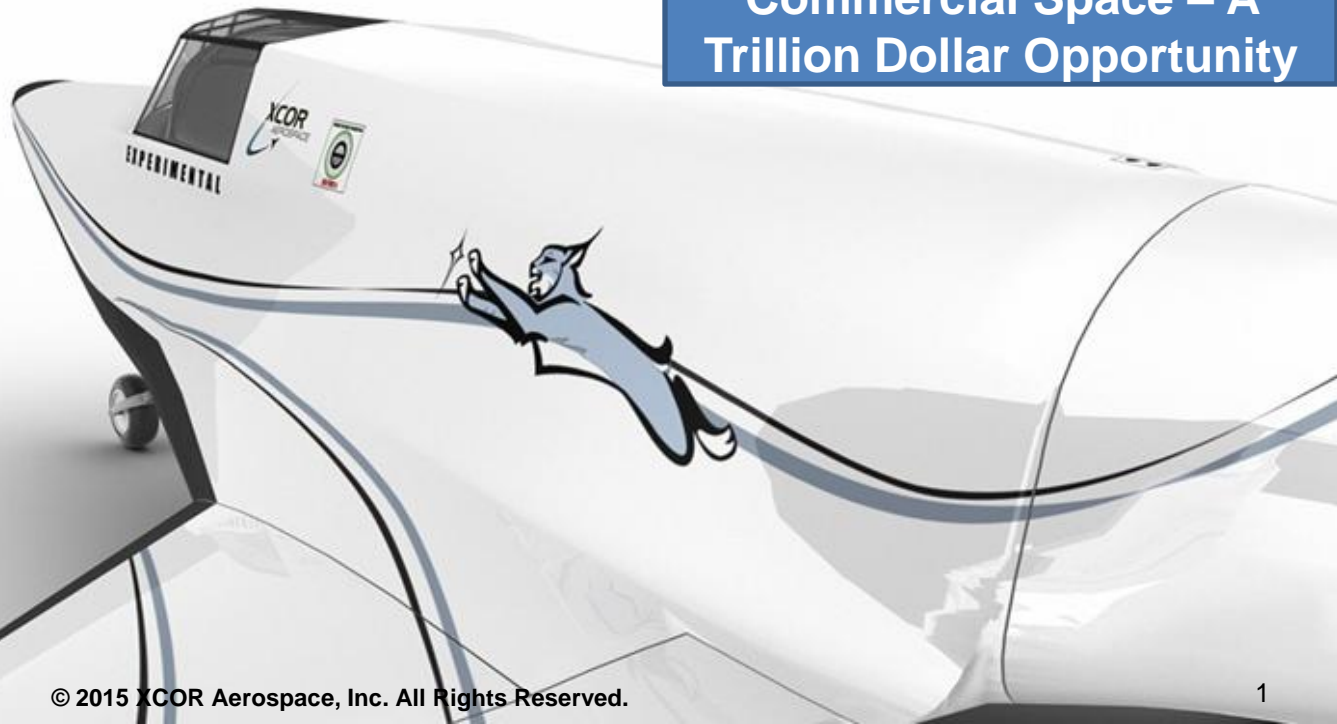


**YOUR MISSION.
OUR SHIP.**



Beijing University
Commercial Space – A
Trillion Dollar Opportunity



Outline



- What is a \$1 Trillion Marketplace?
- Visionaries
- Transformation of Space
- The XCOR Lynx

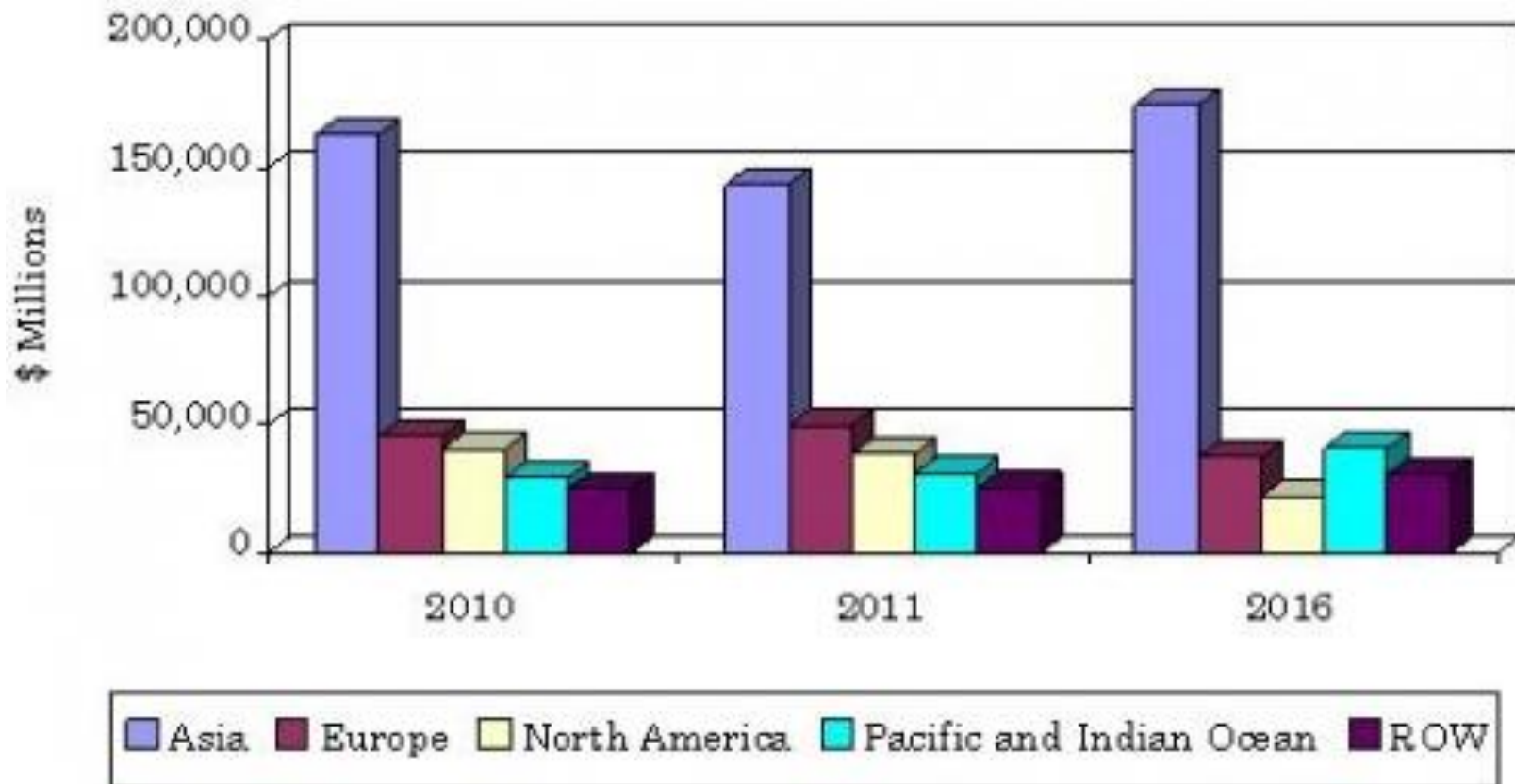
WHAT IS A TRILLION DOLLAR MARKET PLACE?

(DEF. TRILLION --- 1,000,000,000,000)

Global Electricity Generation Markets



Electricity Generation is about \$300 Billion / Year



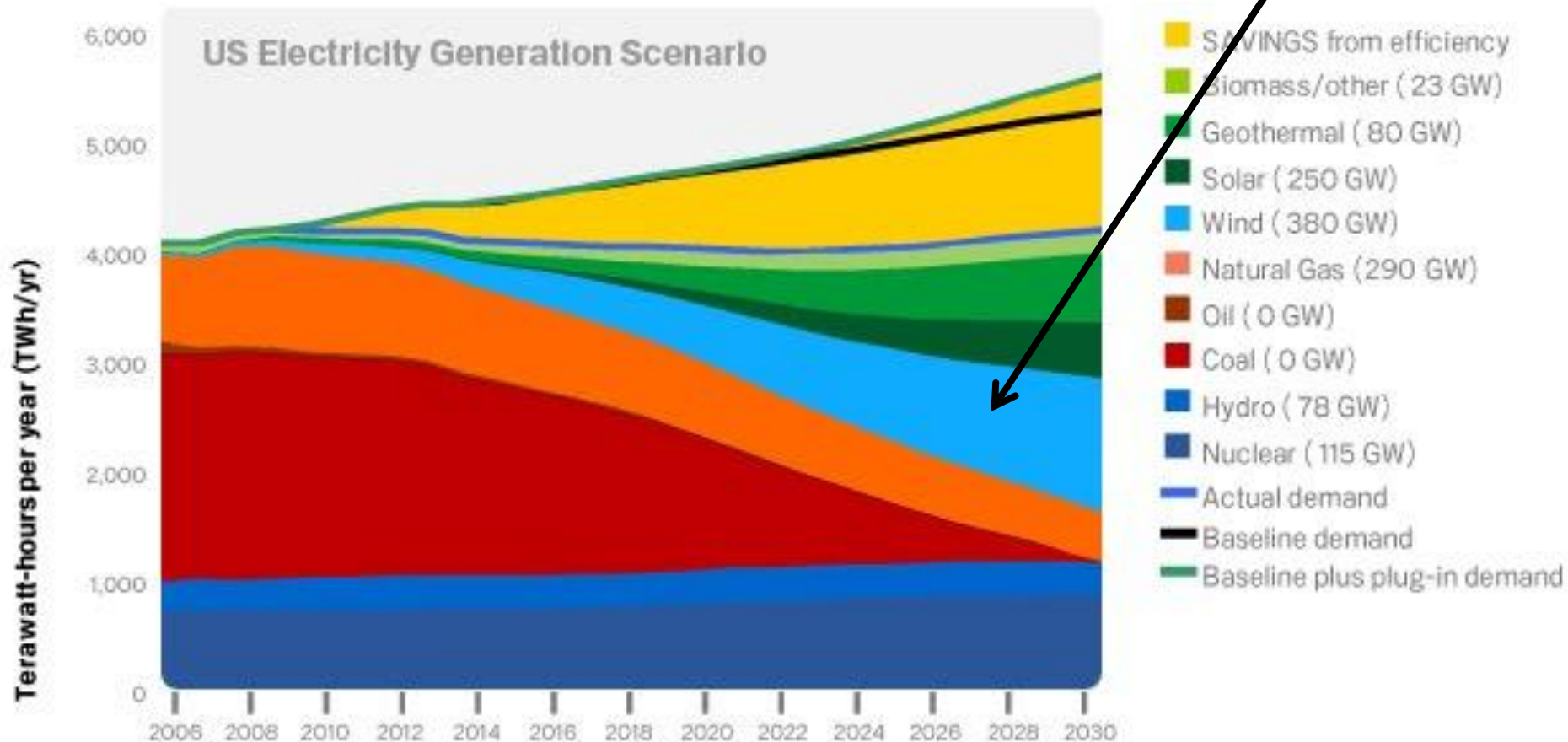
Source: Bcc Market Research

Electricity Market Evolution (Google)



