Solar radiation modification: a public dialogue

Public views on SRM research & potential deployment

Hopkins Van Mil

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Natural Environment Research Council

sciencewise

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Foreword

Our climate is changing. This has galvanised action across the globe, with national commitments to reach net zero, and those countries (including the UK) which bet early on low-carbon solutions beginning to realise the economic opportunity of green technologies alongside the environmental benefits they provide. However, there is more to do if we are to fully transition to a low carbon economy, deliver energy security and protect citizens from the impacts of a changed climate. Moreover, the impacts of climate change lag behind its causes, increases in temperature are already locked in, regardless of our work to mitigate the changes and we will need to adapt to a changed climate in the coming decades.

This reality requires us to explore and understand potential interventions that could complement mitigation efforts, recognising the UK may not develop or lead these activities but would nevertheless be affected by them. Solar radiation modification (SRM) is one such intervention: a set of approaches that aims to cool the Earth by reflecting sunlight away. UK Research & Innovation - Natural Environment Research Council (UKRI-NERC) does not regard SRM as a substitute for reducing carbon emissions, and the UK Government has no plans to deploy these approaches. However, research is essential to understand whether SRM could ever be feasible, safe, and governable, and to ensure that decisions about its role are informed by robust evidence and societal values.

That is why UKRI-NERC has invested £10.5 million in four projects to model how Earth systems might respond to SRM. These projects will not conduct real-world experiments; they will use computer modelling and historical data to examine potential impacts and risks. This investment complements the work of the UK's Advanced Research and Invention Agency (ARIA) which has developed a £56.8m "Exploring Climate Cooling" programme that aims to build a robust evidence base to explore climate cooling approaches. ARIA is funding transparent, public-good research, from ethics to real-world experiments, so the UK and other global actors can make better-informed decisions about this field. Taken together, these investments will build on previous UK funded research in this space adding to the available body of SRM understanding.

Alongside the UKRI-NERC research programme, we commissioned this public dialogue, in partnership with the Sciencewise programme, to bring public voices into the conversation at an early stage. As interest in SRM increases, discussions about governance and ethics are gaining momentum, as such, it is vital that public perspectives help shape research priorities and principles from the outset.

Through this dialogue, participants engaged deeply with the science, ethics, and geopolitics of SRM. Their insights highlight the importance of transparency, global collaboration, and public engagement throughout the research process. They call for SRM research to proceed only within a framework that prioritises the public good, safeguards future generations, and does not distract from the urgent task of reducing emissions. These principles will inform how UKRI approaches SRM research, how

we communicate its purpose and progress, and how we ensure our insights inform UK policy and international frameworks.

Commissioning this dialogue reflects our commitment to responsible research and innovation. We are grateful to the participants who gave their time and energy to this process, and to Hopkins Van Mil for their expert delivery and facilitation.

Looking ahead, we intend that combining world-class research with conversations such as this dialogue will strengthen public understanding, inform policy, and ensure that decisions about SRM are grounded in evidence without advocacy. This includes:

- working with the awardees, Government and ARIA to develop a framework for SRM research
- ensuring UK research feeds into global initiatives to understand SRM, such as GeoMIP, and engagement with multi-regional initiatives on research governance (e.g. the Solar Geoengineering Research Governance platform)
- funding research which meets the concerns of the participants, including understanding the impacts and implications of potential deployment and any unintended consequences

Above all, this work demonstrates that environmental research and innovation is most powerful when it is open, inclusive, and forward-looking. This dialogue marks the beginning of a conversation which will continue to evolve alongside the science.

Kate Hamer
Director, Strategy and Performance
Natural Environment Research Council (NERC)

Executive Summary

Context and purpose

Solar radiation modification (SRM) refers to a range of ideas that propose to cool the planet largely by reflecting sunlight away from the Earth. As current climate mitigation efforts have not kept global temperatures below critical thresholds, SRM has emerged as a potential intervention, though it remains highly contentious with significant scientific uncertainty.

The Natural Environment Research Council (NERC) has invested £10.5m to fund four projects (2025-2030) exclusively using computer modelling research to understand how Earth systems would respond to SRM. This public dialogue was commissioned in April 2025. At the same time the Advanced Research + Invention Agency (ARIA) announced a £56.8m programme to build a robust evidence base to explore if climate cooling approaches could ever be feasible, scalable, safe, and governable. This programme is funding 22 research teams who will use a range of methodologies, including modelling, observations and monitoring, indoor testing and, in line with strict principles and in a limited way, small-scale, controlled outdoor experiments.

While the NERC funded research projects were the main examples drawn on in this public dialogue, participants also received information on ARIA and its aims during the course of their deliberations.

Method

In the autumn of 2025, 52 participants, broadly reflective of the UK population, engaged in 17+ hours of deliberation across four workshops and in an online space. Participants were recruited from five geographic areas across the UK (Appendix C). They heard from 19 specialist presenters representing diverse perspectives on climate science, ethics, geopolitics, and governance. They spent significant time in facilitated small groups reflecting on SRM research and potential deployment.

Solar radiation modification: a public dialogue – structure and timetable

Most participants had no prior awareness of SRM and initially found the concept surprising, even "science fiction-like". As they progressed through the dialogue, most gradually changed their views, coming to see SRM as serious research with significant implications. Some focused increasingly on risks and governance challenges, while a few retained fixed positions throughout, either supporting or opposing SRM on principle.

Key moments that shifted thinking included: understanding the severity of the climate crisis, hearing from scientists conducting SRM research, and grappling with the geopolitical and ethical dimensions of global decision-making.

Key dialogue findings

The findings from this public dialogue are grouped into where there is support for SRM conditional on good governance; followed by headline summaries of the principles participants developed for SRM research and, to some extent any future SRM deployment. The findings end with broader key themes that emerge from discussing SRM research and principles that should guide it and any future deployment.

Support for SRM Research when conducted within principles

Many participants strongly support SRM research (particularly research using computer modelling) conditional upon it being conducted within an ethical principles framework.

Participants see research as essential for:

- Understanding potential impacts before any deployment decisions;
- Reducing unknowns and unintended consequences;
- Preparing society should urgent climate intervention become necessary;
- Potentially uncovering unexpected solutions to climate change.

Some participants explicitly expressed support for carefully controlled small-scale outdoor experiments.

Caution about large-scale SRM experiments and deployment

While research is welcomed, there is limited support for large-scale outdoor experiments and deployment. Many are wary of it progressing this far and would rather it is never needed. They view SRM as a "last resort" or emergency measure that should only be considered if climate change reaches critical levels. Key concerns include:

- SRM does not address the root causes of climate change;
- Global agreement on deployment seems near to impossible;
- There are too many unknowns and potential unintended consequences;
- There is a risk that SRM could weaken climate mitigation efforts.

Six principles for SRM research and potential deployment

Participants developed six core principles that they believe should guide SRM research, with some also relating to any future SRM deployment. They considered them all to be important, with no one principle standing out as being more important than the others.

- **Do no harm to people or the environment** – Research and any potential deployment must be safe for human and animal life and the environment, both immediately and long-term.
- **Do not distract from reducing GHG emissions** – SRM research and potential deployment must not divert attention or resources away from addressing climate change root causes.
- **Global collaboration, equity, and governance** – Research should be globally coordinated, inclusive of all nations (especially those most vulnerable), and governed by international oversight.
- **Public information and engagement** – The public must be informed, educated, and engaged in SRM research and decision-making.
- **Prioritise the public good and future generations** – Research should focus on global benefit rather than national interests, with particular attention to impacts on young people.
- **Transparency, integrity, and accountability** – Research must be trustworthy, unbiased, and subject to robust governance mechanisms.

Views diverged on the inclusion of a principle that would prevent private, profit driven SRM research. Some participants argued that private companies should barred from engaging in research altogether, while others felt this was an unrealistic principle and instead advocated for robust regulations instead.

These principles developed by participants in this SRM public dialogue complement an existing body of guidance for climate geoengineering developed by specialists, such as the Oxford Principles for geoengineering research (2013)[1], the Tollgate Principles for the governance of geoengineering (2018)[2], and the AGU Ethical Framework Principles for climate intervention research (2024)[3].

Audiences

The principles developed by participants have implications for the research community; government and policy makers; research funders; the public engagement sector and people across society. Participants want people to be more aware of SRM and for these audiences to work together on that. Highlighted in the conclusion of the report is that:

The research community should:

- Adhere to research principles and work across disciplines;
- Seek to co-design research with colleagues around the globe;

[1] Rayner, S., Heyward, C., Kruger, T. *et al.* The Oxford Principles. *Climatic Change* 121, 499–512 (2013)
[2] Gardiner, S. M., & Fragnière, A. (2018). The Tollgate Principles for the Governance of Geoengineering: Moving Beyond the Oxford Principles to an Ethically More Robust Approach. *Ethics, Policy & Environment*, *21*(2), 143–174.
[3] AGU, Ethical Framework Principles for Climate Intervention Research, October 2024

- Understand that their work is only given a mandate when conducted with transparency, integrity and is accountable.

Government and policy makers should:

- Ensure governance measures are in place which prioritise the ethical dimensions of SRM;
- Ensure that the conditions are in place for future-proofed policies;
- Involve people across society, particularly young people, in decision and policy making on this issue;
- Align policies on SRM with the principles devised by public dialogue participants;
- Continue to support ongoing public engagement and awareness on SRM research and any future deployment.

Research funders should:

- Ensure that the conditions are right for global collaborative research with integrity and equity to take place;
- Ensure that the funding of SRM research meets the principles set by participants in this public dialogue;
- Continue to support ongoing public engagement and awareness on SRM research and any future deployment.

Public engagement sector should:

- Work with government and research funders to ensure that societal values shape governance and decision-making through meaningful and ongoing deliberative, participatory and engagement processes.

Further public deliberation

Given the call for further public involvement in this area HVM recommends further deliberative discussions with members of the public as follows:

Foundations for future deliberation

The findings from this public dialogue build on and chime with those of previous deliberations. This should not be the end of the story. For example, the principles developed here could be revisited in future Sciencewise deliberations, to develop understanding of what the principles mean in detail as SRM policies develop.

Outdoor experiments

This public dialogue explored perspectives on SRM across all aspects but did not explore outdoor experiments in depth. We therefore recommend a deliberative process on UK publics' views on different types and scales of outdoor experiment, and what good governance would look like, building on the principles developed by participants in this public dialogue.

Involvement of private companies

Given diverging views on private sector involvement in research, we suggest further deliberation into potential private sector involvement in SRM research, again building on the principles developed as part of this public dialogue.

Global deliberative processes

This deliberative process was conducted with a group broadly reflective of the UK population. Given the global nature of SRM we recommend that a future deliberation is integrated into existing global citizens' involvement mechanisms on climate change, such as the Global Citizens' Assembly[4] or the Global Climate Assembly[5]. This could integrate a standing panel element supported to be kept informed of developments in research, be part of the decision-making process and pay particular attention to the ethical and societal implications of SRM research and any future deployment.

Key Themes

Key themes emerged from deliberations on SRM research and potential deployment over the course of the dialogue.

A desire to tackle climate change

Participants expressed frustration[6] that current efforts to address climate change feel insufficient. They are concerned about what they perceive to be growing climate denial and misinformation. Some see SRM as offering hope by buying time for emissions reduction, while others worry it could become an excuse to delay meaningful climate action.

Global governance and collaboration

Participants strongly believe SRM requires international cooperation and governance. However, they are deeply concerned about the current geopolitical climate and wonder if ongoing conflict in a number of parts of the world will make global cooperation on SRM research and potential deployment even harder. They are concerned about power imbalances between nations, and whether fair global decision-making is achievable. Many called for a global governance infrastructure to be established before field trials or deployment are considered.

Impacts and unintended consequences

An emphasis was placed on the need to understand environmental, health, and economic impacts, and any unintended consequences from SRM. Concerns include effects on ecosystems and biodiversity, potential health risks from reduced sunlight or atmospheric changes, impacts on agriculture and renewable energy, and the risk of SRM being weaponised.

Public trust and engagement are essential

In a context of declining governmental and institutional trust, participants stressed that transparent communication and meaningful public engagement are vital for building support. They fear that without public awareness and involvement, misinformation will fill the void, leading to growing resistance to SRM and potentially other climate research.

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[4] https://globalassembly.org
[5] https://www.aceobservatory.org/peoplesclimate

[6] This is in line with views expressed by the UK Climate Assembly which broadly supported climate action, with strong leadership from government, and ensuring such action is fair to people across society. It is also consistent with polling on climate action which urge tougher action.

Conclusions

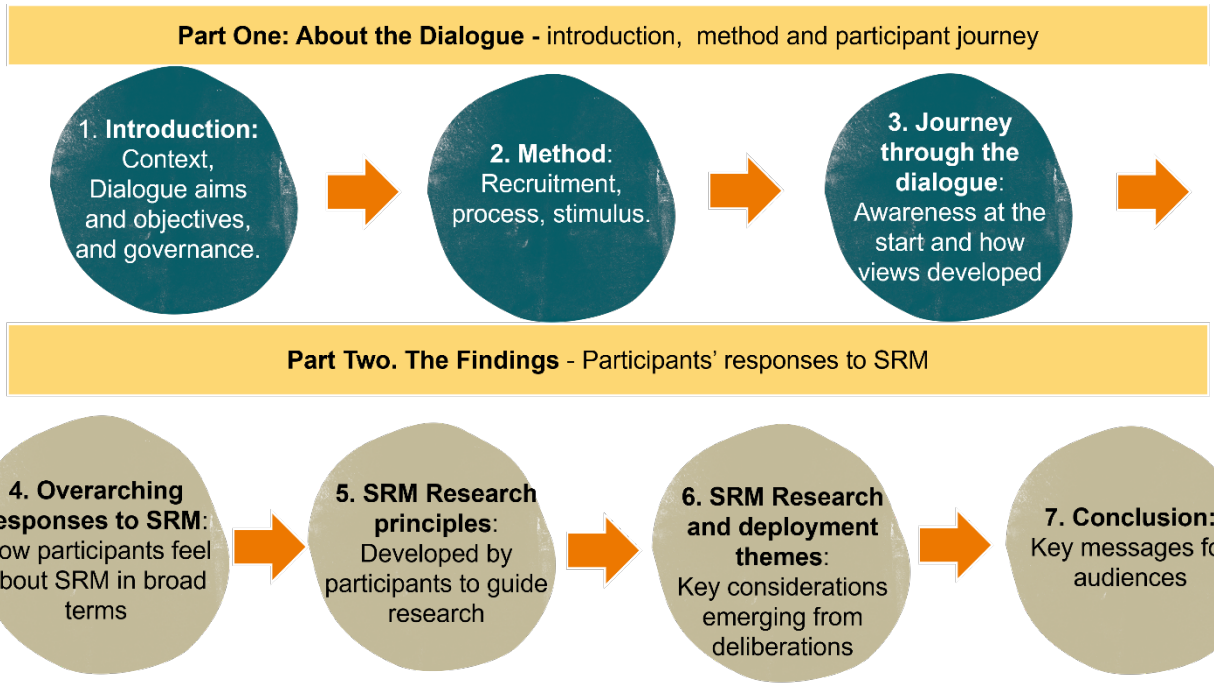
Participants demonstrated thoughtful, informed deliberation on this complex topic. While participants give conditional support to research, conducted within robust ethical frameworks, they highlight some SRM considerations which emerge from consideration of the principles. These include that SRM:

- May have the potential to uncover new solutions and unexpected outcomes in society's desire to tackle climate change;
- Given its innovative nature, could attract the next generation of researchers into environmental science;
- Should use computer modelling more broadly to examine the effects on nature, biodiversity and ecosystems, and people – looking beyond a theoretical of technology-centric understanding, weighing up all possible scenarios to inform decision making;
- Should model realistic scenarios of existing global power imbalances as they are now, to see what implications any potential SRM deployment has for countries with less global power and influence;
- Embeds regular assessment/ review of the research;
- Values interdisciplinary research which examines the efficacy of the science in the context of the ethical/ geopolitical context.

Participants left the dialogue wanting others across the UK and globally to benefit from similar informed deliberation. Their call is clear: if SRM research is to continue, it must be conducted transparently, governed globally and equitably, and never used as a substitute for the urgent work of reducing greenhouse gas emissions.

Reading this report

This report is divided into two parts. Readers of this report who are interested in the dialogue process and method should begin with Part one. Those who want a clear



understanding of participants' responses to SRM should focus on Part two as set out in the diagram below.

To focus the report on the findings we share the details of the method, recruitment strategy and our stimulus materials in the appendices.

Part one: about the dialogue

Image: Participants at the SRM public dialogue workshop 3, Exeter

1. Introduction

1.1 Background and context

Current climate mitigation efforts are widely acknowledged to fall short of agreed targets[7]. Keeping warming below 1.5°C would help avoid the worst impacts of climate change. Every avoided fraction of a degree of warming makes a substantive difference to the severity of climate impacts and reduces the risk of drastic, large-scale, and irreversible changes. Without rapid, substantial emissions cuts, global warming of 1.5°C is likely to be exceeded by the early 2030s[8].

