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The 'Irrational' 'Rationalization' of Space Expansionism

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Abstract

Across the globe, we are witnessing the devastating impacts and far-reaching consequences of the climate crisis, primarily stemming from anthropogenic activity (and inactivity), especially since the mid-1900s. For example, 'natural' and human populations are affected by rising global temperatures, land and sea warming, the melting of glaciers, rising sea levels, more frequent hurricanes, droughts, floods, typhoons, and heatwaves, destruction and disruptions to natural habitats pushing some species to extinction, and the irreversible loss of biodiversity. As recognized by the United Nations General Assembly (2023), "climate change is an unprecedented challenge of civilizational proportions and that the well-being of present and future generations of humankind [and all other living species] depends on our immediate and urgent response to it". More recently, the International Court of Justice confirmed, in its unanimous advisory opinion that states have an obligation "to prevent significant damage to the environment" to curb climate change (June 23, 2025). And yet, the unabated spectacle of space expansionism continues, regardless of the significant negative environmental impacts, from rocket launches to rocket emissions alone, that further exacerbate the climate crisis. During 2025, there were a total of 341 space rockets launched, of which 329 were successful launches and 12 failures (Rocket Launch Recap, 2025). Drawing broadly from Lukacs' notion of irrationalism, Žižek's

concept of fetishistic disavowal, and Fisher's (2008) capital realism, we further unpack the (il)logics fueling the ascending space expansionism project, including the rationale and 'efforts' to engage in 'sustainable space development'.

Keywords: Space expansionism, irrationalism, fetishistic disavowal, capitalist realism, environmental harm, climate harm, sustainable development

1. The 'irrational' 'rationalization' of space expansionism

We continue to witness the devastating impacts and far-reaching consequences of the climate crisis for humans and all other living species, primarily stemming from anthropogenic activities (and inactivity) since the mid-20th century. This has resulted in a range of climate consequences, such as rising global temperatures. For example, during 2024, the Southern and Northern Hemispheres experienced the warmest recorded year since “global records began in 1850 by a wide margin” (Lindsey & Dahlman, 2025). As acknowledged by the International Court of Justice (2025), “as temperatures rise, impacts from climate and weather extremes, as well as slow-onset events, will pose an ever-greater social, cultural, economic and environmental threat” (p. 8). The emissions of greenhouse gases continue to increase regardless of the scientific consensus that these are “the primary driver[s] of climate change” (American Association for the Advancement of Science, 2009; NASA, 2024).

Noting with utmost concern the scientific consensus, expressed, *inter alia*, in the reports of the Intergovernmental Panel on Climate Change, including that anthropogenic emissions of greenhouses gases are unequivocally the dominant cause of the global warming observed since the mid-20th century, that human-induced climate change, including more frequent and intense extreme events, has caused widespread adverse impacts and related losses and damages to nature and people (International Court of Justice, 2025, p. 8).

These impacts include land and sea warming, melting of glaciers, rising as well as shrinking sea levels (e.g., Antarctica), coastal erosion, changing ocean currents, and ocean acidification. Additionally, there are more extreme and frequent weather events, including hurricanes, tornadoes, persistent droughts, floods, typhoons, heatwaves, land loss and degradation, widespread crop failures, disruptions to natural habitats pushing some species to extinction, and the irreversible loss of biodiversity.

As recognized by the United Nations General Assembly (2023), “climate change is an unprecedented challenge of civilizational proportions and that the well-being of present and future generations of humankind [and all other living species] depends on our immediate and urgent response to it” (quoted in the International Court of Justice advisory opinion, 2025, p. 7). In turn, the United Nations General Assembly sought the International Court’s opinion on the obligations of

States in respect of activities that adversely affect the climate system and the legal consequences arising from the breach of these obligations – Relevant conduct comprises all actions or omissions of States which result in the climate system and other parts of the environment being adversely affected by anthropogenic GHG [greenhouse gas] emissions (pp. 1-2).

