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An Overview of Space Policy Perspectives from the Young Space Generation

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Abstract

The Space Generation Advocacy and Policy Platform (SGAPP) US Task Force is an American-led team of passionate young professionals and students in the space industry envisioning the sustainable, fair, and cooperative development of outer space to benefit all people on Earth. We aim to further this vision through policy recommendations, introductory background materials, facilitating discussions with experts, and encouraging broad involvement in US space policy. Since its founding, the US Task Force has taken steps toward these goals through policy briefs, perspective blogs, public webinars, working groups, newsletters, and more. In this paper, we highlight the work of our team on topics including multidisciplinarity and equity in the space sector, space diplomacy and international collaboration, commercial regulation and responsibility, sustainability of the space environment, scientific exploration, and space technology for climate action. We present our perspectives as members of the young space generation who will be influenced by and contribute to space exploration for decades to come. This paper aims to promote our members' hard work and facilitate further discussion with the space community at large to inform our future work.

Keywords: policy, advocacy, youth

1. Introduction

New and non-traditional space actors are rapidly emerging, and with that evolution comes a need for new policy considerations. Space activities are growing to include increased commercial activity, novel space applications, expansion to lunar orbit and the lunar surface, renewed deep space exploration, and more. Concurrently, new legal and policy questions have emerged for addressing challenges such as sustainability of the Earth and space environments, lunar governance, commercial regulation, and more. A diversity of perspectives is critical for informing and shaping space policies that will impact future generations worldwide. [1] This paper presents perspectives from young people active in the space sector.

The Space Generation Advisory Council (SGAC) [2] is an international non-profit organization founded to support the United Nations (UN) Program on Space Applications. SGAC membership consists of young professionals and students worldwide, ages 18-35, with a passion for and interest in space. Since its founding, SGAC has grown into a large network offering regional and international events, project groups, scholarships, and advocacy teams.

In 2021, SGAC's US Task Force [3] was founded as an American-led team to enable young people to share their perspectives on US space policy and law; facilitate discussions between industry, academia, and government experts; encourage broad participation in policy conversations; and compile background information for education on space policy topics. Participation in the US Task Force is volunteer-based and open to all interested members of SGAC. Since 2022, the US Task Force has operated as part of SGAC's Space Generation Advocacy and Policy Platform (SGAPP). SGAPP was founded in 2022 to develop reports detailing SGAC's policy priorities and positions. For this collaboration, the US Task Force distills and presents SGAPP reports in the US context. SGAPP's first report, published in December 2022, focuses on using space technology for climate action. [4]

In this paper, we provide an overview of the policy topics that have been researched and discussed by members of the US Task Force since 2021. We present short sections on the following topics: space diplomacy and international collaboration, commercial regulation and responsibility, sustainability of the space environment, scientific exploration, space for climate

action, and multidisciplinarity and equity in the space sector.

2. Policy Topics

In each of the following sections, we present summaries of material produced by the US Task Force, including group discussions, background briefs, perspective blogs, webinars, and workshops. References to the full versions of US Task Force content are shared in footnotes and at the end of this manuscript.

2.1 Space Diplomacy and International Collaboration

One of the greatest challenges facing the future of space activity is facilitating international cooperation. As evidenced by the orbital debris crisis [5], a lack of global coordination in Low Earth Orbit (LEO) and beyond will result in consequences for all actors. Policy challenges include open data policies, multinational corporation regulation, developing norms of behaviour, and orbital debris management. [6]

Although space governance is relatively new, the history of cooperative regulation is much older. Several attempts have been made to codify international standards and norms for the space industry, beginning back in the 1960s with the Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, Including the Moon and Other Celestial Bodies (commonly referred to as the Outer Space Treaty) [7]. Along with the oceans, the atmosphere, and Antarctica, space is considered by some to be one of the four Global Commons – widely understood as areas of shared natural resources for all countries. The law of the sea – defined as "a body of customs, treaties, and international agreements by which governments maintain order, productivity, and peaceful relations on the sea" by NOAA [8] – has been keeping the peace in international territories for hundreds of years. The Outer Space Treaty follows a similar approach: it relies on self-enforcement and countries voluntarily complying.

As a result of increased interest and activity in space, NASA and the US Department of State spearheaded the Artemis Accords. The Accords go into more detail on interoperability, emergency assistance, registration of space objects, release of scientific data, preserving outer space heritage, space resources, deconfliction of space activities, and orbital debris [9]. However, a major challenge of these international agreements is a lack of enforceability and foresight of potential future issues. Additionally, the US bypassed the UN [10] in creating these Accords, which some considered an uncooperative move.

