Shackleton Energy Company

Mining Lunar Resources

The Shackleton Energy Program

PTMSS / SRR / CIM

Cleared for Restricted Release

6th May 2013

"Fueling the Space Frontier"

Shackleton Energy Company

Mission

Within a Decade

Establish access to over a billion tonnes of water ice located at the poles of the Moon

Open and expand new markets with space-based privately-financed depots supplying propellant in space at a paradigm shifting 10x cost advantage

Establish new infrastructure and business opportunities in space

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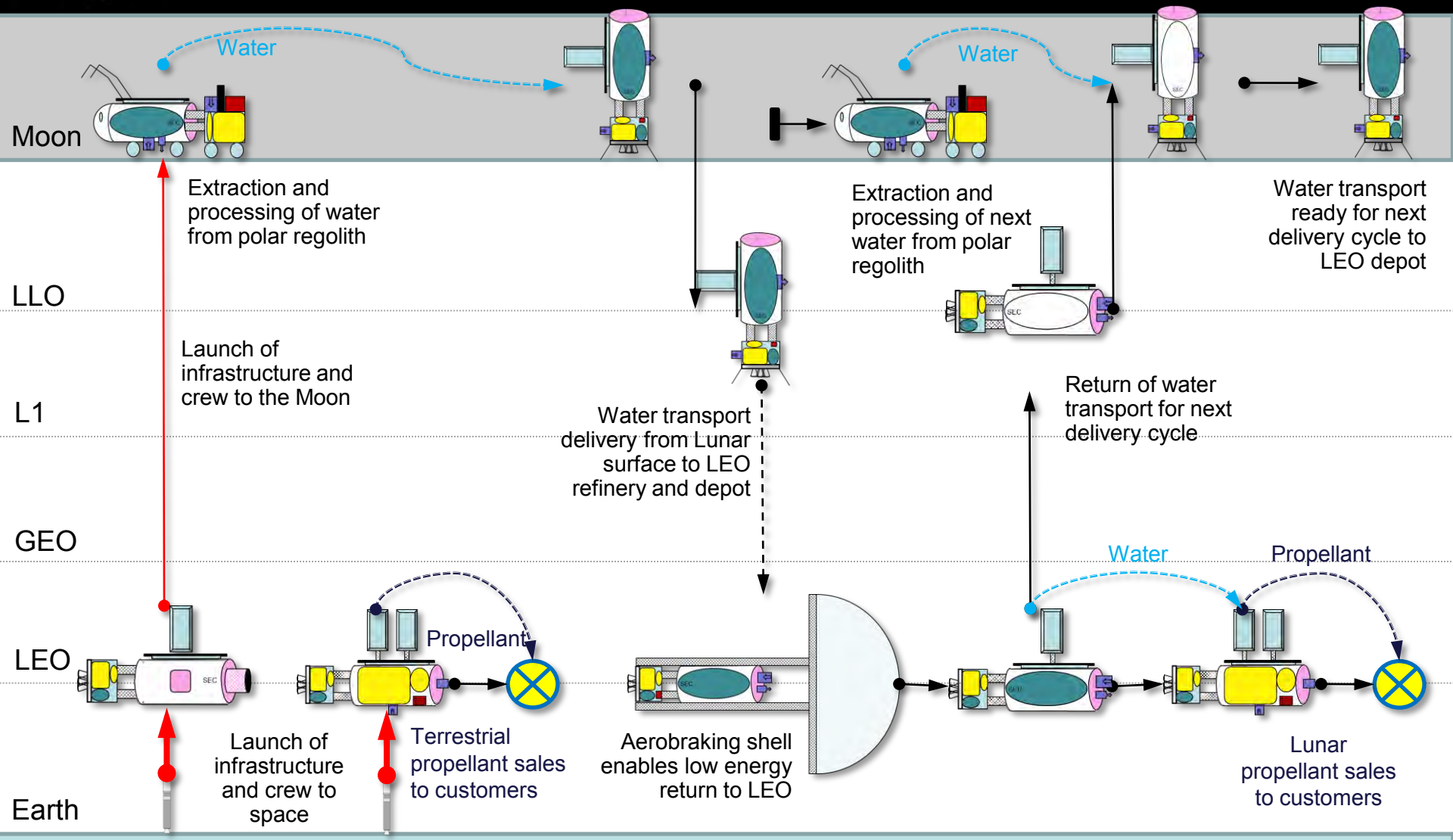
Architecture Overview



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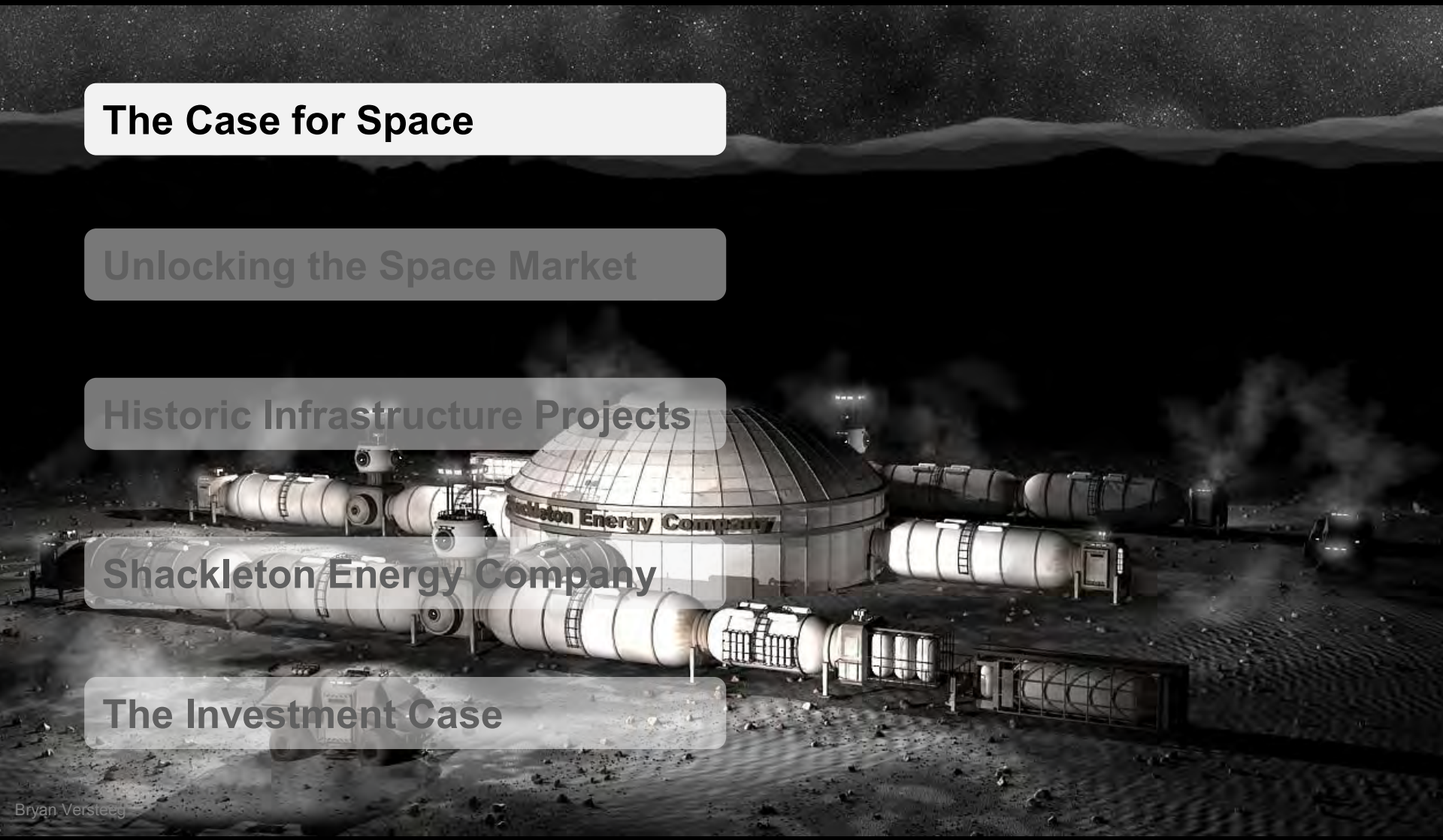
- **The Case for Space**
- Unlocking the Space Market
- Historic Infrastructure Projects
- Shackleton Energy Company
- The Investment Case



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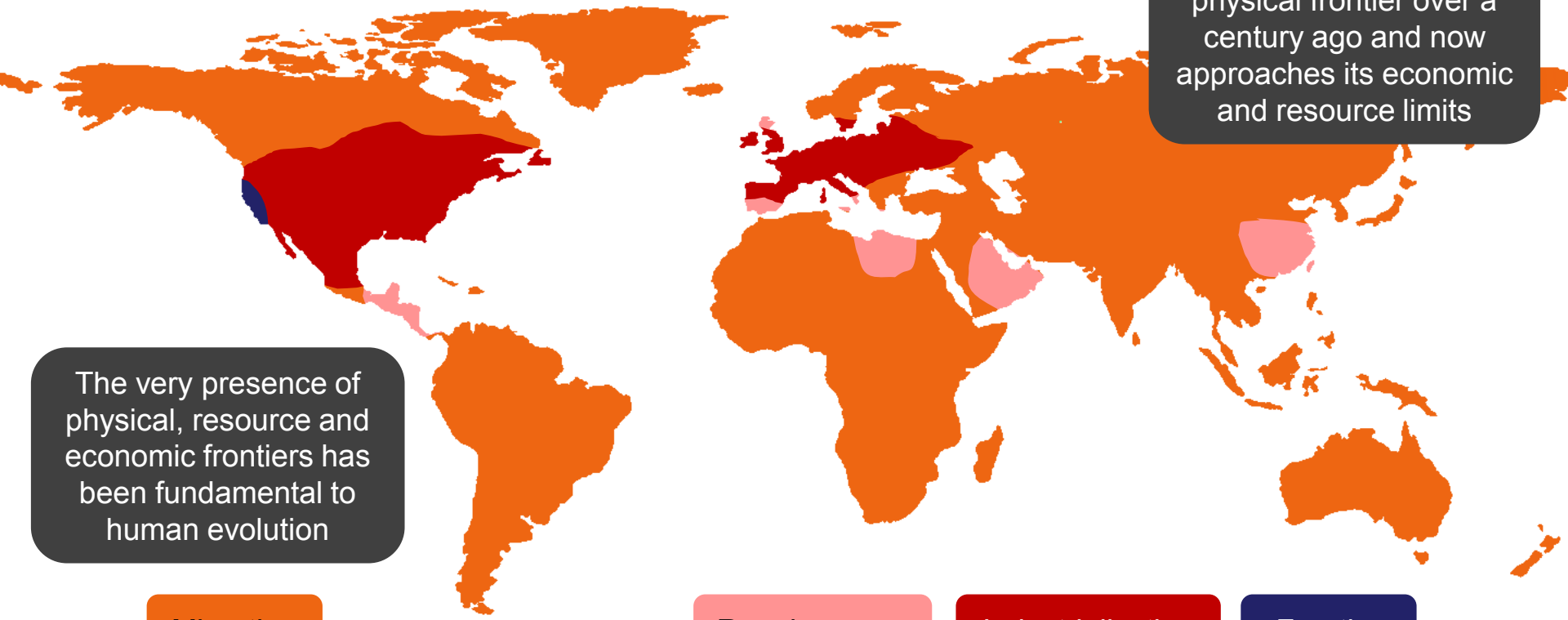
Frontier

Civilization reached its physical frontier over a century ago and now approaches its economic and resource limits