In the Court’s unanimous advisory opinion (2025), it confirmed that states have an obligation “to prevent significant damage to the environment” and to curb climate change (June 23). Yet, ironically, the unabated spectacle of space expansionism persists, despite its negative environmental impacts. For example, as of December 15, 2025, this year 294 space rockets have been launched this year, including 284 successful launches and ten failed launches (Rocket Launch.org, 2025; Space Stats, 2025a). It is worth noting that 19 of those successful launches were suborbital, roughly at or right below 62 miles above Earth’s sea level at speeds of less than orbital velocity, 17,500 mph (Clash, 2022; Mann, 2020). This far exceeds the number of launches during 2024, 271 rocket launches (264 successful launches and seven failures). Before delving further into the race to space and the environmental harms, the following section provides a brief overview of our guiding theoretical frameworks.

2. Theoretical frameworks

Our guiding theoretical frameworks broadly draw from Lukacs' notion of irrationalism as well as Žižek's concept of fetishistic disavowal. Specifically, we broadly draw from Lukacs' (1952, 1980) argument that a crucial hallmark of irrationalism is that the solution to the problem is to rely on the problem.

It's [irrationalism's] history therefore hinges on the development of science and philosophy, and it reacts to the new questions they pose by designating the mere problem as an answer and declaring the allegedly fundamental insolubility of the problem to be a higher form of comprehension. This styling of the declared insolubility as an answer, along with the claim that this evasion and side-stepping of the answer, this flight from it, contains a positive solution and true achievement of reality is irrationalism's decisive hallmark (p. 104).

He continues by stating that the "quality of modern irrationalism... is chiefly the fact that it arose on the basis of capitalist production" (p. 105). As Kelemen (2025) rightly argues, Lukacs' depiction of irrationalists is not that they avoid the problem or lack the understanding that the proposed solution is the recycling of the problem, but rather that they evade accepting this "because of their interest, social role, and other reasons." Just as the notion of irrationalism and irrationality can be useful for understanding the political framing, embedded ideology, and the pursuit of space expansionism at a time of heightened awareness of the climate crisis, we also find it useful to draw from a broader interpretation of Žižek's concept of fetishistic disavowal and ideology. Here, it is not merely about knowing; it is in the doing. As Žižek (1989) states:

They know very well, how things really are, but still they are doing it as if they did not know. The illusion is therefore double: it consists in overlooking the illusion, which is structuring our real, effective relation to reality. And this overlooked, unconscious illusion is what may be called the ideological fantasy (pp. 29-30).

Fetishistic disavowal can be thought of as, "I know, but I don't want to know that I know, so I don't know" (Žižek, 2008, p.53), and then acting as if it is not known to them.

Central to space expansionism, as well as solutions to address the climate crisis, are neoliberal logics. We argue that neoliberal logic allows for and facilitates the current "space race". As Thompson (2005) has argued, neoliberalism pervades all aspects of social life and has increasingly penetrated every sphere of social existence, thereby becoming normalized in our political, social, and cultural lives. It is, therefore, unsurprising that the same logics — those of technological advancement, privatization, corporatization, and capital accumulation — are being applied to space expansionism and commercialization, despite the inherent and well-documented risks of environmental harm (Rothe & Collins, 2025). Simply, neoliberal logics drives the belief that "we can solve what was caused by capitalism and technological exploitation with yet more capitalism and technological exploitation of the planet" (Cikaj, 2023). Here we also draw from "Capitalist realism", a term coined by Fisher (2008), which elucidates the ideology and real condition of a post-postmodern world in which the idea that there is no alternative to capitalism: it has become a taken-for-granted pseudo-natural fact. In this sense, there are no viable alternatives to neoliberalism; that is, a post-capitalist future is unimaginable. As Moore (2017) argued, neoliberalism and capitalist realism can also be thought of as *Capitalocene* - "capitalism as a system of power, profit, and re/production in the web of life" (p. 606), which "is also a *Necrocene* - a system that not only accumulates capital but drives extinction" as we are currently witnessing on Earth and the impact of the anthropogenic climate crisis. The preoccupation and dominance of capital is moving us faster towards extinction, one that is characterized by the depletion of Earth and its finite resources (i.e., fossil fuels, chemical elements, rare-Earth minerals and more). It is this relationship between the material "unfolding of extinction through capital and the history of the scientific inquiry" (McBrien, 2016) that is exemplified in space expansionism. As argued by McBrien (2016) "the ecology of capital is constructed through attempted

erasure of existing ecologies—ecologies that include humans” (p. 117). Prior to discussing space expansionism’s environmental harms, the following section provides a brief overview of the current state of the space industry.

