



PLANETARY
RESOURCES™

@PlanetaryRsrcs

Briefing to Keck Institute for Space Studies
Applications of Asteroid Redirect Technology

Commercial Roles and Connections

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@interplanetary

Why We Are Explorers

“More than by any other imaginative concept, the mind of man is aroused by the thought of exploring the mysteries of outer space. Through such exploration, man hopes to broaden his horizons, add to his knowledge, improve his way of living on Earth.”

—President Dwight Eisenhower, June 20, 1958

*“Fifty years after the creation of NASA, our goal is no longer just a destination to reach. Our goal is the capacity for people to work and learn and operate and live safely beyond the Earth for extended periods of time, **ultimately in ways that are more sustainable and even indefinite.** And in fulfilling this task, we will not only extend humanity’s reach in space—we will strengthen America’s leadership here on Earth.”*

—President Barack Obama, April 15, 2010

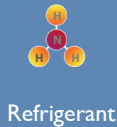
The Resources Near Earth in Space



Potable Water
Radiation Shielding



Fuel

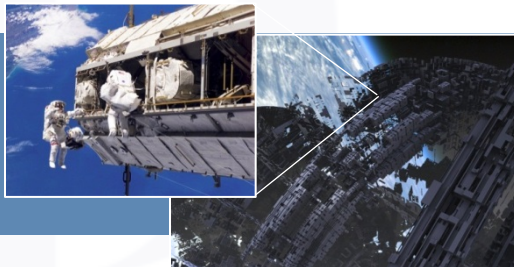


Refrigerant



Agriculture
Metallurgy

VOLATILES AND H₂O
to fuel the growth of humanity
into new frontiers



INDUSTRIAL METALS
to construct and sustainably
service space platforms



Catalytic Converters

LCDs

Advanced materials

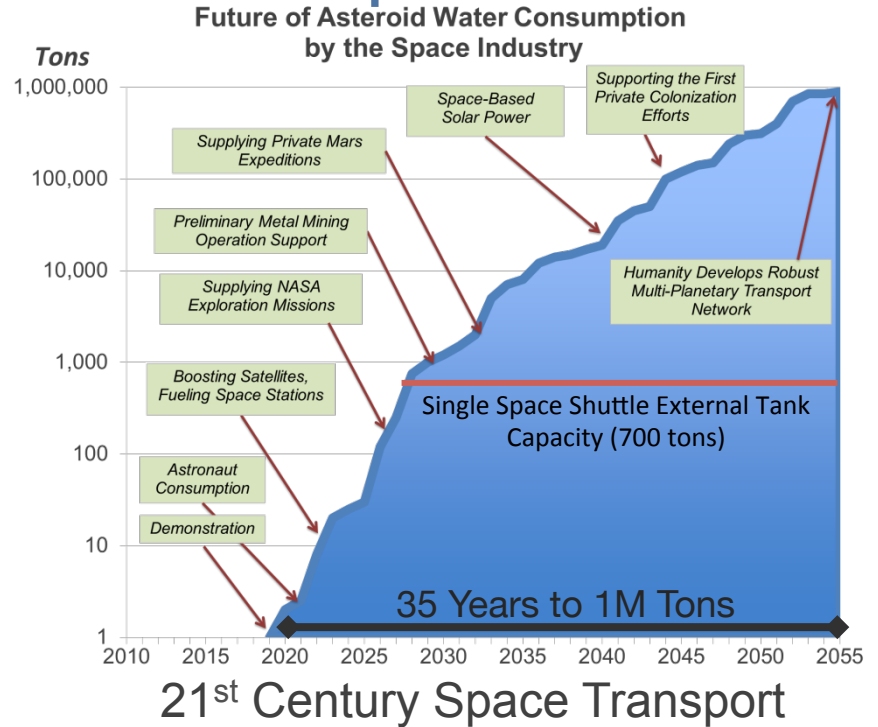
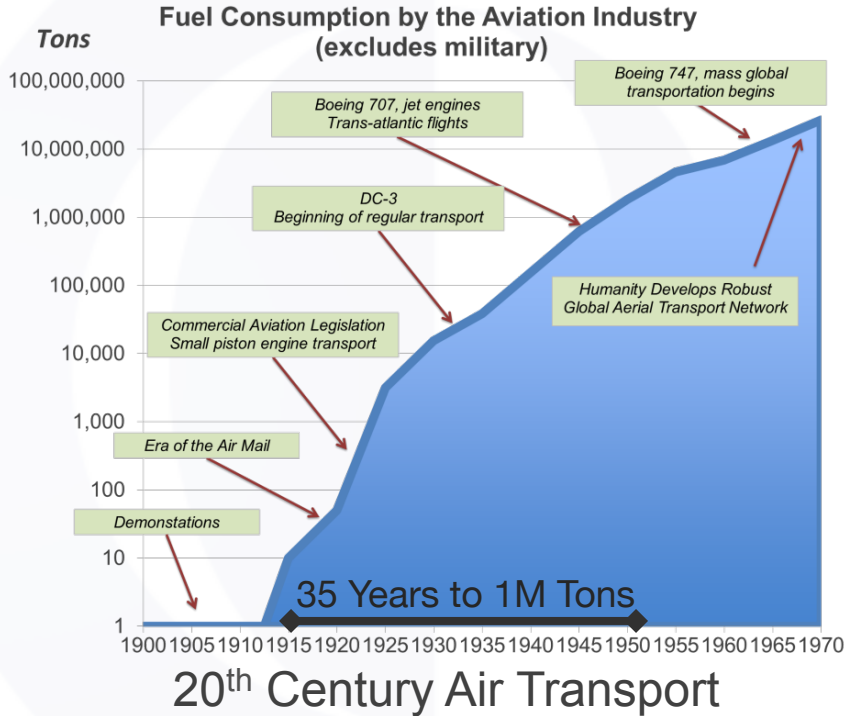
Cancer treatments

PLATINUM GROUP METALS
to support demand growth on Earth



Despite desire to reduce dependency,
one-in-four manufactured goods require PGMs.

