

Space Policy Storylistening Workshop

Workshop Participant Pack

9:30am to 5:30 pm, Tuesday 18th July 2023

Sovereigns' Room, RAF Club, 128 Piccadilly, London W1J 7PY

Followed by a wine Reception at the Churchill Bar, RAF Club, 5:30-7:00 pm

Dress code: <https://www.rafclub.org.uk/dress-code-club-rules>



**Capabilities in Academic
Policy Engagement**



Contents

1. Welcome	pp. 1-2
2. Location and timings	p. 2
3. House Rules	p. 3
4. Programme	pp. 3-4
5. Overview of policy questions	pp. 5-12
6. Synthesis Paper Executive Summaries	pp. 13-22

1. Welcome

Dear Participant,

We are delighted to welcome you to this space policy storylistening workshop, organised by a collaborative team across the Universities of Cambridge, Oxford, and Bristol, and funded by Capabilities in Academic Policy Engagement (CAPE). The workshop is part of a project titled Future Uses of Space (FUS): Narrative Evidence for Science & Technology Advantage through linking Research and Policy.

The project's aim is to consider how evidence extracted from stories can inform policy in the field of science and technology, with the primary case study focusing on space policy. The project applies [storylistening](#): the theory and practice of gathering narrative evidence to inform decision-making, especially in relation to public reasoning. In the storylistening framework, 'narrative evidence' is defined as the product of the expert act of both direct critical engagement with stories, and of critical engagement with others' storyimbining. We understand stories and narrative to be synonymous, and to include both narratives badged as fiction and non-fiction, textual and non-textual, etc.

In the first phase of the project, we commissioned a series of synthesis papers from academic participants which created and collated narrative evidence from a range of humanities and social science disciplines in response to key space policy questions defined by the steering group. The goal of the workshop will be to further collectively identify key policy issues and relevant narrative evidence (informed by this earlier scoping and synthesis work) and to create generalised guidance on the creation and use of narrative evidence.

The Project Team

Project Team

Dr. Claire Craig, University of Oxford, co-author of *Storylistening*
Prof. Sarah Dillon, University of Cambridge, co-author of *Storylistening*
Dr. Alex Tasker, University of Bristol
Dr. Elena Violaris, University of Cambridge

Steering Group

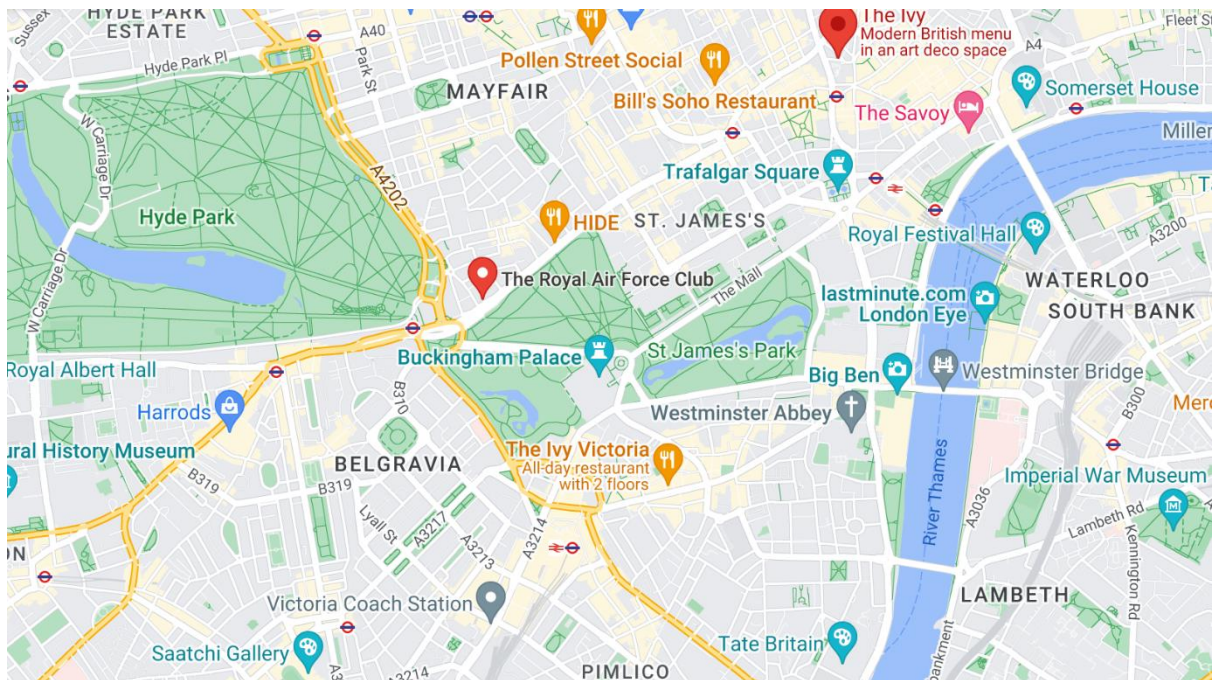
Prof. Duncan Bell, University of Cambridge
Prof. Sa'id Mosteshar, London Institute of Space Policy and Law
Dr. Graham Turnock, European Space Agency
Dr. Tom Wells, Government Office for Science

2. Location and timings

The workshop will open on **Tuesday 18th July** at **0930** and finish at **1730**.

It will be held in the **Sovereigns' Room** at the **Royal Air Force Club, 128 Piccadilly, London W1J 7PY**

The workshop will be followed by a wine reception with canapés at the **Churchill Bar**, which is also at the **RAF Club**, from **1730** to **1900**.



