

Introduction: This paper aims to address the current public narrative surrounding the space industry. Public narrative drives policy making that directly influences the space business and industry. If an inept public opinion gains traction, as we are starting to see with a few issues in the space industry, the recourse could be catastrophic or everlasting. There are several examples in other industries, such as oil and gas, where a narrative took over policy making and directly impacted the industry in a negative way. There are two drivers for unfavorable policy making, an uninformed public and policy making solutions to challenges not yet fully understood. Consequently, leaders in the space industry should put forth efforts to educate the public on incorrect perceptions and to take control of the narrative around the industry. This will inform future policy making efforts and help prevent overly restrictive regulations that will negatively impact future revenue potential.

Spending: The current public narrative around the space industry namely pertains to three items: the “Billionaire Space Race”, the common misconception around NASA’s budget, and rocket exhaust emissions concerns. The “Billionaire Space Race” is driving a narrative that we are devoting an exorbitant amount of money on colonizing other planets and forgetting about Earth and the many problems we face here. The narrative claims this is the ultimate symbol of capitalism’s flawed obsession with growth [1]. Many people think that billionaires have a moral responsibility to help people and solve humanitarian issues such as hunger. Their level of moral responsibility is an argument in and of itself, but we can drive the point that only a relatively small portion is going towards space efforts in addition to the point that having a “Plan B” for colonizing other planets is a good thing. Further, we can drive the point that if money is being spent on such risky endeavors, would the public not prefer it to come from the personal wealth of billionaires instead of a publicly funded agency? If we allow this narrative to grow, the public perception can shift towards a more conservative mindset that may affect future policy making on the expansion of space and space resources.

The “Billionaire Space Race” narrative goes hand in hand with the common misconception about NASA’s budget. Since the Apollo era, surveys have shown that the public routinely thinks that NASA’s budget is around 25% of the entire United States budget. As we know, this is false. The budget peaked at 5% in the 1960s and has been around 0.5% for the past few decades [2]. The public is overestimating the money

spent on space by a factor of 50. This misconception has also developed a faction in society that think we, as a human race, should not spend our money on the space industry, or at least so much money, and instead focus it on solving problems on Earth. NASA, being a public entity, is commonly viewed as the face of the space industry, so perceptions on NASA influence perceptions on the industry. Such perceptions can lead to policies to be enacted that directly or indirectly limit the funding and spending for space and space resources development.

We should attempt to counteract these narratives with three primary points. The first should be around developing an understanding of how much money is spent on space relative to other industries and markets. For example, the tax revenue from cigarettes alone has been able to fund the human spaceflight division of NASA. Helping the public understand relatively how much money is being spent on space will mitigate many concerns around using the money for more pressing problems. The second should be around educating the public on the value return from investment in space. The government of Luxembourg conducted a study on the space resources value chain that projects that market itself will generate 73 to 170B € in revenue from 2018 to 2045, 54 to 135B € in cost savings for space resources customers, 2.5B € in revenue from spillover knowledge and technology, and it will lessen the dependence on Earth’s finite resources [3]. A lessened dependence aides in global warming efforts. Finally, we should drive a narrative of hope and excitement for space. As Elon puts it, “I think we should spend the vast majority of our resources solving problems on Earth...but maybe...1%, or less than 1%, could be applied to extending life beyond Earth... [because] the future is vastly more exciting and interesting if we're a spacefaring civilization”. Not only is the potential in space essentially limitless, allowing for many exciting future possibilities, it is an investment to ensure the most valuable resource, the human race, survives in the event of an eventual cataclysmic event. Driving this narrative with the understanding that the investment is less than 1% of total spending will again help alleviate tension around space spending. Otherwise, the public may inform policy makers to make more restrictive regulations around spending and resources, hindering the development of space resources.

