



Scientific Advice Mechanism
European Commission's Group of
Chief Scientific Advisors

Scoping paper:
Solar Radiation Modification

August 3 2023

1. ISSUE AT STAKE

Solar radiation modification (SRM) is a deliberate and large-scale intervention in the Earth's climatic system, with the aim of reducing global warming. It attempts to offset the effects of greenhouse gases by causing the Earth to absorb less solar radiation.

The idea that the climate could be artificially cooled emerged in the 1960's at the same time as the potential risks of climate change were first being taken seriously. SRM is an umbrella term for proposed technologies that would reflect more sunlight back into space, or allow more infrared radiation to escape into space, thereby creating a net cooling effect on the earth's climate. SRM technology options include stratospheric aerosol interventions (SAI - the most studied option), marine cloud brightening (MCB), ground-based albedo modifications (GBAM), ocean albedo change (OAC) and cirrus cloud thinning (CCT). Modelling studies have shown SRM could potentially offset some climate change risks, including the increase in frequency and intensity of extremes of temperature and precipitation. However, it could also introduce a range of new risks related to the change of global weather patterns.

SRM could be relatively cost-effective¹ and several countries could develop a capacity for its deployment. SRM does not reverse climate change and it could cause unintended climate changes (warming or excessive cooling), regional precipitation changes, harm the ozone layer², and impact human health and well-being. Sudden and sustained termination of SRM (in particular SAI) would cause rapid climate change. There is also a worry that SRM could be used for military purposes. Furthermore, there is the "moral hazard" suggesting that SRM's recognition as option may divert governments and companies from necessary GHGs emission reductions. In addition to physical risks of SRM, the response of political and social systems is decisive.

According to the IPCC most recent, Sixth Assessment report³, the current speed and scale of global emissions reductions is insufficient for meeting the Paris Agreement temperature goal of holding the increase in the global average temperature to well below 2 °C above pre-industrial levels and pursuing efforts to limit the temperature increase to 1.5 °C above pre-industrial levels. To reach the Paris Agreement temperature targets, global climate action needs to be accelerated and there are multiple, feasible and effective options available today to reduce GHG emissions and adapt to anthropogenic climate change. However, in most of the scenarios and modelled pathways considered in the IPCC, it is now more likely than not that global warming will exceed 1.5 °C, at least temporarily by the end of this century.

Therefore, additional climate responses such as SRM are gaining more attention. Nevertheless, keeping global warming at a specific temperature level using SRM does not have the same impact on the climate system as limiting warming through GHG emissions reduction, and with SRM multiple impacts on important elements of the climate system remain (e.g. ocean acidification). Moreover, SRM could exacerbate or overcompensate climate changes, and create multiple novel risks. The IPCC emphasises that in order to limit temperature increase to 1.5°C with no or limited overshoot, net-zero

¹ [One Atmosphere: An independent expert review on Solar Radiation Modification research and deployment](#)

² See also National Academies of Sciences, Engineering, and Medicine. 20 21. ReflectingSunlight: Recommendations for Solar Geoengineering Research and Research Governance. Washington, DC: The National Academies Press. <https://doi.org/10.17226/25762>

³ [AR6 Synthesis Report: Climate Change 2023](#)

CO2 emissions at global level needs to be achieved around 2050⁴. On this basis, the European Green Deal sets out the objective for climate neutrality to be reached in the EU by 2050.

The IPCC indicates that while some SRM techniques may be theoretically effective in reducing some climate hazards, the risks or benefits they pose are poorly understood and relevant rules, procedures and institutions (often referred to as “governance”) are weak or missing.

In addition to the IPCC, other UN bodies (including the UN Human Rights Council and UNESCO) are addressing SRM and its governance. The UNEP has published the Report “[One Atmosphere: An independent expert review on Solar Radiation Modification research and deployment](#)” on 28 February 2023 calling for: global scientific assessment process for SRM; exploration of prospects for a multilateral SRM governance; a framework for the governance of the stratosphere, and inclusivity in the evolution of SRM governance and research.

A number of academics signed the call for an [International Non-Use Agreement on Solar Geoengineering](#). On the other hand, one group of scientists published a [call](#) for proceeding with responsible research to objectively evaluate the potential for SRM and another one an [open letter](#) calling for balance in research and assessment of SRM.

