The National Academies of
SCIENCES • ENGINEERING • MEDICINE

Committee on Developing a Research Agenda and Research Governance Approaches for Climate Intervention Strategies that Reflect Sunlight to Cool Earth

July 22, 2019 Solar Climate Intervention Strategies Scenarios Webinar
12 p.m. – 2 p.m. EDT

Scenarios

Scenario 1: Launching a Coordinated National Research Program on Climate Engineering

It is 2020 and you are a cabinet member for a large developed country in an administration that has committed itself to aggressive climate action consistent with the temperature targets of the Paris Climate Agreement. Nonetheless, your government's chief science advisor has produced a report duplicating similar analyses by other sources that it is highly unlikely that the world will achieve this target at the current rate of international action. These findings were received with intense criticism and concern, especially from countries considered to be the most vulnerable to climate change. The science advisor also warns that there is ample evidence that even with aggressive adaptation measures, your own country will suffer far higher economic and health impacts by the end of the century at the current rate of temperature increase than lower scenarios. In addition to scaling up other more conventional R&D efforts, your government decides to initiate its first coordinated national research program on solar radiation management. You are given the lead responsibility for creating and executing it, with a multimillion USD budget for the first five years.

You create a team to set priorities for research on specific technological pathways with a focus on scaling up and enhancing modelling work, and design and execution of initial outdoor experiments. These experiments will be limited to testing physical properties for dispersion and control of substances that might be used in a deployable technology (or proxies for such substances) or testing prototypes of equipment that might be used in a deployable technology. You stipulate that these initial outdoor experiments must have minimal or no environmental impacts and can have no physical transboundary impacts or implications. They will not result in a temperature response. Nonetheless, once these plans become public, some governments and civil society organizations express grave reservations about the proposed research program. Some are skeptical that these outdoor experiments can be designed without creating environmental or human health risks. Others argue that experiments like these might set in motion political or economic forces that would bias future national and international decisions toward continuation and expansion of solar geoengineering research, or even a gradual slide into full-scale operational deployment, without adequate assessment, deliberation, or public consultation.

You have been asked by your head of government's science advisor to prepare and present a plan that responds to these concerns, which can include plans concerning the design, funding, oversight, or control of the research program to protect against such risks. We are your team of technical and policy advisors tasked with preparing this plan for you. What information would you like to have in hand about the risks and benefits of this research program in order to inform future directions including a response to public perceptions of the program? What options for responding to these concerns, if any, would you like us to prepare? Looking further down the road, what issues do you imagine would be

most important for a research program to explore to inform a later discussion of large-scale outdoor experiments or possible deployment?

Scenario 2: Launching Field Tests with Possible Temperature Response and Trans-Boundary Implications

It is 2027 and you are a senior official working directly for your head of government, whose responsibilities include running an interagency task force on solar radiation management in the country in Scenario 1. Your responsibilities include: coordinating the ongoing development of research priorities for the program, ensuring that the program is producing usable, relevant science for policy makers, overseeing a domestic program which engages with and responds to public concerns about it, and coordinating the response of your government to the growing number of formal and informal international discussions on climate engineering. On the latter, while there is a system of voluntary reporting of climate engineering activities coordinated by the UN, there is as yet no other system of international governance for solar radiation management.

Several years after the initiation of your national research program, predictions are now nearly universal that stabilization of global average temperature at 1.5 degrees Celsius is out of reach, unless it follows an extended overshoot of 2 degrees Celsius or higher. The science agencies working in your research program have presented a plan to move to outdoor tests of possible deployable technologies. One team funded by this program proposes a limited test of a marine cloud brightening system to be conducted either within your country's maritime boundaries or over a small uninhabited Pacific island protectorate of your country, to measure the potential temperature response and durability of the system. Because your country has been compliant with the voluntary international transparency system, many close observers have anticipated a decision like this, and your country has received several formal diplomatic inquiries about whether you plan to execute such a test, expressing skepticism that impacts can be contained within your boundaries.

