#### “The eyes of the world now look into space, to the moon and to the planets beyond, and we have vowed that we shall not see it governed by a hostile flag of conquest, but by a banner of freedom and peace.”

#### Because I agree with former President John F. Kennedy, that space is the final frontier, but must guarantee safety and liberty, I proudly affirm the resolution Resolved: The appropriation of outer space by private entities is unjust.

#### First, I would like to offer some definitions.

#### Black’s Law Dictionary defines private as “Affecting or belonging to private individuals, as distinct from the public generally. Not official.”

[“What is PRIVATE?” Black’s Law Dictionary. No Date. Accessed 1/4/21. <https://thelawdictionary.org/private/> //Xu]

#### Merriam Webster defines entity as “something that has separate and distinct existence and objective or conceptual reality”

[“entity”. Merriam Webster. No Date. Accessed 1/7/22. <https://www.merriam-webster.com/dictionary/entity> //Xu]

#### This means that the affirmative burden is to prove that space appropriation by completely nongovernmental companies is unjust.

#### Second, Merriam Webster defines appropriation as “the act of taking or using something especially in a way that is illegal, unfair, etc.”

[“appropriation”. Merriam Webster. No Date. Accessed 1/7/22. <https://www.merriam-webster.com/dictionary/appropriation> //Xu]

#### This means that even if there are some benefit to appropriation, it is definitionally unfair which means they aren’t distributed properly.

### FW

#### I value morality per the usage of the word ought in the resolution implies a moral action.

**Thus, the value criterion is maximizing expected wellbeing, meaning that we should prioritize the impacts that help the most people and prevent the most harm.**

**Pleasure and pain are intrinsically valuable – they’re where we reach the end of the line in matters of value**

**Moen 16** [Ole Martin Moen, Research Fellow in Philosophy at University of Oslo “An Argument for Hedonism” Journal of Value Inquiry (Springer), 50 (2) 2016: 267–281]

Let us start by observing, empirically, that a widely shared judgment about intrinsic value and disvalue is that pleasure is intrinsically valuable and pain is intrinsically disvaluable. On virtually any proposed list of intrinsic values and disvalues (we will look at some of them below), pleasure is included among the intrinsic values and pain among the intrinsic disvalues. This inclusion makes intuitive sense, moreover, for there is something undeniably good about the way pleasure feels and something undeniably bad about the way pain feels, and neither the goodness of pleasure nor the badness of pain seems to be exhausted by the further effects that these experiences might have. “Pleasure” and “pain” are here understood inclusively, as encompassing anything hedonically positive and anything hedonically negative.2 The special value statuses of pleasure and pain are manifested in how we treat these experiences in our everyday reasoning about values. If you tell me that you are heading for the convenience store, I might ask: “What for?” This is a reasonable question, for when you go to the convenience store you usually do so, not merely for the sake of going to the convenience store, but for the sake of achieving something further that you deem to be valuable. You might answer, for example: “To buy soda.” This answer makes sense, for soda is a nice thing and you can get it at the convenience store. I might further inquire, however: “What is buying the soda good for?” This further question can also be a reasonable one, for it need not be obvious why you want the soda. You might answer: “Well, I want it for the pleasure of drinking it.” If I then proceed by asking “But what is the pleasure of drinking the soda good for?” the discussion is likely to reach an awkward end. The reason is that the pleasure is not good for anything further; it is simply that for which going to the convenience store and buying the soda is good.3 As Aristotle observes: “We never ask [a man] what his end is in being pleased, because we assume that pleasure is choice worthy in itself.”4 Presumably, a similar story can be told in the case of pains, for if someone says “This is painful!” we never respond by asking: “And why is that a problem?” We take for granted that if something is painful, we have a sufficient explanation of why it is bad. If we are onto something in our everyday reasoning about values, it seems that pleasure and pain are both places where we reach the end of the line in matters of value.

#### Prefer additionally -- Governments have to use util since collective actions necessarily benefit some people while hurting others either due to resource tradeoffs or scope of effect.

### My first Contention is that Private Space Enterprises are Unsustainable

#### First, the commercial Space Industry requires an enormous increase in launches – that causes pollutants and warming.