Space Diplomacy[a] [11]

The US benefits from fostering global cooperation using norms to promote the safe, stable, and secure use of space. The International Space Station (ISS) has been a bastion of collaboration for decades – but the ISS faces retirement within a decade with only commercial replacements. One potential path forward is bringing new countries into the Artemis Accords – as of 2023, 28 countries have signed the Accords, with Argentina being the most recent addition in July 2023. [12]

However, challenges remain to truly open collaboration between the US and other countries. For example, the Wolf Amendment [13] prevents collaboration with China, another major actor in space. The US has an important opportunity to model the creation of diplomatic norms for the benefit of all through initiatives such as the Accords and other more creative solutions.

Space in 2050 Webinar: Space Diplomacy[b] [14]

In a 2022 webinar, the US Task Force heard from Mike Gold (Redwire, formerly NASA associate administrator for space policy and partnerships) and Daniel Porras (UNIDIR, formerly Secure World Foundation) about the importance and limitations of the Artemis Accords. Gold expressed great excitement for Mexico's recent signing of the Artemis Accords – the more countries that sign these accords, the more goodwill there is towards international collaboration. However, Porras pointed out that although these symbolic steps are being taken, very little progress has been made towards preventing an arms race in outer space.

The space economy and its relationship with the military make diplomacy challenges extremely difficult to solve. However, recent events such as Russian anti-satellite (ASAT) tests have helped convince the US government of the need for norms of behaviour and new legal frameworks in space. Porras highlighted that increasing diversity in the discussions about space diplomacy has also contributed to increased momentum in this area. Gold spoke about his work with the Global Expert Group on Sustainable Lunar Activities [15], which has significant participation from Chinese scholars. Investment in committees like these helps create diverse global connections within a rapidly polarizing and growing space community. Unfortunately, US export regulations can cause major challenges in fulfilling a vision of international cooperation beyond academic think tank groups. Projects such as Orion, a collaboration between NASA

[a] An abridged policy brief from the US Task Force.

[b] A summary of a webinar discussion hosted by the US Task Force.

and ESA, can serve as a framework for developing a more collaborative approach to Moon exploration.

2.2 Commercial Regulation and Responsibility

Commercial regulation and responsibility refer to the legal frameworks governing commercial activities in outer space. As more private companies venture into space, as shown in Fig. 1, it becomes crucial to establish guidelines to ensure safe conduct and accountability. Policy challenges include licensing and authorization of commercial space activities, intellectual property rights in space technology, liability for space debris and its potential damages, data sharing and transparency in commercial space ventures, regulations for resource utilization on celestial bodies, and more. This domain also includes legal issues related to commercial space tourism, space mining, space-based services, and space advertising. Balancing innovation, profitability, safety, environmental protection, and international cooperation are key challenges as commercial activity increases.

The space age started in the late 1950s and 1960s [16], characterized by NASA's collaboration with commercial partners during its iconic government-led Mercury, Gemini, and Apollo programs, mainly contracting aerospace companies like Boeing, Lockheed Martin, and Northrop Grumman. The 1980s and 1990s brought an expansion in the launch of commercial satellites, necessitating both international agreements and domestic regulations for responsible operations. In the 2000s, a transformative era of new commercial actors began, with companies like Orbital Sciences and SpaceX playing pivotal roles in resupplying the International Space Station. Concurrently, Blue Origin is developing reusable rocket technology targeting both suborbital and orbital flights. Nowadays, with the rise of satellite mega-constellations like SpaceX's Starlink and competitive plans for lunar and Mars missions by commercial entities, regulatory frameworks are evolving rapidly to ensure safety, responsible behaviour, and international coordination.

