

**Briefing Note on Solar Radiation Modification as addressed in the
Intergovernmental Panel on Climate Change Sixth Assessment Report
Working Group II: Climate Change 2022 - Impacts, Adaptation and Vulnerability**

The IPCC AR6 Working Group II (WG-II) reportⁱ published on 28th February 2022 assesses the vulnerability of socio-economic and natural systems to climate change, the consequences of climate change and options for adapting to it. This briefing summarizes how solar radiation modification (SRM) is addressed in the reportⁱⁱ (Part I) and identifies some key policy implications developed by C2G (Part II).ⁱⁱⁱ SRM is expected to be further addressed in the forthcoming WG-III (expected April 2022). The final AR6 Synthesis Report, which will cover the findings of all three Working Group reports, is expected in September 2022.

Part I: Summary of key findings on SRM from the WG-II report

SRM and related information can be found in different parts of the report, including a detailed assessment of SRM approaches in the "Cross-Working Group box SRM" located in Chapter 16 of the WG-II report. Some mention of SRM is also included in both the [Summary for Policymakers](#) (SPM) and the [Technical Summary](#) of the WG-II report. Part I includes extracts from these sources.¹

Summary for Policymakers

- *“Across all three AR6 working groups, risk provides a framework for understanding the increasingly severe, interconnected and often irreversible impacts of climate change on ecosystems, biodiversity, and human systems; differing impacts across regions, sectors and communities; and how to best reduce adverse consequences for current and future generations. In the context of climate change, risk can arise from the dynamic interactions among climate-related hazards (see Working Group I), the exposure and vulnerability of affected human and ecological systems. The risk that can be introduced by human responses to climate change is a new aspect considered in the risk concept.” {SPM A}*
- *“Climate change impacts and risks are becoming increasingly complex and more difficult to manage. Multiple climate hazards will occur simultaneously, and multiple climatic and non-climatic risks will interact, resulting in compounding overall risk and risks cascading across sectors and regions. Some responses to climate change result in new impacts and risks. (high confidence)” {SPM B.5}*
- *“Solar radiation modification approaches, if they were to be implemented, introduce a widespread range of new risks to people and ecosystems, which are not well understood (high confidence). Solar radiation modification approaches have potential to offset warming and ameliorate some climate hazards, but substantial residual climate change or overcompensating change would occur at regional scales and seasonal timescales (high confidence). Large uncertainties and knowledge gaps are associated with the potential of solar radiation modification approaches to reduce climate change risks. Solar radiation modification would not stop atmospheric CO₂ concentrations from increasing or reduce resulting ocean acidification under continued anthropogenic emissions (high confidence).” {SPM B.5.5}*

Technical Summary

The details in the Technical Summary provide a fuller sense, and context based on which most of the elements for the SPM were built. In the following two bullets this is illustrated with text used in the SPM from the Technical Summary being underlined.

¹ To note that the final text of the SPM contains a mixture of exact quotes, as well as additional and sometimes different text to what is in the detailed technical report.

- *“Emergent risks arise from responses to climate change, including maladaptation and unintended side effects of mitigation, including the case of afforestation and hydropower (very high confidence). Solar Radiation Modification (SRM) approaches introduce a range of new risks to people and ecosystems, which are not well understood (high confidence).” { 1.3.1, 3.6.3, 5.13.6, CWGB SRM}(TS.C.11.10)*
- *“Solar Radiation Modification (SRM) approaches have potential to offset warming and ameliorate other climate hazards, but their potential to reduce risk or introduce novel risks to people and ecosystems is not well understood (high confidence). SRM effects on climate hazards are highly dependent on deployment scenarios and substantial residual climate change or overcompensating change would occur at regional scales and seasonal timescales (high confidence). Due in part to limited research, there is low confidence in projected benefits or risks to crop yields, economies, human health, or ecosystems. Large negative impacts are projected from rapid warming for a sudden and sustained termination of SRM in a high-CO₂ scenario. SRM would not stop CO₂ from increasing in the atmosphere or reduce resulting ocean acidification under continued anthropogenic emissions (high confidence). There is high agreement in the literature that for addressing climate change risks SRM is, at best, a supplement to achieving sustained net zero or net negative CO₂ emission levels globally. Co-evolution of SRM governance and research provides a chance for responsibly developing SRM technologies with broader public participation and political legitimacy, guarding against potential risks and harms relevant across a full range of scenarios.” {CWGB SRM} (TS.C.13.4)*