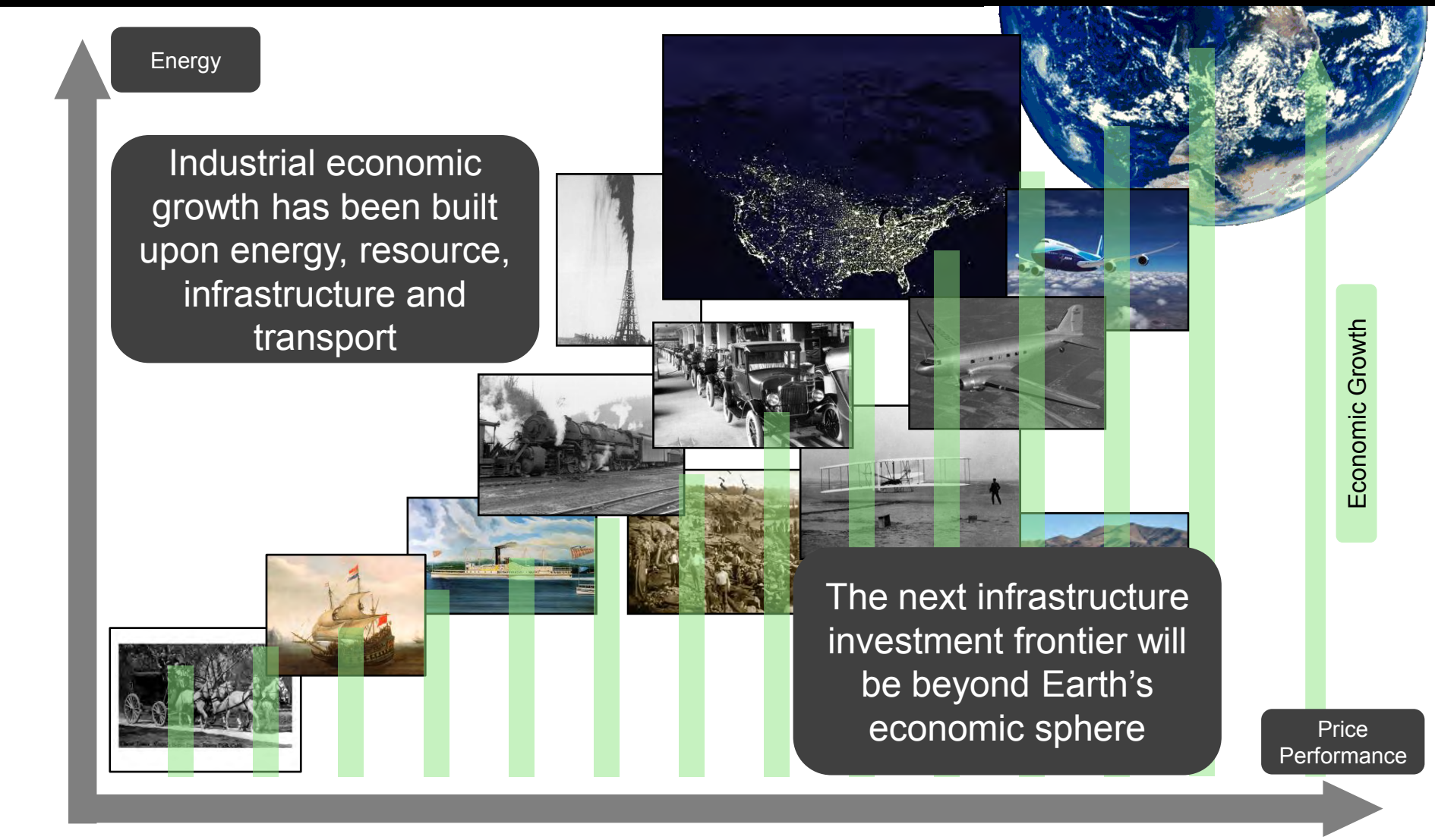
The very presence of physical, resource and economic frontiers has been fundamental to human evolution



Migration | Renaissances | Industrialization | Frontier

50000 BC – 5000 BC | 2000 BC – 1500 AD | 1700 AD – 1900 AD | 1900 AD

Energy, Resources, Infrastructure



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Water in Space

Water in Space Solves
Critical Societal Needs
And Underpins an Historic
Economic Opportunity

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Population

Earth's ecosystem will strain under the population of 10 Billion by 2050

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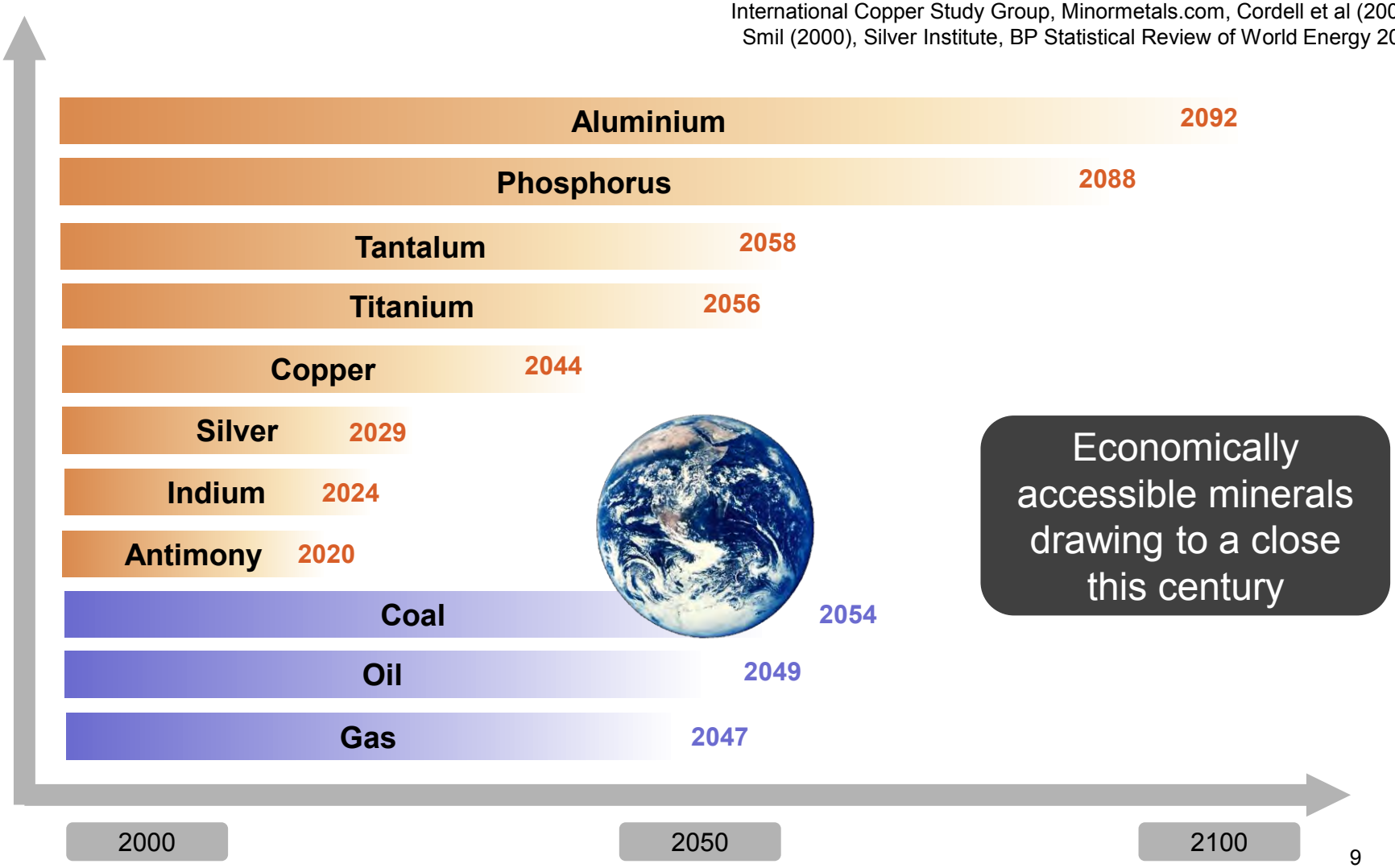
Resources

US Geological Survey, Adroit Resources, World Bureau of Metal Statistics, International Copper Study Group, Minormetals.com, Cordell et al (2009), Smil (2000), Silver Institute, BP Statistical Review of World Energy 2010



Economically accessible minerals drawing to a close this century

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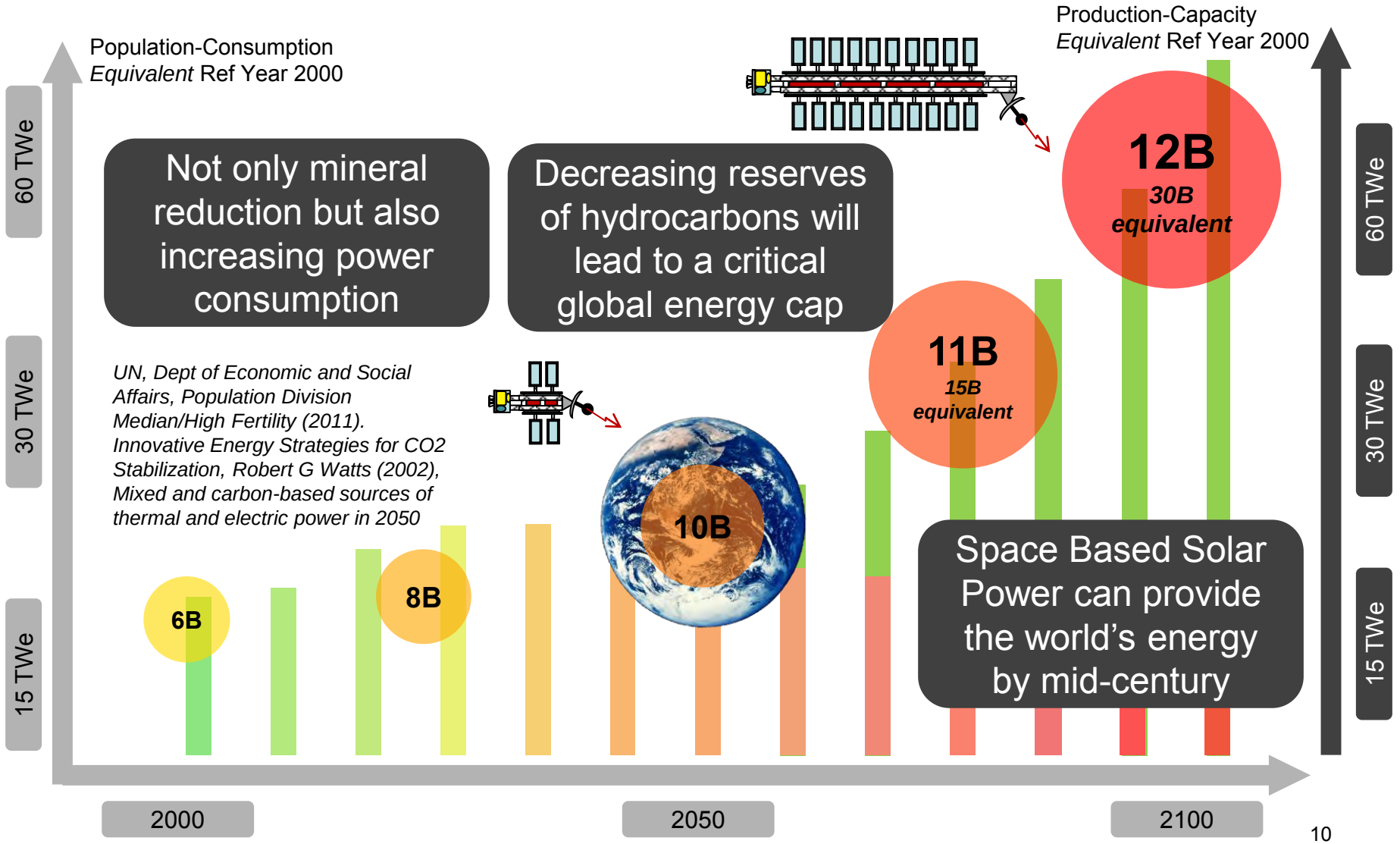
Energy



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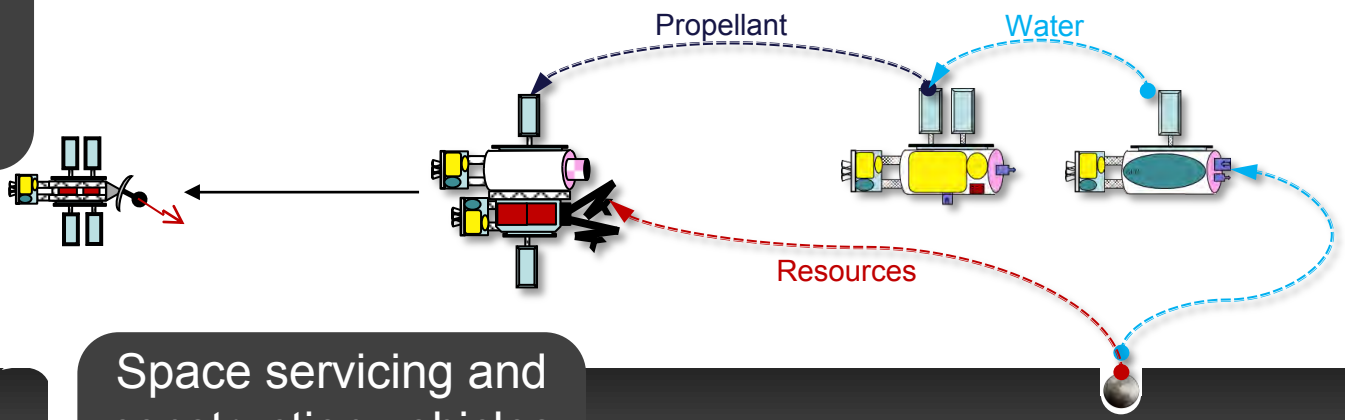
Space Resources