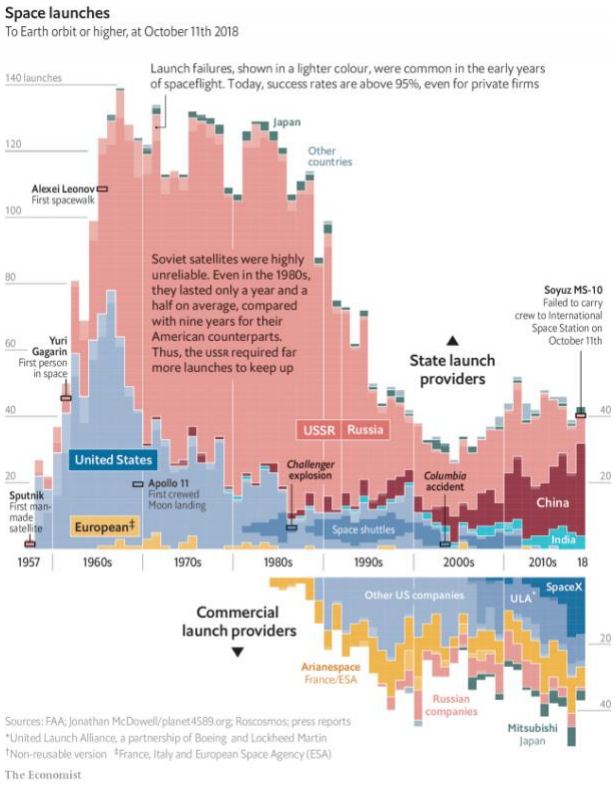

Fig. 1. A compelling view of rocket launches with time – commercial actors are becoming increasingly significant. [17]

Rocket Fuel and the Environment[c] [18]

The space industry in the United States is projected to reach $1 trillion in revenue by 2040, representing a dramatic increase in rocket launches and commercial activity in space [19]. Therefore, the lack of regulation on appropriate forms of rocket fuel poses serious environmental risks. Toxic rocket fuels deteriorate the ozone layer and harm ecosystems on Earth [20]. Existing international and national regulations are vague and unable to address the full scope of rocket emissions' impact. Furthermore, the ability of the space industry to reach high into the atmosphere means there are special concerns about the environmental impact of rocket launches that need to be addressed [21]. The Environmental Protection Agency (EPA) targets substances used in different types of rocket fuels [22, 23]. However, the EPA's rules do not comprehensively address the impacts of rocket fuels. More work needs to be done in creating regulatory frameworks to protect our environment from rocket launch by-products.

[c] An abridged policy brief from the US Task Force.

Rocket Exhaust: The Need for Proper Regulations[d] [24]

Like the challenges with regulation of rocket fuels, environmental reviews of rocket launches themselves by the Federal Aviation Administration (FAA) do not consider specific issues arising from rocket engine ignition [25], instead substituting aviation standards to make up for a lack of scientific understanding of the impacts of rocket launches. Rocket launches are powerful and have caused air quality problems and structural damage on the ground [26]. Furthermore, rocket engines produce different air pollutants than airplane engines. Aviation standards for emission regulation are not adequate to prevent environmental damage caused by rocket launches [27]. We must conduct further research, and policies addressing rocket launches need to be updated to mitigate current and potential problems posed by rocket launches.

Satellite Data Sharing: Paths Toward Data Democracy[e] [28]

Geopolitical tensions require a thoughtful and responsible approach to the use of data delivered by satellite technologies. Still, Earth observations can be critical for rapid response to crises. Earth observation data can provide accurate information about the status of a territory, an asset in case of a humanitarian crisis, for example. One such example is visible in Fig. 2, which depicts the La Palma volcanic eruption. Domestic-level policies on data sharing have evolved towards more open frameworks, driven by the concept of "data democracy." Space policymakers need to consider economic, normative, and institutional perspectives when regulating the sharing of Earth observation data [29], emphasizing the responsible use of data for the benefit of all countries, irrespective of their economic or scientific development [30]. The harmonization of domestic policies with international frameworks is crucial to enable safe, rapid, and responsible data exchange for humanitarian purposes [31].

[d] An abridged perspective blog from a US Task Force member.

[e] An abridged perspective blog from a US Task Force member.

Fig. 2. La Palma volcanic eruption, as captured by Copernicus Sentinel-2 [32].

Commercial Space Technology Transfer in Challenging Times[f] [33]

The invasion of Ukraine destabilized the geopolitical order needed to make international business prosper, impacting the wave of commercialization in the space industry. Comprehensive guidelines for open access to space technologies and collaboration are vital in these sensitive situations.

Initiatives like INNOspace Masters [34] promote collaboration, while programs like NASA Technology Transfer [35] support idea implementation. Challenges arise, however, when innovative space technologies also serve the defense industry [36]. Referring to international laws and treaties, such as the Outer Space Treaty [7], provides some guidance during discussions of technology access. Global space governance emphasizing transparency and declaration of intentions before technology transfer could prevent the misuse of technology during conflicts [37]. The traceability of transfers between entities must be guaranteed [38].