In this context, more extreme intervention ideas have proliferated, including climate intervention or geoengineering. Solar radiation modification (SRM) is one of the many approaches being explored. SRM focuses on methods and approaches which propose to cool the Earth by reflecting away sunlight (solar radiation).

The Natural Environment Research Council (NERC) has provided £10.5m funding to model environmental responses to SRM. From 2025 to 2030 NERC are funding four projects (Appendix A) to model how key aspects of Earth systems (e.g., climate, humans and ecosystems) would respond to SRM approaches to control Earth surface temperature if implemented at scale. The NERC funded projects are being conducted in parallel with the Advanced Research + Invention Agency (ARIA) programme *Exploring Climate Cooling*[9]. This £56.8m programme aims to build a robust evidence base to explore, with independent oversight, if climate cooling approaches could ever be feasible, scalable, safe, and governable

This current public dialogue is part of NERC's SRM programme. It seeks to understand public views on these novel concepts to inform future research funding, research and policy in this area. This dialogue cannot be seen in isolation, and its findings build on the work done through a small but significant body of peer reviewed research. These have accumulated evidence, some using deliberative methods, on public views and perceptions of SRM research and potential deployment. Their findings are broadly in line with this current NERC deliberation. The previous public perceptions programmes include, but are not limited to:

- A deliberative public dialogue on geoengineering, *Experiment Earth?*[10] was commissioned in 2010 with support from Sciencewise. Participants explored nine geoengineering methods, including SRM. SRM was seen to be the least supported method by dialogue participants because of their concern that these approaches do not address the root causes of climate change.
- In 2012 further public dialogue research[11] was commissioned by the Engineering and Physical Sciences Research Council (EPSRC) and NERC as part of the

[7] NERC: Modelling environmental responses to solar radiation management – programme, September 2024
[8] IPCC: 'Summary for Policymakers'. In: Climate Change 2023: Synthesis Report.
[9] ARIA: Exploring climate cooling
[10] Ipsos MORI Experiment Earth? Report on a Public Dialogue on Geoengineering, Sciencewise, NERC, August 2010
[11] Pidgeon, N., Parkhill, K., Corner, A. *et al.* Deliberating stratospheric aerosols for climate geoengineering and the SPICE project. *Nature Climate Change* **3**, 451–457 (2013). https://doi.org/10.1038/nclimate1807

evaluation for a proposed field trail (which did not go ahead). The participants in this deliberation echoed findings from *Experiment Earth?,* voicing conditional support for basic research and for the proposed field trial to go ahead, while being unwilling to endorse the idea of SRM deployment without the development of significant and suitable international governance and control.

- An analysis of public discourse on solar radiation management was conducted in 2013[12]. It found that solar radiation management would be publicly acceptable only under very specific, and highly contingent, conditions, providing specific challenges and implications for SRM governance.
- In 2024 a cross-cultural study in 22 countries around the world (covering all inhabited continents, including five countries from the Global South and five 'non-WEIRD' (i.e. not Western, Educated, Industrialised, Rich, and Democratic) countries from the Global North)[13] was conducted by a consortium led by the University of Groningen. It found that participants perceived SRM as only slightly effective in limiting global warming. The data suggested overall a conditional, reluctant acceptance of SRM.

1.2 Why the dialogue was commissioned

The climate crisis is one of the main contexts for this public dialogue, with adaptation being much higher on the agenda based on the 2024 WMO report highlighting that globally we are not on course for the 1.5-2^{0}C targets[14], and the upward trends in global warming. The World Meteorological Organization (WMO) cited 2024 as the warmest year on record and, the Met Office has found 2025 to have been the third warmest year on record[15]. The Environment Agency has warned that significant parts of England are on a drought trajectory for 2026 without significant additional rainfall over the winter of 2025[16].

The climate context is the backdrop for SRM, a contentious topic for a range of reasons. At present there are large uncertainties about the feasibility and potential impacts of SRM methods and approaches which the NERC and ARIA funded projects are helping to address.

The need to explore SRM through research is underlined by recent high-level reports[17,18,19,20,21]. Together these indicate a heightened interest in this research

[12] Macnaghten, P., Szerszynski, B., Living the global social experiment: An analysis of public discourse on solar radiation management and its implications for governance, Global Environmental Change, Elsevier, April 2013
[13] Low, S., Fritz, L., Baum, C.M. *et al.* Public perceptions on solar geoengineering from focus groups in 22 countries. *Commun Earth Environ* **5**, 352 (2024).
[14] WMO, State of the Global Climate, 2024
[15] WMO: 2024 the warmest year on record, January 2025 and 2025 continues series of world's three warmest years, January 2026
[16] Environment Agency: Drought prospects for 2026, Gov.UK, November 2025
[17] UNEP, An Independent Expert Review on Solar Radiation Modification Research and Deployment. February 2023
[18] Group of Chief Scientific Advisors, Scientific Advice Mechanism to the European Commission Solar Radiation Modification: Expert Review Report, December 2024
[19] World Climate Research Programme (WCRP), 2023, Research to Inform Decisions about Climate Intervention (wcrp-climate.org).
[20] Climate Overshoot Commission, Reducing the Risks of Climate Overshoot, September 2023
[21] Royal Society, Solar radiation modification policy briefing, November 2025

area and demonstrate that research-led understanding of SRM is lacking and would be valuable in providing knowledge, capabilities and tools that inform policy and decision-making. The UK Government's position on SRM specifies that it is not deploying these methods and has no plans to do so[22]. However, it is important to note that there is a continuum from modelling research, through lab-based research, to small scale field experiments to deployment using these methods at scale. It is therefore difficult to limit the scope for dialogue discussions solely on research conducted using computer models. Participants explored the full continuum in their deliberations.

There are profoundly mixed views across expert communities as to the potential consequences and effectiveness of SRM methods and approaches. Three open letters[23] have been signed by the research and scientific community, one calling for balancing research and assessment of SRM (142 signatories), another in support of climate intervention research (110 signatories), and a third advocating an international non-use agreement on solar engineering (500 signatories). From the rapid topic review[24] undertaken in preparation for the public dialogue we saw that arguments in policy and scientific spheres against SRM research and potential deployment include:

- Concern that risks are poorly understood;
- SRM may have unjust and unpredictable consequences for societies and individuals as its impacts are not likely to be evenly distributed around the Earth;
- Some populations, especially those in the Global South who are already experiencing the most damaging effects of climate change, may be most impacted by SRM;
- Concern that if SRM deployment suddenly and permanently stopped, global temperatures would rapidly rise;
- Some governments might see its deployment as a reason to back-pedal on international agreements on emission reduction.

Arguments for SRM research and potential deployment include, for example, that:

- Research into technologies such as Stratospheric Aerosol Injection (SAI) and Marine Cloud Brightening (MCB) may be important as a back-up plan if net zero agreements are not delivered to prevent further warming of the planet;
- Tackling climate change will require a multi-faceted approach and SRM could mask inevitable warming for long enough to develop improved mitigation strategies (and commitment to mitigation);
- SRM could reduce global temperatures relatively quickly compared to emissions reduction, offering a potential emergency response to severe climate risks.

This was the complex landscape in which the SRM public dialogue took place, indicating the need for a public dialogue which explored people views and opinions on SRM, as well as the values and principles that informed them. The contextual picture demonstrates that this dialogue is both timely and important in understanding

[22] UK government's view on greenhouse gas removal technologies and solar radiation management - GOV.UK
[23] Open letters on: International non-use agreement on solar engineering, launched January 2022 and in support of research on atmospheric aerosols, signed 27 February 2023, Call for balanced research, 2023
[24] Hopkins Van Mil, Rapid Topic Review Findings, May 2025

public views on this complex topic with significant scientific, geopolitical and ethical dimensions.

1.2 Dialogue aims and objectives

The overall aim of the solar radiation modification (SRM) public dialogue was to engage a diverse group of the UK public to deliberate on SRM to understand public views and considerations on the topic. This included the social, legal, economic and ethical issues bound up with both research and potential deployment of SRM. The dialogue aimed to provide information and evidence on public views which would be relevant to a broad audience including a range of decision makers, researchers and UKRI.

Objectives

Through a process of deliberative public dialogue participants were asked to explore and share their perspectives on SRM. The process sought to:

- Understand opinions on SRM research, what is important for this topic as well as views on how research should be managed;
- Explore public understanding of potential approaches and some of the main impacts of any potential deployment, and the actions and/ or trade-offs needed to be considered or resolved;
- Understand the values and principles that underlie dialogue participants' views;
- To inform a broad audience of the evidence gathered including a range of decision makers, researchers and UKRI.

1.3 Commissioning, delivery and governance

Commissioning

The SRM public dialogue was commissioned by:

The Natural Environment Research Council (NERC) The Natural Environment Research Council (NERC) is the UK's leading public funder of environmental science. It invests £330 million each year in cutting-edge research, postgraduate training and innovation in universities and research centres.

Sciencewise is an internationally recognised public engagement programme which helps to ensure research and policy is informed by the views and aspirations of the public. The programme is led and funded by UK Research and Innovation (UKRI). Sciencewise supports policymakers and research funders to carry out public dialogues on issues with a scientific or technological component. This public dialogue was conducted in line with Sciencewise Guiding Principles[25], including its latest quality framework. The dialogue was supported by a Sciencewise advisor.

[25] https://sciencewise.org.uk/about-sciencewise/our-guiding-principles/

Delivery

This UK-wide public dialogue was designed, delivered and reported on by Hopkins Van Mil (HVM). HVM is a specialist deliberative social research agency which for 20 years has been engaging people across society in deliberative processes on complex, contentious and sensitive societal issues.

HVM worked with Postcode Films who created a film of the public dialogue, illustrating the dialogue process. In the film participants and specialists share their views on the complexity of the SRM landscape. Participants speak about why the dialogue process was valuable in hearing the views of people across society on the issues that matter to them.

As with all Sciencewise projects, an independent evaluation was commissioned at the beginning of the project in this instance from URSUS consulting. The evaluators provided formative evaluation by taking part in each element of the design process, including co-design meetings, Oversight Group meetings, and internal project meetings. The evaluators were also present for all the online workshops, and all but one of the in-person workshops. A full evaluation of this study will be published in mid-2026 to assess the shorter-term impact of the project on research and policy agendas.

Governance

The project team met weekly in the scoping, design and fieldwork phases of the programme. The team comprised the commissioning bodies, the programme evaluators URSUS Consulting with meetings run by HVM. An Oversight Group was established involving multiple stakeholders from academia, NGOs, government and policy bodies.

Those involved in the programme's governance played a significant role in designing the public dialogue, informing, shaping and making decisions on each element.

1.4 About this report

Public dialogue reports are qualitative in nature. As such we do not report on the number of times something was said, but rather the strength of feeling expressed across the methods used. For this project we used grounded theory, which means the HVM analysis team read and re-read the transcripts many times. What was said was collated into key themes and those themes were used to draw out meaning from the discussions. This approach was chosen to ensure the findings are rooted in what participants told us, guided by the dialogue objectives and the research questions, rather than looking for confirmation of preconceived ideas.

The dialogue engaged participants broadly reflective of the UK population in terms of demographic characteristics. They were drawn from five broad geographic areas across the UK (see chapter 2).. Commonalities, patterns and differences were analysed across the complete data set.

In accordance with reporting on qualitative research processes, and in line with Sciencewise reporting on public dialogues, we use the following quantifiers in the report:

- “Participants”, “many” or “most” when it is clear that all or almost all participants shared a similar view.
- “Some” when a reasonable number of participants shared a similar view.
- “A few” when a small number of participants shared a similar view.

Bullet points are used to summarise key points made. These mostly reflect areas of agreement and where points were made by many participants across many groups. Public dialogue participants reflect together on the implications of a topic for society. For this reason, our analysis does not pull out differences in view according to demographics.

Anonymised quotations are used to highlight points made by participants and to underline points made by a range of people. They also highlight points of particular significance to participants. Participants from each location were put together in workshops 1, 2 and 4. In workshop 3, held in person, participants met in specific location groups for their discussions. This is why the location is mentioned for workshop 3 quotations, but not for the other workshops.

Analysis of dialogue findings does not track how participants reacted to specific pieces of evidence, nor when they might have changed their mind on the topic or a specific aspect of it. Given the uncertainty in the evidence, and the range of perspectives presented to them on it, they might have changed their minds a number of times in the course of one workshop, and over the whole project. Significant shifts in attitude are reported on mainly in chapter 3.

The amount of evidence and specialist input that the participants could consider was limited to what was reasonable in the twelve-week dialogue process. Nevertheless over the 17 hours + of deliberative time this was substantial. The list of specialists and the topics covered is listed in Appendix D and the stimulus in Appendix F.

Throughout the process the HVM coding, analysis and writing team maintained a rigorous approach, holding sense-checking sessions as a team to mitigate against researcher bias. The purpose of the analysis is to meet the dialogue aims and objectives, accurately reflecting participants’ views and sharing what they have found to be important.

2. Method

2.1 Who took part in the dialogue?

Dialogue participants were recruited through a stratified, randomised sortition process delivered by the Sortition Foundation. A carefully designed recruitment specification (see Appendix B) was developed to select a cohort of 56 participants broadly reflective of the UK population, without being able to extrapolate the views of all publics across the UK[26]. The size of the cohort is typical for public dialogue methodologies seeking to gain a depth of understanding on the views of diverse publics.

Demographic criteria were developed and agreed by the project team, in consultation with the Oversight Group. These were applied to participant selection to ensure the dialogue included people from diverse backgrounds: age, gender, ethnicity and socio-economic status. Additional criteria ensured diversity beyond standard demographics, including a boosted sample of people with religious faith to support a range of values-based perspectives and a broad spectrum of attitudes towards climate change, ensuring that the dialogue did not exclude minority viewpoints, including two participants who described themselves as climate change sceptics.

Recruitment sought a spread of rural and urban residents in areas that varied across climate risk. Participants attended from the following areas: Scotland and Northern Ireland (in-person workshop in Glasgow); North Wales and North West England (in-person workshop in Chester); Southern England (in-person workshop in Exeter); and North East and Eastern England (in-person workshop in Peterborough).

Exclusion criteria meant that any individuals professionally involved in the SRM field and UKRI employees would not be involved. Recruitment drew on individuals who had expressed interest in earlier Sortition Foundation processes but had not been selected. 52 participants were retained for the full process.

Table 1: Recruitment regions, workshop locations and number of participants

Region	Number of participants attending workshop 3 (in-person)	In-person workshop location
Scotland and Northern Ireland	12 (3 Belfast, 9 Glasgow and surrounding area)	Glasgow on 20 September 2025

[26] Using the term 'broadly reflective' indicates that sampling was conducted knowing that it would of course not be possible to represent all the multiple publics to be found across the UK population.

Wales and North West England	12 (6 Wales and 6 North West England)	Chester on 27 September 2025
Southern England	13 (Southern England)	Exeter on 20 September 2025
North East and Eastern England	13 (North East and Eastern England)	Peterborough on 27 September 2025

2.2 Definitions and terminology

Participants were introduced to words and terms that would be used in the dialogue in a glossary of terms. They also received information on climate change and ways to address it. These information sheets are shared at Appendix E.

Box 1: terminology on SRM used in the public dialogue

Participants were told as they joined the dialogue the following: SRM refers to a range of ideas for ways of potentially reflecting sunlight away from the Earth to limit the effects of global warming. There are various ways to describe SRM including Solar Radiation Modification, Solar Radiation Management and Solar Geoengineering.

SRM potential approaches:

- **Cirrus Cloud Thinning (CCT)** – Cirrus clouds are thin clouds that trap heat in the atmosphere. Thinning these clouds by adding particles in the right places could allow more heat to be released from the atmosphere to space.
- **Ice thickening** – Involves pumping sea water onto existing ice in order to thicken it.
- **Marine Cloud Brightening (MCB)** – Aims to increase how reflective low marine clouds are by injecting or spraying (sea salt) particles from the ocean into them. This would increase cloud droplets within a cloud so there is more surface for sunlight to be reflected from, which may reduce the amount of heat that reaches the Earth's surface.
- **Stratospheric Aerosol Intervention (SAI)** – Aims to release sulphate particles into the stratosphere to increase the reflection of sunlight.
- **Space mirrors/ sunshades** – Sending mirrors into space to reflect sunlight.
- **Surface Albedo Modification (SAM)** – Aims to increase the reflectivity of Earth's surfaces. Proposals include urban albedo modification (using more reflective building materials or colours in urban settings e.g. for roofs and paving), crop albedo modification (planting crops with a higher albedo than currently grown) and desert albedo modification.

2.3 What participants did

Dialogue participants took part in 17+ hours of deliberation over the course of four workshops from early September to mid-October 2025, and in using an online space

to share their views. Observers, including NERC, members of the Oversight Group, evaluators and other stakeholders, were also present to provide transparency and accountability in line with best practice for public dialogue.

Participants were supported through a structured onboarding process, including a welcome call, participant handbook and technology support drop-in session to ensure everyone was able to take part fully and confidently.

