



Workshop proceedings

Workshop on transdisciplinary research and governance on climate-related geoengineering

Montreal, Canada, 17 December 2017

For further information contact Nicholas Harrison: njharrison@c2g2.net

Summary

On 17 December 2017, the Carnegie Climate Geoengineering Governance initiative (C2G2) convened a workshop in collaboration with the Secretariat of the Convention on Biological Diversity (CBD) on the side-lines of the 21st Meeting of the Subsidiary Body on Science, Technical and Technological Advice (SBSTTA-21) in Montreal, Canada.

The workshop brought together 47 international experts (including SBSTTA Members and Observers) to explore the issue of transdisciplinary research and governance on climate-related geoengineering in relation to the CBD¹. Discussions were stimulated by short presentations and commentary provided by leading voices from policy, academia, research, civil-society and indigenous people's groups. During two breakout sessions, participants identified a range of transdisciplinary research gaps and regulatory options for governing geoengineering research which are summarised in the Annex.

C2G2 is grateful to all speakers and workshop participants who contributed to this important discussion and to the Secretariat of the CBD for their collaboration in convening this workshop and preparation of the workshop report.

¹ See CBD COP Decision XIII/14 paragraph 5: <https://www.cbd.int/decisions/cop/13/14>

Background

1. The Carnegie Climate Geoengineering Governance Initiative (C2G2) is organizing a series of activities throughout 2017 and 2018 to engage with Parties and other stakeholders to mobilize public policy inputs to guide the climate-related geoengineering research agenda relevant to the Convention¹. This workshop on Transdisciplinary research and governance on climate-related geoengineering, organized in collaboration with the Secretariat of the Convention on Biological Diversity (CBD) in Montreal, Canada, is the second series of activities led by C2G2.
2. The objective of the workshop was to explore and discuss with CBD Parties' and stakeholders' experts how the Convention can provide policy inputs and guidance into the global geoengineering research agenda through the lens of biodiversity conservation policies. More specifically, it seeks to address the following questions:
 - a) What kinds of transdisciplinary research on geoengineering are needed?
 - b) What signals can CBD Parties provide to guide the geoengineering research community?
 - c) What are the regulatory options for geoengineering research?
3. The discussions in the workshop were expected to produce a list of potential transdisciplinary research topics on climate-related geoengineering relevant to the CBD, a list of regulatory options for geoengineering research governance and proposed next steps and any proposals for further discussion of this matter under the Convention.

Item 1. Welcome and introduction

4. The workshop was opened at 09:00 a.m. on Sunday, 17 December 2017.
5. Mr. Janos Pasztor, Executive Director of the Carnegie Climate Geoengineering Governance Initiative, delivered opening remarks. He welcomed participants, thanked the hosts of the meeting for the venue and the Secretariat for supporting the organization of the workshop. Mr. Pasztor provided an overview of the C2G2 Initiative, explaining the objective of the initiative is to catalyse the creation of effective governance for climate geoengineering technologies by shifting the conversation from the scientific and research community to the global policy-making arena, and by encouraging a broader, society-wide discussion about the risks, potential benefits, ethical and governance challenges raised by climate geoengineering. He subsequently presented the topics and questions to be addressed in the breakout groups, explaining that these will provide an important opportunity for participants to provide their views on the questions related to transdisciplinary research on geoengineering. Participants were reminded that the workshop would follow Chatham House Rules.
6. Mr. David Cooper, the Deputy Executive Secretary of the Secretariat of the Convention on Biological Diversity, welcomed participants to the workshop on behalf of Ms. Cristiana Pasca-Palmer. He provided a background on geoengineering in the context of the Convention. Mr. Cooper noted that the CBD Secretariat is the only UN body to date that has addressed geoengineering in a comprehensive manner. It has adopted a number of decisions on the matter, including a qualified moratorium on geoengineering activities beyond small scale research with appropriate risk assessments, and has published authoritative reports on both scientific and regulatory aspects. Mr. Cooper also noted that geoengineering includes controversial approaches, such as bioenergy with carbon capture and storage (BECCS), to highly controversial approaches such as solar radiation management (e.g. spraying sulphur into the stratosphere) and ocean fertilization (e.g. dumping iron into the sea). In addition, now that geoengineering is being addressed by other UN bodies, such as the Intergovernmental Panel on Climate Change (IPCC), it is important to enhance the understanding of issues and to discuss governance approaches.

