### intro

#### “If you want to reach the infinite, then explore every aspect of the finite.”

#### It is because poet Johann Goethe’s words continue to ring true to this day, that I negate the resolution:

#### The appropriation of outer space by private entities is unjust.

### fw

#### Observation 1 – because the resolution uses the word “just”, the most important value in today’s debate is justice

#### In order to evaluate justice, we should use the criterion of utilitarianism

#### Observation 2 – to best understand the resolution, defining important terms is key:

#### Justice means maximization of welfare

**Mill 63** (John Stuart Mill, English philosopher, “Justice”, Uilitarianism, Wikipedia, 1864, <https://en.wikipedia.org/wiki/Justice?scrlybrkr#:~:text=According%20to%20the%20utilitarian%2C%20justice,is%20taken%20impartially%20into%20account>.) // el

According to the utilitarian, justice requires the maximization of the total or average welfare across all relevant individuals.[16] This may require sacrifice of some for the good of others, so long as everyone's good is taken impartially into account. Utilitarianism, in general, says that the standard of justification for actions, institutions, or the whole world, is impartial welfare consequentialism, and only indirectly, if at all, to do with rights, property, need, or any other non-utilitarian criterion. These other criteria might be indirectly important, to the extent that human welfare involves them. But even then, such demands as human rights would only be elements in the calculation of overall welfare, not uncrossable barriers to action.

#### Prefer utilitarianism –

#### Maximization of lives – only util demands we condition action for preservation of future life, as in order to achieve subsequent gains in quality mean preservation is a prior question

#### Pain and pleasure – it demands we prioritize the decreasing of pain and increasing of pleasure across the board which is beneficial for humanity as a whole

### contention 1

#### contention 1 is climate

#### private space exploration tech is key to monitoring the future of climate

**Thales 20** (Thales, global leader in building a trustable future, “Monitoring Earth and Climate Change Impact from Space”, 7/7/20, <https://www.thalesgroup.com/en/group/magazine/monitoring-earth-and-climate-change-impact-space>) // el