Estimated Costs for Added US Transmission Capacity to Enable Wind = \$130 Billion

**Remember
This Number**



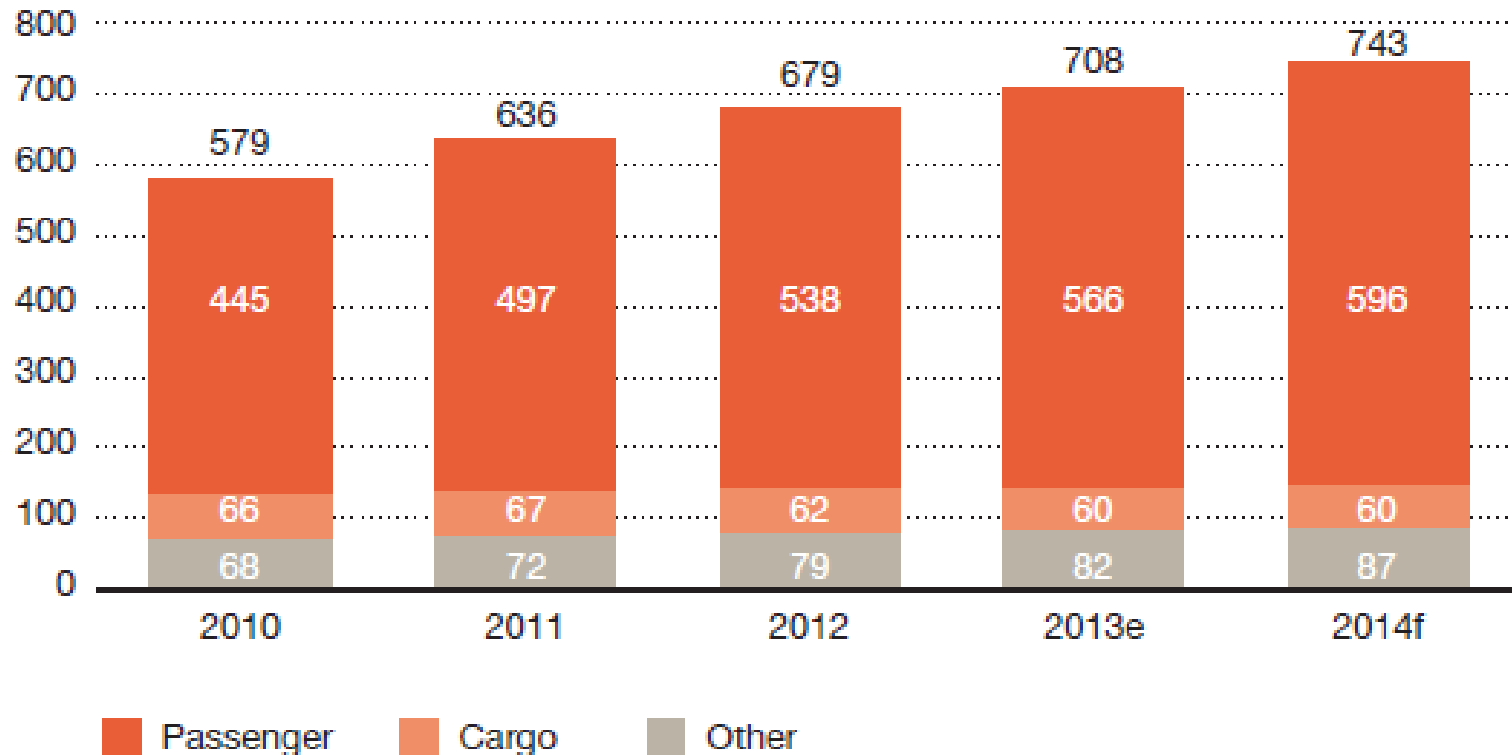
Source: Clean Energy 2030, Google

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Global Airline Revenue



Global Airline Revenue 2014 (Top 150 Airlines) ~\$743 Billion



Note: (e) estimated and (f) forecast

Source: International Air Transport Association (IATA), International Civil Aviation Organization (ICAO)

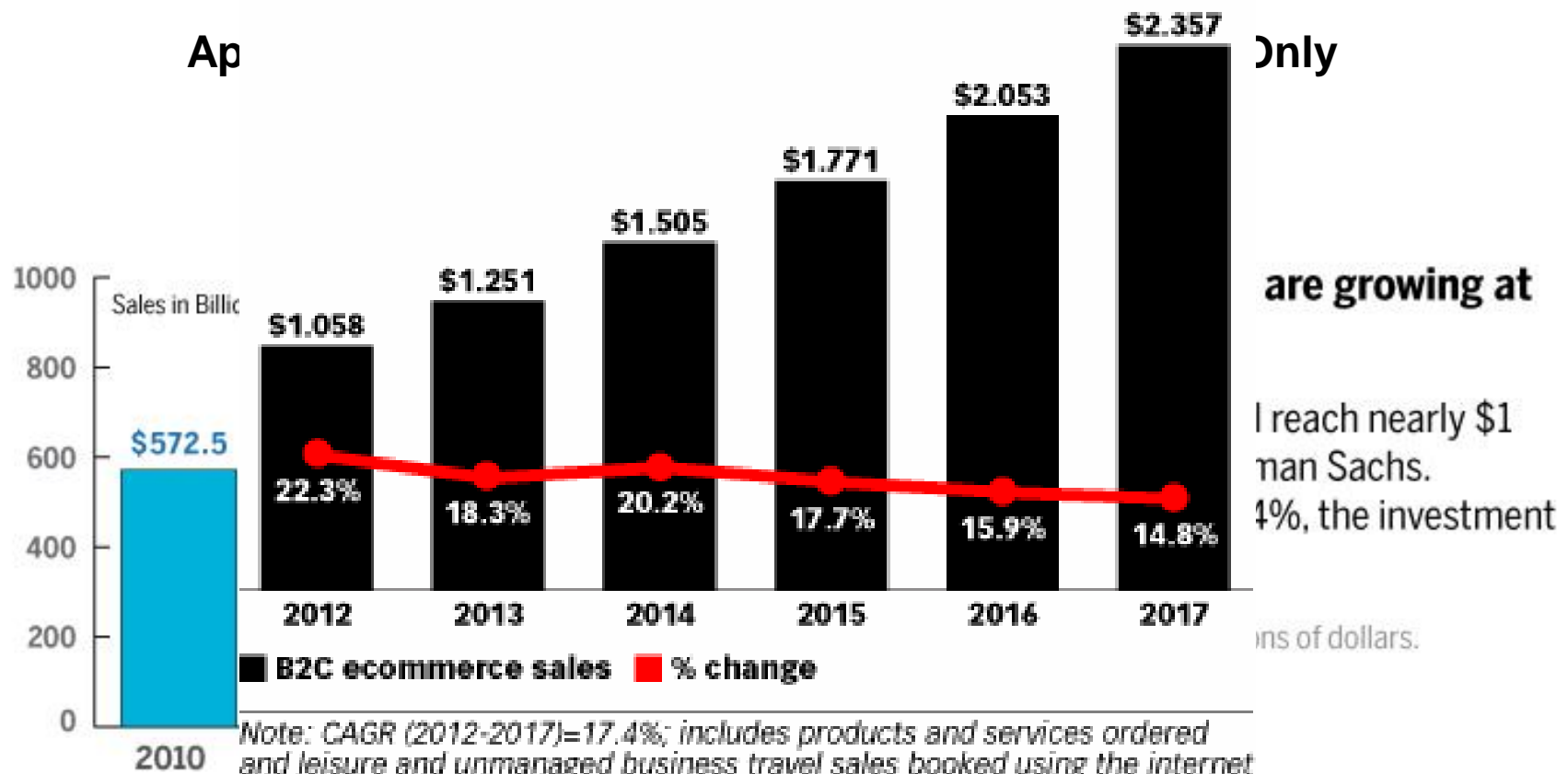
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Global e-Commerce Retail Sales



B2C Ecommerce Sales Worldwide, 2012-2017

trillions and % change



Note: CAGR (2012-2017)=17.4%; includes products and services ordered and leisure and unmanaged business travel sales booked using the internet via any device, regardless of the method of payment or fulfillment
Source: eMarketer, Jan 2014