Outside of the workshops, participants spent up to three hours contributing their thoughts in an online space, Recollective. Using the platform, they completed workshop pre-tasks, reviewed presentations they had heard in the sessions, reflected on other contextual material and received answers to questions that arose throughout the process.

Participants received a thank you payment of £325 for taking part in the process, in recognition of the significant time and insight they contributed.

Figure 1: Solar radiation modification: a public dialogue – structure and timetable

Dialogue specialists, structure and stimulus

In all public dialogues it is essential that participants hear a range of perspectives to be as informed as possible as they deliberate on all sides of an issue.

The specialist presentations were given iteratively across the dialogue as follows:

Online workshop one:

- What is NERC and why has this public dialogue been commissioned, including the UK government policy on SRM;
- An introduction to climate change and the ways to tackle it;
- What is SRM? The basic idea in the context of climate change and ways to address it, brief history and introduction to considerations.

Online workshop two:

- A panel discussion to inform participants of the range of considerations: ethical, geopolitical, social, economic, and environmental;
- A deeper dive into the science and the main SRM approaches.

In-person workshop three in each of the four locations:

- A review of all the presentations and stimulus shared throughout the dialogue;
- A climate scientist and ethicist available at each in-person workshop;
- An overview of the science and the key considerations on ethics, geo-politics and governance.

Online workshop four:

- A presentation of principles developed by participants at workshop 3;
- Presenting SRM in context: examples from the arctic and globally to demonstrate potential impacts on communities, society, nature, and ecosystems.

During the workshops, participants had dedicated time to ask questions of the specialists and about the information contained in the stimulus materials. They spent a substantial time in facilitated small-group discussions, supporting them to explore the issues in depth. Workshop 3 enabled participants to review all the presentations and stimulus up until that point in the process to reduce the risk of forgetting information introduced to them in the early stages of the process, or to place disproportionate weight on the presentations they had heard most recently. This was particularly important as they drew conclusions on SRM research and potential deployment.

Participant-led materials and questioning

A key part of any dialogue is ensuring participants can bring their own experiences to the discussion, starting from whether they are in their thinking rather than with any specialist standpoint. Participants were therefore asked before the first workshop, to upload one or two images that represented how they were aware of climate change in the local, national or international context. These images were discussed in workshop 1 and helped ground conversations about the topic in relation to climate change.

Before meeting in person, participants were asked to chat with family and friends about what they had learnt about SRM from the process and their reactions to SRM. Insights from these conversations were then brought back and discussed at the beginning of workshop three. All these activities ensured that participants entered each workshop with personally grounded perspectives and a broader sense of perceptions of SRM, laying the foundation for deeper, more informed discussions.

3. Journey through the SRM dialogue

In this section we share how participants navigated the complexity of the topic, with most changing their minds on the topic iteratively and gradually as they progressed through the process. Some participants retained a view on SRM throughout the dialogue, others described pivotal interactions which changed their view. Participants' stance on SRM is discussed in the next chapter.

3.1 Very little awareness of SRM at the start

Most participants shared that before they joined the dialogue, they had not heard of SRM. It was a surprise for many that research was being conducted to explore how to cool the planet in the face of post-industrial revolution temperature rise. They describe their initial thoughts on the range of methods and approaches when being asked to join the dialogue as science fiction, or even some kind of, "elaborate ruse" because the topic felt so unlikely. But as they progressed through the dialogue, heard from specialists, and discussed the topic with other participants, they changed their view, saying that the topic became for them a serious area of research, with issues that were worth discussing.

> *"My views have changed radically because when I first heard about it, I thought, 'this is sci-fi and it's completely crazy'. As we've gone through it and talked about the different ways of doing it, I can see that there's been considered thought and it's not completely crazy. Rather than what I thought at the beginning which is, 'that's daft'."* Workshop 4

For some participants the more they developed their understanding of SRM research, the more they felt that this research is important and necessary as we discuss in chapter 4.

> *"My overriding theme is that throughout it I've felt more and more strongly that it should be something that is invested in more in terms of at least the research into it."* Workshop 4

3.2 A focus on the risks of SRM

Some participants had a somewhat different reaction. They began the dialogue in the same place, knowing nothing about SRM, but as the discussions progressed, they began to focus on the risks of SRM deployment and although they still felt research on the topic is important, they had an increasing sense of caution about real world experiments and any potential use of SRM technologies.

> *"I'm not sold either. I think today's been really insightful. I didn't know anything about it beforehand. But the more I hear, the more I think there could be too many risks for using it on any kind of scale."* Workshop 3, Peterborough

> *"I think at the start for me it was, 'if anything can aid climate change it should be used'. Now I think I'm a bit more sceptical, but I'm still more for than*

against it. I think it should be regulated and controlled and done carefully. It shouldn't take away from net zero. That should be more important." Workshop 4

Some participants focused on governance issues as a key point in their understanding of the topic and solidifying their views. The said that although they welcomed research on the topic, they were concerned that the collaboration needed to deploy SRM technologies for the global public good would be impossible to achieve. This is explained further in chapter 5.

3.3 Concern around the range of methods

An important part of the journey through the dialogue for some participants was the understanding that a range of methods and approaches were being explored through the NERC programme, and other research being funded by ARIA. A few became concerned that these methods are different from each other, and each could have different implications for the planet, society and for efforts to combat climate change. This concern fed into their responses to SRM research and deployment (see chapter 4).

"There are very different methods and that means different kinds of risks, different levels of risks, different levels of effort and funding. Once I'd got that my views began to change – surely we need to decide on one method; my preference would be aerosol injections and really go for that. Why spread our resources across a range of increasingly impossible tools?" Workshop 4

3.4 Those less convinced of climate change are more likely to have heard of SRM

A few participants had heard of SRM before joining the dialogue because they had heard about it in news and broadcast articles that set out what the NERC and ARIA programmes were intending to do[27]. For two participants understanding of SRM was rooted in the context of climate scepticism and the belief that SRM is already being deployed without public knowledge. They saw evidence of this in the condensation trails left by aeroplanes which they believe are "chemtrails" being used to inject aerosols into the sky for a range of purposes, including to block out the sun.

"Everyone I know is aware that chemtrails are being used now to block out the sun and for other nefarious reasons. It's already being done. This is a matter of public record and has been done for some time. It's the same thing and exposes the whole climate change hoax." Workshop 1

[27] For example: BBC News UK experiments to reflect sunlight one step closer, May 2025; BBC Rare Earth podcast, Engineering the Planet, 5 September 2025; New Scientist – Geoengineering is not going to save the poles from climate change, 9 September 2025

3.5 When views didn't change

A few participants said that they retained a fixed view on SRM research and deployment throughout the dialogue. Each held these views for different sets of reasons including that:

- Aiming for net zero emissions is the most important task;
- Society should not try to "play God" and intervene with planetary systems;
- SRM will never be deployed – it is not possible to collaborate globally on how it should be done;
- Human-made climate change is not true, and therefore human-made interventions should not be considered.

3.6 Key moments informing changes of view

Whilst changes in view happened frequently throughout each workshop while listening to specialists or discussing the issues in small groups, some described lightbulb moments which triggered a shift in their thinking. These three specific moments are summarised in Figure 2.

The seriousness of the climate crisis.

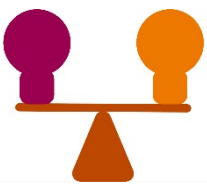
Hearing about climate change, and discussing climate change with fellow participants, and how far we are from achieving net zero ambitions shifted some people's views.

> *"Hearing about climate change and its impacts made me think a bit more. Seeing those temperature graphs made me realise this is really serious."* Workshop 4

Research being done in SRM

When participants heard from specialists in climate science researching these methods and approaches, their views shifted.

> *"That turned my whole mind in favour of it. Hearing from someone doing the science."* Workshop 3



The geopolitics and ethical dimensions of SRM

Hearing reflections from specialists on who has power and influence over SRM research and deployment caused some participants to rethink their view.

> *"Wow, it's been mind-blowing. We've heard about a world which is dominated by very uneven amounts of financial and political power. Thinking about this has made me realise it is very hard to deploy, or even research, SRM without it being unfair to one community or another."* Workshop 3

Figure 2: Three standout moments which triggered a change in participant thinking

Part two: The findings

Image: participants at the SRM public dialogue workshop 3, Exeter

4. Overarching responses to SRM

In this chapter we describe participants overarching positions on SRM. Participants understood from the pre-materials sent to them on joining the dialogue that the NERC projects are using computer modelling and historic data, not live field trials or real-world experiments. Some were also aware of SRM following the media coverage on the launch of the ARIA programme, and the 22 research teams being funded for a range of methods including modelling, observations and monitoring, indoor testing and (where strictly necessary and in accordance with ARIA's oversight and governance principles) small scale, controlled outdoor experiments. We describe in this section how participants felt in broad terms about both SRM research and potential deployment. A detailed description of the principles participants wish to see applied to SRM research is given in the next chapter.

4.1 Support for SRM research

Support for SRM research, and a desire for it to continue, subject to appropriate governance (see next chapter), was high in all locations and important factors in participants' deliberations. They discussed this in workshops, commented on it in the online space and shared this interest in research in their conversations with friends and family, many of whom were equally supportive.

> *"These are difficult decisions, but research is needed."* Workshop 3, Peterborough

> "I spoke to my son, he's in the younger age group, and thinks the science will prove the technology one way or another. He was excited by it, that thinks it will give good results in the future. For him research is never a bad thing." Workshop 3, Exeter

Many participants expressed this support for SRM research on condition that there are safeguards and a strong ethical framework.

> *"There is a need for research. I'm totally in favour of research. I'm not condemning any research. But I'd like to hear a wee bit more proven evidence, written evidence, or spoken evidence, on the safeguards, and the thinking they've done on the possible effects over time."* Workshop 3, Glasgow

Participants described key benefits of SRM research being:

- Having all the evidence in place should a decision to deploy be required;
- That decisions are only made in the face of concrete evidence on the impacts and implications of SRM;
- It reduces the fear of the unknown, and can create better understanding of potential unintended consequences;
- Understanding how much time could be bought to address greenhouse gas emissions and meet net zero ambitions;

- That research itself can have unintended, and yet positive, consequences e.g., that researchers may in researching SRM find another, better solution for combatting climate change.

> *"There is hope that something that they don't know about yet that actually solves the problem on a larger scale than this. SRM research feels like a big undertaking, and it's not actually going to solve the climate crisis we face. But what if this research turns up something else, some new angle or idea which could solve it."* Workshop 2

4.2 SRM research using computer modelling is welcome

Many participants expressed support for using computer models to research SRM and its possible impacts. They were aware that modelling is used in a range of spheres of scientific inquiry and felt that using models is a valuable aspect of understanding the potential impacts of SRM.

> *"Computer modelling has been used for many years in a variety of areas in ways such as tracking infectious diseases, weather forecasting, reacting to natural disasters, to name but a few. With this in mind, I feel it would seem logical and sensible to use computer modelling to understand and evaluate the possible impact of SRM in the real world."* Workshop 3, Glasgow

4.3 Mixed views on moving from modelling to real-life experiments

The focus in this dialogue was on research using computer modelling, based on the NERC funded programmes. Groups did discuss deployment, and the grey area when research tips into deployment. There were mixed views on SRM research moving from computer modelling to real-life experiments. Some saw value in carefully controlled outdoor experiments, while others were more cautious about the move from modelling to the field.

Some participants considered SRM computer modelling to be a useful first step, though they also highlighted its shortcomings. They commented that computer models can be an over-simplification of real-world systems which can lead to inaccurate results. For this reason, some were open to research progressing from modelling to outdoor experiments.

> *"This [computer modelling] in principle is a good first phase to analyse the different outcome possibilities. The hope would be a follow-up with a real-life scenario experiment with the test findings from the computer analysis."* Recollective

Some are concerned that spending too much time on computer modelling delays understanding the real-world picture. For some this could mean the climate crisis worsens while the world waits for usable evidence on the potential implications of SRM deployment.

> *"The longer we spend on computer modelling, the worse the situation may become in the real world."* Workshop 3, Chester

> *"Surely someone has to take this into practice instead of talking for the next 20 years and using better computers that can never show you how it really is in practice."* Recollective

A few participants were concerned that SRM might not be progressed fast enough, and an irreversible climate change tipping point might be past, making any further research on SRM redundant.

However, some other participants feel that SRM should be thoroughly investigated using computer models and were less inclined to support a move to research through outdoor experiments due to a concern that they might cause disruption to planetary systems, making a bad situation worse.

> *"I'm very happy with researchers doing computer modelling. It has the advantage from governments and taxpayers' point of view of costing very much less than real-world experimentation. It also has the advantage of that if an experiment goes wrong, it won't make matters worse."* Workshop 3, Chester

> *""I just don't know how ethically it will ever be OK, even if it's in this country, to actually test when ultimately it is actually going to affect, you know, the globe." Workshop 4*

4.4 Cautious about large scale experiments and SRM deployment

While seeing value in research, most participants are much less supportive of large scale SRM experiments and SRM being deployed. Many believe that all our resources should be entirely focused on taking action to reduce greenhouse gas emissions and meeting net zero targets. Participants said that:

- Global agreement on deployment will never be achieved;
- The current research investment will have been redundant if a country works independently of others to implement SRM;
- The use of SRM feels "dangerous" with, despite modelling and research, too many unknowns and potential unintended consequences.

However, only a few participants said that SRM deployment was a complete red line for them. For many, balancing the risk of SRM being deployed, and the harms from an ever-warming planet, led them to the view that SRM might have to be deployed as a last resort to rapidly cool the Earth if the situation becomes critical and there is no alternative.

> *"The serious nature of climate change means drastic remedies might be required."* Recollective

"It would be much better if we could get our act together and stop destroying the planet. But I'm pessimistic about that so have [SRM] in the back pocket as an emergency measure. It would only be used if there was no other way, if we just needed more time." Workshop 4

4.5 Participants set conditions for SRM deployment

Whether supportive of SRM deployment or not, participants set out conditions that in their view must be met before any SRM deployment. These include:

- A full understanding of all risks and evidence of its effectiveness, making sure effective use is made of the research being done;
- A global governance mechanism is in place, including a monitoring system;
- The most "natural" and least invasive methods should be chosen;
- Countries must reduce greenhouse gas emissions before being permitted to deploy SRM;
- Continue to conduct research to see if better options become available;
- Deployment should be fair and not result in harms for any country or region.

"I just wanted to echo that, just in terms of research. Make sure that the research is fully completed and all risks assessed before, obviously, any kind of deployment is considered." Workshop 2

"Again I'll start first so we're talking about deployment, my recommendation will be that the people who decide to do the deployment that they start with the least invasive or the one that would least affect the environment before going to the extreme ones, so not start with the most extreme way of doing it, start with the least invasive way, if that makes sense." Workshop 4

4.6 Uncertainty in the face of complexity was felt by a few participants

For a few participants whether SRM research should be conducted, or SRM methods deployed, remained key questions throughout the dialogue. This uncertainty stemmed from the:

- Range of methods and approaches that were being discussed;
- The fact that the scientific, ethical and geo-political communities are not in agreement on whether SRM could ever be safely deployed;
- Desire to retain the hope that the planet can be cooled through climate change mitigation action;
- There might be more effective options to address climate change that do not involve these methods and approaches, but which are not being explored while efforts are being put into SRM research.

"The Jury's out for me. I keep changing my mind. I'm not sold either way really. I think today's been really insightful. I didn't know anything about it beforehand. I've learnt a huge amount, but yeah, so far not sold, particularly

when the scientists aren't in agreement on whether it should be researched, let alone deployed." Workshop 4

4.7 Two main responses to SRM methods and approaches

Participants reflected on the range of methods and approaches being explored. Even if participants were against SRM in principle, they still discussed this range and two main responses to SRM methods and approaches came to the fore.

1. Drawing on existing resources/ mechanisms is preferred

Hearing about the Theme 3 of the NERC programme and the research on natural analogues, and learning from what happens already on the planet, was reassuring to some participants.

> *"There is something reassuring about the fact that nature's own way of doing this is a volcano."* Workshop 3, Glasgow

They combined this with taking minimal action to increase the reflectivity of the planet such as painting rooves white or planting crops which are hyper-reflective. This preference for 'natural' solutions is in line with the 2010 Sciencewise public dialogue and other research on public views and perceptions.

In this dialogue participants felt this way because they believe that mimicking natural processes, or using resources such as seawater, ice and reflective clouds, will have fewer risks to people and the planet than using other materials. Words that participants used to describe these processes included: natural; organic; eco-friendly.

