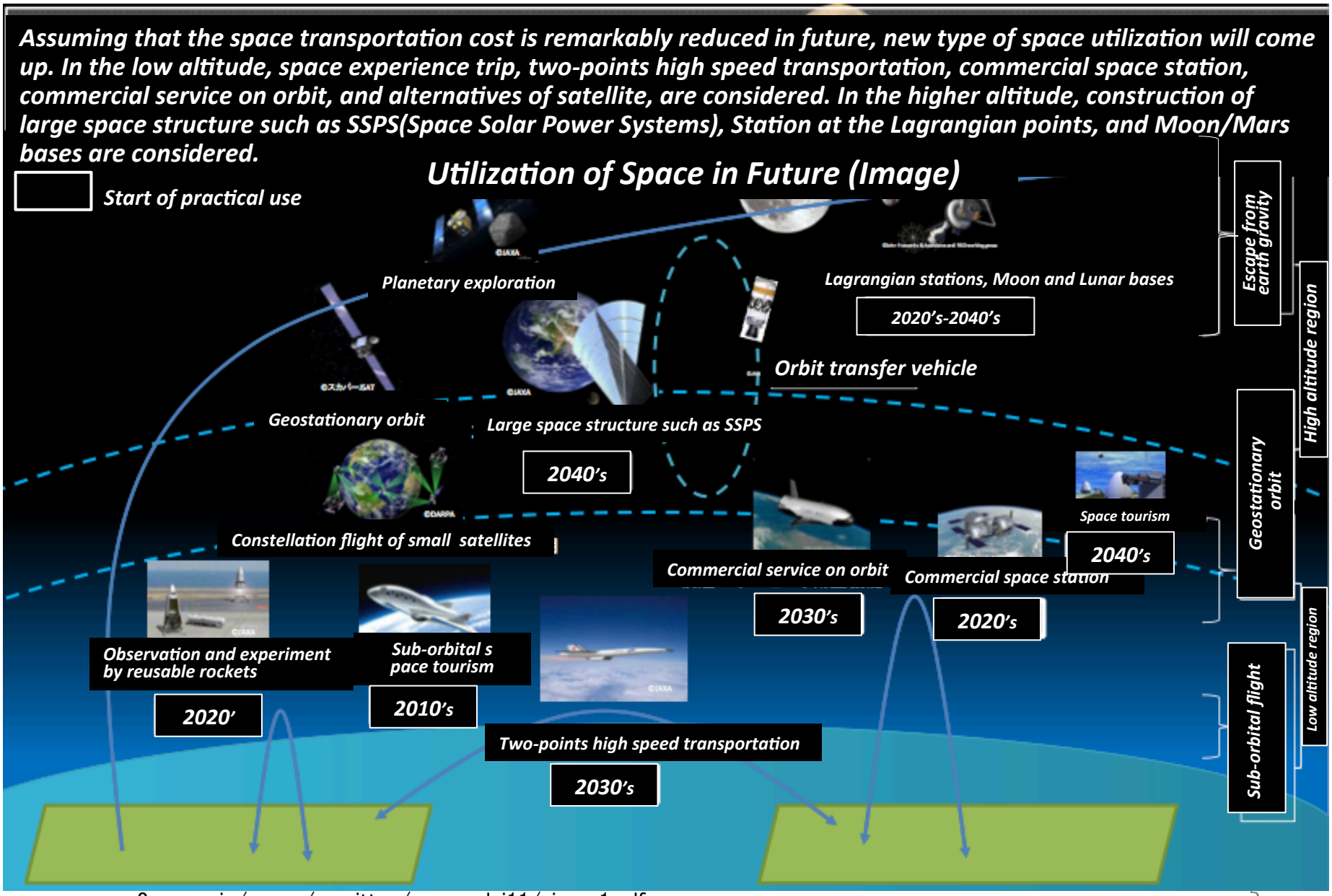
In JAXA, there was a space plane concept of two-stage rocket type, as a forerunner to the reusable launch vehicle. The target cost was 1/10 of the conventional rocket with the same reliability as commercial airplane.

After 2000, suborbital space planes, not reaching the orbit, have been developed and tested. Virgin Galactic plans to operate SpaceShipTwo space plane in a commercial service in the near future. The ticket is already sold at the price of $250,000.

The dreams for the reusable launch vehicle were shuttered in 1990's, but with the recent progress of material science and space systems, the reusable launch vehicles are now expected to be realized in the not-so-distant future.

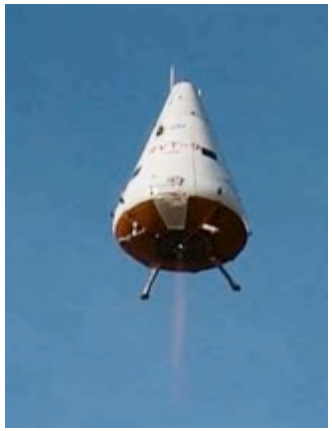
A Long-term Vision for Space Transportation System
-Material (Draft) of Government Space Committee-

Assuming that the space transportation cost is remarkably reduced in future, new type of space utilization will come up. In the low altitude, space experience trip, two-points high speed transportation, commercial space station, commercial service on orbit, and alternatives of satellite, are considered. In the higher altitude, construction of large space structure such as SSPS(Space Solar Power Systems), Station at the Lagrangian points, and Moon/Mars bases are considered.