3. Brief overview of the scope of space expansionism

The space race today is far beyond the Cold War era between the United States and the former Soviet Union. It is now an ever-unfolding and increasingly growing industry with states (primarily the United States, China, Russia, followed by India, Japan, and other European countries) and the commercial sector, racing to commercialize space (i.e., SpaceX, Rocket Lab, Planet Labs, Honeybee Robotics, Blue Origin, Relativity Space, Axiom Space, Redwire, Sierra Space, Safran, Virgin Galactic, Firefly, and Astroscale) (Naoum, 2025). There are also major players in aerospace defense (e.g., Boeing Space and Security, RTX Corporation – Collins Aerospace Systems, Lockheed Martin, General Dynamics, and Northrup Grumman). Beyond these, there are private corporations that focus on satellites and satellite miniaturization, orbital space construction and manufacturing, space mining of asteroids, the Moon, and other planets, space-based energy production, space-based mitigation to address the vast array of space debris, public-private partnerships to extend human and robotics presence in orbital space, space colonies in orbit, on the Moon and Mars, as well as space tourism for billionaires, to name a few. As of July 2025, the space economy totaled a record \$613 billion USD and is projected to cross the \$1 trillion mark by the early 2030s. It is worth noting that governments account for roughly 22% of the global space economy, with the commercial sector accounting for the remaining 78% (Space Foundation, 2025).

To give context to the growing number of objects launched into space (satellites, probes, landers, crewed spacecrafts, and space station flight elements), consider that in 2000 only 121 objects were launched that year. The same number of objects were launched in 2010. Five years later, 241 objects were launched (2015). In 2017, 456 total objects were launched into space. Significant increases in objects launched increased in 2020 with 1,274 objects; in 2022 the number of objects launched in that year increased to 2,479; in 2024 there were a total of 2,849 objects launched and at the end of 2025 that number increased to 3,945 objects launched (Our World in Data, 2025a). For further context, consider the cumulative total numbers of objects launched into space since 1957 when a total of 2 objects were launched into space by Russia. For example, in 1970 – 1,210 objects, in 1980 the cumulative number of objects launched increased to 2,638. A decade later, 1990, there were 4,146 total objects that had been launched. Fast forward to 2000, the total number of launches increased to 5,408 (an increase of 1,262 additional objects). By the end of 2015, the number increased to 7,321 and by 2020 that number increased to 10,310. Over the past 5 years the total cumulative number of objects in space significantly increased to a total 24,299, double the total cumulative objects launched into space since the end of 2020 (Our World in Data 2025b).

Consider also that as of June 29, 2025, there were roughly 12,952 active satellites orbiting Earth. Of these, over half of all the active satellites are commercial (Baker, 2025), with the United States having the highest number, namely due to SpaceX’s Starlink (AC, 2025). Other countries and companies are developing and/or launching their own megaconstellations, such as China’s Guowant and Qianfan (i.e., Thousand Sails), Amazon’s TeraWave (previously called the Kulper Project), Telestat, IRIS, OneWeb Gen 1, and Hanwha (Baker, 2025; Future Timeline, 2025).

We recognize this is a very general, cursory overview of the current state of space expansionism and by no means covers all aspects of space expansion efforts (for a more comprehensive overview of space expansionism, see Deudney, 2020; Eski & Lampkin, 2025; Lampkin & White, 2023; Rothe & Collins, 2025; Scharmen, 2021); however, this is not our focus here. Rather, we are concerned with the irrational spectacle of space expansionism that continues unabated, regardless of the significant

negative environmental impact and the (il)logics fueling space expansionism, including the 'rationale' which includes 'efforts' to engage in 'sustainable space development'.

4. An unfolding comical tragedy: space expansionism's environmental harm and destruction

The selves indigenous to this world had destroyed it even though it was the only one they had access to. And Rupshees' drones had found thousands more worlds depopulated in the same and other ways. Were all those dead worlds Scoured? Or was there some tendency in the minds of organics that pulled them towards their own destruction? (Carey, 2024, p. 90).

