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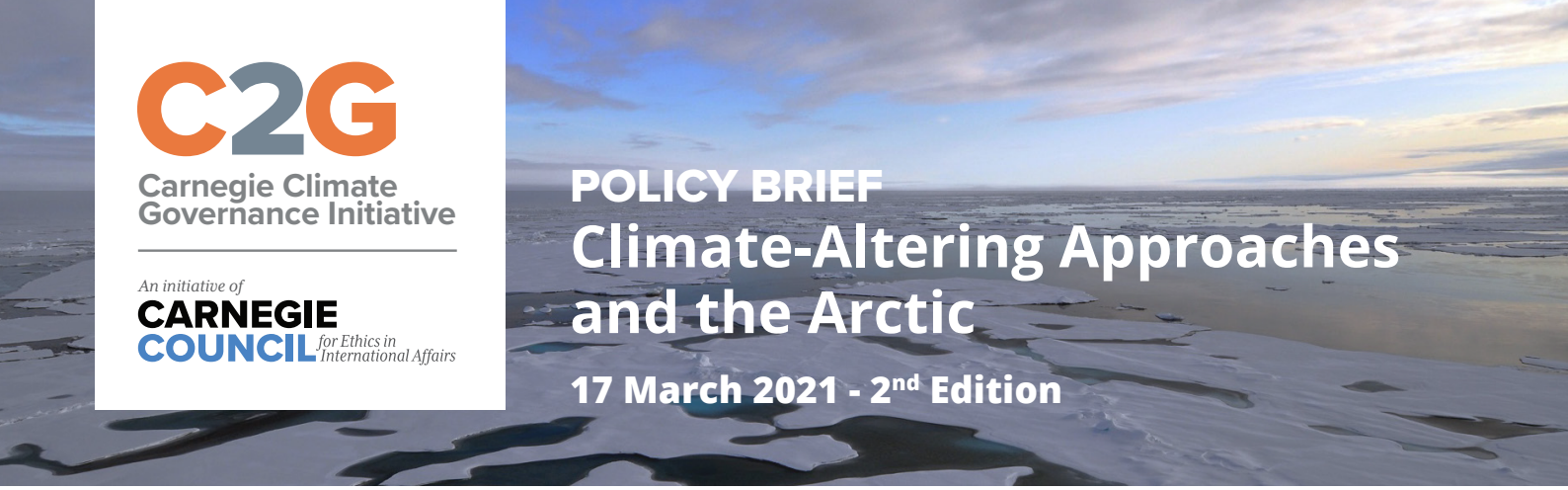

POLICY BRIEF

Climate-Altering Approaches and the Arctic

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The Arctic plays a key role in the global climate system. Current commitments made under the 2015 Paris Agreement on climate change are insufficient to keep global warming to 'well below' 2°C, and according to the Intergovernmental Panel on Climate Change (IPCC), much greater ambition is necessary.

In response to the risks posed by climate change, some are considering the viability of developing and deploying climate-altering approaches in the Arctic such as Solar Radiation Modification (SRM) and large-scale Carbon Dioxide Removal (CDR). SRM techniques such as the deployment of reflective aerosols into the stratosphere, known as stratospheric aerosol injection (SAI), would aim to reflect more solar radiation back into space or allow more heat to escape Earth's atmosphere, whilst CDR would aim to reduce atmospheric concentrations of carbon dioxide. Some of the techniques, such as creating new sea-ice, would initially seek to affect the Arctic alone, whereas SAI could be deployed in the Arctic with the intention of quickly and directly changing the global climate. Any measures that sought to change the Arctic environment alone would, in turn, affect the global climate over time, although to a lesser degree than the larger scale interventions. This demonstrates the key importance of the region in the global climate system – a change in the Arctic climate will inevitably affect the global climate. In addition to climate-altering techniques, it has also been suggested that glaciers in the Arctic could be engineered to reduce ice melt and hence sea level rise – addressing the results of climate change, rather than seeking to slow or stop it.

