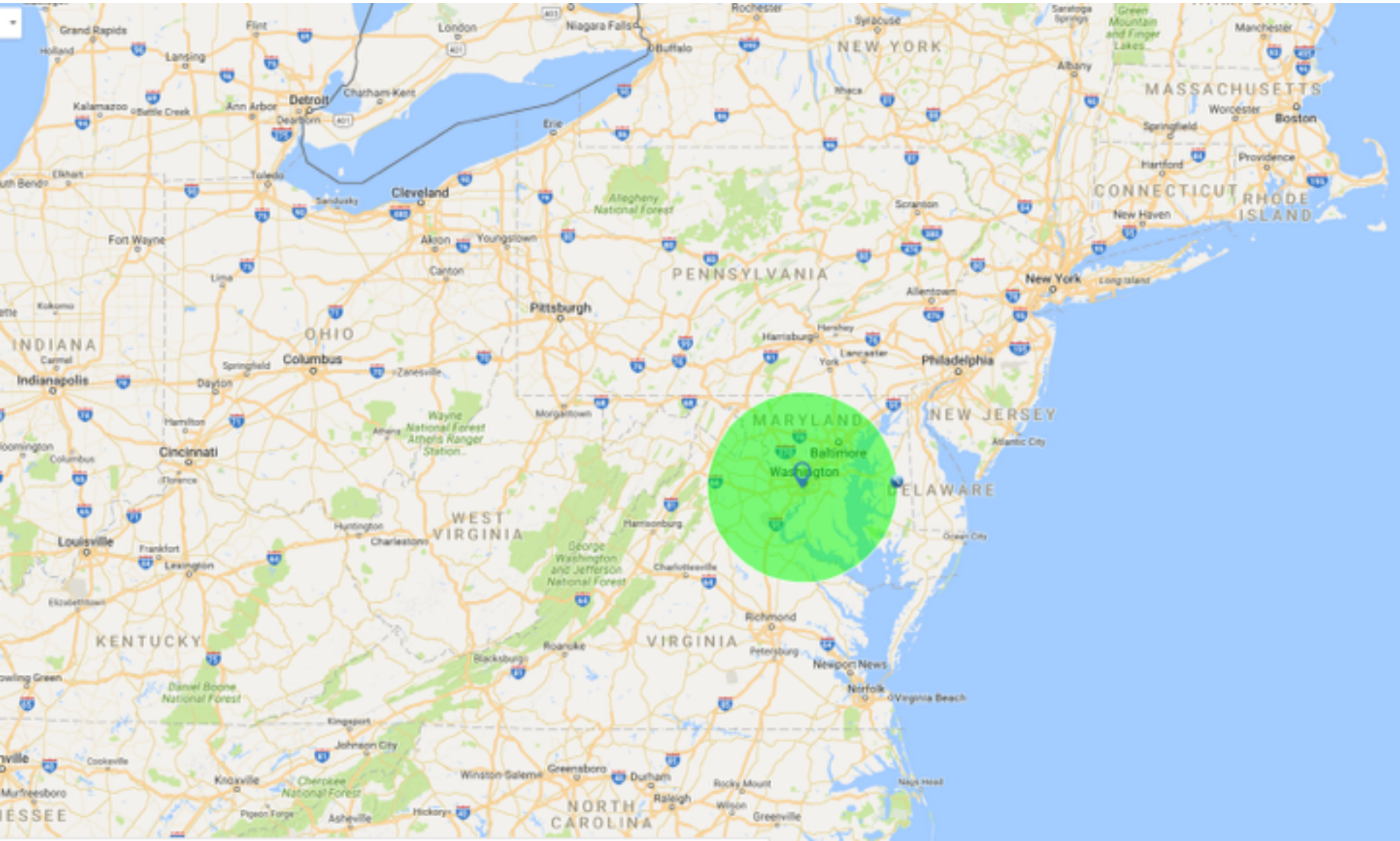
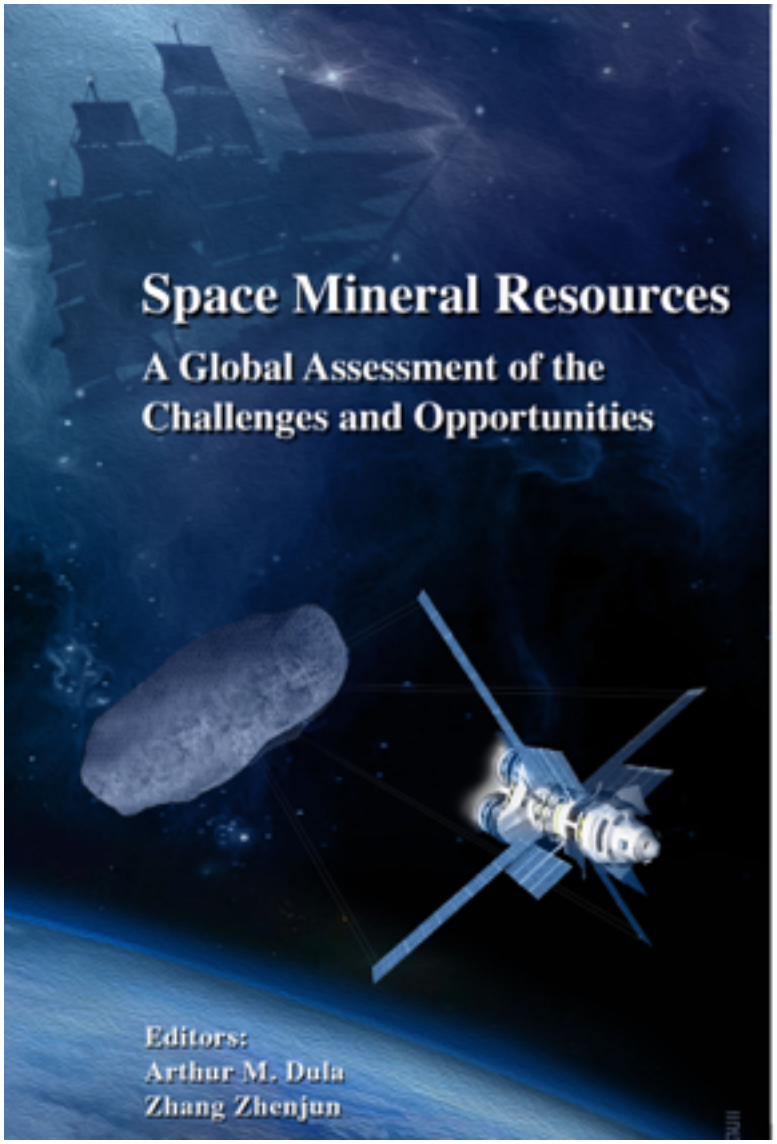
APSCO

QUICK FACT

- Space starts at 100 km up.

DISTANCE TO SPACE





International Academy of Astronautics

Study

Purpose: To provide an authoritative summary of the technology, economics, law & policy of Space Mineral Resource opportunities and to make recommendations for moving forward to develop these natural resources for human benefit.

31 Study Group Members from17 countries, 11 organizations provided content, 5 firms provided business road maps

A second IAA study on this subject has begun. The IAA seeks and invites experts from developing countries to join this study group. Please contact the editors for more details.

Principle Finding of the study.

SMR ventures cannot wait for government programs to lower technological and programmatic risks. Commercial ventures must determine the optimum path for commercial success and aggressively lead the way beyond low Earth orbit (LEO). During the first half of the 21st century, space leadership will come from commercial enterprises and not government space programs. Private enterprises will be there first and will support government explorations by selling fuel and water at designated locations. ULA now offers to pay $3,000 per kilogram of water delivered in low Earth orbit.

How can space mining benefit developing countries?

Higher GDP per capita - leapfrog over developed economies.

Genius of students - invent the future with half the world's brains.

Adventure - take the risks and reap the rewards.

Education is the key to a positive human future and the joy of discovery.

Major Study Conclusion and an update after Trump's election.

Members of the study group found that mining space mineral resources will enable economic travel between the Earth's surface and near-by locations within our solar system. The process of mining water from asteroids, the Moon or Mars will ensure that key elements are available at the spaceports of the future. Water will ensure that human exploration will expand beyond low Earth orbit with the profit motive driving the exploitation of resources.

The USA and Luxembourg have passed laws and made investments to encourage commercial space mining. The first companies are now working. I recommend that the PRC do the same.

Public-private partnerships will likely be the focus of President Elect Trump's space policy. Trump has proposed a stronger manned space program that uses commercial rockets from SpaceX, Blue Origin and others. There could be a return to the moon, possibly to mine fuel. The future of some big government programs - SLS and Orion is uncertain. The key will be probably be more "bang for the buck " by commercial competition.

UNITED STATES SPACE MINING LAW

The Supremacy Clause of the United States **Constitution** (Article VI, Clause 2) establishes that the **Constitution**, **federal laws** made pursuant to it, and **treaties** made under its authority, constitute the supreme **law** of the land.