We recognize there are negative environmental harms associated with the front-end of the production processes required for space expansionism. For example, the environmental impact from the pre-production and production of launch vehicles, rockets, required fuels, chips, minerals, satellites, ground-based support systems, and vast data centers alone requires a significant amount of extraction of finite minerals and other materials that must be accessed, transported, and manufactured. However, given space limitations and our main emphasis here, we focus on the environmental impact and harm related to satellites, rocket launches, and reentries. Consider that the construction of satellites (and satellite constellations) requires aluminum, titanium alloys, or stainless steel, although aluminum is the most common material (Maloney, et al., 2025), which makes up roughly 35 to 40% of the mass of one satellite (Gasston, et al., 2023; Schultz & Glassmeier, 2021). They also require other scarce elements such as lithium and gallium. The environmental impact from the extraction to the processing of materials such as lithium, aluminum, and titanium alloys increases greenhouse gas emissions (Chang, 2024), a primary cause of the climate crisis, as we previously noted. Satellite production and operations, such as those required to support Earth observation satellites, require large data storage facilities that produce significant carbon emissions (Mowbray, 2025). The "data that are stored, distributed and processed, often on the cloud, generate widespread environmental impacts" (Anderson, et al. 2024, p. 224) such as CO₂ emissions. It is estimated that by the end of the 2029, these large data sites "could account for 2.5 billion metric tonnes of CO₂" (Hale, 2025). These data storage facilities, such as cloud computing consume roughly two to five million liters of water daily (Jennings, 2025; Wells, 2025). Additionally, they require significant amounts of water.

There is also the environmental impact from satellites' end-of-life disposal, such as reentries (Change, 2024). With the growing rate of satellites and megaconstellations in low Earth orbit, projected to exceed 60,000 by 2040, there will be an inevitable increase in the "amount of anthropogenic material into the upper atmosphere" (Maloney, et al., 2025). As old satellites reenter and burn as they fall, pollutants such as aerosolized aluminum are released. Researchers have simulated the effects and found that annually there will be a release of roughly "10,000 tonnes of aluminum oxide by 2040 (the amount estimated to be released from disposal of 3,000 satellites a year, assuming a fleet of 60,000 satellites)" (Maloney, et al., 2025) along with "Other metals including titanium, lithium, iron and copper will also be released" (Ravillious, 2025). Consider the rate of SpaceX satellites reentering, given roughly 40% of disused satellites burning in Earth's atmosphere are from Starlink megaconstellations, which "amounts to "a minimum of 500 kilograms [1,100 pounds]" of incinerated satellite trash a day" (Pultarova, 2024). Moreover, as Jonathon McDowell stated, "There is now a Starlink reentry almost every day...Sometimes multiple." (Quoted in Pultarova, 2024). For example, between February and August 2025, SpaceX re-entered roughly 500 satellites which added "around 15,000 kilograms of aluminium oxide to the upper atmosphere" (Satellites Space, 2025).

Just as satellite reentries have negative environmental harm, so too do defunct rockets and rocket stage reentries (controlled and uncontrolled), ranging from harmful emissions to leaving debris scattered on Earth, including in oceans. NASA (2025) recently reported that during 2024, roughly

“2,500 spacecraft were deployed to the near-Earth space environment, from low Earth orbit (LEO) to Geosynchronous Earth Orbit (GEO)” (p. 3). Rocket tests and launches, successful (and unsuccessful) pose an inherent environmental impact, including rocket emissions to fuel consumption, toxins, and carbon dioxide. After all, rockets “are unique among anthropogenic sources, due to direct injection of pollutants to all atmospheric layers” (Ryan et al., 2022, p. 2). Recent research by Kukreja et al. (2025) found that launch vehicles and their propellant combustion during launch contribute significantly to greenhouse gas emissions. Focusing on the launches of satellite megaconstellations, they found that there are additional risks from propellant combustion. They noted that “The launch event and launcher transportation emerged as the dominant contributors, collectively accounting for 95.6% of total emissions”, underscoring “the significant role of propellant combustion and transportation logistics in shaping the environmental footprint of satellite deployment” (p. 22). Consider that solid propellants release chlorine compounds as well as aluminum oxide particles upon combustion. Liquid propellants such as kerosene (RP-1), including those mixed with liquid oxygen or hydrogen and oxygen, release carbon dioxide and nitrogen oxides, as do methane-based fuels (Biology Insights, 2025). Rockets that rely on liquid hydrogen include Ariane-5, 62, 64, and the Vulcan Centaur. Kerosene-fueled rockets include the Soyuz, Falcon-9, Falcon-Heavy – both of which are SpaceX rockets, whereas SpaceX’s Starship uses liquid methane (Kukreja, et al., 2025). Given that greenhouse gas emissions are the primary driver of the climate crisis, consider that the SpaceX’s Starship rocket produces the highest rate of these emissions, roughly 5.5 kilotons, or 5,500 metric tons “with 99% of these emissions stemming from propellant combustion during the launch event” (Kukreja, et al., 2025), followed by the Falcon Heavy, which emits 2.37 kilotons or 2,370 metric tons, with the Falcon-9 producing 8 metric tons, 830 metric tons and the New Glenn (Blue Origin) producing 1.5 kilotons of emissions or 1,500 metric tons. On average “total emissions for a rocket are approximately 1.75 kt per launch...and across all rockets, the launch event consistently dominates as the primary source of emissions (51.6%), while launcher production (26.2%), electronics production (2.3%), transportation (8.2%), and electricity consumption (11.6%) play smaller roles” (Kukreja, et al., 2025).