**Katharine Gammon, a science journalist with degrees from MIT and Princeton, reports in 2021 that** Katharine Gammon 7-19-2021 "How the billionaire space race could be one giant leap for pollution" <https://www.theguardian.com/science/2021/jul/19/billionaires-space-tourism-environment-emissions> (I’m an award-winning independent science journalist based in Santa Monica, California. My interests range from culture and nature in public lands to the lives of scientists to the complexity of baby brains. Before I became a professional journalist, I served in the Peace Corps in Bulgaria, and attended MIT and Princeton University.)//Elmer

**Last week Virgin Galactic took Richard Branson past the edge of space, roughly 86 km up – part of a new space race with the Amazon billionaire Jeff Bezos, who aims to make a similar journey on Tuesday. Both very wealthy businessmen hope to vastly expand the number of people in space. “We’re here to make space more accessible to all,” said Branson, shortly after his flight. “Welcome to the dawn of a new space age.” Already, people are buying tickets to space. Companies including SpaceX, Virgin Galactic and Space Adventures want to make space tourism more common**. The Japanese billionaire Yusaku Maezawa spent an undisclosed sum of money with SpaceX in 2018 for a possible future private trip around the moon and back. And this June, an anonymous space lover paid $28m to fly on Blue Origin’s New Shepard with Bezos – though later backed out due to a “scheduling conflict”. **But this launch of a new private space industry that is cultivating tourism and popular use could come with vast environmental costs, says Eloise Marais, an associate professor of physical geography at University College London. Marais studies the impact of fuels and industries on the atmosphere. When rockets launch into space, they require a huge amount of propellants to make it out of the Earth’s atmosphere. For SpaceX’s Falcon 9 rocket, it is kerosene, and for Nasa it is liquid hydrogen in their new Space Launch System. Those fuels emit a variety of substances into the atmosphere, including carbon dioxide, water, chlorine and other chemicals**. The **carbon emissions from rockets** are small compared with the aircraft industry, she says. But they are **increasing at nearly 5.6% a year**, and Marais has been running a simulation for a decade, to figure out at what point will they compete with traditional sources we are familiar with. “**For one long-haul plane flight it’s one to three tons of carbon dioxide [per passenger],”** says Marais. For one rocket launch 200-300 tonnes of carbon dioxide are split between 4 or so passengers, according to Marais. “So it doesn’t need to grow that much more to compete with other sources.” **Right now, the number of rocket flights is very small: in the whole of 2020, for instance, there were 114 attempted orbital launches in the world, according to Nasa.** That compares with the airline industry’s more than 100,000 flights each day on average. **But emissions from rockets are emitted right into the upper atmosphere, which means they stay there for a long time: two to three years. Even water injected into the upper atmosphere – where it can form clouds – can have warming impacts, says Marais. “Even something as seemingly innocuous as water can have an impact.” Closer to the ground, all fuels emit huge amounts of heat, which can add ozone to the troposphere, where it acts like a greenhouse gas and retains heat. In addition to carbon dioxide, fuels like kerosene and methane also produce soot. And in the upper atmosphere, the ozone layer can be destroyed by the combination of elements from burning fuels. “While there are a number of environmental impacts resulting from the launch of space vehicles, the depletion of stratospheric ozone is the most studied and most immediately concerning,”** wrote Jessica Dallas, a senior policy adviser at the New Zealand Space Agency, in an analysis of research on space launch emissions published last year. Another report from 2019 penned by the Center for Space Policy and Strategy likened the space emissions problem to that of space debris, which the authors say creates an existential risk to the industry. “**Today, launch vehicle emissions present a distinctive echo of the space debris problem. Rocket engine exhaust emitted into the stratosphere during ascent to orbit adversely impacts the global atmosphere,” they wrote. “We just don’t know how large the space tourism industry could become,”** says Marais. A new market report estimates that the global suborbital transportation and space tourism market is estimated to reach $2.58bn in 2031, growing 17.15% each year of the next decade. “**The major driving factor for the market’s robustness will be focused efforts to enable space transportation, emerging startups in suborbital transportation, and increasing developments in low-cost launching sites,”** the report says. In the past, most space transportation has been focused on cargo supply missions to the International Space Station and satellite launch services, but currently, this focus has shifted to in-space transportation, planetary explorations, crewed missions, suborbital transportation and space tourism. Several companies, including SpaceX, Blue Origin and Virgin Galactic, have been focusing on developing platforms such as rocket-powered suborbital vehicles that will enable the industry to carry out suborbital transportation and space tourism. People have pointed out that the money these billionaires have poured into space technology could be invested in making life better on our planet, where wildfires, heatwaves and other climate disasters are becoming more frequent as the globe warms up in the climate crisis. “Is anyone else alarmed that billionaires are having their own private space race while record-breaking heatwaves are sparking a ‘fire-breathing dragon of clouds’ and cooking sea creatures to death in their shells?” the former US Labor Secretary Robert Reich tweeted last week. Marais says that there is always an element of excitement to new developments in space – but it’s still possible to be responsible while doing something exciting. She urges caution as the space tourism industry grows, and says there are currently **no international rules around the kinds of fuels used and their impact on the environment. “We have no regulations currently around rocket emissions,”** she says. “The time to act is now – while the billionaires are still buying their tickets.”