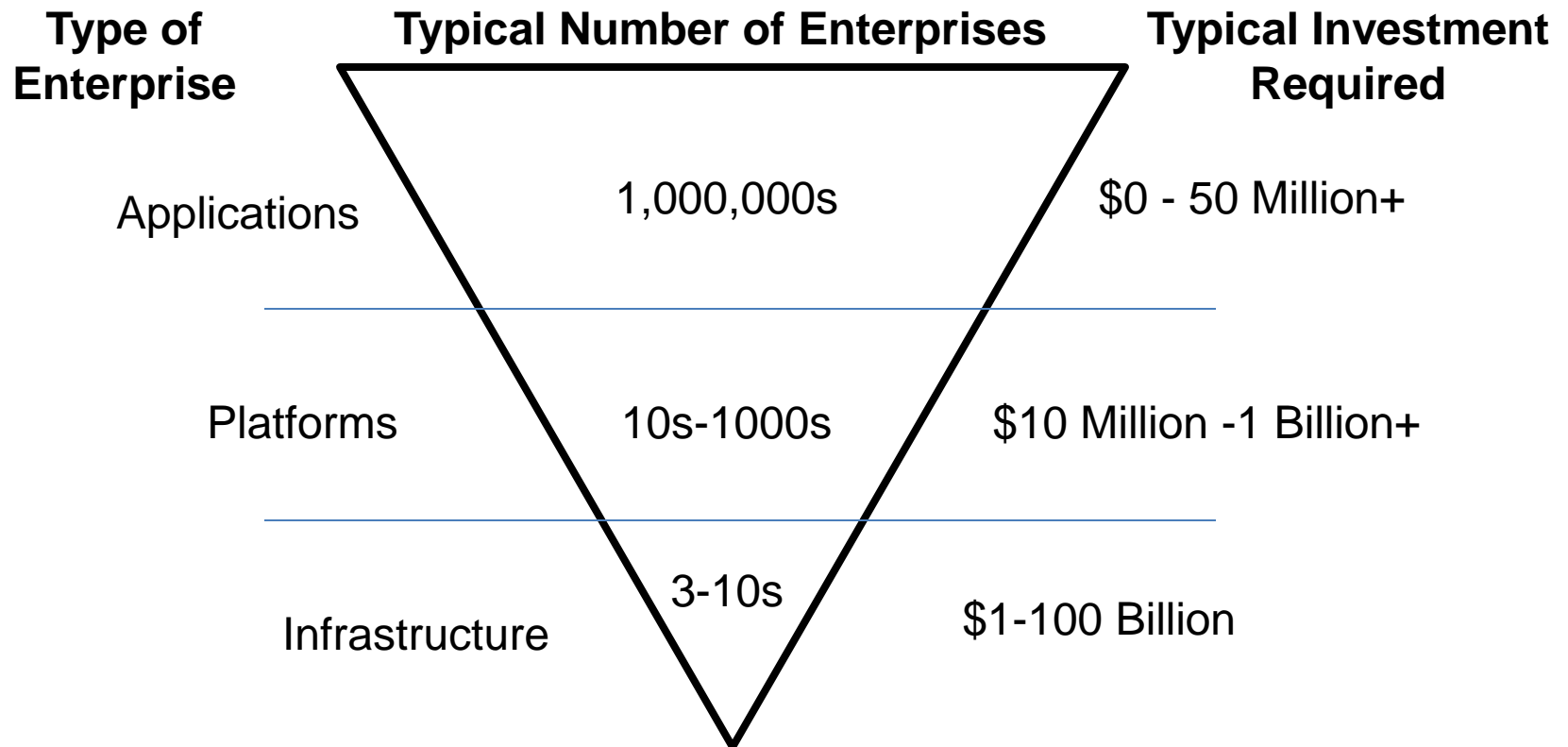
167671

www.eMarketer.com

Creating Big Markets & Structure



- Fundamental Change Impacting 'Everyone'



How do you build a \$Trillion Market?



- Solve a Fundamental Need in a Uniquely Different Way that is Valued by Others
- Enlightened Regulatory Frameworks
- **Innovation and
Visionary Leadership**

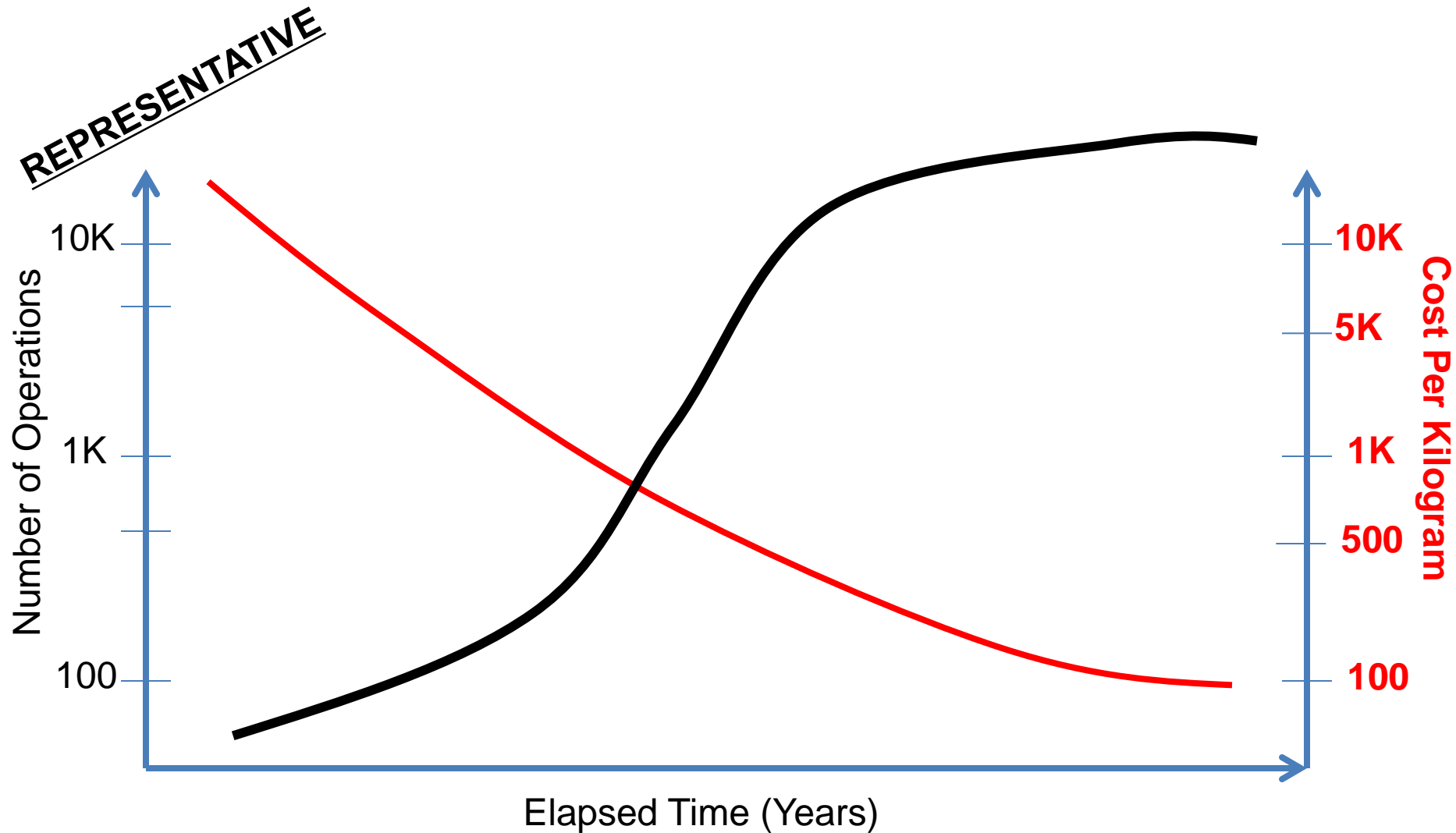
Creating The \$Trillion Space Market



Solve Launch Bottleneck ...

**Reusable
Spacecraft / Launchers**

Creating the \$Trillion Space Market



Who are Space Visionary Leaders??

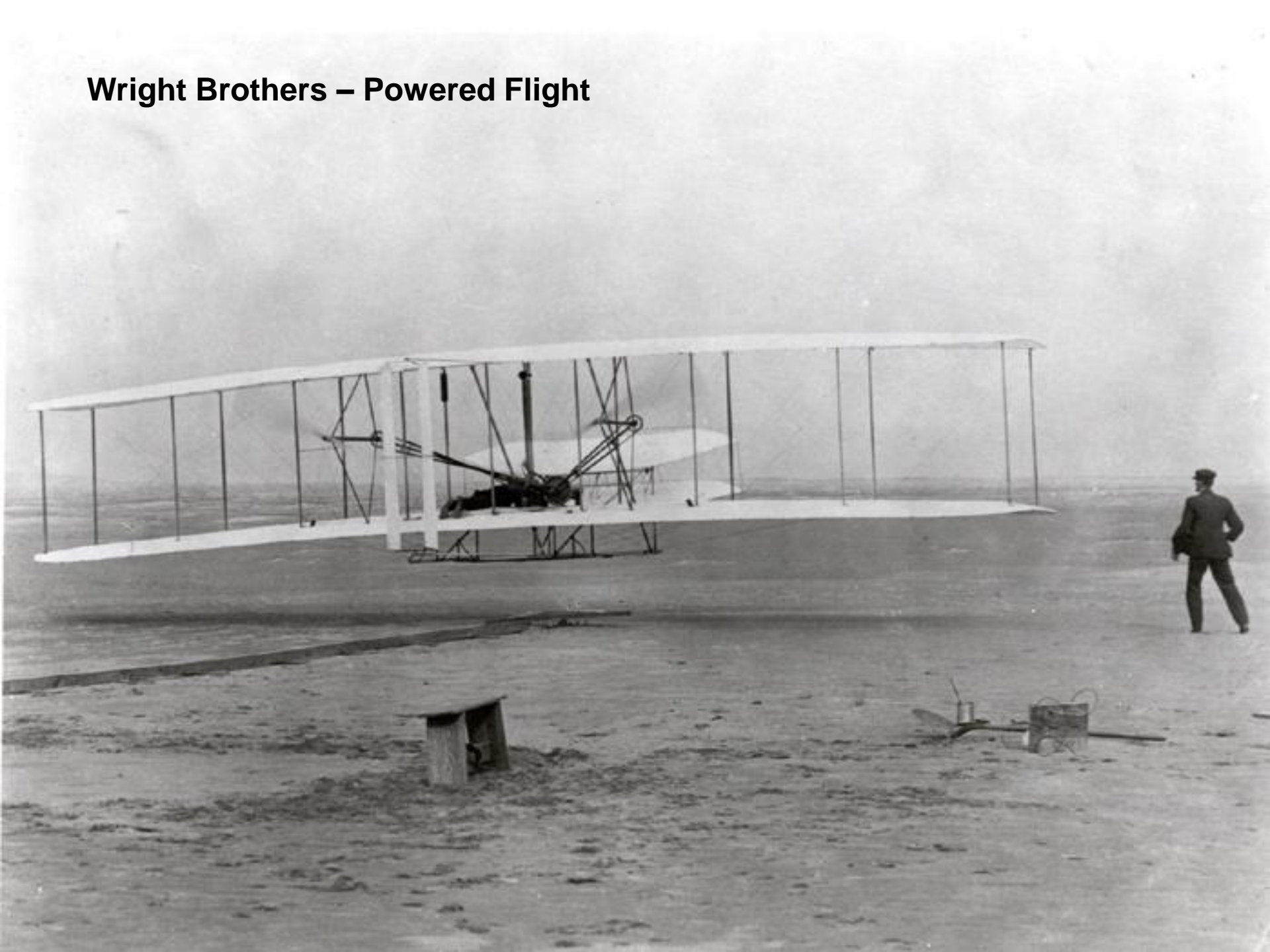


- Who is solving the launch bottleneck?
- Who is making the platforms & apps?
- **Who are the Innovators
and Visionary Leaders?**

VISIONARY

adj. “Having or marked by foresight and imagination”
noun “One who can envision the future”

Wright Brothers – Powered Flight



Pan Am China Clippers – Global Reach



DC-3 – Practical / Cost Effective Operations



Boeing 747 – Global Game Changer



Steps to Reusable Space

X1 – Sound Barrier



X15 – Hypersonic & Suborbital/Reusable



**X20 – The Next Step
Interrupted – Too Bad**



**Space Shuttle –
Unrealized Promise**



New Space Visionaries (1)

Launchers



Burt and Richard



PETER BECK



**THOMAS
MARKUSIC**



JEFF GREASON



Elon Musk



**Jeff
Bezos**



Paul Allen

New Space Visionaries (2)