Additionally, chlorine and soot from solid rocket propellants from hydrocarbon fuels such as kerosene and methane break down ozone molecules and linger in the “stratosphere, warming it and accelerating ozone-depleting reactions” (NASA Space News, 2025; Revell, et al., 2025). To provide further context, consider the 373 mass tons of propellant required for each rocket launched by SpaceX’s Falcon-9 (Kukreja et al. 2025), which has been launched 155 times between January 1, 2025, and December 15, 2025 (SpaceX, 2025; Space Stats, 2025a; Wall, 2025). Moreover, it leaves behind a significant amount of carbon dioxide that extends roughly 40 miles above the launch site (Kokkinakis & Drukakis, 2022; Waldweck, 2022). When it comes to black carbon soot, rockets release tons of “particles in the stratosphere, especially between 15 and 40 kilometres above Earth’s surface ground . . . each year.” This means that roughly every year, “1 gigagram, or 1,000 metric tons, of black carbon is released” (Skibba, 2022). Soot and alumina particles from solid fuels “linger in the stratosphere, absorbing solar radiation and influencing atmospheric chemistry” (Biology Insights, 2025). Based on the acceleration of launches over the past three years alone, the resultant environmental harm is only going to increase as more launches are scheduled each year.

Likewise, there are environmental concerns and harms associated with various launch sites where rocket launches and tests have resulted in explosions, leaks that posed risks to waterways, soil contamination from fuel leaks and exhaust residues, and other chemical leaks to scattered debris (e.g., Atlas V rocket, Starship, SpaceX Dragon, Zhuque-2E Y3, Tianlong-3, and Ceres-1). Additionally:

Fuel spills and runoff from launch pads can introduce pollutants into nearby rivers, lakes, and coastal waters. Re-entering rocket stages and debris...designed to splash down in oceans, can also impact marine ecosystems by introducing foreign materials and chemicals...[and] have been linked to fish kills and broader impacts on biodiversity in areas adjacent to launch operations (Biology Insights, 2025).

We could continue with many more examples of the negative environmental harms on Earth and beyond, all associated with space expansionism, including human-made trash in orbit such as Elon Musk's Tesla Roadster dubbed Starman that was launched into space in 2018 that is currently headed towards Mars (Cao, 2025) to the geo stationary "space graveyard", as well as the array of human trash left on Mars and the Moon to name a few. However, we believe that the above is demonstrative of our point: space expansionism amplifies our anthropogenic harms to Earth and its living species, to other planets, asteroids, and space. As the opening quote to this section asks: Is there some intrinsic "tendency in the minds of" humans that drives us towards our own destruction? Why are we continuing the race to space and space expansionism, knowing the negative impact it has had, and will continue to have, on Earth and beyond? The following section delves into demystifying the irrational rationalization embedded in the space race.

5. Discussion

Thunder from above and a dark shadow drawing across, as another space plane hurtled into the sky...and he remembered that standard transporter planes, like that one overhead spanned six hundred meters from nose to rocket engines and were capable of hauling two hundred tonnes of passengers and cargo up into orbit. Amazing that humans could build such a massive, complex, and wonderful piece of technology, yet could not apply the same degree of logic and intelligence to building their societies or preventing their eventual decline (Asher, 2011 p.143).

