



# **DECONSTRUCT 2.0 SPACE MINING**

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# MEANING AND SIGNIFICANCE

Quietly on January 1st 2009, a company called ARKYD Astronautics was formed, a secretive organization with ties to billionaires with founders Peter Diamandis and James Cameron. In 2012, they revealed their plan to the world under the banner of a new company ' Planetary Resources ', **they would mine asteroids for their precious resources and perhaps save the world along the way.**

Space mining refers to the mining of celestial bodies, mainly asteroids, spent comets, minor planets and other near - Earth objects for metals, minerals and water. According to some estimates, it is possible that our planet will run out of key elements that are needed for modern industry and food production within the next 50-60 years. The space exploration is a pretty good incentive to tap the virtually inexhaustible supply of elements located off-world. Precious metals such as gold, silver, and platinum group metals could be transported back to Earth, while iron group metals and other common ones could be used for construction in space. Many companies are coming up with newer technologies to be able to extract these innumerable space resources.

In 1997, it was speculated that a relatively small metallic asteroid with a diameter of 1.6km contains more than 20 trillion US dollars' worth of industrial and precious metals. The asteroid '16 psyche' is believed to contain  $1.7 \times 10^{19}$  of nickel-iron ore, which could supply the world's population requirements for several million years. **According to NASA, the market value of all the asteroids is greater than 7 lakh quadrillion dollars** which is also equal to 7 billion years of continuous mining on earth, which is also equal to 100 billion dollars to each person to each person a year. The development of small space crafts that are mass produced are key to economic viability. The economic implications of space mining are immense and undeniable if all its possibilities are explored to the fullest. It might possibly disrupt the economy of the earth to a large extent, but it is a "*necessary evil*" if we want life on Earth to sustain for hundreds of years.

# WHAT'S BEEN ACHIEVED

*Energy is limited here. Within just a few hundred years, you will have to cover all of the land mass of Earth in solar cells. So what are you going to do? Well, what I think you're going to do is you're going to move out in space ... all of our heavy industry will be moved off planet and Earth will be zoned residential and light industrial*

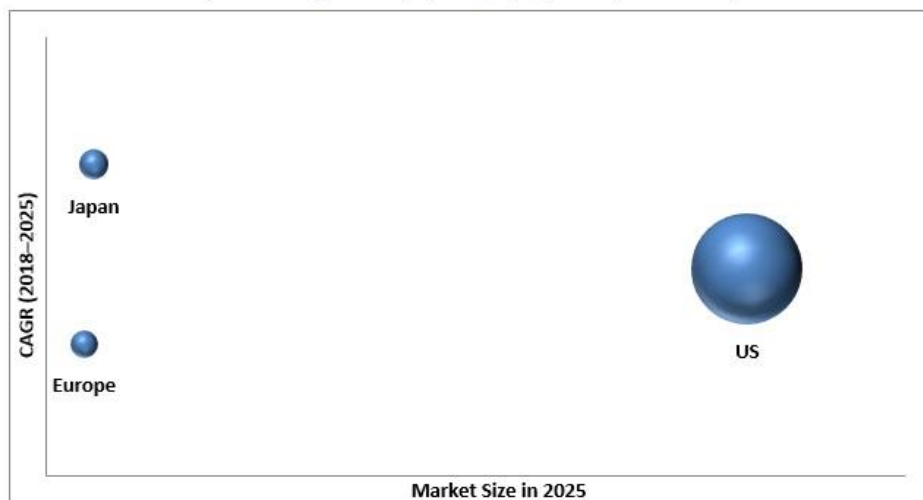
*~ Jeff Bezos*

- Technological innovation, primarily brought about by **commercial players such as Elon Musk and Jeff Bezos, is changing the landscape of space exploration**. Leading the way in this new-era race are the startups including Planetary Resources, Deep Space Industries, Ispace, and Kleos Space.
- Many prominent personalities from various fields have contributed funding and advice for the future of space mining, including the likes of Google's Larry Page and Eric Schmidt, Microsoft pioneer Charles Simonyi, filmmaker James Cameron, early Google investor Ram Shriram, and investor Ross Perot Jr.
- From aiming to protect earth against asteroids as propagated by the B612 Foundation, a California-based non-profit made up of scientists, former astronauts, and engineers, we have come a long way in the field of space exploration as we begin to **use asteroids' resources at our disposal**.
- One of the earliest recorded examples of asteroid mining-advocacy was made by Peter Diamandis, the founder of the X Prize competition that offers incentives to encourage tech developments.
- In 2008, he predicted that asteroid mining was the way of the future, a claim he expanded in his 2015 book *Bold: How to Go Big, Create Wealth and Impact the World*.
- In 2012, NASA commissioned a project called Robotic Asteroid Prospector (RAP) intended to assess the feasibility of asteroid mining. They identified four different classes of asteroid mission that would be possible using conventional technology (or what is already in the process of being developed).
- In September 2014, NASA took an important step forward by holding a conference at the Ames Research Center titled **"The Economics of NEOs"** bringing together leaders from the space mining community, academia, and government to explore the contours of the industry, identify overlap with other federal activities, and find areas for further collaboration.
- The **Hague International Space Resources Governance Working Group** was formed by the International Institute of Air and Space Law in December 2014. The aim of the Working Group is to recommend a stringent space policy to the UN that takes into account space mining.