Map showing workshop location

3. House Rules

Our participants come from a wide range of backgrounds including some who have active and ongoing involvement in complex settings. In addition to the standards of normal professional behaviours we would also ask that you are mindful of the following:

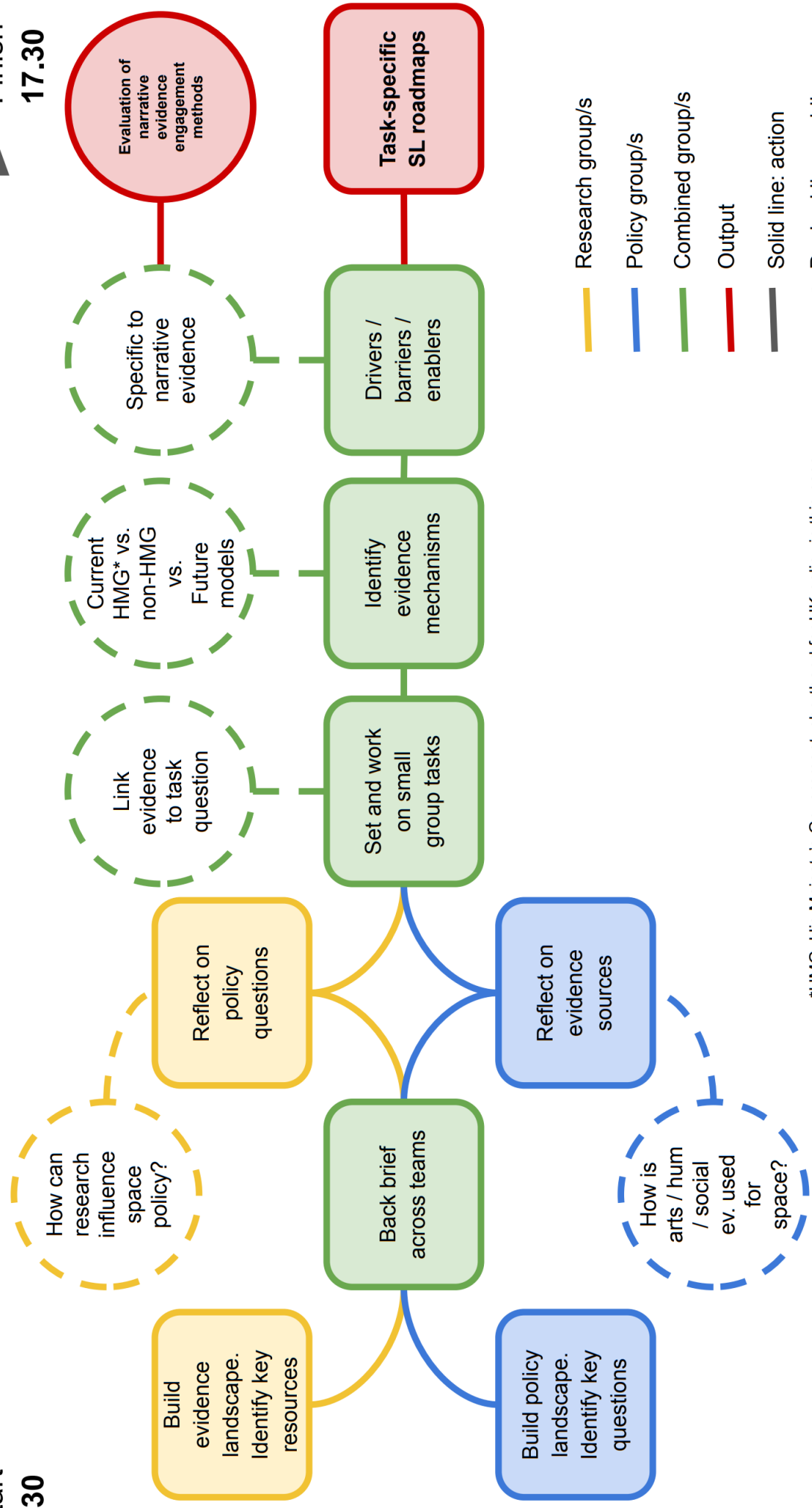
1. The power of this workshop is in part the ability to reach across disciplines and experience. As such, no single participant will have full command of the topic in hand. We ask that you **approach the activities with curiosity**, and are **respectful of those who have differing opinions** and positions to your own.
2. The event is held under **Chatham House Rule**, specifically that *‘when a meeting, or part thereof, is held under the Chatham House Rule, participants are free to use the information received, but neither the identity nor the affiliation of the speaker(s), nor that of any other participant, may be revealed’*.
3. The workshop should be considered a closed professional event, and **will not include sensitive or classified materials**. Should you wish to discuss classified subjects, please contact the project team who can arrange for a suitable space at a later date.
4. The workshop will not be digitally recorded, and we ask that you **do not take photographs or other forms of record**.
5. **Participant titles, affiliations, and contact details will not be shared** by the Project Team at the workshop or placed on identification materials. Names of participants have been shared with the venue, at their request, for security reasons. We hope to stimulate the creation of meaningful relationships, and would therefore encourage you to continue conversations through personal contacts.

4. Programme

The workshop will be structured through a series of consecutive phases as indicated by the flowchart on the following page.

Start
9.30

Finish
17.30



*HMG: His Majesty's Government, shorthand for UK policy in this case

- Research group/s
- Policy group/s
- Combined group/s
- Output
- Solid line: action
- Dashed line: guiding q.

5. Overview of Policy Questions and Supporting Evidence

Prior to the workshop, the project informally scoped the field of key space policy issues, as detailed in the following report, which may or may not inform further scoping at the workshop. The report conveys perspectives from practitioners and academics with backgrounds in space policy and research (listed in Annex B), and is structured around the following questions:

1. What are the biggest decisions concerning space policy, in the next ten years?
2. What are the areas of greatest need for evidence, models, and anticipations of the future?
3. What stories are most influential to key existing and emergent collective identities in the relevant fields?