Cross-Working Group Box SRM: Solar Radiation Modification

In considerable detail, this part of the report “assesses SRM proposals, their potential contribution to reducing or increasing climate risk, as well as other risks they may pose (categorised as risks from responses to climate change in the IPCC AR6 risk definition in 1.2.1.1), and related perception, ethics and governance questions.” {CWGB SRM} The bullets below identify some key findings to illustrate the aspects being covered by the Cross-Working Group Box (with text in italics as direct quotes){CWGB SRM}:

- *"SRM contrasts with climate change mitigation activities, such as emissions reductions and carbon dioxide removal, as it introduces a 'mask' to the climate change problem by altering the Earth's radiation budget, rather than addressing the root cause of the problem, which is the increase in greenhouse gas concentrations in the atmosphere" ... "There is high agreement in the literature that for addressing climate change risks SRM cannot be the main policy response to climate change and is, at best, a supplement to achieving sustained net zero or net negative CO₂ emission levels globally". (See more in box section on “Proposed Solar Radiation Modification Schemes”)*
- *"In the context of reaching the long-term global temperature goal of the Paris Agreement, there are different hypothetical scenarios of SRM deployment" presenting "different levels and distributions of SRM benefits, side effects."... " If emissions reductions and CDR are deemed insufficient, SRM may be seen by some as the only option left to ensure the achievement of the Paris Agreement's temperature goal by 2100". (See more in box section “Which scenarios”)*
- Recent studies suggest that it is conceptually possible to meet multiple climate objectives through optimally designed SRM strategies. However, SRM approaches introduce a range of new risks to people and ecosystems, including risks to crops, human health, biodiversity, as well as risks for international collaboration and peace. Due in part to limited research, the risks to crop yields, economies, human health, or ecosystems are not well understood and large uncertainties and knowledge gaps are associated with the potential of solar radiation modification approaches to reduce climate change risks. (Content of this bullet was compiled from a number of paragraphs. For all the details see box section “SRM risks to human and natural systems and potential for risk reduction”)

- “Most studies [on public perception] have been limited to Western societies with some exceptions. Studies have repeatedly found that respondents are largely unaware of SRM.” (See more in box section “Public perception”)
- “There is concern that publicly debating, researching and potentially deploying SAI could involve a ‘moral hazard’, with potential to obstruct ongoing and future mitigation efforts, while empirical evidence is limited and mostly at the individual, not societal level” ... “There is low agreement whether research and outdoors experimentation will create a ‘slippery slope’ toward eventual deployment, leading to a lock-in to long-term SRM, or can be effectively regulated at a later stage to avoid undesirable outcomes” ... “SRM research has been conducted predominantly by a relatively small number of experts in the Global North, and that more can be done to enable participation from diverse peoples and geographies ...” (See more in box section “Ethics”)
- “Currently, there is no dedicated, formal international SRM governance for research, development, demonstration, or deployment...” and “...the lack of robust and formal SRM governance poses risks.” “Co-evolution of SRM governance and research provides a chance for responsibly developing SRM technologies with broader public participation and political legitimacy, guarding against potential risks and harms relevant across a full range of scenarios”. (See more in box section “Governance of research and of deployment”).

Part II: C2G Analysis and Potential Policy Implications

This part presents potential issues arising from C2G’s analysis for consideration in relation to the governance^{iv} of solar radiation modification in light of the new findings presented in the IPCC AR6 WG-II report.