Hierarchy of Sources of Law

a. U.S. Constitution.
b. Federal statutes, treaties, and court rules.
c. Federal administrative agency rules.
d. Federal common law caselaw.
e. State constitutions.
f. State statutes and court rules.
g. State agency rules.
h. State common law caselaw.
i. Secondary authorities

---

* Each level of enacted law includes caselaw interpreting enacted law.

History

1960

September 22: Addressing the UN Gen. Assembly, Pres. Eisenhower proposes that Antarctic Treaty principles be applied to outer space and celestial bodies.

Soviet Union would not restrict outer space to peaceful uses unless U.S. foreign bases which held short-range and medium-range missiles were eliminated.

1963

August 5: After the signing of the Nuclear Test Ban Treaty in Moscow, the Soviet Union's position changes.

October 17: UN General Assembly unanimously adopts a resolution calling upon all states to refrain from introducing weapons of mass destruction into outer space.

1966

U.S. presses for a Treaty that would give further substance to the U.N. resolution.

June 16: U.S. and the Soviet Union submit draft treaties.

June 19: UN General Assembly approves by acclamation a resolution commending the Treaty.

1967

January 27: Treaty is opened for signature at Washington, London, and Moscow.

April 25: U.S. Senate unanimously consents to its ratification.

October 10: Treaty enters into force.

Five International Treaties

- The Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, including the Moon and Other Celestial Bodies, 1967.
- The Agreement on the Rescue of Astronauts, the Return of Astronauts and the Return of Objects Launched into Outer Space, 1968.
- The Convention on International Liability for Damage Caused by Space Objects, 1972.
- The Convention on Registration of Objects Launched into Outer Space, 1975.
- The Agreement Governing the Activities of States on the Moon and Other Celestial Bodies, 1979.


CONESTOGA 1
PIONEERING THE COMMERCIAL SPACE FRONTIER
September 9, 1982, Matagorda Island, Texas

COMMERCIAL SPACEFLIGHT INDUSTRY

- Launch providers
- Payloads
  - Satellites
  - Cargo
  - Science
  - People
- Spaceports
- Supporting organizations

COMMERCIAL SPACE LAUNCH ACT

- The organic statute governing commercial spaceflight (1984)
- 51 U.S.C. 50901-50923
- Updated
  - Commercial Space Launch Amendments Act (2004)
  - FAA Reauthorization (2012) – limited extension
  - Commercial Space Launch Competitiveness Act (2015)

REGULATORY FRAMEWORK

- FAA's regulatory authority is –
  - Unlimited, when protecting the public
  - Limited, when protecting spaceflight participants

REGULATORY FRAMEWORK

- FAA regulates commercial spaceflight
  - Issues permits for experimental launches
  - Issues licenses for commercial launches
  - Does not have “in-space authority”