The blue planet or the green one? As climate change is becoming one of the greatest long-term challenges that society is facing, its consequences on Earth are more and more visible, starting with its colour, when observed from space. To anticipate the consequences of global warming and protect our planet, we need precise information about how the natural environment is changing. Some Earth Observation satellites can provide reliable and highly accurate information on Earth over long periods of time and on a global scale. While meteorology was the first scientific discipline to use space capabilities in the 1960s, satellites are now able to help us monitor how healthy – or not – the planet we call home is, based on a broad range of data including weather analyses, the oceans’ colour and temperature, or measures of earth gravity. Three-quarters of the data used in numerical weather prediction models depend on satellite measurements, says OECD's quarterly magazine, OECD Observer. “It’s not something we can study from Earth. Of course we would get some data, but we wouldn’t be able to get a global view. It would be like watching television through a little hole,” says Sandrine Mathieu, Product Line Manager for Meteorology, Environment and Oceanography, at Thales Alenia Space. “Satellites give us a global view that progresses in time, showing how events are related and how fast they are evolving,” she adds. Some of the observation satellites orbiting around the Earth are purpose-designed for environmental monitoring. Satellites allow scientists and decision makers to better monitor the impact of climate change, and they can also be the only solution to monitor parts of the world where ground systems are not deployable. Every day, their eyes stay focused on our planet, capturing images that provide invaluable data to help us respond when nature goes wild, as well as to understand climate change, make better use of natural resources and protect populations at risk. Creating a ‘digital twin’ of Earth For example, satellites were able to detect the impact that the intense bushfires in Australia at the end of 2019 had on air quality in the United States, 15,000 kilometres away. Another key purpose of satellites is the monitoring of oceans. Around 70% of the planet’s surface is covered by oceans, which have a crucial impact on climate, regulating heat, absorbing CO2 and providing food as well as economic sustenance to coastal communities. Monitoring the oceans from space means we can have a comprehensive picture of their health by checking their depth with millimetre accuracy thanks to radar technology, their temperature with thermal infra-red sensors, and their salinity and – last but not least – their colour through the eyes of optical sensors. Oceans are not always blue. Their hue depends on the concentration of phytoplankton and other particle matters that could indicate discharges or the presence of pollution. By keeping an eye on oceans, we can detect algae bloom, which have a deadly effect on marine wildlife. The new-generation satellites will offer greater capabilities. The next step in the study of the Earth from space will be a hyperspectral 2D sounding meteorology mission that will provide a 3D vision of the atmosphere, compared with the surface data we can gather today. This will provide a gigantic leap in the knowledge we can apply to air transport, as well as the study of typhoons and air quality. “The logical continuation is the creation of a ‘digital twin’ for the Earth, which will allow us to gather all sorts of environment parameters (biodiversity, agricultural ressources, water quality, water height, …) on the global surface planet and monitor them in real time. By observing and understanding interactions we will eventually be able to anticipate pollution, extreme events, harvests, forest fires, climate change impacts, etc ,” says Sandrine Mathieu. Providing technology that benefits the daily lives of people At Thales, we’re fully aware of the impact of global warming. For more than 40 years now, Thales Alenia Space engineers have leveraged their expertise to give the world’s scientists and decision-makers the means they need to acquire vital data for environmental monitoring, oceanography and meteorology. Thales Alenia Space has been at the forefront of European geostationary meteorology, as prime contractor for three generations of Meteosat weather satellites on behalf of the European Space Agency (ESA) and EUMETSAT, the European operational satellite agency for monitoring weather, climate and the environment. The company is also involved in major Sentinel missions, a key to Europe’s environmental monitoring efforts. Sentinel satellites are being built on behalf of ESA as part of the European Union’s Copernicus programme. Thales Alenia Space is a major partneronboard this very ambitious programme, which is designed to monitor land and ocean, vegetation, soil and coastal areas, and study sea-surface as well as the temperature and colour of sea and land. As a world leader in altimetry and a major partner onboard the most iconic international missions dedicated to oceanography, Thales Alenia Space is also working on the French-American oceanography satellite SWOT (Surface Water Ocean Topography), which will revolutionise modern oceanography by detecting ocean features with 10 times better resolution than current technologies. Thales, which aims to provide technology that benefits the daily lives of people around the world, is committed to fighting climate disruption. Observation of the Earth from space is crucial to defining and implementing responsible environmental policies as satellite missions ensure that the environment we live in – the air we breathe, the water where we bathe and the forests we walk in -- remains as clean as possible.

#### climate change triggers sweeping death and population loss (AGW = anthropogenic global warming)

**Parncutt, 19** - Professor of Systematic Musicology at the University of Graz. Honours (Master's) degree in Physics from University of New England (UNE), Australia. Interdisciplinary PhD in psychology, music and physics from UNE (Richard, Edited by: Eric Brymer, Australian College of Applied Psychology, Australia Reviewed by: José Gutiérrez-Pérez, University of Granada, Spain; Robert Martin Rees, Scotland’s Rural College, United Kingdom, 10-16-2019, accessed on 6-28-2021, Frontiers in Psychology, "The Human Cost of Anthropogenic Global Warming: Semi-Quantitative Prediction and the 1,000-Tonne Rule", doi: 10.3389/fpsyg.2019.02323)ao **AGW = Anthropogenic Global Warming**

Today, about 30% of global population experiences deadly heat for over 20 days per year. By 2100, this will rise to 48% if GHG emissions are drastically reduced and 74% if they continue to grow (Mora et al., 2017).