- **Knowledge gaps** – The report notes that while SRM may potentially be able to offset warming and alleviate some climate hazards as a supplement to the main climate response options (i.e., mitigation and adaptation) their potential to reduce risks or introduce novel risks remains poorly understood. **Policymakers may wish to consider whether and how to strengthen understanding and address these knowledge gaps to inform any potential considerations or decision making regarding SRM in the future while addressing issues related to moral hazard. Strengthening transdisciplinary knowledge of SRM risks and impacts could help inform risk-risk analysis to compare the relative risks of deploying – or not deploying - SRM in future scenarios in which the world exceeds or overshoots the agreed temperature goals or significant global climate tipping points.** Such comparative risk analysis may become increasingly important for policymakers. Such analysis could also provide important inputs for strengthening governance relating to SRM.
- **Governance of research** – The report highlights the growth, but current paucity, of SRM research and lack of formal international research governance, which are also contributing factors to, inter alia, the particular challenges concerning outdoor experiments where the distinction between research and deployment may be less clear. **Policymakers may wish to consider how more formal, dedicated international governance around such research may be important and how it could be implemented in practice, including how to address best the issue of moral hazard.** One potential approach highlighted in the report suggests “Co-evolution of SRM governance and research provides a chance for responsibly developing SRM technologies with broader public participation and political legitimacy, guarding against potential risks and harms relevant across a full range of scenarios..” **Policymakers may also wish to address concerns that researching SRM could distract, delay or downplay the critical need for transformative emission reductions, removals and adaptation (moral hazard). They may also wish to weigh these concerns against the risks of not knowing whether, or not, SRM might be scientifically, societally, operationally, and politically viable as a possible additional climate response option.**

- **Governance gaps** – The report highlights the current lack of dedicated, formal international SRM governance for research, development, demonstration, or deployment. It also assesses that “there is high agreement in the literature that for addressing climate change risks, SRM cannot be the main policy response to climate change and is, at best, a supplement to achieving sustained net zero or net negative CO₂ emission levels globally”. With no comprehensive international frameworks to provide space to exchange views on; to learn about the risks, benefits, and governance challenges of; and eventually to enable decision-making about SRM, this leaves a governance vacuum that is itself a global risk. **Policymakers may wish to consider:**
 - a. **Whether, how and where to organize the needed inclusive, transparent, global discussions so that countries can together decide whether or not the risks and benefits of using SRM outweigh the risks and benefits of not using it;**
 - b. **Whether and how the world might minimize risks (both known and unknown) and maximize gains related to any potential use of SRM; and,**
 - c. **Whether and how to deal with the implications of including – or excluding - SRM from the list of potential responses to manage climate risks.**

- **Societal appraisal** - Inclusive discussions with globally diverse audiences, including the voices and views of climate-vulnerable communities and drawing on multiple disciplines, could help to address the high level of complexity associated with any policy position on SRM. In addition, such discussions could improve understanding of varying levels of risk tolerance and build a greater common understanding of the evidence base. **Policymakers may wish to consider whether and how to encourage and support such activities.**

- **Multilateral discussions**, such as within the UN, could raise awareness and broaden understanding of the potential role of SRM, if any, as part of climate response options. Global discussions, knowledge sharing and reviews of SRM by processes like the UN Environment Assembly (UNEA) as well as assessments of the latest science by the IPCC could be helpful. An initial consideration by the UN General Assembly (UNGA) could provide high level guidance to multilateral discussions and identify follow-up actions to enhance the understanding of the role, if any, SRM could play in addressing scenarios in which global temperatures exceeded (overshoot) agreed temperature goals or climate-induced global tipping points. **Policymakers may wish to consider whether and how to advance consideration of these issues in relevant intergovernmental processes and fora both informally as well as formally.**

*Further information on SRM and the IPCC reports is available on the C2G website at:
<https://www.c2g2.net/intergovernmental-panel-on-climate-change/>*

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ⁱ See: <https://www.ipcc.ch/report/sixth-assessment-report-working-group-ii/>

ⁱⁱ A separate briefing note on how SRM is addressed in the WG-I report is available from the C2G website here: <https://www.c2g2.net/intergovernmental-panel-on-climate-change/>

ⁱⁱⁱ More detailed information about emerging approaches to altering the climate and their governance is available on the C2G website: www.c2g2.net in addition, the [C2G Glossary](#) may provide useful information for those new to this topic.

^{iv} A comprehensive and inclusive concept of the full range of means for deciding, managing, implementing, and monitoring policies and measures ([IPCC SR15 Glossary](#), p550).