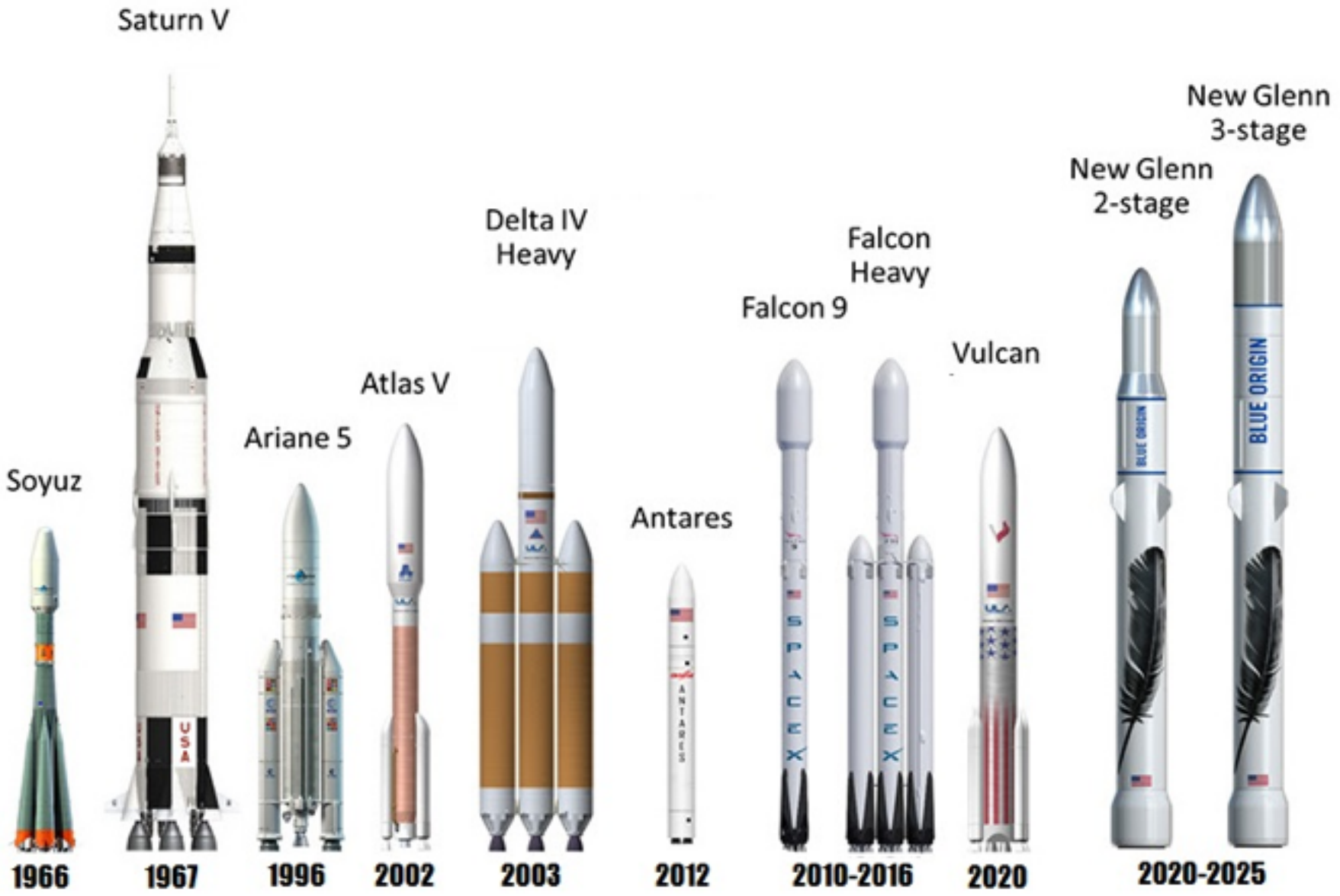
OCTOBER 4, 2004


N202VG
aabar

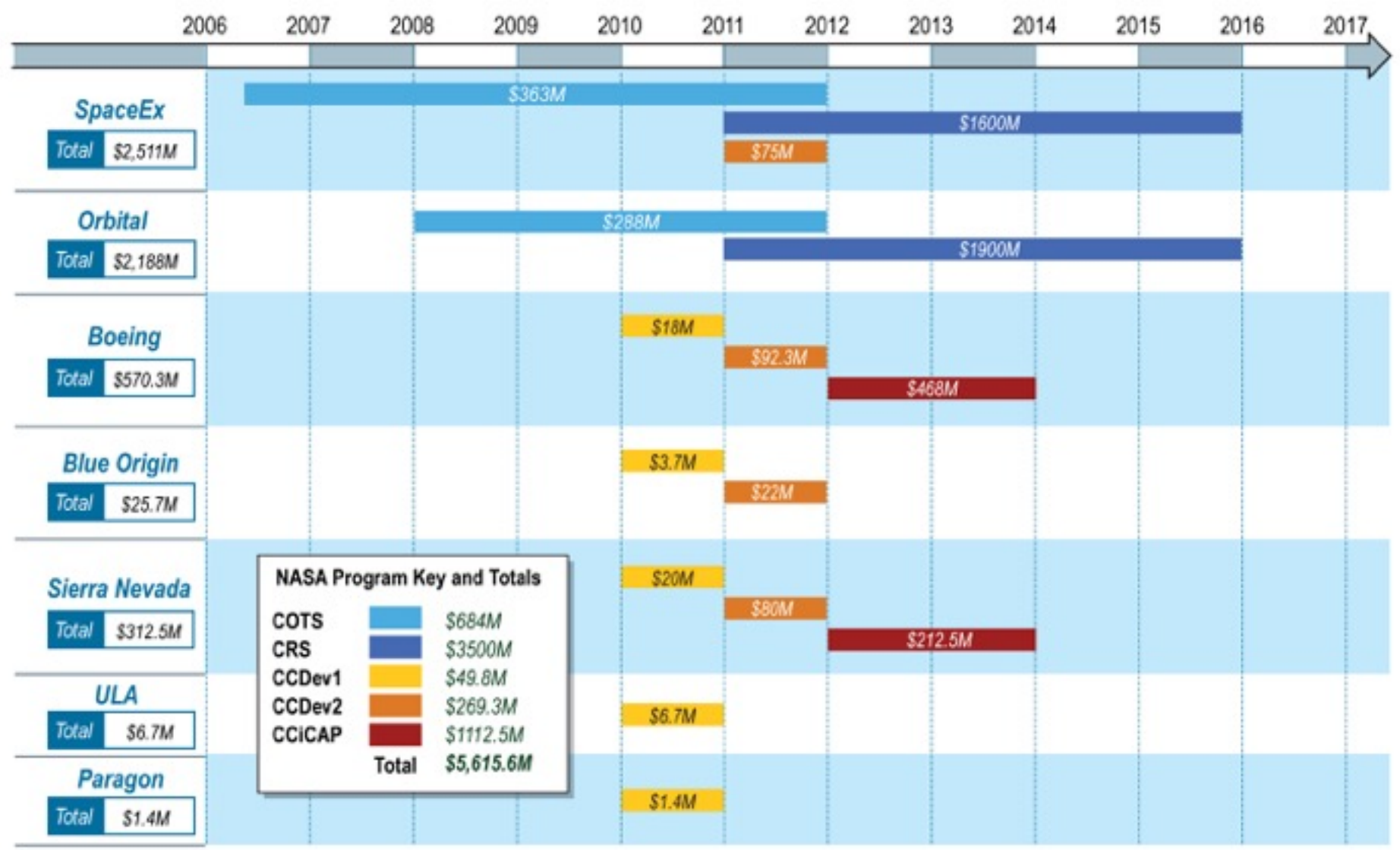

BLUE ORIGIN


BLUE ORIGIN


NASA


Soyuz
1966
Saturn V
1967
Ariane 5
1996
Atlas V
2002
Delta IV
Heavy
2003
Antares
2012
Falcon 9
Falcon
Heavy
2010-2016
Vulcan
2020
New Glenn
2-stage
New Glenn
3-stage
2020-2025

NASA Funding Timeline



This modest investment in US commercial space industry has already produced operational equipment faster and at less cost than government programs.

- Falcon 9 space launch vehicle
- Dragon reusable spacecraft
- Anteres launch vehicle
- Cygnus spacecraft

Fig. 4 – NASA Cost Analysis Comparing NASA's Predicted Cost vs. SpaceX Falcon 9 Actual Costs: >10X Cost Reduction (NASA 2011)

	NASA Model Based Prediction				SpaceX Actual Performance			
		NASA Approach				Firm Fixed Price Acquisition		
Elements	Weight (lbs)	DDT&E (FY2010 $M)	Flight Unit (FY2010 $M)	Total (FY2010 $M)	Weight (lbs)	DDT&E (FY2010 $M)	2 Test Flt Units (FY2010 $M)	Total (FY2010 $M)
Stage One (Including Engines)	39,080	$1,535	$206	$1,741	39,080	$188.7	$109.3	$298.0
Stage Two (Including Engine)	6,520	$608	$44	$651	6,506	$89.0	$23.6	$112.6
Fee (12.5%)		$268	$30	$298		$0.0	$0.0	$0.0
Program Support (10%)		$241	$21	$263		$0.0	$0.0	$0.0
Contingency (30% Vehicle, 10% Engine))		$674	$68	$741		$0.0	$0.0	$0.0
Vehicle Level Integration (8%)		$258	$24	$282		$22.2	$10.6	$32.8
Total	45,600	$3,584	$393	$3,977	45,586	$299.9	$143.6	$443.4

>10X Cost Reduction

Commercial space is the future of space.

- NASA has invested over $5 billion to create new commercial space industry in the United States.
- Europe and Japan are also actively encouraging the development of private space companies.
- These national investments have already yielded real success at a cost of less than 10% of government programs.

One Hundred Fourteenth Congress of the United States of America

AT THE FIRST SESSION

Begun and held at the City of Washington on Tuesday, the sixth day of January, two thousand and fifteen

An Act

To facilitate a pro-growth environment for the developing commercial space industry by encouraging private sector investment and creating more stable and predictable regulatory conditions, and for other purposes.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled,

SECTION 1. **SHORT TITLE; TABLE OF CONTENTS; REFERENCES.**

(a) SHORT TITLE.—This Act may be cited as the "U.S. Commercial Space Launch Competitiveness Act".

(b) TABLE OF CONTENTS.—The table of contents of this Act is as follows:

House Passes Commercial Space Industry Wish List

Misses Opportunity to Pass Bill that Could Become Law

MAY 21, 2015

News

Press Releases

In The News

Letters

News Feeds

Also See

- Full Committee Markup of: H.R. 2262, the "SPACE Act of 2015"; H.R. 1508, the "Space Resource Exploration and Utilization Act of 2015"; H.R. 2261, the "Commercial Remote Sensing Act of 2015"; and H.R. 2263, the "Office of Space Commerce Act."

KEY PROVISIONS OF CSLCA

- Extends limitations on FAA's ability to regulate
- Extends and updates launch risk-sharing
- Expands indemnification
- Streamlines licensing and permitting
- Supports industry-led standards development
- Begins to address in-space authority
- The best part

EXTENDING THE LEARNING PERIOD

- CSLAA expectations
- Expectations v. reality
- Effectuating congressional intent
  - A learning period, not a head start
  - Regulating the right way
  - Preventing barriers to entry

LAUNCH RISK-SHARING

- How it works
  - Launch provider responsible for damages up to maximum probable loss
  - US Government potentially responsible for damages above that threshold up to a limit
  - Launch provider responsible beyond that limit
- Who benefits?
- A first cut at modernization

INDEMNIFICATION

- Everybody indemnifies everybody else
- The special case of spaceflight participants
- Fun with trial lawyers

LICENSING AND PERMITTING

- Streamlines the regulatory process

- I can’t make this interesting

STANDARDS

- Supports development of industry standards
  - Industry is too diverse and rapidly-changing for technology mandates
  - Promotes standards that are –
    - Industry-led
    - Consensus-based
    - Voluntary

IN-SPACE AUTHORITY

- Outer Space Treaty question
  - Article VI:
    - …The activities of non-governmental entities in outer space, including the Moon and other celestial bodies, shall require authorization and continuing supervision by the appropriate State Party to the Treaty….
  - Is the US in compliance?
  - Should we be doing more?

THE BEST PART

- “A United States citizen engaged in commercial recovery of an asteroid resource or a space resource under this chapter shall be entitled to any asteroid resource or space resource obtained, including to possess, own, transport, use, and sell the asteroid resource or space resource obtained in accordance with applicable law, including the international obligations of the United States.”

THIS IS…

…the single most sweeping
legislative recognition
of property rights
by a country able to act on it,
ever.

Commercial Space Launch Competitiveness Act (2015)

- Extends limitations on FAA's ability to regulate
- Extends and updates launch risk-sharing
- Expands indemnification
- Streamlines licensing and permitting
- Supports industry-led standards development
- Begins to address in-space authority
- Recognizes property rights to resources obtained in space

American Space Commerce Free Enterprise Act (2017)

- Streamline the process of certifying space objects
- Streamline permitting for space-based remote sensing systems
- Ensure prompt consideration of applications by the government
- Create a presumption that permission will be granted

FOX NEWS U.S. 23 June 2017

Space Warfare: America could soon have a new branch of the military protecting outer space

By **Jason Kopp** • Published June 23, 2017

Members of Congress have laid the groundwork for the U.S Air Force to establish a new branch of the military, known as a Space Corps, by January of 2019.

The proposal came from Congressmen Mike Rogers, R-Ala., and Jim Cooper. D-Tenn., the top representatives of the Strategic Forces Subcommittee, which oversees military space operations. They introduced the legislation into the House Armed Services Committee National Defense Authorization Act (NDAA) on Tuesday.

According to a joint statement by Rogers and Cooper, the Space Corps would reorganize the national security space enterprise "to ensure prioritization of the space domain by creating a U.S. Space Corps as a separate military service within the Department of the Air Force and under the civilian leadership of the Secretary of the Air Force."

WASHINGTON — Lawmakers on Tuesday took the first step towards establishing a 'Space Corps' within the Air Force — similar to the way the Marine Corps functions in the Navy — by drafting legislation that would require the new organization to be set up by January 1, 2018 to serve "as a separate military service within the Department of the Air Force and under the civilian leadership of the Secretary of the Air Force."."

"We must act now to fix national security space and put in place a foundation for defending space as a critical element of national security. Therefore, our Mark will require the creation, under the Secretary of the Air Force, of a new Space Corps, as a separate military service responsible for national security space programs for which the Air Force is today responsible. We view this as a first, but critical step, to fixing the National Security Space enterprise."