SBSP systems are truly economical if not launched from Earth but built in-situ



Space servicing and construction vehicles can supply SBSP and other customers

Using Lunar resources to provide the mass of space vehicle construction

SEC resupplies their propellant depots with Lunar polar water for operations

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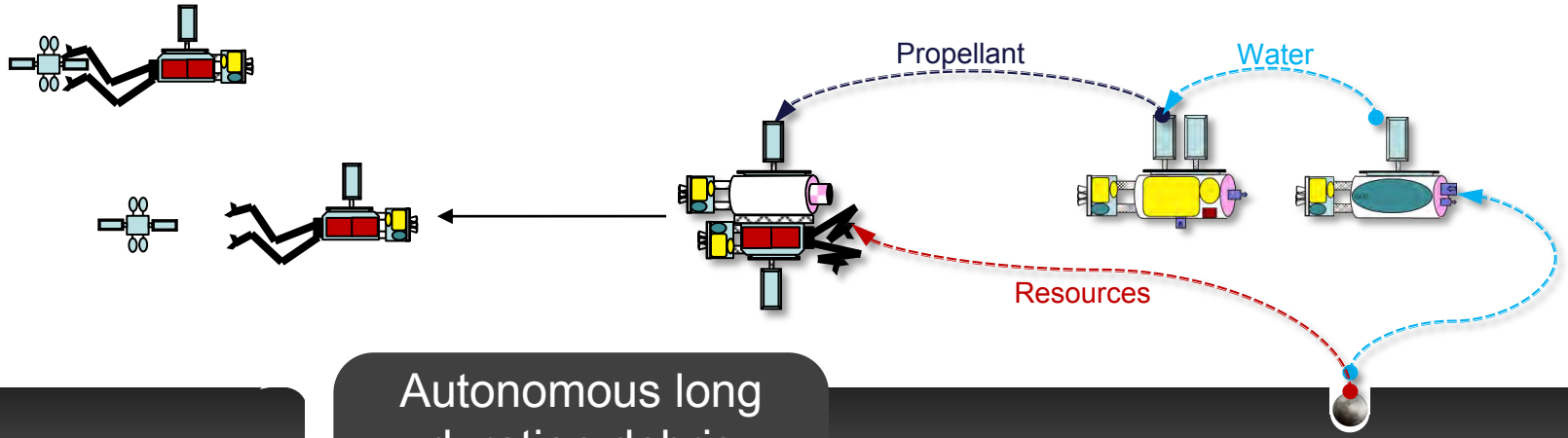
Space Debris Mitigation



Autonomous long duration debris mitigation vehicles built in space

Providing a fleet of genuine heavy duty systems capable of orbital maintenance

Avoiding the trillion dollar economic consequences of the Kessler Syndrome

Using Lunar resources to provide the mass of space vehicle construction

SEC resupplies their propellant depots with Lunar polar water for operations

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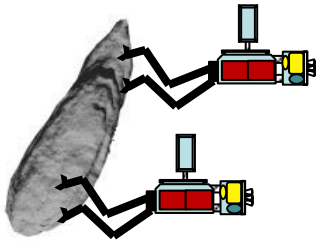
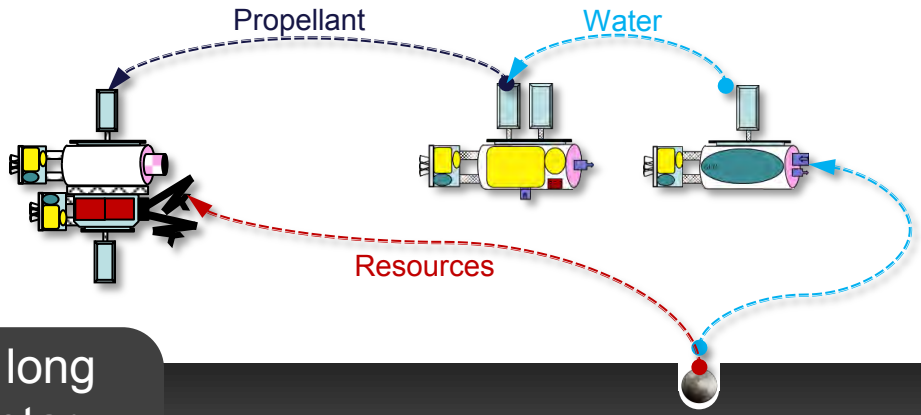
Planetary Protection





Providing a fleet of genuine heavy duty systems capable of asteroid deflection

Autonomous long duration planetary protection vehicles built in space

Using Lunar resources to provide the mass of space vehicle construction

And ultimately retrieval for additional in-space resource utilization

SEC resupplies their propellant depots with Lunar polar water for operations

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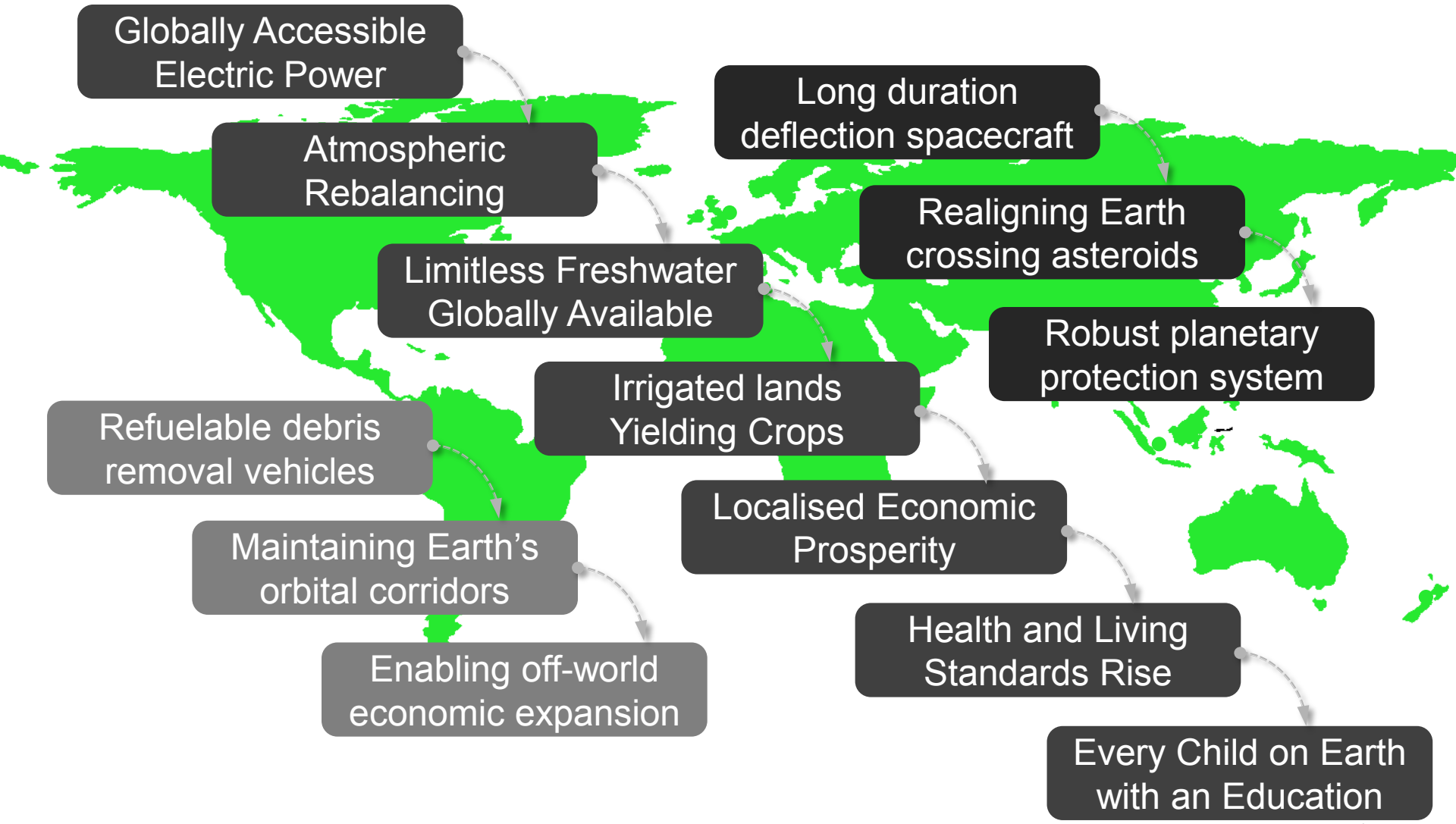
Cascading Civilization Benefits



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The Case for Space

Unlocking the Space Market

Historic Infrastructure Projects

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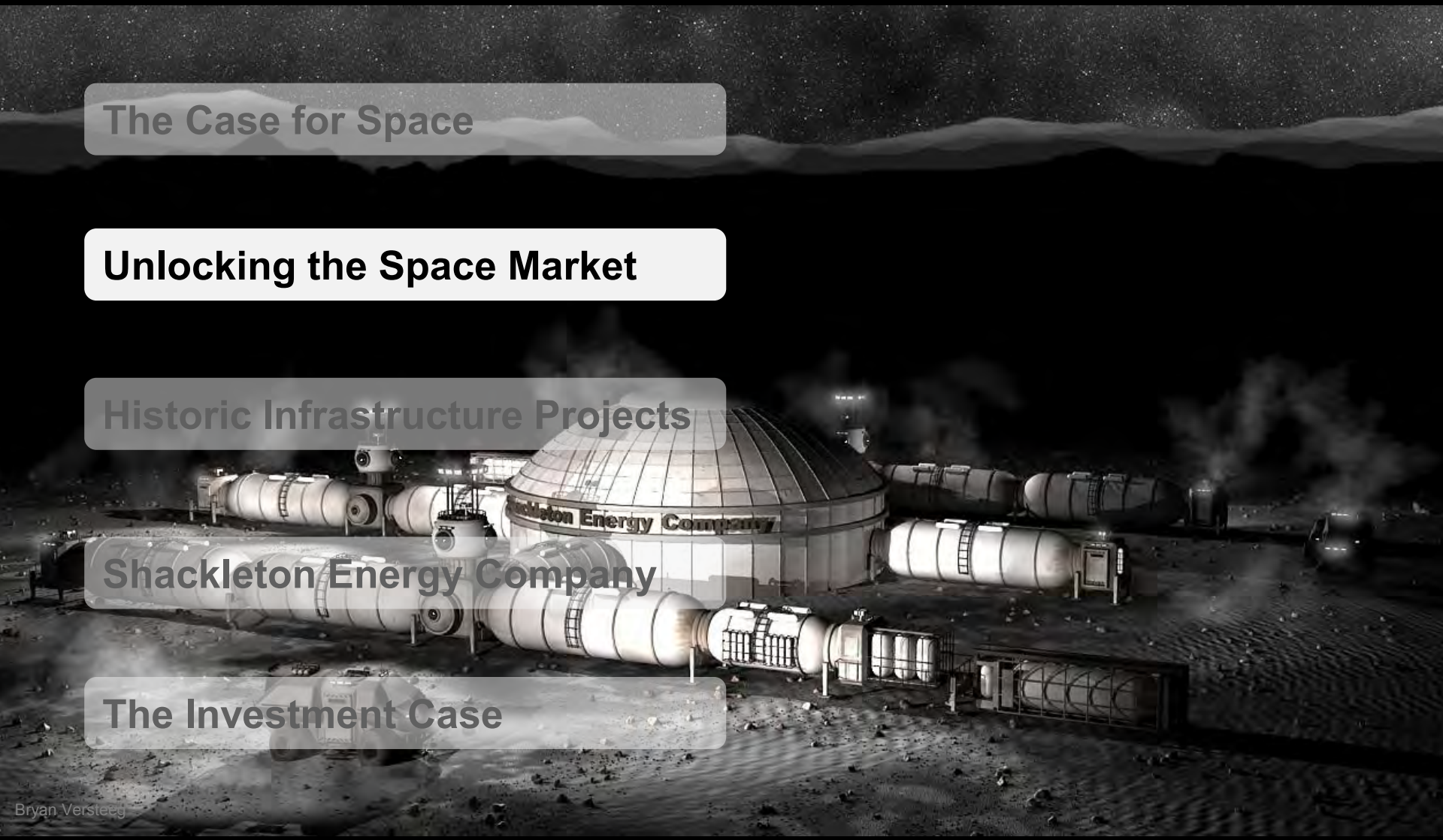
The Investment Case