1. What are the biggest decisions concerning space policy, in the next ten years?

Space policy is affected by a range of geopolitical, economic and technological trends and developments. These create a wide range of choices and decisions for policy-makers, and require judgements about framing, risk and uncertainty in the face of multiple potential futures.

1.1 Sovereignty, defence and security

Each nation and major player has to consider **whether and how to ally or partner** in developing strategic capabilities. For example, the war in Ukraine brought this question to the fore in the EU, because the EU was using a Russian launcher based in French Guiana. The UK faces decisions about its own multilateral and global arrangements, for instance deciding whether to seek increased alignment with North America, or to become more independent and risk isolation within a geopolitical arrangement dominated by large blocs.

Policy-makers need also to contend with the **interdependencies created by national or local reliance on globally operating** space-based systems.

There are policy choices about setting **limitations on military uses of space**: Article IV of the UN's Outer Space Treaty restricts military use of space and this remains widely supported: "States Parties to the Treaty undertake not to place in orbit around the earth any objects carrying nuclear weapons or any other kinds of weapons of mass destruction, install such weapons on celestial bodies, or station such weapons in outer space in any other manner. The moon and other celestial bodies shall be used by all States Parties to the Treaty exclusively for peaceful purposes." But these boundaries can be tested at the margins: WMDs cannot be placed in space, but other weapons

might be; while nuclear weapons might be flown through space, without being stationed on a celestial body.

Dual military and civilian uses pose further choices. These might include the extent to which it is practicable or desirable to use the same capabilities for observation in military and civilian - especially perhaps humanitarian - contexts. The dependence of Ukrainian defence on the commercial Starlink communication satellite service gives a different illustration of controversial and apparently unintended dual use.

Policy-makers must consider how to respond to risks to the space sector *and to the sectors and infrastructure that depend upon it* from **cyber attacks**. For example, before it invaded Ukraine, Russia launched an attack on American company Viasat, a commercial satellite communications company on which the Ukrainian military relied for command and control of the country's armed forces. The attack not only resulted in immediate significant loss of communication for the Ukrainian military at the start of the war, but also had wide and perhaps unintended impact on Viasat's capabilities more generally, such as affecting the operation of thousands of wind turbines in Europe.

Space-based **geo-engineering** technologies such as mirrors, umbrellas or atmospheric particulates and aimed at increasing national or global security in the face of climate change, raise further major policy questions about multinational and global governance, responsibility for unintended effects, dual use potential and the balance of risk and benefit.

Every country faces continual decisions about the right levels and types of public sector **investment** in scientific research, technological support, space-based or space-oriented infrastructure and defence.

1.2 Exploration, ownership and governance

Exploration brings new decisions, especially concerning **access, ownership, rights and responsibilities**. Commercial, public, and military objectives may collide. Issues to consider include whether and how to develop frameworks that enable exploitation for resources, or for human access in the future. Some have suggested that deliberation should be informed by notions of colonialism drawing on the experiences of historic exploration and exploitation on Earth.

The idea of outer space as a largely **ungoverned commons** underlies the Outer Space Treaty (1967), which can be considered, on its own terms, to have been a successful attempt to anticipate future governance needs. Decision-makers today need to be able to consider how it needs to evolve and what, if anything, can be applied today from the way it was created 60 years ago. The UN Moon Treaty (1979) establishes a framework of laws belonging to the moon and other celestial bodies, including (in Article 7.1) the requirement that lunar exploration does not disrupt the

existing environmental balance, and that the environment of earth is not disrupted through the introduction of extraterrestrial matter. However, in contrast to the Outer Space Treaty, fewer than 20 nations have signed up to the Treaty, and even fewer to the US-initiated The Artemis Accords. This in turn raises fundamental questions about the **future design of effective negotiation and governance structures** at regional bloc and global scales.

As space transitions from being accessible only to a small number of wealthy nation states to something accessible to most nation states and an increasing number of private companies, the notion of it as an ungoverned commons may become less sustainable. Different choices about the basic approach may apply to different elements of space, such as Earth orbits as opposed to outer space.

In earth orbital space increasing levels of use bring the inevitable challenges of potential harm due to collisions or other aspects of operation; and choices about responsibilities with respect to debris and end of life operations. These in turn raise questions about **future regulation that might form, in effect, rules of the road** and which would require policy agreements and regulatory infrastructure. The European Space Agency has adopted a unilateral target of Zero Debris by 2030, but such an approach, and any regulation, inevitably increases the cost of operations and shifts costs between current and future users and between sectors.

2. What are the areas of greatest need for evidence, models, and anticipations of the future?

2.1 General challenges to the provision of evidence and the quality of debate

It is likely that public reasoning about space suffers from a number of challenges that are common to other areas of policy, but that come together sharply with respect to space. Some of the reasoning is about matters that are extremely long term and **highly speculative**, such as terraforming, and human colonisation on other planets, making it harder to establish evidential standards, and harder to sustain public and political interest. **Dual use** technologies and operations complicate access to evidence and to decision-makers as leading edge operations may be militarily sensitive or commercially confidential. The **path dependency of different uses** of space results in different approaches that may then converge in unexpected ways. For example, Innovate UK has an earth imaging strand and a space strand, which can appear disconnected. As is often the case with public reasoning in policy areas associated with new technologies, debate and decision-making may **focus on the (popularly exciting) nature of the technologies**, rather than their social, systemic and political consequences.