Exploration / Manufacturing



Schmidt



Simonyi



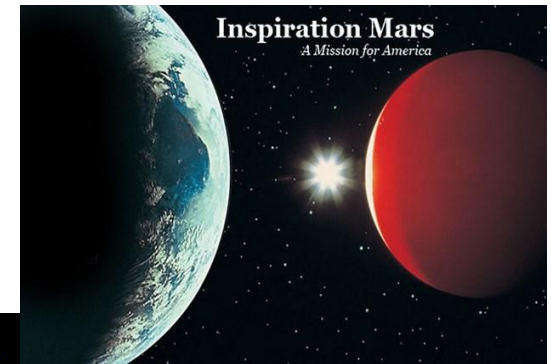
Perot



Page



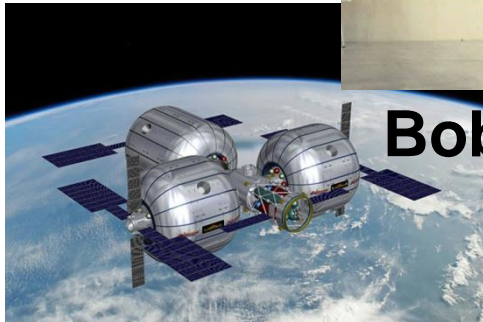
Cameron



Tito



Bob Bigelow



New Space Visionaries (3)

Satellite Applications



Planet Labs



WILL MARSHALL

Skybox Imaging



DAN BERKENSTOCK

Accion Systems



NATALYA BRIKNER

New Space Visionaries (4) Venture Capitalists



Draper Fisher Jurvetson



**STEVE JURVETSON &
RANDY GLEIN**

Bessemer Ventures



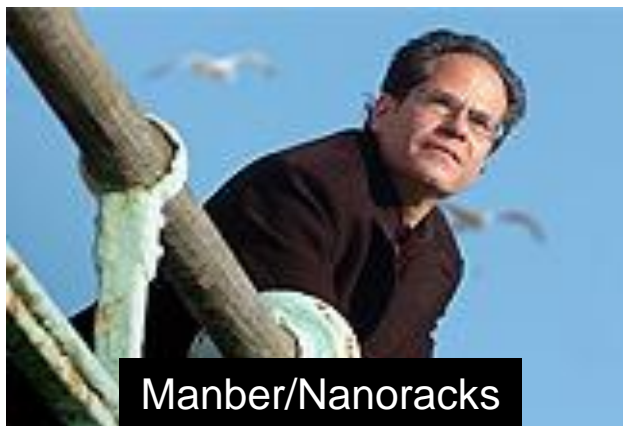
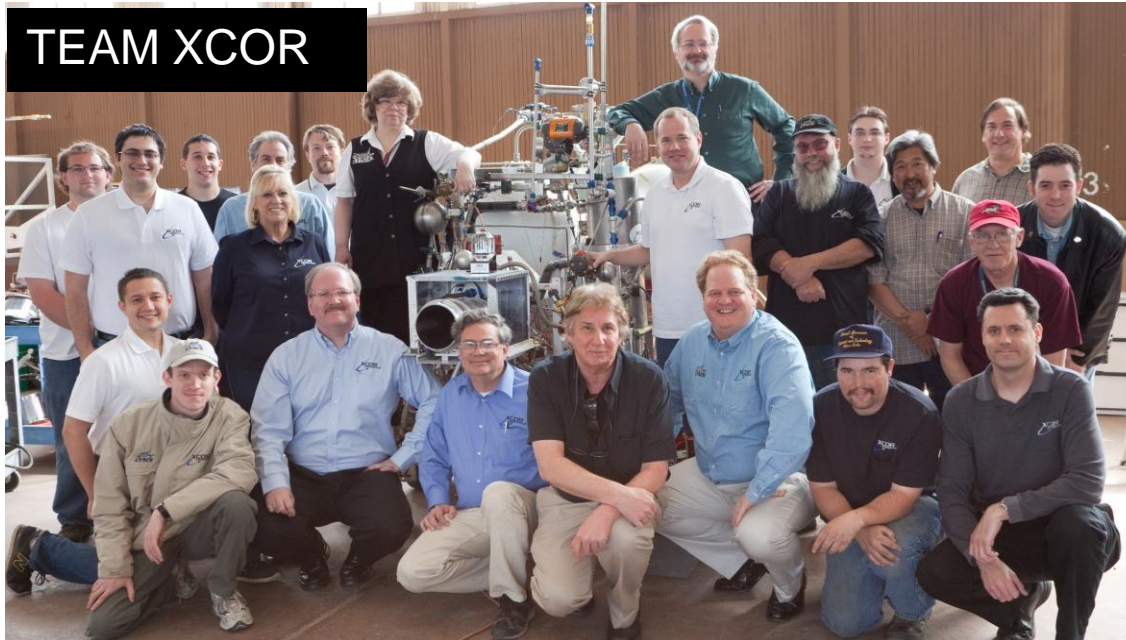
**DAVID COWAN &
SUNIL NAGARAJ**

Haiyin Capital



YUQUAN WANG & XIN MA

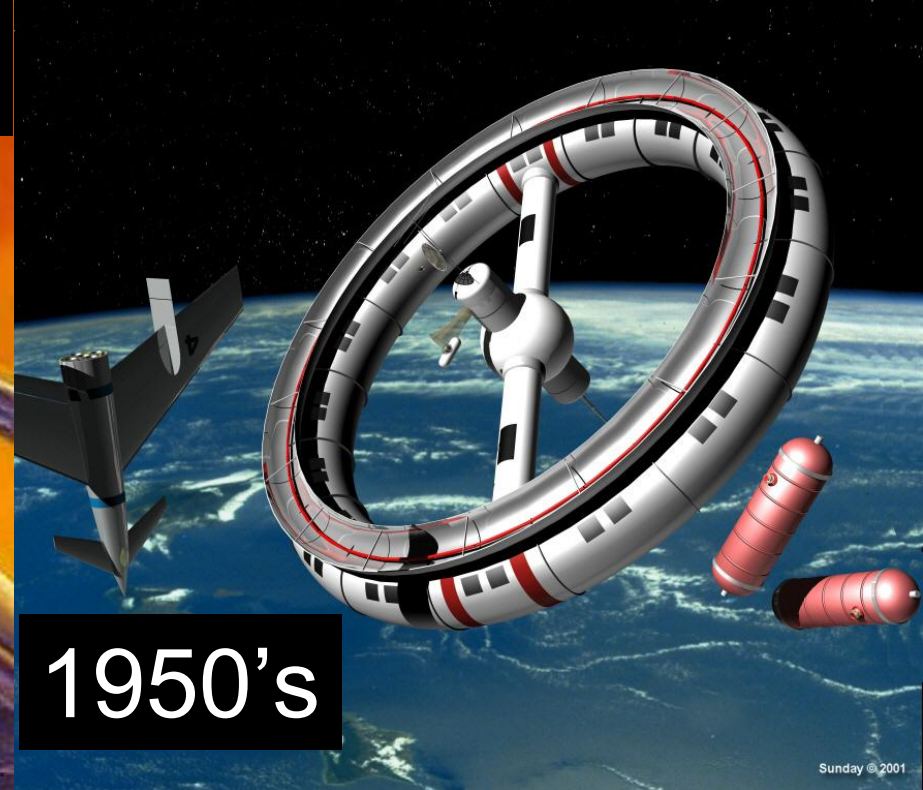
Some of My Personal Favorites



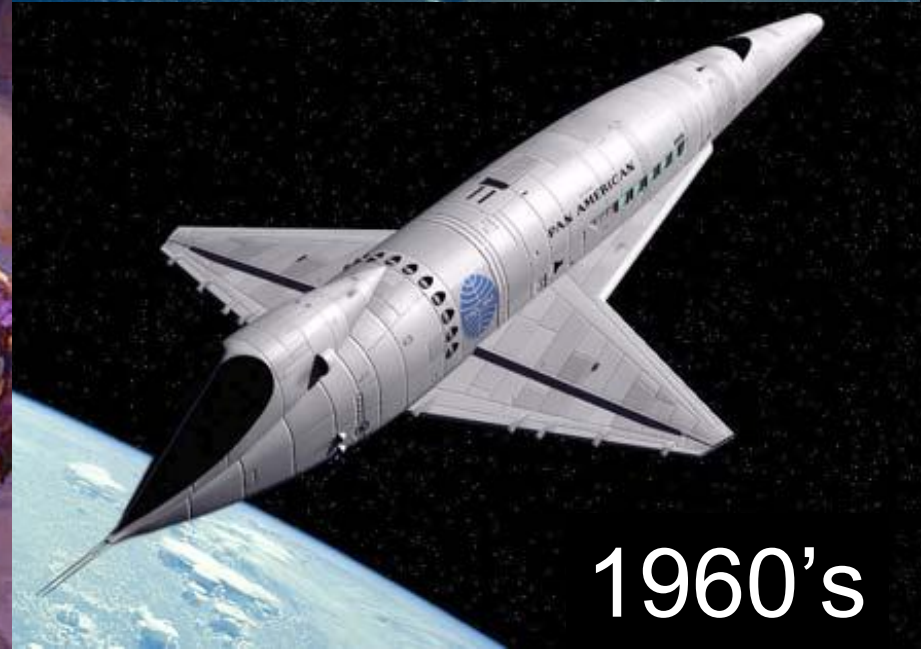
TRANSFORMATION (OF SPACE)

noun “A dramatic change in form or appearance”