Like all other transportation sectors, space must be regulated to ensure human and environmental safety. Space activity prompts a broad range of challenges, from environmental protection to ethics. The commercial space industry has amazing potential for improving lives but also potential for great risk. Methods are needed to mitigate environmental damage and pollution, ensure the responsible use and sharing of

[f] An abridged perspective blog from a US Task Force member.

satellite data, and moderate the transfer of space technologies. Proper guidelines will ensure safety and accountability as the commercial space industry evolves.

2.3 Sustainability of the Space Environment

The challenge of orbital debris in LEO is one of the most urgent crises facing the space sector today. As debris from satellites, launch vehicles, and ventures such as Starlink crowd up LEO, future launches become more uncertain. Although some commercial solutions are in development, debris prevention and removal are extremely difficult problems.

Space Debris[g] [39]

The Kessler Syndrome is a hypothetical scenario in which the debris field around Earth becomes so dense that space becomes inaccessible [40]. Several US institutions monitor space debris, such as the US Space Command, which tracks debris on space-track.org. Other responsibilities for monitoring launches are spread out around the US government: the Department of Transportation's Federal Aviation Administration (FAA) licenses rocket launches, the Department of Commerce's National Oceanic and Atmospheric Administration (NOAA) licenses remote sensing satellites, and the Federal Communications Commission (FCC) regulates satellite communication operators. [41]

Many actors are involved in monitoring space debris, but stronger action is needed on mitigation and removal. Barriers to addressing the orbital debris problem include a lack of frameworks for international cooperation and immature technologies for debris removal. The most significant action from the FCC targeted at debris prevention was the implementation of a "5-year rule" [42] for de-orbiting defunct satellites. The US must take decisive action to prevent the worsening of the orbital debris crisis.

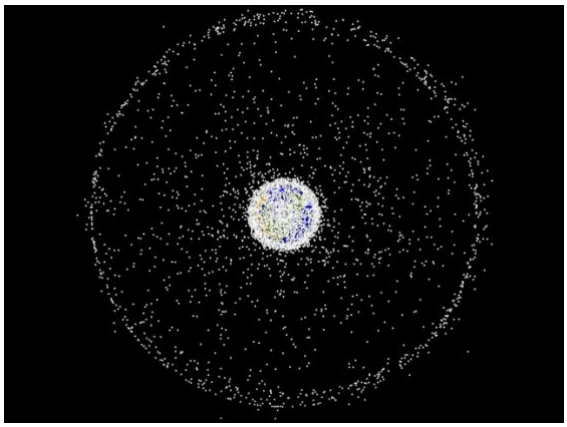

Fig. 3. Space debris clutters Earth orbit. [43]

[g] An abridged policy brief from the US Task Force.

Space in 2050 Webinar: Orbital Debris[h] [44]

The US Task Force hosted Charity Weeden (Astroscale) and Gabriel Swiney (NASA, formerly US Department of State) for a 2021 webinar discussion on solving the space debris crisis by utilizing more diverse perspectives. Weeden began by highlighting the lack of regulatory framework for the rapidly increasing use of LEO by the majority of countries on Earth. In addition to the challenge of mitigating debris in LEO, more work needs to be done in space traffic management.

In the past 10-15 years, the use of LEO has dramatically diversified: instead of just military and remote sensing satellites, we now have commercial projects, manufacturing, small-scale scientific research, and even student competitions vying for space. Swiney highlighted how these changes in launch volume, location of orbit, and categories of use are creating an accelerated need for international oversight in space congestion: "Internationally, there's not a single coherent system. There are some non-binding guidelines that we could talk about, but there's a real paucity of binding rules… It's going to require congressional action to truly modernize our regulatory system."

The current framework in the US is surprising: regulation is split between multiple organizations, including NOAA, the FAA, and the FCC. The FCC controls licensing for communication frequencies; thus, they have become the most important gate for enforcing rules on commercial launches in the US. Weeden pointed out that outside of the US, licensing and regulation on a national level becomes even more diverse. This necessitates more work in developing an international framework for space traffic management and debris mitigation.

Orbital Debris: Why don't we just clean it up?[i] [45]

The Commercial Space Act of 2004 [46] has led to an increase in companies that offer launch services. This has resulted in a more robust and active space industry and a dramatic increase in objects in orbit around Earth. However, cleaning up Earth's LEO is a complex engineering and political challenge.

Dealing with debris can be broken down into two areas: Space Traffic Management (STM) and Space Situational Awareness (SSA). STM is concerned with licensing, debris avoidance, and mission operations, while SSA focuses on tracking objects in space.

The movement toward containment of the orbital debris crisis has accelerated in recent years, with the UN and other countries backing the development of regulations and technologies for preventing debris [47].

