

# **How Will Generation Z Prioritize Either Climate Change Or Space Exploration In The Future?**

**5,018 Words**

## **Introduction**

With the rise of technology, the human race has been able to achieve the extraordinary. On July 16, 1969, mankind was able to accomplish the unthinkable by landing a man on the moon. This is one of the largest technological advancements throughout human history. Adjusted for inflation, the United States government has spent almost one trillion dollars on the National Aeronautics and Space Administration (NASA) (Bill of Rights). Though, with the planet Mars seeming within reach, questions are being asked whether we should shoot for the red planet, or spend time solving the problems on Earth. Since the United States Industrial Revolution began in the early 20th century, carbon emissions have grown almost exponentially (Lindsey). This, combined with the rise of Generation Z, people born between 1997 and 2012, created a national awakening for humanity's impact on the climate. With the rise in severity of the climate crisis, Generation Z has sparked many movements to reduce the anthropogenic causes of climate change. These movements can be as small as encouraging people to carpool to work, or as large as demanding large companies to become carbon neutral or reduce the use of chemicals that harm the environment. With the climate crisis, Generation Z must determine whether spending resources on NASA and other private space companies to explore space is more important than focusing on issues on Earth, such as climate change. This paper will explore how Generation Z will prioritize either climate change or space exploration.

## **Context: Space Exploration**

NASA is responsible for many of the technological advancements we use in modern society. NASA contributed to many modern day commodities such as flame retardants, solar panels, and LED lights. In her article, Josie Green provides a list of many of the things that

NASA has created that people use in their everyday lives. Green also gives her perspective of what NASA's inventions mean for society, "Unlike modern inventions we no longer use, these inventions are employed daily to save lives, improve environmental sustainability, and keep humans healthy" (Green). Many of the items on Green's list allow for humanity to live a safer, more comfortable life, but at what cost? Since its peak during the 1960s Apollo missions, NASA's funding (adjusted for inflation) has been declining steadily. NASA has not been getting as much funding as it did during the height of the Cold War because by the time the US landed a man on the moon, the space race was won, and soon after, the Cold War followed suit (Conn). Now that space is not a necessary expense for Homeland Security, the government has put it on the back burner. As of 2021, NASA's budget is \$28.6 billion for the year (Weitering). This is a slight increase from previous years. Bill Nelson, the current administrator for NASA, explains how he feels about the budget increase in a conference, "The Biden administration is proving that science is back" (qt. In Weitering). This increase could be a foreshadow of what is to come next for NASA, space exploration, and innovation.

### **Context: Climate Change**

Climate change is a very controversial topic in the world today. Though as time has come along more people have acknowledged its existence. The real debate is how we, as a society, can solve it. According to a survey conducted by Alec Tyson, an associate director of research at Pew Research Center, and Brian Kennedy, a senior researcher at Pew Research Center, most people who live in the United States believe the government should be doing more to combat climate change. In their article, Tyson and Kennedy's research shows how people believe climate change is an issue that needs to be solved. Solutions range from planting trees to creating more restrictions on corporations to reduce the carbon footprint of individuals (Tyson and Kennedy).

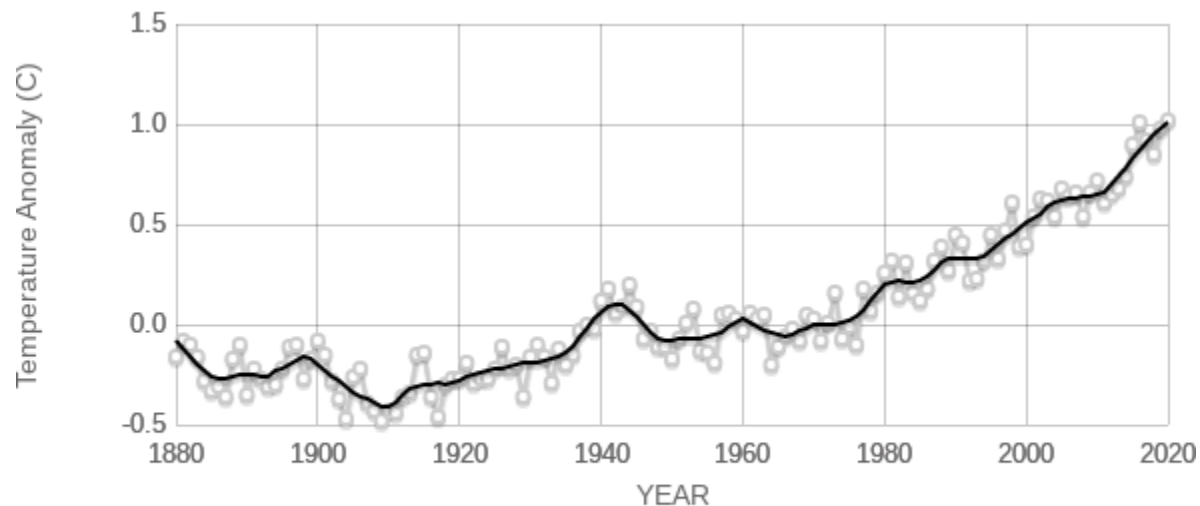
Though this research does not survey a specific demographic. The survey conducted by Tyson and Kennedy only surveys adults. The next generation, Generation Z (sometimes referred to as gen-z or I-gen), has a major role to play in the future of climate change.