1940's



1950's



1960's

Reality of Space Through 2013+



Mercury / Gemini



Apollo



SKYLAB



SHUTTLE



Shuttle at ISS

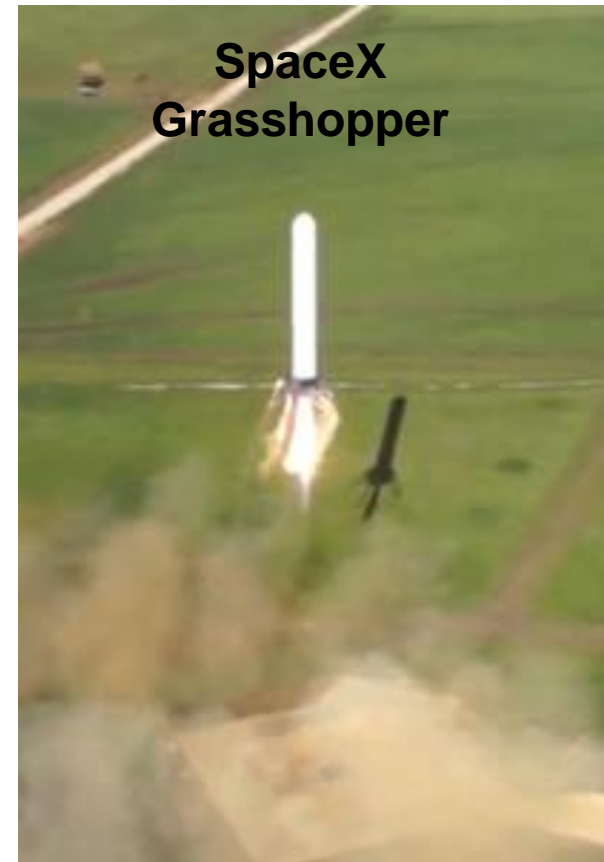
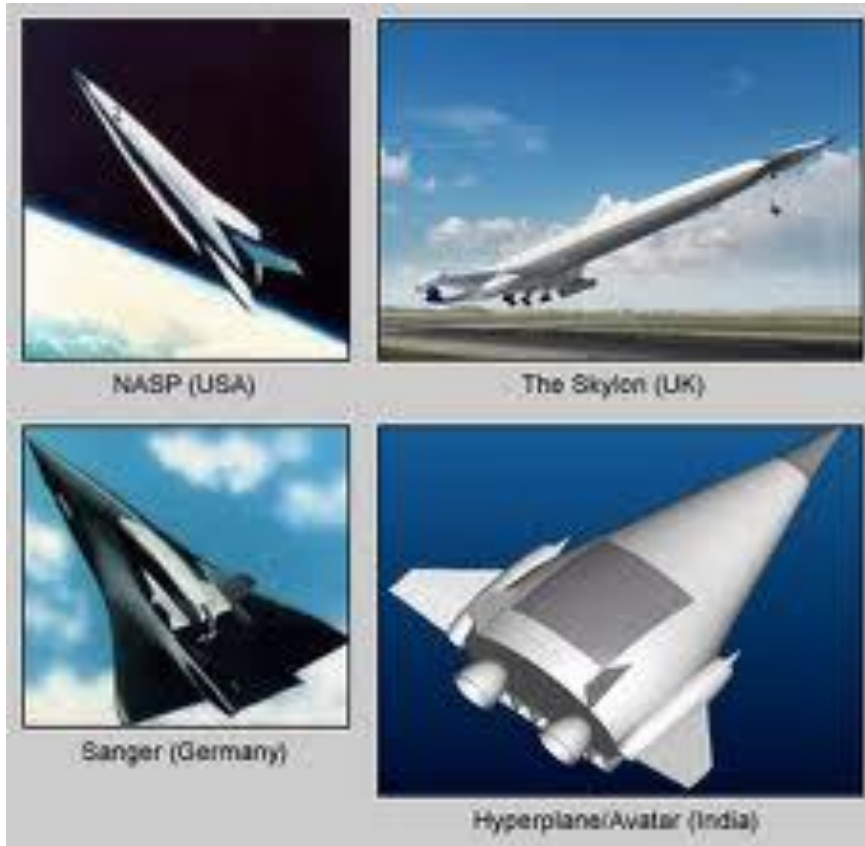
New Reality – Reusable Suborbital Craft as Enabler



Future Steps to Orbit



- Lowering the Cost to Orbit – Full Reusability



Steps to Creating The \$Trillion Space Market

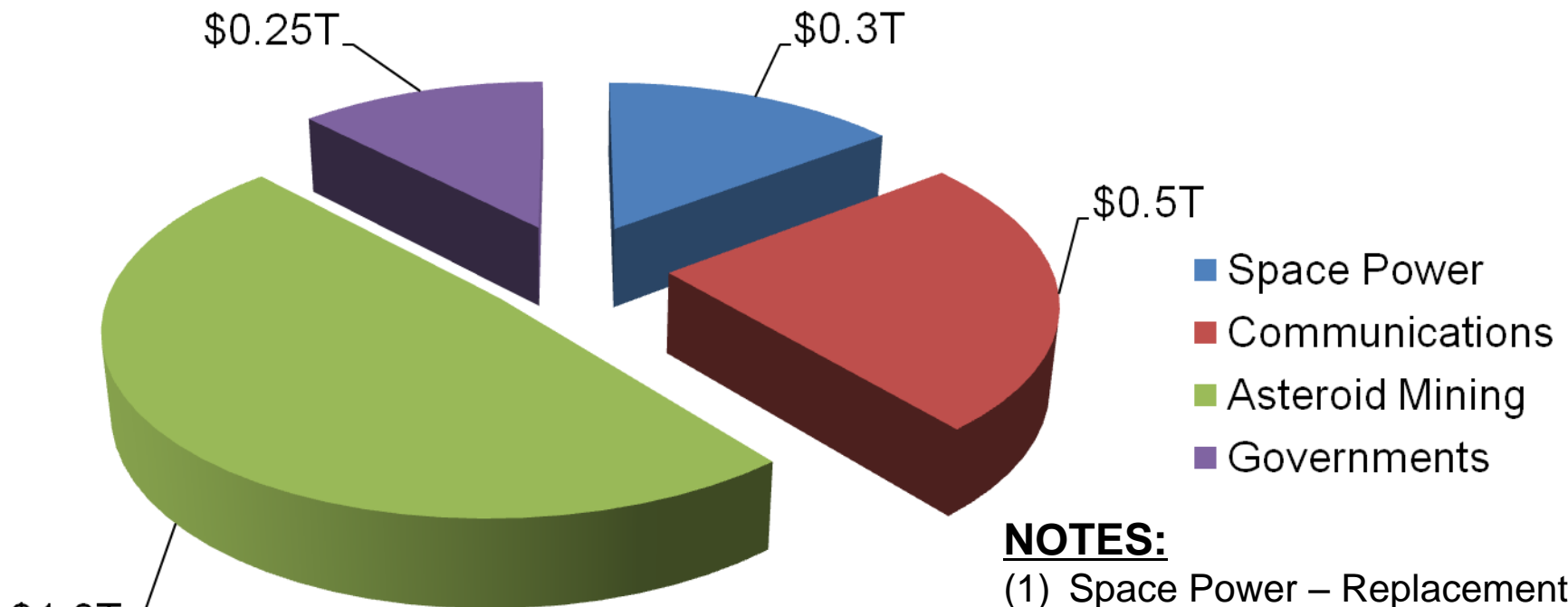


- Suborbital Reusable
 - Demonstrates low cost, safer operations
- Orbital Satellite from Reusable Suborbital
 - Demonstrates responsiveness, reliability
 - Demonstrates market for applications
- Orbital Reusable Satellite Launch
 - Enables space exploitation
- Orbital Manned Reusable Launch
 - Enables settlement

Future Markets



Over \$2 Trillion Opportunity for “Big Rocks” Over 20+ Years



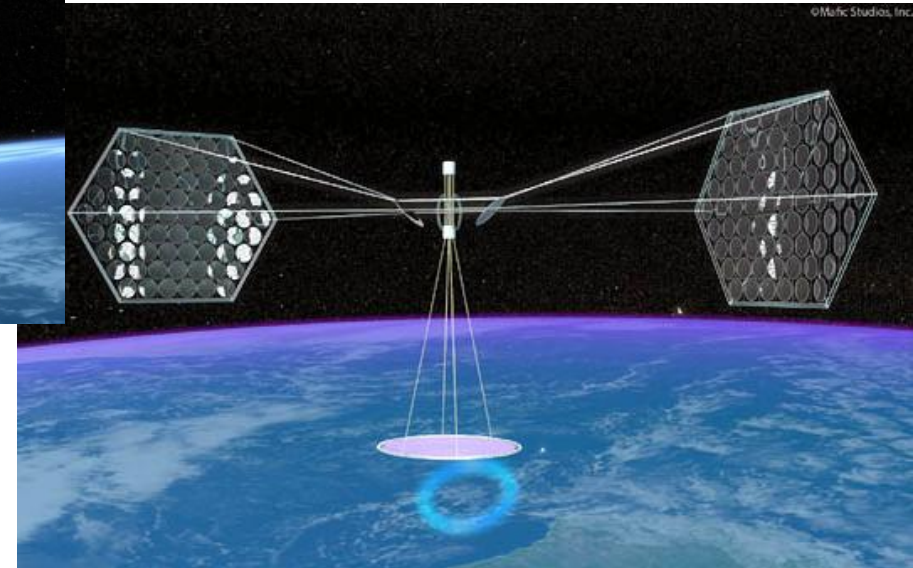
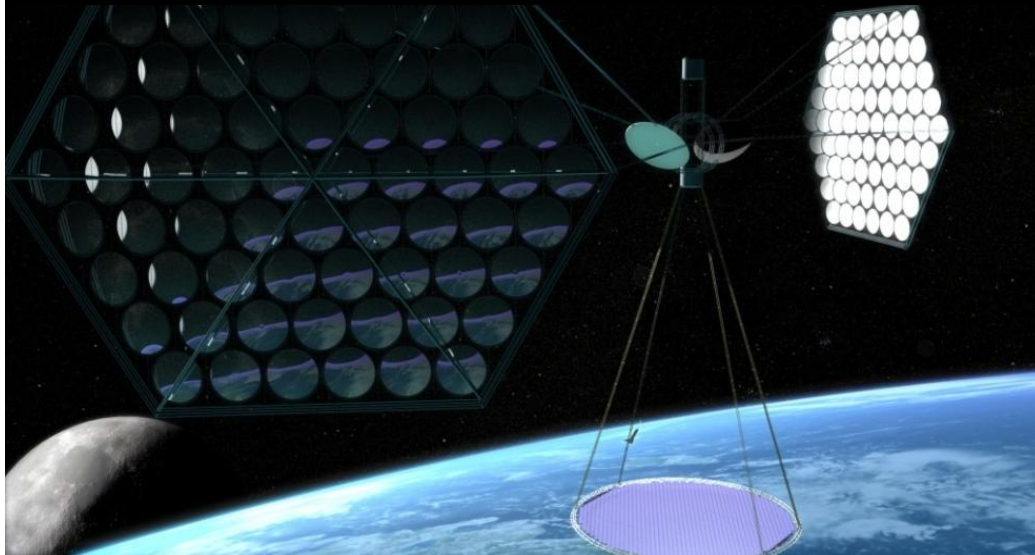
NOTES:

- (1) Space Power – Replacement and Growth
- (2) Comms – Growth (today ~\$200B)
- (3) Mining – New Market
- (4) Governments – Replacement and Growth