#### Public launches are goldilocks, but Commercialization increases it ten-fold which overwhelms alt-causes – specifically decks the Ozone Layer.

**Eloise Marais, professor in Physical Geography writes 21** Eloise Marais 7-19-2021 "Space tourism: rockets emit 100 times more CO₂ per passenger than flights – imagine a whole industry" <https://theconversation.com/space-tourism-rockets-emit-100-times-more-co-per-passenger-than-flights-imagine-a-whole-industry-164601> (Associate Professor in Physical Geography, UCL)//Elmer

The **commercial race** to get tourists **to space** is **heating up** between Virgin Group founder Sir Richard Branson and former Amazon CEO Jeff Bezos. On Sunday 11 July, Branson ascended 80 km to reach the edge of space in his piloted Virgin Galactic VSS Unity spaceplane. Bezos’ autonomous Blue Origin rocket is due to launch on July 20, coinciding with the anniversary of the Apollo 11 Moon landing. Though Bezos loses to Branson in time, he is set to reach higher altitudes (about 120 km). The launch will demonstrate his offering to very wealthy tourists: the opportunity to truly reach outer space. Both tour packages will provide passengers with a brief ten-minute frolic in zero gravity and glimpses of Earth from space. Not to be outdone, Elon Musk’s SpaceX will provide four to five days of orbital travel with its Crew Dragon capsule later in 2021. What are the environmental consequences of a space tourism industry likely to be? Bezos boasts his Blue Origin rockets are greener than Branson’s VSS Unity. The Blue Engine 3 (BE-3) will launch Bezos, his brother and two guests into space using liquid hydrogen and liquid oxygen propellants. VSS Unity used a hybrid propellant comprised of a solid carbon-based fuel, hydroxyl-terminated polybutadiene (HTPB), and a liquid oxidant, nitrous oxide (laughing gas). The SpaceX Falcon series of reusable rockets will propel the Crew Dragon into orbit using liquid kerosene and liquid oxygen. **Burning these propellants provides the energy needed to launch rockets into space while also generating greenhouse gases and air pollutants. Large quantities of water vapour are produced by burning the BE-3 propellant, while combustion of both the VSS Unity and Falcon fuels produces CO₂, soot and some water vapour. The nitrogen-based oxidant used by VSS Unity also generates nitrogen oxides, compounds that contribute to air pollution closer to Earth. Roughly two-thirds of the propellant exhaust is released into the stratosphere (12 km-50 km) and mesosphere (50 km-85 km), where it can persist for at least two to three years. The very high temperatures during launch and re-entry (when the protective heat shields of the returning crafts burn up) also convert stable nitrogen in the air into reactive nitrogen oxides. These gases and particles have many negative effects on the atmosphere**. **In the stratosphere, nitrogen oxides and chemicals formed from the breakdown of water vapour convert ozone into oxygen, depleting the ozone layer which guards life on Earth against harmful UV radiation. Water vapour also produces stratospheric clouds that provide a surface for this reaction to occur at a faster pace than it otherwise would. Space tourism and climate change Exhaust emissions of CO₂ and soot trap heat in the atmosphere, contributing to global warming. Cooling of the atmosphere can also occur, as clouds formed from the emitted water vapour reflect incoming sunlight back to space. A depleted ozone layer would also absorb less incoming sunlight, and so heat the stratosphere less**. Figuring out the overall effect of rocket launches on the atmosphere will require detailed modelling, in order to account for these complex processes and the persistence of these pollutants in the upper atmosphere. Equally important is a clear understanding of how the space tourism industry will develop. **Virgin Galactic anticipates it will offer 400 spaceflights each year to the privileged few who can afford them. Blue Origin and SpaceX have yet to announce their plans. But globally, rocket launches wouldn’t need to increase by much from the current 100 or so performed each year to induce harmful effects that are competitive with other sources, like ozone-depleting chlorofluorocarbons (CFCs), and CO₂ from aircraft. During launch, rockets can emit between four and ten times more nitrogen oxides than Drax, the largest thermal power plant in the UK, over the same period. CO₂ emissions for the four or so tourists on a space flight will be between 50 and 100 times more than the one to three tonnes per passenger on a long-haul flight**. In order for international regulators to keep up with this nascent industry and control its pollution properly, scientists need a better understanding of the effect these billionaire astronauts will have on our planet’s atmosphere.