### **Gap in Research**

There is plenty of research regarding space exploration, climate change, and Generation Z; though there is little to no research combining all three. These three topics intersect at a very specific point, but one that is extremely important to the future of humankind. The future is held in the hands of Generation Z and how they decide to distribute resources. Where those resources go will play a crucial role in the world's health and those who inhabit it. How will Generation Z prioritize spending resources on the exploration of space versus solving climate change? This paper will explore how high school students believe resources should be spent regarding space and climate change.

### **Literature Review**

According to NASA the global average temperature has increased by  $1.02^{\circ}\text{C}$  ( $1.84^{\circ}\text{F}$ ) as compared to the average temperature of the planet from 1951-1980 (“Global Surface Temperature”). Figure 1 (below) illustrates the trend of rising temperatures throughout the years.

**Figure 1:**

Source: [climate.nasa.gov](https://climate.nasa.gov)

It is undeniable that the world is becoming increasingly warmer. Implications of rising temperatures affect many different people in many different ways.

The effects of rising global temperatures have large impacts on different stakeholders throughout the world. Some of which affect humanity directly, while others affect humans indirectly. A study by Alec Trájer, professor at the Institute of Environmental Engineering, University of Pannonia, Veszprém, Hungary, attempts to find the effects rising temperatures have on the earth's ozone layer. Trájer explains how warmer temperatures affect ozone, “Tropospheric ozone is highly sensitive to global warming since the chemical reactions that form ozone are particularly dependent on temperature as the temperature catalyzes the production of ozone precursors such as nitrogen-oxides” (Trájer et al. 276). Trájer goes on to explain how that affects the human population, “Warmer temperatures can result in an increase of near-surface ozone concentrations in urban and polluted rural environments (Sillman and Samson 1995), which may lead to higher levels of hospital admission due to the increasing respiratory morbidity

and other adverse effects” (Trájer et al. 277). High levels of ozone can lead to many public safety concerns. If the ozone is too high, it can be recommended not to pump gas for that day due to poor air quality in the gas pump areas. This poor air quality can affect people with breathing or lung problems. However, it is not just humans that can be affected by warmer temperatures.

A study by Sandra Díaz, an Argentinian ecologist and professor of ecology at the National University of Córdoba, sheds light on all of the effects of global warming on the earth itself, “The frequency and intensity of extreme weather events, and the fires, floods and droughts that they can bring, have increased in the past 50 years, while the global average sea level has risen by 16 to 21 cm since 1900, and at a rate of more than 3 mm per year over the past two decades” (Díaz et al. 4). Trájer and Díaz both came to the conclusion that global warming has affected different parts of the earth. Abnormality in climate, warmer weather, and poor air quality can be linked back to global warming and the emission of greenhouse gasses into the atmosphere. These abnormalities in climate can affect many aspects of human life. Hurricanes devastate coastal cities and droughts affect farmers and the world's food supply.

Climate change can also heavily influence the world's ecosystem. Díaz describes the effects global warming has on biodiversity, “These changes have contributed to widespread impacts in many aspects of biodiversity, including species distributions, phenology, population dynamics, community structure and ecosystem function” (Díaz et al. 4). Biodiversity is very important in the survival of an ecosystem. For example, if a farmer's crops are all the same genetically, a disease can spread throughout the farmer's crop because the lack of genetic biodiversity prevents crops from potentially having a gene that protects them from the disease. With a more biodiverse crop growth, less crops will die due to the disease, because with more biodiversity comes the possibility of a gene to protect against the disease. The use of pesticides

and genetic modification can decrease biodiversity in an ecosystem. With more species in an ecosystem the healthier an ecosystem is. Farming in general can add a lot to global warming. For crop based agriculture, tilled soil has a much greater potential to contribute to global warming (Mangalassery et al. 3).

