

Resource Markets in Space

You won't buy it, even if it's free.

How I got here

- Amateur satellites
- Micro-satellites
- Inflatable space stations
- Mining Instrumentation
- Antarctic Broadband
- CubeSats
- Deep Space Industries
- Orbit Fab



Space Exports

Existing:

- Telecommunications
- Remote Sensing
- Precision Navigation and Timing
- National Security
- Science, Politics and Prestige

Possible:

- Tourism
- Entertainment Content
- Manufacturing
- Mining (for Earth return)



Terrestrial Markets (2011)

Metal	Tonnage for \$100M value	% Annual Market for \$100M	Tonnage for \$1Bn value	% Annual Market for \$1Bn
Platinum	1.8	0.9%	18	9.4%
Total PGE	2.6	0.6%	26	5.7%
Gold	3.1	0.1%	30	1.3%
Silver	86	0.4%	860	4.0%
Molybdenum	2,265	1.1%	22,647	11.1%
Tin	3,021	1.1%	30,209	11.1%
Nickel	6,250	0.4%	62,500	4.0%
Chromium	7,505	0.4%	75,053	4.3%

Price and Market – Helium-3 (2011)

- 2010 Report “The Helium-3 Shortage”
- Used in research and neutron detectors
- Produced from Tritium decay
 - Nuclear weapons program, ~8,000 liters per year
 - Potential supply from heavy-water reactors
- Demand increase for nuclear material detectors after 9/11
 - Stockpile 230,000 liters in 2001
 - Stockpile 40,000 liters in 2010
- Price steady at \$100/liter (\$17M per tonne)
 - Some reports of \$2,000 per litre
 - Total < USD \$10 million

In-Space Economy

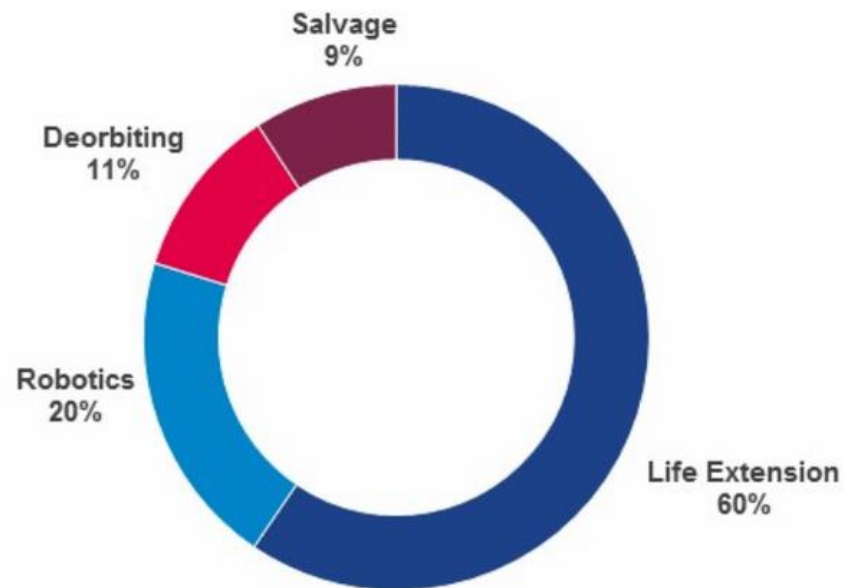
- Satellites
 - Electronics
 - Structures
 - Propellant
 - Consumables
- Propellant \$3Bn/yr
 - 2015 launch market: \$6Bn
 - Propellant Fraction: 50% (50% GeoCom, each with 4x fuel mass)
- ULA CisLunar 1000
 - 210 tonnes LH2/LOX @ \$3M/tonne => \$630M

A False Start

- MDA / Intelsat supply agreement, March 2011
 - 1,000 kg of Hydrazine
 - \$280M
- MDA predicted \$200M/year
- Price of the rocket fuel only a fraction of this
 - \$20,000/kg displaced launch cost
 - ~1 tonne = \$20M/year total market
- Contract was cancelled
 - Establishes the potential for selling commodity materials in orbit

An Auspicious Future

IoS Addressable Market by Type of Service
(2017 - 2027)



Source: NSR

- NSR's In-Orbit Servicing Markets report, Jan 2018
 - Total market of over \$3B in the next 10 years
 - 71% fuel-dependent
- NGIS MEV: 2 launches in 2019
- SSL/MDA: DARPA RSGS and NASA Restors-L contracts
- Effective Space: \$100M contract, \$15M VC funding
- AstroScale: \$60M VC funding
- Orbit Fab: undisclosed VC funding