> *"They're not making up man-made chemicals or gases. It's things that are already present in the atmosphere or the sea, like salt. There's nothing artificially manufactured apart from the vessels that are going to contribute to spreading it."* Workshop 2

> *"If this is a known fact that roof whitening could make such a big difference why has a tile manufacturer not come up with the idea? Everybody's into building eco-houses now, so it seems like we're all missing a trick here."* Workshop 4

2. Methods that use more innovative technologies require more research

More concern was expressed for methods and approaches which use untested, uncertain, or man-made solutions. For example, Marine Cloud Brightening (MCB) was supported as a potential SRM technology more frequently than SAI because of fears for human and animal health, environmental impacts and unintended consequences (see chapter 6). Participants were concerned that SAI:

- Would require a large number of planes to deliver the aerosols into the atmosphere, and this would contribute to an increase in emissions;

- Involves putting sulphur dioxide into the atmosphere and if a large amount is required over a sustained period this could have negative impacts;
- Could create a risk of acid rain, which feels both counter-intuitive and counter-productive in an endeavour to support climate change initiatives;

These responses to SAI led participants to think that more research is required to consider further what the potential impacts and implications are of this method, and really understand how feasible it is. They understand it in part meets their requirement for using a "natural" approach as sulphur dioxide is already in the atmosphere and is the product of volcanoes, but the mechanism for deployment does not feel as safe to them as that used for MCB.

> *"I was just shocked at how much was going to be needed on like an annual basis and how many planes it's going to take. It just seems like a lot and then doing that on a global scale and trying to control where all these planes are going. It seems very counter-productive."* Workshop 2

> *"The method of using sulphur dioxide, although there is quite a bit up there already, but the amount you would need to coat the earth almost, or great swathes of it anyway to bring the temperature down. It seems a bit pie in the sky mad."* Workshop 1

5. Research principles

This section outlines the principles participants believe should be guiding SRM research, including their reasoning for proposing these principles and ideas for how they might be achieved.

5.1 Context for the principles

How the principles were developed

The principles were developed by participants during workshop 3. This consisted of in-person workshops held in four locations (see chapter 2). Following the workshops, the HVM team combined the principles from the different sessions into a summary draft document. The summary was shared with participants in the online space and at workshop 4, giving them the opportunity to review, discuss and feedback on the combined principles. The final summary of participants' principles for SRM research, outlined below, takes into account the feedback received at workshop 4.

Existing principles for climate geoengineering

The principles proposed by UK publics as part of this SRM public dialogue complement an existing body of guidance for climate geoengineering developed by specialists and academic institutions, such as the Oxford Principles (2009)[28], the Tollgate Principles (2018)[29], and the AGU Ethical Framework Principles (2024)[30]. There is much consistency between the principles proposed here and this existing guidance, for example the importance of transparency and public engagement.

5.2 Six important SRM research principles

Figure 3 gives a summary of participants' SRM research principles. These were developed during workshop 3, building on the discussions participants had throughout the dialogue, and finalised in workshop 4, having had time to reflect on the principles developed in each location. They are presented in alphabetical order, as participants considered all of them to be necessary and important

[28] Rayner, S., Heyward, C., Kruger, T., Pidgeon, N., Redgwell, K. and Savulescu, J. (2013) The Oxford principles. *Climatic Change*, 121(3), 499-512. doi: 10.1007/s10584-012-0675-2

[29] Gardiner, Stephen M., and Augustin Fragniere. "The Tollgate Principles for the Governance of Geoengineering: Moving Beyond the Oxford Principles to an Ethically More Robust Approach." *Ethics, Policy and the Environment* 21:2 (2018): 143-174.

[30] American Geophysical Union. Ethical Framework Principles for Climate Intervention Research. *ESS Open Archive .* October 17, 2024

Do no harm to people or the environment

Participants require that SRM research is safe for both human life and the environment, in both the immediate and the long-term future. Participants were primarily thinking of outdoor experiments and potential deployment.

Do not distract from reducing greenhouse gas emissions

An emphasis was placed by participants on SRM research not diverting attention away from efforts to address the underlying causes of climate change – specifically decreasing GHG emissions – both within the UK and internationally.

Global collaboration, equity, and governance of SRM research

With this principle, participants call for SRM research to be globally coordinated and collaborative. They want to see specialists with a diversity of expertise working together. They believe these efforts should be governed by an international body, providing oversight and ensuring all countries have a voice in decision making.

Public information and engagement in SRM research and decision-making.

This principle requires the public to be informed, educated, and engaged in SRM research and decision-making, in the UK and around the globe. It links closely to the transparency principle.

Prioritise the public good and future generations

With this principle, participants call for SRM research to prioritise the public good, focusing on the needs of all nations and people, and with a particular focus on future generations.

Transparency, integrity, and accountability in SRM research

Participants consider transparency, integrity, and accountability as foundations for ethical and trustworthy SRM research.

Figure 3: Six SRM research principles

Views diverged on one potential SRM principle

Of all the principles suggested by participants, only one is not included in the final list of SRM research principles. This related to whether profit-driven research conducted by private companies should be permitted. It is the only principle where participants' views diverged strongly, and for that reason it has not been included in the final list of participants' principles; instead, a summary of the principle, and the differing views, is provided in section 5.7.

Research principles are also relevant to SRM deployment

Although participants focused on principles to guide SRM research, they sometimes also discussed the principles in the context of the potential deployment of SRM. They considered some of the principles, such as "Do no harm to people or the environment," to be particularly relevant to deployment, especially when the research shifts from small-scale controlled to larger-scale outdoor experiments.

5.3 Doubts over achievability of the principles

When participants reviewed the summary principles at workshop 4, they felt that they reflected their discussions at workshop 3 and were broadly supportive of them. However, a few doubted that the principles would be adhered to, particularly if SRM moves from research to deployment, and they lacked trust that they would come to fruition.

> *"For me, I think I agree with all these principles. I like them, whether I think they're achievable. It's probably a different story*." Workshop 4

> *"I think all the principles that were talked about were the ideal principles, but how realistic it is that they would actually happen is a completely different thing. I mean if one country, for example, if one country like USA decided they were going to do SRM, they would just do it and not care what effect it has on other people. So, I think all the various ethics and principles that we've been talking about are all ideal and I think they're all important but whether they would happen in the real world I'm not sure."* Workshop 4

5.4 The rationale for the six principles

Do no harm to people or the environment

The principle "Do no harm" requires for SRM research to be safe for both human life and the environment, in both the immediate and the long-term future. Participants were often thinking of this principle in the context of outdoor experiments, as well as the potential deployment of SRM. Some felt that even when research is done with good intentions, there is still the chance it will have negative consequences and will lead to deployment whether the harms are clear or not.

> *"This is just a research stage, but at some point you have to go from the (computer) models to deployment. And what it must always have as a first principle, is, "cause no harm". We heard earlier about the Arctic, how*

indigenous tribes in the Arctic were affected by stuff. And the reindeer herds can be affected by this kind of stuff or have been affected by some scientific research." Workshop 4

Some described "Do no harm" as a red line that should never be crossed, while others questioned whether it would ever be feasible for SRM, particularly SAI, to be deployed without consequences. They queried the feasibility of testing SAI in one location without it affecting another and were concerned that impacts might be felt by countries that do not have a say on whether an experiment should take place.

> *"I just don't know how ethically it will ever be OK, even if it's in this country, to actually test when ultimately it is actually going to affect, you know, the globe. You can say, oh, our country will just test it here in this area. I just don't understand if, especially in developing countries, whether they're going to have a big enough say in any of it. Ultimately the impacts are going to fall on, you know, more than likely on them. The ethics around it, being fair, is important*." Workshop 4

"Do no harm" for many also meant that research should not lead to the weaponisation of SRM where one country uses it against others to negative effect.

> *"One of our speakers earlier on said that the likelihood of it being used as a weapon is fairly slender, because there are actually much more efficient ways of causing destruction. Nevertheless, I still think it's of great importance to make sure, presumably through global governance, that it isn't and can't be used as a tool of war."* Workshop 4

Participants proposed outdoor testing conditions and restrictions

In discussions across the dialogue, particularly by the end of the process when they had devised the "do no harm" principle, participants proposed a number of conditions for and restrictions on outdoor experiments. These came from an awareness that some small-scale outdoor experiments had been conducted, and knowing that the ARIA programme also includes research outdoors on a small-scale. Their conditions and restrictions included:

- Outdoor experiments should be safe for human life and the environment, both now and in the long-term;
- The vulnerable in society and across the world should be protected against any side effects (e.g., pollution);
- Locations should be carefully chosen to minimise the risk e.g., there should be no outdoor experiments in populated areas;
- The Global South should not be used by the North as a testing ground for SRM;
- Outdoor experiments should be small-scale and in clearly defined geographical areas;
- Outdoor experiments should not take place until a (global) governing body has approved them;
- Outdoor experiments should be approved by the communities living in the areas where they will take place.

"The local people in the area that that test is going to be happening need to approve it. You know, it's not just necessarily about the country itself agreeing to it but also that local population agreeing to it as well." Workshop 4

"Some of them [other countries] may not be aware that this is going on and they could be used as testing grounds. And that shouldn't happen because that is unfair. And that it's literally corruption, indirect, and it's just not right. I believe whichever country is funding the research should do the research in their own country. That way it's fair." Workshop 4

Harm if AI in SRM research is used unethically

For a small number of participants, another aspect of the "Do no harm" principle related to the ethical and careful use of Artificial Intelligence (AI) in SRM research (e.g. computer modelling). They were concerned that AI might draw upon inaccurate or biased data or produce results that are not robust. For this reason, they called for there to be human oversight when using AI in SRM research.

> *"It [Artificial Intelligence] can often do things that you don't want it to. Taking over the world's a bit farfetched, but it can pull data from places it's not supposed to and give outputs it's not supposed to."* Workshop 3, Chester

What level of risk is acceptable?

During discussions, some participants explored what level of risk might be acceptable in relation to the testing and deployment of SRM. Some felt it would be important to have a debate and reach agreement on what level of risk would be acceptable, while others believe that some people might expect no risk to be taken. Some also highlighted the importance of comparing the risks of testing and deploying SRM (e.g., unintended consequences) with those of not deploying it (e.g., risk to life from rising temperatures). They emphasised the need for honesty and ethics when deciding what level of risk is permitted.

> *"If things suddenly go wrong, climate-wise, there is loss of life, so yes, is there a line? Where do we draw that line? Has it got to be a hundred per cent no risk, or is there going to be a debate about actually, we're willing to take 95 per cent, 90 per cent?"* Workshop 3, Exeter

5.5 SRM research must not distract from reducing GHG emissions

Most participants felt strongly that SRM research should not divert attention away from efforts to address the fundamental causes of climate change, both within the UK and internationally. They highlight the continued importance of decarbonisation through the reduction of GHG emissions and in meeting net-zero targets. Some worried that SRM would provide an excuse to stop climate change mitigation.

> *"I think it is tremendously important that SRM doesn't distract attention from the real problem and the long-term solution, which is to decarbonise as far as we can. It's very important that SRM doesn't provide an excuse for stopping climate change mitigation."* Workshop 4

As in public deliberations and other public perceptions research conducted since the early 2010s[31], participants emphasised this principle out of concern that SRM does not address the root causes of climate change. Added to which they were concerned that if deployed and then stopped, without tackling GHG emissions, it could make the situation worse.

> *"I think for me, the biggest priority would be not distracting from reducing emissions because SRM is not a solution in any way, shape or form. If you did that [SRM] without reducing emissions, you're just kind of left in the exact same place you were when you started, if not worse, because now you're reliant on SRM and you can't really take it away without the entire system collapsing."* Workshop 4

5.6 Global collaboration, equity, and governance

Participants strongly agreed that SRM research should be globally coordinated and collaborative. It should be inclusive, engaging researchers from across the globe, from diverse backgrounds, expertise, and perspectives. It should not be dominated by high income nations but governed with oversight from an international body which supports all countries to have a voice at the table.

SRM research should be collaborative and co-ordinated globally.

Participants shared ideas on what this might look like in practice, for example:

- Global collaboration on specific research projects;
- Global co-ordination across different research projects;
- Collectively developing universal modelling software so it is easier to share data and compare results;
- Sharing and comparing research data and findings amongst nations;
- Mechanisms for researchers to share information and collaborate, such as conferences and physical spaces.

> *"Even if the countries worked on their own, did their own [research] and then came back together, just kind of like what we were doing, and then if there was a central body to authorise the data, and then all countries can see what the other country came up with, and compare the data together."* Workshop 3

The reasons for calling for global collaboration and co-ordination on SRM research included:

- Recognition that SRM, particularly SAI, would be a global measure that could have global impacts;
- Preventing more powerful countries from dominating the space;
- Avoiding duplication of effort and ensuring findings are shared;
- Facilitate the benefits of different expertise coming together;

[31] E.g., Ipsos MORI Experiment Earth? Report on a Public Dialogue on Geoengineering, Sciencewise, NERC, August 2010 and Pidgeon, N., Parkhill, K., Corner, A. *et al.* Deliberating stratospheric aerosols for climate geoengineering and the SPICE project. *Nature Climate Change* **3**, 451–457 (2013). https://doi.org/10.1038/nclimate1807

- Improving global transparency and trust.

Engaging a diversity of specialists

In addition to engaging climate scientists from across the globe, participants argued that SRM research should engage specialists from a diversity of backgrounds, expertise, and perspectives. They felt it important not just to focus on the climate science, but to bring in other areas of expertise given the geopolitical and ethical considerations. Some highlighted the value of interdisciplinary research that brings together different areas of expertise such as ethics, economics, engineering, climate science, and governance.

Equity and fairness among countries

Equity and fairness among countries was a strong principle for many participants. They believe that research should be fair and inclusive, ensuring that all countries – especially smaller, poorer, and climate vulnerable nations – can take part. Ideas on what participation might look like included all countries having access to research data and funding to conduct research, and all countries having an equal voice in planning and decision-making on SRM research, for example on the location and methods for outdoor experiments.

For many participants, fairness and equity would mean SRM research is not driven by the self-interest and power of high-income countries, but instead, there would be independent oversight that gives all nations an equal voice in the governance of SRM research and potential deployment.

> *"I feel every country should have a representative at the table with an equal voice. Like, America should not drown out Sudan or something just because they're a bigger financial player. It's so everyone can get their country's views across."* Workshop 3, Chester

> *"It's fairness. I think it's trying to be fair, again. It's coming again, making sure the big boys are looking after the little boys, trying to make it equal."* Workshop 3, Exeter

Participants shared views on why embedding equity and fairness into SRM research was important. These included:

- Concern that smaller countries may not have the resources to take part in SRM research, and a desire that they should be able to engage in it and benefit equally;
- Concern that powerful nations might disregard the interests of less powerful nations, which could lead to tensions;
- An appreciation that SRM (particularly SAI) could bring global benefits, but also unintended consequences.

> *"It should be devised by all the people as well, not just the biggest players. And there shouldn't be any bullying. It should just be 100% neutral, and every nation should have somebody, because I think, and I'm not a scientist, but*

there's going to be cause and effect with it all. Everybody's voice should be heard equally with all this." Workshop 4

Fair and transparent funding mechanisms

Some participants highlighted the importance of having fair SRM funding research models. A few argued that high-income countries, which have been the main contributors to climate change, should contribute more financially to SRM research for the benefit of all nations. Some participants saw value in there being an international body to fund research. The perceived benefits included enabling lower income countries to take part in research and have a greater say on what research is conducted, as well as greater transparency, ensuring that research results are accessible to everyone.

Global governance of SRM research

Participants argued that it is critical that SRM research, particularly when it reaches the experimental stage, is effectively governed. Some called for a global governance system and an international body with oversight for SRM research, outdoor experiments, and potential deployment. This related to a concern that currently anyone can conduct research and outdoor experiments as there is no comprehensive international framework governing SRM.

"Yeah, I think like a small amount of research on this is good. And I think governance is needed to kind of oversee like what everybody's doing in the world. So I know from what I understand, like anybody can kind of conduct SRM research or experiment." Workshop 4

Participants made several suggestions on what effective governance should look like:

"I think one of the other red lines is that something that affects the entire globe is that it shouldn't be going into implementation or full-scale testing until there is governance around it." Workshop 3, Chester

They said that good governance would include:

- Neutral, unbiased oversight by an international, independent oversight body;
- Guidelines or an international agreement which all countries adhere to;
- Restrictions, controls, and regulations;
- Continuous monitoring;
- Large penalties for non-compliance with the governance agreement;
- A compensation fund in case of negative impacts.

"Agreements on the research that each country needed to carry out to the same guidelines. If we've agreed that all testing will be small-scale, all countries have got to work to the same standards." Workshop 3, Peterborough

For some participants, it is essential that a global governance framework is in place before the full-scale testing and implementation of SRM.

Many participants believe there should be a governing body overseeing SRM research and potential deployment which provides unbiased oversight. Some thought this should be an existing international institution, such as the United Nations (UN), while others were sceptical that the UN would be the right vehicle for this. One noted issue with the UN taking on this role was a specific concern that countries that have historically been the biggest polluters would have the power to veto decisions.

> *"If we went back to an overall global governing body to go with the governance of it, if we went to something like the United Nations to do it, I think it would be drastically unfair that the main countries in the world that do most of the polluting have got a veto on any decisions that are made. I think everybody every country in the world should have equal voting rights and not a small group having vetoes on those decisions."* Workshop 4

A few participants discussed who should be involved in the governance process. Some felt that it should be non-political and without bias. Many called for an independent body. Suggestions on who might be involved included scientists, ethicists, and young people, as part of a global Youth Forum.