These negative effects on the climate, such as the ones that have been brought up by Mangalassery, Díaz, and Trájer have been noticed by humanity and plans have been made to help reduce the world's impact on climate change, such as no till farms (Mangalassery et al.) and reduced carbon emissions. However, much of regulatory practices are in the hands of the government. The government has put many regulations on carbon emissions and enacted programs to take carbon out of the atmosphere. However, these programs alone might not be enough. The Center for Climate and Energy Solutions sheds light on exactly how the government plays a role in regulating the climate,

“Congress is responsible for authorizing laws to address the climate challenge and appropriating funding for relevant programs. The Clean Air Act, for instance, provides the foundation for many existing climate policies. An economy-wide, market-based approach to climate change would require Congress to enact new legislation. Congress also has an important role in oversight of the executive branch and ensuring the administration is implementing existing law” (Center for Climate).

Much of what happens to climate change is based on how much the government is willing to give in order to enforce, to create, and to run these programs as well as legislation that helps fight climate change. President Biden’s spending bill has many items on its agenda, including funding to combat climate change. An article by Deirdre Walsh and Kelsey Snell, regarding items on

Biden's spending bill, speaks to how much climate change will be getting out of this spending bill, "\$555 billion in spending on climate, including clean energy tax credits for rooftop solar, electric vehicles, clean energy production; a civilian climate corps program; and investments in clean energy technology and manufacturing" (Walsh and Snell). With so much being spent on climate change, many other organizations may be getting less funding. This may be a foreshadow as to how Generation Z decides to spend their government's money. If so, how does this affect funding for other programs, such as space exploration?

NASA has been a major subject for the government's spending agenda for decades. Ever since John F. Kennedy set his goal to reach the moon, government spending has increased heavily on space exploration. However, over the last couple decades the government has spent less and less on space exploration (Planetary Society). Currently, President Biden is planning on spending \$24.8 Billion on NASA within his new budget directive (Planetary Society). However, this is significantly less than the \$555 Billion Biden is spending on the climate. This makes it look quite obvious that the current government is not prioritizing scientific advancement. However, NASA is not the only space company in the United States and the government is not the only thing that can fund space exploration.

Private space companies have taken flight over the last decade. Unlike NASA, private space companies are not taxpayer funded. This comes with advantages and disadvantages. NASA has much more access to resources than private companies. Private companies have to come up with their own resources and can't rely on the government to give them funding. That being said, private companies and NASA have very different goals. NASA is more focused on creating new technologies, as about 31.5% of their funding goes towards science and innovation (Planetary Society). Whereas private companies usually have different goals. These goals can be



profit or some humanity goal, like putting a man on Mars. It is also important to note that there are many companies that innovate new technologies. For example, Boeing is known for making commercial airliners, but has been commissioned by the government to create technologies suitable for space flight. They also make profit off of inventing new technologies for a wide variety of uses. This scenario is true for many aerospace and technology companies similar to Boeing.

Though their specific goals are different, private companies and NASA share a common goal of improving the technological limits of humanity. Space exploration companies (including NASA) aren't just companies that seek to explore space. Much of what they do is innovative: inventing new things, pushing the limits of science and making their mark on the world and society. Society owes much of its modern day commodities to NASA and other space agencies like it. Many of these technologies have also been made to help solve world problems such as climate change and world hunger.

Generation Z is a major part of combating climate change because the world's future is in their hands. The technological age of humanity is only inventing more and more new technologies. The effects of climate change are being seen in effect today, and unless something is done, the world's condition will only get worse. And how this new generation handles it could change the course of the world forever.

## **Method**

This paper explores the approach of the upcoming generation and their views on how we should allocate resources to prioritize climate change or space exploration. The future of this earth and our human species depends on the future generations and how they treat our planet.

In order to study this question, a high school in the suburbs of Denver, Colorado was selected and the students were given a series of questions to further understand their approach on resource prioritization. A high school was chosen due to its high density of Generation Z population. The results consisted of quantitative and qualitative research. The quantitative data was compiled into a data sheet for general analysis of student opinions. Each question in the quantitative sections was on a scale of 1-10, 1 being no or disagree and 10 being yes or agree. Split into two parts, one for climate change and one for space exploration, this section found general trends in Generation Z opinions to help the analyses. The qualitative data was used to determine why students came to the conclusions they did. The qualitative section was set to optional in order to keep the length of the questionnaire short so students would be more likely to complete it. An optional section also allows for more genuine data for that section. The data was collected via a questionnaire which was sent out to all of the students of the high school.

Part A, Climate Change:

- I. In your opinion, how important is it for humanity to focus on solving climate change?
- II. What percentage of money from government spending do you think should go to climate change?
- III. In your opinion, how well do you think the current government is dealing with climate change?
- IV. In your opinion, how necessary do you think it is to regulate practices that cause greenhouse gasses?
- V. At the world's current pace, how likely do you think humanity will be able to solve climate change?