Thank you

For more information please contact:

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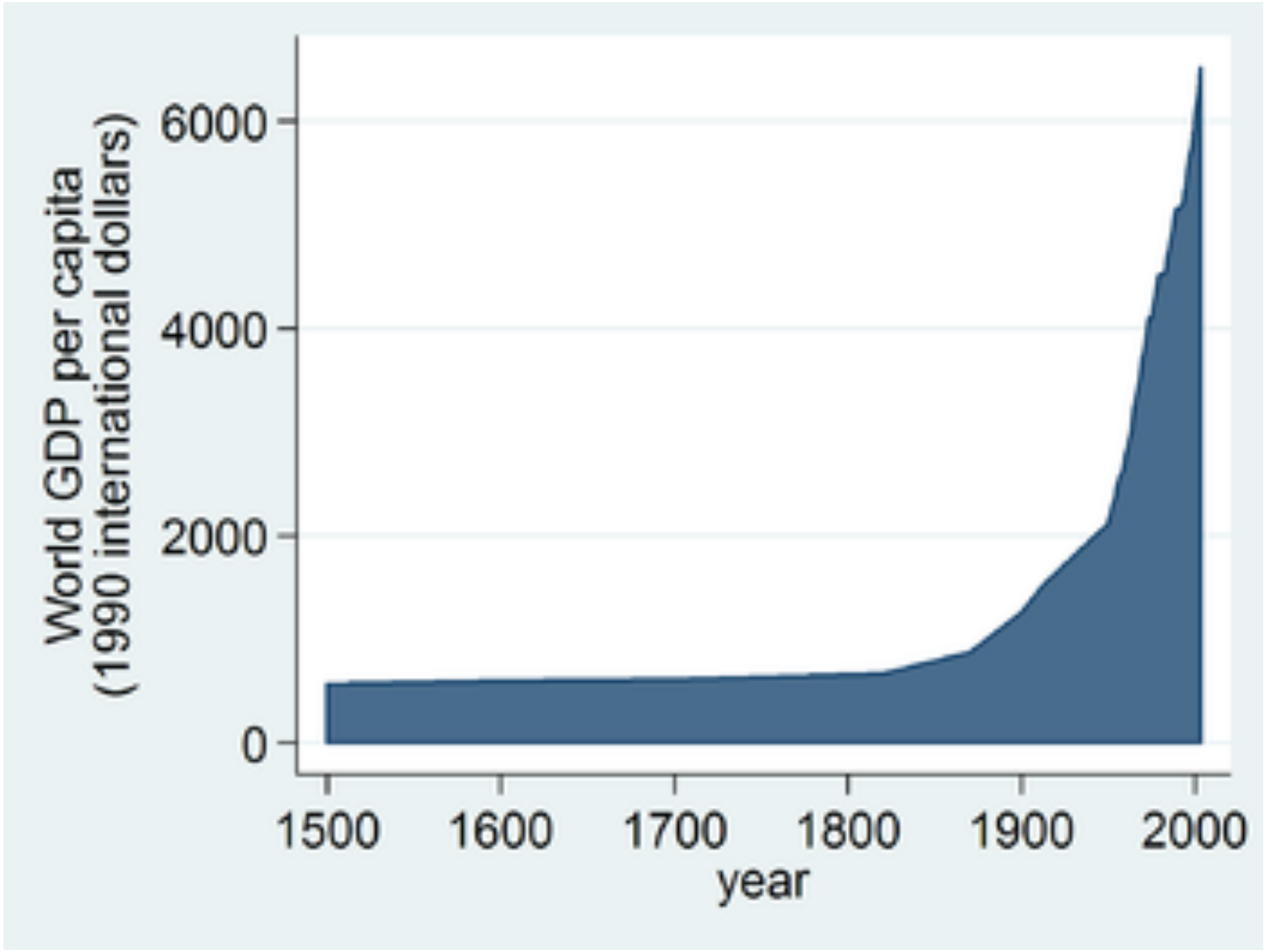
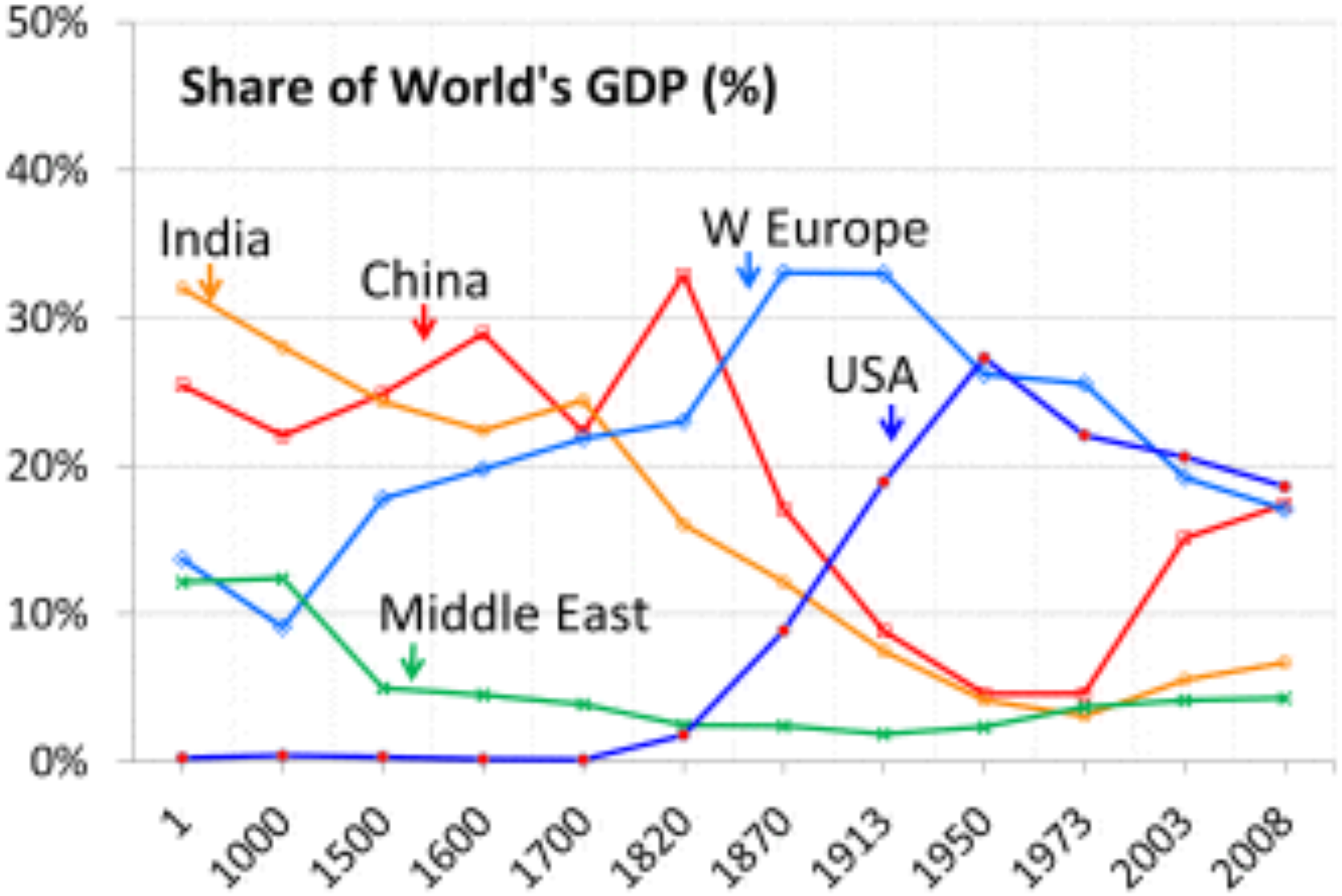
zhenjun_zhang@126.com

Back up slides
Economics
Heinlein Prize Trust

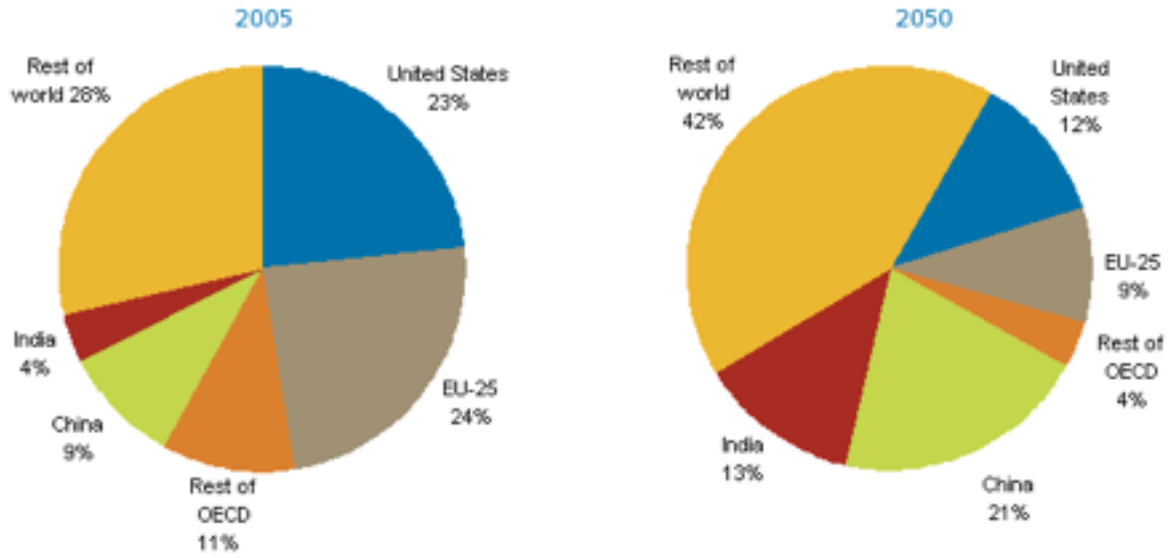

World Population
Since 1800 Wikipedia and the CIA World Factbook estimate that the Gross World Product (the combined product of all nations) has grown from U.S. $175 billion to $84.97 trillion.
A growth rate of 48,554%.
The population grew 725% during that same period
7,000,000,000
6,000,000,000
5,000,000,000
4,000,000,000
3,000,000,000
2,000,000,000
1,000,000,000
-
1300
1400
1500
1600
1700
1800
1900
2000


World GDP per capita
(1990 international dollars)
6000
4000
2000
0
1500
1600
1700
1800
1900
2000
year


Share of World's GDP (%)
50%
40%
30%
20%
10%
0%
India
China
W Europe
USA
Middle East
1
1000
1500
1600
1700
1820
1870
1913
1950
1973
2003
2008

By 2021, China overtakes the United States as the world's largest economy; in 2083, India overtakes China, largely due to higher population growth. India's GDP reaches nearly US$34 trillion by 2050. By 2050, China, India and other currently developing economies comprise over 67 per cent of global GWP (Chart 3.11).