[h] A summary of a webinar discussion hosted by the US Task Force.

[i] An abridged perspective blog from a US Task Force member.

Additionally, commercial solutions such as Astroscale's ELSA-d mission, with a focus on satellite repair and reuse, show promise [48]. As the space community works toward a solution for orbital debris, we must balance the need for international buy-in, the immature state of current debris removal technologies, and the reliable use of norms of behaviour and legal precedent for developing regulations.

Space Sustainability: We need to do more.[j] [49]

In the context of space, the term "sustainability" commonly means mitigation of the orbital debris crisis. However, the conversation cannot stop there. The environmental impacts of the already material resource-heavy space industry [50] are often overlooked. We are already facing a resource crisis on Earth, so we must weigh our every move before expanding the boundary of our environmental impact. This starts with re-imagining every single component of the space industry supply chain: from how we source (and recycle) materials, to whose voices we listen to during mission planning, to our willingness to commit to greener technologies. It is time to re-examine what we mean when we say, "space sustainability."

Takeaways from the Space Generation Fusion Forum[k] [51]

The US Task Force hosted a breakout session at the 2023 Space Generation Fusion Forum (SGFF) in Colorado Springs, CO. This working group discussed government, industry, and community collaborations for sustainability in the space environment.

The SGFF delegates focused on open access to space as the underlying motivation for space debris mitigation. Future generations will rely on sustainable access to space for continued research and discovery. Sustainability of the space environment requires debris management, space traffic management, communication frequency regulation, and prevention of environmental damage to planetary bodies. Working group members proposed tax incentives may be a viable option for encouraging cooperation with commercial sustainability guidelines, and international arbitration may be a reasonable method of dispute resolution. All in all, sustainability actions should be normalized, standardized, and transparent.

2.4 Scientific Exploration

The US Task Force is passionate about continued advocacy for space science. Scientific discovery has been a constant motivator for space activities and inspires future generations of thinkers. A handful of our US Task Force members come from professional backgrounds in space sciences, and we are eager to continue activity in this area.

Enabling Astronomy and Planetary Science through Policy[l] [52]

For many of us, curiosity is enough to motivate scientific space missions. However, here are three additional reasons to support scientific endeavours: (1) research and development (R&D) produces new technologies, and in turn supports the commercial industry and military [53]; (2) through space missions, the US builds its national leadership and influence; (3) space missions and associated educational programs provide inspiring opportunities for the next generation [54].

Impacts of commercial space: Decreasing launch costs can reduce the overall cost of a mission. Additionally, the increasing number of launches expands access to orbital experiments and may help to enable the construction of larger structures, such as massive space telescopes, from pieces launched separately. With private space actors providing access to LEO, NASA may be freed up to focus on deep space. However, increasing commercial launches also mean large numbers of satellites cluttering the night sky and hindering ground-based telescope observations. Commercial space can benefit science, but it must be proactive about solving space traffic.

The Artemis Program: Motivations for the Artemis lunar exploration program are not purely scientific – economic incentives and the positioning of the US as a leader in space are significant. For that reason, Artemis is particularly compelling to many policymakers. For the scientific community, Artemis is a method for developing new exploration capacity. With new technologies being developed, it may become possible to build large structures, expand our ability to service space-based instruments, and conduct new experiments. One perspective is that a politically motivated Artemis program is not an efficient use of funds for answering big science questions. However, there may still be long-term benefits for non-lunar scientists.

2023-2032 Planetary Science and Astrobiology Decadal Survey[m] [55]

In April 2022, the National Academies of Sciences released the 2023-2032 Planetary Science and Astrobiology Decadal Survey [56], a 782-page

[j] An abridged perspective blog from a US Task Force member.

[k] An abridged summary of a US Task Force working group held at SGAC's 2023 Space Generation Fusion Forum (SGFF) in Colorado Springs, CO.

[l] An abridged perspective blog from a US Task Force member.

[m] An abridged perspective blog from a US Task Force member.

document recommending a slew of planetary science priorities for the next 10 years. Of the many topics tackled by the report, several stand out as key policy agenda items. (1) The survey advocates for a flagship orbiter and probe mission to Uranus. The survey also provides themes for guiding smaller class missions. (2) The survey recommends NASA's Planetary Science Directorate (PSD) increase its investment in R&D to 10% of PSD's total annual budget by 2028. (3) Also recommended is a shift in organizational structure to grant SMD the authority to implement requirements on the Artemis program, given their role to execute lunar science [57]. (4) The new "State of the Workforce" section reports severe underrepresentation of Black, Latinx, and LGBTQAI+ researchers in planetary science, and high counts of sexual harassment across the field. The survey recommends a focused data collection and monitoring campaign, targeted fellowship opportunities, a code of conduct, and ongoing training to deal with implicit bias. (5) Finally, the report urges a Near-Earth Object (NEO) Survey follow-up mission to track potentially dangerous asteroids and comets.