The combination of AGW and high population growth in developing African countries such as Equatorial Guinea, Omar, Niger, Uganda, Angola, and Congo will lead to unprecedented death rates due to poverty (hunger, disease, and violence) and massive population displacement. Africa’s population (currently 1.3 × 109) will rise to roughly 2.5 × 109 by 2050 and 4 × 109 by 21002. Between 2017 and 2050, 26 African countries may double their populations (United Nations, 2017b). Even without AGW, it will not be possible to produce and deliver sufficient food and fresh water (Godfray et al., 2010). AGW will exacerbate the crisis—even without considering population growth (McMichael et al., 2006, 2008). By 2100, the total death toll due to 2°C AGW may approach 10^9 in Africa alone. There will be severe climate impacts in the Middle East and Northern Africa, with mean temperature increases well above GMST and displacement of large human populations (Economist, 2018). Thomas et al. (2004) estimated that 15% of all species will be extinct by 2050 if AGW is limited to 1.5°C; 37% if limited to 2°C. Ecological dependencies may multiply the direct effects of environmental change on the collapse of planetary diversity by 10 (Strona and Bradshaw, 2018). Loss of biodiversity will make it impossible to feed a larger African population (Frison et al., 2011). Insect populations will be affected by a combination of AGW and insecticides (Boggs, 2016). Forty percent of the world’s insect species may go extinct in coming decades (Resnick, 2019; Sánchez-Bayo and Wyckhuys, 2019). In the past 50 years, bee pollinations have declined as demand for agricultural pollination has approximately tripled, triggering a pollination crisis that affects crop yields (Goulson et al., 2015). Extinction of bee species could lead to the extinction of plant species that depend on bees for pollination, leading to other animal, plant, and insect extinctions, which in turn affects insect-eating bird populations (Goulson, 2014). Biodiverse coral reefs will be degraded due to pollution, overfishing, and rising temperature and acidity of ocean waters (Hughes et al., 2017). Oceanic oxygen concentration is also falling (Poppick, 2019). Most reefs will be seriously threatened or irreversibly damaged by 2050 (Burke et al., 2011) and the rest may die by 2100. Sekerci and Petrovskii (2015) showed that “the oxygen production by marine phytoplankton can stop suddenly if the water temperature exceeds a certain critical value. Since the ocean plankton produces altogether more than one half of the total atmospheric oxygen, it would mean oxygen depletion not only in the water but also in the air. Should it happen, it would obviously kill most of life on Earth” (p. 2349). Soil will be degraded by chemical-heavy farming techniques and deforestation-induced erosion, reducing crop yields (Arsenault, 2014). “There is rapidly escalating competition between the demand for land functions that provide food, water, and energy, and those services that support and regulate all life cycles on Earth” (United Nations, 2017c, p. 8). Groundwater (Dalin et al., 2017) is the largest available store of global freshwater and 2 × 10^9 people rely on it. About 6% of global groundwater is readily available and can be replenished with a human lifespan (Gleeson et al., 2016). Where groundwater is depleted, recovery may take centuries or millennia (Cuthbert et al., 2019, p. 140). About 10% of global land is covered by glaciers, and 10^9 people depend on their meltwater (Qui, 2019). AGW will cause non-polar glacier volume to fall by 29–41% in 2100; “glaciers in Central Europe, low-latitude South America, Caucasus, North Asia, Western Canada, and US are projected to lose more than 80% of their volume by 2100” with “major implications for regional hydrology and water availability in the near future” (Radić et al., 2014). Clarke et al. (2015) predicted that by 2100 Western Canadian glaciers will shrink by 70% relative to 2005, affecting aquatic ecosystems, agriculture, forestry, and water quality. Iceland’s glaciers will shrink by 40% in 2100 and 100% in 2200 (Poore et al., 2000). Accelerated deglaciation in Greenland from 2003 to 2013 suggests a tipping point driven by changes in air temperature and solar radiation (Bevis et al., 2019). Pathogens such as anthrax may emerge from melting permafrost (Revich and Podolnaya, 2011; Legendre et al., 2015) and cause regional or global pandemics (Wu et al., 2016). Humans have little immune resistant to zoonoses—diseases transmitted between human and non-human animals, such as ebola and salmonellosis. In the 14th century, bubonic plague (spread by fleas or body fluids from plague-infected animals) killed 25–40% of European children and adults (Galvani and Slatkin, 2003). 2°C AGW will trigger conflicts over natural resources (Barnett and Adger, 2007). Political destabilization could lead to use of nuclear weapons, causing radioactive fallout and ozone depletion (Mills et al., 2008). In a zeroth-order estimate, one or more of these points could alone cause 10^7 deaths per year for a century—a total of 10^9 deaths each. If that is true, a worst-case estimate of 3 × 10^9 for the worst-case AGW death toll may be realistic. That would correspond to roughly 30% of future world population, which will reach 9.8 × 10^9 in 2050 and 11.2 × 109 in 2100 (or between 8 × 109 and 15 × 109; United Nations (2017a). Given the high degree of uncertainty, a more precise estimate is hardly realistic.