In order to get a deeper understanding of what the student thinks needs to happen regarding the future of climate change, it is first necessary to understand where they stand on the climate change issue. Question A-I was intended to gather a deeper understanding of how the student feels about climate change. Perhaps if the student does not think climate change is an issue, they will not care as much about spending resources on it. Question A-II gathers data on specifically how many resources should be given towards climate change in the government. This found how the student prioritized climate spending over other government expenditures. Question A-III Is intended to determine if the student thinks there should be more being done or less being done about climate change. This gives the perspective of the student to see if they believe society is taking climate change seriously. Question A-IV gathers data regarding how the student thinks regulations on carbon emitting entities should be enacted. A large part of climate change is carbon emissions and the government plays a big role in regulating those emissions. Question A-V is intended to see if the student thinks there is hope for the future of this planet's climate. This is to see if students think that the world is too far gone for saving or if they think there is hope.

Part B, Space Exploration:

- I. In your opinion, how important is the study of space exploration for the advancement of humankind?
- II. Agree or disagree: It is possible to solve world problems so long as humanity keeps creating new technology.
- III. What percent of the government's spending bill do you think should be spent on space exploration?
- IV. How necessary do you think technological advancement is for the human race?

- V. Agree/Disagree: Private space companies help advance the human race technologically.

Part B of the questionnaire seeks to find how the students feel about space exploration and its outcomes. Question A-I intends to see if the student believes space exploration is necessary. If exploring space is not necessary in the eyes of the student, they may not think that space exploration deserves focus and funding from the government. Question A-II finds if the student thinks humanity can use innovation to solve world issues. This puts climate change and space exploration against each other seeing if the student believes humanity can use one to solve the other. Question A-III sees if the student believes that the government is doing enough for space programs. This can show if a student is in favor of or in favor of not having a larger space program in America. Question A-IV found how students see the importance of innovation. Much of humanity's evolution coincides with major technological advancements such as the wheel or gravity. Question B-V found that students believe that private companies contribute towards the technological evolution of the human race. This is an important distinction between private and government funding.

The final part of the questionnaire was the qualitative portion. The qualitative portion was predominantly used to determine why students think the way they do. In order to do this six questions were asked. Question C-II is dependent on question C-I. C-IV is also dependent on C-III. This is because the reasons for answering no to those questions are not needed in the analysis of this paper.

#### Part C, Qualitative:

- I. Do you plan on taking action against climate change in the future? (e.g. participating in rallies, holding a position in politics, pursuing a career in environmental science or something similar)

- II. If you answered yes to the above question, how and why? If you answered no, put N/A.
- III. Do you plan on pursuing a career in a STEM (Science Technology Engineering Math) field?
- IV. If you answered yes to the above question, what career and why? If you answered no, put N/A.
- V. What do you think is necessary for the human race to do in order to solve climate change? Please be as detailed as possible.
- VI. If you have any other thoughts please feel free to leave them below.

The two main questions of this section are C-I and C-III both asking if the student plans on participating in climate activism or STEM respectively. If the students answered no to these questions then they would not need to answer the question afterward. The following questions, C-II and C-IV, asked how and why the student answered the way they did above. This will yield qualitative data to compare against the quantitative data to help in the analysis of this paper.

Question C-V found how the students think climate change is solvable. This question is asked in order to find what exactly needs to be done to assist climate change. This will identify what resources need to be spent on and the more resources that need to be spent the less will be able to go to other programs. The final question in the questionnaire was a general thoughts question. If the student had anything they wanted to say that was not specifically asked in a question then they can leave it in this space. Part C of the questionnaire was used in order to connect the quantitative data to why students think the way they do.

## **Results**

Being sent out to a wide variety of students, the questionnaire gained 231 submissions over a period of about 2 weeks. Most questions had a clear trend or pattern while other questions

were more varied in their responses. A large majority of students (~71.5%) answered 8 or higher in question A-I. In question B-I a majority of students (~76.7%) was not reached until 5 and higher. This difference is important to note with the other questions as students tend to prioritize climate control over space exploration.

With that precedent set, an interesting regulation pattern is seen in questions A-II and B-III. A-II presents a bell curve with the highest percent of students in the 4 or lower category. Question B-III presents an exponential decay curve with no students choosing the 9 or 10 category. Question A-III also shows a bell curve with the majority of students in the 3 range and no students choosing the 9 or 10 category. This question found that most students think that the government is not dealing with climate change well.

One of the questions that did not yield much of a pattern was question A-IV. A majority of students answered with a 7 or above but there is no consistency with which answer was the highest. In another vein, question A-V yielded a bell curve but the answers were quite homogenous with a majority of students answering in the 4 range. This shows that students are about 50/50 on whether or not humanity will overcome climate change.