#### Second, unregulated commercialization triples debris and renders satellites unusable.

**Christopher Fabian, techologist and founder for techologyand finanice inativites at UNICEF writes in 19** (Christopher; January 2019; B.S. from the United States Air Force Academy, thesis submitted in partial fulfillment of the requirements for a M.S. from the University of North Dakota, approved by the Faculty Advisory Committee and in coordination with Dr. Michael Dodge, David Kugler, and Brian Urlacher; University of North Dakota Scholarly Commons, “A Neoclassical Realist’s Analysis Of Sino-U.S. Space Policy,” <https://commons.und.edu/theses/2455/>)

b. Defect/Defect **The ubiquity of space technology** has also **yielded the negative externality of overcrowding the space domain. Despite its** seemingly unlimited **size, there are a limited number of useful earth-centric orbits to optimize terrestrial coverage**. It is projected that **there are over 300,000 medium** sized **objects capable of causing catastrophic failure of a satellite upon collision** currently **in** earth’s **orbit**.159 Of these objects, **20,000 are actively tracked by the comparatively robust space surveillance network** (SSN) **of the** United States **Air Force, only 1,000 are active** payloads, **and even fewer have maneuver capability**.160 **Recent trends indicate that** the problem of **orbital congestion will only worsen in** the coming **decades as** the **barriers to entry are reduced. Launch** service **cost is rapidly decreasing due to** an increased number of **service providers and technology revolutions** such as reusable rockets. Also, **the miniaturization and simplification of** satellite **payloads** further **reduces the cost and infrastructure** needed to be a spacefairing nation.161 **This is evidenced by** the **near doubling of state** operated **satellites** from 27 in 2000 to over 50 in 2012, **coupled with** a near doubling in **total space objects** from 1997 to 2007.162 The **accumulation of space debris is a vital concern to** the **sustainable development of** the **space** environment **due to the increased probability of conjunction between active payloads and** all **other objects** that results **from crowded orbits**. This **increase in collision** probability **occurs proportionally to the number of objects in** a given **orbital domain. The tripling of** orbital **debris projected to occur in the** next **century, due to routine use and accumulation alone, would cause a tenfold increase in** the probability of **collision. In the event of** a catastrophic **collision between** two **objects, the resulting debris cloud could cause a cascading effect. Each successive collision increases** the **probability of another** occurrence in **a given orbit until an instability threshold is reached**. At this threshold, **debris removal due to decay would be negligible compared to debris created by** subsequent **collisions. As** the **propagation** of debris **continues, the cost of** launching **a satellite would** eventually **outweigh the benefits** received **due to the probability of that asset being destroyed by errant debris**, effectively **rendering the** given **orbit unusable**. This debris propagation model and the dangers associated with it are colloquially referred to as the Kessler Syndrome. **Kessler asserts unstable regions of low** earth **orbit** (LEO) currently **exist and** that, **barring** the **addition of** more **debris**, a major **collision would occur** once **every 10-20 years**. If debris doubles, as it has in the last decade, the collision rate would increase to 2.5 years. Although most models’ time scales **are on the order of centuries, it is widely accepted** that **the current rate of** debris **accumulation will render critical orbits unusable unless immediate measures are taken to return stability**.163 **There is** near **universal acceptance of the danger** space **debris presents, yet little** substantive **action has been taken** to solve the problem. **Current debris** accumulation and propagation **models show that earth orbiting domains are finite** resources. **Continued** unsustainable **development** moving forward **may preclude future usage, making** earth **orbits rivalrous goods**.164 Furthermore, orbital **domains are made** a **non-excludable** good **by the OST** which states, “Outer space… shall be free for exploration and use by all States without discrimination of any kind.”165 As a non-excludable public good, **space succumbs to the tragedy of the commons where the** privately **beneficial strategy of space utilization differs significantly from the** socially **optimal strategy promoting** orbital **stability**.166 Understandably, **most analysis** has **focused on solving** the problem of **orbital instability by addressing the market failure** responsible for debris creation. The current reasoning suggests that **if actors creating** space **debris internalize the cost of their actions, a solution can arise**. Proposed solutions run the gamut of ideologies from free market tax incentives, to command and control legislation, to restructuring orbital property rights. Scientific solutions have also been proposed, but technological feasibility and cost remain major problems. Furthermore, analogous environments susceptible to the tragedy of the commons have been examined in hopes that they may prove applicable to the problem of orbit instability.167 **This analysis is** ultimately **useful** if the problem is to be solved **under nominal conditions, but there is an underlying problem that needs to be addressed before any** of these proposed **solutions can** realistically **be enacted**.