### contention 2

#### contention 2 is colonization

#### commercialization drives space colonization – private investment places it as a possibility by 2030

**Tangermann 17** (Victor Tangermann, staff writer and photo editor at Futurism,"A timeline for humanity's colonization of space," Futurism, 10/17/17, <https://futurism.com/a-timeline-for-humanitys-colonization-of-space>)

Humans have long desired to explore the vast realms of space. Today, we are finally poised to send people out into the cosmos. Indeed, a number of private and public space companies are gearing up for Space Race 2.0 — a (very expensive) competition that inches us closer to uncovering answers about our universe and exploring new realms of our own humanity. Though they are still in the race, shifting priorities and limited budgets have undermined NASA’s lead in exploring the solar system and beyond. In the meantime, private entities like SpaceX and Virgin Galactic are flush with cash, and they are stepping up to try and engineer better, bigger, and faster rockets. And this is a good thing because, if humans are to find life on other planets, or perhaps a new planet for ourselves, more work needs to be done. Engineers and scientists need to develop life support systems, find reliable sources of water and fuel, overcome the negative effects living in space has on the body, and find a faster way to travel. There is still much to be done, but sending the average person to the Moon and beyond no longer seems so far out of reach. Yet, when will it finally happen? When will humans finally roam across an alien world? Here’s a comprehensive timeline of our future beyond Earth. Late 2017: Heavy Falcon Launch SpaceX plans to launch the Falcon Heavy for the first time before the end of 2017. Because the rocket can be reused, the Falcon Heavy rocket can deliver its payload into space at only a third of the cost of the next closest operational vehicle, the Delta IV Heavy. This lower upfront cost means that more organizations can carry out experiments in outer space. One of these experiments is the Planetary Society’s LightSail 2 solar sail that will launch on board a Heavy Falcon in early 2018. SpaceX’s Falcon Heavy rocket lives up to its name. 27 rocket engines weigh down the 70-meter (229-foot), 1.4-metric-ton (3.1-million-pound) rocket. That’s a lot of extra weight, but the payload makes it worthwhile — the rocket can launch 63,800 kg (140,660 lbs) of equipment, cargo, and passengers into orbit around Earth. That’s more than double the weight that the Space Shuttle can haul to the same altitude. 2018: Preparing For Space Tourism In 2018, SpaceX plans to launch more than ever before, sending 30 rockets into orbit (up from 20 in 2017). More attempts give the company more data to show how it can perfect its technology to launch rockets cheaply and securely. Eventually, this inexpensive and safe spaceflight will make space tourism finally viable. In fact, just this year, SpaceX announced that they would be sending two humans to orbit the Moon in 2018. Image Credit: Virgin Galactic Virgin Galactic is gearing up to launch its first astronauts into space before the end of February 2018. Before it launches with passengers on board, though, the spacecraft will have to undergo a series of test flights. The space plane, called the VSS Unity, completed its fifth ‘glide flight’ (distinct from the vertical trajectory of traditional space rockets) earlier in 2017. In the first months of 2018, it will be taking flights closer to the Karaman line, the official border between the Earth’s atmosphere and outer space located 100 km (62 miles) above the Earth’s surface. Around that same time in early 2018, scientists will test the LightSail 2, a device that moves through space by harnessing the power of solar photons — no fuel tanks or thrusters required. The LightSail 2, a citizen-funded spacecraft and created by the Planetary Society (the largest nonprofit organization that promotes the exploration of outer space), would be a proof of concept that solar sailing could propel spacecraft deeper into space. The unmanned, light-propelled spacecraft will hitch a ride on SpaceX’s Falcon Heavy rocket before taking its test flight at an altitude of 720 km (447.4 miles). 