Chart 3.11: Distribution of gross world product



Source: Treasury projections.

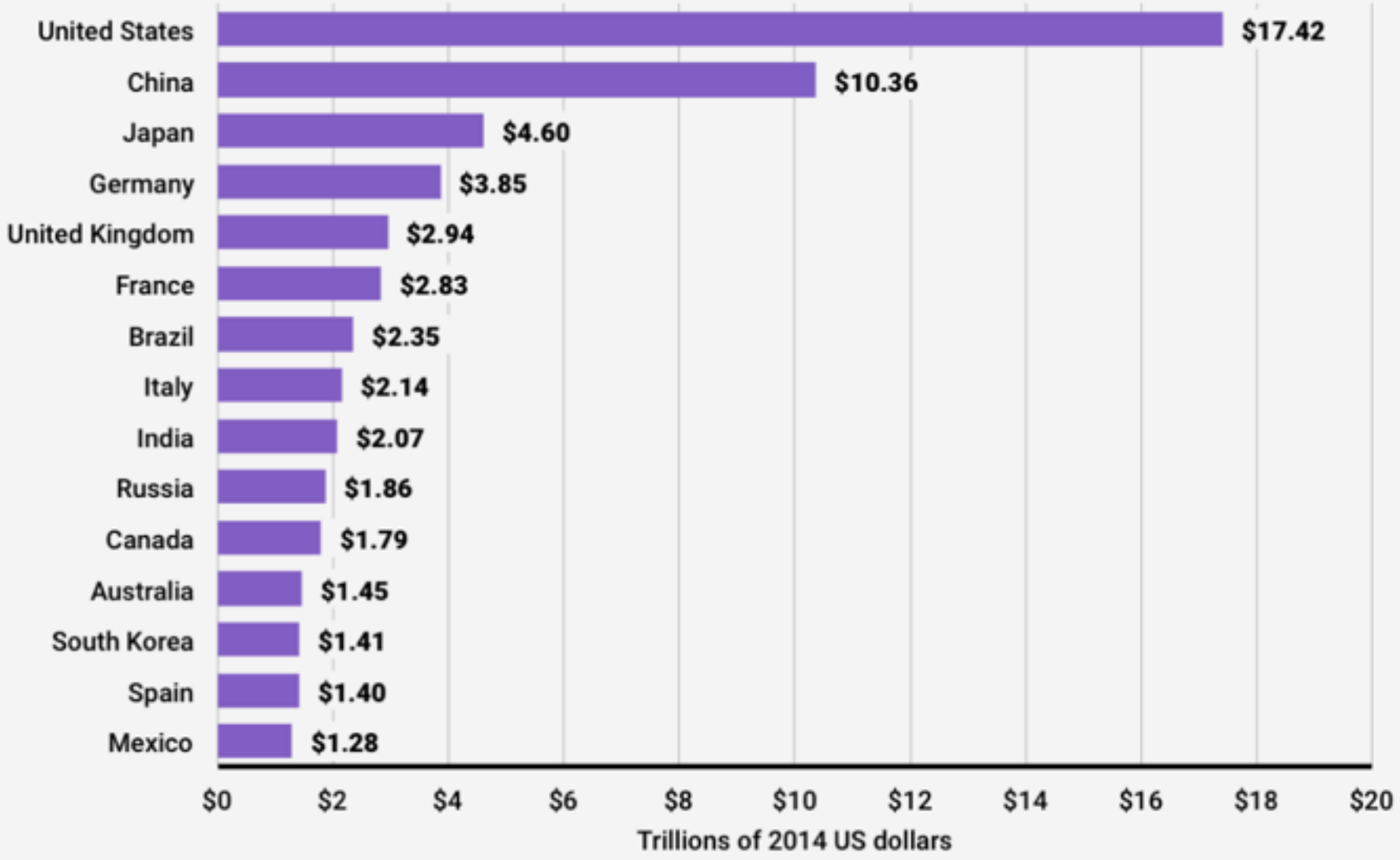
3.1.3 Sectoral analysis

As developing economies' living standards improve, the composition of their economies is expected to adjust. The share of GDP being derived from the services sectors will shift as more luxury goods appear in developing economies. This generally lowers the emission intensity of output, as the services sector is relatively low in emissions.

However, other trends push in the other direction. Adjustments occur in the types of goods in demand within sectors. For example, meat consumption, which is relatively more emission intensive, is expected to increase, while grain consumption is expected to fall in relative terms.

Developed economies continue the trend towards an increased share of the service sector (Chart 3.12). The United States service sector increases from around 63 per cent of total output in 2005 to over 68 per cent in 2050. At the same time, the share of other sectors such as manufacturing declines. A similar pattern occurs in developing regions, where the share of the service sector increases from around 32 per cent of total output in 2005 to 41 per cent by 2050.