Let's return to Mars Sample Return[n] [58]

In July 2023, the US Senate Appropriations Committee passed a budget containing a blow to the Mars Sample Return (MSR) mission: stay on budget or get cut. If MSR is cancelled, those funds will be redirected to Artemis and a handful of other initiatives. $5.3 billion for returning tubes of Martian dirt to Earth may seem excessive, but in the US context, over budget military projects receive far less criticism.

For example, throughout the 2000s and 2010s, the US military aimed to create state-of-the-art ground vehicle systems through its Future Combat Systems project. Future Combat Systems was eventually deemed a failure, the Army had nothing to show for the tens of billions of dollars already invested, and final estimates for the program were at over $200 billion [59]. In another case, the Space-Based Infrared Systems satellite project, meant to improve the US's ability to track intercontinental missiles, had its original budget of $4.1 billion increased over 250% to $10.4 billion [60]. In 2006, the Pentagon reported "that 36 of its major next-generation weapon systems are over budget, some by as much as 50 percent" [61]. The 2023 budget for the US military is over $800 billion. NASA's is $32 billion [63].

Remaining on budget and on time is in the best interest of every American taxpayer – but why penalize planetary science? Let's not cancel this key opportunity to better understand the origins of Mars, our home Planet, and habitable worlds.

[n] An abridged perspective blog from a US Task Force member.

Developments in Orbital Science

Space provides a unique vantage point and location for experimental efforts. The space environment differs from Earth and provides a platform for observing the Earth and the universe, not obstructed by Earth's atmosphere. In turn, there have been thousands of scientific experiments [64, 65] on the International Space Station, which is designated as a US National Lab [66]. Examples of experiments range from fundamental disease research, the study of flame formation, water purification systems, drug development, studies of muscle atrophy and bone loss, exploring the fifth state of matter, understanding how our bodies adapt in microgravity, growing food in space, deployment of CubeSats, Earth observation, and measurements of the cosmic background radiation, pulsars, and black holes. There also exist citizen science projects for public engagement with orbital science [67].

Science experiments benefit from reproducibility and sustainability, so in turn, policies should foster space-based R&D. The commercial space industry is now providing services, such as rockets, payloads, technologies for the ISS, etc., that have increased capabilities to conduct science in space, which may grow with more planned space stations from commercial actors [68].

2.5 Space for Climate Action

Fig. 4. A view of Earth from space. [4]

The use of outer space can be leveraged to advance the knowledge, technology, and insights needed to address significant weather events and climate change on Earth. Satellite observations enable continuous monitoring of global weather patterns – especially in areas without weather stations on the ground – and persistent tracking of key environmental issues such as methane leaks, coastal erosion, and ice melts. It is critical that the valuable data and innovations brought by space exploration and utilization not be overlooked in the fight against climate change. Leveraging "space for climate action" has been a focus of SGAPP and the

US Task Force in 2023. As previously noted, "space for climate action" is the subject of SGAPP's first report, published in December 2022 [4].

SGAPP's "Space for Climate Action" Report[o] [4]

In September 2021, the Secretary General of the United Nations released "Our Common Agenda," outlining priorities for the next five years. At the top of this list of priorities were "climate action" and "youth engagement." In response to these critical areas, SGAPP established a policy working group on "Space for Climate Action." This working group developed an SGAC policy report, "Saving Our Future on Earth Through Our Presence in Space," outlining SGAC's views and proposals about how space could, and should, contribute to climate action.

The report acknowledges that the space industry should not be viewed separately from growing climate concerns and takes the position that the space sector must implement policies and practices wherever possible that mitigate and reduce harm to the Earth's climate.

The authors note that, within SGAC and globally, there is an increased awareness of environmental sustainability and a greater emphasis being placed on sustainable practices. Space technologies are leading to a widespread belief in the necessity of sustainable development. Broadly, the report concludes that space exploration, along with advancing technologies, practices, and knowledge, has a role in creating far-reaching changes to support the global fight against climate change.

The report reviews the state of the sector and its implications for climate, covering topics including policy and law; space technology and science; education, capacity building, and outreach; green economy and finance; and the new space economy. Further, it discusses the ethical and political considerations of space for climate action, including the ethics of climate change, international cooperation, accessibility of data, and the role of satellite applications.