Of note, 2025 marks the tenth year since the Paris Agreement on climate change was adopted by 195 parties at the United Nations Climate Change conference (2015) (United Nations for Climate Change, 2025). If you recall from above, during 2015, as world leaders signed on to the Paris Agreement, there were only 222 total objects in space. Moreover, each year, well over a hundred heads of states and their delegates routinely participate in the annual climate change conferences. Consider that during the 2024 United Nations Climate Change (COP 29) conference, 195 countries were present or represented (McSweeney & Viisainen, 2024). This included the United States¹, China, Russia, the European Union (78 parties), Japan, and India, who are all 'committed' to addressing the climate crisis, yet, ironically, they are the leading countries in the *new* space race, which, to us, defies intellectuality and logic, as reflected in the epigraph above. As Žižek (1989, 2008) argues, they know very well how things really are, but they are still acting as if they do not know of the harms and impact this has on Earth and beyond, as noted above in the overview of space expansionism and its environmental harms. Yet, recall that at the end of last year, 2024, as heads of state gathered for the 29th climate conference celebrating the tenth anniversary of the Paris Agreement, 2,849 total objects had been launched, a significant increase since 2015. Again, irrationality relies on developing scientific solutions through technology and innovations in response to the situation (Lukacs', 1952, 1980), in this case, the climate crisis, by designating the problem as *the* answer and declaring the answer as a 'true' achievement. As we previously wrote elsewhere, this is hardly surprising considering Earth-bound (and off-Earth) policy solutions to climate change also adapt to capitalism, where economic viability and growth take precedence. As such, the solution to climate change is more of the same in the name of 'sustainability' and 'sustainable development', which fails, or more precisely, ignores that even these 'solutions' do not address the root of the problem. As we noted above, it is a delusion that "has

¹ It must be noted that since Trump's second term, which began January 2025, the United States has not only pulled out of the Paris Agreement (Kayton & Arasu, 2025), as he did during his first term (2016-2020), but also other significant climate change initiatives. Trump and his administration have also decreased environmental regulations (such as his more recent proposal by the Environmental protection agency that would end requiring 8,000 facilities to report their greenhouse gas emissions), and reduced regulations involving the government and private sector in the space industry, as well as engaging in a host of other climate-denying actions.

convinced us that we can solve what was caused by capitalism and technological exploitation with yet more capitalism and technological exploitation of the planet" (Cikaj, 2023). After all:

Capitalism always needs to expand, we need to consume more, companies need to earn more than last month and GDP needs to keep going up. A capitalist economy with no growth hits a recession and a capitalist economy with growth hits the finite boundaries of our planet (Cikaj, 2023).

As the Council of the European Union's Green Deal (2025) recognizes, "[o]ur current economic and consumption patterns do not match what the planet can offer and are detrimental to the environment and nature...3 planets would be needed by 2050, if we continue using resources as we do today". Yet, the solution remains embedded in neoliberal logics, capitalist realism. Which is "irrationally rational because they employ the same logic and inversion of means and ends that oversaw the degradation of Earth (Gunderson, Stuart, & Peterson, 2021)². As Gambino (2023) has argued, "[t]he idea of sustainable development advances the false claim ¹that protection of the environment ("sustainability") and perpetual economic growth ("development") can coexist" (p. 39).

Just as the responses to the climate crisis, including the belief that 'sustainable development' and the notion of 'sustainability' are the solution to the crisis, the same irrational rational dogma of neoliberal logics is applied in relation to space expansion: 'sustainable' space expansionism. Simply, the proposed solution for addressing our anthropogenic harm is to further technological advancement, investing in the current neoliberal economic system (i.e., capital accumulation and economic growth), as problems arising from space expansionism can be managed scientifically through further human intervention (Das, 2009). This includes a variety of government, corporate, and private 'sustainable' projects related to space, from 'sustainably' addressing the growing problem of space debris or space junk in low-mid-high Earth orbit, to in-situ construction and manufacturing space infrastructure, space mining, to space colonization and tourism, and 'sustainable' rockets and satellites. As Žižek (2006) argues, "the very way we perceive a problem is an obstacle to its solution" (p. 137). As we have done above, we limit our discussion here to the latter two, sustainable or reusable rocket launch vehicles, and a brief note on sustainable satellites.