Your next step is to convene a cabinet level inter-agency meeting to make recommendations to the head of government on whether to move forward with this limited outdoor test. What items and questions do you want to put on the agenda for this meeting that the heads of the various science, domestic, and foreign policy agencies involved should be prepared to answer? What background information do you require to create this agenda?

Scenario 3: Regional Marine Cloud Modification

You are the Minister of Science for an island nation, which depends on its world-renowned reef system, rainforests, and wildlife to generate 50% of GDP through tourism, with the remainder coming predominately from agriculture. Global efforts for climate mitigation continue, but your country is already experiencing a 3 degrees Celsius increase in average annual temperature. The combination of that temperature increase, corresponding local seawater warming and acidification, and poorly understood changes to ocean and atmospheric circulation seem to be negatively impacting your weather and natural resources. The reef system off your coast has been decimated. Average annual rainfall has decreased 5% per year over the past 5 years, causing the rainforest to recede and decreasing crop yields. As a result, revenue from tourism and agriculture are falling off rapidly, causing an economic shock, lowering the standard of living of your citizens, and leading to increasing civil discord.

A proposal has been submitted to your government to institute a marine cloud modification program to manipulate cloud cover to reflect more sunlight back to space. The proponents claim that for a moderate but affordable investment, they can locally augment marine cloud formation, sustainment, and brightness. They claim that these cloud modifications can lower local average air temperatures, lower local seawater temperatures, at least partially restore rainfall, and enhance natural rainforest growth.

You have been asked by your president to prepare and present a decision memorandum to respond to this proposal. We are your team of technical and policy advisors, available to answer questions and provide data to help you prepare the memo, what would you like to know to prepare your draft decision memo?

Scenario 4: Developed Country Unilateral Response

You are a cabinet member for a large developed country. Global climate mitigation efforts have been underway for years, with mixed results. While global average warming has been held to 2 degrees Celsius over pre-industrial levels, the regional impacts have varied dramatically. Your country has been particularly hard hit, with higher temperature rise, extended drought across your agricultural areas, and a series of natural disasters that have been made more intense and sometimes more frequent by climate change, affecting your major population centers. Your government has fully mobilized its resources and policies to counter the impacts, but global conditions are predicted to worsen for decades at least before they get better. It is becoming clear that even with full commitment of resources you will not be able to avoid catastrophic negative impacts across your population.

A consortium of domestic business and academic entities has drafted a proposal to implement a stratospheric aerosol injection program (SAI – spraying large quantities of inorganic particles, e.g., sulphur dioxide, into the upper layer of the atmosphere where they could reflect a small fraction of sunlight back into space). Based on the best known science and modeling, they project that such a program can not only lead to a meaningful reduction in global average temperature, but if implemented to their specifications, may forestall further impacts while reversing some of the disproportionate impacts that your country has experienced. This kind of solar geoengineering effort has been debated in world forums for years, but has been stymied by lack of consensus about risk and governance. The domestic proponents have done a detailed deployment analysis, showing that the cost of full-scale deployment is within reasonable means for your country, and is actually a fraction of the projected cost of continued environmental adaptation efforts.

You have been asked by the President to prepare and present a decision memorandum to respond to this proposal. We are your team of technical and policy advisors, available to answer questions and provide data to help you prepare the memo. What would you like to know to prepare your draft?

Scenario 5: Global Coordinated Effort

You are the head of a national delegation to a multi-national body. The world has reached net zero emissions target. Nevertheless, based on best model projections, global average temperatures will continue to increase, peaking in several decades.

A group of fellow member nations have submitted a proposal for a comprehensive solar geoengineering program of marine cloud brightening and stratospheric aerosol injection, with a goal of slowing the rise

in global average temperature. The proposal is for the program to be administered and monitored by a committee of the multi-national body.

You have been asked to prepare a policy position for your nation to support debate of the solar geoengineering proposal. We are your team of technical and policy advisors, available to answer questions and provide data to help you prepare the memo. What would you like to know to prepare your policy position? If the best scientific assessment of the proposed solar geoengineering program indicates that it is likely to have widely varying regional effects, with significant secondary impacts to local temperatures, cloud cover, rainfall, and biomass, how would your position change? What is the information required to identify and compensate for these varying regional secondary impacts?