The report acknowledges that satellite applications, including Earth observation, communications, and navigation satellites, are key tools for climate disaster mitigation and management. Space data-derived risk maps show hazard exposure and vulnerability to events and their impacts; this information is crucial for making strategic decisions and strengthening resilience to climate change. Through remote sensing technology, responders can access real-time and accurate information to gauge the extent and severity of damage and organize appropriate responses. Satellite navigation and communications allow first responders to locate the affected areas, which are often remote and lack adequate infrastructure, and to coordinate response actions more effectively and efficiently.

Thirty-one recommendations are provided in the SGAPP report for implementation by the international space sector, spanning topics from space law to finance. They emphasize the need for quick and global execution to ensure a more equitable, environmentally ethical, and sustainable space industry.

Space for Climate Action Webinar[p] [69]

On July 6th, 2023, the US Task Force held a public webinar to discuss "space for climate action," with a focus on the intersection between space technology and climate monitoring. Expert panelists included Dr. Cassidy Rankine (Planet), Caroline Juang (Columbia University), and Sahba El-Shawa (Jordanian Space Initiative). The webinar focused on the benefits and limitations of using space technologies and capabilities for weather and climate monitoring. Dr. Rankine, Juang, and El-Shawa discussed their involvement with space sustainability and climate initiatives.

A key takeaway from the webinar was that space data is becoming increasingly useful for tracking, quantifying, and understanding the planet's changing climate and weather cycles. Scientists can compare space-based observations with Earth-based measurements to gain a deeper understanding of the Earth and how our climate is changing over time. However, the panelists noted that, despite having space-based climate data available today, there continue to be policy limitations and challenges to bridging the "gap" between gaining climate information and actual implementation of its use.

The webinar audience asked whether space utilization for activities such as orbital manufacturing or mining can help reduce climate change and the degradation of environments on Earth. In response, the panelists agreed that the global community should consider how we think about climate vis-a-vis how we use space – and to explore opportunities such as repurposing debris for on-orbit manufacturing. However, they suggested that space utilization alone won't solve climate crises. For example, large-scale agricultural activities are unique to Earth and significantly impact carbon footprints. Addressing these Earth-based issues will make a larger and more immediate impact on climate change than transitioning industry to space.

Another focus of audience questions was regarding access to space for "non-traditional" and "underserved" populations and countries, as well as efforts underway to collaborate with indigenous communities. The panelists agreed that inequity in space data access is a

[o] A summary of a report from SGAPP.

[p] A summary of a webinar discussion hosted by the US Task Force.

considerable challenge, however, it is an issue actively being tackled. For example, NASA's Applied Remote Sensing Training Program trains non-experts to monitor water quality and air pollution to support environmental justice initiatives. Additionally, companies such as Planet [70] can provide open-access Earth-observing data for private and non-governmental use. The panelists expressed that the space community should not impose a specific scientific or technical approach to the use of space-derived data upon indigenous communities. Rather, the space sector should partner with communities to improve their data access and let them decide how to best use the information. Emerging technologies, such as machine learning, can help further tackle the issue of inequitable data access and utilization.

In concluding remarks, the panelists discussed positive ongoing efforts to utilize space for predicting humanitarian crises; that spinoff technology can help create more resilient and adaptable communities on Earth; and that new technologies are helping us adapt to an ever evolving and changing climate. A final observation was that "space for climate action" is a growing and interdisciplinary field – the community should think about this role for space from many angles.

2.6 Multidisciplinarity and Equity in the Space Sector

To accomplish large feats of space exploration, the space sector has brought together diverse disciplines and backgrounds. Projects are developed by national space agencies, private companies, and academic institutions, as well as through large international collaborations. Collaborations, such as the ISS, are historic examples of how including different cultural perspectives and expertise leads to advancement and benefit for all humanity. The space industry should set an example for international collaboration, harnessing the strengths of individual actors to develop large space projects.

The launch and satellite industries are growing, amplifying challenges such as space debris. This growth in the space sector adds urgency to the development of national and international standards of responsible behaviour in space, but also provides incredible opportunities for space-based projects from a broader and more diverse set of actors. New actors should continue to be supported by internationally collaborative initiatives for a long-term presence in LEO and beyond. During a US Task Force webinar on space diplomacy [14], Mike Gold highlighted the importance of foresight as we build a long-term and sustainable space future: "We must and will build a better future in space than we have here on Earth. We all need to dedicate ourselves to that…As Soyuz demonstrates, I can't think of a better place where diplomacy and international relations can flourish than in space."