Item 2. Geoengineering research: The cutting edge

7. Professor Frank Keutsch (Harvard University) delivered the first presentation on the emerging geoengineering technology of Solar Radiation Management (SRM), explaining that SRM, if deployed, should complement, rather than be an alternative to mitigation. Professor Keutsch focused on the

Stratospheric Controlled Perturbation Experiment (SCoPEX). He explained that one of the primary challenges from a scientific perspective is how to perform experiments in a manner that exemplifies good governance. He expressed his hope for greater cooperation at the international level on the scientific experimentation front and to share governance lessons in the research community. Professor Keutsch viewed the workshop as an opportunity to learn more about the framework of the CBD and how it applies to scientific research. He also informed participants that his team is in the process of setting up an advisory committee to provide oversight and guidance for experiments, as well as to look at issues related to transparency. He noted that these were important issues to enhance the engagement of stakeholders.

8. Dr. Wil Burns, Co-Executive Director of the Forum for Climate Engineering Assessment, delivered a presentation on Carbon Dioxide Removal (i.e. carbon negative emissions). He explained that CDR approaches seek to remove CO₂ from the atmosphere and sequester or utilize it, directly reducing the greenhouse effect. He presented examples of specific technologies that fall under the negative emissions technologies as well as some of the challenges associated to each of the technologies: afforestation and reforestation; bioenergy with carbon capture and sequestration (BECCS); biochar and soil carbon sequestration (SCS); enhanced weathering; ocean fertilization; direct air capture (DAC). Dr. Burns ended his presentation by urging the Secretariat to encourage climate scientists to take into account assessments of the deployment of geoengineering technologies on biodiversity. He also underscored the need for an expansion of the risk assessment framework to include not only individual assessments but also large-scale deployments and their implications on biodiversity from a risk perspective (comparative analysis and assessment of trade-offs with climate change).

Item 3. Transdisciplinary research: The state of play

9. The subsequent agenda item sought to provide an overview of the state of knowledge of the potential impacts of geoengineering on biodiversity, ecosystem functions and services and socio-economic, cultural and ethical issues.

10. Dr. Phil Williamson, UK Natural Environment Research Council (NERC), University of East Anglia, began his presentation by referring to COP decisions XIII/14, paragraph 5, emphasizing that more transdisciplinary research and sharing of knowledge among appropriate institutions is needed in order to better understand the impacts of climate-related geoengineering on biodiversity and ecosystem functions and services, socio-economic, cultural and ethical issues and regulatory options. Dr. Williamson noted that a scientific approach requires clarification on the terminology of what geoengineering encompasses. There is an overlap, for instance, between geoengineering and mitigation in UNFCCC and IPCC definitions. He presented two main types of geoengineering approaches: sunlight reflection methods (decreasing energy gain) and greenhouse gas removal (increasing energy loss). Dr. Williamson argued that the governance on geoengineering must be specific, focusing on impacts and implications while also adopting a holistic approach by considering the complexities and interconnectedness of natural systems. The impact of the technologies can be categorized into the following three groups: i) climate effectiveness (positive): to what extent is the method able to counteract global warming; ii) obligatory non-climatic impacts (positive or negative): unavoidable consequences of specific approaches; iii) non-obligatory impacts (positive or negative): additional risks/co-benefits associated with specific approaches that depend on techniques and their deployment. Dr. Williamson concluded his presentation by providing a general framework for technique-specific transdisciplinary research which includes the following elements: effectiveness, scalability, non-climate impacts, socio-economic consequences, full life cycle analysis and scientific and societal questions.

