Carnegie Climate Geoengineering Governance Initiative

CARNEGIE COUNCIL for Ethics in International Affairs

Carnegie Climate Geoengineering Governance Initiative (C2G2)

Our Approach

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What is C2G2?

C2G2 is a global initiative that provides an **impartial platform for all voices and views** to be aired on an important, emerging issue: how the world should govern carbon removal and solar geoengineering technologies – often referred to collectively as geoengineering.

C2G2 serves as a **convener, a catalyst, and an ideas incubator** for grappling with the many risks, concerns and potential benefits these technologies raise.

C2G2 is **neither for nor against research on or deployment of geoengineering** technologies. These are decisions for society to make. However, it recognises the risks posed by these technologies if left ungoverned, and in particular the profound global risk posed by a hasty, unilateral, ungoverned deployment of solar geoengineering or of carbon removal technologies at gigaton scale.

C2G2 will **catalyse the creation of effective governance** by shifting the conversation from the scientific and research community to the global policy-making arena.

Our aim is **informed, prudent, and inclusive decision-making** that weighs carefully the risks and potential benefits of geoengineering, within the context of a warming world of escalating climate impacts.

Our approach is to hold **a global, informed, consultative and transparent society-wide discussion** on how to govern these emerging technologies**.** C2G2 encourages dialogues, convenes and provides a platform for government, intergovernmental and non-state actor policymakers to discuss these difficult issues.

C2G2 believes a conversation about geoengineering and how it might be governed needs to take place before these technologies are fully developed and potentially ever used.

What is Geoengineering?

Geoengineering is defined as intentional, large-scale human interference in the Earth's climate system to reduce the negative impacts of climate change.1 It generally refers to two types of technologies:

1) **Carbon removal technologies,** which address the source of human-caused climate change by drawing out carbon dioxide from the atmosphere. These are also known as Carbon Dioxide Removal (CDR), Greenhouse Gas Removal (GGR), or Negative Emissions Technologies (NETs), as referred to in many scenarios of the Fifth Assessment Report of the Intergovernmental Panel on Climate Change (IPCC).

2) **Solar geoengineering technologies**, which address one of the key effects of climate change, warming of the Earth's temperature by reflecting more solar radiation into space. These are also known as Solar Radiation Management (SRM) or Albedo Modification technologies.

C2G2 uses the umbrella term 'geoengineering' only rarely, as in most cases, it is more accurate to refer to a specific technology.

Carbon removal technologies, which vary considerably in scope and nature, are already built into most international climate models to keep temperature rise between 1.5-2°C by 2100. Scenarios in the Intergovernmental Panel on Climate Change's (IPCC) Fifth Assessment Report (AR5) relied on the very large-scale use of one of these technologies, Bioenergy and Carbon Dioxide Capture and Storage (BECCS), in the second half of this century to meet the temperature goals. Some scientists now argue that to avoid a damaging temperature overshoot, which is likely, they need to be deployed much sooner than the second half of the century. The longer and the higher temperatures are above a 1.5C rise, the more carbon removals will be needed.

Several real-world applications are under development, and some governments are exploring national policies. But there has been limited consideration of their many governance challenges, including for biodiversity, land and water use, and food security.

When used in conjunction with emissions reductions efforts, carbon removal technologies could address the primary cause of anthropogenic climate change by reducing atmospheric concentrations of

[1] See the Glossary of the IPCC, Fifth Assessment Report

greenhouse gases, but they come with environmental, social and economic risks. Despite the limited evidence that they could work at the speed and scale needed, and in the absence of understanding how they might be governed, these technologies are nonetheless still included in the IPCC scenarios for a below 2 degrees temperature rise pathway and are indirectly referenced by the Paris Agreement. Some scientists dismiss their inclusion in climate models as 'magical thinking', which might cause policy makers to believe the technologies are more advanced than they really are.

The discussion of carbon removal technologies now needs to move from the scientific to the policy community, including at the international, national and sub-national level. In the coming years, use of these technologies could become part of countries' 2050 mid-century strategies and their national climate plans ("Nationally Determined Contribution" - NDC) as part of the Paris Agreement.

Solar geoengineering has not yet been tested in-situ nor deployed at planetary level. According to scientists, this set of technologies is at least 15-20 years away from a properly researched and governed deployment. However, it too has been drawing increased attention in a number of countries. In November 2017, the US Congress held a hearing on solar geoengineering research, even as it announced stepping back from the Paris Agreement. Public funding could follow. A planned experiment by Harvard University in 2018 on stratospheric aerosol injection, as well as potential projects by others on marine cloud brightening and arctic refreezing, are focusing growing attention on the consequences of premature action in the absence of international governance.

Scientists say that solar geoengineering technologies would likely reduce global temperatures, but they pose potentially profound risks – both known and unknown – that transcend borders and raise significant ethical, socio-economic, political and governance challenges. These technologies have planetary-wide consequences, and hence need to be discussed by national governments and intergovernmental institutions, including the United Nations. Large-scale testing of solar geoengineering by any one country – or non-state actor –could put all countries at risk.[2]

Why Focus Now on the Governance of Geoengineering?

Two years after the landmark Paris Agreement on climate change, concern is growing that without a rapid acceleration in action, limiting global average temperature rise to 1.5-2°C might not be achieved through emissions reductions alone. So far, that acceleration shows little sign of occurring at the speed or scale needed.

Once seen as a fringe subject, geoengineering has over recent months received increasing attention in the mainstream media – largely resulting from the publication of new articles from academia and the scientific research community.

C2G2 believes now is the right time for a conversation about how geoengineering might be governed, before these technologies are fully developed and potentially used.