Question B-II found that a majority of students answered with a 7 or higher with most students in the mid to high range. This question had little pattern to it with the least number of students answering 1 (1.3%) and the most answering 7 (19%). Question B-IV, however, had an increasing curve with the least number of students answering 1 and 2 (1.3%) and the most answering 10 (18.6%). Most students (51.9%) answered at an 8 or above making this question one of the highest scoring questions. Question B-V provided the most diverse set of answers with the majority of students (58%) answering with a 6 or higher. Many students seem to be fairly apathetic with 47.4% answering a 4, 5, or 6.

The last section of the questionnaire was the qualitative optional portion. Each portion did not have a full range of participation so the amount of people that responded will be taken into consideration during the analysis. 209 people responded to question C-I. 45.5% answered yes while the rest answered no. For question C-II, the follow up question for question C-I, the results displayed a common theme. Almost all students that answered C-II said they would either participate in rallies, pursue a career in environmental science, or do small things to reduce consumption such as reducing the use of single use plastics. As to why, most students that answered explained “The world is quite literally on fire”, or that they worry for their children’s future. One student who answered no on C-I interestingly answered C-II explaining, “I would not because we still have way bigger problems”. In question C-VI, this student explained how there are more important things to focus on “like covid[SIC]”.

For question C-III fewer students answered yes with only 34.5% of students who plan on pursuing a career in STEM. In question C-IV students often said they wanted to pursue STEM simply because it piqued their interests. There were almost little to no outliers in this sense. Some students wanted to take nursing or medical school while most wanted to go into just general engineering.

Question C-V acquired 168 responses with answers ranging from regulating industries to promoting a paradigm shift in people, or reducing the amount of consumption in the world. Many students suggested carbon sequestration which is a process that takes carbon out of the atmosphere and into carbon sinks like the soil, or even just solid carbon. However many students also seemed pessimistic simply answering, “Not sure” or “What humanity has already caused on earth is irreversible”. Question C-VI on the other hand did not yield high results. There were

only a handful of serious answers most of which just reiterated what was said in earlier questions.

## **Discussion**

This paper set out to find how Generation Z will prioritize either innovation or world problems, specifically climate change and space exploration, in the future. The method yielded many results in order to answer this question. In order to answer this question, the questions asked in the questionnaire will be compared to each other to develop a new understanding.

Question A-I correlated with question B-I. The results show that students mostly prioritize climate change over space exploration but hold both in high regards. However it is easy to know which one Generation Z prioritizes more, it is more of a question of what this means for the future. In the future, a large part of how humanity deals with climate change will be in politics. How much the government spends on each is very important. As seen in Figure A-II and B-III, it is very clear that students care more about taking action against climate change than funding space exploration. This gap in funding could be due to the results of question A-III. Figure A-II shows that most students do not think the current government is handling climate change well. This could impact how students answered questions A-II and B-III, influencing them to want to put more into climate control and take more out of other programs.

Throughout the questionnaire there was a common theme of some pessimistic views on the future of climate change. In questions A-V and C-V, some students show how they think humanity will not be able to overcome climate change. Low scores in A-V show how students are pessimistic towards solving climate change. This pessimism could potentially lead to an apathetic view on the future of the world's climate. Some students may think that there is no point in trying to solve it, thus not putting as many resources into solving it. However, with the



large amount of suggested solutions given in question C-V, it is likely this is not the case. Many students were optimistic in their answers which varied from carbon sequestration (taking carbon out of the atmosphere and putting it into other carbon sinks such as soil or the ocean) to cutting back on the amount of greenhouse gasses pumped into the atmosphere.

Additionally, students showed much more interest in environmentalism than STEM (Questions C-I through C-IV). With almost half of the students planning on taking action against climate change and only a third of students planning on pursuing a career in STEM, students seem to be much more interested in solving climate change as compared to exploring space. But most students seem to be either in the middle or apathetic about both subjects because neither C-I nor C-III answered more than 50% yes.

### **Implications**

The results of this study can potentially assist policy makers in determining how to prioritize resources to either climate change or space exploration. The youth in the United States makes up about 22% of the country's population. Almost a quarter of every person in the US is under 18, and can therefore not vote or make governmental change. As a policy maker it is important to keep in mind the future of children, and the future of policy making. This study helps with establishing how the American youth feel about climate change and space exploration.

This study can also be insightful for the future of space exploration. If climate change is continuing to dominate resources then NASA may get less and less funding, making it more difficult for innovation. This study can be used to determine what kind of projects will be taken on in the future by NASA. However, funding could also go towards space exploration to aid in climate change which space companies may assist with. Many students suggested carbon

sequestration, a switch to renewable energy, and use of nuclear energy in order to reduce greenhouse gasses. These technologies could be the future of research and technological innovation for Generation Z.

### **Limitations**

Some questions apart from the questionnaire did not contribute as much to the study as others. Questions A-II and B-III were not set up as well as they could have been. Given in increments of ten, the percent of funding was not accurate to how much money the government actually spends on each program. If this question were to be changed it would have smaller increments, 0%-30% instead of 10%-100%.