More than many such areas of emergent technology, however, space policy suffers from **inconsistent terminology** and lack of standardised definitions, which hamper reasoned debate.

It may also be helpful to note that the evolution of governance with respect to space means there are relatively **few arrangements for public engagement** with decision-making, despite the popularity of space as an academic subject and site of public speculation.

2.2 Governance

A set of key questions concerns the development of plausible and well-founded potential models for future governance at national, multinational and global scale and across multiple types of use. Developing these models requires anticipations about geopolitics, power and conflict, technological development, and climate change. In the face of such complexity and competing potential uses, one view is that in recent years **lack of clarity about the purpose and objectives** of different approaches to space has hindered the creation of effective governance frameworks.

One potential source of evidence for reasoning about previously ungoverned spaces, and about access to major commons, would be to draw on **historical analogies**. For example, the signatories to the [Antarctic Treaty](#) (1959) committed to leaving Antarctica as a pristine environment for scientific exploration, but this may change as the cost of access lowers. Other potential analogies are the evolution of the laws of the sea and access to the deep oceans, the evolution of governance with respect to cyberspace, and even land-based exploration such as the colonisation of the USA, including the West Coast Gold Rush. Space poses a risk of unregulated and potentially confrontational conflict, where analogies can be made with WWI and its causes involving competition over possessions and colonial expansion. To what extent can historical evidence from the management of these events, and learning about their social and economic consequences, inform space decision making.

2.3 Anticipating technologies and their uptake

Many of the policy questions require the best available evidence on current and potential future technologies and on the likely nature and scale of their uses over time. It is notoriously difficult to anticipate the business models of the future. As the future uses of space are likely, at least in economic terms, to benefit the sectors which depend on them, rather than creating net value on their own terms, such deliberation rapidly becomes particularly difficult to quantify.

For example, satellite-based communications and earth observation capabilities have been transformative and underpin commercial activity and public services (such as those relating to weather and climate) that are essential to society. However, much

space exploration is not currently economically justified or justifiable, and judgments about how much to invest depend on other objectives such as research, defence, or long term national positioning.

3. What stories are most influential to key existing and emergent collective identities in the relevant fields?

Sections 1 and 2 describe a very wide range of sectors, and therefore of particularly relevant collective identities. It would be helpful to public reasoning to learn in more detail about the characteristics of reasonably well defined groups such as particular national military players, influential business people and researchers, and the communities closely associated with the evolution and implementation of global and multinational space law and policy. For example, there may be different narratives and narrative networks associated with the military in different nations and groupings. The entrepreneurs of Surrey Satellites will almost certainly have different collective identities to those expressed in Silicon Valley. Across the public sector, regulators (such as Ofcom) may have different narratives from space agencies (such as the ESA), which may themselves have regulatory functions.

Starting from the narratives rather than the apparent collective identities, it might amongst many others - be helpful to explore narratives around the future of the UN, about the meaning of Mars, about environmental sustainability in Earth orbit, about colonisation and exploitation, about potential future governance, business and social models dependent on future uses of and in space, or about any of the subjects listed in the earlier sections.

Space is an area of public reasoning that takes place against a longstanding tradition of widespread forms of popular fiction, popular non-fictional interest in stories about major new developments from Moon landings to rocket launches, and continued amateur participation in some forms of astronomical observation and/or speculation. Evidence might be usefully gathered about such the nature and influence - changing perhaps over time - of such stories, including science fictional speculations' influence on individual entrepreneurs, on technological development, and on informing public (mis)perception of space (e.g. by making it seem easier to escape Earth's atmosphere than it actually is).

Appendix 1

The Royal Society are currently running a 'Perspective on Space' that will look at the current and future applications of science and technology in the context of space, humanity's role in it, and possible implications on society. The future time frame is longer than FUS: the 'Perspective' is looking ahead to 2075, to outline plausible future scenarios based on current trends in space science and technology. It will explore the

impact these developments could have on society and what governance systems could be put in place today to prepare for future scenarios.

FUS complements the larger Royal Society exercise, by gathering in particular narrative evidence (from the Humanities and Social Sciences) to inform debate and decision making, and by focusing on policy concerns within the more immediate next ten years. It starts from these immediate policy issues, rather than from longer-term anticipations of the development of the science and technology. Nevertheless, the Royal Society has identified the following areas of focus for their working groups which might usefully provide further context to FUS:

1. Space Robotics

- Exploring different facilities in space and their uses.
- Robotic built infrastructure for scientific observations and experiments.
- Encouraging international collaboration on grand projects.

2. Astrobiology, Synthetic Biology, and the Discovery of Life

- Philosophical and policy considerations around the discovery of life.
- What implications would the discovery of life have on the field of biology?
- Will further regulations around interacting with bodies known to have lifeforms be needed?

3. Space Medicine and Human Life in Space

- How could we keep people healthy in space; and how to ensure space medicine research improves life on Earth?
- How could we cater for a larger and more diverse group of people going into space?
- Mechanisms to improve international astronaut medical data sharing to advance the field.

4. Long-term Science Goals and Challenges

- Whilst space scientific goals up to 2050 are already laid out by major space agencies (ESA, NASA), what scientific missions could be on the horizon for 2075?
- With upcoming Moon missions this decade, what scientific missions could be done from the Moon, e.g., largescale telescopes built in lunar craters?
- What big scientific questions can we try to answer by developing new technologies?

5. Commercial Space and Enabling Technologies

- How to manage and increasingly commercialised sector with a growing number of private actors.
- How to ensure growing commercial activity and investment in space benefits humanity.
- Exploring the impact of taking traditionally terrestrial industries off-planet.
- What technologies and infrastructure are necessary to enable broader space activities? • How might these developments be enabled?
- What policy and innovation environment could develop these technologies?