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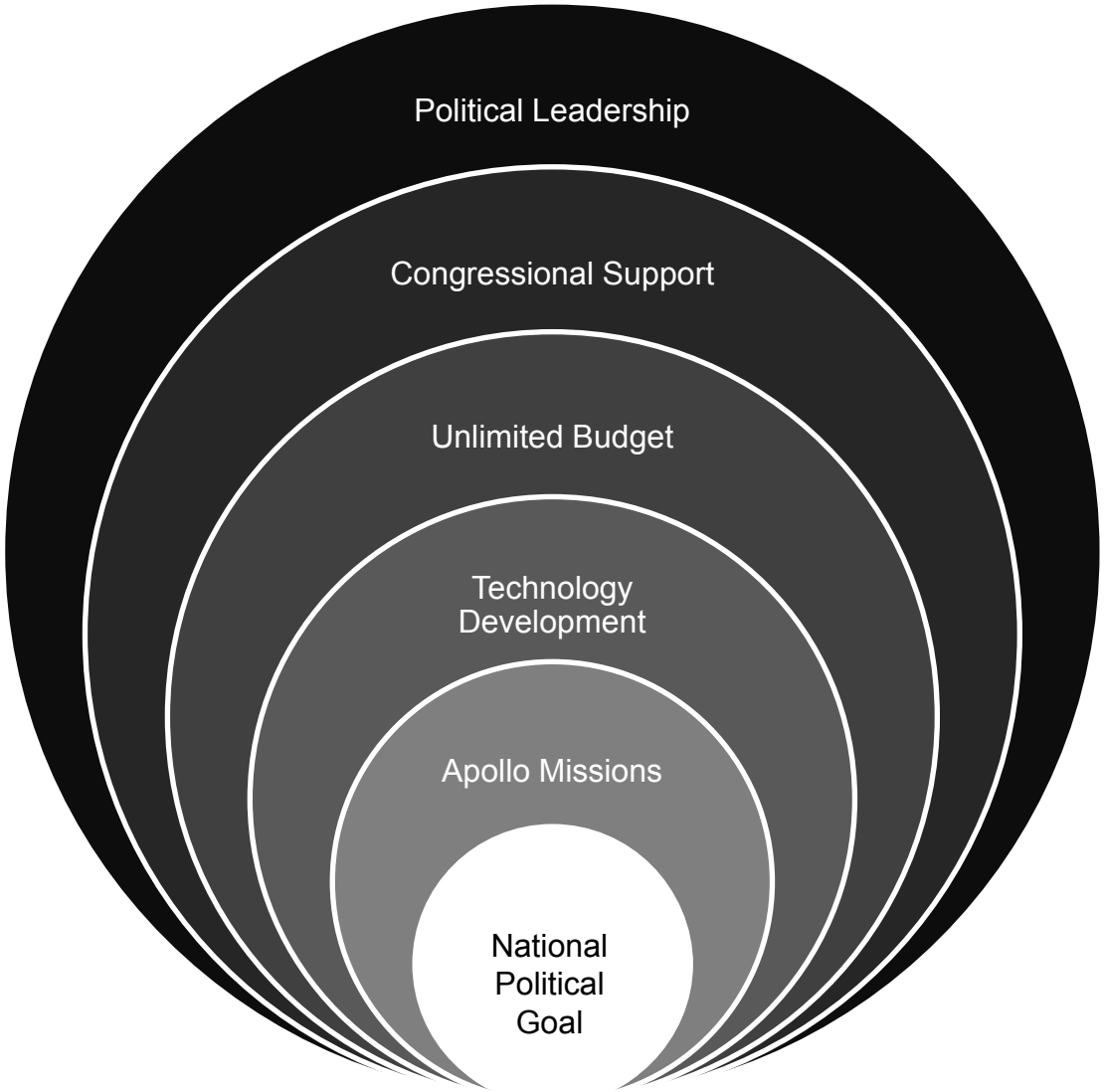
Apollo Space Model



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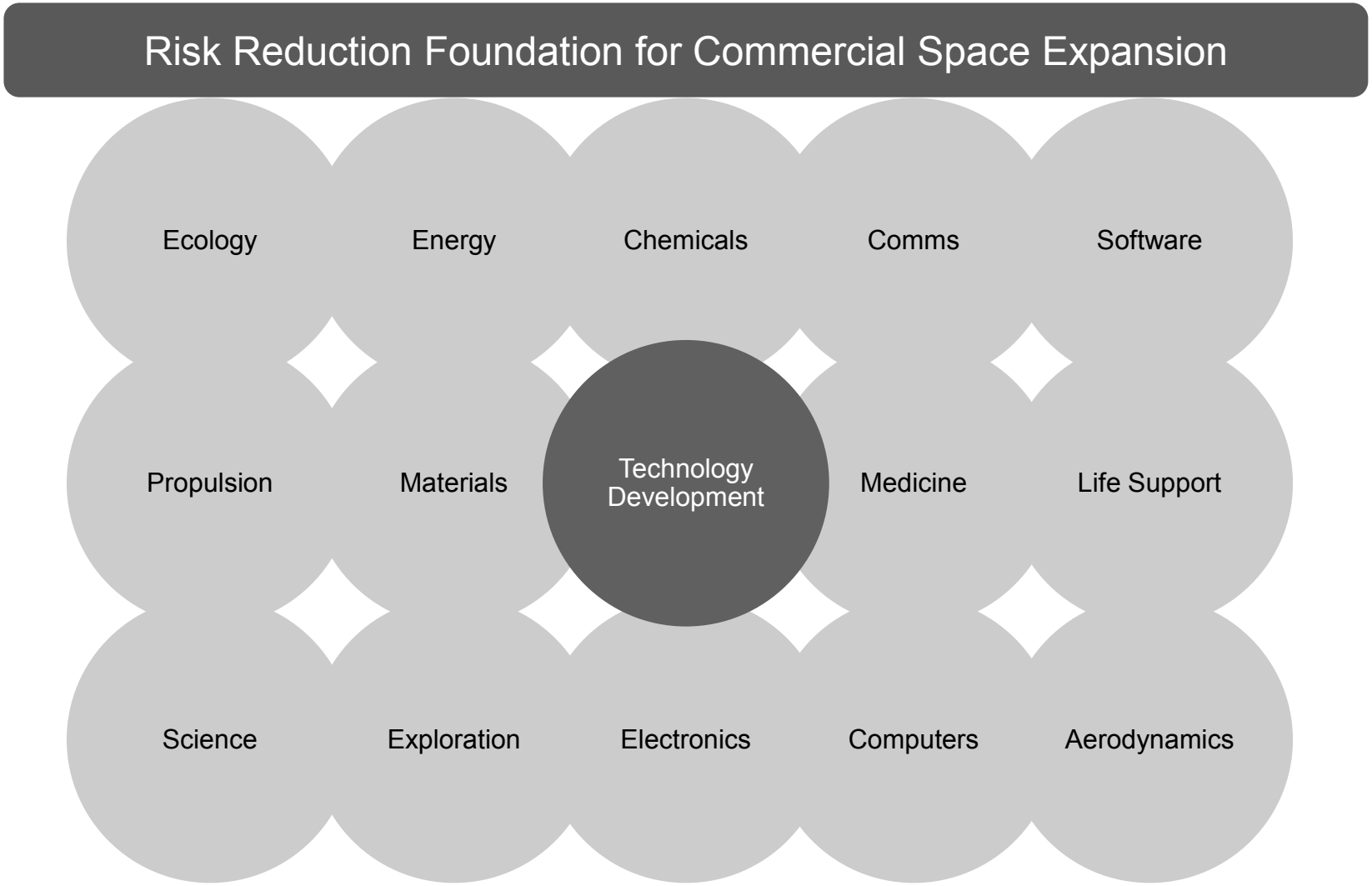
Agency Technology Development



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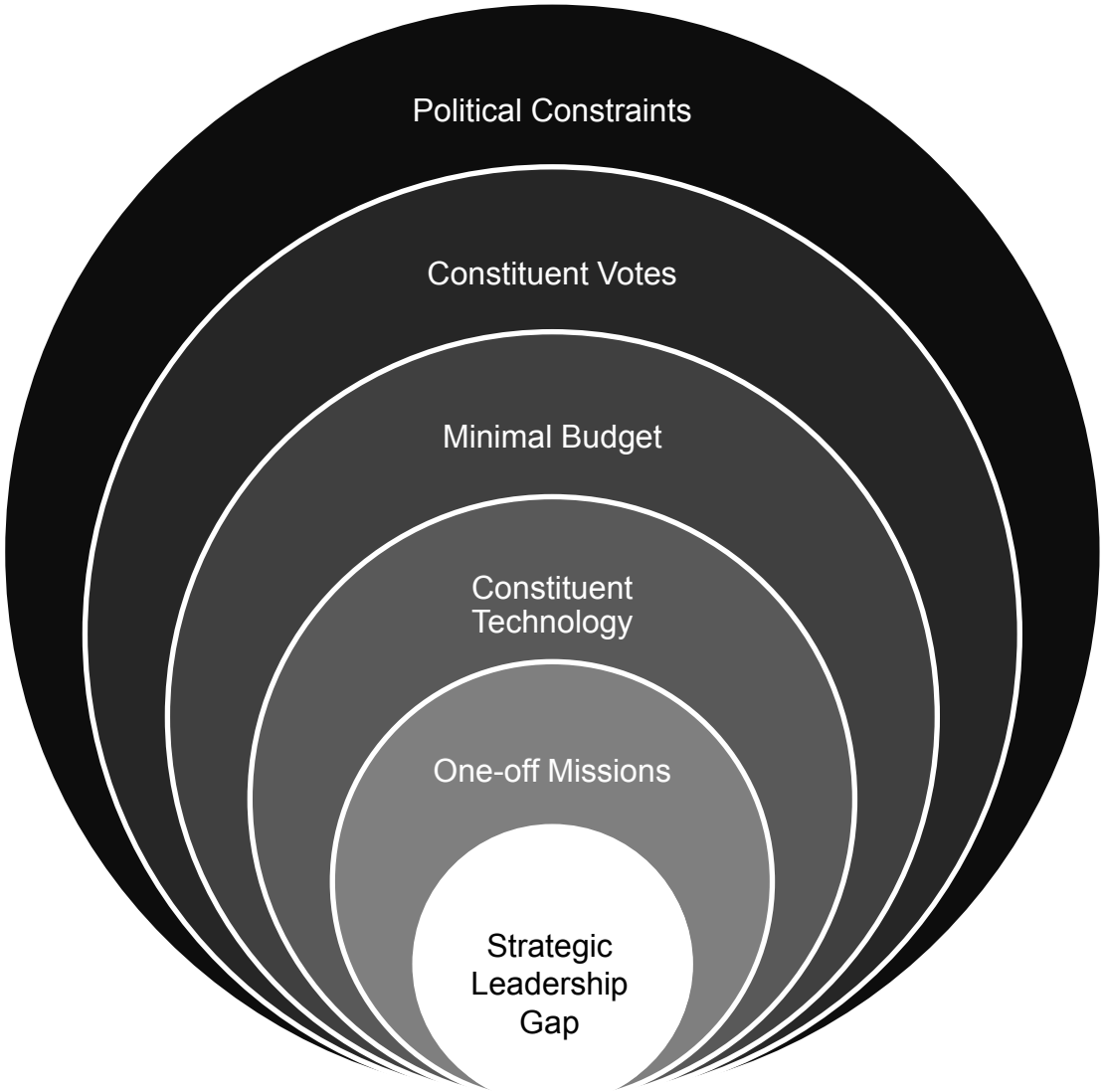
Mature Agency Space Model



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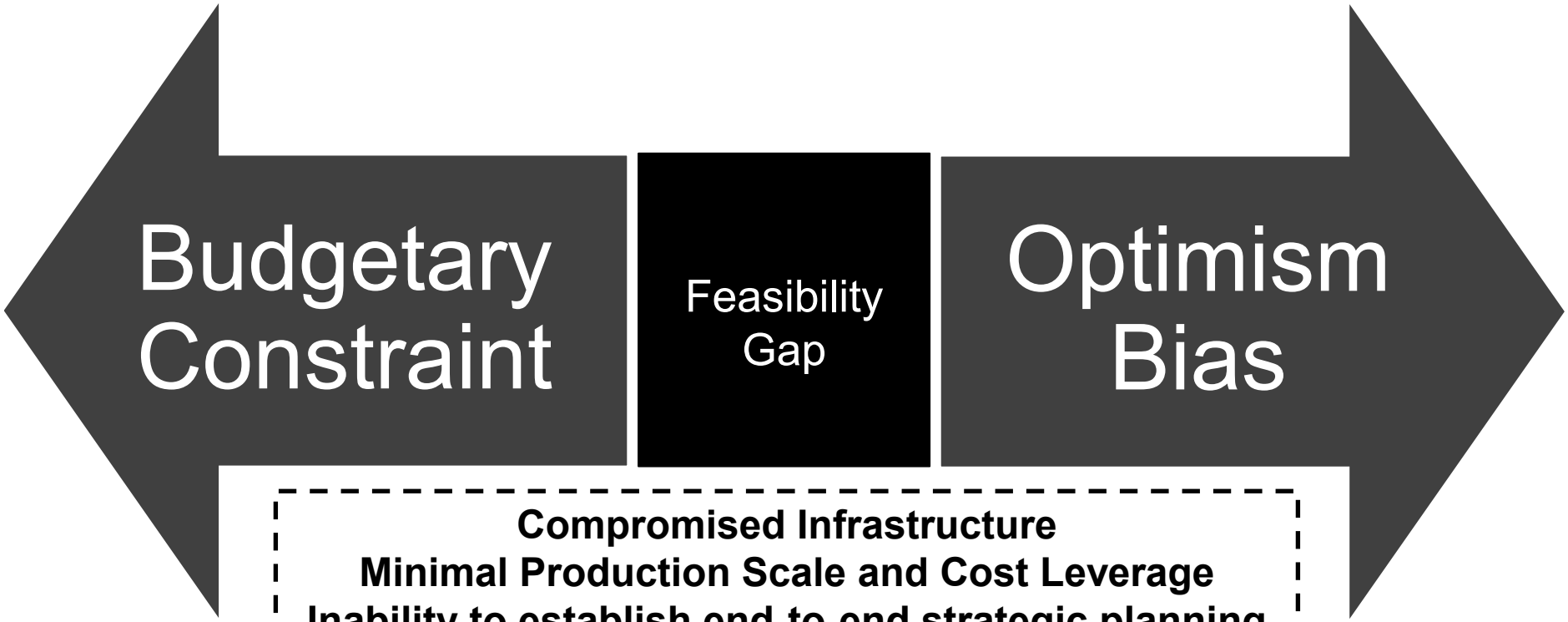
Current Space Feasibility Gap