Overall, the study was a little too focused on climate change. There should have been more questions regarding how students felt about space exploration and innovation. The questionnaire felt more like how to solve climate change rather than whether climate change or space exploration was more important and how students might implement it in the future. This is partly due to more information being available for climate change especially with its connections to Generation Z as compared to space exploration.

### **Future Research**

This study researched how students will prioritize either climate change or space exploration. There are many different kinds of world problems and kinds of innovation that can be researched in the future. Other research could also be done in larger test groups and larger, or other, geographical areas. The future of humanity depends on the upcoming generation, and there is so much research that can be done regarding Generation Z.

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## Appendix

Figure A-I

In your opinion, how important is it for humanity to focus on solving climate change.

231 responses

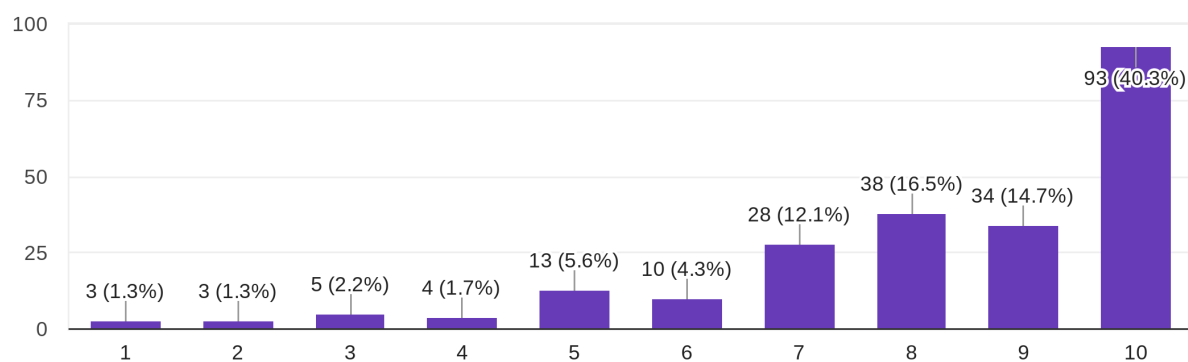


Figure A-II

What percentage of money from government spending do you think should go to climate change (answers in factors of ten e.g. 3 = 30%).

231 responses

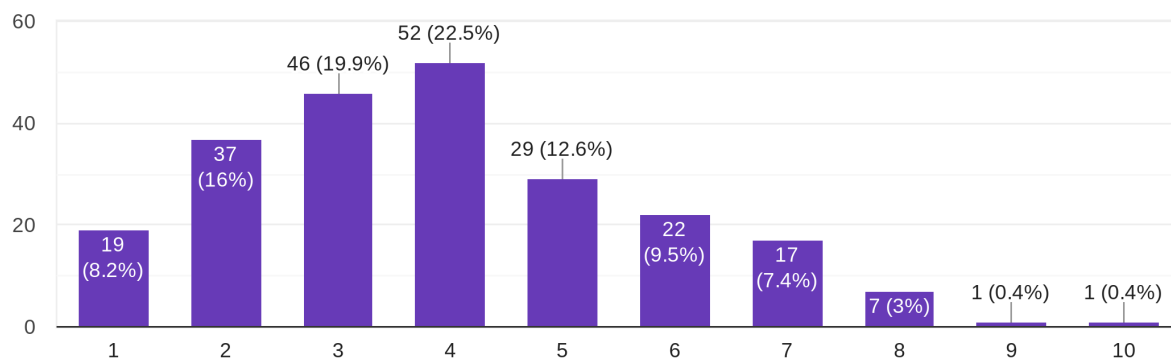


Figure A-III

In your opinion, how well do you think the current government is dealing with climate change?

231 responses

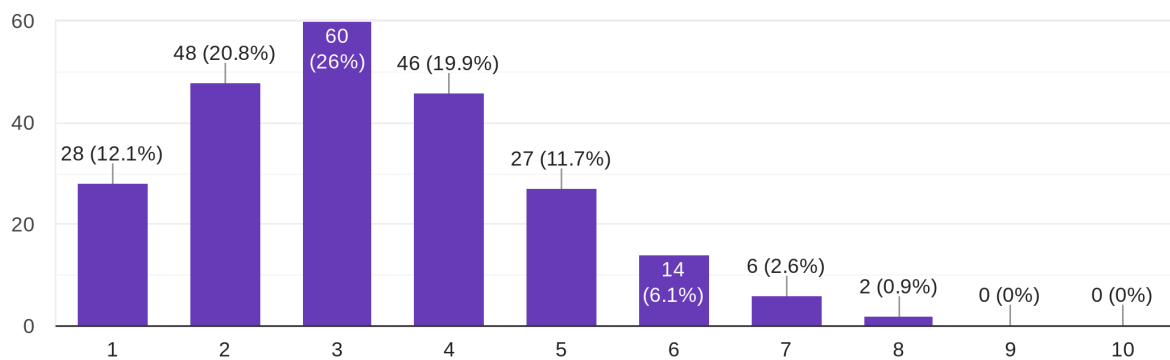


Figure A-IV

In your opinion, how necessary do you think it is to regulate things that cause greenhouse gasses?