#### Earth observation satellites key to warming adaptation

**Elisa Alonso** communications consultant for a climate resilance organization writes in **18** [(Elisa Jiménez Alonso, communications consultant with Acclimatise, climate resilience organization) “Earth Observation of Increasing Importance for Climate Change Adaptation,” Acclimatise, May 2, 2018, <https://www.acclimatise.uk.com/2018/05/02/earth-observation-of-increasing-importance-for-climate-change-adaptation/>] TDI

**Earth observation (EO) satellites are playing an increasingly important role in assessing climate change**. By providing a **constant and consistent stream of data about the state of the climate**, EO is **not just improving scientific outcomes but can also inform climate policy**.

**Managing climate-related risks effectively requires accurate, robust, sustained, and wide-ranging climate information. Reliable observational climate data can help scientists test the accuracy of their models and improve the science of attributing certain events to climate change. Information based on projections from models and historic data can help decision makers plan and implement adaptation actions.**

Providing information in data-sparse regions

**Ground-based** weather and climate **monitoring systems only cover about 30%** of the Earth’s surface. In many parts of the world such **data is incomplete and patchy due to poorly maintained weather stations and a general lack of such facilities.**

**EO satellites** and rapidly improving satellite technology, especially data from open access programmes, **offer a valuable source information for such data-sparse regions. This is especially important since countries and regions with a lack of climate data are often particularly vulnerable to climate change impacts.**

International efforts for systematic observation

The importance of satellite-based observations is also recognised by the international community. Following the recommendations of the World Meteorological Organization’s (WMO) Global Climate Observing System (GCOS) programme, the UNFCCC strongly encourages countries that support space agencies with EO programmes to get involved in GCOS and support the programme’s implementation. The Paris Agreement highlights the need for and importance of effective and progressive responses to the threat of climate change based on the best available scientific knowledge. This implies that climate knowledge needs to be strengthened, which includes continuously improving systematic observations of the Earth’s climate.

To meet the need of such systematic climate observations, GCOS developed the concept of the Essential Climate Variable, or ECV. According to WMO, an ECV “is a physical, chemical or biological variable or a group of linked variables that critically contributes to the characterization of Earth’ s climate.” In 2010, 50 ECVs which would help the work of the UNFCCC and IPCC were defined by GCOS. The ECVs, which can be seen below, were identified due to their relevance for characterising the climate system and its changes, the technical feasibility of observing or deriving them on a global scale, and their cost effectiveness.

The 50 Essential Climate Variables as defined by GCOS.

One effort supporting the systemic observation of the climate is the European Space Agency’s (ESA) Climate Change Initiative (CCI). The programme taps into its own and its member countries’ EO archives that have been established in the last three decades in order to provide a timely and adequate contribution to the ECV databases required by the UNFCCC.

Robust evidence supporting climate risk management

Earth observation satellites can observe the entire Earth on a daily basis (polar orbiting satellites) or continuously monitor the disk of Earth below them (geostationary satellites) maintaining a constant watch of the entire globe. Sensors can target any point on Earth even the most remote and inhospitable areas which helps monitor deforestation in vast tropical forests and the melting of the ice caps.

**Without insights offered by EO satellites there would not be enough evidence for decision makers to base their climate policies on, increasing the risk of maladaptation. Robust EO data is an invaluable resource for collecting climate information that can inform climate risk management and make it more effective.**

#### Third, Unchecked Commercial Appropriation causes Space Conflicts due to conflicting goals.

**Veronica Perez, head resarcher for human rights law 21** Veronica Delgado-Perez. 12/14/21. Argument | The Commercialization of Space Risks Launching a Militarized Space Race. <https://www.theintlscholar.com/periodical/12/14/2020/analysis-commercialization-space-risk-international-law-military-space-race> [Veronica Delgado-Perez is a Staff Writer at The International Scholar.] // CVHS SR