Compromised Infrastructure
Minimal Production Scale and Cost Leverage
Inability to establish end-to-end strategic planning
Overbearing Quality Assurance & Overheads
Extensive Operational Risk Profiles
Time, Economy and Opportunity Loss

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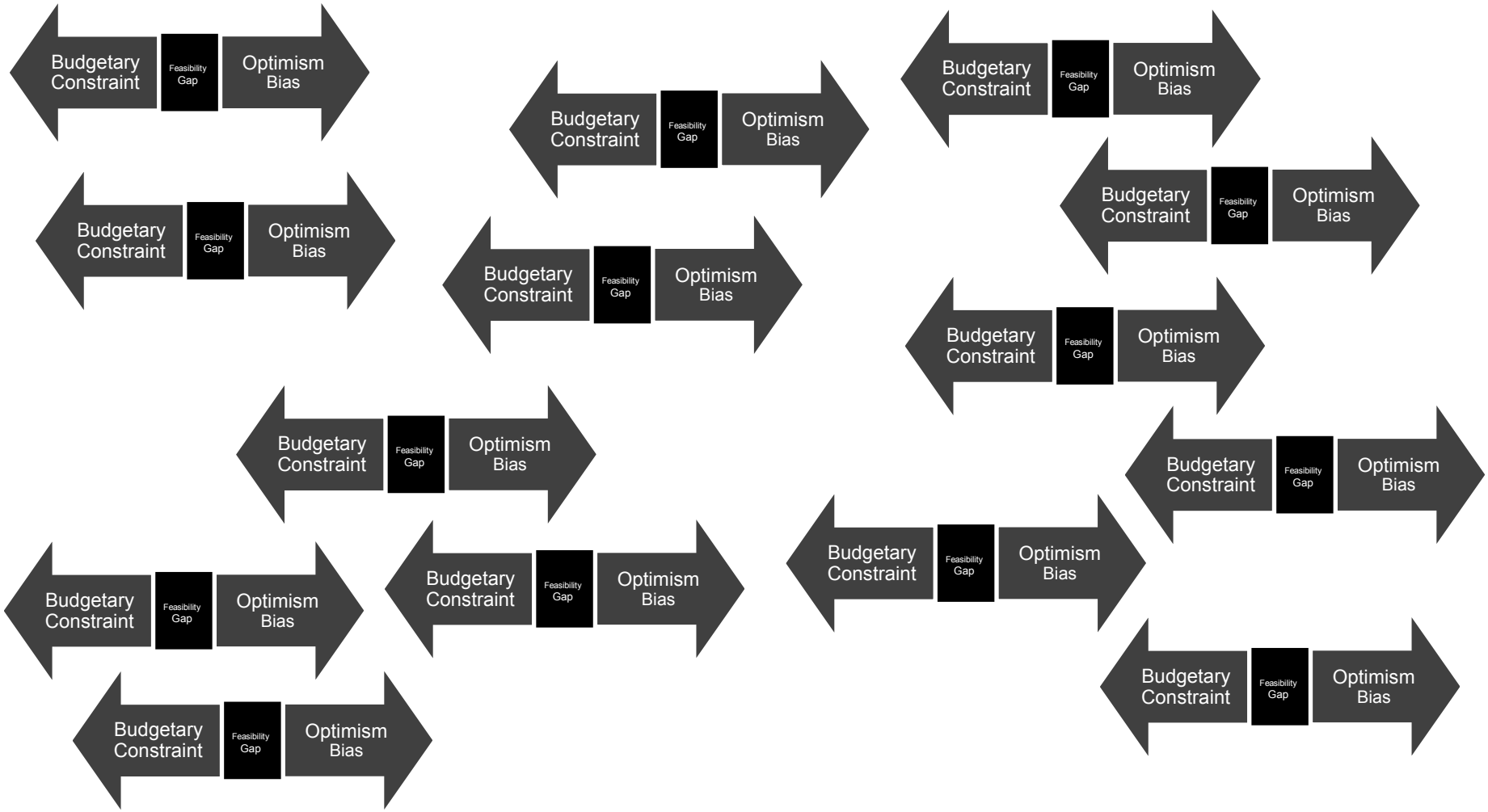
Attrition Model



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Foundations of the Space Market

Low cost transportation from Earth to LEO

The Paradigm Buster! Energy & its Infrastructure!

Space and surface destinations for new markets

Transport

Energy

Destination

Energy connects LEO transports to space destinations

… and connects destinations to new market segments

Market

Leadership

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Transport & Destinations Exist

Surface Habitation

Tanker

Propellant Depot

Transport

Energy

Destination

Processing Refinery

Mining Rover

Powersat

Human Space Transport

Servicing Vehicle

Market

Leadership

The Platform for New Space Markets

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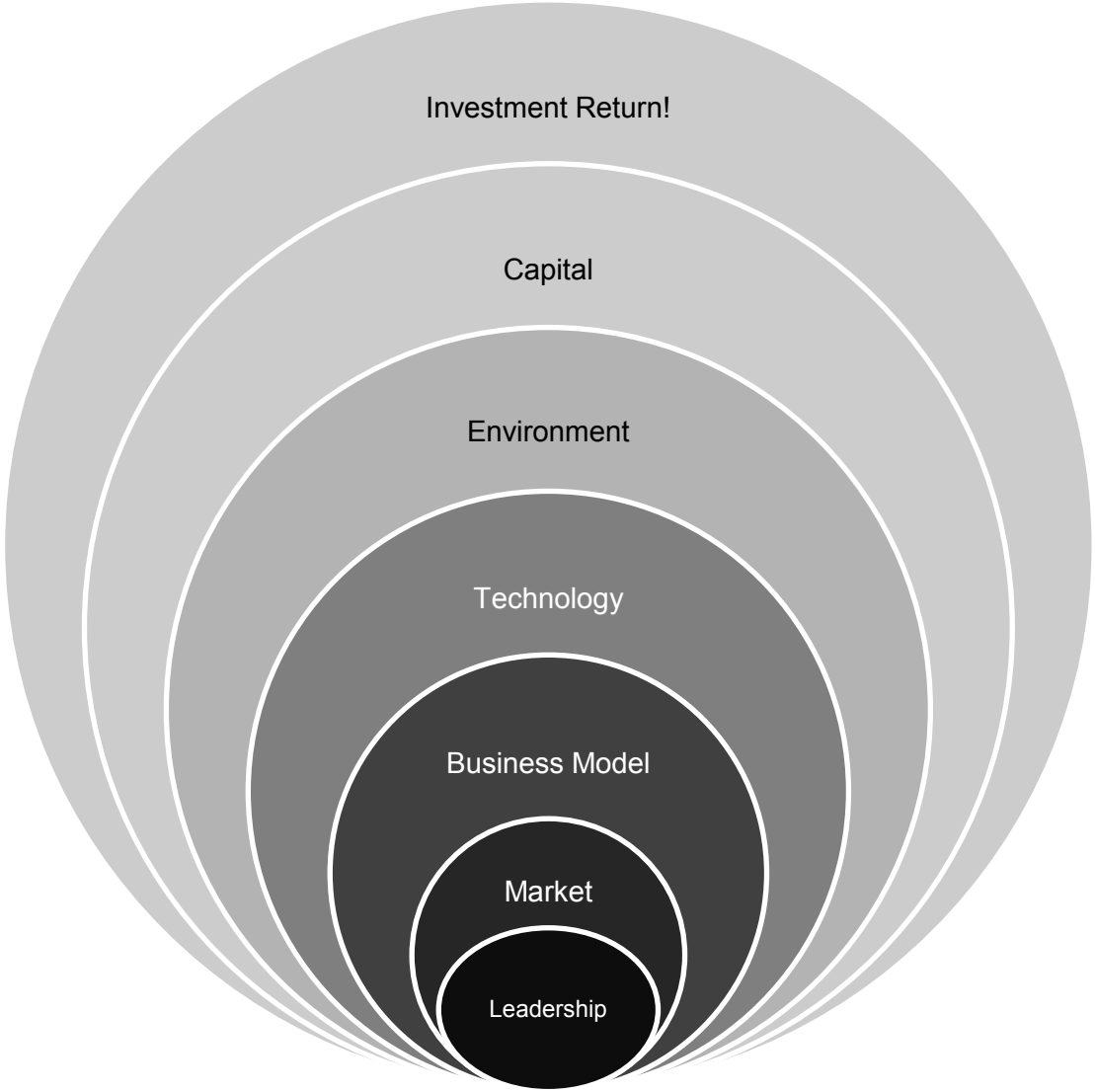
Shackleton Energy Model



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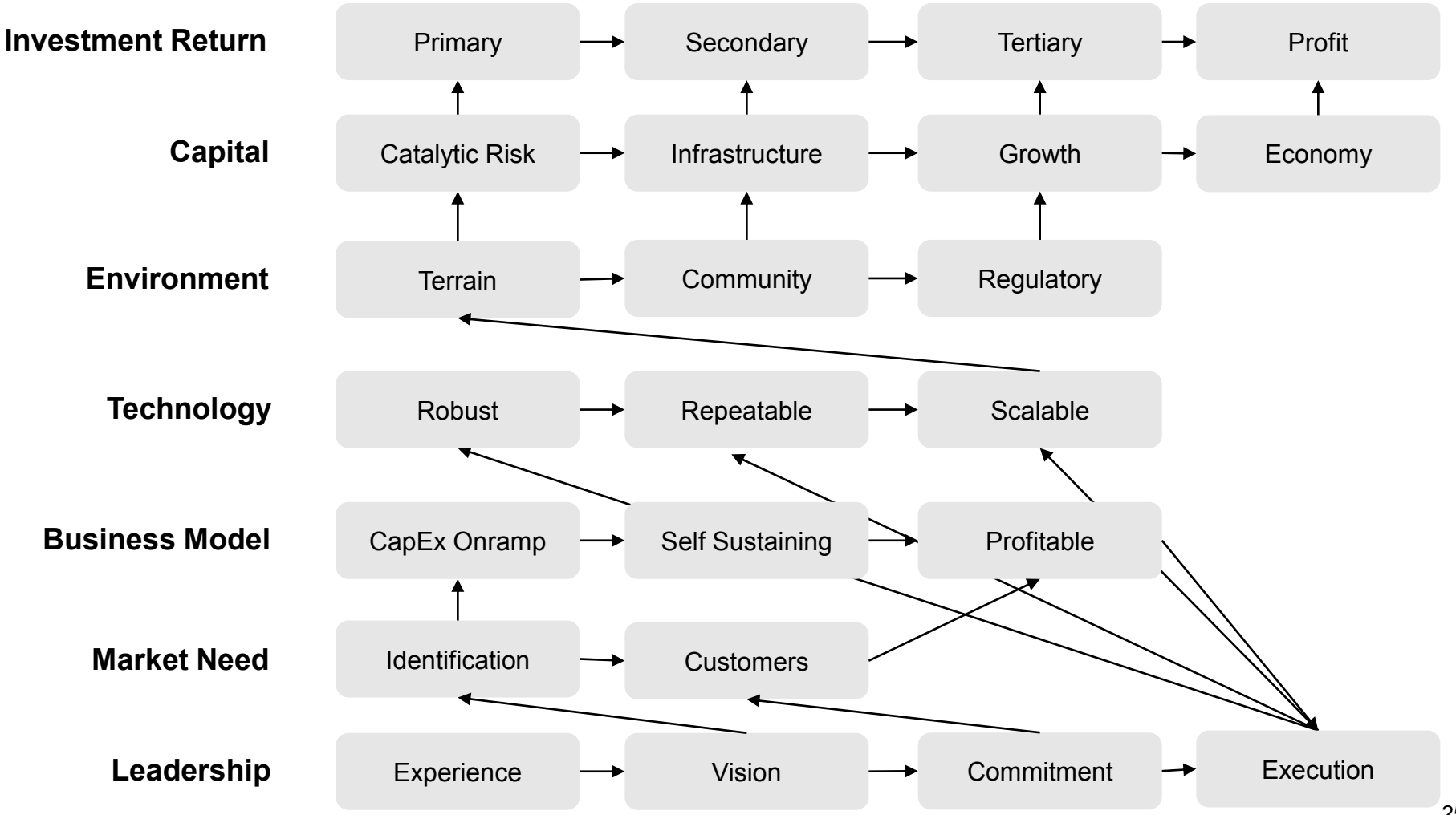
Infrastructure Model