2019: Space Tourism And Observation Image Credit: Blue Origin Blue Origin, the spaceflight services company started by Amazon founder Jeff Bezos, recently announced that it intends to take tourists to space before April 2019. In groups of six, passengers will board an 18-meter (60-foot) rocket to the edge of space, around 100 km (62 miles) from the Earth’s surface. Once there, they will experience zero-gravity flight. Three independent parachutes and a retro-thrust system ensure that passengers will gently sail back to Earth. This experience does not come cheap — a ticket to board the New Glenn to reach Earth orbit is rumored to cost anywhere between $150,000 and $250,000. And, yet, there’s little question that people will want to sign up — Virgin Galactic, a competing space tourism project, reportedly already has 700 people signed up. In 2019, Blue Origin plans to add two- and three-stage rockets to its arsenal. They are fully reusable, up to 99 meters (326 feet) tall, and can deliver payloads at a relatively low cost, competing with SpaceX’s Falcon Heavy rockets. Image Credit: NASA NASA also intends to launch its James Webb Telescope in the first quarter of 2019. The telescope will observe the solar system in the infrared to see every phase of the solar system’s maturation; it will ultimately be 100 times more powerful than the Hubble Space Telescope, thanks to its array of 18 hexagonal mirror segments. With a combined mirror diameter of 6.5 meters (the Hubble measures in at only 2.4), the James Webb Telescope will be able to detect events such as the formation of galaxies dating back to the time of the Big Bang. It will also have a special focus on discovering new planets that could be capable of supporting life. 2020-2025: “Earth Reliant” And Beyond From finding evidence of liquid water to detecting organic matter in the soil of the Red Planet’s surface, the Curiosity rover has answered some fundamental questions about what it’s like on Mars. However, that information has also sparked more questions about what other elements may be present. To this end, in an effort to establish whether oxygen is present in the Martian atmosphere, and at what concentration, Curiosity’s successor, the Mars 2020 rover, will be saddled with a host of sensors and instruments that will allow it to answer this question. Information about oxygen concentration will be important if humans are ever able to visit the Red Planet themselves, which could be possible as early as 2030. There are other things that need to happen if we’re going to colonize other planets. NASA has established three phases that we need to complete before this is possible. In the first, which NASA calls “Earth Reliant,” we continue to test the feasibility of living in space and conduct more research aboard the ISS. In the second (“Proving Ground”), operations around the Moon will be used to establish ways to return humans to the Earth safely. With those stages complete, we will finally reach the third stage (“Earth Independent”) in which humans establish a self-sufficient colony on Mars. Image Credit: NASA Just over 50 years after humans first touched the lunar surface, NASA is gearing up to launch another manned spacecraft to go beyond the Moon. The astronauts will be on board a ship called the Orion, which will lift off using NASA’s Space Launch System (SLS), a modular heavy launch vehicle. SLS is similar to SpaceX’s Heavy Falcon and has a maximum payload of 70 to 130 metric tons (150,000 to 290,000 lbs). First, though, the spacecraft will do a few test runs without any humans on board. The first mission, Exploration Mission-1, is slated for late 2018. The SLS will launch the unmanned craft, travel to the Moon, enter orbit about 100 km (62 miles) above the lunar surface, and use gravity to propel itself into deep, unexplored space. The goal of this mission is to see if the craft can help humans survive a trip to distant planets. The second mission (Exploration Mission-2), planned for August 2021, will be NASA’s first manned test flight beyond the Moon. “During this mission, we have a number of tests designed to demonstrate critical functions, including mission planning, system performance, crew interfaces, and navigation and guidance in deep space,” Bill Hill, the deputy associated administrator of Exploration Systems Development at NASA Headquarters said in a 2016 NASA blog. To gain enough momentum to make the trip around the Moon, the spacecraft will have to make multiple orbits around Earth, occasionally igniting its thrusters. During its stable orbit of the Moon, the Orion will gather data and test the spacecraft’s capabilities for interplanetary flight. 