231 responses

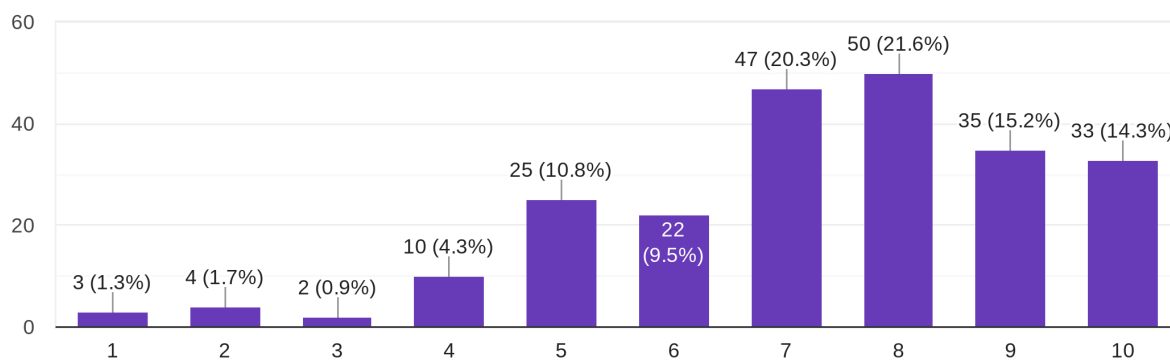


Figure A-V

At the world's current pace, how likely do you think humanity will be able to solve climate change.

231 responses

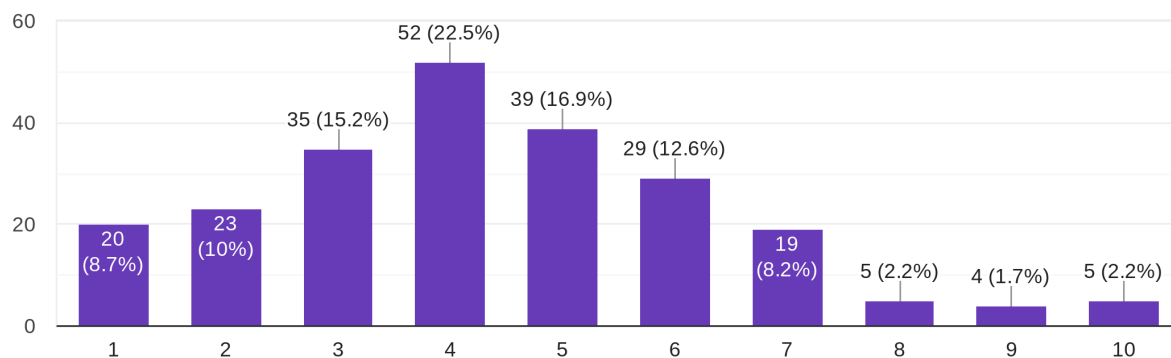


Figure B-I

In your opinion, how important is the study of space exploration for the advancement of humankind?

231 responses

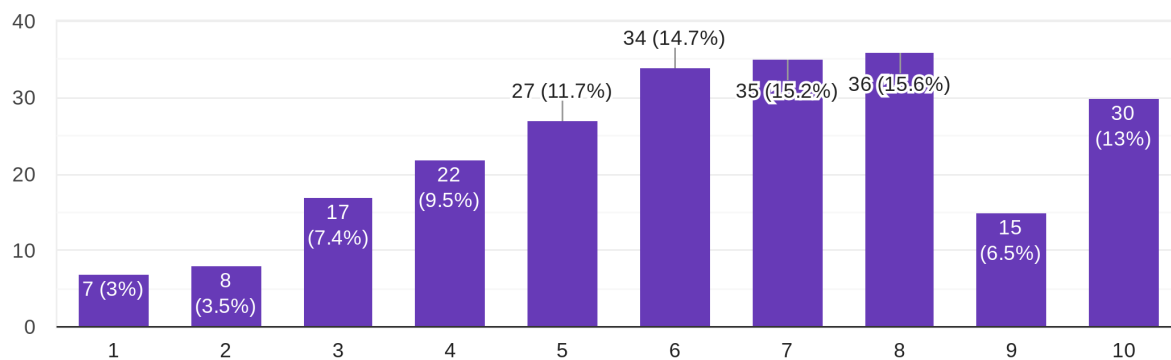




Figure B-II

It is possible to solve world problems so long as humanity keeps creating new technology.