Questioning the feasibility of global governance

Although the principle of global governance and decision-making on SRM was a priority for many participants, some were doubtful it could be delivered. A few queried the effectiveness of existing international bodies, such as the World Health Organisation (WHO) and the UN, and doubted that 193[32] countries would be able to reach an agreement on SRM research or deployment.

5.7 Public information and engagement in SRM research

This principle requires for the public to be informed, educated, and engaged in SRM research and decision-making.

Public information and education

Many participants felt that the public should be more aware of SRM. Many commented that they were not aware of SRM before this public dialogue and were struck by how few of their friends and family members had heard of it.

> *"People I spoke to hadn't heard of it at all. I think I'm getting from people I spoke to and from the in-person workshops; everybody was saying that it seemed that everyone they spoke to hadn't heard of it. But neither had I before this started. So they've kept it very quiet."* Workshop 4

Some reflected on how much they have learnt about SRM from taking part in the public dialogue and contrasted this with how little the average person would know or learn from what is available in the media. They believe knowledge is essential for

[32] The current membership of the UN

enabling citizens to develop informed opinions and engage on SRM, and to prevent misinformation.

> *"[We need] ongoing education about it, because even all of us on this workshop, we've all got different opinions, and we've spent hours now learning and discussing about it. And the average person that just hears about it on the TV or in the newspaper, like, they're not going to have anywhere near as much information, are they?"* Workshop 4

Some mentioned information that should be provided including:

- The potential pros and cons of SRM;
- Why SRM might be needed and how it would be implemented;
- What research is being conducted, by whom, and how it is being financed.

They also emphasised the need to communicate research results in a way that is easily understood by non-technical audiences.

> *"Make sure that once research has been done, and the reports have been produced, that ordinary people, politicians, non-scientists, people like ourselves, actually, understand what that report is saying."* Workshop 4, Chester

They also highlighted the importance of presenting information to the public in a balanced way. By balanced they mean showing both supporting and opposing views, so that people can form their own opinions based on a range of perspectives. They value clear explanations of the methods and approaches, what principled research looks like and how SRM is governed should it ever be deployed at scale. Participants did not spend time developing a range of communication tools, but they indicated that communication could be done by government on new policies and decisions; through trusted broadcast media outlets and by research teams themselves communicating their results. How public viewpoints could be further explored is set out in chapter 7.

Some noted the need for information on SRM to be presented within the broader context of tackling climate change.

> *"I feel like lots of work and money and research needs to go into working with the public to inform them and to talk through the options. I feel like most people aren't aware of the situation in all its complexity and severity, and do not understand what the options are at all really."* Workshop 3, Exeter

Public engagement in SRM research and decision-making

Participants focused on this principle because they called for public engagement in decision-making on SRM research and potential deployment. They discussed the importance of engaging people from a range of backgrounds, such as different education levels, ages, and religious beliefs.

> *"What do we mean by, "What would moral and ethical research look like?"*

> *I think what we're doing now, getting a big opinion from public domains in different parts of the globe, really does matter. Because politically, yes, it's fine that leaders will ultimately make a decision, but it really should be led by the people who are the everyday Joe Bloggs."* Workshop 3, Chester

Others highlighted the importance of engaging the people who are most likely to be affected by decisions, although they were doubtful this level of public engagement would happen.

> *"If I ruled the world, I would just pick the kind of bottom of society and the ones that have, you know, the little croft, for example, who is going to be affected by rainfall. Try and get the people involved who are going to suffer if anything goes wrong. It's all I can think of, but I kind of feel also that's never going to happen because it never happened in the past.*" Workshop 4

While some participants highlighted the need to engage the public globally on SRM research and decision-making, others doubted the feasibility of involving publics everywhere, given differences in political systems and the sheer number of people who could be affected.

*"How do you get 8 billion people to consent to SRM? That seems a step too far to me?" Workshop 3, Glasgow*This discussion point is explored further in section 6.4.

Educating and engaging young people

Many articipants called for young people to be central to thinking on SRM research and potential deployment. They argued that they should be informed and educated from school level, and included in the decision-making process, as they are likely to be the ones making decisions about SRM in the future and will be most affected by the outcomes.

> *"There's an opportunity there, and you must give the younger people advice on this. You have to, because they are the people that are going to be affected the most. They must have a say. If you don't involve them in this, it's morally wrong. The younger generation must have a big input into this and must have an input into the decisions that are made as well."* Workshop 4

5.8 Prioritising the public good and future generations

This principle calls for SRM research to prioritise what is in the public interest, with a particular focus on future generations. pParticipants stressed that research should consider the needs of all nations rather than a few and should consider the interests of future generations. Some specifically called for an overarching aim to build a better and safer world for all.

Thinking about young people was a key factor in how some participants developed their views on SRM research and on what would be in the best interests of future generations. Putting these issues into perspective was important for some participants.

> *"One thing that stood out to me just now […] was that the younger generations must be informed. I'm father to two young boys. And when we were looking at some of the earlier data in one of the previous meetings, looking at the predictions for global temperatures come the year 2100, my boys are only going to be in their late 70s. It puts it into perspective. It's not actually that far away. They'll hopefully be grandparents by then. I think getting the younger generations involved as much as possible is very important. It's going to affect the younger generation more than the current older generation."* Workshop 4

5.9 Integrity, transparency, and accountability

Integrity, transparency and accountability were highlighted by participants as fundamental to ethical and trusted SRM research.

Integrity and accountability

Participants stressed that SRM research should be trustworthy, unbiased, and conducted with integrity and accountability. They noted that this includes both a personal commitment to ethical, unbiased research, as well as governance mechanisms which hold people to account.

The following quote illustrates the views of many on the importance of unbiased research, which looks both at the pros and cons for SRM. This perspective comes from their assumption that researchers who are particularly keen to work in this area may be biased towards it.

> *"I hope that the people carrying out the research are looking at the risks and the negatives of it just so that we can make sure we've got a balance. Because if they're doing research, but they really want it to work, we might only see that part to it. I hope that they really concentrate on the 'what ifs' as well, and then it can be really balanced."* Workshop 2

Being transparent about research actors and their motivations

Participants stressed the importance of being clear about who is conducting the research, what is motivating it, potential conflicts of interest, and where the funding comes from. For some, this stems from a concern that profit-driven programmes might result in less ethical research.

> *"We've got the different sort of experts declaring what their interest is, and whether it's different countries, different kind of funders, whether they're public or private, being transparent as to their intentions is critical. Because if all they want to do is make more money and not care about anything else, then obviously that would be an issue because that puts everyone in danger.*" Workshop 4

Participants also call for transparency and accountability for all research results. They feel it is important to know whether the findings show SRM would be effective or not, and whether it has identified potential negative effects.

"Facilitator: Why is that important, when you were saying don't hide anything?

Participant: If you're doing your research, you don't want to scare people, so you don't tell them some negative effects, and then there's a leak where someone finds out there are these negative effects. Then, you're left in a situation where you've been hiding, and people are going to be stressed." Workshop 4

Participants also recommend open access to research data and peer evaluation of research projects as a means to foster transparency and integrity within the research community.

5.10 Diverging views on private and profit-driven research

Participants views diverged on whether profit driven research, which is conducted or funded by private companies, should be prevented or whether it could be permitted on condition it is regulated and constrained within an ethical framework

Support for a principle that prevents profit-driven research

Some participants felt there should be a principle that SRM research should not be driven by profit, or conducted or funded by private companies, due to concern that this might lead to bias, short cuts being taken, and less transparency. Instead, their preference is for SRM research to be funded by government and conducted by not-for-profit institutions, such as universities.

"I think the non-profit was one that I'd consider vital. I think as soon as you start making profit from something like this, you get people trying to take advantage of it and cutting corners." Workshop 4

"You shouldn't be doing this to make money; you should be doing this to save the planet. The trouble is, when money gets involved, the big, powerful companies will just take over and bend the science and do whatever they've got to do to promote their narrative." Workshop 3, Peterborough

Support for private companies and investment in research on condition there it is constrained by an ethical framework

However, some participants were not supportive of a principle that prevents the involvement of private companies and funds. Some did not feel it would be realistic to exclude t industry involvement, given that we live in a market-driven society, and reflected on the private sector's ability to deliver world leading research and drive technological advancements.

"I don't think it makes sense in a capitalist society to say research should not be driven by profit. It happens all the time. It's not ideal. But capitalism isn't ideal. I think if you say to all the companies that are capable of doing very good, groundbreaking, world leading research, you can't make any profit out

of it. They're not going to be bothered. I think it will impede progress. I mean, whatever research they do needs to be peer reviewed. There needs to be constraints and restrictions and a framework of ethics around it. But to say you can't make any profit, I think is negative." Workshop 4

Some also reflected that governments may also be looking to make profit through policies.

> *"It did occur to me that Trump the other day was saying about the tax on steel, and he was like, "Oh, but we'll make a nice profit." I think it's not just private companies that want to make a profit, it's countries. I think we should be aware of that."* Workshop 3, Exeter

Some also reflected that if philanthropists fund research, they too will have agenda, even if it is not profit driven.

> *"These are philanthropists, they are putting in the money, I'm sure there will still be an agenda and there will still be some sort of outcome that they would prefer to come from their investment. No one's going to give that money 100% freely, especially those sums of money."* Workshop 2

Participants who felt it would be unrealistic to exclude private companies from SRM research argued for strong controls to ensure ethical practices, and for there to be transparency requirements around who is conducting the research and how it is being funded.

> *"I don't think we could ever completely stop entrepreneurial companies being involved in SRM research. They might fund it in the future, we've seen they've already tried to. Wouldn't it be better to bring them into the fold, but using the same global governance? Ensure that they work to the same standards as academic teams?"* Workshop 3, Peterborough

6. Key dialogue themes

In this chapter we introduce dialogue themes that have emerged from discussing SRM research and deployment across the public dialogue. They include all the themes that emerge from discussions on SRM research and potential deployment which weren't directly about (although they are related to) the principles-led discussions covered in the previous chapter. These themes include participants' views on climate change; the importance of global governance; SRM impacts and unintended consequences plus developing the themes that came out of the discussion on principles described in the previous chapter. The themes include sharing that gaining public trust and acting with transparency are vital concepts when considering methods and approaches yet to be tested at scale and with uncertain consequences.

6.1 A desire to tackle climate change

At the start of the dialogue the potential for SRM to buy time for society to take the necessary action on climate change was introduced. This rooted discussions in the climate change context and enabled people to start thinking about the topic in relation to their own experiences.

Participants shared striking examples of how climate change has impacted their local area. These included examples of global warming-induced damage (see Figures 1-4 below), which included flooding, declining biodiversity, coastal erosion and drought.

Figure 4: "Ladybower dam. Low water levels."

Figure 6: "Streets in Plymouth which never used to flood."

Figure 5: "A typical example of the crumbling cliffs along the South West Coast in North Cornwall affected by aggressive erosion".

Figure 7: "Plum trees- a mild-winter early blossoming: insects no bees, lots of fruitlet drop."

Participants described feeling, “unsettled”, “anxious” and “panicked” as their local environment became increasingly unfamiliar.

> *“The constant fluctuation and how we are going to manage in the future, is really worrying and concerning especially as I have a young family.”* Workshop 1

Tackling the impacts of climate change without SRM

Many participants expressed frustration that current efforts to tackle climate change, whether at an individual or societal level, are not having enough impact. They feel that while people are being encouraged to recycle, reduce waste and change their daily habits, these actions alone are not meaningfully mitigating against damage caused by global warming. Their frustration extends to governments and global initiatives and agreements which do not seem to be achieving their ambitions.

> *“I think there's a sense of hopelessness in the UK in the sense that, you know, whatever we do feels really minimal compared to, for example, you see what they're doing in China, how they're still burning coal as though it's the only form of heating there is, you know. I buy an electric car, so what difference does that make?”* Workshop 1

Some also feel let down by wider climate strategies, such as carbon capture, which they see as failing to deliver the results promised. This has led to a sense of disappointment and, for some, hopelessness, as participants question whether existing approaches are capable of addressing the scale of the crisis.

Climate change denial and the misinformation context

Many participants said these concerns are heightened by the increasing levels of climate change denial and scepticism that they are aware of in society[33]. Some participants struggle to understand how people can hold these views with so much climate-change induced damage occurring, but others are less surprised. They link denial to the large amount of climate misinformation and disinformation online, encouraged by influential voices with a public platform.

> *“I think there's a lot of confusion as to how important climate change actually is because of what is going on globally with Donald Trump and, “drill baby drill”. Climate change has been shut down by Nigel Farage. The political side has really made it quite a muddled, confused crisis.”* Workshop 3, Peterborough

Some participants think that sometimes the issue stems from people enjoying the longer periods of warmer weather experienced in the UK in recent years. As such they do not see that there is a problem on which action needs to be taken.

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[33] YouGov, Earth Day 2025: Where do Britons stand on climate change? Found that although just 4% of Britons believe that the climate is not changing, public scepticism towards climate policy is increasing. April 2025

Others suggested that people deny climate change because it feels easier than facing the anxiety that comes with accepting it.

> *"It's difficult sometimes for people to hear – I was the same – about how bad things are, the projections. I was watching one of the recaps, and actually, someone waved at me and they were like, "Are you okay?" because I was so shocked at seeing the impacts of climate change."* Workshop 3, Chester

Several participants shared their concerns about how a low level of climate literacy in society is causing a lack of engagement in efforts to tackle climate change, as it is difficult to engage in something you do not understand. They would like to see more widespread education, including in schools and for adults, about the impacts of climate change.

These participants are very concerned about how climate misinformation is negating efforts to tackle climate change. Some feel that SRM could make misinformation worse because of popular chemtrail and weather-control conspiracy theories. However, others think that because SRM is attention-grabbing, it might help spread accurate information, if the media covers it responsibly.

Tackling climate change with SRM

In this context some participants see SRM as something that could offer hope, mainly because it might buy society more time to enhance emissions reduction strategies and technologies. However, other participants are worried that SRM will act as a "sticking plaster", covering up the problem rather than solving it. They fear fossil fuel companies might support SRM so as to continue producing emissions. Similarly, some participants are concerned that SRM could weaken government and public motivation to act on climate change, by giving the impression that technological cooling makes governmental and personal efforts less important.

> *"Well, I think the benefit that it buys us time is, in fact , a risk because I think the danger is that people will think, "Oh, well, some of our scientists are going to come up with a solution in a couple of years' time"."* Workshop 3, Peterborough

6.2 Global governance and collaboration

Many participants believe that countries should work together at every stage of SRM research and deployment. They considered this a high priority in the context of other global uncertainties. Strong global rules and oversight also matter to participants because of the risk that SRM deployment could cause worldwide harm if things go wrong.

Participants are concerned about the international relations context

Many participants feel that today's global political climate is not well suited to having productive or fair discussions about SRM.

They worry that powerful “greedy and disruptive” world leaders will dominate SRM conversations and make decisions that protect their own interests while leaving smaller or poorer countries exposed to negative impacts of SRM.

> *“It's a political problem, isn't it? Countries have vested interests. They always have. They always will have. What's good for the US might not be good for Tuvalu, let's say.”* Workshop 3, Exeter

> *“It's going to be more about the haves and the have-nots. So, those economically rich countries will be able to have more and dictate to the detriment of those that have not.”* Workshop 2

Some participants believe ongoing global conflicts will make global cooperation on SRM even harder. They fear that SRM could be weaponised or used for political leverage (see Theme 3 impacts and unintended consequences).

> *“This could be used by bad actors to control. Countries with a lot of power could start using SRM as a way to manipulate, as a political distraction. There is enough global conflict going on, for example, Ukraine and Russia, to make that plausible.”* Workshop 3, Peterborough

Because of these concerns, some participants want researchers to model more realistic scenarios, where global power imbalances mean poorer countries have little influence on SRM decisions, or where some countries refuse to take part at all – including due to climate change denial.

> *“I think that this research needs to be more driven and focused on more realistic geopolitical scenarios. I’d like to see a bit more done to say, for example, if these countries don't buy into this, what are the impacts? If we're doing [SRM over] one quarter of the Earth or whatever, what are the sort of overarching impacts if we don't have full adoption and collaboration of various countries around the world?”* Workshop 2

Several participants referred to global events like COP meetings to show that international climate discussions often end with little agreement or progress.

Some participants are doubtful about the UK’s ability to engage effectively in a global conversation on SRM. They feel that UK politics, and the 4-5 year election cycle, drives a system which is too focused on short-term wins with climate action being deprioritised because it does not lead to quick political gains compared to other policies.

> *“People in power want quick wins to gain votes. These things are going to take a long time to implement, a lot of commitment, and they're not going to see results in a lot of people's lifetimes, or a lot of people's political career lifetimes. They're not going to see the fruits of their labour.”* Workshop 1

However, not all participant opinions are negative. Some do see potential for SRM to encourage greater global cooperation, noting that crises (such as the COVID-19 pandemic) can sometimes bring countries together.