Currently, there is no dedicated, formal international SRM governance for research, development, demonstration or deployment. There are restrictions on deployment of SRM stemming from the [UN Convention on Biological Diversity \(CBD\) decision 2010 X/33](#) and [Resolution adopted by the General Assembly on 9 December 2021 \(76/112 on Protection of the atmosphere\)](#).

2. EU POLICY BACKGROUND

The EU does not consider SRM as a solution, as it does not address the root cause of the problem, which is the increase in greenhouse gases in the atmosphere. Even if technically feasible and proven safe, it would provide only a temporary relief, not a cure. In the current state of development, SRM deployment represents an unacceptable risk for humans and the environment. Only massive climate change mitigation together with climate change adaptation leads to fulfilment of the Paris Agreement objectives.

The EU strongly focus on its objective to achieve climate neutrality by 2050 (Climate Law), reduction of GHG emissions by 55% by 2030 (Fit for 55 legislative package) and adaptation to the climate change (Adaptation Strategy).

The Commission and the Member States are united in the scepticism about SRM and the EU supported restrictions on geoengineering (including solar radiation modification) in framework of the CBD. Nevertheless, a wide-ranging EU position on SRM is not developed.

SRM research in the EU is limited. Some projects focusing on the implications and risks of engineering solar radiation have been supported by EU funds (focusing on the modelling of implications and risks of engineering solar radiation⁵; Geoengineering and Negative Emissions

⁴ Synthesis Report of the Sixth Assessment Report of the Intergovernmental Panel on Climate Change: [Synthesis Report — IPCC](#)

⁵ <https://cordis.europa.eu/project/id/226567>

Pathways⁶). One project focusing on governance of research on the SRM will be funded by Horizon Europe. Number of projects are also supported in the US and Australia (including Marine Cloud Brightening field tests). Some stratospheric aerosol injection-related experiments planned in the past were cancelled following objections from indigenous people and environmental groups.

According to IPCC review, the public has a little knowledge about SRM. Some surveys indicate that the public prefers Carbon Dioxide Removal (CDR) to SRM, is very cautious about SRM deployment because of potential environmental side effects and governance concerns, and mostly rejects deployment for the foreseeable future.

It can be expected that interest in some forms of SRM is likely to grow in the future in case of temperature overshoot due to insufficient mitigation or the risk of climate tipping points being reached.

3. REQUEST TO THE GROUP OF CHIEF SCIENTIFIC ADVISORS

Given the complexity of the issues related to SRM, the EU needs to carefully assess its position taking into account all risks and potential benefits. There are wide-ranging risks, including potential harm to the environment, climate, security, social, occupational, political, economic impacts as well as ethical, moral, legal and justice issues. On other hand, SRM could potentially provide a temporary support in case of the catastrophic impacts of increasing global warming or/and high risk of reaching climate tipping points.

The EU needs to address risks and potential benefits connected to SRM. It should also be ready to engage actively in discussions on international level to address governance issues related to SRM regarding its research, small tests and potential deployment. At the same time, the EU needs to define how to regulate SRM research in the EU. The potential application of any SRM method, including for research, would have to be fully aligned with the broader EU policies, including with climate policy objectives.

There is a good basis for the comprehensive assessment of SRM technology stemming from a number of reports including the IPCC report³, UNEP report, the 2021 report of the National Academies of Science², the 2023 OSTP report⁷ as well as [EuTRACE Horizon 2020 project](#).

Consequently, the request to the Group of Chief Scientific Advisors is:

How to address the risks and opportunities associated with research on Solar Radiation Modification and with its potential deployment? What are the options for a governance system for research and potential deployment taking into account different SRM technologies and their scale?

This scoping question should be analysed by reviewing scientific evidence, including from social sciences, and taking a systemic approach which considers the complexity of all aspects of the issue.

⁶ [GENIE: GeoEngineering and Negative Emissions pathways in Europe | GENIE Project | Fact Sheet | H2020 | CORDIS | European Commission \(europa.eu\)](#)

⁷ [Congressionally-Mandated Report on Solar Radiation Modification | OSTP | The White House](#)

The scientific advice requested here should be delivered by Q3 2024. It will contribute to the definition of EU position in international discussions on SRM governance and for planning of EU research programmes, decisions on implementation of EU financing instruments.