11. Dr. Holly Buck, NatureNet Science Fellow at the University of California Los Angeles's Institute of the Environment and Sustainability, delivered a presentation on the state of social science and ecological research on geoengineering. Dr. Buck brought attention to the fact that little research on geoengineering is currently undertaken from an ecological or conservation biologist's perspective. She provided an overview of some of the traditional social science research questions on SRM, such as public knowledge and perceptions of geoengineering. She questioned whether research on SRM and CDR could be grouped together as they have very different governance needs and interact with social

systems in a variety of ways. Dr. Buck subsequently presented an overview of existing socio-ecological research (which focuses on impact assessment via modelling studies) and suggested opportunities for further socio-ecological research. More research could be done to examine the impacts and drivers of geoengineering both from a past and future perspective: i) review and synthesis research on the lessons from recent history that integrate existing knowledge of fields that are not tagged with 'geoengineering'; ii) policymaker knowledge and demand research; iii) landscape-level analysis: the feasibility of technologies on the local level; and, finally, iv) citizen demand research. Dr. Buck closed her presentation by stating the need for a socio-ecological systems framework which takes into consideration feedback loops and not only one-way impacts. She also encouraged participants and researchers to go beyond an examination of the socio-ecological impacts and public perceptions of technologies by including an examination into the social drivers associated with geoengineering.

12. Ms. Silvia Ribeiro, Action Group on Erosion, Technology and Concentration (ETC Group) delivered a presentation from the perspective of a non-governmental organization which supports a moratorium on geoengineering research. Referring to COP decision XIII/14, she reminded participants that Parties noted that the application of the precautionary approach and requirements with regard to environmental impact assessment may be relevant for geoengineering activities but would still form an incomplete basis for global regulation. She also reminded participants that, in the same decision, the Conference of the Parties, emphasized that climate change should primarily be addressed by reducing anthropogenic emissions by sources. Moreover, decision X/33 reaffirmed its encouragement to Parties to promote the use of ecosystem-based approaches to climate change adaptation and mitigation. According to the ETC Group, research on geoengineering should be banned because it is a 'moral hazard', diverts resources and attention of causes and alternatives and poses a distraction in climate negotiations from reducing GHG emissions. It would allow scientists and other actors to conduct studies and open-air experiments. Ms. Ribeiro questioned whether geoengineering research and deployment could be separated. She also noted that the CBD perspective is very different from scientists/engineering (CDR/SRM), and that CDR and SRM are not useful categories, because they focus on the technologies but not the impacts on ecosystems. She concluded by stating that many organizations forming civil society stakeholders, through the CBD Alliance, support a moratorium on geoengineering because of its potential weaponization, impacts on ecosystems and livelihoods, unequal distribution of impacts, distraction to address other causes of climate change and the drivers of biodiversity loss.

13. Yolanda Teran, Indigenous International Forum on Biodiversity (IIFB), delivered a presentation from the perspective of indigenous peoples. Indigenous Peoples have a very close relationship with nature ('Mother Earth') which they view as sacred and alive. Ms. Teran provided an overview of traditional knowledge and indigenous research approaches, as well as their applicability to geoengineering research.

Item 4. Research governance: The state of play

14. Professor Anna-Maria Hubert, Assistant Professor of Law at the University of Calgary, presented an overview of the current legal landscape with respect to geoengineering research governance. This overview included: customary international law (e.g. principles of prevention and precaution, environmental impact assessment); treaty law (COP decisions and other international and regional agreements); and domestic law and soft law (public and private forms). However, international law is mostly silent on geoengineering research which means that there are no rules and principles in place to govern it. The principle of 'do no harm' (due diligence obligation) does not apply to small-scale experiments. The function of geoengineering research governance is to prevent and minimise harm, promote responsible research practices in order to inform decision-making and ensure legitimacy. Geoengineering could fall into numerous international legal frameworks, none of which, however specifically refer to geoengineering, with the exception of the CBD COP decisions on geoengineering and London Protocol which addresses ocean fertilization. Professor Hubert noted that treaty laws are very technical, and the social elements are more difficult to include at the international level. She also noted that the following issues had to be addressed in order to design research governance: legal form; level of governance; defining the object of governance; content and role of scientific advice in decision-making about geoengineering research and its governance; and the involvement of private actors, commercial interests and intellectual property. After presenting her proposal for a Code of Conduct for