231 responses

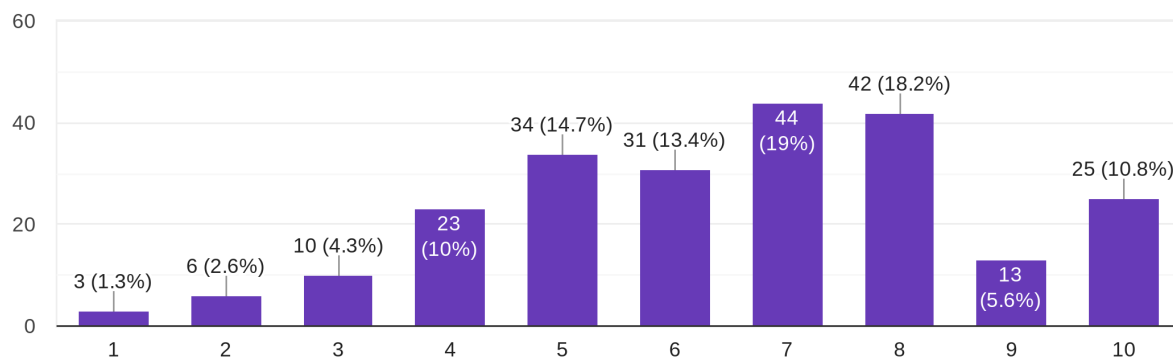


Figure B-III

What percent of the government's spending bill do you think should be spent on space exploration (answers in factors of ten e.g. 3 = 30%).

231 responses

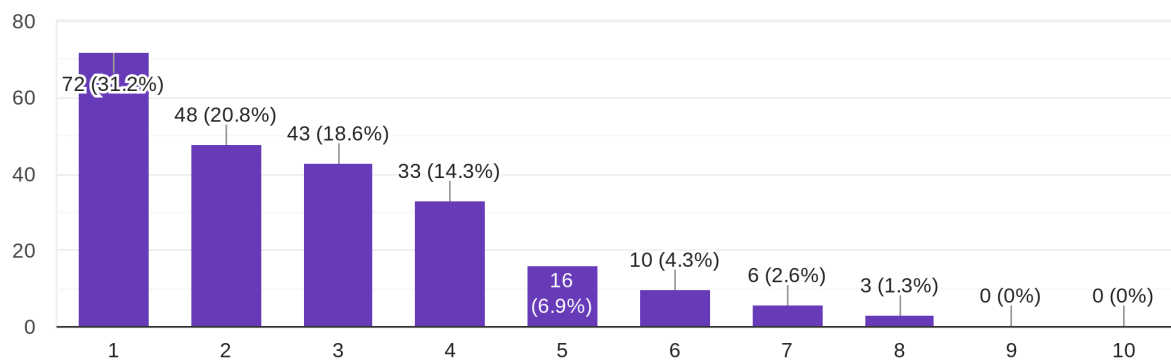


Figure B-IV

How necessary do you think technological advancement is for the human race?

231 responses

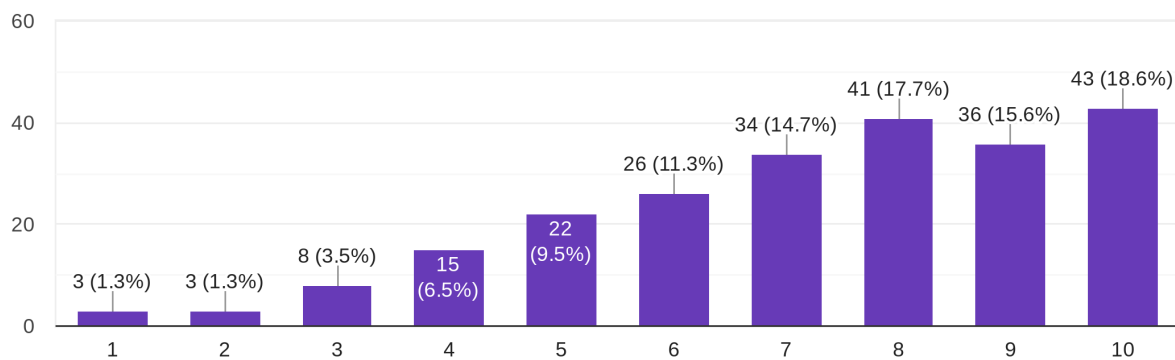


Figure B-V

Private space companies help advance the human race technologically.

231 responses