To date, discussions about geoengineering have taken place primarily in academic circles. Policymakers generally have very low levels of awareness about these technologies. Few, if any, comprehensive rules and guidelines exist at the national or international level to govern how these technologies might be tested or used.

At present, there is no comprehensive, multilateral framework[s] to govern the research, testing or possible use of geoengineering technologies. Some elements of domestic and intergovernmental governance are in place, which can be the starting point for further work.

Later this year, the IPCC will release its special report on the impacts of global warming at 1.5°C degrees, which is expected to highlight the extreme difficulty of staying within the Paris agreed temperature goals through emissions reductions alone. The UNFCCC Talanoa Dialogue this year is also expected to

[2] While experiments and tests can be done at various scales to measure certain chemical and physical responses in the atmosphere due to solar geoengineering interventions, the only way to test atmospheric climate response (i.e., the intended effect of solar geoengineering) is through full-scale deployment, since any intervention less than full-scale deployment is essentially undetectable in the atmosphere.

underscore just how much more ambitious governments need to be to meet the Paris temperature goals.

Most scientists now concur that some form of **carbon removal** will be needed to stay within the Paris 1.5-2°C temperature rise goal. Which specific technologies to use – or to what extent much more aggressive mitigation is the best pathway - is a decision for governments, not scientists, to make.

At present, there is no indication that any country or any other actor has decided to deploy **solar geoengineering**. However, research programmes are in place in a number of countries, and scientific experiments are already moving from the laboratory to the outdoors this year. The world needs guardrails in place before the science runs too far ahead of what society is willing to accept. Effective governance can help to address society's concerns and guide critical research.

Growing risk of ungoverned solar geoengineering deployment

As climate impacts increase, there is growing concern that some country or actor(s) could decide to deploy solar geoengineering in a hasty, unilateral manner without proper transparency, oversight and multilateral governance in place.[3]

C2G2 strongly believes that the risk of not discussing the governance of solar geoengineering is significantly greater than the risk of doing so.

For better or worse, consideration of solar geoengineering is not going away. Wishing that it would simply disappear puts the world at even greater risk, particularly since global emissions are not being reduced at nearly the speed and scale scientists say is needed. Every day the world refuses to face this reality, we paradoxically hasten the possibility that solar geoengineering might one day be used without international guardrails in place.

The world needs to know more, now

Governments and international organizations need to know more about the risks and potential benefits of all geoengineering technologies, and to develop ways to govern the research and potential use of these powerful new tools.

They also need to know how geoengineering might affect the attainment of the Sustainable Development Goals, which were adopted by all governments in 2015.[4]

This discussion needs to take place now, before these technologies are considered for deployment. Developing new international rules and guidelines takes many years, especially on issues that affect every country and raise ethical concerns. Sufficient lead time is also needed for sound policy and governance decisions to be taken at the appropriate international, national and sub-national levels.

Moral hazard

C2G2 is fully cognizant of the moral hazard surrounding the geoengineering debate. This is the view that by talking about geoengineering, we might diminish political will for essential emissions reductions.

But we also see a hazard in overly optimistic assumptions about what the world is able and willing to do to reduce global emissions. (See the C2G2 blog: Optimism vs prudence in geo-governance.)

C2G2 believes the world must be prudent and take **precautionary actions that reduce future risks. We call for realism, not fatalism, in addressing how the world can meet the climate challenge.** We do not have the luxury of a consequence-free approach to addressing climate change.

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[3] This applies most specifically to the potential deployment of one type of solar geoengineering, stratospheric aerosol injection (SAI), which involves injecting aerosols into the stratosphere to reflect solar radiation and lower temperatures.

[4] To take but one example, land use is a key concern with BECCS, a carbon removal technology that was included in the vast majority of model runs the IPCC conducted to see how the world could limit temperature rise to below 1.5-2C degrees above pre-industrial levels. Estimates are that using BECCS at such a scale would require land the size of India – or larger – solely for this purpose, thus causing severe pressure on land used for agriculture and human habitation.

C2G2's Guiding Principles

The Carnegie Climate Geoengineering Governance Initiative (C2G2) started its public work in January 2017 based on the following principles:

Impartiality

We take an impartial approach: we are not for or against research, testing or potential use of climate geoengineering technologies. That is a choice for society to make.

Our focus is on catalysing transparent, inclusive policy discussions at the international, national and sub-national level on the risks posed by geoengineering technologies and on how to govern them.

C2G2 understands that remaining impartial is itself a challenge, given that the topic of geoengineering is so fraught with assumptions. Terminology matters[5], as does engaging divergent voices and world views.

A Risk Management Approach

Any response to climate change must be seen through a risk management lens. This means weighing risks against potential benefits, both known and unknown.

Relying on current emissions reductions alone is itself a high-risk option. The world may be headed toward a more than 3°C temperature rise by the end of this century, if the current Paris pledges are not strengthened. This would likely cause massive suffering for our own species and threaten the survival of many others.

Radical, urgent reductions of global greenhouse gas emissions, coupled with adaptation, are the first priority in reducing the risks of climate change. Under no circumstances can geoengineering be considered alternatives to those reductions. Geoengineering should only be considered as one piece of a broader climate response portfolio.

But if emissions reduction proves insufficient, and temperatures continue to rise, those suffering the worst impacts might see the relative risk of geoengineering as less than the risks from escalating climate impacts under a business as usual scenario.

Carbon removal and solar geoengineering technologies present a complex mix of potential benefits, risks (both known and unknown), and trade-offs – environmental, developmental, political and ethical. Society must weigh these carefully in the context of an overall response.