6. Space Exploration and Utilisation – Policy and Legal

- This subgroup will primarily focus on contributing their expertise and perspective on the legal aspect of areas highlighted by other subgroups.
- The subgroup will take ownership of the topic of lunar governance.

Appendix 2

The policy concerns report is based on a meeting with the project steering group, whose members have backgrounds in space policy, qualitative evidence and academic space research. The meeting addressed the three key questions outlined above, and was held online on 2nd February 2023. The details of participants are as follows:

Name: Prof. Duncan Bell

Roles held: Professor of Political Thought and International Relations at the University of Cambridge; British Academy Fellow

Name: Dr. Claire Craig

Roles held: Provost of The Queen's College, University of Oxford; former Director of the UK Government Office for Science; co-author of *Storylistening*

Name: Prof. Sarah Dillon.

Roles held: Professor of Literature and the Public Humanities, University of Cambridge; co-author of *Storylistening*

Name: Prof. Sa'id Mosteshar

Roles held: Director of the London Institute of Space Policy and Law

Name: Dr. Alex Tasker

Roles held: Lecturer in Human Ecology, UCL; ESRC Policy Fellow in International Relations and National Security

Name: Dr. Graham Turnock

Roles held: Special Advisor at the European Space Agency; former Chief Executive of the UK Space Agency

Name: Dr. Tom Wells

Roles held: Deputy Director at the Government Office for Science

6. Synthesis Paper Executive Summaries

Participants are invited to read the executive summaries of the seven synthesis papers we commissioned from academics with narrative expertise. The full papers are circulated separately (Appendix 3). The purpose of these papers is to synthesise the most cutting-edge research in the author's academic field in order to generate evidence in ways that could in turn, and when set alongside scientific and technical evidence, inform decision-making by space policy practitioners. Synthesis authors were provided with the summary of key space policy concerns (Section 5).

We asked synthesis authors to draw together research and evidence from the relevant discipline, attending to the cognitive value that can be derived from consideration of the functioning of relevant stories. Authors were invited to think specifically about the four cognitive and collective functions of stories outlined in *Storylistening*. These four functions are: offering multiple points of view and new **framings**; providing insights into **collective identities**; functioning as narrative **models** that enable surrogative reasoning about the target system; and informing **anticipations** of the future.

Authors:

- [Dr. Elena Cirkovic](#), Senior Researcher, Max Planck Institute for Procedural Law, Luxembourg/University of Helsinki/Massachusetts Institute for Technology Media Lab.
- [Dr. David \(Jeeva\) Jeevendrampillai](#), Anthropologist of Outer Space and Director of the Centre for Outer Space Studies, University College London
- [Dr. Chris Pak](#), Lecturer in English Literature, Swansea University
- [Prof. Juan Francisco Salazar](#), Professor of Communications, Media and Environment, Western Sydney University
- [Fred Scharmen](#), Associate Professor, Morgan State University
- [Dr. Elizabeth Stanway](#), Reader in Astronomy and Astrophysics, Centre for Exoplanets and Habitability, Department of Physics, University of Warwick
- [Dr. Natalie Trevino](#), Postdoc at the Space Ethics Group, The Open University

1. Defining sustainability in the international law of outer space: plural actors and new narratives

Dr. Elena Cirkovic (Law)

The advancement of space technologies and applications has significantly contributed to environmental monitoring, resource management, weather forecasting, climate modelling, satellite navigation, communications, and early warning systems for disaster mitigation. At the same time, there are increasing concerns over environmental protection and sustainable use of the outer space environment.

Sustainability in outer space generally refers to the principles, practices, and policies aimed at ensuring the responsible and long-term use of space resources, while minimizing negative impacts on the space environment and preserving the ability of future generations to benefit from space activities. However, there is no precise definition, principle, or rule of space sustainability in the current international legal regime in general, and the outer space regime, in particular. While the majority of space activities are still driven by governments with private industries acting as contractors for public programmes and relying greatly on public funding, there is also a growing investment by private actors in the sector and the emergence of a more business-oriented leadership. In this context, sustainability efforts in outer space are beginning to rely on sustainability value in the private sector. The private commercial sector has linked "sustainability" with the capacity for ongoing use, exploration, and exploitation of space resources. The principle of Corporate Social Responsibility (CSR) implies that public and private socio-technical systems can be managed and improved to make way for economic growth, which would recognise and incorporate ongoing environmental feedback, and aim for more sustainable approaches.

This synthesis paper will provide a non-exhaustive map of the interdisciplinary and diverse narratives surrounding the concepts of "sustainability", "corporate social sustainability", and sustainable value creation in public and private sectors. Mapping different definitions of sustainability and how they might apply to the outer space sector is one of the tools for policy and legal decision-making enabling the identification of sustainability objectives at state, regional, transnational, and international levels. In addition, orbital and planetary sustainability, and the corresponding evolution of domestic, international, and regional regulatory instruments, are taking place in conjunction with the sustainability of the Earth System, where the term "Earth system" refers to Earth's interacting physical, chemical, and biological processes.

The starting point is the international outer space law and its mechanisms, including primarily the existing norms emanating from the United Nations Office for Outer Space Affairs (UNOOSA) and the United Nations Committee on the Peaceful Uses of Outer Space (UN COPUOS). UNOOSA is the U.N. Secretariat office that promotes and facilitates peaceful international cooperation in outer space. UN COPUOS is a UN

committee whose main task is to review and foster international cooperation in the peaceful uses of outer space, as well as to consider legal issues arising from the exploration of outer space. The paper considers the evolution of sustainability, first in the outer space sector, and second in the international legal regime, more broadly. Lastly, it situates the role of private corporations and Sustainability Values and CSR in outer space and the Earth System. An example of such an initiative, the Space Sustainability Rating (SSR), seeks to foster voluntary action by satellite operators to reduce the risk of space debris, on-orbit collisions, and unsustainable space operations.

