WAGENINGEN
UNIVERSITY & RESEARCH

Political Perspectives on Geoengineering: Navigating Problem Definition and Institutional Fit

Möller, I.

Accepted for publication in Global Environmental Politics, issue 20-2 (May 2020)

Political Perspectives on Geoengineering: Navigating Problem Definition and Institutional Fit

Ina Möller

Abstract

Geoengineering technologies are by definition only effective at scale, and so international policy development of some sort will be unavoidable. It is therefore important to include this dimension when assessing the technologies' feasibility and potential role in addressing climate change. The few existing studies that address this question indicate that policy development at the international level will be exceedingly difficult. This study provides an in-depth, theoretically informed analysis about why this might be the case. Using data in the form of negotiation proceedings, observations, and key-informant interviews with government officials from seven different countries, it argues that a significant part of the challenge lies in dissonances between problem definitions that characterize the geoengineering governance debate, and the structures and expectations that shape global environmental governance. These include a lack of institutional fit between the process-based differentiation of geoengineering technologies (CDR and SRM) and the international legal architecture; a lack of fit between the urgency of demanded governance action and prevalent scientific and political uncertainties; and a lack of fit between risk-risk trade-off narratives and the precautionary norms of environmental governance.

In recent years, suggestions to use geoengineering technologies to counter the climate crisis have spawned a dynamic debate amongst scientists and other non-state actors.[1] Prominent studies project that removing carbon dioxide from the atmosphere, and/or reflecting incoming sunlight at scale, could become tools in slowing down climate change (Rogelj et al. 2018, Irvine et al. 2019). But because the economic incentives to develop and deploy these technologies within projected time-frames are lacking, scientific authorities like the British Royal Society (2018) or the US National Academy of Sciences (2015) recommend government support to stimulate research and economic investment. Meanwhile, the European Academies Science Advisory Council warns that overoptimistic expectations about carbon dioxide removal

[1] Geoengineering technologies describe large-scale, intentional interventions into natural systems in order to stabilize global temperatures. Prominent examples include planting and processing massive amounts of biomass to capture and sequester atmospheric carbon dioxide (Bioenergy with Carbon Capture and Storage – BECCS), or artificially injecting reflective particles into the stratosphere to reflect incoming sunlight (Stratospheric Aerosol Injection – SAI).

technologies (CDR) could have serious social and ecological side-effects, and that decision makers should be prudent when considering them as policy options (EASAC 2018). Multidisciplinary assessments of solar radiation management technologies (SRM) express comparable warnings, recommending anticipatory governance to manage research trajectories and highlighting the need for multi-stakeholder engagement at international level (Chhetri et al. 2018).

How do such recommendations for geoengineering governance resonate with policy makers? The few studies that examine this question show that government actors across the ideological board express concerns about technical feasibility and risk, but also about the political difficulties of governing geoengineering technologies. Huttunen et al. (2014) conclude that clear differences in the framing of geoengineering-related policy documents between the United States and Germany promise significant difficulties for international policy development. Himmelsbach (2018) finds that scientists who advise the European Commission anticipate problems of distributive justice and the general complexity of governing climate change. And in their survey of US-based environmental policy professionals, Talati & Higgins (2019) find a prevalent assessment that governance at national or international level will be significantly more difficult than at institutional or scientific level.

The anticipated political difficulties pose a significant problem in the face of recommendations to govern these emerging technologies. Geoengineering, both in the form of CDR and SRM, is by definition only effective at scale and will eventually require international engagement of some sort. It is therefore imperative that the governability of these technologies is included in assessments of whether and how they can offer effective responses to climate change.

This study provides an in-depth, theoretically informed analysis of the challenges that policy makers face when creating governance mechanisms for geoengineering. Notably, it draws on key-informant interviews with government officials who are already familiar with geoengineering. They provide valuable insights about how policy makers reflect on geoengineering technologies, and the methods by which they try to make them governable. The study discusses both CDR and SRM in order to better understand policy makers reasoning around commonalities such as scale, international collaboration, and anticipatory nature.