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The Case for Space

Unlocking the Space Market

Historic Infrastructure Projects

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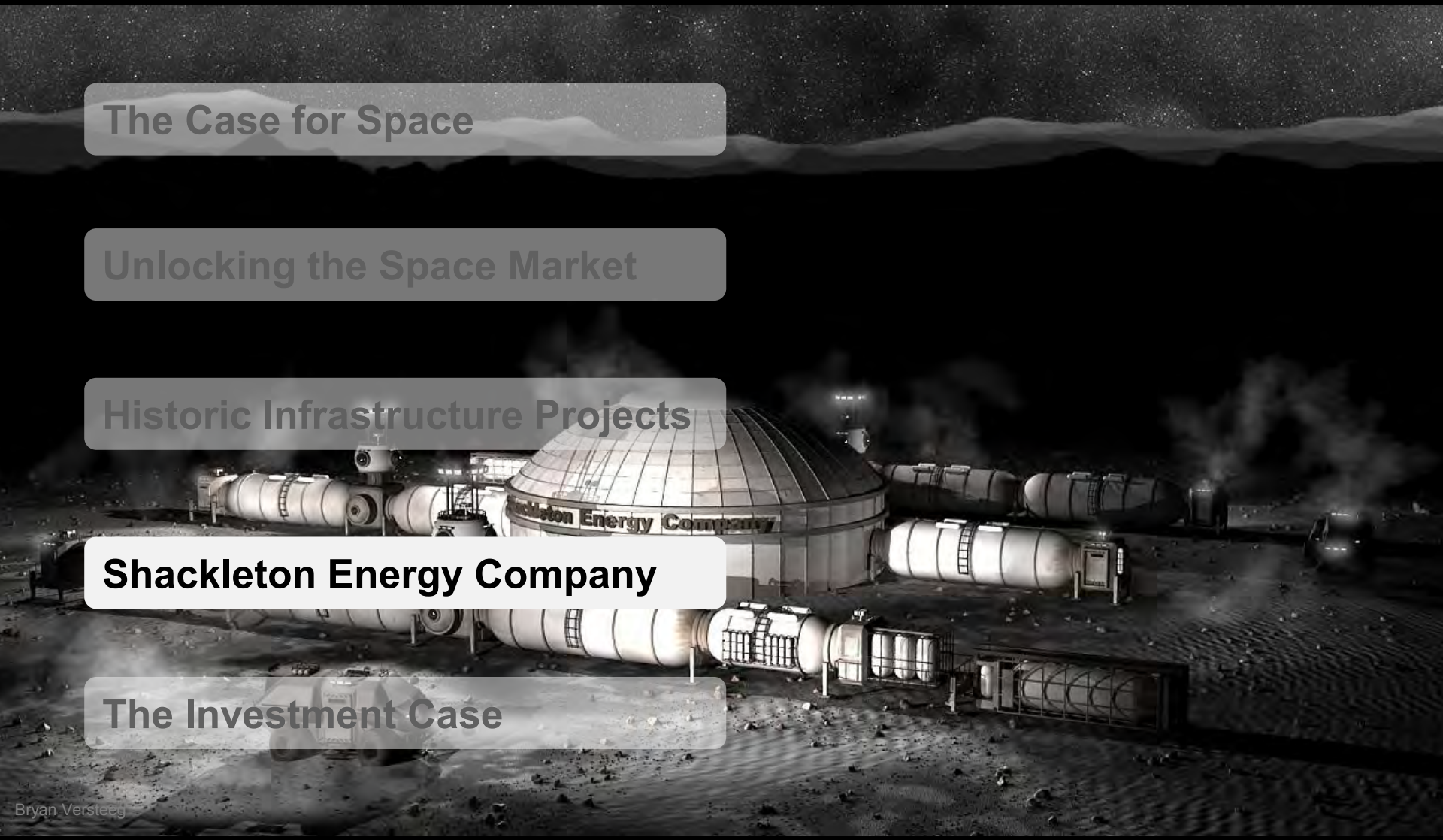
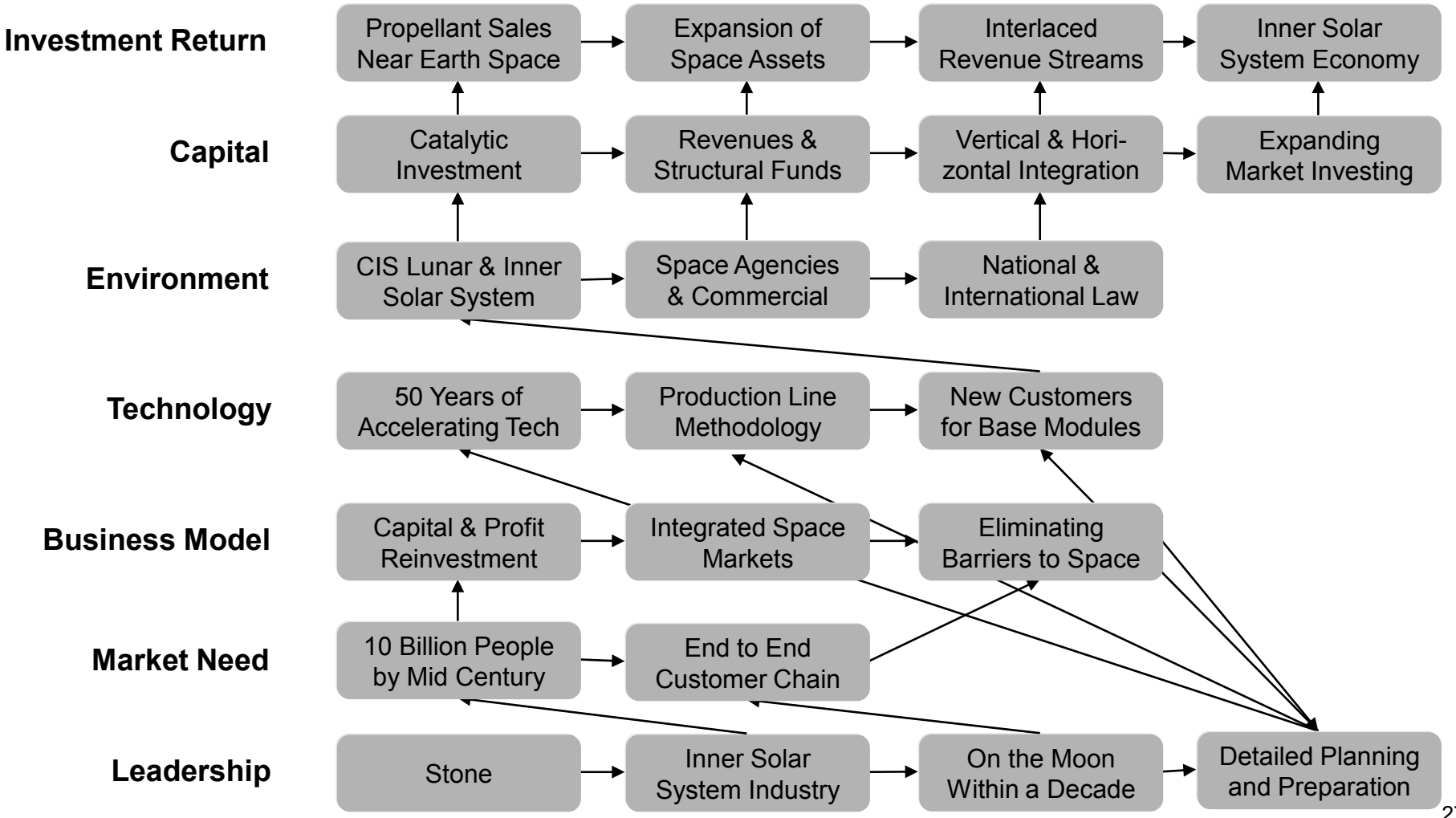
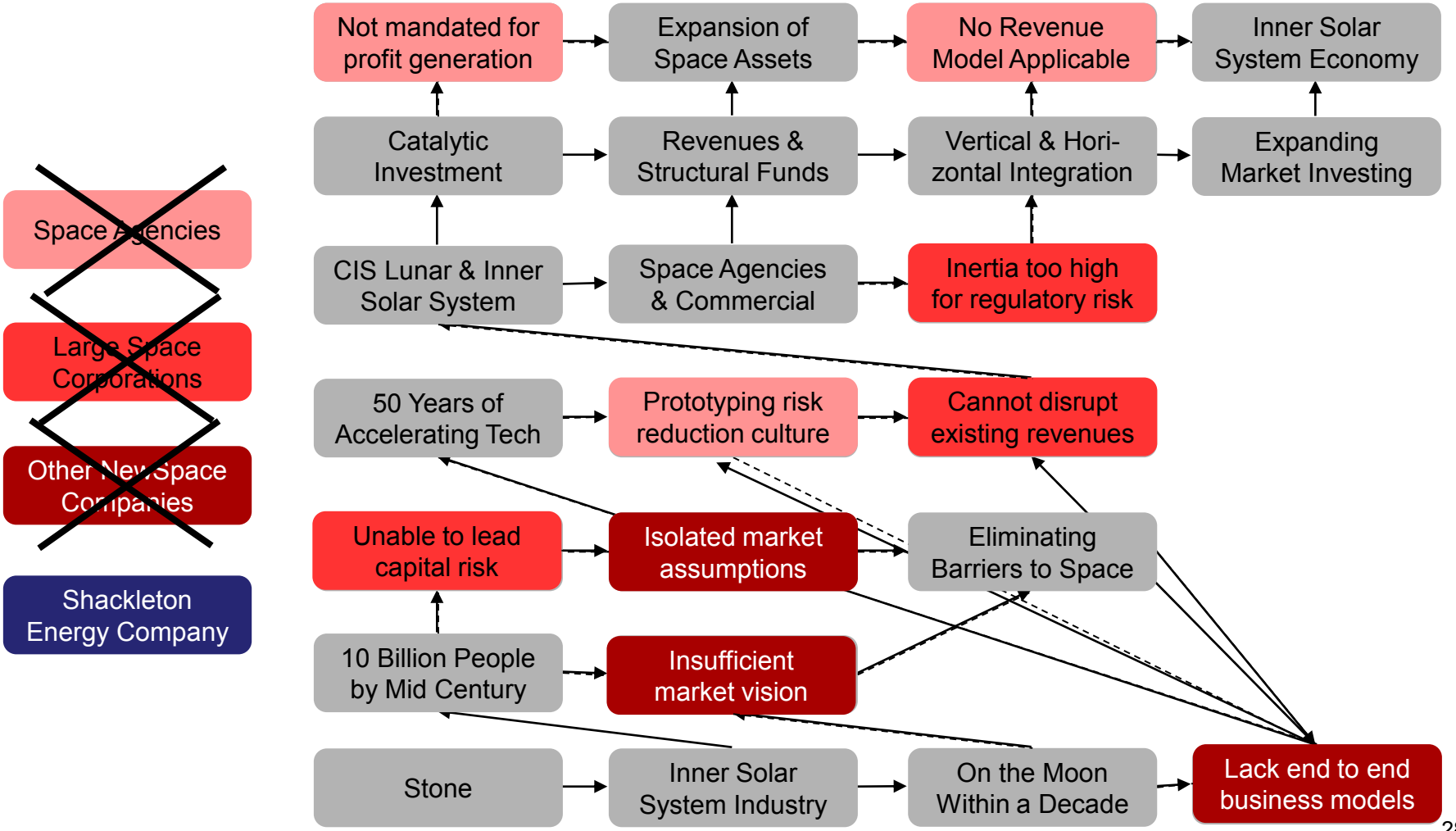
The Investment Case



Shackleton Energy Architecture



Shackleton Leads Consortium



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Founders

Dale Tietz

Chief Executive Officer

Former US Air Force officer and pilot. Pentagon Strategic Defense Initiative (Star Wars) acquisition program manager. Internationally-recognized development pioneer in unmanned aerospace systems and high tech business leader.

Bill Stone

Chairman and Chief Technology Officer

World-class explorer/ inventor/ engineer/ business developer. Dr. Stone has led scores of expeditions worldwide, developed advanced life support systems, autonomous robotics and space systems

Jim Keravala

Chief Operating Officer

International space systems director; planned and launched of over a dozen spacecraft. High tech entrepreneur; systems engineering and technology program management expertise.