Power

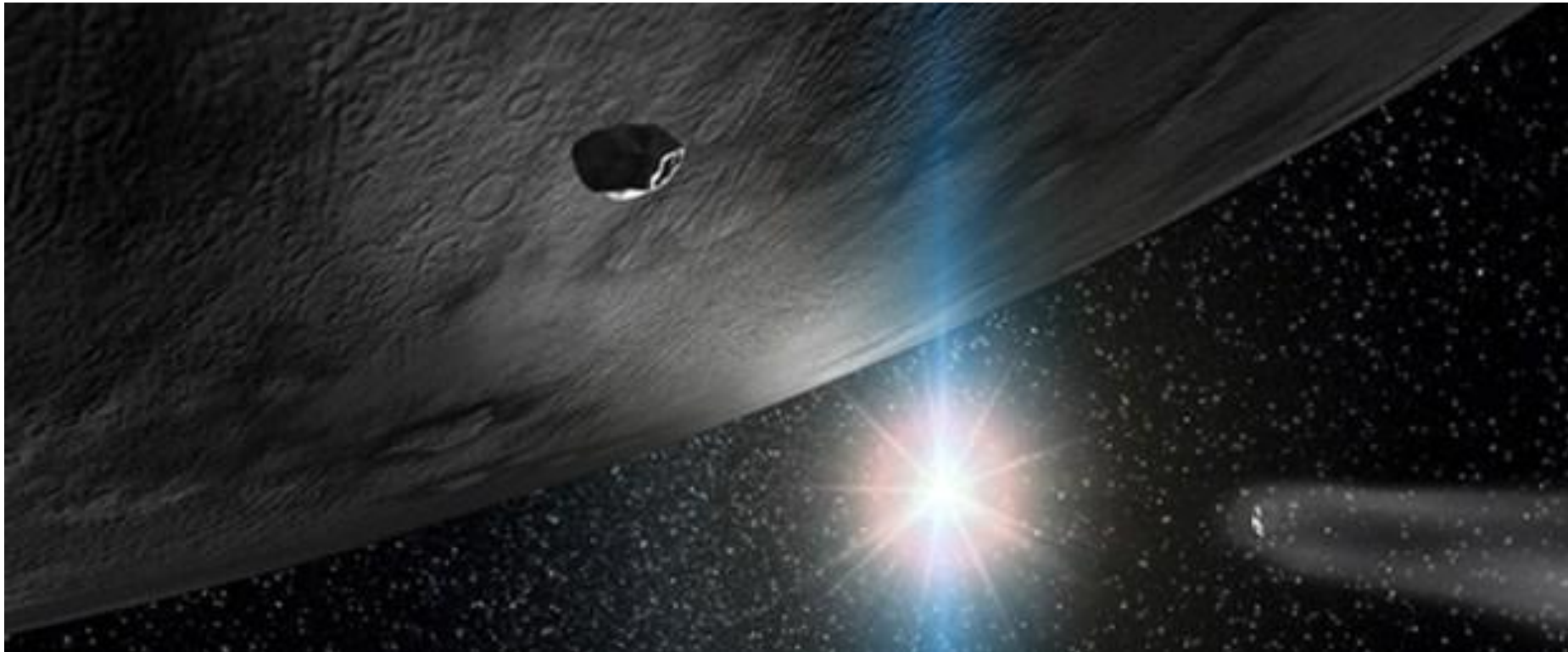


Space Based Solar Power



WHAT ELSE?

The Platinum Asteroid



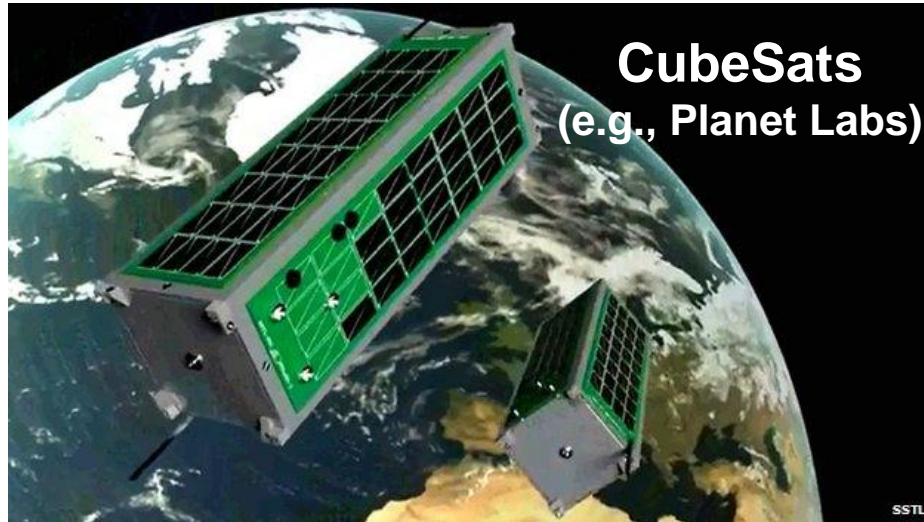
WHAT ELSE?

Orbital Manufacturing & Presence



WHAT ELSE?

Platforms & Applications



WHAT ELSE?

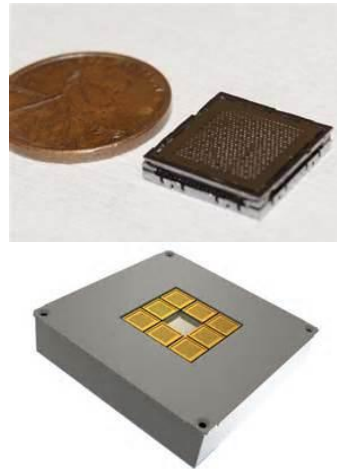
“Picks and Shovels” & Applications



Pressure Suits



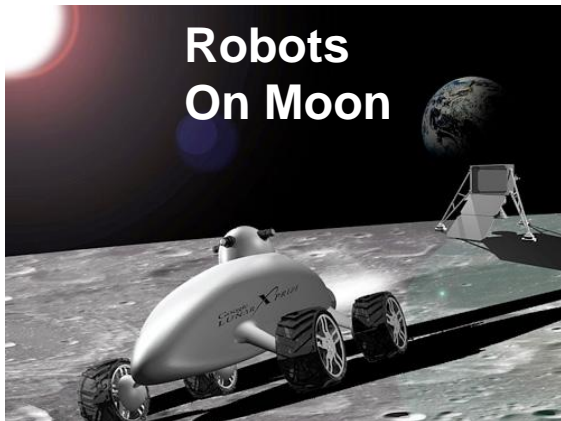
Micro Thrusters



Payload Processing



Robots On Moon



Zero Gravity Solutions Directed Gene Expression™



LYNX AND FUTURE

noun

- 1. “A wild cat with yellowish-brown fur, a short tail, and tufted ears, found chiefly in North America and Eurasia”**
- 2. “A hot rock’in space plane from XCOR Aerospace”**

The First Step To the Future



XCOR History ...



- **Founded in 1999**
- **Located at Mojave Air & Spaceport, CA**
- **Fourteen different rocket engine designs with approximately 5,000 firings**
- **Two generations of rocket powered vehicles built & flown**
- **Building suborbital Lynx – FAA-licensed launch vehicle**
- **Funded by angel investors, institutional investors, sales and contract revenues**
- **Revenue producing**



Lynx Heritage ...



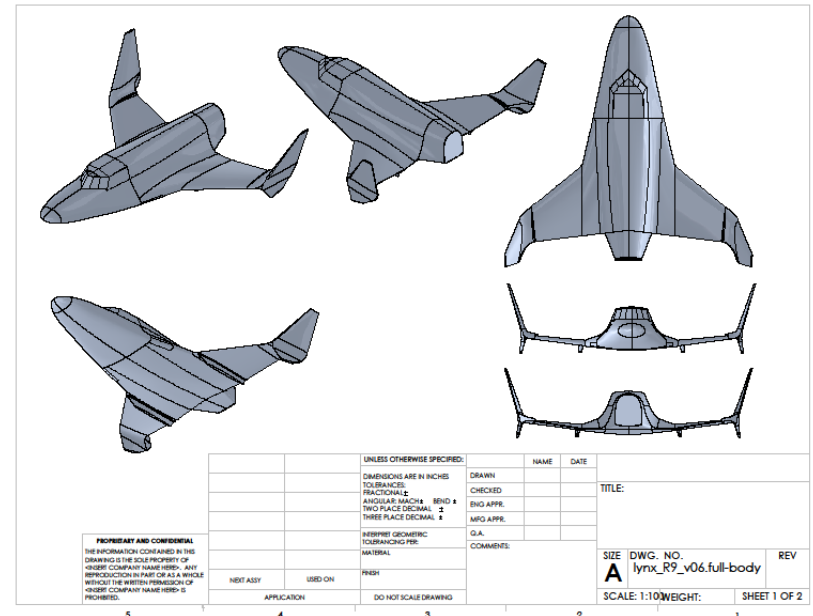
- EZ Rocket taught us ...
 - Development of safe reusable propulsion
 - Integration into airframe
 - Low cost & safe operational procedures
 - Regulatory framework
- X-Racer taught us ...
 - Pump fed fuel enabled high performance for future ops
 - Improved low cost ops and safety regime processes
 - Improved airframe skill sets and avionics integration



Lynx Overview ...



- Suborbital space vehicle
- Horizontal takeoff/landing
- Two seats – pilot plus one
- Small vehicle
 - Wingspan ~24 feet
 - Length ~30 feet
- Multi-mission capable
 - In-cockpit experiments
 - External mount experiments
 - Test pilot/astronaut training
 - Upper atmospheric sampling
 - Nano-satellite launch
 - Space tourism



Flight Operations ...