> *"I'm just thinking, another hope could be global cooperation in the event it's decided and governed fairly, deployment could foster collaboration and maybe shared responsibility in all of this."* Workshop 2

As a result of the current complexity of geopolitics participants urgently call for global SRM governance infrastructure to be established. Many were concerned to learn that a global governance body did not already exist to regulate SRM research, experiments and potential deployment. They want to see a move from individual research institutions/ governments making their own rules to a global standard that reduces risk of harmful or rogue actions.

> *"I've put governance needing to be the urgent priority. When we were speaking in our groups, we were saying that we feel like we've almost missed a step. We're doing all this research and we haven't even sorted the governance part out. No matter how much the research progresses, if we're not all agreed on governance, then that could be really important."* Workshop 3, Peterborough

Participants have mixed views as to how best to globally govern SRM. Some think that a completely new governance body should be created, while others would prefer for it to be governed by existing institutions such as the UN. Some favour the UN because of its global reach and equal membership. One participant called it, "the safest possible pair of hands".

Others are worried because they perceive that the power of veto within the UN framework means that it is not an equal stage for decision making, thus leaving some countries vulnerable to negative consequences of SRM.

> *"If we went to something like the United Nations to do it, I think it would be drastically unfair that the main countries in the world that do most of the polluting that they've got a veto on any decisions that are made. I think everybody - every country in the world - should have equal voting rights and not a small group having vetoes on those decisions. Because…one of these big countries can just go in and say no if they don't like what they're hearing."* Workshop 4

Global collaboration between SRM researchers

As shared in chapter 5, participants strongly support international collaboration in SRM research. For some this is important because they feel that sharing modelling data globally could make predictions more accurate, and thus SRM a less risky option. For others, sharing work would increase the efficiency and efficacy of SRM research.

> *"We will do this, you do that. We'll research this, we'll do that, because you can make more progress that way."* Workshop 3, Peterborough

Many participants are concerned that without global collaboration the benefits of SRM will be confined to those countries with world-leading research facilities. They are concerned that an imbalance like this could have disastrous consequences for poorer or less developed countries. They see managing these relationships as being

part of the role of the research governance/ regulation framework that prevents this from happening.

Participants also call for collaboration across different types of expertise. They worry that if climate, political, social and engineering researchers each work in siloes progress will be slower and less effective. They would like to see investment in supporting these disciplines to work together.

Many participants are concerned about private companies accessing SRM research. They fear risks such as weaponisation, exploitation and reckless use. Some want private investment in SRM to be banned altogether, while others think that it is more realistic to create robust global rules that apply to both public and private sectors.

> *"I think one of the panellists mentioned that even if governments decide not to go with SRM, if we know how to do it, then there's also nobody in place to stop people with their own money doing it either. So there's this kind of governance issue, whether or not you decide to go for it, which I think should be kind of figured out before we start going full steam ahead."* Workshop 2

A global effort to reduce emissions

For many participants, it is crucial that SRM research does not distract from reducing GHG emissions (see chapter 5). Their view is that we cannot afford such a distraction and diversion of resources and investment when we are already missing emissions reduction targets.

Participants would like to see a more globally cohesive effort to reduce GHG emissions. If there is investment in SRM global governance infrastructure, participants call for equal investment in improving the governance of GHG emissions reduction. For example, they would like to see greater consequences for countries that invest in continued fossil fuel reliance despite knowing this will increase emissions.

> *"I think it's really difficult in our current climate when you've got the likes of America and Trump leading one of the biggest countries, you know, who don't believe in climate change and is pushing, you know, for fossil fuels. He's got such an influence over the world and other world leaders as well are on the same page. It's really difficult to see how, you know, how they are going to interpret SRM, because I feel like it could be used to their benefit because they're not bothered about climate change."* Workshop 1

6.3 Impacts and unintended consequences

Environmental impacts

As described in chapter 5 on research principles for SRM, participants feel strongly that SRM research should be guided by the principle "do no harm". Some participants are concerned that SRM research to date has been considered in abstract, theoretical terms, or at a minimum as human-centric, with little focus on potential harms to ecosystems, flora and fauna from SRM deployment. In their view,

this risk is increased by the fragility of ecosystems and the inability of plants and animals to speak up for themselves when decisions are made.

Participants are concerned about the environmental impact of SAI. They worry about sulphur dioxide in the atmosphere causing acid rain and call for detailed modelling to predict this risk. A few participants also mentioned the possibility of the air or rain creating a sulphurous smell.

> *"Everyone knows that sulphur smells. Is SAI going to make the air or the rain smell?"* Workshop 3, Chester

They also see SAI's need for many flights as hypocritical during a time when people are being encouraged to reduce air travel.

Many participants fear SRM could change weather patterns in ways that leave some countries vulnerable to heavy rainfall, especially places without strong infrastructure or enough funding to build it. This is why some participants see a global compensation fund as being crucial.

Some participants note the recent growth in renewable energy, specifically solar panels and wind farms, and want to understand how SRM might affect energy production. Some worry that reducing sunlight could make solar panels less effective, wasting money that people and governments have invested.

> *"What about the potential reduced power generation from solar panels by blocking out the sun. Would the solar panels that we've installed everywhere work as effectively now we're blocking out the sun? Does that negate going to work we've done over the last 50 years of putting solar panels everywhere?"* Workshop 3, Peterborough

Health impacts

Some participants are concerned about how SRM could impact both physical and mental health. This includes consequences of a lack of vitamin D (from lower levels of sunlight), such as increased levels of seasonal depression.

> *"Whenever we have no sun, everyone is miserable for long periods. I just feel…could this affect our mental health?"* Workshop 3, Glasgow

Others are more concerned about system level impacts, such as an increased pressure on the health system if temperatures drop leading to cold weather related illness increasing. There is also concern related to the health impacts of injecting sulphur dioxide, and potentially other material, into the atmosphere for SAI.

> *"Thinking about the chemicals they use in SAI. I've looked them up and there's health issues with all of them from respiratory problems, digestive problems, skin irritation, interfering with the body's hormones. That's my worry that this will be used for a prolonged period, and we will suffer with our health."* Workshop 2

These risks led many participants to call for World Health Organisation (WHO) involvement in SRM research as well as thorough modelling of the impact of SRM on human and animal health. They warn that if SRM is found to cause health problems, public support will drop quickly.

Economic impacts

Participants are worried about how temperature drops caused by SRM deployment could affect agricultural production and how this could hurt economies, especially in less developed countries that depend heavily on agriculture. They fear this could worsen global inequalities. Participants are also concerned about the cost to taxpayers if SRM is deployed. They warn that this could lead to backlash, given how controversial SRM is. However, some participants are hopeful that SRM could save money compared to adapting to constantly rising temperatures.

> *"It costs nothing compared to in terms of what we currently pollute in terms of SO_2. And also costs. I mean, he said it would cost £50 billion per year. I didn't actually think that was much at all, when you consider that every world government would contribute towards the 50 billion. I mean, you know, for someone, for America on its own, I don't think it would think anything about spending 50 billion."* Workshop 2

Participants call for comprehensive economic modelling and forecasting in order to understand the impact of SRM deployment on local and global finances.

> *"Economic impact. If we act, what will it do to economies? Will it be beneficial? I mean, this is just looking at cooling the climate, but could it have effects on farmers, crop growing, or other industries?"* Workshop 4, Chester

Weaponisation

The risk of SRM being used as a weapon concerns participants, rooted in the belief that SRM deployment will most likely happen (if it does happen) in a time of ongoing global conflict. They mostly fear that SRM could be used to damage crops, cause famine, or trigger storms or other weather events with the aim of destroying infrastructure. Some drew on the Vietnam war as an example of weather modification[34] to lead them to this conclusion.

> *"My son has worked for the last 16 years as a Royal Marine. He thinks SRM will be weaponised. He thinks 100%, not even 80%, he went 100%. If it gets done, it will be used as a weapon, either to cause drought or whatever, to cause rain, as it was done in Vietnam. It was the Americans used it to cause rain, to flood, so the Vietnamese couldn't load up their troops. My son says 100% it'll get used as a weapon somewhere."* Workshop 4

Some participants defined the weaponisation of SRM as a geo-political negotiation tool, via monetisation. They felt that one country could fund SRM research being

[34] The New York Times (Archive), U.S. Admits Rain-Making From '67 to '72 in Indochina, May 1974

conducted by another, but that in doing so they would want something in return. They described this in terms of the Global North extracting resources from the Global South.

> *"Obviously, the big one, the old elephant in the room was weaponisation from the government and the private sector because they can monetise it. A poorer continent like Africa, America can turn around and say, "We're going to give you X millions of pounds to help your research, but we want something back. It could be minerals. It could be things that are beneficial to Africa, which they're taking away. I mean, it's happening in Ukraine right now."* Workshop 3, Exeter

Many participants add this to the arguments for global governance to prevent misuse. It is also one of the reasons why participants were so supportive of transparency at all stages in the continuum from SRM research to deployment, and why they want to make sure that scientists are central to the governance effort, in an effort to ensure all research, small-scale trials and potentially larger scale deployment are conducted ethically.

> *"Making sure that it isn't weaponized, and if there was a body who governed SRM that it was not made up entirely of politicians. Obviously, you'd have to have some, but to make sure that it included a lot of scientists who really knew what they were talking about. Just making sure that every aspect of it was ethical."* W3 Chester

There was agreement across all the locations that weaponisation of any potential SRM technologies is a real threat which needs to be taken into account by research funders and policy makers alike. Some, therefore, felt that research should be done which considers which countries or states might be more likely to use SRM for harm and why.

> *"Has there been any kind of analysis done on the likelihood of any particular state to deploy this? Like, given nuclear weapons, for example, we know that there are a number of nuclear powers, but the likelihood of any of them using nuclear weapons is incredibly slim because it's you use your discretion. So is there any analysis done to say that actually it's likely or unlikely that this particular state is going to deploy?* Workshop 3, Peterborough

Termination shock

Some participants were particularly concerned about the potential for termination shock, and the impact of stopping deployment would have on the climate. They called for research in this area and clarity on what the exit strategy would be should SRM be deployed.

> *"I think the thing that scares me about it is that if it was to be deployed, that it couldn't just be terminated, because that would have even greater consequences."* Workshop 2

> *"I'd want them to look at the exit strategy. How reversal strategy if it did go wrong-- Because a termination shock is not just going to pull a plug. If we start*

seeing negative effects of what we're doing, how are we going to get ourselves out of that." Workshop 3, Chester.

6.4 Public trust and engagement are essential for SRM

Given the complexity of the issues, responses to climate change and the febrile geopolitical context, trust was a thread that ran through dialogue discussions. Throughout the dialogue process participants raised the importance of building trust through public engagement on SRM. This is in the context of what they see as a disintegration in recent years of trust between countries, in government, in public institutions and across communities.

> *"An issue is that lack of trust between countries, there is no trust between countries. If Putin came up with an idea and told Trump we're going to do this, do you think they agree?"* Workshop 3, Chester

> *"I just think trust is very important going forward because I honestly feel the UK citizens don't have any trust anymore. There's a lack of trust at the minute in the government. That will affect everything."* Workshop 3, Glasgow

> *"We don't even trust each other in our communities at the moment. We need to do everything we can to rebuild trust in all aspects of life."* Workshop 1

Participants' reflections on the principle of transparency, integrity, and accountability described in chapter 5, link closely to their perspectives on trust in institutions. Some felt that full transparency would help to overcome mistrust in research and reduce the likelihood of conspiracy theories developing.

> *"I'd say publicising what they're doing because I think the majority of people have a bit of scepticism about these sides of things behind closed doors, big thick concrete walls. In those gaps, that's where conspiracy theories take hold. If they were to come forward and be open and honest with it all, then you might have more support from the public about it."* Workshop 4

Perceived lack of trust and potential for transparency not to be embedded in SRM research and future deployment led participants to place a high value on engaging the public in a range of ways in SRM research. Their suggestions include:

- A public vote/ referendum on more significant decisions;
- Surveys and deliberative workshops to understand public opinions as publics become more aware of SRM research;
- A standing panel of citizens who can be informed of research progress, be part of decision-making processes and be mindful of the potential unequal impacts depending on where and how research experiments and field trials take place;

> *"The panel would oversee the information that's being presented to them, and their thoughts have to be taken into account, especially in the areas that they're representing. Say, because we're Glasgow, it might not have the same effect for us. I feel it's very important, as citizens with something like us here, there has to be a panel for citizens."* Workshop 3, Glasgow

- A youth forum which puts its focus on the benefits and risks of SRM research and deployment for future generations;
- Public debates to take place should it ever come to the point of deployment – and the views that come from that debate informing the decision on whether to deploy or not;
- Education, in its broadest sense, on SRM research so as to include children and young people, but also to ensure that policy and decision makers understand SRM and its implications so that they can make informed decisions;
- Communication on SRM research, including visualisations of the methods and their potential effects.

> *"Public awareness and spreading that research is very, very important. Anybody can tell you about what the last Star Wars film was about. Nobody can tell you about the world's suffering from global warming and what researchers are working on to cool the planet. I think that's kind of ridiculous. There should be a way for researchers and science and education to reach masses, not just other educated people, or other scientists."* Workshop 4

The main reason participants are calling for public engagement, awareness raising and clear communications around SRM research is to build trust. A few participants are worried that, without meaningful engagement, fear could be generated causing a backlash against SRM research, and potentially other climate related research programmes. They believe this would be harmful in efforts to mitigate against climate change and could cause more climate scepticism in the population.

> *"Globally and nationally the awareness with the public does need to come to the fore about this research, because I don't think people know about it. And I think if it was dropped on the public without anything, it could be very scary. And you'd get a lot of resistance and people would take against this research and other climate research."* Workshop 4

Clear communications about SRM research are highlighted as essential by participants. They suggested that if there is a vacuum in factually correct information on these methods and approaches from the scientific community then others, not working from a position of truth, come in to fill the information void.

> *"I think the gap gets filled by misinformation on the Internet. That's another big worry and issue because there's so much information that is wrong and people believe it. And it's so difficult that link between what the scientists are doing and what the public understand and what the public wants to believe as well. It's a problem."* Workshop 4

Participants joined the dialogue without knowing about SRM. As the dialogue progressed this led to a strong desire for early, transparent, accessible education and communication on SRM research. Many want the public, especially young people, to understand SRM well enough to participate in decision-making. Trust, misinformation, side effects, and governance challenges all emerge as key concerns that participants feel better engagement and communication could help to address. This belief is shared because of the potential for SRM research and potential deployment to affect all people wherever they live on the planet.

7. Conclusion

The public dialogue reveals that people are largely unaware of SRM, but are deeply thoughtful about reasons for SRM research and potential consequences of any future deployment once they are informed. The findings here are consistent with the 2010 Sciencewise public dialogue and public perceptions research since then. Participants express a combination of curiosity, caution, and concern, consistently calling for:

- Assurance that SRM will not distract from emissions reduction;
- Robust global governance and ethical oversight;
- Clear communication of risks, uncertainties, and alternatives so that trust is built;
- Greater public education and transparency of outcomes and potential impacts.

SRM research and any potential deployment is contingent upon trust, legitimacy, and ethical integrity being embedded across all actions with key principles and global governance for if and how SRM is developed. Future SRM research, field experiments, or potential deployment must prioritise public involvement, open access to information, and global cooperation, reflecting the seriousness and global reach of SRM decisions.

Key themes woven through participants' responses to SRM:

SRM research is supported when conducted within research principles

Participants show interest in and conditional support for SRM research which they believe is important in informing policy, decisions and future action. They consider ethically conducted research is essential in understanding the potential implications, consequences and effectiveness of SRM. Participants agreed on a set of six research principles which further demonstrate their support for SRM research conducted within robust ethical frameworks and global governance measures. There is much consistency between participants' principles and existing principles and guidance developed through academic research.

The principles set out in chapter 5 are reshared in Table 2 below with the addition of a commentary on the main audiences for each principle. They draw on what participants said during the dialogue rather than setting out a comprehensive plan for communicating each principle to each main audience. We recommend that further work is done by stakeholders: government, research funders (including NERC and ARIA), and those working on public engagement on complex and controversial areas of science, to understand the implications of these principles and to apply and develop them further as the science, the research and any potential deployment approaches are developed.

Table 2: Key principles and the audiences to which they relate	
Principle for SRM	**Audience**
Do no harm to people or the environment Participants require that SRM research is safe for both human life and the environment, in both the immediate and the long-term future. Participants were primarily thinking of outdoor experiments and potential deployment.	**Research community** Should adhere to research principles and work across disciplines to consider all impacts. **Government/ policy makers** Should ensure governance measures are in place which prioritise the ethical dimensions of SRM. **Research funders** Should include this as a criterion when assessing funding applications.
Do not distract from reducing greenhouse gas emissions An emphasis was placed by participants on SRM research not diverting attention away from efforts to address the underlying causes of climate change – specifically decreasing GHG emissions – both within the UK and internationally.	**Government/ policy makers** Should ensure that nothing is done distract from national and global ambitions to tackle climate change urgently. **Research funders** Should ensure funding of SRM research does not divert funding or resources from emissions reduction research or other research to combat the implications of climate change. **Research community** Should ensure that academic institutions' research strategies are not diverted from reducing greenhouse gas emissions because of SRM efforts.
Global collaboration, equity, and governance of SRM research With this principle, participants call for SRM research to be globally coordinated and collaborative. They want to see specialists with a diversity of expertise working together. They believe these efforts should be governed by an international body, providing oversight and ensuring all countries have a voice in decision making.	**Research funders** Should ensure that the conditions are right for global collaborative research with integrity and equity. **Research community** Should seek to co-design research with colleagues around the globe. **Government/ policy makers** Should ensure governance measures are in place which are global, collaborative and inter-disciplinary. Work should be done to establish effective oversight for research and any future deployment.