2. Narratives of community, participation and belonging in Space Science

Dr. Jeeva Jeevendrampillai (Anthropology)

This report highlights the narratives around the idea of public participation in space science. As a new commercial space age expands towards a trillion-dollar industry by 2030 and space is seen as a resource to be used for 'all humanity' then, as Alan Marshall notes "it is appropriate to inquire about the real and potential participatory mechanisms whereby the global public could be involved in such a grand project." (2023:61).

The report outlines the ways in which space activity has permeated a popular imagination. It outlines the impact of such things as the visual culture that emanated from the Apollo era. The famous images of the Earth as a 'blue marble' (1972) and the Earth rising above the surface of the Moon (1968) are, according to historian Robert Poole, the most circulate images in the history of humanity. Described by environment photographer Galen Rowell as "the most influential environmental photograph(s) ever taken" they have had a profound impact on the way many people situate themselves in relation to others, the planet, and the future, in particular with a regard to human activity in outer space. In an age marked by increasing ecological concern for the planet, high speed communications and heightened cultural exchange then such images and the role of human activity in space takes on a renewed importance as the planetary, as an orientation point for identity, comes into the foreground. This report outlines this key narrative drive to situate the role of the UK and its space activities within a wider popular imagination.

The report outlines that, despite its large and significant contributions to space science the UK's reputation within the public imaginary is marked by (predominantly political) failures such as the bureaucratic wranglings the Galileo satellite project or lack of funding for Virgin Orbit after its launch failure. Whilst the UK has a relatively good spread of education and outreach programs about space there are few ways for citizens to meaningfully engage in the future policy direction of the UK government regarding outer space activity. Citizen engagement has been a key policy of the UK

government for the last twenty years culminating in the localism act of 2011. This policy drive has placed an emphasis on participation at the community level. It has placed emphasis on community involvement in things like urban planning and local government. This policy focus has not been matched by meaningful engagement of citizens in policy of large infrastructure investment at national or international level. Given the role of outer space in the popular imagination, its significance as a marker of identity and a personal, national, and planetary level the report argues that new and innovative models of participation and policy consultation should be considered.

Existing models for participation in space science focus on social media campaigns, education and outreach for existing science projects and education centres. Whilst significant this model largely creates engagement with a space science project that are already happening. As such participation at the level of policy formation, science itself and assessment and appraisal are lacking. The exception may be participation. Citizen science projects, hackathons and open innovation challenges have allowed greater public participation in space science. However, critics have argued that such participation is only a level of involvement with science agendas that are already set out.

The report concludes with a case study of a group of space enthusiasts who have taken it upon themselves to create a 'citizen authored blueprint'. Here the group employ a model like those found in peoples parliament and radical democracy movements. Namely this is consensus-based knowledge building. From this a series of reports are being made that aim to influence public opinion and policy makers. This methodology shows not only a way forward but the appetite for it. The groups innovation and use of free web-based tools such as google drive and discord show that such citizen engagement is possible. What remains to be seen is if this should remain at the level of self-motivated groups or brought into structured policy initiatives.

3. An 'Issue of Sound Policy': Science Fiction as Evidence to Inform Terraforming Policy

Dr. Chris Pak (Literature)

Science fiction (sf) can be understood as an archive of scenarios that model approaches to terraforming, which can be used to think through key issues in policy and governance. Following Clifford Geertz's (1973) distinction between 'modelling of' and 'modelling for,' this chapter reads sf as constructing models *of* phenomena that enable the generation of further knowledge about pre-existing realities that may be poorly understood or about ones that are yet-to-exist. Assembling works of sf that construct models of terraforming, this chapter provides insights into the implications of transforming other planets for communities on Earth and beyond. Key themes that emerge from the literature include the construction of new collective identities rooted

in the work of terraforming and inhabiting other planets, the complexities involved in developing appropriate modes of deliberation and the repercussions of failing to do so, the tensions attending interplanetary relations and the conflicts and opportunities afforded by the establishment of independence for interplanetary colonies, the role of private actors in developing commercial interests on other planets and the possibilities and threats for the economic and cultural growth or decline of colonies.

In the first section, “Modelling Terraforming and Deliberation in Kim Stanley Robinson’s Mars Trilogy,” Kim Stanley Robinson’s landmark *Mars* trilogy (comprising *Red Mars*, 1996c; *Green Mars*, 1996b; and *Blue Mars*, 1996a; along with the companion collection of short stories *The Martians*, 2000) is analysed to establish how sf stories of terraforming construct scenarios for reflection on the social, political, material and scientific dimensions of adapting other planets. The *Mars* trilogy demonstrates the dialogues about identity and governance that sf across the twentieth and twenty-first centuries engage and is used to open up key issues relevant for policy. The fragmentation of collective identities and the development of appropriate modes of representation is a key theme developed across the trilogy. The potential for the emergence of conflict as a response to the narrowing of the value of Mars as a site solely for the extraction of resources highlights differences in how other planets are valued by actors on Earth in contrast to those on Mars. Such conflict is balanced by the opportunities Mars affords to Earth for thinking through and testing solutions to issues related to the effects of climate change for communities on Earth.