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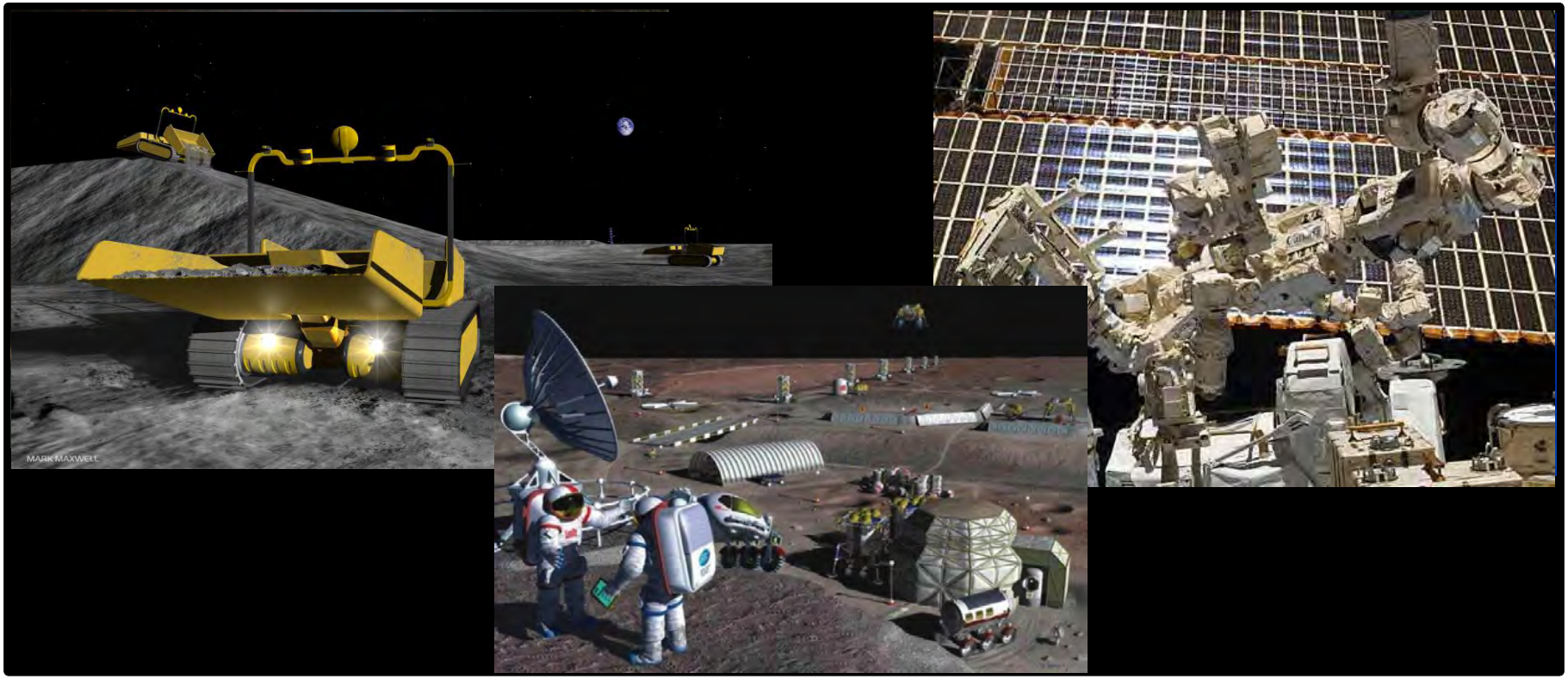
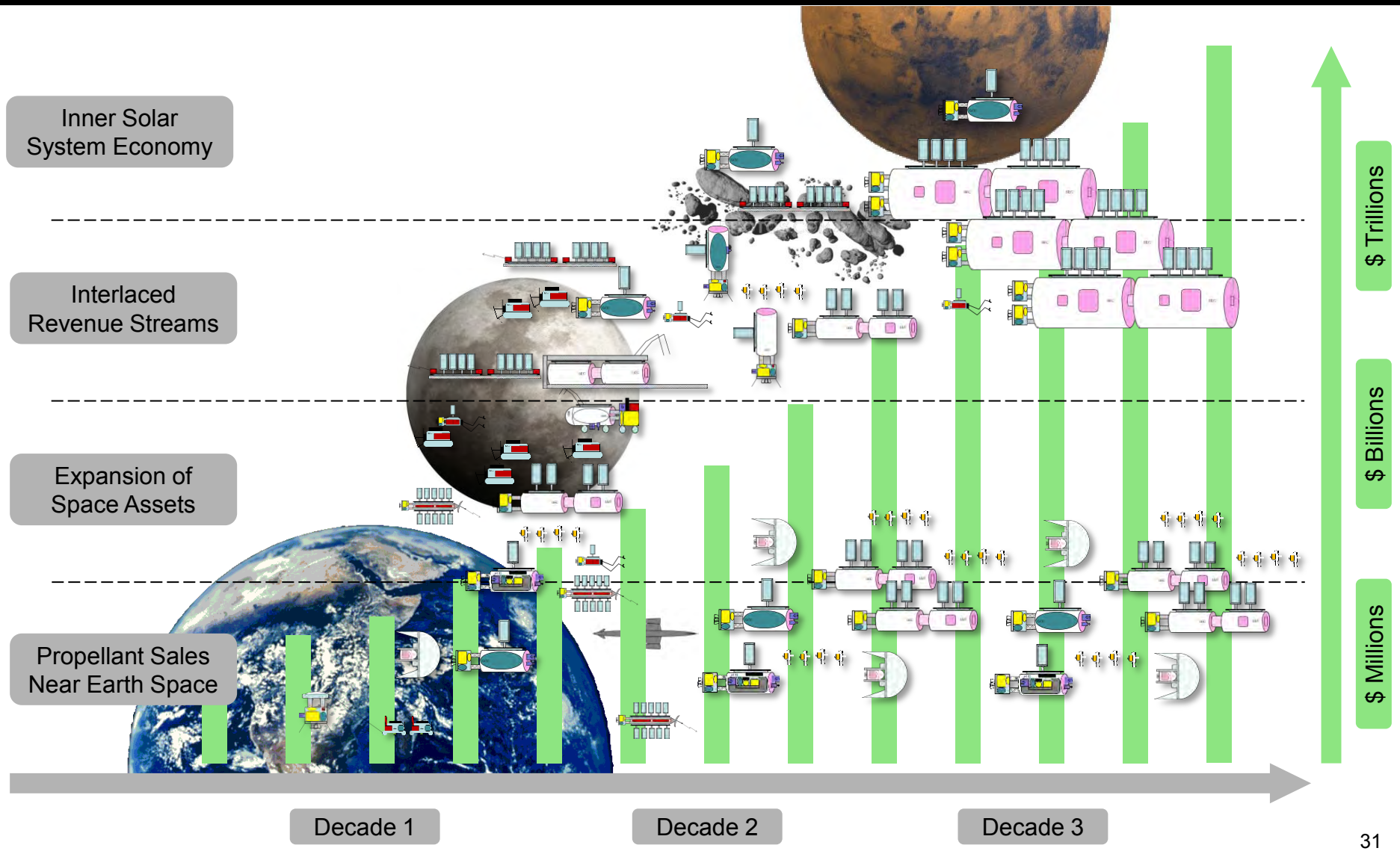
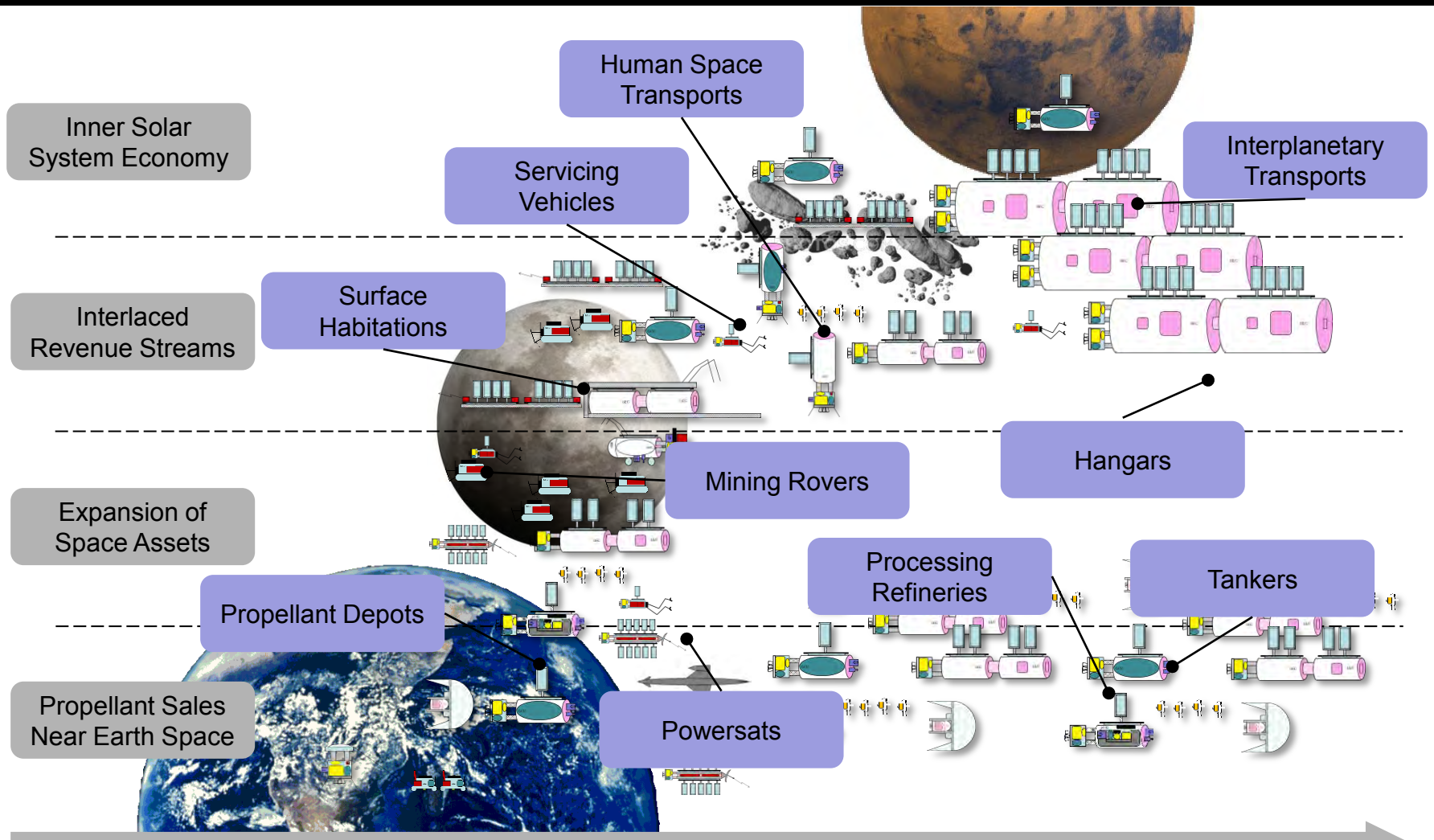
Shackleton Energy Engineering



Shackleton Energy Space Economy



Shackleton Energy Space Economy



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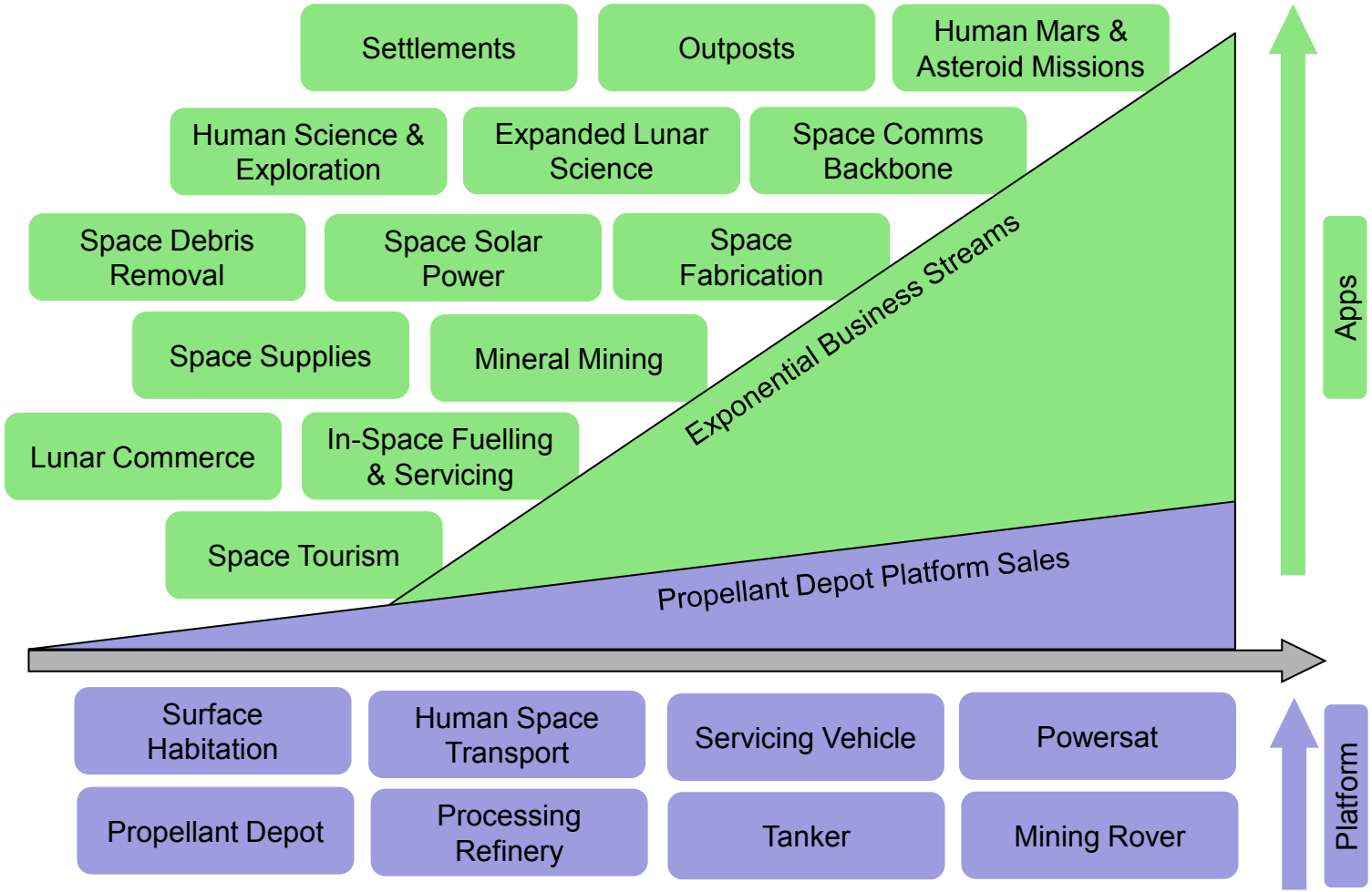
Integrated Market