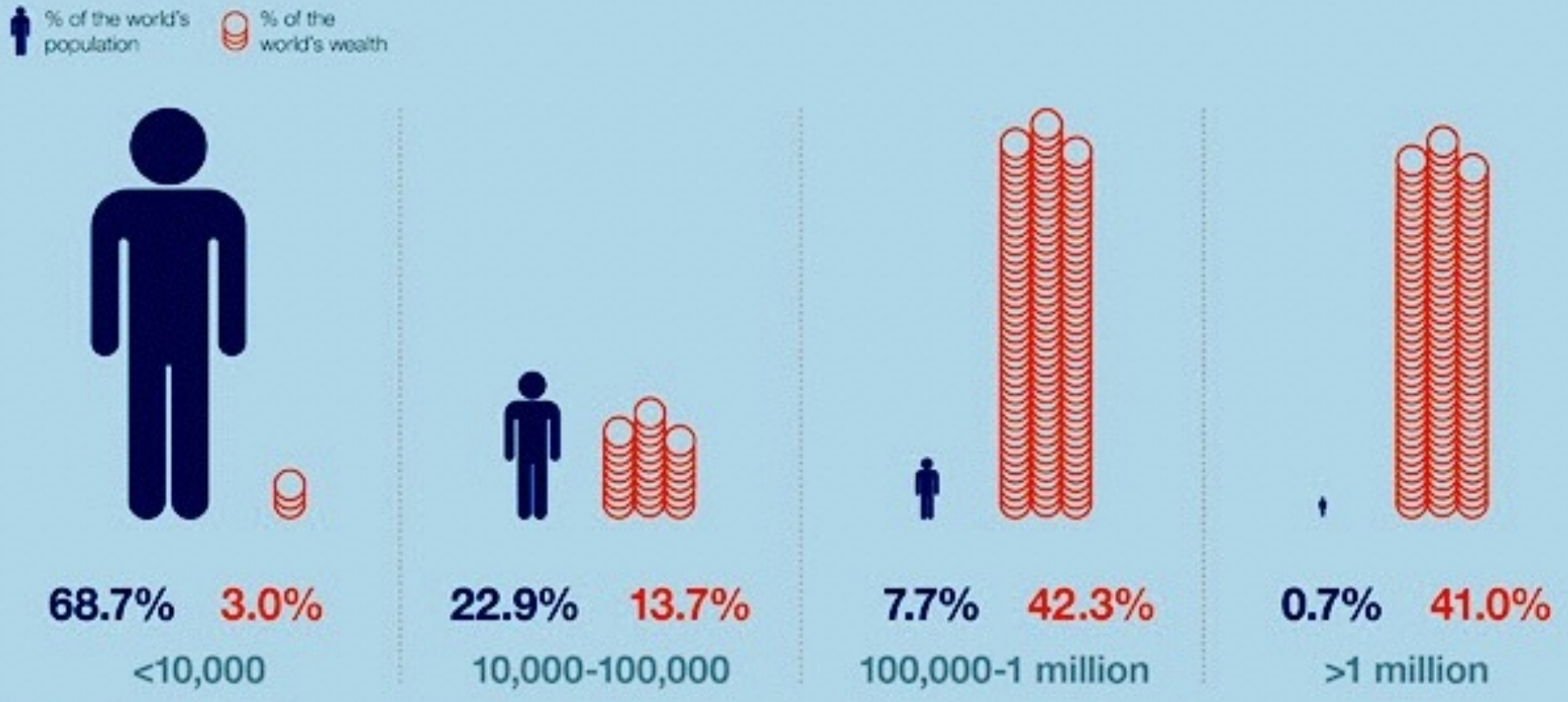
GROSS DOMESTIC PRODUCT, 2014



SOURCE: World Bank

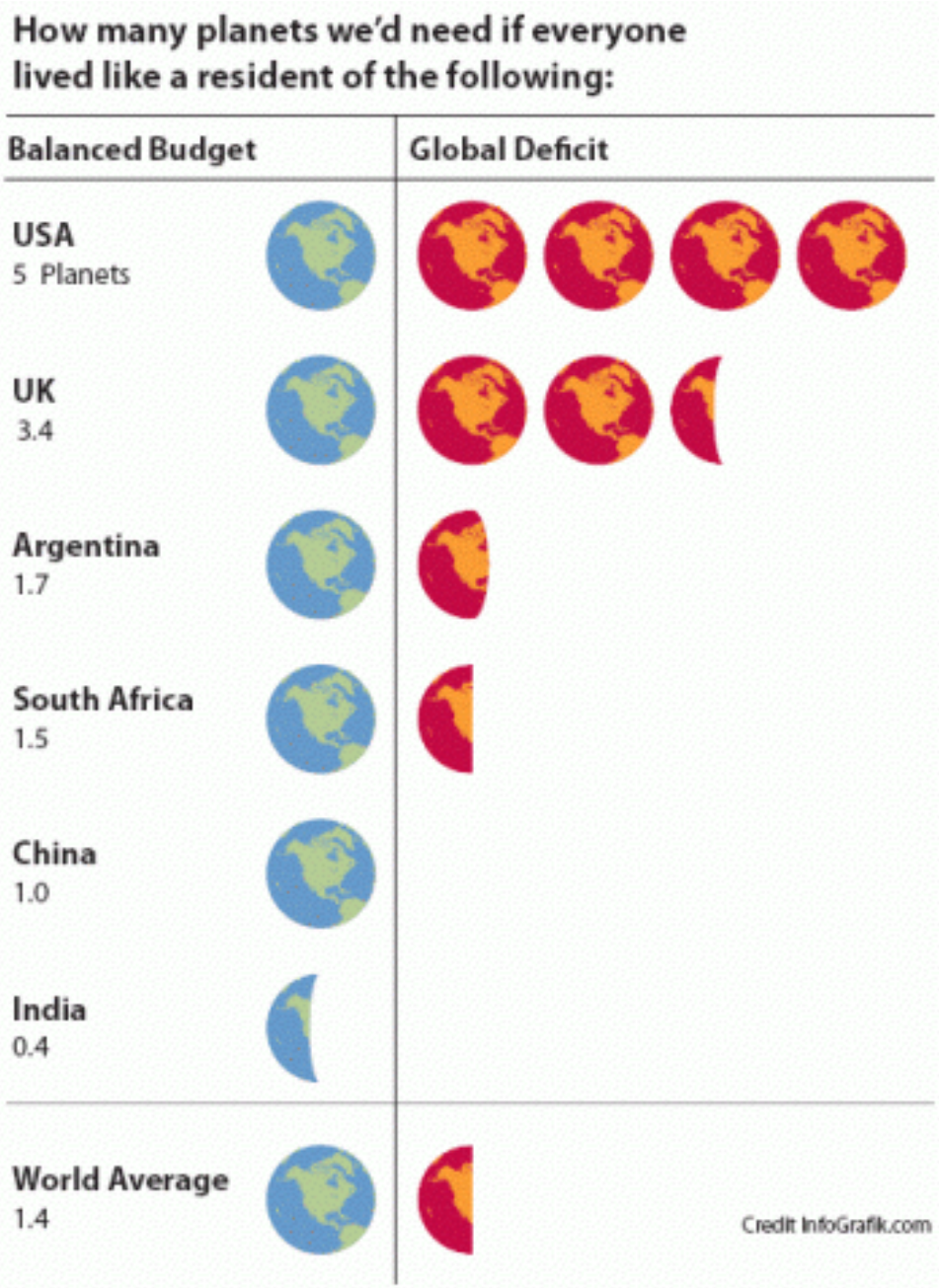
BUSINESS INSIDER

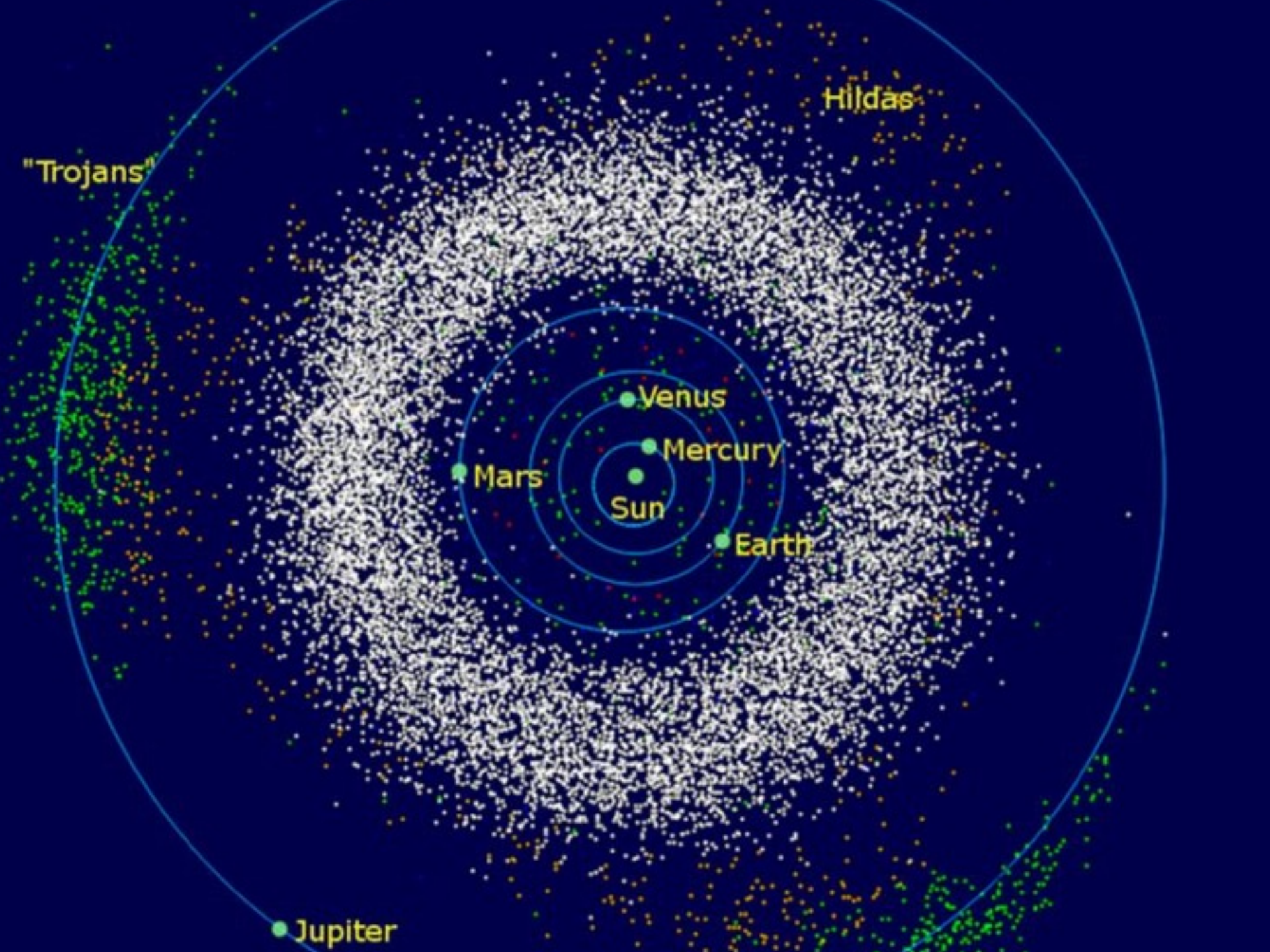
How is the **world's wealth** shared amongst its population?