Pollution: The third growing public concern is around rocket exhaust pollution. This faction of the public is worried about the increased carbon footprint from increased number of rocket launches. Conse-

quently, my concern is that if this faction grows, a set of policies could be enacted to restrict the number or type of launches, again hindering the development of space resources. Although this concern has some merit, we should illustrate to the public that one, the New Shepard rocket's exhaust, for example, is water vapor, not a pollutant, and two, that a primary goal of space resources is to establish a framework for refueling rockets with hydrogen and oxygen on the Moon and cislunar space [4]. Additionally, no amount of pollution is explicitly good, but the pollutants from rocket launches are an investment to reduce global emissions in the future by moving several manufacturing industries to space.

Analogs: Before dismissing the concerns around these potentially small factions' narratives, consider the situation with the oil and gas industry in California. A small faction of society developed the incorrect view that hydraulic fracturing causes earthquakes and is made of toxic chemicals and acid that pollutes the water supply. The industry did nothing to counteract it, in part because the fracture fluid was proprietary and in part because they did not think this minority had any influence. Eventually that small faction grew to the majority, along with other misconceptions, and now many policies and regulations have been enacted to stop the supply of oil and gas within California (and instead import the increasing demand from overseas). For example, the banning of any new cyclic steam wells in California (a primary well type to produce oil in California). The oil and gas companies spent millions to drive their own narrative after the fact and in courts to fight baseless regulations but are currently losing the "narrative war". If we sit by and watch these narratives against the space industry unfold, we may stand to lose too.

Policy: The second driver for unfavorable policy making is enacting solutions to challenges not yet fully understood. This is currently prevalent in the Outer Space Treaty of 1967. Two of the provisions' state that the Moon and celestial bodies are not subject to national appropriation by claims of sovereignty and that it's use should be for the benefit of all [5]. Considerations and markets for space use were essentially non-existent at the time of the treaty as compared to today. Consequently, a perceived tension exists where space mining is concerned, as mining will require some level of temporary possession rights to regions in space. The tension drives uncertainty and concern on the legality of space resources activities and thus is a hinderance to the development of our industry. Leading the narrative around the industry and policy making can help the the industry from further hindering ambiguities in polices of the future.

One of the narratives that should be driven is that policymakers should adopt an incremental regulatory approach. Further, we should consider separate legal regimes for separate activities, such as lunar and asteroid mining operations, as each will require different technologies and infrastructure. The Hague Working Group has proposed an incremental approach to policy development based on technological progress⁶. That is, if the technology to exploit a particular space resource does not yet exist, the policy should not either. This is understandably a slippery slope, as the pace of innovation and technological development can often move faster than the pace of policy making. Calibration through the practice of incremental policy development will help us hone in on appropriate timing of policy enactment, however.

Policies are formed on the basis of public opinion, and policy and regulation dictate what we can and can't do as an industry. Government interference i.e., regulation, in the free market decreases the number of sellers in the market at a given price. The decrease in sellers decreases the market supply, shifting the supply curve to the left on the supply-demand chart. This has the intended consequence of lowering the market equilibrium quantity as those who cannot meet the regulation are no longer sellers in the market. It has the unintended consequence of increasing the equilibrium price, however. This shift in supply reduces the total gains from trade in the market and prolongs the development of the space resources industry. The longer we wait to take control of the narrative, the more we stand to lose in the long run. We should act now and educate the public on the happenings of our industry and benefits our company brings. We should put the narrative we want to be heard out in the public, the correct narrative, and help inform policy makers.

References: [1] Tim Jackson. "Billionaire Space Race: The Ultimate Symbol of Capitalism's Flawed Obsession with Growth." *The Conversation*. [2] Mary Lynne Dittmar. "Sustaining Exploration: Communications, Relevance, and Value". [3] SpaceResources.LU. 2018, *Opportunities for Space Resources Utilization*. [4] Fauzia, Miriam. "Fact Check: Jeff Bezos' New Shepard Rocket Launch Didn't Emit Carbon." *USA Today*. [5] Robert.wickramatunga. "United NationsOffice for Outer Space Affairs." *The Outer Space Treaty*. [6] Ian Christensen, Ian Lange, et al. "New Policies Needed to Advance Space Mining."

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