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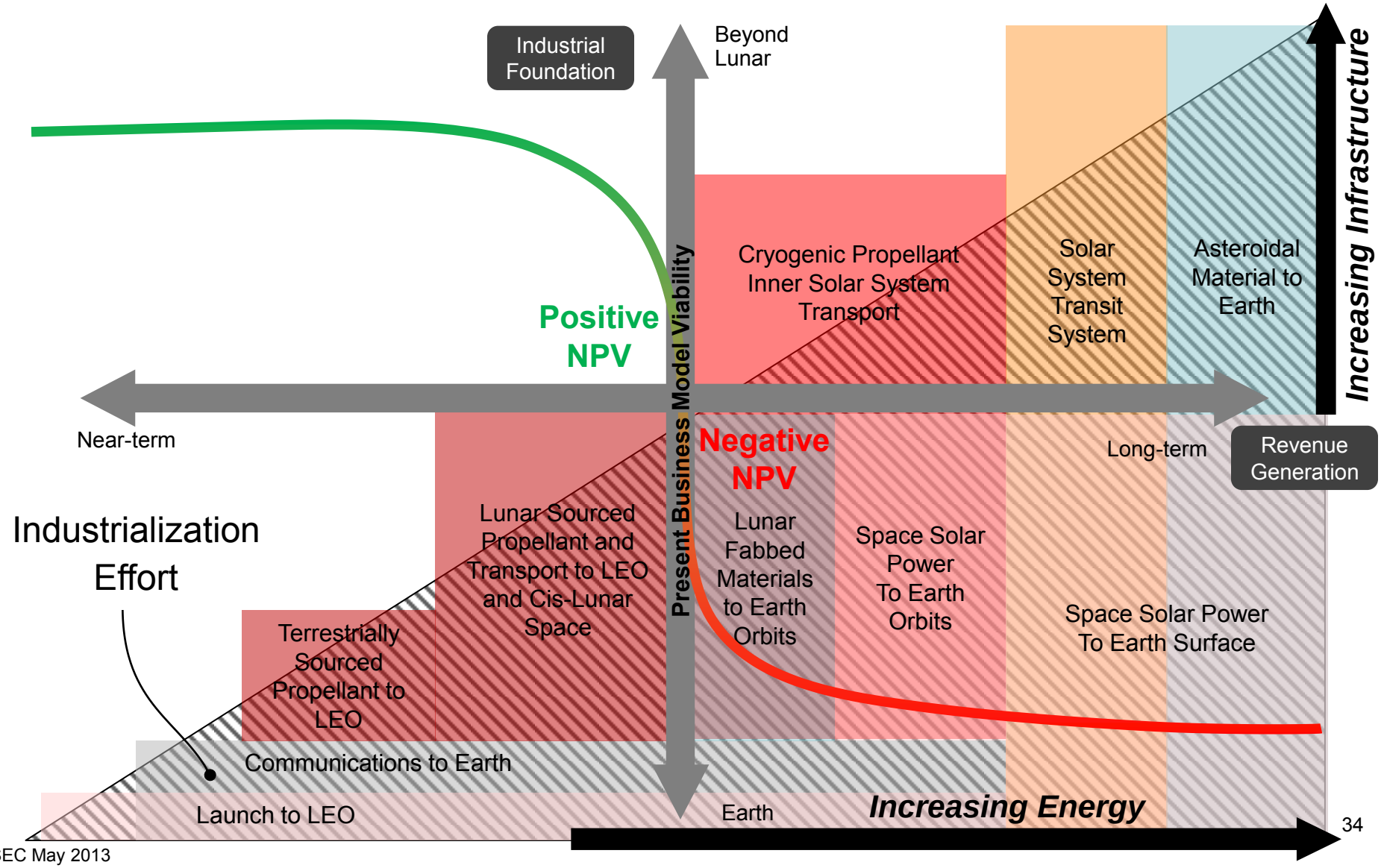
Space Industrialization Domains



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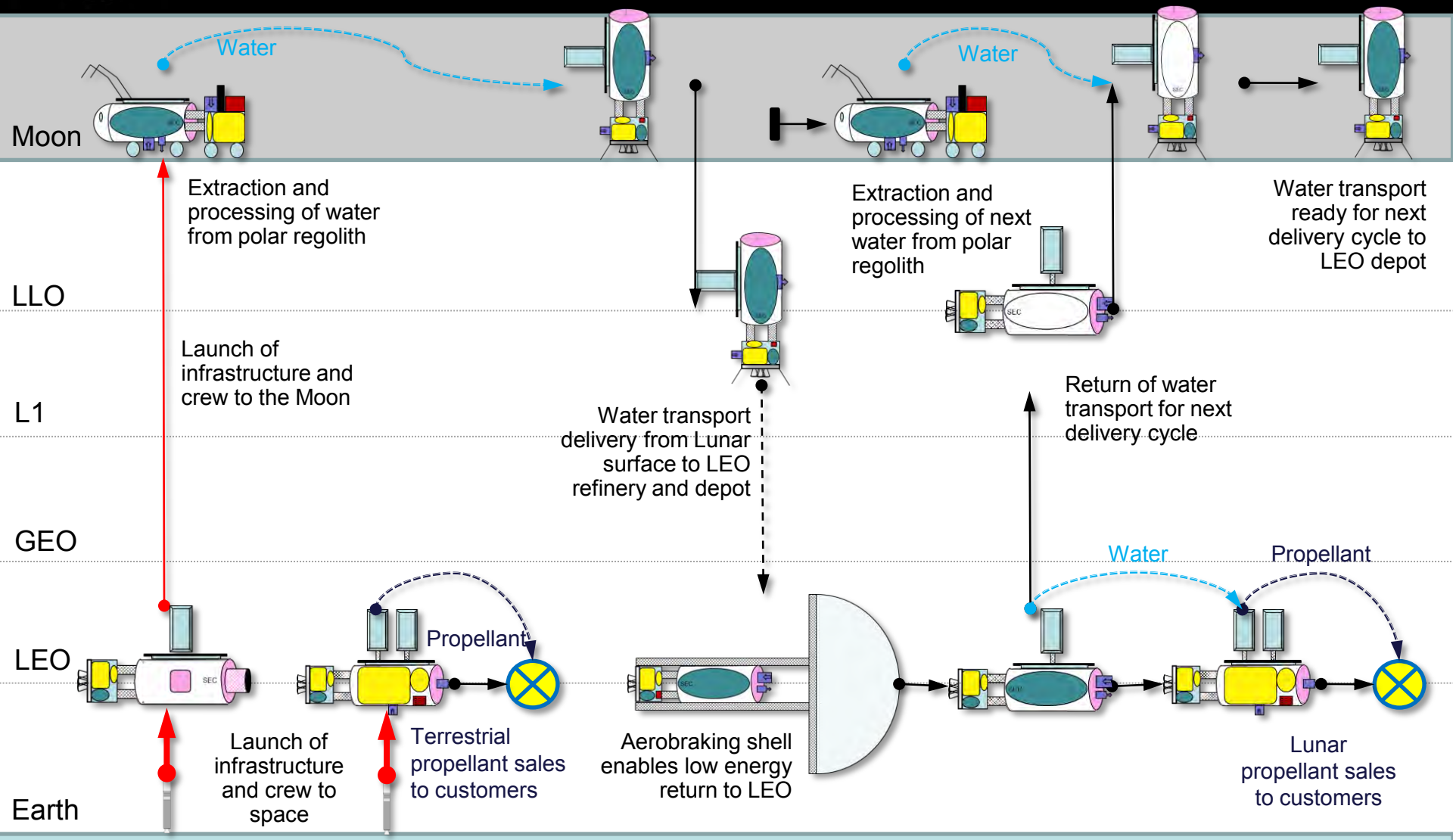
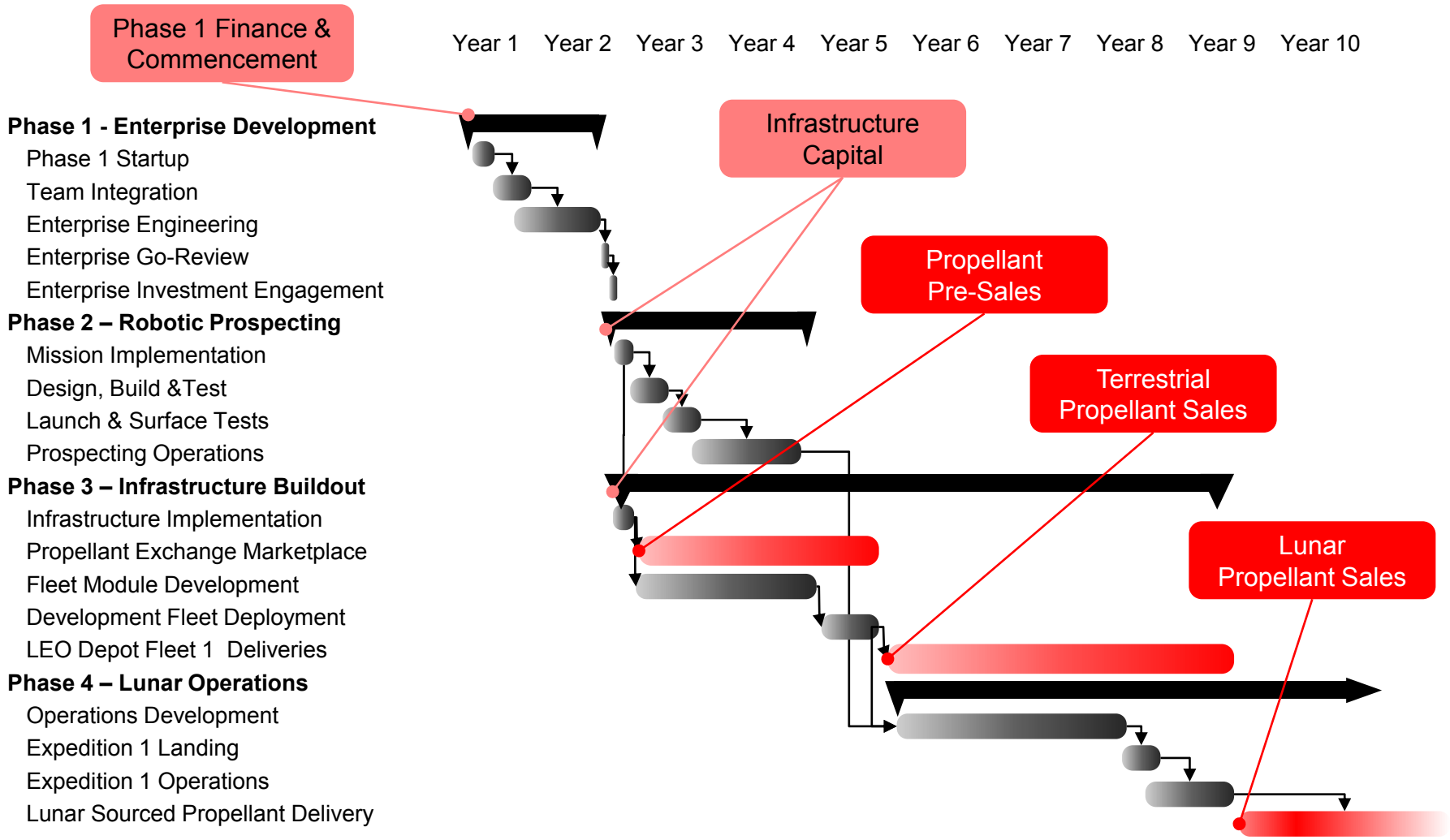
Architecture Overview



Program Schedule Phases 1-4



Non Linear Disruption

"I think there is a world market for maybe five computers" *Thomas Watson (1874-1956), Chairman of IBM, 1943*

"Space travel is bunk." *Sir Harold Spencer Jones, Astronomer Royal of Britain, 1957, two weeks before the launch of Sputnik*

"640K ought to be enough for anybody" *Bill Gates 1981*

"Heavier-than-air flying machines are impossible“ *Lord Kelvin, President, Royal Society, 1895*

"This 'telephone' has too many shortcomings to be seriously considered as a means of communication. The device is inherently of no value to us" *Western Union internal memo, 1876*

"There is no reason anyone would want a computer in their home" *Ken Olson, president, chairman and founder of Digital Equipment Corp, 1977*

"Man will never reach the moon regardless of all future scientific advances" *Dr Lee De Forest, 1967*

"We don't like their sound, and guitar music is on the way out" *Decca Recording Co. rejecting the Beatles, 1962*

"All attempts at artificial aviation are not only dangerous to life but doomed to failure from an engineering standpoint" *Editor of 'The Times' of London, 1905*

Shackleton Energy Company

Jim Keravala

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