This is especially true for solar geoengineering, which has numerous known and unknown environmental and geo-political risks, including for future generations. It also raises profound governance challenges, including whether the international community --and society at large-- will deem it acceptable to use as a potential response to climate change, and if so, manage the deployment over many decades and potentially much longer.

Solar geoengineering also presents a particular challenge: the so-called 'Termination Effect'. It refers to premature termination of solar geoengineering, which could create a sudden shift in temperatures back to what it would have been without solar geoengineering. Scientists believe that such rapid temperature changes could have catastrophic impacts for biodiversity and the successful adaptation of species to these rapid temperature swings.

Under no circumstances should deployment of solar geoengineering proceed without effective governance in place.

Research needs to inform how governance is developed

C2G2 believes that prudent research and the evolution of governance need to occur in parallel, so that the former informs the latter for maximally effective governance. There is currently too much society doesn't know about geoengineering's environmental and socio-political impacts, as well their effects on global equity and justice. Further research may be necessary to make informed decisions about risks, but such research must be well-governed and sanctioned by society.

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[5] See for example C2G2 blog: How do we categorise carbon removal?

Ad hoc governance mechanisms currently applied to geoengineering research need to evolve into formal governance frameworks.

Risk management occurs at multiple levels

Most scientists concur that solar geoengineering would have planetary wide implications, however there are regional approaches to solar geoengineering that also pose serious risks.

Several proposed ideas focus on ameliorating climate impacts at a regional or even national level, such as extreme temperature rise, catastrophic flooding or massive loss of sea/land ice in the Arctic or Antarctica. Indeed, it is quite likely that serious consideration of solar geoengineering would occur in response to the breach of a key tipping point (either climatic or political), or an extended period of extreme climate impacts, which leads to popular pressure for a government to respond immediately (e.g., extremely high temperatures in several regional mega-cities). In these situations, there would almost certainly be transboundary impacts - either real or publicly perceived.

Governance frameworks at the regional level might prove more flexible, timely and useful as a supplement to or precursor to global agreements. C2G2 is thus actively reaching out to policymakers in regional organizations, such as the African Union, Small Island Developing States, the Least Developed Countries, the, Arctic Council and Arctic Circle, to raise awareness of the pros and cons of regional approaches to governance.

An Inclusive Approach

C2G2 is conducting extensive outreach within the top echelons of the UN system and other multilateral organizations to advance progress on geoengineering governance. C2G2 is also building a coalition of national governments that will spearhead diplomatic efforts to create geoengineering governance within the UN system, while also developing a network of civil society and private sector actors who support the establishment of proper governance.

In addition, C2G2 is cultivating a group of high-level individuals from around the world ('champions') who can take the message to variety of audiences drawing on their own professional credibility. For example, C2G2 is engaging with former heads of state to examine how solar geoengineering might upset global stability and trigger conflict.

In addition to its work with policymakers, C2G2 believes all sectors of society should be encouraged to participate in thoughtful, transparent and inclusive discussions of whether geoengineering should be researched, developed and potentially deployed.

C2G2 is reaching out to faith communities, NGOs, and think tanks in both developing and developed countries. It is vital that young people be a part of this dialogue, as they, along with future generations, will live with the consequences of climate impacts and of geoengineering.

C2G2's Theory of Change

Prior to C2G2, discussions on geoengineering governance were held within the academic community, but only to a limited extent amongst political decision-makers. As a result, policymakers have been dangerously uninformed about the very difficult choices they – and society – will have to make to meet the Paris goals. C2G2 believes that informed, prudent decision-making is essential for creating effective governance of emerging carbon removal technologies and solar geoengineering. A **core assumption** of

C2G2's work is that specific multilateral institutions and fora have both the international legitimacy and capability to govern key aspects of geoengineering, but that **no one existing global body can address all the dimensions of geoengineering governance**.

In the 21st century, effective action requires a multiplicity of processes and centres of power and influence coming together, rather than one paramount command and control process. Different multilateral institutions can best address different aspects of governance, and C2G2 will target its engagement accordingly.

For example, C2G2 is actively working with the Secretariat of the Convention on Biological Diversity (CBD) to support implementation of the CBD's 2016 decision on the proper scope for research of geoengineering. The UNFCCC is best suited to address the international governance of carbon removal technologies and C2G2 is already in active discussion with them on this issue.

C2G2 will engage in a multi-prong effort to bring the conversation on geoengineering to policymaking communities at the global, national and sub-national levels. It will leverage its extensive global network of high-level contacts to:

(a) organise educational briefings, webinars and meetings for multiple, diverse sectors of society, with a special focus on multilateral and government policymakers;

(b) create balanced information materials that elucidate the key risks, issues and concerns about carbon removal technologies and solar geoengineering, as well as potential benefits;

(c) actively engage with key actors in governments, the UN system, civil society, faith communities, defence and security sectors, and the private sector to support discussion and activities on geoengineering governance; and

(c) trigger and support governance discussions on carbon removal and

C2G2's Core Assumptions

- **The time is now:** The best time to discuss the governance of geoengineering is now, not later. There is a far greater risk in delaying or not having this discussion, than there is in grappling with the many governance issues raised by geoengineering in a thoughtful, well-informed, inclusive and transparent manner.