www8.cao.go.jp/space/comittee/yusou-dai11/siryou1.pdf

Introduction of Reusable Rocket Currently Studied by JAXA
-Small, but steady step towards Reusable Launch Vehicle-



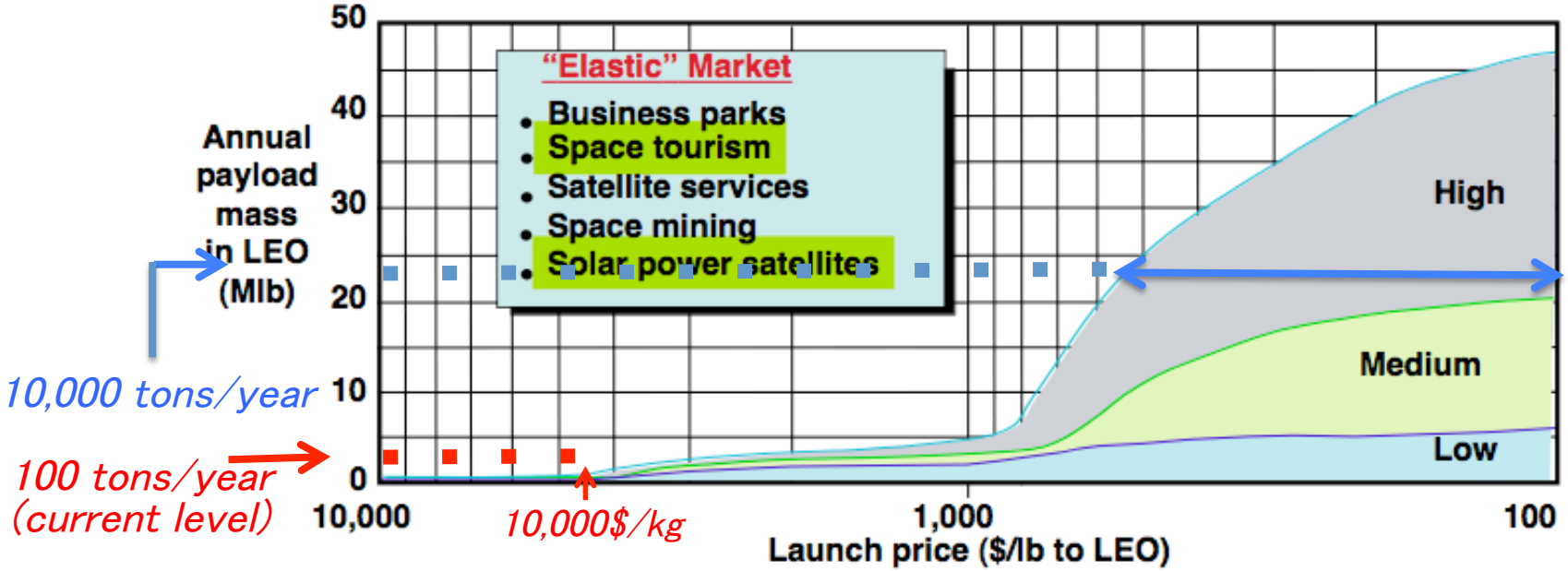
Flight test conducted at JAXA Noshiro Rocket Testing Center

Experiment of reusable rocket. Weight:500 kg
Length: 3.5 m

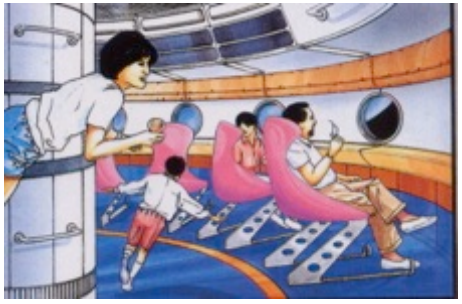
Future image of reusable transportation system, just like airplane operation

Space Transportation Cost vs. Cargo Traffic

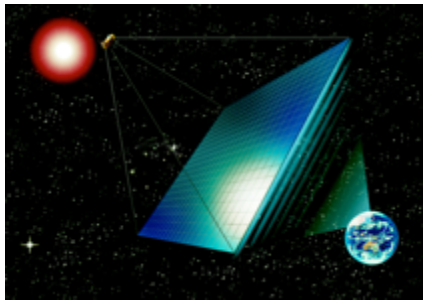
In reality, the space transportation cost will never be reduced without massive cargo flow between space and ground, as shown below.



There are two major candidates for the massive cargo flow in future; space tourism and solar power satellite (space solar power plant).



Space Tourism



Solar Power Satellite (Power plant in space)

Example of Commercial Space Tourism

Club Tourism Space Tours Inc
http://www.club-t.com/space/

SpaceShipTwo is carried up to 16 km altitude using Mother Ship (White Knight 2), and then is separated from the mother ship. By operating rocket engine, SpaceShipTwo reaches 110 km altitude. Passengers enjoy the micro-g experience and the window view for about 4 min. Total flight time is about two hours. The ticket price is 250 K$ per person.

Space Future Japan
http://uchuumaru.official.jp/spaceship/kankohmaru.htm

The size is 22 m long and 18 m in diameter. The launch weight is 550 tons. There are 12 rocket engines including redundant engines. It vertically takes off and lands. It reaches 200 km altitude. The operation cost is 800 K$. It carries 50 persons with a ticket price of 20-30 K$. The passengers will enjoy the space view of the earth and micro-g environment.