# CURRENT PROGRESS

- Scottish aerospace company the Asteroid Mining Corporation (AMC) has announced plans to launch the UK's first asteroid mining operation, seeking an investment of £2.3m to build and launch a mining satellite by 2020.
- Planetary Resources, Inc., the asteroid mining company, secured US\$21.1 million in Series A funding in May 2016. **The capital is being used to deploy and operate Ceres, an advanced Earth observation business that features the first commercial infrared and hyperspectral sensor platform to better understand and manage humanity's natural resources**
- Launch of space probes and telescopes to prospect and **collect data on near earth asteroids**, such as the LEO Space telescope and the ARKYD Series 100 Interceptor, and ARKYD Series 300 Rendezvous Prospector began in 2012 and is likely to continue until 2025.
- In 2018, the Colorado School of Mining began running the **world's first space resources university course, the graduates of which will join the likes of Hunter-Scullion and Lewicki** and head out into space to make their fortune. The new gold rush has begun.

Space Mining Market, by Geography, 2025 (USD billion)



Source: Press Releases, Investor Relation Presentations, Annual Reports, Expert Interviews, and MarketsandMarkets Analysis

# FUTURE OF SPACE MINING

Space mining is still considered to be a serious topic only in the next decade or so. However, projects are already being set in motions.

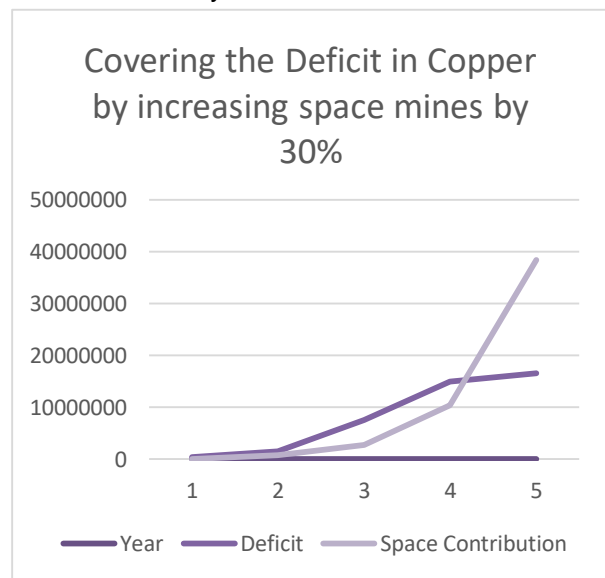
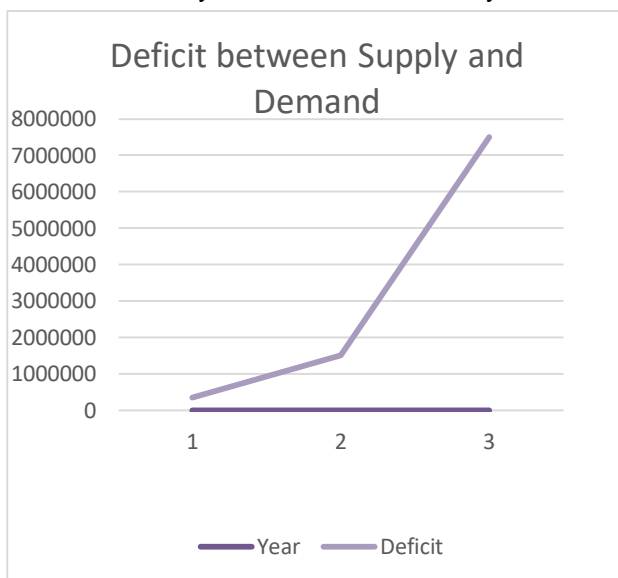
**The economics of it is what determines if it's prudent or not.** There are two schools of thought: One, space mining would lead to the fulfilment of demand of certain rare elements, thus giving the global economy a boost, or, it would lead to increase in the supply of elements, causing prices to fall, leading to losses to the investors.

One thing we can compare it to is the Gold Rush that happened across the globe. Let's take the case of the Australian Gold Rushes from 1851 to 1914. It promoted civilization in such areas. It is not dreamy to say that space mining might also lead to the setting up of human civilization centres across the solar system, and much later, the universe.

