C2G
Carnegie Climate Governance Initiative

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POLICY BRIEF

Governing Solar Radiation Modification

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Current commitments made under the 2015 Paris Agreement on climate change are insufficient to keep global warming below 2°C, and according to the Intergovernmental Panel on Climate Change (IPCC), much greater ambition is necessary. In response, scientists and others are considering the viability of climate-altering technologies known as Solar Radiation Modification (SRM). These aim to reflect solar radiation (sunlight) back into space or allow more heat to escape Earth's atmosphere in order to counter some of the effects of climate change by reducing the global temperature.

SRM technologies would not address the causes of climate change and so cannot be substitutes for reducing emissions or removing carbon dioxide (CO_2) from the atmosphere. At best, they might 'buy time' while those essential measures are accelerated. They include a range of technologies (see table) which vary significantly. They are mostly theoretical, but if ever deployed at scale, some could create large and potentially long-term risks and governance challenges.

The need for governance

The international community does not yet know enough about the risks, costs and potential benefits, or governance requirements, to understand if SRM technologies could be viable, or – if so – whether, when or how to deploy them. If ever deployed, they could affect a diverse range of physical systems including the oceans, weather, regional hydrological cycles, stratospheric ozone, high-altitude tropospheric clouds, biological productivity and agriculture. They could also affect economic and social structures and pose profound cultural and philosophical questions, challenging deeply held values. The geopolitical and security implications of SRM are also not well understood. There are currently no governance frameworks in place through which to effectively explore these issues and address concerns, which in itself is a risk.

An immediate challenge is the governance of SRM research, with small-scale outdoor experiments of some methods already underway. Research governance could include public policy guidance, codes of conduct or independent monitoring and safeguards to ensure research doesn't lead us down a slippery slope towards eventual deployment.

In the longer term, due to the potential transboundary and/or uneven impacts of SRM, some level of international governance may become essential. Fora and processes which could contribute include the UN General Assembly (UNGA), the UN Security Council, the UN Framework Convention on Climate Change (UNFCCC), the Convention on Biological Diversity (CBD), the London Convention and London Protocol (LC/LP), the Vienna Convention (VC) and the UN Convention on the Law of the Sea (UNCLOS). In addition, regional bodies, governments, civil society organisations, research communities and others might all usefully participate in discussions about how SRM should be governed.

Important governance challenges include:

- agreeing codes of conduct, safeguards and policy direction for research;
- analyzing and agreeing on the risks and potential trade-offs between scenarios, including non-action;
- resolving who decides whether or not, when, and under what conditions to undertake research;
- resolving who decides whether or not, when and under what conditions to deploy;
- the monitoring and attribution of climate impacts that may arise from SRM;
- assessing and managing the impacts of SRM on the Sustainable Development Goals;
- agreeing the levels of cooling that would be required and globally acceptable;
- designing procedures and institutions to mediate geopolitical and security tensions, potentially including conflicts;
- long-term institutional guarantees against premature termination; and,
- issues around liability and compensation in case of harm and loss.

SRM Technologies, Readiness and Governance Challenges

Proposed Method	Readiness and potential	Governance Challenges
 **Stratospheric aerosol injection** Injecting reflective aerosol into the stratosphere to increase planetary albedo (reflectivity) and thereby reduce temperatures.	• Largely theoretical understandings of the technique only. Mechanisms not yet developed. • Modelling suggests planetary cooling is possible. • Small-scale experiments to advance understanding of stratospheric aerosols relevant to the technique are planned for 2020.	• Unresolved, as there is no clear fora or entity to consider SAI governance. Potential existing governance instruments may include state and customary law, CBD, the UNFCCC and the VC. • Evidence suggests potential security issues may arise. • Social acceptability remains uncertain.
 **Marine cloud brightening** Seeding and whitening clouds above ocean surfaces, (e.g., with self-steering, autonomous ships), most likely using sea salt spray.	• Technology theoretical, based on natural analogues and computer models. • Some potential for small-scale outdoor experiments in 2020.	• Regulation would likely be covered by customary international law. • The proposal to use sea salt may in due course be interpreted as a pollutant, and the technique would then be subject to the London Protocol (LP). • Regional variation in impacts (e.g., temperature and hydrological). • Social acceptability remains uncertain.
 **Cirrus thinning** Thinning of cirrus clouds to allow more infrared radiation from Earth to escape.	• Technology still theoretical, based on simulations. • High levels of uncertainty about aerosol and cloud behavior require research.	• Regulation would likely be covered by customary international law. • Social acceptability remains uncertain.
 **Surface albedo modification** Making surfaces brighter (e.g., polar icecaps, urban landscapes, agricultural land, grasslands and deserts) to reflect solar radiation.	• Mechanism confirmed by simulations and demonstrations. Small-scale trials using silica spheres, bubbles and foams are underway. • Potential technical limitations to scale, scope and longevity of materials in situ.	• Regulatory and legal measures include customary international law, the LP, CBD and UNCLOS, but these may not be comprehensive and would apply to ocean-based activities only. • Regional variation in impacts (e.g., temperature and hydrological) are expected and will require governance. • Environmental protection and food safety regulations.