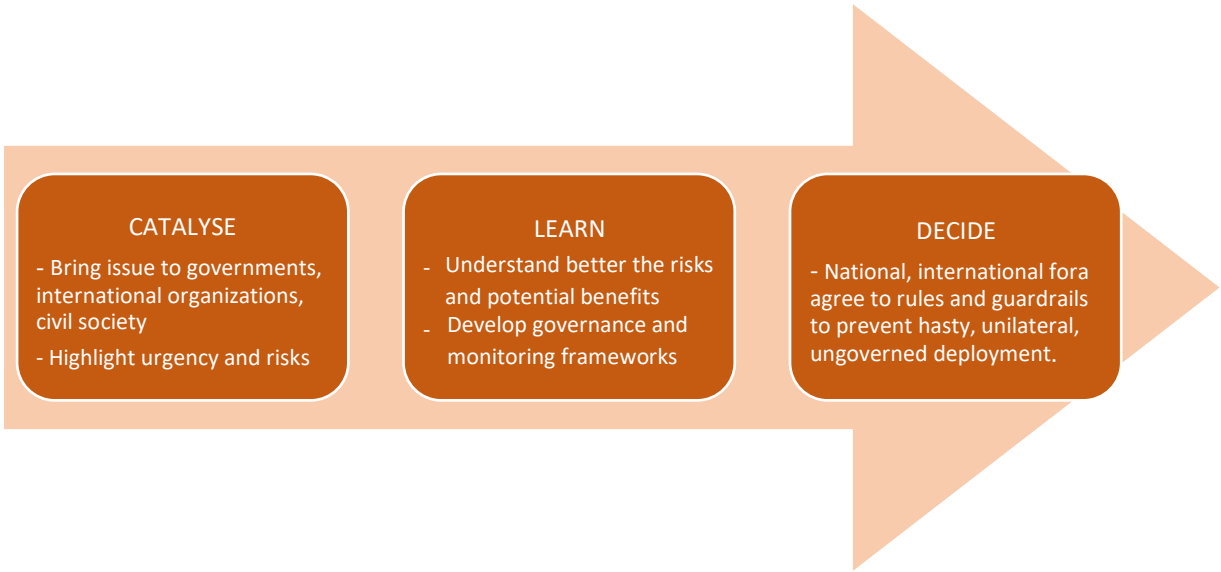
- **It takes a village:** No one global institution can address all the dimensions of geoengineering governance. In a multipolar world, the effective governance of emerging technologies depends on engaging multiple actors, processes and institutions, from the global to the local. Given the planetary-wide impacts of geoengineering, C2G2 believes it also is important to engage in intergovernmental processes that have broad international membership.

- **The need to learn more:** The world currently does not know enough about the risks, unintended consequences and potential benefits of solar geoengineering. Well-governed research may help answer these questions. In the meantime, international agreements calling for no deployment of solar geoengineering before certain conditions are met would reduce risks and allay concerns about hasty, unilateral, ungoverned action, while allowing essential research to take place.

- **The need to engage all sectors of society:** C2G2 will generate political momentum for the governance of geoengineering through a hybrid top-down/bottom-up approach. On the one hand, we will continue to work with senior policymakers and a small group of political influentially countries to spearhead diplomatic efforts at the global level. At the same time, we will actively raise awareness amongst broad swathes of society and encourage civil society organizations, faith communities, the private sector and young people to make their voices heard in this critical global discussion.

solar geoengineering in key multilateral fora, including the CBD, UN Environment Assembly, the UNFCCC and the UN General Assembly, at key moments on the international calendar from 2018-2022.

Figure 1: Catalysing the learning process



Each of these activities will build upon the other, thereby generating political momentum for governing these emerging climate technologies. C2G2 will also communicate the results learnt from each of these various activities to target audiences via social and traditional media.

Key intergovernmental outcomes that will be catalysed by C2G2's work could include:

a detailed, well-vetted trans-disciplinary research framework for geoengineering under the CBD in 2018;

a resolution on the research, testing and hold on deployment of solar geoengineering in the UN Environment Assembly, in 2019;

a discussion of geoengineering governance at the UN Secretary-General's Climate Summit, in 2019;

engagement with the UNFCCC and Parties to the Paris Agreement regarding the governance of carbon removal technologies that might be included in the 2050 national strategies and national climate plans, possibly in the first global stock-take in 2020;

consideration in the UN General Assembly (UNGA), in 2022, seeking to prevent the ungoverned deployment of solar geoengineering.

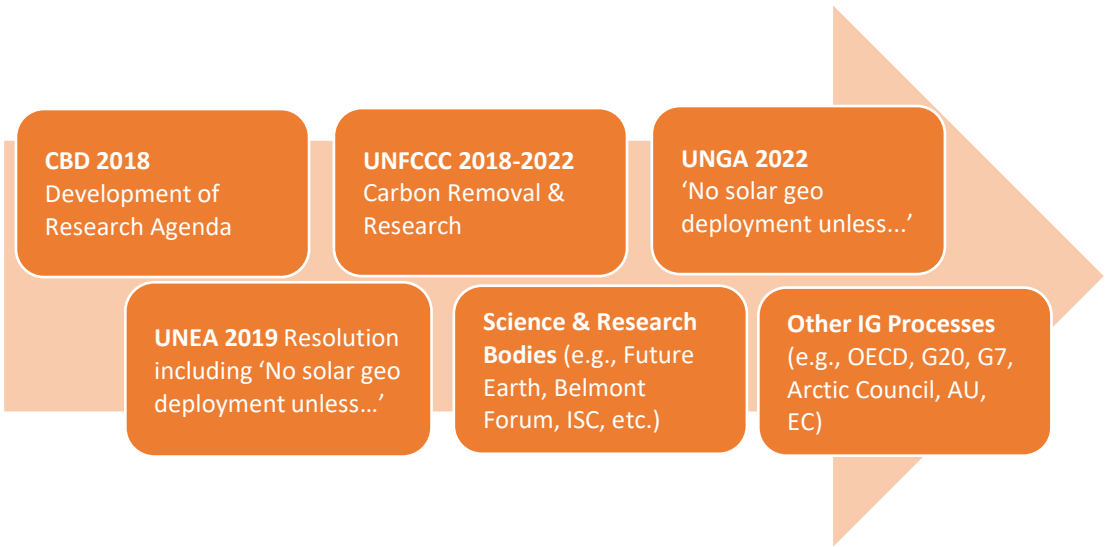
C2G2 recognises that the UNGA, like all intergovernmental processes, has limitations, including enforcement powers. Nevertheless, the UNGA has unique legitimacy given that it is the most universal membership body in the world and is the appropriate place for a global discussion on how to govern an emerging technology, solar geoengineering, which has planetary-wide impacts.