Space presents a unique opportunity for young people to be involved in shaping the laws and policies that will govern human presence in a new environment. History provides us with lessons on what strategies have and have not led to successful and sustainable exploration and expansion, allowing us to learn from these experiences and implement equitable and inclusive approaches to our presence in space.

One example of the push towards an equitable and diverse space sector is NASA's "Equity Action Plan" [71], released in 2022, with four focus areas: (1) Increasing integration and utilization of contractors and businesses from underserved communities and expanding equity in NASA's procurement process; (2) Enhancing grants and cooperative agreements to advance opportunities, access, and representation for underserved communities; (3) Leveraging Earth science and socioeconomic data to help mitigate environmental challenges in underserved communities; (4) Advancing external civil rights compliance and expanding access to limited English proficient populations within underserved communities.

Diversity is also at the heart of the ESA's values for the ESA Agenda 2025 [72] to complete the ESA Transformation. Eight steps, aimed at advancing these values as concrete initiatives, will pave the way for continuous improvement: (1) Aim for at least 40% recruitment of women by 2025; (2) Make visible ESA's commitment to a gender-balanced workforce; (3) Strive for gender diversity in evaluation panels and advisory bodies; (4) Increase the number of new recruits with disabilities; (5) Remove physical barriers; (6) Ensure a work environment where staff can be comfortable and confident about their identity; (7) Reduce the average age of recruitment at ESA; (8) Secure the leadership team's support for enhancing diversity & inclusiveness at the workplace and ensure that they communicate internally and externally ESA's commitment to progress.

Currently, Caucasian men from industrialized countries dominate the space sector. Women, BIOPIC communities, and the LGBTQAI+ community are underrepresented. This demographic condition may be improved through educational, early career, and financial support. Mentorships, paid fellowships, accessible education, and social awareness are key to progressing toward equity and inclusion. It is fundamental to inspire students and young professionals from all backgrounds and to communicate opportunities for joining the space sector – this can be done through social media, networks such as SGAC, events, and more. It is important that we, as the space sector, continue promoting and fostering collaborations across institutions and agencies, inviting individuals from diverse backgrounds and experiences, supporting people with programs that contextualize and understand their

circumstances, and providing guidance from relevant professionals. [73]

In the US Task Force, we strive to promote policy conversations between students, young professionals, and experts from throughout the space sector, inviting broad perspectives to these discussions. We aim to provide resources for individuals to learn about space policy topics, online and in-person events/workshops, web communication via social media and email newsletters, and partnership with external organizations to foster and develop more interactions, content sharing, and communication across different initiatives that share the common interest in a multidisciplinary and equitable space sector.

6. Conclusions

Human activity in space has changed and grown over the past decade. With this second space age, fresh perspectives from younger generations are important to highlight, as they will see the longest-term impacts of today's decisions. The US Task Force exists to provide a voice to this space generation.

The discussions, perspective blog posts, policy briefs, webinars, and workshops US Task Force members have developed cover wide-ranging topics. The section of this manuscript focused on Space Diplomacy and International Collaboration (Section 2.1) examined the past and looked to the future of intersecting global political response with policy, environmental, and technological problems facing space; Commercial Regulation and Responsibility (Section 2.2) turned the lens toward the rise of commercial space and its implications for the environment and technological freedom; Sustainability of the Space Environment (Section 2.3) shined a light on the stresses facing the outer space commons caused by increased human use of Earth's orbit and urged a more proactive response; Scientific Exploration (Section 2.4) urged renewed interest in flagship efforts in space science; Space for Climate Action (Section 2.5) noted the ways in which space technologies may aid climate monitoring and solutions on the ground; and Multidisciplinarity and Equity in the Space Sector (Section 2.6), explored increasing inclusion within the space sector.

Organizations such as SGAC and the US Task Force play an important role in projecting perspectives from the young generation. For the broader success of youth influence on space policy, looking toward other examples of successful advancement of youth interest in policy will be useful. One such example may be in the climate movement, where various youth groups have successfully driven change and led conversations from both science and social policy perspectives.

The US Task Force has had successful beginnings as a youth-led region-specific space advocacy group. Demonstrating this success, SGAC's SGAPP has since started a new regional division for young voices in Europe, the European Space Exploration Taskforce. By fostering the growth of youth organizations and demonstrating their work in mediums such as this manuscript, SGAC and the US Task Force are building a strong foundation for future developments in space advocacy expressed by the space generation.

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