In the theory section, I suggest an analytical framework that conceptualizes the creation of new institutions as a process in which policy makers need to create ‘institutional fit’ between an existing problem definition and the context in which they work. In the methods section, I explain how I use policy relevant literature to identify common problem definitions in the expert debate on geoengineering governance, and interviews, observations of deliberations, and negotiation proceedings to study the performance of these problem definitions in a policy making context. In the analysis, I give an overview of common problem definitions and then apply the analytical framework to three areas where a widely spread problem definition lacks institutional fit. The conclusions summarize and suggest pathways forward.

Problem Definition and Institutional Fit

Problem definition and institutional fit are concepts that highlight the importance of structure for individual action. They also allow the researcher to examine how an agent navigates and changes the structures that surround them, thereby expressing agency. Introducing such a dual-nature perspective is necessary for scholars to go beyond understanding the internal structures of expert driven discourses on geoengineering (e.g. Anshelm & Hansson (2014), Talati & Higgins (2019)). To understand what these discourses mean for the policy making process, it is necessary to examine their performance in an institutional context.

The concept 'problem definition' describes the way in which an issue is defined in order to inform the shape and content of a policy or institutional set-up. Its function in a political discourse is "at once to explain, to describe, to recommend, and above all, to persuade" (Rochefort & Cobb 1994, p.15). The concept is used in constructivist, post-modernist and policy analysis literature to emphasize the importance of language for understanding the dynamics of policy making. Importantly, it highlights that at the level of language, social problems are malleable, and that actors can use problem definitions to steer the course of a given political development.

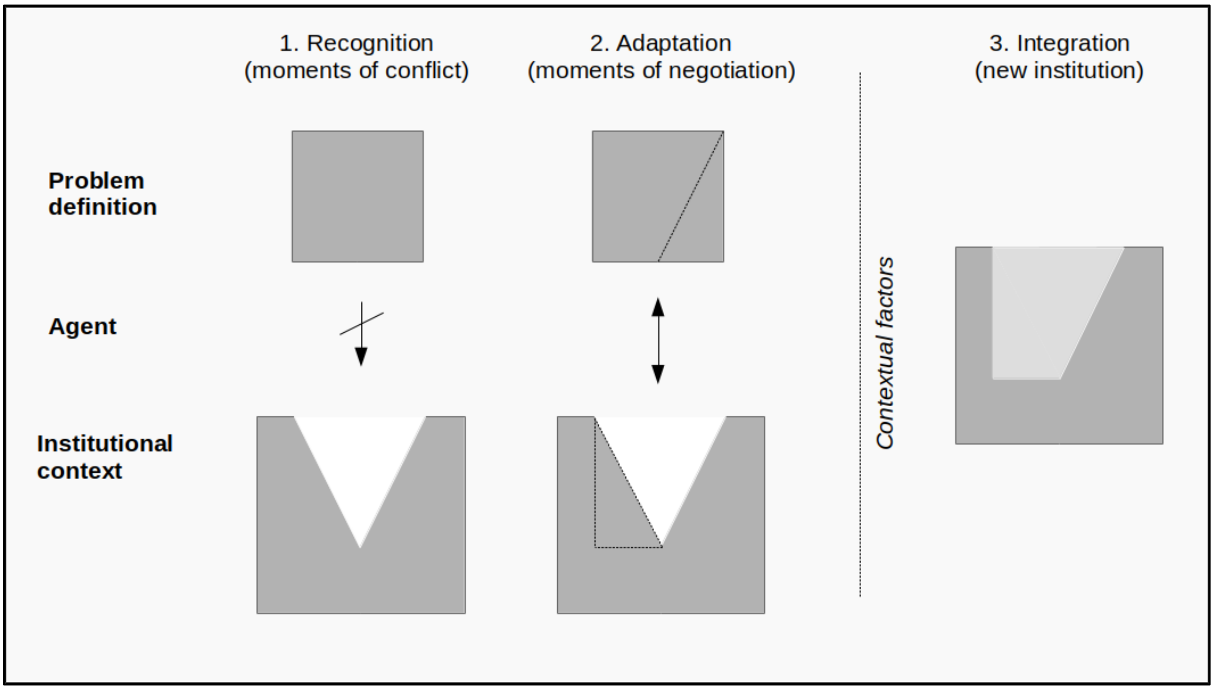
Problem definition is usually applied in analyses of how politicians and journalists frame a social issue in the media. In this context, dimensions like magnitude, severity, proximity and crisis play an important role in determining whether or not a social issue makes it onto the policy agenda (Rochefort & Cobb 1994). The purpose of this study, however, is to understand what happens when a given problem definition, already pre-defined by experts or advocates, meets the institutional context of policy makers. To study this process, I follow the assumptions of organizational theorists James March and Johan Olsen (2011), who argue that political actions are determined by a logic of contextual appropriateness. Policy making is a process of collective negotiation and takes place in an environment structured by laws, bureaucratic procedures, expectations and values. In addition to their own preferences, policy makers need to take into account these structures when creating new institutions.