Creating informed communities of interest

As a result of C2G2's efforts, there will be **a global network of leaders** in key multilateral institutions, national governments and civil society capable of understanding the scientific, geo-political and ethical issues raised by different geoengineering technologies.

C2G2 will also catalyse the creation of a **group of national governments ('friends of geoengineering governance' that will spearhead discussions within diplomatic circles on the governance of geoengineering.** This group would include countries that are prepared to engage in discussions about geoengineering governance at UN Headquarter locations, such as New York and Nairobi, and elsewhere as needed. These groups could also spearhead efforts, to build political momentum with other governments in support of governance. C2G2 will engage on a regular basis with key governments from developing and developed countries who have a powerful influence on climate change issues.

Figure 2: A potential timeline towards multilateral governance of geoengineering



Top-down, bottom up

Ultimately, it is governments that need to act, including at the international level, to reach the overall objectives and priorities of this initiative.

At the same time, non-state actors also play a vital role in calling on governments to act in a transparent, accountable manner, and ensuring that the views of all sectors of society are taken into consideration.

C2G2 recognises the importance of working in a manner that builds knowledge, understanding and support from the ground up, as well as from the top down.

Pivot moments

C2G2 will anticipate and respond quickly to potential 'pivot moments' in which the conversation on geoengineering shifts, or pivots in a discernibly new manner.

Pivot moments could include the launch of an outdoor solar geoengineering experiment; a new government decision to fund research or support an international research effort; the sudden realization of funding from a private actor to accelerate research and/or test and deploy solar

geoengineering; or the occurrence of a climate tipping point that prompts a massive public outcry to "do something".

Three Governance Priorities

C2G2 will focus on three governance priorities: governing solar geoengineering, governing geoengineering research, and governing carbon removal technologies.

These three priorities are **interlinked and mutually reinforcing**. Governance of geoengineering research is necessary, as without further research and knowledge, governments may not have the information to assess whether the potential benefits of these technologies outweigh their risks.

Carbon removal technologies need to be governed to ensure internationally agreed standards of monitoring, reporting and verification are followed, and so that potentially significant trans-boundary issues (land use, migration, food security) are adequately addressed. Carbon removal will also be an essential part of any possible deployment of solar geoengineering, since the latter only masks a symptom (temperature rise) but does not address the cause of warming (excess CO_2 in the atmosphere).

THREE PRIORITIES FOR GEOENGINEERING GOVERNANCE

(1) Catalyse international agreements to help prevent the deployment of solar geoengineering technologies before (i) the risks and potential benefits are sufficiently understood for decision making, and (ii) international governance frameworks are agreed;

(2) Support the development of governance of research, particularly for solar geoengineering. This could include codes of conduct; criteria for testing; and public engagement.

(3) Encourage discussions about the governance of carbon removal technologies at the appropriate sub-national, national and global levels.

C2G2 does not have definitive answers as to how these areas should be governed. Governments and society must decide. C2G2's role is to pose questions, educate, convene and catalyse discussions among relevant actors so that well-informed governance decisions are made in a timely manner.

Annex: C2G2's Three Priorities in Detail

Priority One: Governance of Solar Geoengineering

C2G2 will catalyse international agreements to help prevent the deployment of solar geoengineering unless (i) the risks and potential benefits are sufficiently understood, and (ii) international governance frameworks are agreed.

Challenge

C2G2 believes the absence of governance surrounding the deployment of solar geoengineering poses a critical risk to society -- and to future generations. It is our top governance priority in terms of potential adverse global impact.

It is unlikely that even a poorly-researched deployment at a significant scale will be achievable within a decade. However, C2G2 believes that a low probability but very high consequence scenario should receive priority attention.

The international community currently does not have a sufficient understanding of the risks, cost and benefits of solar geoengineering, as well as of its governance requirements, to be in a position to decide whether to deploy. There is currently no comprehensive international governance to regulate the development and potential use of solar geoengineering.

A critical need has thus arisen for a global, open and inclusive discussion on the governance of solar geoengineering. Some of the challenges include:

- The global nature of solar geoengineering will require **unprecedented governance structures** to address aspects such as: inter-regional and inter-generational justice; long-term governance stability that is resistant to economic and geo-political turbulence; multiple security risks emanating from deployment; the necessity for a well-managed tapering off so as to avoid the termination effect ; stability of financing, and overall compatibility with the Sustainable Development Goals.
- Solar geoengineering **does not address the cause of anthropogenic climate change**, so greenhouse gas concentrations in the atmosphere would still have to be reduced through radical emissions cuts and use of carbon removal technologies. Solar geoengineering could thus be complementary to other methods of managing climate risks but is not a solution on its own. What solar geoengineering could temporarily do is reduce temperatures until greenhouse gas concentrations are sufficiently decreased through emissions reductions and carbon removal.
- According to current understanding – based mainly on computer models – the higher the temperature reduction through solar geoengineering, the higher the likelihood of regionally varying negative environmental impacts. This makes governance even more necessary, given there could be regional "winners and losers" resulting from this global technology.
- Solar geoengineering is still in the laboratory phase of development. However, this could soon change if an outdoor experiment planned this year in the US goes forward.
- Moreover, there is a low barrier of entry to deploy solar geoengineering, such as the relatively low costs, the availability of the required technologies, and a lack of legal barriers. Consequently, a single country, a small group of countries, or even a wealthy individual, may decide to unilaterally deploy. While the political barriers to unilateral deployment could be substantial, it is nevertheless important on the one hand to reduce the risks to the extent possible, and on the other hand to be prepared for appropriate action were such deployments to occur.