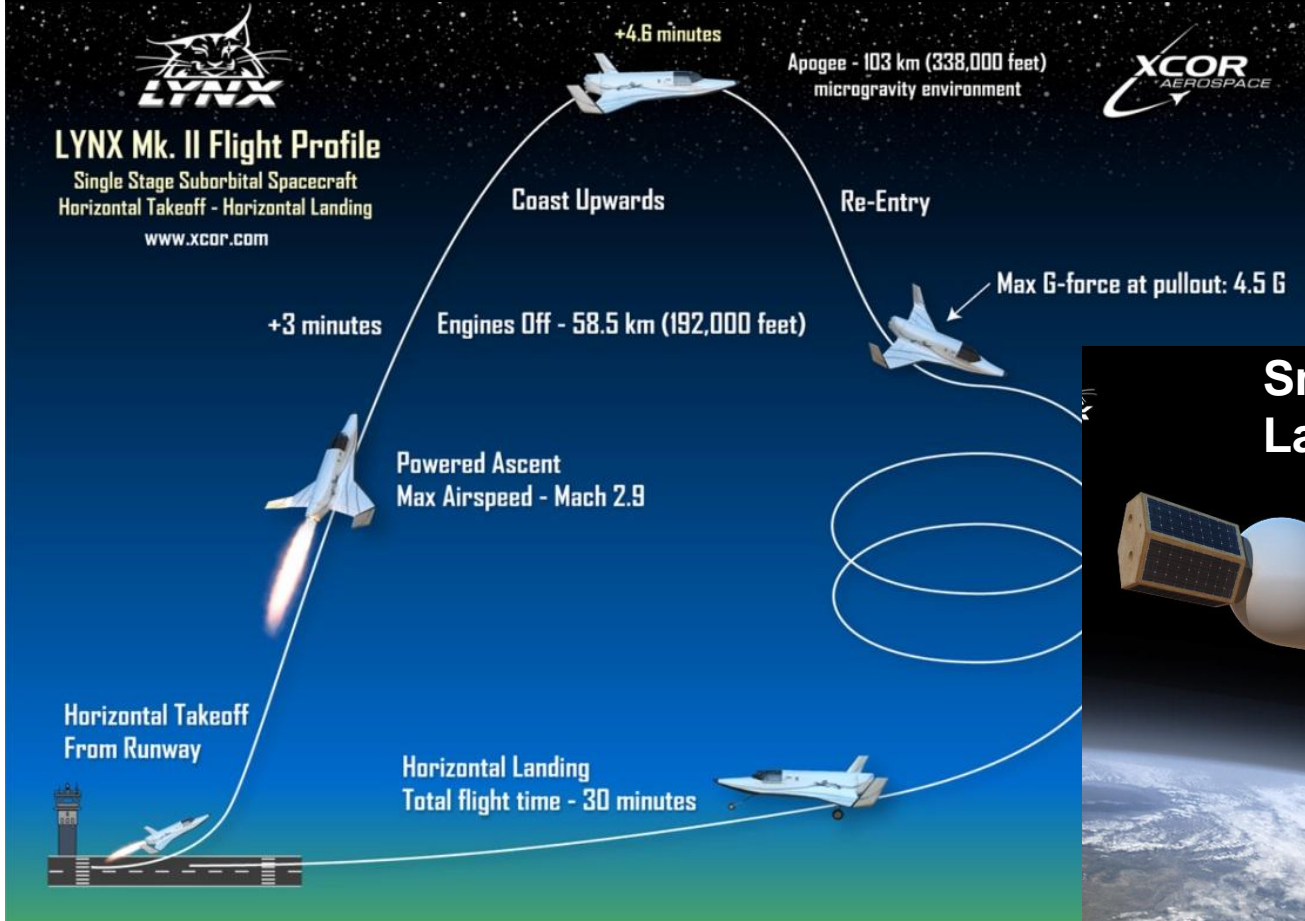


- **Aircraft-like operations from any airport with a 9,000-foot (~2800 m) runway and appropriate airspace**
- **Fast turnaround**
- **Low maintenance: two-hour engine runtime overhaul intervals**
- **Up to 4 sorties per day**
- **Weather and seasonal constraints including winds**

Lynx Missions ...



Suborbital Payloads & People



Screening & Training



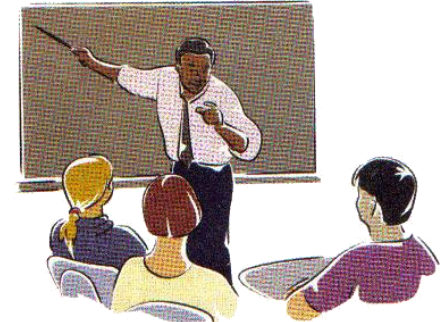
Resort Lodging:
4 days, 3 nights



Thorough Medical
Screening



Training Seminars



- “Rocket 101” – basic info found in public domain
- What not to touch!
- “Informed Consent”
- How to ingress/egress

G-Force Training
Options



Altitude Chamber

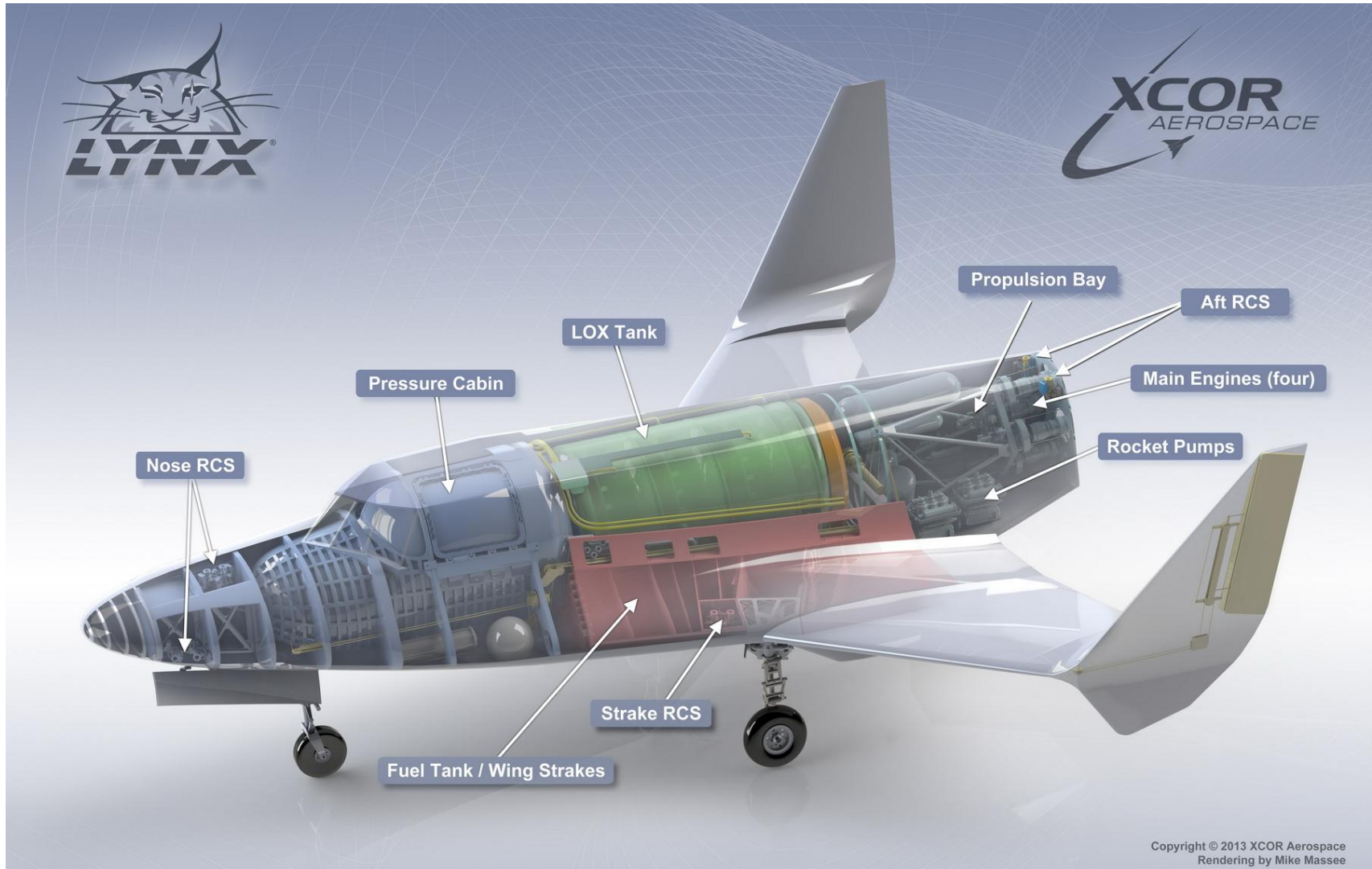


Suborbital Pressure Suit



- Manufacturer – Orbital Outfitters
 - <http://www.orbitaloutfitters.com>
- Emergency pressure suit for sub-orbital operations (“get me down suit”)
- Some Features:
 - Life support functions for 30 mins @ 500 K Feet
 - Mass of <20 Kg
 - Comfortable for the wearer
 - Can be integrated into a parachute harness
 - Visibility which is superior to existing designs
 - Cooling systems from auto racing & film industry
 - Automatic rapid activation function
 - Intuitive to operate
 - Audio system interface to vehicle