The changing Arctic climate

The Arctic region plays a key role in the global climate system acting as a carbon sink and a virtual mirror reflecting solar radiation back out into space. The rate of climate change is now significantly greater in the Arctic, which has warmed 2.4 times faster than the rest of the planet over the past 40 years.

According to the United Nations Environment Programme, an Arctic 'climate tipping point', or threshold that, when exceeded, leads to permanent changes in the Arctic system – and thus, over time, globally – may have already been reached. This creates a vicious circle in which ice loss reduces the amount of sunlight that is reflected into space, which in turn leads to warming and further ice loss, and accelerates permafrost melting. As a result, large stores of methane, which is almost 30 times more potent than carbon dioxide as a heat-trapping gas, are irreversibly released. If climate-altering techniques were, as is suggested by theoretical research and modelling, capable of slowing or reversing this vicious circle, it makes the region an area of special interest for those considering such climate-altering techniques to cool not only the Arctic but the entire global climate.

Governance issues

The deployment of climate-altering approaches could lead to a range of impacts, both negative and positive, for not only the Arctic but also the rest of the world.

This raises important questions for both regional and global governance, including:

- Should these technologies ever be researched, tested or deployed in the Arctic, how might they, and decisions about them be governed?
- If tested or deployed, who would monitor their effects to ensure against harms?
- If testing is agreed, who should fund Arctic field trials in the open ocean or on sea-ice?
- By whom, and how, might global scale climate-altering interventions be maintained and financed?
- Would interventions be governable under existing governance arrangements such as the UN Convention on the Law of the Sea, or the London Convention and London Protocol?

Although many climate-altering techniques will have international governance implications, they can also create domestic governance issues for individual countries. For example, decisions about, and monitoring of, the development of a technique during research or field trials within state boundaries would sit with the state alone, unless a field trial caused trans-boundary climate effects. The question of when a field trial affects the global climate is, however, a point of contention.

Deploying climate-altering techniques in the Arctic could have global geopolitical ramifications. This makes governance issues challenging to address through existing mechanisms and procedures. For example, if a climate-altering technique deployed in the Arctic affected weather patterns elsewhere, which governance entity, mechanisms or procedures would be capable of mediating any claims of harm and loss? Governance dialogue may therefore need to include regional bodies, such as governments at all levels, the Arctic Council, the UN Environment Assembly (UNEA), the UN Framework Convention on Climate Change (UNFCCC), the UN General Assembly (UNGA), the Convention on Biological Diversity (CBD), the London Convention and London Protocol (LC/LP), the UN Convention on the Law of the Sea (UNCLOS), as well as civil society organisations including the Arctic Circle, research communities and the commercial sector.

The table below summarises some climate-altering techniques relevant to the Arctic. More information on these and other techniques can be found on C2G's website at www.c2g2.net.

Proposed Technique		Technique Readiness	Specific Governance Challenges
	**Enhancing surface albedo** Making surfaces brighter to reflect solar radiation.	• 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 LC/LP, CBD and UNCLOS, but these may not be comprehensive and, other than the CBD, would apply to ocean-based activities only. • Regional variation in impacts (e.g., temperature and hydrological) may occur and will require governance. • Environmental protection and food safety regulations.
	**Marine cloud brightening** Seeding and whitening clouds above ocean surfaces, most likely using sea salt spray, to reflect solar radiation back into space.	• Technique theoretical, based on natural analogues and computer models. • Some small-scale outdoor experiments by 2020.	• Regulation would likely be covered by customary international law. • Regional variation in impacts (e.g., temperature and hydrological). • Social acceptability remains uncertain.
	**Stratospheric aerosol injection** Reflective aerosols would be deployed in the stratosphere to reflect solar radiation.	• Theoretical understanding of the technique only. Mechanisms not yet developed. • Modelling suggests planetary cooling is possible.	• Unresolved, as there is no clear fora or entity to consider SAI governance. Governance measures, however, may include state and customary law, UNEA, CBD, the UNFCCC and amended instruments which could include air pollution instruments, the Vienna Convention and others. • Evidence suggests potential security issues may arise.