- Insufficient progress on mitigation and worsening climate impacts make that possibility of a hasty, unilateral, ungoverned deployment more likely.

Theory of Change

Key actors are holding back from essential discussions about the governance of solar geoengineering. There are numerous reasons for this, including moral hazard and a pervasive lack of awareness on the part of decision-makers as to the risks and potential benefits.

To overcome this reluctance to engage requires informed actors who can share information and mobilize others, assume leadership of specific ideas, and ultimately develop the knowledge needed to design appropriate governance frameworks.

International agreement(s) calling for no deployment of solar geoengineering until certain conditions are met can reduce the risks of hasty, unilateral and ungoverned action, while allowing and encouraging more essential research to inform decision-making.

C2G2 will work to create **a network of actors** – in intergovernmental bodies, governments and civil society -- who can spearhead global discussions on governance of solar geoengineering and achieve those agreements.

C2G2 has identified and has been approaching representatives of several politically influential national governments and senior leaders in multilateral and regional intergovernmental organizations. It is also reaching out to key non-state actors in civil society. In this way, C2G2 will catalyse a **leadership movement** that is committed to preventing the hasty, unilateral, ungoverned deployment of solar geoengineering, and that can collaborate to develop a better understanding of its risks and potential benefits and the governance frameworks needed before any consideration of deployment.

Key International Outcomes

By building political momentum within countries, and in different intergovernmental fora, by 2022, C2G2 aims to catalyse international agreements that no solar geoengineering should be deployed before (i) the risks and potential benefits are sufficiently understood for decision making, and (ii) the necessary international governance frameworks are agreed.

Activities

C2G2 will pursue three tracks of activities to reach the objective of calling for international agreements on no deployment of solar geoengineering until the risks and potential benefits are much better understood, and international governance frameworks are agreed:

1. **Intergovernmental track**: Within the UN system, C2G2 is engaging with the UN Environment Assembly (UNEA), UNFCCC, CBD, the IPCC, UN Executive Office of the Secretary-General (including plans for the 2019 UNSG's Summit). Specific processes and outcomes include:
    - **UNEA**: catalyse the preparation of a UNEA resolution in April 2019, which would include placing carbon removal and solar geoengineering governance within the context of Agenda 2030 and the Sustainable Development Goals;
    - **UN Secretary-General (UNSG) Summit in 2019**: seek to include language on the need for the governance of geoengineering in the UNSG's statement, and to seek inclusion of these issues in the Summit program;
    - **UN General Assembly (UNGA):** catalysing the initiation of a New York-based "friends of governance of geoengineering" group of national government representatives that will make the diplomatic case for geoengineering governance before, during and after the UNSG's Summit and put it on the UNGA's agenda for "consideration" by 2022. Such 'consideration' could include a resolution; calling for more work in a working group or in a high-level panel; or even mandating a negotiating process.

- **IPCC**: Publication of the Special Report on 1.5°C in 2018 and 6th Assessment Report (AR6) in 2021 could have significant implications for geoengineering and its governance. C2G2 will actively seek opportunities to educate and inform IPCC delegates, IPCC Secretariat and lead authors on governance issues.
- C2G2 will explore the possibility of engaging with representatives of countries on the **UN Security Council** on the geopolitical and security risks of ungoverned deployment of solar geoengineering, and the need for international agreements or resolutions to address them.
- C2G2 is also planning to engage with representatives of other intergovernmental groups, processes and organizations, including the G20 and G7, the Commonwealth, as well as key regional groups, such as for example the Arctic Council, the Arctic Circle, the African Union, ASEAN, and the European Commission.

2. **National governments track**: C2G2 will encourage 25 or so "key countries"[6] to support actively (or at least passively) our approach and governance priorities. C2G2 will speak with relevant government officials and key non-state actors. We will also encourage countries to join other governments that are willing to spearhead discussions on on the governance of geoengineering within diplomatic circles in cities where relevant intergovernmental organizations have their headquarters.
3. **Non-state actors track:** C2G2 is working with numerous civil society organizations, faith groups, think tanks, humanitarian organizations, and sub-national actors to build support for the governance of geoengineering. Strong relationships with these groups can build grassroots, bottom-up momentum to spur action by elected officials and other policymakers. Partners include the Forum for Climate Engineering Assessment; Climate Interactive (modelling and educational tools); Climate Action Network (CAN) International. Solar Radiation Management Governance Initiative – SRMGI (for developing country contacts). Planned activities include a workshop in New Delhi; a conference of think tanks in Beijing, and building a small network of individuals and organizations exploring geoengineering governance and its implications for international security.

[6] Their selection will include geographically diverse countries that have political/economic importance in the climate context, or that are in chairing or coordinating positions in intergovernmental processes.

Priority Two: The Governance of Research

C2G2 will support the development of international governance of research, particularly for solar geoengineering.