Public information and engagement in SRM research and decision-making. This principle requires the public to be informed, educated, and engaged in SRM research and decision-making, in the UK and around the globe. It links closely to the transparency principle.	**Government/ policy makers and the public engagement sector** Should ensure that societal values shape governance and decision-making through meaningful and ongoing deliberative, participatory and engagement processes. This endeavour should be led and supported and encouraged by **research funders, the research community,** and **government/ policy makers**.
Prioritise the public good and future generations With this principle, participants call for SRM research to prioritise the public good, focusing on the needs of all nations and people, and with a particular focus on future generations.	**Government/ policy makers** Should align policies on SRM with these research principles, ensuring that the conditions are in place for future-proofed policies and the involvement of people, particularly young people in decision and policy making. This endeavour should be supported by **research funders** and the **research community.**
Transparency, integrity, and accountability in SRM research Participants consider transparency, integrity, and accountability as foundations for ethical and trustworthy SRM research.	**Research community** Should adhere to research principles and understand their work is given a mandate when conducted with transparency, integrity and clearly demonstrates accountability to society. **Research funders** Should ensure funding of SRM research meets the principles set by participants in this public dialogue. **Government/ policy makers** Should align policies on SRM with these research principles.

Participants included in their deliberations thinking about aspects of SRM research, which are not part of the principles but are related to them. These include the consideration that SRM:

- May have the potential to uncover new solutions and unexpected outcomes in society's desire to tackle climate change;
- Given its innovative nature, could attract the next generation of researchers into environmental science;
- Should use computer modelling more broadly to examine the effects on nature, biodiversity and ecosystems, and people – looking beyond a theoretical of technology-centric understanding, weighing up all possible scenarios to inform decision making;

- Should model realistic scenarios of existing global power imbalances are now, and if they do not change what implications any potential SRM deployment has for countries with less global power and influence;
- Embeds regular assessment/ review of the research;
- Values interdisciplinary research which examines the efficacy of the science in the context of the ethical/ geopolitical context.

Do no harm is a key principle

Participants want to ensure the research (and potential deployment) has no serious adverse consequences. They highlighted that:

- Field trials and real-world experiments are in their view "risky" compared to computer modelling;
- Some would prefer SRM not to be considered at all, but want the toolbox to be ready in case of urgent need to cool the planet at pace;
- Global cooperation, accountability and planning is recognised as hard to achieve, but essential in ensuring risks are minimised and there is a global commitment to the principle of "do no harm";
- They worry about unintended consequences, both potential environmental and health impacts, and the harm would come from SRM research (and potential deployment) being seen as a replacement for net zero policies and action.

Exercise care and caution

A call for researchers, government and policy makers to exercise care and caution over the next steps for SRM research and potential deployment was highlighted. Participants said:

- Time should be taken to consider the unintended consequences of SRM, including termination shock;
- Including reflections on the global and regional impacts, particularly if some countries take unilateral action;
- Caution at this stage should extend to field trials and small-scale real world experiments – particularly in Global South and countries which have less power and influence on the global stage;
- Care should be taken on how the research is funded and by whom, with some being extremely wary of private companies or entrepreneur funded projects which would not have the same guardrails around it as publicly funded research.

Act with transparency, communication with clarity

Building trust by acting with transparency and communicating clearly is essential for participants who, as we've seen, are conditionally supportive of SRM research when conducted within principles. Participants said that public awareness should be raised significantly on SRM research. If it is not, they feel there will be resistance to future research, including on climate mitigation, and a space will be created which will be filled by misinformation and conspiracy theories. They shared a desire for more engagement in a variety of forms: dialogue, deliberation, public votes, and a specific focus on the youth voice.

Participants said they joined the dialogue with no understanding of SRM. They left feeling the process had been worthwhile and wanting other people across society in the UK and globally to benefit from such deliberation and awareness raising.

> *"I joined this knowing nothing about SRM. But I really enjoyed the whole thing. I think it was done really well. I think it's very good to have all the people that the experts are, the people that know what they're talking about, especially how they often had conflicting opinions and different opinions. I think that was very well done to have a diverse range of information. People everywhere could really benefit from this, and that would support SRM research further."*
> Workshop 4

Given the call for further public involvement in this area HVM recommends further deliberative discussions with diverse people across society, in the UK and globally. Such deliberation could include work in the following areas:

Foundations for future deliberation
The findings from this public dialogue build on and chime with those of previous deliberations. This should not be the end of the story. The principles developed here could be revisited in future Sciencewise deliberations, to develop understanding of what the principles mean in detail as SRM policies develop.

Outdoor experiments
This public dialogue explored publics perspectives on SRM across all aspects but did not explore outdoor experiments in depth. We therefore recommend a deliberative process on UK publics' views on different types and scales of outdoor experiment, and what good governance would look like, building on the principles developed by participants in this public dialogue.

Involvement of private companies
Given diverging views on private sector involvement in research, we suggest further deliberation into potential private sector involvement in SRM research, again building on the principles developed as part of this public dialogue.

Global deliberative processes
This deliberative process was conducted with a group broadly reflective of the UK population. Given the global nature of SRM we recommend that a future deliberation is integrated into existing global citizens' involvement mechanisms on climate change, such as the Global Citizens' Assembly[35] or the Global Climate Assembly[36]. This could integrate a standing panel element supported to be kept informed of developments in research and be part of the decision-making process. This group could pay particular attention to the ethical and societal implications of SRM research and any future deployment, being mindful of the potential for unequal impacts depending on where trials and scaled deployment take place.

[35] https://globalassembly.org
[36] https://www.aceobservatory.org/peoplesclimate

Acknowledgements

Hopkins Van Mil would like to thank all the participants in the SRM public dialogue who, from in the autumn of 2025, explored the topic of SRM with such care, thoughtfulness and kindness. Their commitment to their responsibility of hearing the evidence, reviewing the information and forming opinions was impressive and profound.

We are grateful to the project team from NERC and Sciencewise, plus the evaluation team from URSUS Consulting. Your expertise in the topic and in deliberation has been an essential guide to the process.

Thank you to members of the project's Oversight Group, chaired by Professor Jack Stilgoe, science and technology policy at University College London, who have given impartial, informed advice, challenge and guidance on the complexities of SRM. The OG worked hard to ensure the evidence, content, and stimulus materials presented to the public dialogue participants shared a range of perspectives and covered the key issues of SRM research and potential future deployment. They have guided and advised on this report to ensure it is a balanced representation of participants' views and builds on previous public engagement and participatory programmes.

We also thank those who took part in the design workshop in the scoping phase of the project. This event helped to shape and inform the public dialogue process and the findings presented in this report.

We are very grateful to all our specialist speakers. They generously gave their time to ensure that public dialogue participants heard evidence and a range of views on this complex and contentious topic.

Thank you to our partners the Sortition Foundation and Postcode Films, who worked tirelessly to deliver key elements of the project. The recruitment process and the public dialogue films have all been essential to our robust and transparent process.

Appendices

Postcode Films: participants in workshop 3, Peterborough

Appendix A: NERC SRM research funded projects

The Natural Environment Research Council (NERC) is investing £10.5 million in four research projects to model the risks and impact of SRM. The four projects (themes 1-4) will not deploy SRM in the real world or real-world experiments, instead they will use computer modelling and historical data to understand the potential risks and impacts of SRM.

Theme	Title	Organisations	Link
Theme 1: Stratospheric Aerosol Injection (SAI)	Advancing holistic risk assessment for measures to address climate change	**Imperial College London,** University of Bristol, University of Leeds, University of Exeter Led by Sebastian Eastham	**Video**
Theme 2: Marine Cloud Brightening	MACLOUD (MArine CLOUD Brightening)	**University of Exeter,** University of Leeds, University of Reading, University of Manchester, University of Oxford Led by James Haywood	**Video**
Theme 3: Natural analogues	QUESTION: Quantifying efficacy and risks of solar radiation management approaches using natural analogues	**University of Brimingham,** University of Edinburgh, Centre for International Climate & Environmental Research Led by Ying Chen	**Video**
Theme 4: Novel Solar Radiation Modification (SRM)	ECLIPSE: Evaluation of CLimate Intervention through novel Potential StrategiEs	**University of Cambridge**, University of Exeter, Imperial College London Led by Shaun Fitzgerald	**Video**

Appendix B: Oversight Group members

Oversight group	
Jack Stilgoe (Chair)	Professor of Science and Technology Studies, University College London
Alexander Hall	Science communication expert, McMaster University
Duncan McLaren	Research Fellow at the Emmett Institute, University of California, Los Angeles (UCLA)
Joanna Haigh	Professor of Physics, Imperial College London
Nick Pidgeon	Professor of Environmental Psychology and Risk, Cardiff University
Chukwumerije Okereke	Professor of Global Governance and Public Policy, University of Bristol
Hugh Hunt	Professor of Engineering, University of Cambridge
Jim Haywood	Professor of Mathematics and Statistics, University of Exeter
Savio Moniz	Head of Climate Science Research, Department for Energy Security and Net Zero (DESNZ)
Kate Scott	DESNZ
Tracey Dale	Senior Research Portfolio Manager, Economic and Social Research Council UKRI (ESRC)
Jim Fleming	Head of Energy Theme, Engineering and Physical Sciences Research Council UKRI (EPSRC)
Emma Bessent	Senior Investment Manager for Environment and Health, Arts and Humanities Council UKRI (AHRC)

Appendix C: Recruitment Specification

This specification was developed by the HVM team and incorporates suggestions from the OG.

The aim was to recruit 56 people who are broadly reflective of the UK population. Table 1 provides information about where participants were drawn from and where they met.

Table 1: Indicative recruitment and workshop locations		
Region	**Number of participants per region (approx. split)**	In-person workshop location
Scotland and Northern Ireland	14 (4 Belfast, 10 Glasgow and surrounding area)	Glasgow
Wales and North West England	14 (approx. 7 Wales and 7 North West England, aiming for good transport links to Wrexham e.g., Cheshire West, Shropshire, Liverpool)	Chester
Southern England	14 (Southern England, aiming for good transport links to Exeter e.g., Plymouth, Taunton, Bristol.)	Exeter
North East and Eastern England	14 (North East and Eastern England, aiming for good transport links to Peterborough e.g., Nottingham, Doncaster, York, Leicester, Hull, Cambridge)	Peterborough

The following criteria were applied to participant selection:

- Gender – An appropriately balanced mix of people who identify as male, female or non-binary.
- Age – A broad distribution across all adult age groups from 18 upwards. Slightly boosted sampling for 18-24 year olds, aiming for a minimum of two young people in each location.
- Ethnicity – Broadly reflective of the UK population, aiming for a minimum of two participants from ethnic minority backgrounds in each population.
- Socio-economic status – Broadly reflective of the UK population, using educational attainment as a proxy for socio-economic status.
- Geography – Aiming for a mix of rural and urban participants, with some representation from coastal areas.
- Religion – A slightly boosted sample of people who identify as having religious faith, exceeding current census data. The aim was for a diversity of faiths (e.g. Christian, Muslim, Hindu, Jewish, Sikh, and others).
- Attitudes towards climate change – A spectrum of attitudes towards climate change, aiming for a minimum of two in each location who are less concerned.

Participants were recruited by Sortition Foundation using their database.

Appendix D: Specialist presenters

Nineteen specialists provided information and evidence to dialogue participants in the online and in-person workshops. They also answered questions in formal Q&A sessions and informally during breaks and in small group sessions.

- Dr Lizzie Garratt, NERC: An overview of NERC and NERC's research funding role
- Bob Ward, LSE: Introduction to climate change and ways to address it
- Trisha Patel, University of Cape Town: An introduction to SRM
- Professor Catriona MacKinnon: University of Exeter; Professor Chukwumerije Okereke, University of Bristol; Dr Shaun Fitzgerald OBE FREng, Director of Research in the Centre for Climate Repair at Cambridge University; Dr Shuchi Talati, Founder and Executive Director of the Alliance for Just Deliberation on Solar Geoengineering (DSG): A panel discussion on the range of issues and ethical considerations on SRM
- Professor James (Jim) Haywood, University of Exeter: A deeper dive into the SRM science
- Nikolaj Kornbech, University of Roskilde: SRM in the arctic and potential impacts on communities if deployed
- Professor Olaf Corry, University of Leeds: the global and planetary perspective on SRM – the context of all species
- Cynthia Scharf, Senior Fellow at the Centre for Future Generations
- Dr Ying Chen, Birmingham University
- Professor Mark Symes, ARIA

In each of the in-person workshop locations, presentations were given by a climate scientist and an ethicist:

Exeter:

- Alistair Duffey, UCL
- Dr Danielle Young, University of Leeds

Glasgow:

- Professor Gabi Hegerl, University of Edinburgh
- Professor Rita Floyd, University of Birmingham

Chester:

- Dr Sebastian Eastham, Imperial College London
- Dr Wouter Peters, University of Birmingham

Peterborough:

- Jacob Pantling, University of Cambridge
- Clara Botto, Director of Outreach at DSG

Appendix E: Sample workshop programmes

Online workshop one: Context setting:

Programme 9 September	
6:00	Welcome and introduction, including ways of working
	Menti question (tracking question throughout): What words come to mind when you hear SRM?
	Presentation NERC – the context for the dialogue, why it was commissioned and the expected influence that participants will have in taking part. Which organisations are involved. + Q&A.
6:40	Small group discussion on the images participants have shared on climate change, locally, regionally, nationally, globally
7:10	Presentation – Bob Ward, Policy and Communications Director and Interim Executive Director of the Just Transition Finance Lab Grantham Institute: an introduction to climate change and ways to tackle it + Q&A
7:35	Break
7:45	Presentation – Trisha Patel, Research Assistant, African Climate and Development Initiative (ACDI), University of Cape Town, SRM part 1: What is SRM? The basic idea in the context of climate change and ways to address it, brief history and intro to considerations + Q&A
	Small group discussion to reflect on what's been heard including initial thoughts on SRM.
8:55	Briefing for next workshop, wrap-up
9:00	Close

Online workshop two: Deeper dive into the topic:

Programme 16 September	
6:00	Welcome and introduction, reminders of ways of working
6:10	Menti question (tracking question throughout): What words come to mind when you hear SRM?

6:15	Panel – SRM part 2: A Panel discussion to inform participants of the range of considerations - ethical, geopolitical, social, economic, environmental. Panellists bring a range of perspectives + Q&A. Professor Catriona MacKinnon, University of Exeter; Professor Chukwumerije Okereke, University of Bristol; Dr. Shaun Fitzgerald OBE FREng, Director of Research in the Centre for Climate Repair at Cambridge University; Dr. Shuchi Talati, Founder and Executive Director of the Alliance for Just Deliberation on Solar Geoengineering (DSG).
	Small group deliberation on SRM and the considerations it raises
7:30	Break
7:40	Presentation – SRM part 3: A deeper dive into science / the main approaches + Q&A. Professor James Hayward, Professor of Atmospheric Physics, University of Exeter
	Small group deliberation on SRM and the considerations it raises
8:55	Briefing for next workshop, wrap-up
9:00	Close

In-person workshop three: From considerations to conclusions

Programme 20 (Exeter & Glasgow) or 27 (Peterborough & Chester) September	
11:00	Welcome and introduction, reminders of ways of working
11:15	Menti question (tracking question throughout): What words come to mind when you hear SRM?
11:25	Small group discussion: feedback on the friends and family discussion task
11:50	Carousel sessions (small group deliberations with groups swapping topics): Thinking about key considerations (supported by ethicist) Thinking about the science (supported by a climate scientist)
12:50	Lunch

1:35	Small group deliberations, drawing conclusions from the information shared throughout. Considering the principles, red lines and conditions to guide SRM research and any potential next steps.
3.30	Whole group sharing and collating key themes that have emerged Specialists share their reflections
3:50	Briefing for next workshop, wrap-up
4:00	Close

Online workshop four: Bringing it all together: UK reflections in a global context:

Programme 16 October	
6:00	Welcome and introduction, reminders of ways of working
6:15	Menti question (tracking question throughout): What words come to mind when you hear SRM?
6:20	Small group deliberation: reflections, thoughts and feelings on SRM having been this far through the process, changes in views and attitudes since joining the dialogue.
6:40	Presentations: 1) National and global considerations, looking to the future. 2) Feeding back the recommendations made/ principles agreed in each location + Q&A
7:30	Break
7.40	Small group deliberation: reflecting on the recommendations and principles, what's missing, what's most important, what has the biggest implications and what are those implications
8.35	Plenary sharing key points and amended principles
8.55	Briefing on reporting and next steps
9:00	Thanks from NERC / HVM and close

Appendix F: Sample stimulus materials

Words and terms we'll use in this SRM public dialogue

1. Introduction

This public dialogue is about SRM, a range of ideas for ways of potentially reflect sunlight away from the Earth to limit the effects of global warming. These ideas are known by various names, including Solar Radiation Modification (SRM), Sunlight Reflection Methods, and Solar Geoengineering. We explain more about SRM in the document *What SRM means and words to describe it*.