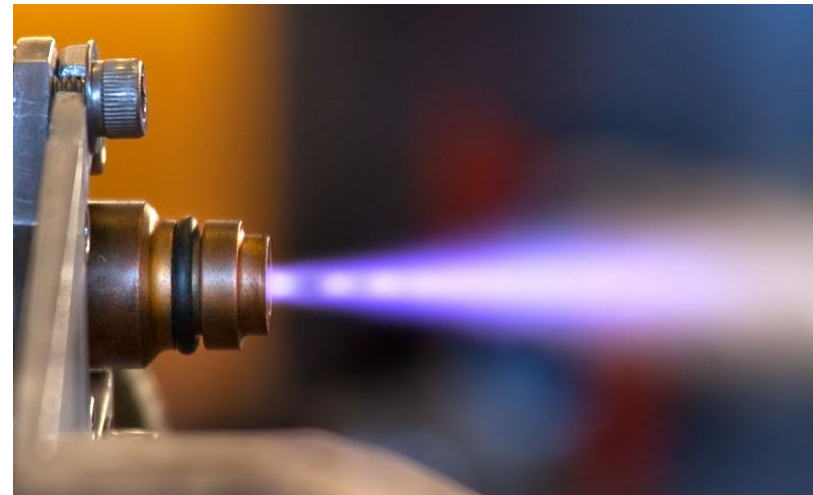
Lynx Vehicle – Main Subsystems



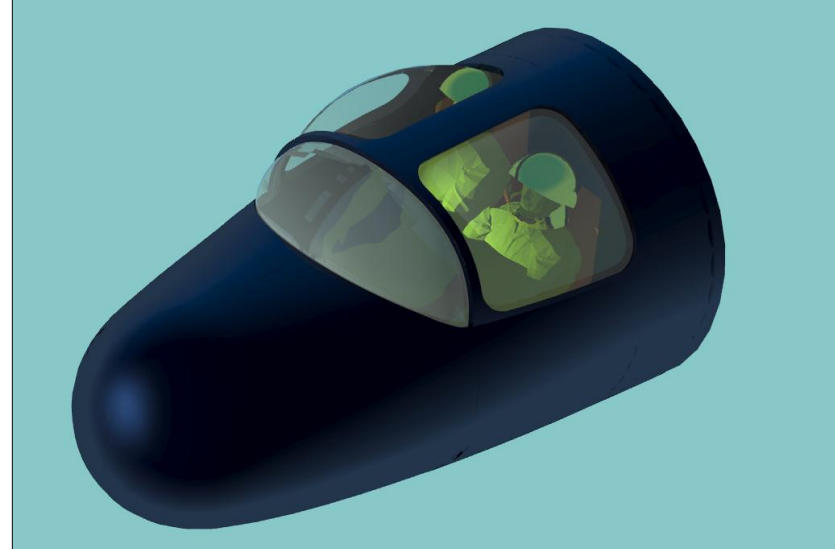
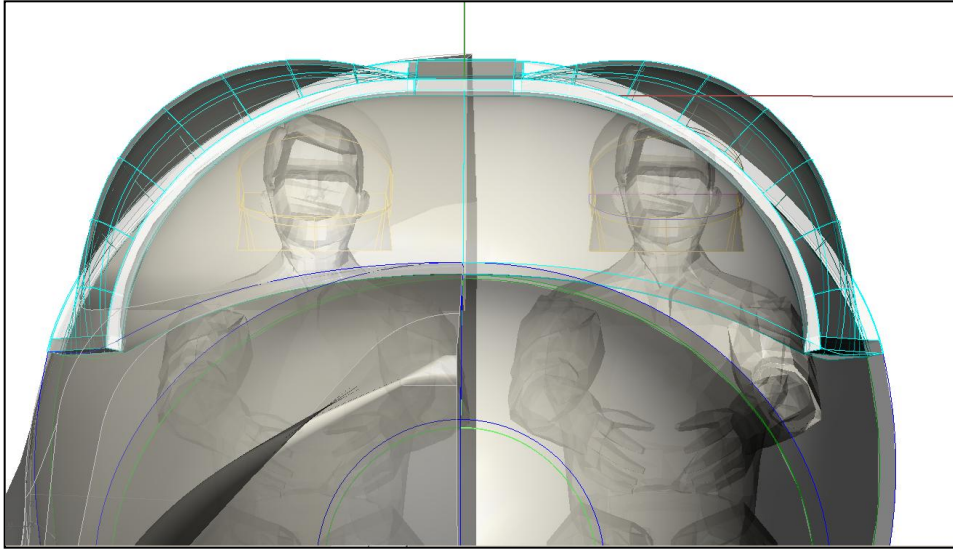
Propulsion



- Fully reusable
 - Low touch labor after flights
- Non-toxic propellants
 - LOX (Liquid Oxygen)
 - Kerosene
- Lynx 5K18 LOX/Kerosene on test stand
 - Regeneratively cooled
- Unique RCS thrusters
 - Non-toxic
 - Proprietary Bi-propellant

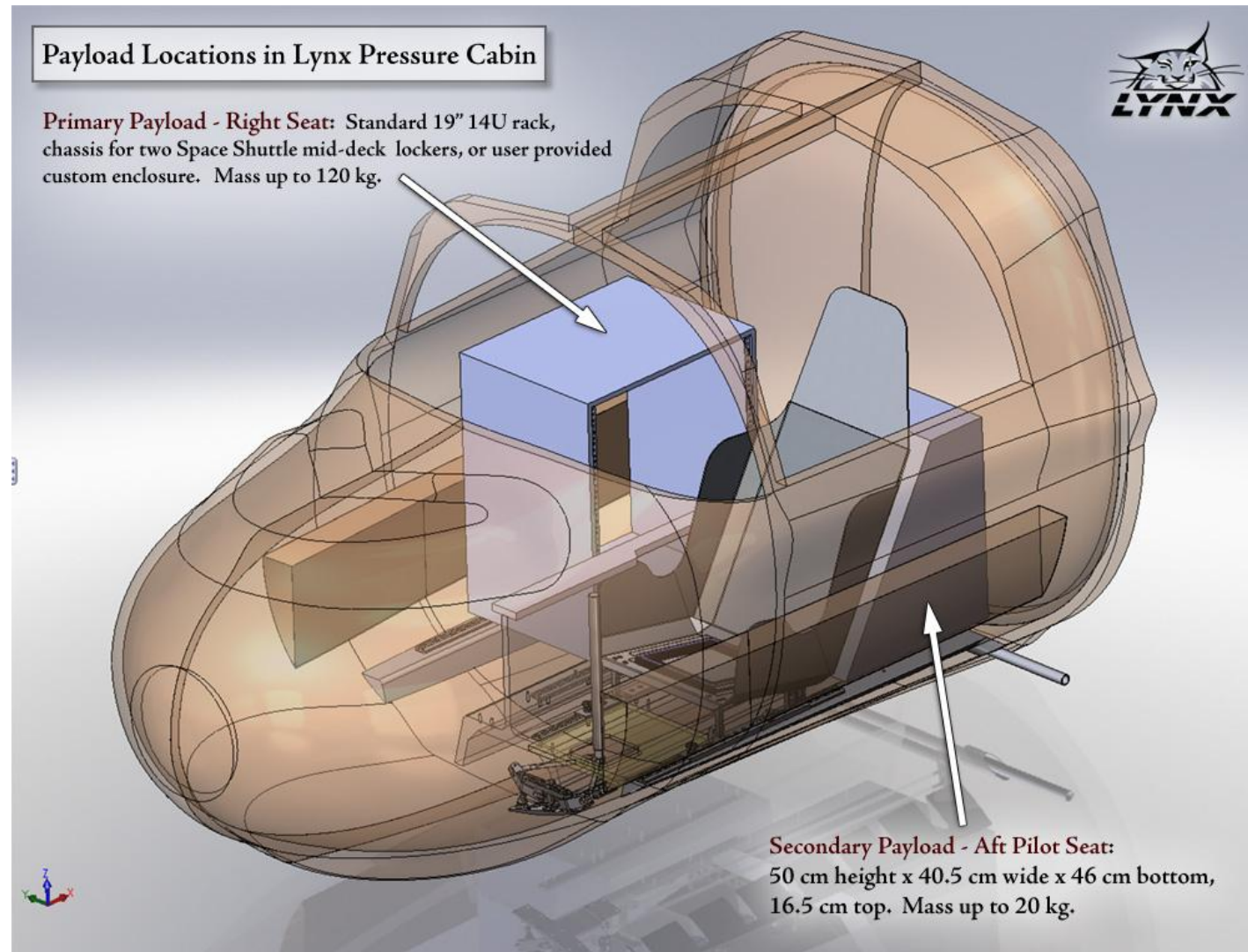


Payload Capabilities ...



- Human Payload: Pilot + Spaceflight Participant
- Internal Payload: Behind pilot and/or in place of participant
- Dorsal-mounted: Lynx pod (see next slides)

Internal Payloads



External Payloads

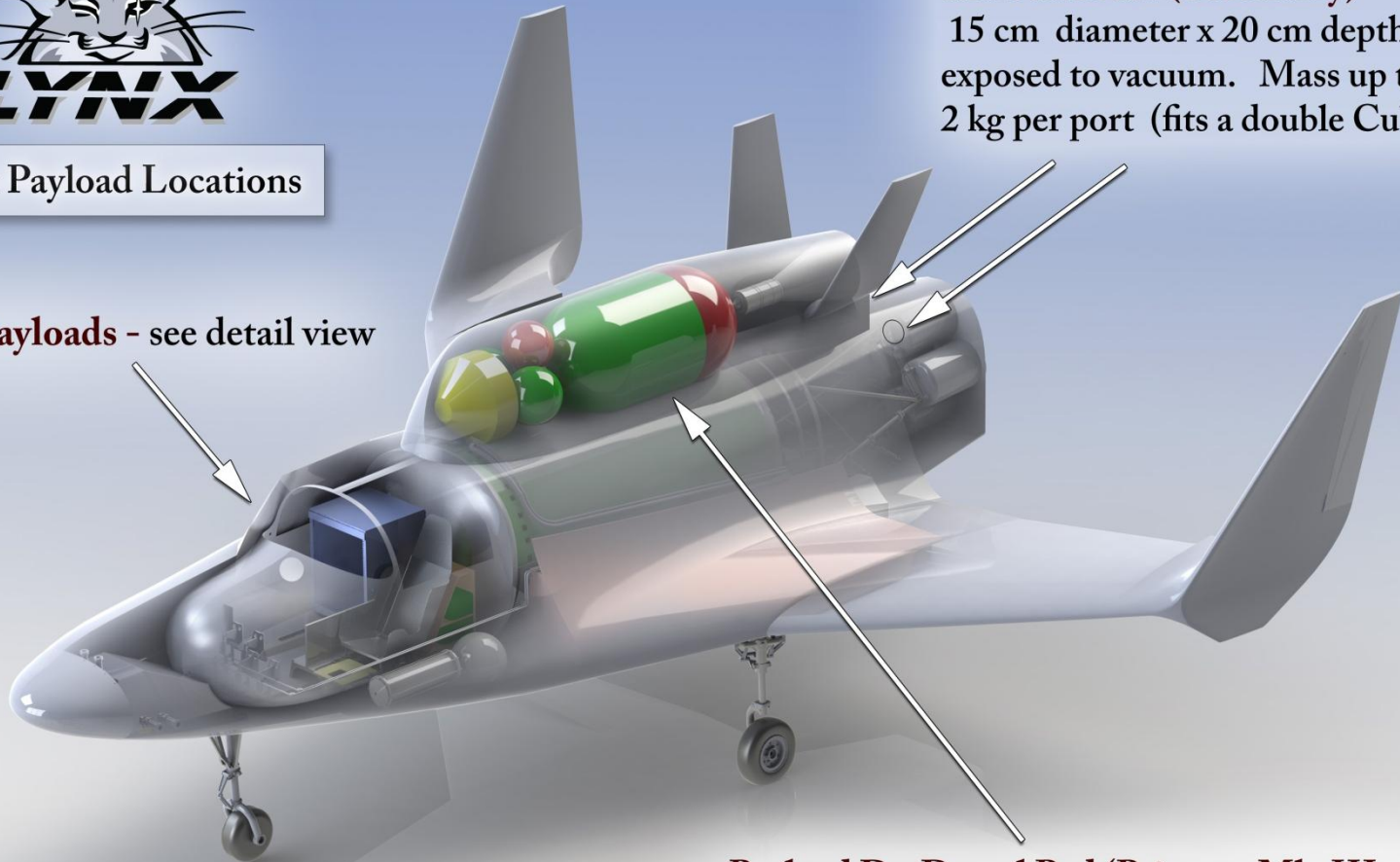


Lynx Payload Locations

Cabin Payloads - see detail view

Payloads CP and CS - Cowling Port and Starboard (Secondary)

15 cm diameter x 20 cm depth, exposed to vacuum. Mass up to 2 kg per port (fits a double CubeSat).



Payload D - Dorsal Pod (Primary, Mk. III only)
Cylindrical volume: 76 cm diameter x 340 cm long.
Mass up to 650 kg.

Lynx Build Status (2)



Lynx Build Status (3)



Questions?



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