Challenge

Technologies for both carbon removal and solar geoengineering are in their infancy. The basic technologies exist for different carbon removal approaches, but none of them exist at the scale scientists say is needed. Solar geoengineering technologies are based on laboratory ideas and exist only in computer models at this stage, however outdoor experiments by Harvard researchers are planned starting this year in the United States.

If societies were to decide to address whether these technologies are feasible additional tools to manage climate risk, and if so, under what conditions, and with what risks, costs and benefits to society, then the necessary research for this needs to be well governed. Public participation in research governance is also important to ensure that research does not result in a 'slippery slope' leading to hasty deployment.

C2G2 does not take a position on which types of research are acceptable; this is a critical issue that society must decide.

C2G2 believes further, well-governed research may be necessary for informed decision-making on the governance of carbon removal technologies and solar geoengineering. Research could also provide decision-makers with critical information on the ethical and socio-political impacts of these technologies and guide strategies for public engagement. Without governance and oversight of research, however, governments will be hesitant to commit public funds.

C2G2's focus will be on the **international dimensions** of research, calling for agreed norms, standards, and guidelines as well as consistent monitoring, reporting and verification processes. International cooperation on research can enhance its legitimacy and yield fresh insights emanating from different geo-political vantage points.

To this end, C2G2 will work with national and international research bodies (including the Belmont Forum, International Council for Science and Future Earth, among others) on these governance objectives. We will also encourage inputs from multilateral processes to feed into the development of governance so that research addresses issues that society deems important.

- Assuming the IPCC's 1.5°C report and UNFCCC's Talanoa Dialogue this year both confirm the difficulty in keeping temperature rise within 1.5-2°C, governments may call for a focused, mission-oriented research programme at national and global levels.
- Most research is being defined by the research community itself, without clear public policy inputs on what is most useful to decision-makers, and without internationally agreed standards and norms.
- Much of the research currently taking place does not have appropriate oversight: existing governance of research often does not apply, and some technologies, in particular solar geoengineering, raise completely new governance issues, including about the legitimacy of some research. Harvard's planned outdoor experiment (SCoPEx) this year raises particularly challenging issues for research governance, including social legitimization, and public engagement and accountability.
- Research on carbon removal technologies and research on solar geoengineering raise different governance issues, with the latter requiring multilateral governance, while carbon removal technologies are, for the most part, better addressed through sub-national and national

governance. That said, there are important international dimensions to research on carbon removal technologies, and C2G2 will work closely with the UNFCCC and other bodies as needed to provide key actors with useful information, and to encourage interaction through a series of specific activities, focused on specific results. These can include public policy inputs into research agendas, research governance frameworks, as well as codes of conduct.

Theory of Change

Currently most discussions of how to govern geoengineering research are held in academia. C2G2 believes it is time to broaden this discussion so that government policymakers at the international, national and sub-national levels are aware of the issues and can respond to public concerns regarding these technologies. At present only a small minority of policymakers around the world have even a minimum understanding of geoengineering and what governance might be required to enhance safety, accountability and transparency; provide strategic guidance on the kinds of research that could support decision-making; and support a social license to operate.

C2G2 has excellent, long-standing relationships with key actors in key multilateral, national and subnational governments, which will enable it to successfully shift the discussion of research governance from the academic community to the policy world. Connecting the dots between government policy makers, multilateral institutions, potential funding entities and scientists, is another way in which C2G2 can make a unique and much-needed contribution to the governance of geoengineering research.

A key part of C2G2's work will include educational outreach to governments, from the global to the local (sub-national) levels. C2G2 will take up a similar role with key multilateral entities, in particular the UNFCCC, which is the appropriate institutional home for the international governance of research on carbon removal technologies. A third category of actors are the national and international research councils, which may be key for funding some of the future research on geoengineering.

Where relevant, C2G2 will identify gaps in existing international governance of research. It will encourage the three categories of actors to work with scientists to address those gaps, and to ensure there is ample input from the public regarding how and what kinds of research will be governed; how best to ensure accountability and transparency; and last but not least, how to protect the public's safety while enabling scientists to conduct research that provides socially useful information.

By identifying and bringing together key entities involved in different aspects of geoengineering research, C2G2 will catalyse the development of governance frameworks which both enable geoengineering research and appropriately regulate it.

Activities

- **Support the development of a transdisciplinary research framework for the Convention on Biological Diversity (CBD).** The CBD is one of the few intergovernmental treaties that has specifically addressed geoengineering through different decisions. The CBD's 2016 Conference of Parties (COP) called for "more trans-disciplinary research" into geoengineering, but was silent on its content. In cooperation with the CBD Secretariat, C2G2 will lead the development of a report to provide that content, with the aim of making it an input at the CBD COP in 2018. It will do so through targeted webinars, seminars, side events, and informal gatherings of senior CBD delegates.

- **Work within the UNFCCC Subsidiary Body for Scientific and Technological Advice (SBSTA) process to support the development of a geoengineering research framework.** Initial consultations have started, concentrating on a possible research framework focused on carbon removals. Drawing on the analysis in IPCC SR1.5 and the results of the Talanoa Dialogue at COP24, C2G2 will convene relevant global actors from the public and private sectors to discuss an initial roadmap of this research framework.

- **Develop and encourage the use of "codes of conduct" of geoengineering research**. A Draft Code of Conduct for Responsible Scientific Research involving Geoengineering has been developed at the University of Calgary, and similar work is ongoing in a number of other institutions. C2G2 will work with leading national science and research bodies (e.g., national research councils and academies of science) and at the international level (e.g., Inter-Academy Council, ISC, Future Earth, Belmont Forum, etc.), as well as with relevant intergovernmental organizations (e.g., UNESCO, UN Environment, CBD, UNFCCC, WMO), to catalyse the further development and uptake of codes of conduct. C2G2 will encourage the **development of internationally agreed mandatory approaches** for certain aspects of geoengineering research.
- **Encourage the development and application of geoengineering research frameworks by subnational and non-state actors.** C2G2 will also catalyse and participate in discussions that can help governments at sub-national level to govern research conducted within their jurisdictions.