responsible geoengineering research, Professor Hubert noted that the advantages of a Code of Conduct include flexibility and adaptiveness, compatibility with a pluralistic system and greater ambition of commitments if in the form of soft-law. However, a code of conduct does not provide institutional structure and presents weakness in terms of enforcement and compliance capacities.

15. Noting that most research is undertaken in developed countries, Professor Hubert pointed to the issue of global equity in geoengineering research and the need for broader, more inclusive and equitable research. In other words, global equity had to be established both at the governance level but also in the involvement of research participants. Professor Hubert also noted the importance of absorption capacities and capacity development to facilitate local decision-making.

Item 5. Geoengineering and the CBD

16. Mr. David Cooper, CBD Secretariat, presented an overview of CBD COP decisions on climate-related geoengineering and its application. The Parties to the Convention on Biological Diversity adopted a number of decisions on geoengineering and published authoritative reports on both scientific and regulatory aspects.

17. The Convention first addressed the issue of geoengineering in 2008, focussing on the specific issue of ocean fertilization. In a decision negotiated among Ministers and brokered by the German government, Parties to the Convention agreed on language, which amounts to a qualified moratorium on any ocean fertilization activities. Following this, the London Convention/Protocol (under the International Maritime Organization) adopted regulations governing ocean fertilization experiments. And in 2009, the Convention published a scientific synthesis report of the Impacts of Ocean Fertilization on Marine Biodiversity.

18. In 2010, the Conference of the Parties addressed geoengineering more broadly. Again, after many negotiations, first in the Convention's scientific body and subsequently by Ministers, the Conference of the Parties agreed by consensus of all Parties that "in the absence of science based, global, transparent and effective control and regulatory mechanisms for geoengineering, ..., that no climate-related geoengineering activities that may affect biodiversity take place, until there is an adequate scientific basis on which to justify such activities". The Conference of the Parties mandated the preparation of two reports: one on the potential impacts of geoengineering on biodiversity and one on the regulatory framework. These two reports were prepared by a team of renowned scientists and legal experts and reviewed by peers and governments.

19. On the basis of these reports, the Conference of the Parties in 2012 adopted a comprehensive decision, reaffirming the qualified moratorium of 2008, emphasizing the need for action to reduce GHG emissions, noting that there is no single geoengineering approach that currently meets basic criteria for effectiveness, safety and affordability. It also noted the lack of science-based, global, transparent and effective control and regulatory mechanisms for geoengineering, and the need for a precautionary approach. It further noted that effective control and regulatory mechanisms would be most necessary for those activities that have a potential to cause significant adverse transboundary effects, and those deployed in areas beyond national jurisdiction and the atmosphere.

20. A peer-reviewed update to the earlier reports was prepared in 2015, confirming the earlier findings. Following consideration of the report in the Convention's scientific body, the Conference of the Parties, yet again, reaffirmed the qualified moratorium. The Conference of the Parties also recognized the importance of taking into account the knowledge, experience and perspectives of indigenous peoples and local communities when addressing geoengineering and protecting biodiversity.

21. Mr. Cooper also noted that although the Secretariat does not have a specific mandate under the CBD to examine the research and governance frameworks needed, it is important to address these issues given the importance of new technologies as we prepare for the Post-2020 vision and Post-2020 framework. He also noted that more transdisciplinary research in the social science and the sharing of knowledge is needed to better understand the impacts of climate-related geoengineering on biodiversity and ecosystem functions and services, and to better understand the socio-economic, cultural and ethical issues and regulatory options.