2022: Making Mars Habitable While NASA spends the 2020s exploring how to best keep humans healthy in space, SpaceX plans to start putting down the infrastructure for humans to colonize it. SpaceX anticipates completing its first 54.6-million-km (33.9-million-mile) trip to Mars in 2022. Image Credit: SpaceX In his update earlier this year, Elon Musk revealed plans for a rocket that is far bigger and more powerful than NASA’s Space Launch System and even his agency’s own Falcon Heavy — the BFR. A rocket that big would have enough space for fuel to take humans to Mars, or even allow for Earth-based city-to-city travel. With a maximum payload of 150 tons, the enormous 106-meter (347.7-feet) rocket would break the current record for biggest payload (including cargo, fuel, and passengers) launched into orbit, while providing the lowest cost for each additional launch. To reach the Moon, the BFR would launch from the Earth’s surface, transfer propellant from fuel depots previously stationed in Earth’s orbit, accelerate in orbit, pick up an injection of fuel for the remaining distance to the lunar surface on the way, and land. SpaceX plans to refuel the rocket once it is in orbit in order to extend its range and payload capacity so that it can return safely to Earth. Tests have already shown that it’s possible to refuel rockets in space. NASA conducted the Robotic Refueling Mission in 2011, and it successfully completed a robot-actuated propellant transfer on an exposed platform of the International Space Station. Image Credit: SpaceX By 2022, SpaceX expects to land at least two cargo ships on Mars in order to establish a habitat for humans. The primary goal of those initial missions is to find a reliable source of water on the Martian surface. 2024: Manned Missions On The BFR Image Credit: SpaceX Two years after those cargo ships establish an infrastructure, SpaceX plans to send humans to inhabit a colony on Mars. The passengers aboard the BFR’s 40-cabin Mars transit module will be the first to make the unprecedented trip. This is, Musk would probably admit, an aggressive timeline. And it may not work in SpaceX’s favor: Due to planetary alignments and other factors such as solar power requirements and fuel limitations, the launch window of Earth-Mars travel is only a few weeks, according to Wired. And that’s assuming that all the other pieces fall perfectly into place — neither the BFR nor its predecessor, the Falcon Heavy, has yet had a successful launch. Should the BFR mission make it to Mars, it will contain the materials to construct a propellant production plant as part of its Martian colony. The plan would suck carbon dioxide from the atmosphere and turn it into deep-cryo CO4 fuel using solar power. 2025-2030: A Year In Space Image Credit: NASA SpaceX might be ready to send humans to live in space by the early 2020s, but NASA is a little more cautious. The government space agency is planning to put astronauts into orbit for a year to find out if humans are indeed ready to live on a different planet. In March 2016, NASA astronaut Scott Kelly completed a similar year-long mission aboard the ISS to test the effects of zero gravity on the human body and what that will mean for future space travel to Mars. Unlike Kelly’s mission, however, NASA’s 2021 mission will put astronauts in orbit around the Moon. They’ll be in a “deep-space gateway” — a small ISS-like station that will serve as a testing ground for future deep space missions, including later missions to Mars. It will be built over five earlier missions, four of them with humans aboard. The effects of spending a year in lunar orbit on the human body, caused by factors such as different day-night cycles and solar radiation, are still unknown. 2030s: NASA Sends Humans To Mars Five years after SpaceX’s manned missions to Mars, NASA plans to send its own spacecraft to the Red Planet. Using data and samples from the Curiosity and Mars 2020 rovers, NASA will first establish how humans could sustain themselves on the Martian surface before sending manned spacecraft from its deep-space gateway to do so.