The following section, entitled “Interplanetary Relations and Independence,” excavates short stories and novels to explore further the interplanetary dynamics that are imagined as emerging between Earth and its colonies. It explores issues related to the persistence of identities imported to interplanetary colonies from Earth and the emergence of new collective identities that depart from those on Earth. These new identities are imagined as essential for the coherence and persistence of interplanetary colonies. Stories addressed in this section include Jack Williamson’s (2004) ‘Collision Orbit,’ Isaac Asimov’s (1974) ‘The Martian Way,’ Arthur C. Clarke’s (1976) *The Sands of Mars*, Poul Anderson’s (1964) ‘To Build a World,’ Robert A. Heinlein’s (2001) *The Moon is a Harsh Mistress*, Michael Allaby and James Lovelock’s (1984) *The Greening of Mars*, S.C. Sykes’ (1991) *Red Genesis*, Mary Robinette Kowal’s Lady Astronaut sequence, comprising the novella *The Lady Astronaut of Mars* (2013) and *The Calculating Stars* (2019a), *The Fated Sky* (2019b) and *The Relentless Moon* (2020), and Robinson’s (2018) *Red Moon*.

The final section, “The Closure of the Colony,” considers the obverse of the growth of interplanetary colonies. These works identify the failure to develop unique and coherent modes of collective identity as critical to the failure of interplanetary colonies. Geopolitical, economic, social and cultural tensions on Earth constrain the development and growth of interplanetary colonies and undermine attempts to establish resilient communities on other planets. The short stories and novels

considered in this section include Ray Bradbury's (1958) *The Martian Chronicles*, Frederik Pohl and C.M. Kornbluth's (1974) *The Space Merchants*, Walter M. Miller's (1973) 'Crucifixus Etiam,' Luiza Sauma's (2019) *Everything You Ever Wanted*, Ian McDonald's *Luna* sequence, comprising *Luna: New Moon* (2015), *Luna: Wolf Moon* (2017) and *Luna: Moon Rising* (2019), and Jane Killick's (2021) *In the Shadow of Deimos*.

This chapter concludes by acknowledging how the speculative nature of terraforming and its long timescale can function as an alibi for avoiding the establishment of modes of deliberation that would appropriately acknowledge the interests of all those involved in such a project. Furthermore, the legacy of the unevenness of social structures and the historical and unresolved differences between groups provide a possible foundation for the emergence of conflict on other planets should those differences remain unacknowledged and unresolved. Collective identity is a key theme that will have repercussions for how governance on other planets is conducted. Ultimately, sf imagines terraforming as an expression of collective identities and the values that inhere within a community.

4. Regarding Citizenship and Affordances, on Earth and in Space: Listening to some Stories about Idealism, Identity, and Interoperability in Built Environments Everywhere

Fred Scharmen (Architecture)

This article synthesizes three primary threads: 1) some stories from American history, 2) a broad look at policies regarding the legal regulation of the built environment, and 3) a set of interpretations of the Outer Space Treaty. The 2013 film *Gravity* is used as an example to illustrate certain implications of future policy regarding the legal status of astronauts and the built environment in outer space.

In legal documents, these stories show how three figural categories are created and used: "man," "architect," and "astronaut." In the first case, the question of the rhetorical intentions of the use of "man," "men," and "mankind" is instructive to trace. Whether or not the original meaning was meant to be narrow or abstract, advocates for disenfranchised have successfully used this rhetorical construction to hold power to account and effectively create the broadest possible expansion of the category. Today, while this language is deprecated in institutions and politics as being unnecessarily gendered, it is still broadly understood to be inclusive of all of humanity, and by extension certain rights are guaranteed to all of us in this category. The term "architect" has a specific legal definition in most jurisdictions. The professional role comes with certain rights and responsibilities, most notably to the public health, safety, and welfare. These obligations are recognized as being in potential conflict with a client's private interests, but the professional regulations say that the public good should take

precedence. In the case of “astronaut,” the Outer Space Treaty, a foundational document for law in outer space, has certain things to say about the rights and responsibilities that come along with this category and designation. Interpretations vary about who can claim that role and title. When placed alongside stories about the other two roles and terms here, certain implications about future scenarios regarding interpretation of “astronaut” narrowly or broadly come to light.

The roles of these three figures - man, architect, astronaut – resonate with one another. These abstractions all come together and intersect at the material level. The design and construction of the built environment fill out these stories with concrete reality. The built environment, on or off of Earth, supports the rights and responsibilities of those who use it safely. The obligation to the health, safety, and welfare of those users starts with the designers of the built environment, but it extends into basic standards of care and requirements for mutual aid that ultimately define the daily life of that public itself. The tendency for these roles to collapse into one another is implied in both the foundations of space law, and in the existence and utility of regulations and standards for the production of space in space, where, after all, the hostility and dangers of the environment outside put all the more onus on the architecture itself.

This paper will specifically answer the prompt's call for work on questions of access, ownership, rights and responsibilities in space, and especially the need for “future design of effective negotiation and governance structures.”

5. Storymaking Outer Space Otherwise¹

Prof. Juan Francisco Salazar (Media and Communications)

The value of the space sector relies on collective processes of co-creation that emerge from open forms of discussion, debate and which may inform public reasoning. For these debates to happen it is necessary to widen our repertoire for storymaking and for storylistening otherwise. This synthesis document provides an outline of “other”, non-mainstream and counter-narratives of outer space. This is critical for opening up public reasoning at a time when humans reach for the stars with a series of very concrete plans for the next twenty years, when storylistening becomes crucial to resist and rethink normalised narratives of the inevitability of humans becoming a multiplanetary species, as a global corporate manifest destiny takes hold. It is of utmost importance to expand our understanding of what other stories, how storymaking otherwise, constitute forms of “evidence”, how they could inform policymaking beyond scientific facts and models, enable novel conversations about the public value of outer space, and spark a deeper dialogue about more diverse future uses of space. The synthesis paper is divided into four short sections or vignettes. The

¹ This synthesis paper reworks previously published work. See Salazar 2017; Salazar and Castaño 2022; Salazar 2023; and Salazar and Gorman 2023.

first one starts reference to processes of storymaking and how these relate to theories of storylistening. The next section provides a short critical engagement with what might be called NewSpace narratives and socio-technical imaginaries. The third section moves onto space environmentalism and the critique of the enclosure of outer space futures; and the fourth section delves into Black and Indigenous futurisms and narratives of outer space.