**Fundamentals of the Final Frontier It is a geopolitical imperative to determine what, if any, commercial activities and use of extraterrestrial resources are permitted** within the confines of international law. Without clear-cut agreements on what activity is recognized by international law, **the world will undoubtedly see states push the boundaries ever further in an attempt to gain the edge over geopolitical competitors — even more-so in an era of renewed great power competition.** **Yet to date, there exists no comprehensive treaty or legal reference to commercial activity in space**. However, this should come as no surprise. It has only been since the turn of the century that technology and markets have progressed to the point where commercial space exploration and exploitation has become possible. Only recently have experts and analysts of geopolitics and international law begun to seriously examine questions surrounding the legal framework that would govern extraterrestrial resource-mining and other commercial activities. **In the last decade, the United Nations Committee on the Peaceful Uses of Outer Space (COPUOS) dealt with commercial aspects in outer space. In one of their last reports, the Committee expressed that the era of the commercial utilization of outer space’s resources is intrinsically linked to the escalation of international competition over resources, which could threaten international peace and security.** By encouraging the international community to engage in outer space’s activities for the benefit of humankind as a whole, “some delegations” have expressed that states should avoid the promotion of laws and regulations related to the commercialization of outer space, arguing that it should be considered the heritage of all humanity. In that regard, states must then ensure that domestic law on the use of outer space complies with international space law, which means that states should respect the principles outlined in the Outer Space Treaty and ensure that national regulations do not contravene international provisions. Even though the Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, including the Moon and other Celestial Bodies (which entered into force in 1967), refers to the exploration and use of outer space, it does not address questions of a commercial nature, which compromises the ability of states and international actors to address new challenges to extraterrestrial activities. In several provisions, the treaty highlights that these activities may be carried out for peaceful purposes and the benefit of all people, reaffirming that outer space is not subject to national appropriation. Were outer space not considered a global commons, that would imply that the resources and results of commercial exploration may fall within the jurisdiction of a country. It is thus incumbent upon Washington — and its commercial enterprises — to demonstrate how American commercial exploration of space benefits other countries and complies with international space law, or otherwise to adhere to the spirit of past treaties which emphasize the impartiality of outer space until such time as the law is clarified. International Law is Adrift in Space The potential benefits of commercial space exploration cannot be ignored. From an economic standpoint, the space industry would generate a significant economic boon for both states and private companies, due to the abundance and variety of resources — particularly scarce minerals that are difficult to extract on Earth. As one example of the vastness of resources held in outer space, one asteroid has the potential to contain more than the total supply of platinum extracted throughout the history of mankind. It may very well open the door to an advanced era of space navigation, building extraterrestrial infrastructure that facilitates the exploration and use of space’s resources, and extra-planetary human habitation. **Inevitably, there are significant drawbacks to the commercialization of space exploration. These can vary, for instance, from the commercial dominance of space’s natural resources only by those** **states with the technical and financial capital to support space missions, to geopolitical competition over extraterrestrial resources that threatens world peace and security, to the potential for the monopolization of extraterrestrial resources by states and private companies.** As was the case during the Cold War, the Soviet Union and the United States began a Space Race in which they struggled to achieve supremacy in space exploration and domination of science**. Today, the number of space powers has increased thanks to continual advancements in flight, combustion, and fueling technologies**. In the three decades since the end of the Cold War, technologically advanced countries like **China, Japan, and France** which previously had no space program have successfully navigated to the top tier of space-faring agencies and programs. **In 2018, the U.S. allocated $41 billion to space programs, followed by China at $5.8 billion, and Russia at $3.1 billion. Collectively, the three major space powers control almost 65% of the global industry, showing space powers are monopolizing space and reinforcing the inequality gap between states that do not have sufficient economic and technological capacity to invest**. **With new actors on the game stage, conflicts of interest may arise. There is a risk that each actor adopts a kind of short-term Realist approach to space policy — one which is driven by self-interest in reaping the greatest benefits of extraterrestrial exploration and commercialization while controlling access to others**. If unmitigated, states may choose to militarize outer space to gain a strategic edge over competitors and adversaries. This process has already begun. **Under the Trump administration, the Pentagon established the U.S. Space Force as a new branch of the Armed Forces to protect the country and allied interests in space.** **Already, Delta 4 — one of the U.S. Space Force’s missions — conducts strategic and theater missile warnings, manages weapon systems, and provides information to missile defense forces**. The measure shows that for the U.S., outer space is not only a domain of scientific exploration but has the potential to become increasingly securitized. With **the impending expiration of the Strategic Arms Reduction Treaty (START) between the U.S. and Russia on February 5, 2021, a number of security dilemmas could arise**. **If the world’s two largest nuclear powers do not edge toward extending the treaty, Washington and Moscow risk returning to the era of unrestricted expansion of launch platforms and strategically-deployed nuclear warheads — potentially with the aid of military infrastructure in space.