#### They’re innovating now

**Sheetz 21** (Michael Sheetz, space reporter, “Elon Musk wants SpaceX to reach Mars so humanity is not a ‘single-planet species’”, CNBC, 4/23/21, <https://www.cnbc.com/2021/04/23/elon-musk-aiming-for-mars-so-humanity-is-not-a-single-planet-species.html>) // el

SpaceX founder and CEO Elon Musk remains focused on his vision for the company: Establishing a permanent human presence on Mars, with its Starship rockets carrying people to and from the red planet. “We don’t want to be one of those single planet species, we want to be a multi-planet species,” Musk said on Friday, speaking after the company launched its Crew-2 mission to orbit. “It’s been now almost half a century since humans were last on the moon. That’s too long, we need to get back there and have a permanent base on the moon — again, like a big permanently occupied base on the moon. And then build a city on Mars to become a spacefaring civilization, a multi-planet species,” Musk also said. Starship is the enormous stainless steel rocket that SpaceX has been building and testing at its development facility in Boca Chica, Texas. Starship’s goal is to launch cargo and people on missions to the moon and Mars. Current Starship prototypes stand at about 150 feet tall, or about the size of a 15-story building, and each one is powered by three Raptor rocket engines. Musk has previously estimated that it will cost about $5 billion to fully develop Starship, although SpaceX has not disclosed how much it has spent on the program to date. The company has steadily raised funds in the past few years, to fund both Starship and its similarly ambitious Starlink project, with SpaceX’s valuation soaring to about $74 billion — making it one of the most valuable private companies in the world. Additionally, SpaceX last week won a $2.9 billion contract from NASA, to help the space agency land astronauts on the moon’s surface with the first crewed mission targeting 2024. ″[Starship has] mostly been funded internally thus far and it’s pretty expensive. As you can tell, if you’ve been watching videos, we’ve blown up a few of them,” Musk said. The company has performed multiple successful test flights of Starship, although landing attempts after the last four high-altitude flights ended in fiery explosions. Despite the the prototypes’ destruction, SpaceX sees the test flights as progress toward creating a rocket that is fully reusable. SpaceX’s current Falcon fleet of rockets is partially reusable, as the company can land and reuse the rocket’s boosters. But Musk hopes Starship transforms space travel into something more akin to commercial air travel. The rocket’s enormous size would also make it capable of launching several times as much cargo at once — for comparison, while SpaceX’s Falcon 9 rockets can send as many as 60 Starlink satellites at a time, SpaceX says Starship will be able to launch 400 Starlink satellites at a time. Musk remains “highly confident” that SpaceX will land humans on Mars by 2026, saying last December that it’s an achievable goal “about six years from now.” He added that SpaceX plans to send a Starship rocket without crew “in two years.” In the meantime, SpaceX has many milestones to go before Starship can carry passengers. The rocket has yet to reach orbit. Musk last year said that the company will fly “hundreds of missions with satellites before we put people on board.” Musk may be focused on Mars, but the hurdles of Starship’s development are not lost on the space billionaire. “It’s a tough vehicle to build because we’re trying to crack this nut of a rapid and fully reusable rocket,” Musk said. “But the thing that’s really important to revolutionize space is a rapidly reusable rocket that’s reliable, too.”