Item 6. Geoengineering governance: The big picture

22. Mr. Janos Pazstor presented an overview of the C2G2 initiative's perspective on the needs for global governance of geoengineering research and deployment in order to enhance the understanding of climate-related geoengineering impacts on biodiversity and ecosystem functions and services, socio-economic, cultural and ethical issues. He began by underlining the importance of a transdisciplinary approach to geoengineering research. Governance does not only involve regulation but must include the provision of public policy participation, input and access to information. According to Mr. Pazstor, public participation is critical in order to allow society to make an informed decision on how to proceed with the research and deployment of these emerging technologies and how they should be governed. Mr. Pazstor noted the challenges of addressing governance in geoengineering broadly because it depends on the technologies which vary greatly. For instance, the global impact of SRM deployment would require a governance framework based on a global decision-making body. Other challenges include addressing ethical issues and the risks associated with the low barrier of entry costs of some potential technologies.

23. During the discussion, several points were raised. One of the key issues was the need for policy coherence among different bodies. This is a challenge because of a lack of coherence between legal frameworks, approaches and actions by countries, intergovernmental organizations and non-governmental organizations alike. There is a need for the policy process to be more coherent which would make it easier for the research community to engage with the policy-making community. The discussions also underscored the importance of identifying the drivers of the debate (scientific, social, private sector, etc.) and to take into consideration the interests of actors in geoengineering research (e.g. interests of patented technology for private sector actors). Another issue concerns the timeframe for the development of these technologies, some of which may take at least 10-15 years and would require significant research before deployment. While these technologies may take a long time to develop, some participants have noted that the research into these emerging technologies may provide important options to reduce emissions levels. At the same time, participants also noted that there were many ethical, socio-economic and political questions that remain unanswered, and there was a need to ensure a more proportional and equitable geographic distribution of research relevant to geoengineering in developing countries.

Item 7. Breakout I: Transdisciplinary research gaps

24. The workshop subsequently broke into groups to discuss and identify transdisciplinary research gaps in relation to climate related geoengineering relevant to the CBD. The first breakout session explored:

- a) What research and knowledge is needed?
- b) Undertaken by and/or shared between which institutions?
- c) How might this be done?

A summary of the responses is provided in the Annex.

Item 8. Breakout II: Regulatory options for governing geoengineering research

25. The subsequent breakout-group discussions sought to give participants an opportunity to address regulatory options for governing geoengineering research. Three questions were explored:

- a) What regulatory options exist?
- b) What transdisciplinary research and knowledge sharing is needed to understand regulatory options;
- c) How might this be done?

A summary of responses is provided in the Annex.

Item 9. Conclusions and recommendations

26. During the discussion period several points were raised. Research on the impacts of geoengineering technologies must include an examination of the impacts on biodiversity, noting the complexity of natural systems and the challenges associated with identifying potential risks of geoengineering. A comprehensive, transdisciplinary cost-benefit analysis of geoengineering technologies compared to other solutions, such as natural mitigation and adaptation techniques (e.g. ecosystem-based approaches) is required going forward. Monitoring, evaluation and verification will continue to be a challenge for geoengineering research. Participants emphasized the need for the identification or establishment of institutional bodies to address these issues, noting the relevance of the CBD as a unique forum to do so. Participants also explored different mechanisms, approaches and tools to share knowledge and enhance access to information in order to strengthen research. It was also noted that many countries lack the institutional capacities to undertake or interpret geoengineering research, concluding that capacity-building plays an important role. Any governance framework will require a fair and equitable inclusion of developing countries and must include multi-stakeholder participation, such as indigenous peoples and local communities. Participants considered the organization of an international conference to enhance synergies among different fora and to facilitate the establishment of a framework for the governance of geoengineering research.