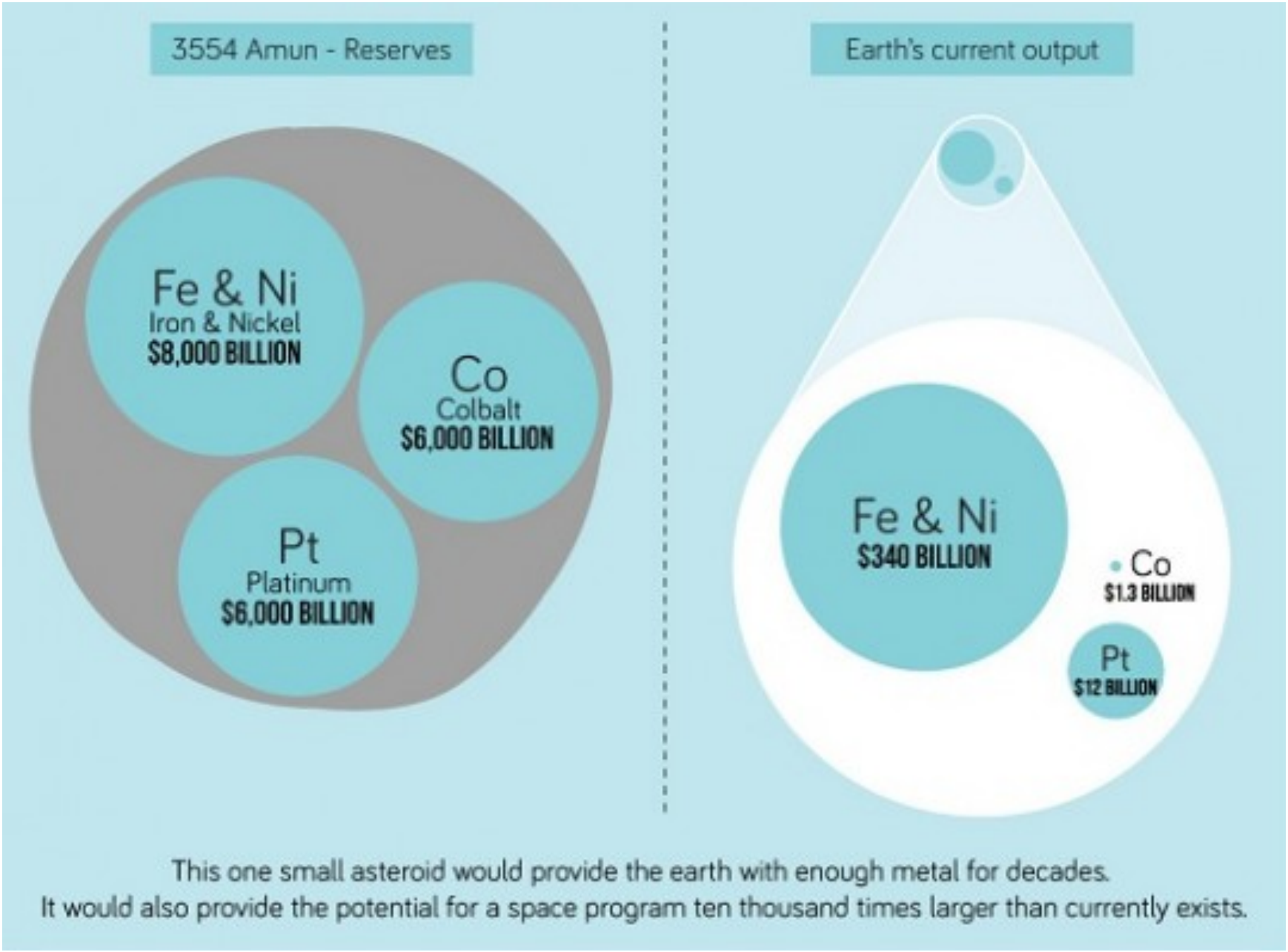


"Wealth" is defined as the marketable value of financial assets plus non-financial assets (principally housing and land) owned by an adult, less debts
Source: Global Wealth Report 2013. Zurich: Crédit Suisse

How many planets we'd need if everyone lived like a resident of the following:



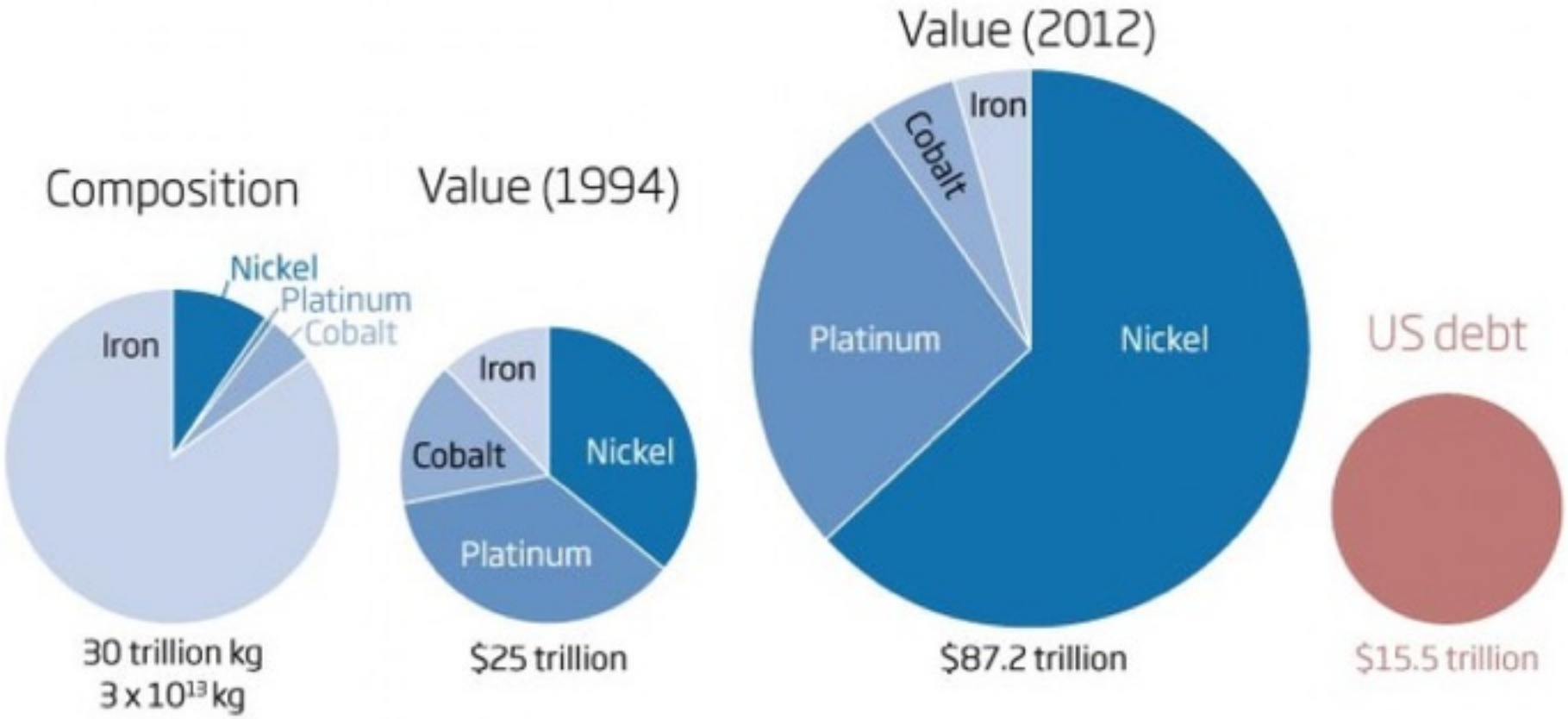

Hildas
"Trojans"
Venus
Mercury
Mars
Sun
Earth
Jupiter

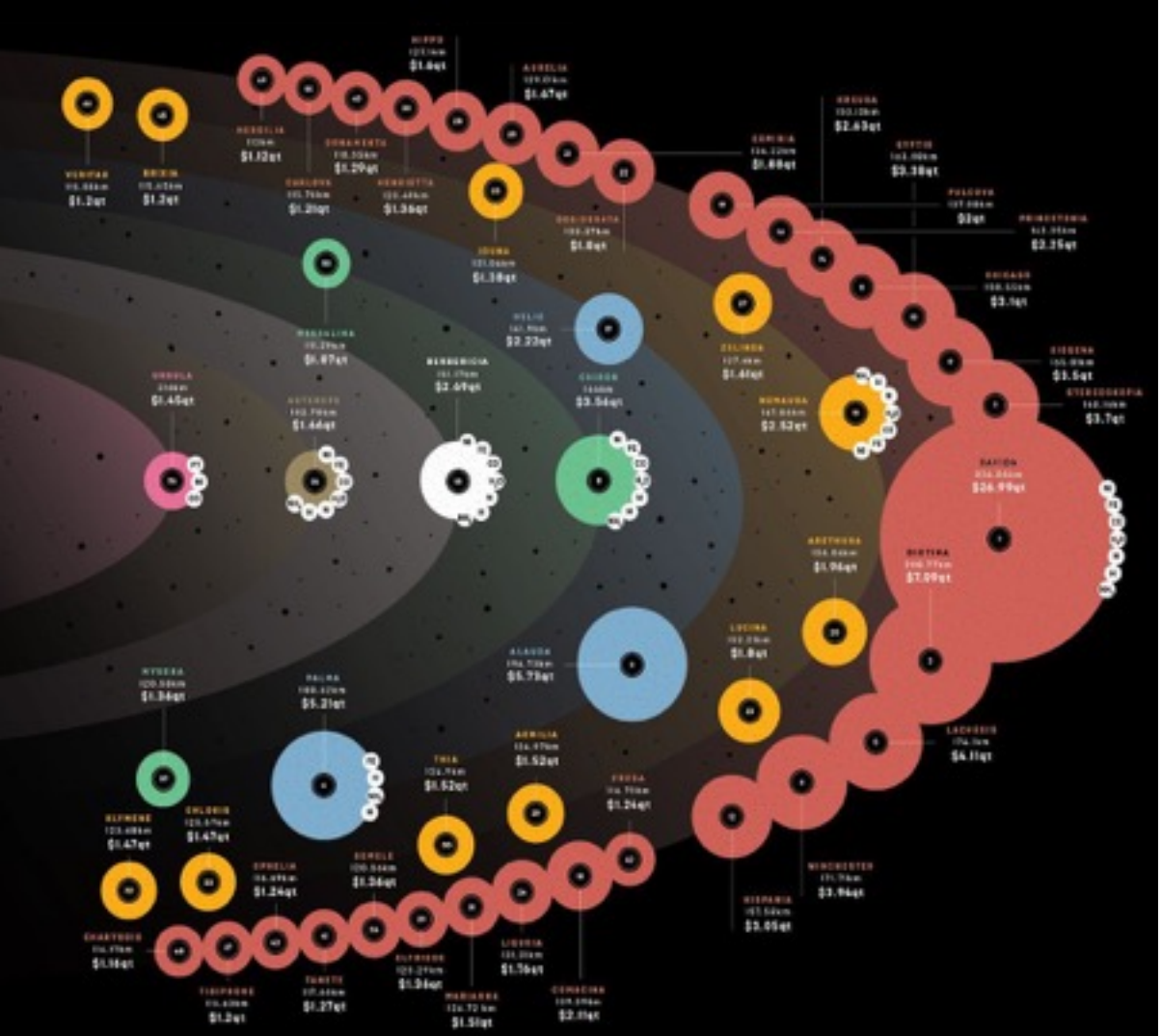

3554 Amun - Reserves
Fe & Ni
Iron & Nickel
$8,000 BILLION
Co
Colbalt
$6,000 BILLION
Pt
Platinum
$6,000 BILLION
Earth's current output
Fe & Ni
$340 BILLION
Co
$1.3 BILLION
Pt
$12 BILLION
This one small asteroid would provide the earth with enough metal for decades.
It would also provide the potential for a space program ten thousand times larger than currently exists.

Cosmic cornucopia

Asteroids could be a valuable source of metals. In 1994, William Hartmann at the Planetary Science Institute estimated the value of a 2-kilometre-wide metal rich asteroid

Asteroid 1986 DA





KEY

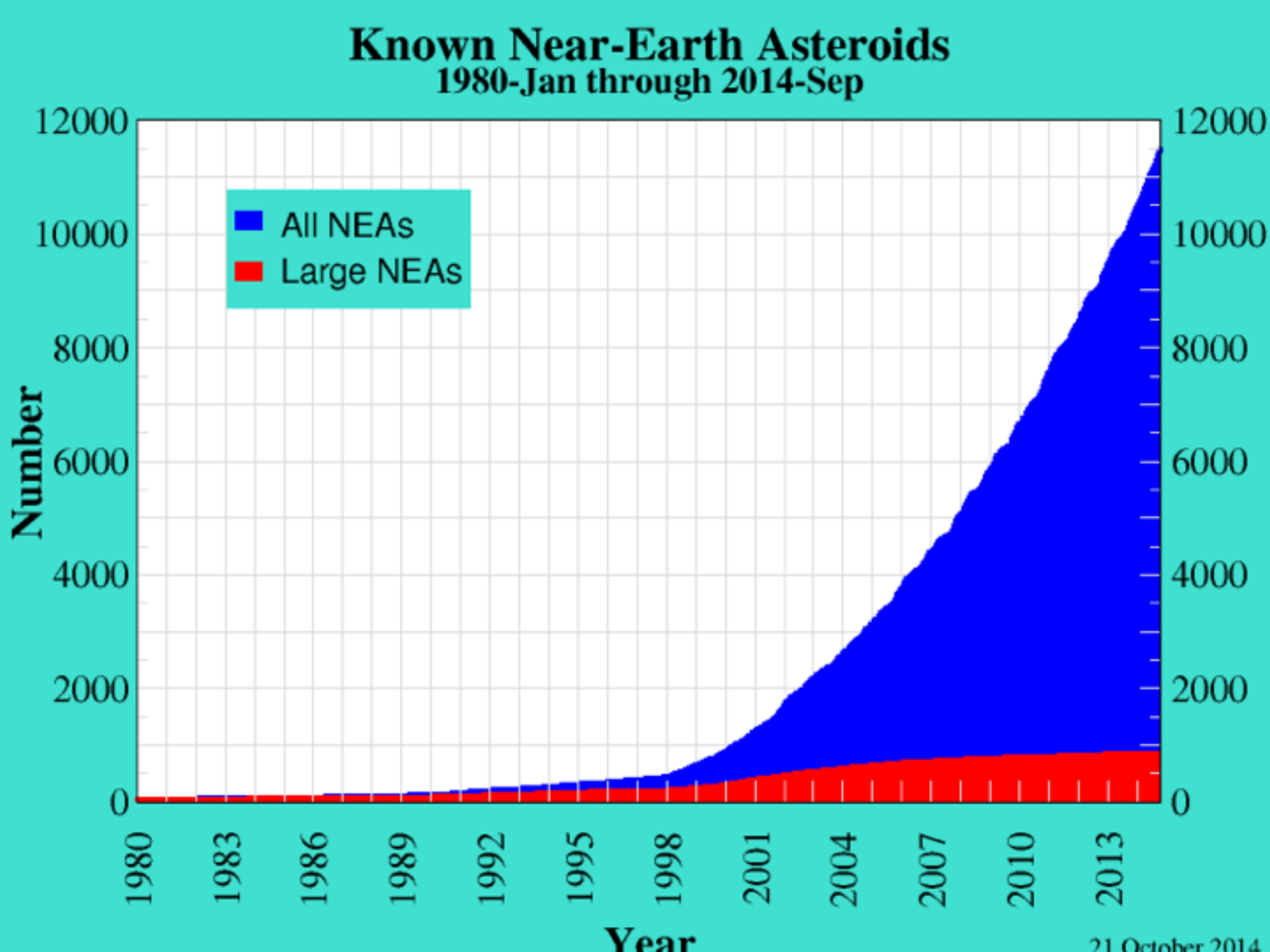
ASTEROID
Real diameter (km)
Value ($) quintillion (qt)

Composition
Rank by value
Size: asteroid value

COBALT
IRON
HYDROGEN
WATER
NITROGEN
AMMONIA
NICKEL
PLATINUM

ASTEROID TYPE

M+ Metallic-carbonaceous
S Stony chondrite
S Uncommon carbonaceous
Ch Chondrite (Bencubbin-like)
Cgh Carbonaceous mica/clay
Ch Chondrite (Alan Hills 85085-like)
C Carbonaceous chondrite


Known Near-Earth Asteroids
1980-Jan through 2014-Sep
All NEAs
Large NEAs
Number
Year
0
2000
4000
6000
8000
10000
12000
1980
1983
1986
1989
1992
1995
1998
2001
2004
2007
2010
2013
21 October 2014

MUCH MORE IMPORTANTLY…

WHAT WE REALLY NEED

- To marshal the forces that have always propelled humanity:
  - Liberty
  - Property Rights
  - Free Enterprise
  - Markets


The Robert A. and Virg
Heinlein Prize Trus


MISSION X
train like an astronaut

Partners for the Future- Spacesuit Exhibition
The Heinlein Prize Trust
Chinese Society of Astronautics

ORLAN SPACE SUIT DISPLAY
"海鹰" 航天服

The Orlan space suit photo stand is brought to you by Excalibur Exploration and the Heinlein Prize Trust (HPT). This spacesuit is part of an actual Orlan suit used for training Cosmonauts in the Russian Space program.

The suit itself, including visors and gloves, are about 30 years old. When you step into this display you're putting on an actual piece of space history.

美国神剑探索公司和美国海因莱茵基金会（HPT）为您带来"海鹰"航天服照相架。"海鹰号"航天服在俄罗斯航天计划中用于航天员训练，该照相架是"海鹰"航天服实物的一部分。

该航天服（包括面罩和手套）已有30年历史。当您踏入展厅，您将置身于一段真实的航天史中。

SOKOL SPACE SUIT
"猎鹰" 航天服

The Sokol space suit (Russian: Сокол, meaning Falcon) is a type of Russian space suit, worn by all who fly on the Soyuz spacecraft. It was introduced in 1973 and is described by its makers as a rescue suit. It is not capable of being used outside the spacecraft in spacewalks or extra-vehicular activities. Instead, its purpose is to keep the wearer alive in the event of an accidental depressurization of the spacecraft.

"猎鹰"航天服是俄罗斯"联盟"号飞船使用的一款航天服，于1973年推出。该航天服能够在飞船出现意外减压时保护航天员，但不能用于太空行走或舱外活动，因而被作为救生服使用。


А.КАЛЕРИ
A.KALERY