Priority Three: Governance of Carbon Removal Technologies

C2G2 will encourage discussions about the governance of carbon removal technologies at the appropriate sub-national, national and global levels, including in particular at the UNFCCC.

Challenge

Very few policymakers are aware of, let alone have accepted, growing scientific evidence that the world must remove excess carbon dioxide in the atmosphere, as well as reduce emissions, in order to stay within international temperature targets. Also, were solar geoengineering ever considered as an option, it would need to be accompanied by carbon removal in order to be able to stop solar geoengineering deployment at some point in the future without the 'termination effect'.

Yet removing greenhouse gases at the necessary scale entails massive governance challenges, which are only just becoming fully apparent. Governance of carbon removal technologies is essential to ensure public accountability, oversight and a transparent discussion of their benefits, risks, and trade-offs (particularly on land-use issues).

While most governance for carbon removal technologies will take place at the national and sub-national levels, there is a need for international governance to set agreed global norms and standards for accounting, monitoring, reporting and verification; to encourage international cooperation on research; and to address a number of other trans-boundary issues.

Governance can also play a critical enabling function by providing public policy incentives for the private sector to scale-up selected technologies. This might include market mechanisms (carbon price, tax incentives, subsidies, and insurance schemes) at the sub-national, national and/or international level to support the transformative scale-up of carbon removal efforts. C2G2 will reach out to private sector coalitions spearheading climate action to seek their views on governance needs.

At present, there is no international agreement that standardises how carbon removals should be measured and monitored. Moreover, there is no comprehensive framework for regulating carbon removal technologies to minimise land-use trade-offs, or for enabling a scale-up of these technologies to meet global temperature goals while realizing the Sustainable Development Goals.

There is only the beginning of a policy discussion amongst Parties to the UN Framework Convention on Climate Change (UNFCCC), which is the appropriate global institution to consider this issue. C2G2 believes that it is essential to kick start that discussion now.

Theory of Change

C2G2 believes it can catalyse essential discussions on the governance of carbon removal over the coming two years by focusing on politically important actors with global reach, and by working with these champions to popularise the need for, and value of, this discussion.

C2G2 will work with senior officials within the UNFCCC, UN Environment, the Convention on Biological Diversity, the IPCC, senior government negotiators, and the Governor of California to leverage the opportunities provided by the September 2018 Climate Action Summit, the release of the IPCC's 1.5C Report, the UNFCCC Facilitative Dialogue at COP24, and the CBD COP14, to advance the governance of carbon removal technologies.

C2G2 will also discuss with the UNFCCC Secretariat what international governance is needed to facilitate the inclusion of carbon removal technologies in the national climate plans and 2050 strategies governments put forward as their contributions to the Paris Agreement.

C2G2 is uniquely capable of catalysing these changes in a relatively brief period due to its extensive global contacts, the high-level experience and expertise of its staff, and the credibility it has built with key climate actors. C2G2 will help form a global network of leaders who understand the potential value of carbon dioxide removal technologies for minimizing the risks of climate change, as well as the need for both regulatory and enabling governance thereof.

Activities

- **Engage in relevant intergovernmental processes** (UNFCCC, CBD, UNEA, etc.) focusing attention on the need for international governance of carbon removal technologies and of the long-term storage of carbon to address a host of issues: global norms and standards for accounting, monitoring, reporting and verification; strengthening international cooperation on research; financing issues and incentives; insurance and liability,; and issues of compensation issues arising from provision of a global benefit versus possible local harm.
- **Discuss and work closely with UNFCCC Secretariat and government representatives** on what international governance might be needed to facilitate inclusion of carbon dioxide removal technologies in the 2050 national climate strategies as well as the revised national climate plans (NDCs) to be written and submitted by governments to the Paris Agreement by 2020. The 2018 Talanoa Dialogue could provide a first opportunity for governments to collectively discuss if and how carbon removal technologies might form a part of their NDCs.
- **Organise and participate in an event at the Climate Action Summit in California in September 2018** on policies and governance required at the sub-national level for incentivizing scale-up of carbon removal technologies by the private and public sectors, as well as relevant international governance issues.
- **Consult with climate business coalitions** (e.g., Business for Social Responsibility, We Mean Business, World Business Council for Sustainable Development, the Climate Group) on the policies and governance needed for the private sector to scale specific types of carbon removal technologies, which have received a social license to operate. Work with these entities to develop a set of recommendations for national and international policymakers on how governance policies can enable the rapid scale-up of these carbon removal technologies.. Collaborate with private sector observers to the UNFCCC process, and participate in relevant side events planned for the COPs.
- **Organise, host and participate in public and private educational briefings of senior leaders and decision-makers** in key countries and organizations on the need for, and value of, international governance of carbon removal technologies to address the issues listed above. Work with modelling experts at Climate Interactive to visually assess the impact of scaling-up carbon removal efforts on global temperature and for land use and other impacts. Jointly publicise visual tools in major media and use them as educational tools in briefings
- **Solicit analyses of** the trans-boundary impacts of different carbon removal technologies and their relevance for international governance. Papers could be solicited from, inter alia, the World Health Organization, Food and Agricultural Organization, CSOs, think tanks, and faith leaders on the land use, food security, migration, human rights, health and equity issues arising from the use of carbon removal technologies at scale.