27. Mr. David Cooper provided some overall observations and reflections on the discussions held at the workshop. He stated that the discussions indicated a clear need for a multilateral and multiscale examination of the issue. A legitimate governance framework requires an informed public that recognizes power imbalances. Furthermore, he stated that the links between climate change and biodiversity are very important and therefore further collaboration between the two communities must be enhanced. Mr. Cooper also highlighted that according to numerous studies, ecosystem-based solutions provide an important approach for climate change adaptation and mitigation, encouraging participants to turn to the Green Climate Fund for funding. He concluded by encouraging participants to remain involved and active in examining this issue through the formal processes of the CBD, as well as broader discussions on the assessments of emerging technologies under the United Nations (e.g. the Technology Facilitation Mechanism).

28. Janos Pazstor summarized discussions over the course of the day and provided some views on the way forward. He said that decision-makers must be brought together to address these issues and share information and build capacities. He also highlighted the need for the focal points of the UNFCCC and CBD Conventions to meet regularly to discuss these issues. One approach to capacity-building is the organization of regional dialogues between climate change and biodiversity communities.

Item 10. Closure of the Workshop

29. The Chair closed the workshop at 5:00 p.m. on Sunday, 17 December 2017

ANNEX

Breakout I: Transdisciplinary research gaps

The following list provides a summary of the points raised by participants during discussions at the C2G2 workshop on transdisciplinary research and governance on climate-related geoengineering. Please note that the list below does not necessarily imply agreement among participants.

1. What research and knowledge is needed?

- Identification of the current state of knowledge is needed before we can proceed to identify other research areas.
- Review of the current regulatory frameworks in place (local, regional and international) and identification of decision-making actors.
- Analysis of the drivers, uncertainties, risks, scenarios of the outcomes and impacts side-effects that could exacerbate climate impacts (e.g. of BECCS).
- Possibility of a joint research inquiry between IPCC and IPBES.
- Research on the impacts of geoengineering technologies specifically on biodiversity.
- Cost-benefit analysis of geoengineering technologies vs. other technological solutions, such as more natural mitigation and adaption techniques (e.g. ecosystem-based approaches).
- What are the risks associated to the emergence of geoengineering technologies diverting attention away from other techniques and approaches to emissions reductions?
- Determine how the policy-making process is being shaped (currently the CBD is most active on this) and how to most effectively design a process that ensures multi-stakeholder engagement, especially the integration of local and global public concerns in decision-making.
- Research on safeguards, emergency measures and scale of research taking place (national, regional, international).
- Research on liability and redress measures.
- Monitoring, evaluation and verification: What institutional body is verifying the results of the research and the claims made?
- Applicability of the research conducted in one country for another country/region.
- Acceptability of these technologies in developing countries.
- Need for research capacity development, especially in developing countries. What type of capacity development is needed? For instance, perhaps some countries would prioritize capacity development for the interpretation of research results for decision-making, rather than capacity development to conduct research themselves.
- Why is there a lack of interest in on-the-ground research and more interest on processes?
- The minimum legal framework required for a country to govern geoengineering broadly, but also for specific geoengineering technologies such as SRM.
- How might knowledge-sharing and enhanced access to information strengthen research?
- Analysis of lessons learned from the governance of other emerging technologies (e.g. synthetic biology).

2. Undertaken by and/or shared between which institutions?

- CBD provides a unique forum to address many of the issues related to geoengineering research governance.
- Identification of relevant institutions and actors (academia, governmental, NGO, private sector) to be involved and in what stage of involvement (e.g. research vs. decision-making). Also determine how non-Parties to the CBD should be involved and treated in the CBD process.
- Collaboration between CBD, UNFCCC and other biodiversity-related conventions is required at the global level. More technical guidance is needed on the local level.

- Decision needed on which institutions to lead on the discussions (national, regional and international levels) and/or whether there is a need for a new institution to be established in order to regulate geoengineering research governance.
- Lack of institutional capacity to assess emerging technologies (biotechnologies, geoengineering) must be addressed.
- Multi-stakeholder engagement: all actors to be involved at some stage.
- The need for a framework to guide governments on how to take on these emerging issues at the national level (e.g. through enhanced discussions between CBD focal points).