#### Space colonization is key to human survival

**David 15** (Javier E. David, CNBC weekend editor, “Why Humanity's Survival May Depend on Colonizing Mars”, CNBC, 10/17/15, <https://www.nbcnews.com/tech/innovation/why-humanitys-survival-may-depend-colonizing-mars-n446196>) // el

After decades of space exploration and countless movies on the subject, why exactly does Mars continue to inspire such high levels of cultural and scientific fascination? Both the red planet and NASA are coasting on a wave of newfound popularity, taking center stage in big-budget Hollywood productions. Whether by coincidence or design, the favorable treatment of NASA by Tinseltown comes at a time when the space agency recently discovered evidence for flowing water on Mars, and last week openly declared colonizing the planet within the next 20 years "an achievable goal." And at least a few scientists think the survival of humanity may hinge on finding a new, hospitable planet to colonize. Just a few years ago, NASA critics and even some supporters were openly questioning whether the Mars science laboratory was worth its $2.5 billion price tag. Fast forward a few years, and the space agency is moving full speed toward establishing a human presence on the planet — a quest that looks less and less quixotic by the day. "Mars is obviously the logical next place to expand our capabilities and getting Earth crews there," Edwin "Buzz" Aldrin told CNBC in a recent interview. The famed astronaut and second man to walk on the moon's surface said sending humans to the planet would be an accomplishment "that's unparalleled in humanity." In a document outlining its rationale for sending humans to the far-flung planet — which lies 140 million miles from the Earth — NASA invoked the 1969 Apollo voyage, adding that unlike the moon, a mission to Mars would involve "going to stay." Mars' atmosphere is noted for its thin, carbon dioxide-filled air and ferocious dust storms that last for months. But given the right conditions, some think Mars could eventually be capable of sustaining humans. "We need to keep public interest stimulated and demonstrate to our leaders ... this is a most historical opportunity," Aldrin said, speaking from a conference in Israel. He added the human race was in a prime position to become "pilgrims in setting up permanence on Mars." In fact, the prospect of humans pioneering on Mars is gradually becoming more and more of a reality — and in some ways may be a necessity, a top-ranking NASA scientist told CNBC recently. "If the human species is going to survive, is it going to survive solely on Earth or not," asked Jim Greene, NASA's director of planetary science. "The appeal has been that as we explore, the next frontier beyond our atmosphere is Mars. That captures a lot of imagination in science, but also in science fiction." Yet Greene also underscored the inherent dangers of outer space, and the imperative to discover other systems capable of sustaining human life. He characterized Earth as existing in "a dangerous part of the solar system" that runs the outside risk of being hit by a "planet-killing" asteroid. Although it may sound like a plot from a science fiction movie, Greene explained that NASA has identified 876 out of more than 12,000 near-Earth objects that the agency is "really monitoring carefully." "In the last 500 million years of the Earth's history there have been five mass extinctions of species. The last one was the end of the dinosaurs," Greene said, referencing the event that scientists surmise brought about the extinction of dinosaurs more than 65 million years ago. Within the known range of potential "planet killers" — asteroids that are at least 2 km in size — that the space agency monitors, "there are more than 150 that we're really watching carefully," Greene said. These "potentially hazardous asteroids" will come within 5 million miles of the planet over the next 100 years. “They cross our orbit frequently, and we know we're going to get hit again," Greene said. "It’s not a matter of if, but when." Within the last several decades, there have been minor brushes with asteroids, but none that have the potential to endanger human life on a large scale — at least not yet. Recently, NASA disclosed it was monitoring a 480-meter asteroid that could collide with the Earth sometime within the next four decades. British astronomers have been even more stark in speaking of the likelihood that a space rock of large enough size could create pandemonium around the world. Asteroids "cross our orbit frequently, and we know we're going to get hit again," Greene said, underscoring that factors such as trajectory and conditions in space can determine whether asteroids hit the earth or pass it by. However, "it's not a matter of if, but when. This planet won't have a planet killer hit it for many hundreds of years, but it will happen," he added. The panoply of risks makes it important to seek out viable alternatives to ensure humanity's survival. Likening the idea of an extraterrestrial colony to a computer's external hard drive, Greene told CNBC that "If we're going to live as a species, we're going to have to 'back up' in other places ... and that place is Mars."