Below you will find words and phrases that you might hear in our workshop discussions or read about as you take part in the dialogue.

- You do not have to learn the words to take part.
- You can come back to this document whenever you need to.
- If anyone uses a word you don't know, ask them to explain it – you probably aren't the only one who would like an explanation.
- We will add new words and explanations that come up during the process.

Words like this (underlined in black) are also explained in this document.

Words like this (underlined in blue) link to external websites to find out more.

We have grouped these words under the following headings:

- About climate change and ways to address it
- About SRM and related terminology
- Other words that relate to climate change, and particularly to SRM

2. About climate change and ways to address it

Words about and related to climate change:

- **Climate change** – The long-term shift in climate patterns such as the Earth's average temperature and weather conditions. Find out more in the Overview of climate change document.
- **Climate misinformation** – Inaccurate or misleading information about climate change, including conspiracy theories.
- **Carbon dioxide (CO_2) emissions** – Carbon dioxide is a greenhouse gas produced by human activity such as burning fossil fuels, which is harmful to the environment. Since the Industrial Revolution, CO_2 emissions from human activity have increased.
- **Global emissions** – The total amount of greenhouse gases emitted across the world.
- **Global warming** – The increase in the Earth's average temperature.

- **Greenhouse gases (GHGs)** – Gases which keep the Earth warm, including for example carbon dioxide (CO_2), methane and nitrous oxide. Human activity has led to increases in greenhouse gas emissions, and this contributes to global warming and climate change.
- **Greenhouse effect** – This is where greenhouse gases (e.g. CO_2) trap heat in the Earth's atmosphere. It keeps the Earth warm so we can survive but too much of the greenhouse effect contributes to global warming. If there is too much CO_2 in the atmosphere it increases the greenhouse effect, which means heat from the Sun can't escape the inner atmosphere, causing the planet to become warmer.
- **Net zero** – Net zero will be reached when the amount of greenhouse gases that are added to the atmosphere is balanced by the amount taken out. This is through reducing emissions and removing greenhouse gases through methods such as carbon capture. The UK Government has committed to reaching net zero by 2050.

Words related to addressing climate change:

- **Adaptation** – Actions to help people adjust to the impacts of climate change now and in the future, such as growing crops that can survive in different weather conditions. Find out more here.
- **Decarbonisation –** Reducing or removing carbon dioxide and other greenhouse gas emissions resulting from human activity from the atmosphere. Ways to decarbonise including using renewable energy sources rather than fossil fuels and reducing the amount of energy that is used (energy efficiency).
- **Emissions reduction** – Lowering the amount of greenhouse gases produced by an individual, organisation, country etc.
- **Geoengineering** – Intentional and large-scale changes made to the Earth's climate, to reduce and counteract climate change. SRM is considered geoengineering and so is greenhouse gas removal.
- **Greenhouse gas removal** – Where humans use approaches to remove greenhouse gases such as carbon dioxide from the atmosphere and store them. This includes carbon capture, where carbon is intentionally captured from sources such as industrial plants before being released into the atmosphere, and instead is stored underground. It also includes approaches such as afforestation, which means planting trees to absorb CO_2. Find out more here.
- **Mitigation** – Action to reduce or remove greenhouse gas emissions, such as replacing fossil fuels with renewable energy.

3. About SRM and related terminology

SRM potential approaches:

- **Cirrus Cloud Thinning** – This is a potential SRM approach. Cirrus clouds are thin clouds that trap heat in the atmosphere. Thinning these clouds by adding particles in the right places could allow more heat to be released from the atmosphere to space. Find out more here.

- **Ice thickening** – This is a potential SRM approach. It involves pumping sea water onto existing ice, which could thicken the existing ice sheet. Find out more here.
- **Marine clouds** – Marine clouds are clouds that form over the ocean. They are usually low lying (e.g. stratocumulus clouds) and reflect sunlight back into space and as a result help to cool the Earth.
- **Marine Cloud Brightening** – This is a potential SRM approach. It aims to increase how reflective low marine clouds are by injecting or spraying (sea salt) particles from the ocean into them. This would increase cloud droplets within a cloud so there is more surface for sunlight to be reflected from. The goal would be to reduce the amount of heat that reaches the Earth's surface. Find out more here.
- **Marine Sky Brightening** – This is a potential SRM approach. Using computers, scientists will test whether a haze could be created in areas where there aren't marine clouds.
- **Stratospheric Aerosol Intervention (SAI)** – This is a potential SRM approach. It aims to release sulphate particles into the stratosphere to increase the reflection of sunlight. Find out more here.
- **Space mirrors/ sunshades** – This is a potential SRM approach. It aims to send mirrors into space to reflect sunlight. Find out more here.
- **Surface Albedo Modification (SAM)** – This is a potential SRM approach. It aims to increase the reflectivity (albedo) of surfaces of the Earth. Proposals include urban albedo modification (using more reflective building materials or colours in urban settings e.g. for roofs and paving), crop albedo modification (planting crops with a higher albedo than currently grown) and desert albedo modification. Find out more here.

Words used to describe parts of the Earth's atmosphere:

- **Atmosphere** – The five layers of gases surrounding and protecting the Earth (including the stratosphere and troposphere).
- **Marine boundary layer** – Part of the Earth's atmosphere just above the sea. It is fundamental to climate because of its role in reflecting sunlight back to space.
- **Ozone layer** – A layer of the Earth's atmosphere that shields the Earth from harmful UV radiation from the Sun. It is part of the stratosphere.
- **Stratosphere** – The second layer of the Earth's atmosphere, above the troposphere and containing the ozone layer.
- **Tropopause** – The boundary in the Earth's atmosphere between the troposphere and the stratosphere.
- **Troposphere** – The lowest layer of the Earth's atmosphere, from ground level to just above sea level.

4. Other words that relate to climate change, and particularly to SRM

- **Albedo** – How reflective a surface is. For example, snow is very reflective and has a high albedo.
- **Natural analogues** – Naturally occurring events which cool the Earth's temperature and are therefore compared to SRM. For example, a natural analogy for Stratospheric Aerosol Intervention is volcanic eruptions, which have cooling effects because of the particles released into the stratosphere.
- **Cryosphere** – Parts of the Earth's surface and system that are frozen water e.g. snow, ice sheets, glaciers, sea ice.
- **Geopolitics** – How geographical factors (e.g. country size, location, natural resources) interact with political power dynamics and international relations.
- **Heat** – Heat is a form of energy that makes things feel warm or hot.
- **Heat flux** – Heat flux refers to how much heat is transferred from one place to another over time. Sunlight entering a window and warming your home on a hot day is an example of heat flux.
- **Modelling** – Computer simulations of the Earth's climate. You might hear the phrase climate modelling, which is used to understand past changes and predict future changes in climate. It can help to predict how the climate might evolve in different situations, such as increases or reductions in greenhouse gas emissions. You might also hear the phrase computer modelling which (in this case) refers to computer simulations of SRM approaches to predict their potential impacts on the Earth's climate.
- **Moral hazard** – With regards to SRM, this is the concern that increased knowledge, information and discussion of SRM will deter efforts to reduce emissions.
- **Reflectivity** – Increasing the Earth's ability to reflect some of the Sun's radiation (solar radiation) back into space. See also albedo.
- **Risk-risk** – Understanding and balancing the risks associated with researching and/or deploying SRM as well as the risks associated with not researching and/or deploying SRM in relation to future climate change.
- **Solar radiation** – The sunlight and energy that comes from the Sun. After passing through the atmosphere, some of the Sun's energy is reflected back into space (e.g. by bouncing off things like clouds), and some of it gets absorbed by the land and oceans, which warms the Earth.
- **Surface UV radiation** – A type of energy called UV rays that come from the Sun and reach the Earth's surface.
- **Termination shock** – If SRM deployment was suddenly stopped, Earth's temperature would rapidly rise and other impacts may be seen.
- **Tipping points** – Critical thresholds that if reached, could lead to major and potentially irreversible changes in the Earth's climate system e.g. extreme weather, rising sea levels, and significant biodiversity loss.

1. What SRM means

SRM refers to a range of ideas for ways of potentially reflecting sunlight away from the Earth to limit the effects of global warming.

There are various ways to describe SRM including **Solar Radiation Modification, Solar Radiation Management, Sunlight Reflection Methods** and **Solar Geoengineering**. These terms have different connotations, but they all refer to SRM.

2. SRM approaches

Approach	Description	Potential local/global reach
Cirrus Cloud Thinning	Cirrus clouds are thin clouds that trap heat in the atmosphere. Thinning these clouds by adding particles in the right places could allow more heat to be released from the atmosphere to space. Find out more here.	This **could** have a global cooling impact, though it would have more detectable cooling impacts in colder places like the Arctic. It would have different effects e.g. on temperature and rainfall in different regions.
Ice thickening	This potential approach involves pumping sea water onto existing ice, which could thicken the existing ice sheet. Find out more here.	This could have local impacts on preserving sea ice in the Arctic.
Marine Cloud Brightening	This is a potential SRM approach. It aims to increase how reflective low marine clouds are by injecting or spraying (sea salt) particles from the ocean into them. This would increase cloud droplets within a cloud so there is more surface for sunlight to be reflected from. The goal would be to reduce the amount of heat that reaches the Earth's surface. Find out more here.	According to models, this could produce local, regional, or global cooling effects, depending on the scale of deployment. These effects would likely be uneven, e.g. a stronger cooling effect in regions with low marine clouds.
Marine Sky Brightening	This is a potential SRM approach. Using computers, scientists will test whether a haze could be created in areas where there aren't marine clouds.	As above.
Space mirrors/ sunshades	This is a potential and theoretical SRM approach. It aims to send	Space-based SRM could potentially target specific regions e.g. the Arctic. It

	mirrors into space to reflect sunlight. Find out more here.	could cool global temperatures.
Stratospheric Aerosol Intervention (SAI)	This is a potential SRM approach. It aims to release sulphate particles into the stratosphere to increase the reflection of sunlight. Find out more here.	This could lower global temperatures, but regions may see different impacts e.g. changes to rainfall.
Surface Albedo Modification (SAM)	This is a potential SRM approach. It aims to increase the reflectivity (albedo) of surfaces of the Earth. Proposals include urban albedo modification (using more reflective building materials or colours in urban settings e.g. for roofs and paving), crop albedo modification (planting crops with a higher albedo than currently grown) and desert albedo modification. Find out more here.	This could have a local impact to provide cooling e.g. painting buildings white in warmer countries. There is more limited potential for global reach, though desert albedo modification **could** have more potential for global cooling.

An overview of climate change

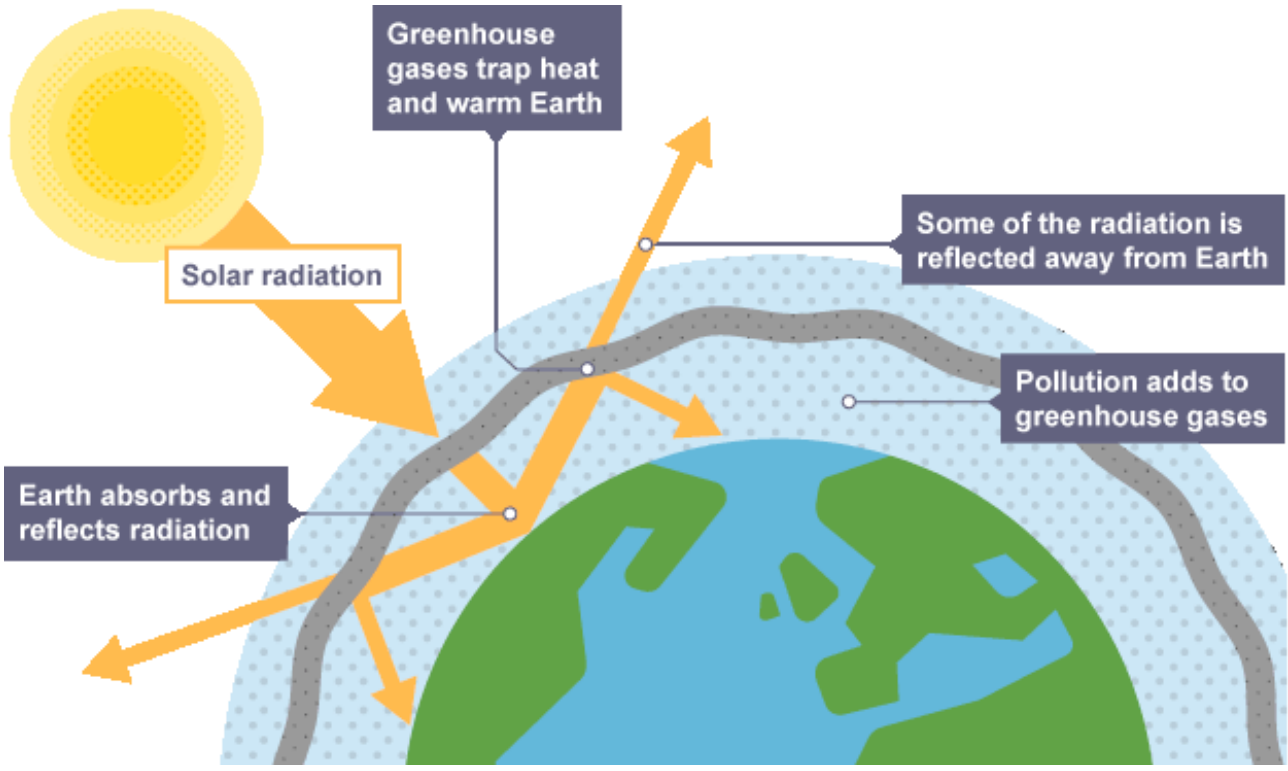
1. What is climate change?

Climate change is the long-term shift in climate patterns such as the Earth's average temperature and weather conditions. Sometimes climate change is referred to as a climate crisis or climate emergency to emphasise the urgent need to address it.

There has been rapid global warming in the last century, since the Industrial Revolution. The world is warming quicker than at any other point in known history[37]. This has been predominantly caused by human activity, in particular burning fossil fuels such as coal, oil, and gas.

Burning fossil fuels releases greenhouse gases (GHG), such as carbon dioxide (CO_2), methane, and nitrous oxide. Over time these have built up in the Earth's atmosphere and they trap the Sun's heat[38]. This has contributed to global warming and climate change. Other factors have contributed too, such as forests being cut down which reduces the amount of CO_2 being absorbed by trees, industrial processes, and farming practices that release greenhouse gases.

The effects of climate change vary in different places across the world but can include more extreme weather such as heatwaves, droughts or floods, more frequent or intense natural disasters, rising sea levels, and loss of species[39].



[37] Causes and Effects of Climate Change | United Nations
[38] What is climate change? - Met Office
[39] Causes and Effects of Climate Change | United Nations

2. Ways to address climate change

There are lots of different ways to address climate change. Actions can be taken on different scales by individuals, organisations, and countries. Sometimes people think about ways to address climate change in terms of:

Reducing greenhouse gas (GHG) emissions: Approaches to reduce greenhouse gas emissions. Also referred to as mitigation and/or decarbonisation.	**Removing greenhouse gases (GHG):** Approaches to remove greenhouse gases from the atmosphere and store them.	**SRM:** Potential approaches to counter rising temperatures. Also referred to as Solar Radiation Modification and solar geoengineering.
Using renewable energy sources such as wind turbines or solar power. Using sustainable transport e.g. cycling, public transport, and low emissions cars. Using sustainable food and farming practices such as reducing intensive farming and food waste. Reducing consumption of food, clothes, materials, and recycling/reusing where possible.	Direct carbon capture and storage, where carbon is captured from sources such as large industrial plants before being released into the atmosphere and instead is stored underground. Protecting and restoring forests, planting new trees and plants to absorb CO_2 from the atmosphere. Protecting and restoring peatlands, which remove and store CO_2. Find more examples here. 1.	SRM approaches include: Stratospheric Aerosol Intervention Marine Cloud Brightening Cirrus Cloud Thinning Ice thickening to protect ice sheets e.g. in the Antarctic, or to "refreeze" the Arctic[40]. And space mirrors to reflect sunlight and reduce warming.

Another way to address climate change is adaptation. This refers to actions that help people adjust to the current and future impacts of climate change. This might include preparing infrastructure for more extreme weather, such as building flood resistant homes; or growing crops that can survive in different weather conditions. Find more examples here.

[40] Refreeze the Arctic | Centre for Climate Repair

Solar Radiation Modification: a public dialogue

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