3. How might this be done?

- Ensure fair and equitable inclusion of developing countries in the governance and conduct of geoengineering research (e.g. through the inclusion of scientists in fora such as IPBES and IPPC). This must also include enhanced access to information in developing countries to support effective decision-making on research governance.
- Lack of local capacity in developing countries will render regulation and the precautionary principle for geoengineering research and deployment challenging and likely ineffective.
- Research governance issues and options depend on the stages of research (e.g. whether the research is indoor or outdoor).
- Governance approaches and regulation processes must take into consideration a variety of stakeholders, such as local communities and the private sector.
- Policy lags and timeframes must be addressed.
- Identify and enhance synergies between the processes and discussions held at UNFCCC and CBD. Suggestion of the chairs of the respective SBIs to meet and discuss progress.
- Greater synergies between the scientific communities: IPCC, IPBES and International Resources Panel.
- Policy-making challenges associated to the inability to determine the trajectory of research in advance.
- Consider organizing an international conference to enhance synergies among different fora and to understand the issues specifically related to geoengineering.
- Consider the establishment of an international, transboundary research group.
- Diversity leads to better research. It is important to ensure the inclusion of a variety of actors, including IPLCs.
- Identification of different ecosystems that might and/or could be used as pilot sites.

Breakout II: Regulatory options for governing geoengineering research

4. What regulatory options exist for climate-related geoengineering research?

- International legally binding governance framework desirable but unlikely to take place in the short term.
- Codes of conduct and guidelines may provide an alternative/temporary solution if countries are unable to decide on a legally binding governance framework. Guidelines may be especially useful if there is too much incentive-driven research or a lack of research governance capacity at the local level. Guidelines will have to be adapted to take into consideration different levels of research/codes of conduct. This option would require a mechanism for verification.
- Protocol on geoengineering.
- Regulatory options must take into account regulation of private sector research. This may require educating companies.
- Framework on ethics for conducting research.
- International framework needed before national regulation.
- Regulatory options must take into consideration the two dimensions: local/national and international and global (London Protocol, CBD, Human Rights Bodies, Environmental Modification Convention, UNCCD).
- Regulatory option must be based on precautionary approach.
- Regulatory options require strong monitoring systems at all levels. Some of the questions to be addressed are: Level of intervention? Level of impacts? Who decides?
- Level of governance for regulatory options:
 - **Local Level**
 - Local level regulation must have binding ethical committee and/or environmental impact assessments.
 - Ethics committees to be established at the national level:
 - Establishment of policies for ethics committees.
 - Determine whether acceptable funding sources for research (public and/or private).
 - In most countries, at the national level, an Environmental Impact Assessment may be required.
 - **Regional level**
 - Regional level governance framework for enforcement and monitoring.
 - **International/global level**
 - International regulation must be based on the precautionary approach.
 - International regulation should work towards a binding agreement (UNGA, IC Justice, and Cartagena Protocol).
 - Must identify which institution/new institution would have the mandate to regulate this cross-cutting issue (UNEA).
 - Sharpening of definitions involves political risk of opening a debate about terminology.
 - International regulation must ensure balanced distribution of research resources. Participants expressed a concern that the economic impacts of doing research on geoengineering may affect developing countries' abilities to develop research support/ecosystem-based solutions.
 - Regulatory options must ensure that developing countries are not used as experiment fields.
 - Regulatory options must take into consideration the fact that some countries/researchers will follow the regulations that they want. International governance framework must target which regulations would be easiest for researchers to comply with and which not to adapt accordingly.
- Transparency: Regulatory options must also take into consideration confidentiality agreements between governments and companies and that some research will be secret. Governments must decide whether to treat geoengineering as a 'global public good' and publish all research

and information on geoengineering research. However, participants noted the high risks associated to making all research public information.