6. Exploring Space Science Community Engagement with Storylistening Principles

Dr. Elizabeth Stanway (Astrophysics)

The Dillon & Craig (2022) storylistening concept has been developed with a focus on proving a robust framework for interpretation of narrative evidence from the humanities and related disciplines. However, while scientists often prefer to frame discussion amongst themselves in quantitative and technical terms, the space science community must also engage with narrative construction and analysis when communicating to a non-specialist audience, including policy makers and the general public. This is particularly true in the related areas of space domain awareness (i.e. the generation and tracking of space debris) and dark sky protection (specifically the impact of satellite mega-constellations), both of which pose questions of sovereignty, defence, governance and technological anticipation. In each case, narratives must balance the benefits of space utilisation with their potential negative impacts, particularly on the space science community, and clearly communicate these with potential stakeholders.

In this synthesis paper, I consider the ways in which the science community has engaged with this narrative construction, and the public response to that engagement, in the context of the storylistening framework. Having first summarised the topics under consideration, I consider formative readings of narrative-representations of space debris and dark skies issues.

The first case study considers fictionalised representation of these issues in the form of science fiction narratives and the dialogue formed by the public response of science communicators to these narratives. Having briefly discussed James White's short story *Deadly Litter* (1964) and Yukimura's manga *Planetes* (1999), I focus on the space debris narrative in Alfonso Cuarón's *Gravity* (2013), exploring how its framing and narrative modelling have been critiqued by space scientists in the public domain. Finally I consider the use of Isaac Asimov's short story *Nightfall* (1941) as an inverted model for stories of dark sky protection.

Moving from fiction to more conventional science communication, the second case study focuses on public-facing journal articles by scientists regarding their concerns over light pollution and the proliferation of satellite megaconstellations, identifying the

narrative elements employed through a storylistening analysis of a Nature Astronomy Focus issue on Dark Skies (2023). I show that even within a single collection of evidence, the framings, identities and models used by science narrators can vary significantly. As in the first study, I consider reactions to the publication, this time from media and non-specialist audiences.

Finally, the third case study discusses *Our Fragile Space* (Alexander, 2023), an artistic narrative designed as science communication co-creation between the artist and expert space scientists. A storylistening analysis is used to demonstrate an expert reading of the narrative and its intent, demonstrating how such installations can be used to generate narrative evidence. In particular, the framing of space debris as a problem for all imbibers is effectively invoked by choice and positioning of pictures, while the setting of the installation provides additional framings which will influence the perception of the art.

In each case, by examination of the case studies and their siting within a wider field of similar communications, I evaluate to what extent the key principles of collective identities, new framings, narrative models and anticipations are represented in the dialogue as presented by the space science communities and interpreted by the media and public. I identify how representations of the same topic can vary in their framing, and the strengths and limitations of narrative models in this field. I determine that of the four key pillars of the storylistening framework, science communication engages least with anticipatory modelling, preferring to offer alternatives rather than resolve narratives with a firm conclusion. Despite this, the synthesis of evidence from the different forms of science narratives considered here demonstrates that expert storylistening can provide a valuable framework for analysis of scientific and science-adjacent narratives.

7. Classic and Contemporary Narratives of Space Exploration

Dr Natalie Trevino (Space Ethics)

From Ancient Greece to the Age of Discovery, outer space has been a source of inspiration, knowledge, and myths. Astrology and astronomy were fundamental to early civilizations. Over the last 65 years, the exploration of space has been a major aspect of the political and societal lives of those in the United States, the USSR (then Russia), Europe, the United Kingdom and much of Africa, Asia, and the Latin America. The justifications for space exploration are often linked to historical conditions-such as the case of the US-space as the new frontier speaks to American sensibilities and manifest destiny, while other historical analogies and narratives, like those of the United Kingdom, focus more on exploration as rationality and routine, mirroring the exploration of the seas and the Arctic. Other narratives of space focus less on justifying the why and focus more of that possibilities of what space exploration could mean: we

find these narratives in the countless works of Afro-futurism, Indigenous Futurism and works of fiction that inspire marginalized peoples and give hope for a better, brighter future.

The narratives of space exploration, both political justifications and possibilities, come from history, experience and often, science fiction. Science fiction cannot be ignored when it comes to a feedback loop of inspiration from and for space exploration. From US President Ronald Reagan's use of Star Wars as a narrative to justify Cold War space technology research to Star Trek fans campaigning for the first Space Shuttle to be named Enterprise, science fiction and science fact often have just as much power and influence. Many classic space narratives often use historical myths to create meaning on a national level, the US with its frontier metaphor is not just popular, it is almost the dominate construction of space with both the UK and the Europe Space Agency using the language even while neither have Frontier history. The United Kingdom's use of Maritime narratives connects its own history as a strong Seafaring society to the exploration of space. Classic space narratives often tie exploration to the nation because during the Space Age space exploration was a national project, while now in the Newspace Age private companies have been major players. There has been an increase in speculative futurisms focused on Afro-centric and Indigenous futures. These contemporary narratives are beginning to have an impact on the way in which space discourse focuses on the who and why of space exploration. Rather than focusing on the nation, ethno-futurisms are focusing on the cultural, artistic, and technological possibilities of space.