** Although President-elect Biden has expressed his interest in negotiating an extension of New START, how Moscow and Washington might proceed remains an open question. Bilateral progress towards a new arms-control regime would require establishing limits on the number and range of long- and mid-range missiles, establishing measures to limit the expansion of traditional missile deployment to space, and banning the deployment of nuclear weapons and weapons of mass destruction in outer space. **More than the risk of the securitization of space, state, and private actors could begin to claim exclusive legal rights over the resources they discover.** Indeed, the U.S. Commercial Space Launch Competitiveness Act, which came into force in 2015, expressly recognizes the right of U.S. Citizens to possess, own, transport, use, and sell space resources. By this means, domestic law already acknowledges the legal claim to property by individuals, which is prohibited by international law. Under the Outer Space Treaty, states renounced any traditional form of acquisition of territories and agreed not to foray unilaterally into space to extend their national policies on Earth or to exercise any kind of sovereignty over celestial bodies or resources. The absence of a modern international treaty that addresses these issues should be received with grave concern, as there is significant potential for risk to become reality. Existing UN treaties lack the technological context and foresight to address legal questions regarding the potential for commercial exploration and exploitation of outer space or its resources. During the sixties and seventies, when international instruments like the Outer Space treaty were conceived, the principal aim of states was to support and expand the scale of the state’s national capacity for operation in space and the development of legal instruments to guide state’s international cooperation in the peaceful exploration of outer space. These instruments were never designed to respond to commercial questions over mining or tourism in space, **private investment in space activities, or the emergence of non-state private enterprises operating in space. As a result, private enterprises operating in the vacuum of space also float in an unstable legal vacuum which threatens to implode in geopolitical competition. Beyond Stars and States In an increasingly commercial outer space in which there are no set limits to the exploitation of resources or claim to property, states and private companies will inevitably pursue the development of new extraterrestrial industries to suit their geoeconomic interests. If unchecked, the legal protection of outer space as a domain of exploration for the benefit of all humanity would functionally fail**. To **protect investments and profit from national space industries, states would likely resort to military force to protect and secure private assets**. Over time, space would ultimately become a fourth border domain over which states claim, exercise, and defend sovereignty — including through the use of force. The challenge is thus to prevent the circumstances that could lead to space-borne conflict before it is made possible. Notwithstanding, commercial exploration and the use of natural resources need not lead to predation among actors involved in space. **The potential rewards — both technological and environmental — that could come from investment in the harvesting of resources in space are immense**. International law cannot afford to wait for the security dilemma posed by commercial activity in space to manifest before addressing it but must anticipate and proactively adopt measures to address future issues that govern extraterrestrial human activity. The **only remedy for the lack of legal governance over commercial activity in space is the creation of new international laws** through a comprehensive international treaty on commercial operations in space. The new treaty must **expressly regulate commercial activities by states and private companies, enshrine an international liability** and compensation regime covering damages caused with workable sanction provisions, and reinforce norms that restrict any militarization of outer space. The international community should focus its efforts on establishing a legal regime, with mandatory provisions (rather than non-binding resolutions, observations, commentaries, and conclusions) which generate both international responsibility and provide enforceable sanctions in the event of violations. The effort should be borne out by expanding the scope and strengthening the oversight powers of the United Nations Committee on the Peaceful Uses of Outer Space (COPUOS), rather than creating a new organ with redundant bureaucracy. Beyond the tasks of encouraging space research programs, studying space activities, and addressing legal questions, COPUOS should be granted the necessary powers to perform control and oversight monitoring functions. Experience has taught the international community that cooperative arrangements between states and international organizations can prevent competition for resources from escalating to kinetic conflict. Through cooperation, there is a chance to preserve extraterrestrial resources for future generations, secure an equitable allocation of resources and benefits with a mind to each country’s specific needs, and prevent the expansion of geopolitical conflict to the domain of space. Space powers must recognize the value in partnering with other states to advance the development of space programs more efficiently. It should be clear now that all nations could reap the benefits of collective action, exploration, and commercialization of resources from beyond Earth’s atmosphere while preventing a drawn-out international conflict to the final frontier. The will of states not to jeopardize the fundamental basis of international law must be reflected in coordination and surveillance efforts to ensure that the advantages derived from space exploration allow humanity to continue evolving.