Long Term H₂O Market Place in Space



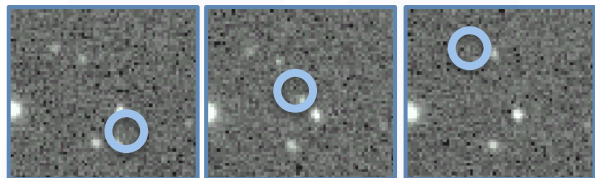
Could the Wright brothers have foreseen the growth of the airline industry?

Staged-Gate Prospecting Phases

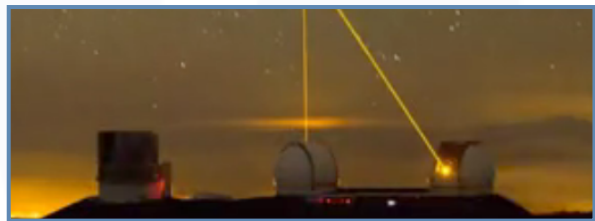


Catalina
Pan-STARRS
LINEAR

Detection



Point-source detection



Location: High Uncertainty

Composition: Unknown

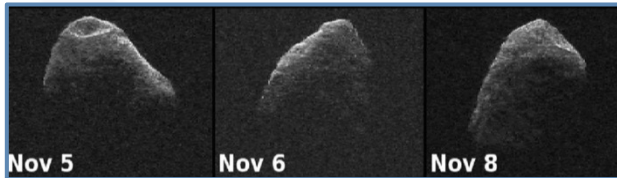
Diameter: 20m ————— 200m

Example In-Situ
Value Bounds: **\$100M - \$500B**

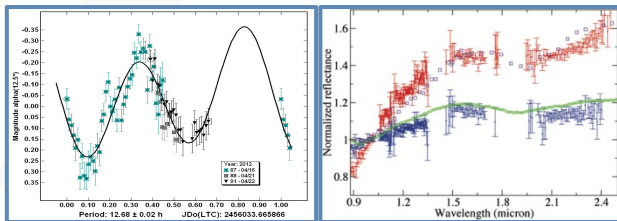


Arecibo
IRTF
Arkyd100/200

Remote Prospecting



Radar shape models, spin rate, albedo, IR spectra



Location: Well Defined

Composition: C-Class (rough classing)

Diameter: 130m ————— 190m

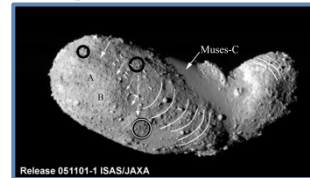
\$40B - \$500B



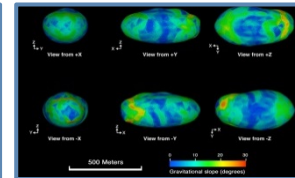
Arkyd 300

Local Prospecting

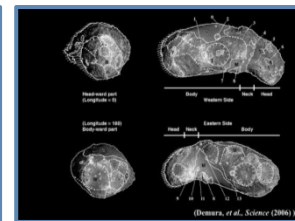
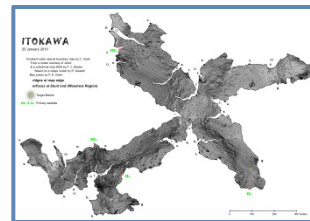
Dev



Release 051101-1 ISAS/JAXA



Terrain mapping, macroporosity, composition subclass



Location: Well Defined

Composition: C_M – 25% volatiles; 15% H₂O

Diameter: 171-172m

\$380B - \$390B



Challenges and Incentive Prizes

- NASA and others are evaluating Centennial and other incentives, perhaps intended to:
 - Broaden involvement beyond NASA and traditional contractors
 - Provide environment for exploration of alternative and/or non-traditional contributing solutions
 - Connect NASA with economic interests leveraging federal investment
- The last few years...
 - Lots of RFIs & workshops
 - Many “no-funds exchange Space Act Agreements”
 - More funding for CubeSats than asteroid applications

Catalyzing commercial space development

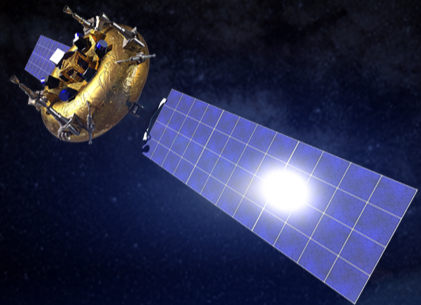
- Provide multiple non-mission critical “supporting roles”
- Create opportunities where marginally commercial programs become economic
- Allow commercial providers to deliver a product, service or technology where they can count, *in part*, on NASA being an early customer
- Facilitate acquisition methods which allow working with minimal FAR and NPR 7120.5 overhead.

Specific Areas of Opportunity – Prior to ARM

- R&D on anticipated material property characteristics and operational environments on small NEOs
 - Terrestrial, parabolic flights, orbital laboratories
- Development and demonstration of ARM technologies (current BAA)
- Precursor missions to reduce prime mission risk
 - Target identification and characterization (Sentinel)
 - Flyby and rendezvous missions to bracket mass and risk environment
 - Characterization of MANY potential candidate asteroids

Specific Areas of Opportunity – Post ARM

- In-situ analyses, processing and beneficiation experiments (robotically or astronaut-placed)
- Demonstrations and increasing utilization of infrastructure *derived from space resources*
- **Follow-on missions** to future targets of interest, including Mars and its moons



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