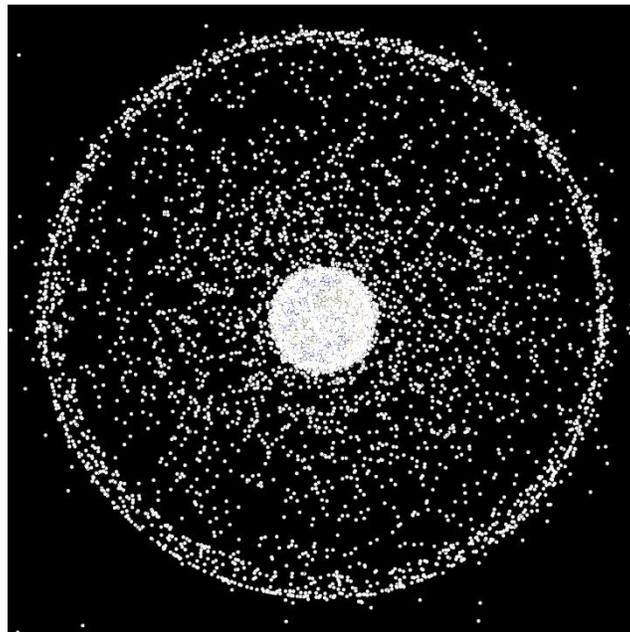
Let us return to the issue of greenhouse gas emissions of the 'sustainable' reusable SpaceX's Falcon 9, Falcon Heavy, and Starship, and Blue Origin's New Glenn. For example, the Starship's overall emissions for the initial launch vehicle totaled 8.4 tons. The Falcon Heavy's emissions for its initial launch were 3.5 tons, and Falcon 9 emitted 1.46 tons of greenhouse gases (Kukreja, et al., 2025). Blue Origin's New Glenn's greenhouse gas emissions for its initial use were 3.5 tons. While touted as great examples of scientific and technological progress for space expansionism of their sustainability or reusability, as we noted above, their reusability impact on greenhouse gas emissions alone is still significant at 5.5 metric tonnes (Starship), 2.6 tonnes (Falcon Heavy), 927 tonnes or 1.02 tons (Falcon 9), and 1.7 tonnes (New Glenn) (Kukreja, et al., 2025). As a reminder, reentries of these reusable rocket vehicle bodies also lead to the release of other toxins into the atmosphere at all levels, including the exosphere – which is roughly 621 miles above Earth's surface, as we previously noted. In addition to the emissions, there is the environmental impact and harm associated with their retrievals. Consider SpaceX's Falcon 9, which has been launched a total of 126 times as of the end of August 2025 (Space Stats, 2025b).

² We recognize that some claim that space can be used to mitigate the ravages of the climate crisis/climate change. From apocalyptic mythmaking by some space enthusiasts that tout the benefits of satellites in mitigating climate changes, or the need to colonize to space to save Earth, to the need for space mining. However, to us, these arguments are embedded in capitalist logics to justify/rationalize the alleged benefits that do not pan out when we consider the harms being caused. In short, we argue that these arguments - space can be used to mitigate the ravages of climate change are part and parcel of the manufactured legitimization of space expansionism that expand our anthropogenic harms that have led to the very crisis they claim to address.

Rockets' reentries oft rely on barges in the open ocean. However, this "reusability is often driven by economics and might not always be environmentally friendly" as they depend "largely on the quantities of additional rocket fuel consumed to maneuver the vehicle components to designated locations and the fuel consumed by marine vessels to recover" (Gaston, et al., 2025), not to mention the potential impact on marine life. As one example, recall when the Falcon 9's first stage booster tipped over and exploded as it landed on its droneship in the Atlantic Ocean (Whitt, 2024). As noted by the Commandant of the United States Coast Guard (2023):

Hazardous debris and jettisoned objects impact the MTS [marine transportation systems] because launch activities may result in components of the launch vehicle being jettisoned into U.S. waters during operations or landing and recovery of boosters on remote or autonomously controlled vessels. Jettisoned objects or debris have the potential to impact the marine environment...including but not limited to: (1) Direct strike from jettisoned objects with persons, marine wildlife, vessels or other watercraft, or offshore installations and infrastructure; (2) Marine pollutants from jettisoned objects.