#### Fourth, unregulated commercial mining exacerbates resource inequalities on Earth.

**Anastasia Bendebury, the Adjunct Instructor of Biology at the University of Portland, clarifies in 2020 that** [Michael Shilo Delay (Ph.D in Biophysics from Columbia University) and Anastasia Bendebury (Adjunct Instructor of Biology at the University of Portland). “Is space mining the eco-friendly choice?”. Astronomy. November 11, 2020. Accessed 1/7/22. <https://astronomy.com/news/2020/11/is-space-mining-the-eco-friendly-choice> //Xu]

**The race to build an industrial foundation in space has already begun, too: Musk promises Mars Base Alpha by 2028; Bezos’ own Blue Origin is working on a “sustained human presence on the Moon;” and NASA’s Lunar Gateway, a permanent orbital station, is set to go into operation by the end of the decade.**

In 40 years, launch costs have fallen from $85,000 per kilogram to less than $1,000/kg, and NASA hopes to get this under $100/kg in the next few years. This trajectory makes space-mining advocate and Skycorp CEO Dennis Wingo more certain than ever that we are on the cusp of a new era of space mining. He reiterates to Astronomy that “industrial activity on the Moon is how we can make things better here on Earth.”

Instead of returning raw materials from the Moon to Earth, which Wingo suggests would “be kind of like shipping dirt from Jakarta to the U.S.,” the space-mining industry would chase profits by finding ways to process raw materials directly at their icy, remote sources. On the horizon, he envisions a solar-powered lunar base capable of producing the gigawatt-level power needed for mining.

The lunar surface, in his eyes, is an incredibly efficient place for industrial processes. Wingo calculates that “the best vacuum you can get on the Earth is about 10-5 Torr.” (That’s about one one-hundred-millionth the standard pressure at sea level.) “But on the lunar surface, you have infinite quantities of 10-12 Torr.” Under those conditions, it’s possible to efficiently process raw lunar regolith — the pulverized rock that covers the Moon’s surface — into valuable materials.

As you “heat regolith to over 2,000 degrees Celsius [3,632 degrees Fahrenheit], the metal oxides it contains dissociate into metal and oxygen,” says Wingo. “That waste oxygen can be compressed and stored or used for breathing.” This creates a self-sustaining system that doesn’t entirely avoid waste products, but still keeps the caustic remnants of mining far from the life-giving ecosystems upon which we depend for survival.

The way Wingo sees it, the Moon could be a testing grounds for new extraction techniques, power-plants, and assembly protocols. Proven operations could then radiate outward from Earth and the Moon into the asteroid belt, where the mineral wealth of the solar system has been estimated to run into the quintillions of dollars. Though the upfront costs of establishing extraterrestrial industry is extremely high, the eventual returns could be beyond the greatest riches the world has ever seen.

Keeping it above board

The financial and ecological incentives of space mining make it easy for planetary scientist Philip Metzger of the Space Institute at the University of Central Florida to agree with Wingo. Reached by email, Metzger mused that “it is inevitable that we will move in this direction very soon. **As robotics and artificial intelligence improve, and as the environmental impact cost of [these industries] on Earth continues to increase,” space-based extraction will become more and more viable. However, there is some concern that without careful transparency and legislative measures, a new industrial space rush could result in unforeseen catastrophe.**

Former NASA navigator, Moriba Jah, now professor in Aerospace Engineering and Engineering Mechanics at the University of Texas, has some ideas about the healthiest ways to approach outer-space resource extraction. In this next phase of expansion, Jah imagines that we take our cues from ancient indigenous land-management practices.

When assessing a new territory like the Moon or an asteroid, Jah says “it doesn't mean that we don't exploit resources. It doesn't even mean that we don't make lots of money. What it means is that we don't treat it as something that we own.” Guided by this mentality, legislation would designate mineral-rich space territory as a shared resource. **The price for access, then, becomes the burden of stewardship. And the tenets that could be used for drafting such legislation, Traditional Ecological Knowledge (TEK), have been in development since the 1980s, meaning they could serve as a robust basis for moving forward.**

**One thing is certain — our planet could use a breather. The mineral wealth of outer space is apparent, and the question of how we will provide for another few billion of our brothers and sisters is never far from the surface. Space mining is one promising multipolar solution, but the burden will be on us to prevent ecological mistakes of previous generations.**