- Regulatory options must take into consideration policy lags.
- Develop national and regional capacities to govern emerging technologies. While lessons can be drawn from the governance of a variety of emerging technologies, (synthetic biology, nanoengineering, geoengineering), each one must also be examined separately.
- Regulatory mechanisms may need to be different for CDR and SRM.
- Enforceability/monitoring must be addressed in the governance framework.

5. What transdisciplinary research and knowledge sharing is needed to understand regulatory options?

- Geoengineering research should be analysed and regulated together (including effects, implications, aims of geoengineering).
- Negative emissions technologies: policy-makers don't understand how they are being integrated.
- More research on economics of BECCS and how they will impact different stakeholders (e.g. land tenure issues/displacements).
- Research on the ramifications of implementing a bad policy (e.g. biofuels/share knowledge that is already available).
- SRM governance and unequal impacts: who decides and how and when?
- CDR is perceived often as 'national' governance, but who governs cumulative impacts if many countries decide to do it? Who can and who cannot?
- Climate change is transboundary, global and governance is very difficult already. How would geoengineering governance be possible?
- Research on uncertainties and the unknowns related to geoengineering, including natural and induced phenomena. Many of these aspects will add to the impacts.
- Compile the lessons learned (both positive and negative) from using market mechanisms for regulation (e.g. could have large impacts on e.g. BECCS).
- Include indigenous peoples and social scientists in the transdisciplinary research.

Workshop participants

- Abdirizak Mohamud, Somalia
- Adam Toussaint, Saint Lucia
- Ana Francisco, Mozambique
- Ana-Maria Hubert, Canada, University of Calgary**
- Belal Alhayek, Syria
- Christian Schwarzer, Germany, German Forum for Environment and Development
- Christopher Pereira, CBD Secretariat
- David Cooper, CBD Secretariat**
- El hadj Sy, Mali
- El Khitma El Awad Mohammed, Sudan
- Eugenia Arguedas, Costa Rica
- Fabiola Gress Carrasco, Mexico
- Francis Ogwal, Uganda
- Frank Keutsch, Germany, Harvard University**
- Genene Tefera, Ethiopia
- Habib Gademi, Chad
- Helena Paul, UK, Econexus
- Holly Buck, USA, Cornell University**
- Janos Pasztor, Hungary, C2G2**

- Jesus Guerra, Cuba
- Joe Horokou, Solomon Islands
- Kongit Haile-Gabriel, Dominica
- Kotchikpa Okoumassou, Togo
- Lili Fuhr, Germany, Heinrich-Böll-Stiftung
- Lydia Zemke, Germany, CBD Secretariat
- Marcal Gusmao, Timor Leste
- Marie-May Jeremie-Muzungaile, Seychelles
- Marina Hernandez, Dom. Republic
- Mensah Bienvenu Célestin Bossou, Benin
- Mohamed Ali Ben Temessek, Tunisia
- Mphatso Martha Kalemba, Malawi
- Nermalie M. Lita, Philippines
- Nicholas Harrison, UK, C2G2
- Paul Demetry, South Sudan
- Phil Williamson, UK, NERC**
- Polina Shulbaeva, IPLC
- Rafiqul Islam, Bangladesh
- Ruth Spencer, Antigua and Barbuda, UNOPS
- Samuel Dieme, Senegal
- Samuel Ndayiragije, Burundi
- Sergei Melnov, Belarus
- Silvia Ribeiro, ETC Group**
- Thinley Dorji, Bhutan
- Thomas J. Chali, Tanzania
- Viviana Figueroa, CBD Secretariat
- Wil Burns, USA, FCEA**
- Yolanda Terán, International Indigenous Forum on Biodiversity (IIFB)**

** Workshop speakers.

Disclaimer

This report has been prepared based on notes taken during the workshop plenary and breakout groups and has endeavoured to faithfully and accurately document points raised during the workshop. All discussions were convened under Chatham House rules and any views expressed do not reflect official positions of C2G2, the Secretariat of the Convention on Biological Diversity nor those of workshop speakers or participants. Please notify Nicholas Harrison njharrison@c2g2.net of any important corrections required.