We briefly note that eco-friendly satellites are being developed, touted as a critical step forward in space sustainability and for addressing the environmental impact of space debris. As one example, the first wooden satellite, LignoSat, designed without metals that would burn upon reentry, was successfully launched into Earth's orbit in November 2024. It was hyped as presenting "a potential paradigm shift in satellite manufacturing" (Central Science, 2024). Yet, such proclamations ignore or fail to acknowledge that they would also add to the extensive space debris that already poses great risks to low-mid-geostationary atmospheres, and the potential of a Kessler Effect³, as can be seen in image 1.



The GEO Polar images are generated from a vantage point above the north pole, showing the concentrations of objects in LEO and in the geosynchronous region. Credit: NASA ODPO:

³ The Kessler syndrome argues that the collision of objects in space could have a knock-on or cascading effect – one that may be slow-moving – that ultimately leads to the destruction of important satellites, as well as the growth of debris, rendering the space orbital to the Earth impossible to occupy (see Rothe & Collins for additional discussion). As the European Space Agency noted in the 2025 Space Environment Report, “Even in case of no further launches into orbit, it is expected that collisions among the space debris objects already present will lead to a further growth in space debris population in Low Earth Orbit” that “could lead to a cascade of collision events” (p. 8).

<https://orbitaldebris.jsc.nasa.gov/photo-gallery/images/fullsize/graphics-geo-polar.jpg>

The European Space Agency (2025a) estimates that there are roughly 1.2 million objects orbiting Earth, with over 50,000 of those being larger than 10 cm. Furthermore, “the density of active payloads [e.g., satellite communication constellations] is approaching that of space debris in these heavily populated altitude bands” (p.5). Satellites, including most of the current proposed space junk mitigation initiatives, require being launched into orbit. For example, LignoSat was launched using SpaceX’s Falcon 9 (Tangermann, 2024), which, as we previously noted, has a negative environmental impact, including greenhouse gas emissions.

To summarize, even the “solutions” we have briefly mentioned above further exacerbate our harmful anthropogenic impact on Earth and space. Given capitalist realism and neoliberal logics, we remain highly skeptical that ‘sustainable’ space expansionist innovations and solutions by states, corporations, and private entities will ever address the root of the problem, as it would not be in the interests of neoliberal profit and market determinism, power, and vested geopolitical interests. After all, sustainability efforts are deeply embedded in economic viability and advancement through technological innovations. As China’s President Xi stated in his remarks during the Leaders Meeting on Climate and the Just Transition, April 23, 2025:

We should ... boost technological innovation and industrial transformation through cooperation, and facilitate the free flow of quality green technologies and products, All parties should do their utmost to formulate and implement their program of action for nationally determined contributions (NDCs) while coordinating economic development...and strike a balance between multiple goals including environmental protection, economic growth, job creation, and poverty alleviation (Xinhua, 2025).

6. Concluding thoughts

Our goal here has been to highlight the irrationality behind the rationalization of space expansionism and space ‘sustainability’ and the intrinsic harm that results from our continued and increasing anthropogenic footprint in space. While embedded in capitalist realism and neoliberal logics, states in particular continue their fantasy illusion, acting as if they do not know. We continue to see the depletion of finite resources, to wit, the solution is to increase capital investment in the advancement of more and greater space technologies, including those sold as sustainable, all while ignoring and evading the reality that the use of these technological advancements is the cause of space-related environmental harm. As we have shown, this elucidates the ideology that there is no alternative to capitalism, creating a reality that does not permit any viable alternatives to neoliberal capitalism. Through this logic, the solution to climate harm caused by space expansionism is more capital investment in ‘sustainable’ space ventures, particularly space technologies. This is coupled with a blind willingness to see the solution to the harms of space expansionism as more of the same; the problem is designated as the answer. We are reminded of a fitting quote from the science fiction novel, *The Departure* (2011) by Neil Asher, “Was the technology itself to blame: should people have Luddite-fashion smashed it? No, the technology is merely a tool, and any blame always rests squarely on the one wielding that tool” (p. 136). Regardless, we continue to witness the unfolding of the Necrocene system that “not only accumulates capital but drives extinction” (Moore, 2017, p. 606). As Eski (2023) rightly asks, “Who in the face of their extinction doesn’t do everything and anything to prevent their extinction from happening” (p. 3)?

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