**As you can see the deficit starts increasing and becomes very huge for copper, which is one of the most useful minerals for us. Space Mining can be utilized to cover this deficit.**

Assuming that an asteroid is discovered in the year 2025, which can cover half of the deficit in 2025, and our total space resources are increasing at the constant rate of 30-35% compounded annually (which is a reasonable assumption, given how setting up a second space mining centre would be easier than the first and so on), we can cover the deficit easily till 2037. The rate infant drops if we expand the time period considered since the demand increases at a rate of 3.5% constantly while supply is nearly finished from the Earth's Crust.

We can also say that the deficit will only be covered after 2035 at any reasonable rate of increase.



# IMPACT ON ECONOMY

Space Mining is believed to be the next big force that will have a monumental impact on the economy. It is believed that space mining will give this world its first trillionaire and will allow business houses to mint billions of profits. The Space Mining Industry is bound to impact the existing industries and alter the established supply chains and value networks.

- **There is an estimated \$700 billion worth of resources in asteroid belt.** From offering us essential minerals such as iron, platinum and gold to alternatives to fuel, this industry is likely to shift industries from the Earth to outer space.
- As these industries shift to outer space, **climate change can be reversed to an extent by transferring the burden of mining on extra celestial bodies.**
- As populations all over the world continue to grow, a seven fold increase in population leads to a thirty fold increase in energy needs. In such a scenario, as the resources to generate energy can be made available the cost of energy generation falls thereby, making it available to the masses at cheap prices.
- This need of technological advancement calls for continuous human resource development, which will ultimately lead to new 'Industrial Age' based in outer space. Thus, in the long run the total job creation will rise majorly in scientific field, however, in the short run a change in production processes is also going to bring about a change in our skills requirements leading to widespread unemployment. Moreover, it also impacts the current technological and infrastructural investments already made.
- **A severe fall in metal prices arising from their oversupply will disrupt the entire commodities market** and these metals would begin being used as regular material instead of being used in a limited quantity in premium products like jewellery and hence there can be a fall in return on investments. The fall in ROI can also lead to investments being withdrawn.
- The indirect implication is the secondary effect on the rest of the industry. Anywhere and anything that uses metal will suddenly become cheaper and more abundant. Iron ore, used to make steel, being even more abundant might cause an even bigger real estate boom.
- Since space mining requires sophisticated technology and strong research base huge amount of expenditure is required. The amount of rocket fuel and other operational costs can make the entire project unfeasible however making robots and other technologies in space can actually bring down the overall expenditure.
- As major countries start having access to important resources and their hegemony is established they can easily dominate the resource market in the world. In such a scenario **countries with a weak space programme which are majorly dependent on the export of resources start losing their main source of income.** .

In order to succeed, the model has to be developed in such a manner that it leads to an efficient, easy and low-cost solution to our problems. Proper regulation and accountability needs to be established so as to ensure the smooth functioning of the new age "Space Economy".

# WILL IT WORK?

Much has already been, and continues to be, invested in the Space Mining industry in terms of time, money and effort. However, the returns on such investments are yet to be reaped. It's often said that all good things take time. Nothing can be truer for the Space Mining Industry: only time can tell how profitable and useful this industry will turn out.

- The amount of expenditure that would have to be incurred still **remains incalculable** since the industry is still in its formative stages and there is immense scope for innovations. The opportunities and impediments that come in the later stages will ultimately determine the investments required.
- Moreover, there is a possibility of a few powerful nations establishing their hegemony on the space resources. Thus, the countries who cannot avail of this **first mover advantage due to lack of technical sophistication** would not be able to enjoy the benefits of this rising opportunity.
- While this industry might help preserve our earth's ecology, it might just lead to a transfer of the ill effects of pollution to the outer space. Devoid of any regulations and accountability, it might lead to unprecedented exploitation of space resources by the big business houses.
- Further, the rise of the Space Mining Industry will come at the cost of the **existing industries, leading to widespread unemployment**. It might also bring about disruption in the established supply chain networks.

Despite these drawbacks, all's not gloomy for the Space Mining industry and a lot of factors strengthen its future prospects of growth as well as usefulness.

- Space Mining offers humans the advantage of attaining essential elements like copper, nickel, platinum, iron etc. that can be used for wide ranging human activities. The moon offers Helium-3 isotopes which are not as abundantly available on Earth. This gas can be used in nuclear fusion plants and can end the quest for a non-polluting source of energy. It is believed that outer space has ample resources to solve our problems for the next three thousand years.
- The industry opens up avenues for **technological progress and foster new value networks without the harmful impacts of environmental degradation**. While this may lead to widespread unemployment among the unskilled or semi-skilled miners, it will create new specialized jobs.
- Since some asteroids are composed of water and ice, if tapped properly they can solve the problem of water scarcity on Earth.

***The success of the space mining industry depends upon the rate of investments, research, technological innovation and the ability of firms to control expenditures. The best way to find out whether the industry model will work or not is to unbiasedly weigh the pros and cons as well as the opportunities and difficulties that come in the future path!***