To describe the necessity of matching problem definitions and institutional context, I borrow the term 'institutional fit' from Lejano & Shankar (2013). In their theory of institutional contextualism, the authors highlight problems that arise when a generic blueprint of an institutional structure is applied to a local context without accounting for the specific conditions of that context.[2] They write that "the ability to tailor programs to the particular needs of a target community has become a central tenet in the literature on designing institutions under complexity" (p.84). These 'target communities,' I argue, can be found at all stages of institution building. The process of creating institutional fit happens not only amongst local implementers who adapt international programs to their given circumstances, but also amongst policy makers

[2] The contextualist definition of institutional fit that I use here differs from the problem structural definition suggested by Oran Young (2002), who uses the term to emphasize that institutional arrangements should match 'the defining features of the problems that they address' [p.20].

who engage with problem definitions delivered by the scientific community or other governance advocates. Institution building is characterized as a ‘constant dialectic’ between the problem definition and the context in which this definition needs to be translated into a governance mechanism.

Figure 1: Analytical framework for studying institutional fit



Combining problem definition and institutional fit creates an analytical framework that focuses on the role of an agent in relation to their structural context (Figure 1). It assumes that agency exists in the agent’s capacity to understand the relation between a given problem definition and the bureaucratic, legal or normative structures that this problem would need to be addressed in. Further agency exists in the capacity to create ‘institutional fit’ by adapting the problem definition and/or parts of the institutional context to facilitate the creation of new governance mechanisms. In the process, the adaptation of problem definitions and institutional context can be done strategically to shape the resulting governance mechanism according to the agent’s preferences.

Whether this adaptation process eventually leads to a new institution is subject to contextual factors. They include the size in discrepancy between problem definition and institutional context; the ease with which the problem definition or institutional context can be adapted; the degree of homogeneity in the preferences of agents involved in the negotiation process; the commitment of participating agents to finding a solution; as well as external developments that may impede or facilitate the decision making process (think ‘windows of opportunity’, as discussed in Kindgon’s (1984) theory of the policy cycle). Creating institutional fit is always accompanied by other political processes that must be taken into account when explaining success or failure in creating new governance mechanisms.

The analytical framework focuses on one process within the larger policy making cycle, namely what policy makers do when they are confronted with a problem definition delivered by experts or advocates, and how they try to make this problem governable. Particularly in technical areas such as climate change or environmental policy more generally, scientific discourse plays a central role in delivering problem definitions and has been shown to take substantial influence on the shape of governing institutions. Allan (2017) demonstrates this for the case of climate change in general, and Boettcher (2019) argues that it is also the case for geoengineering. The purpose of analyzing the interface between science and policy through a theoretical lens of institutional fit is to highlight the agency that policy makers have in making the problem definitions of scientific discourse governable.

Methods

Identifying Problem Definitions

To identify important geoengineering problem definitions, I analyze thirteen geoengineering assessments written for policy makers. These were published between 2010 and 2019 by non-state actors (only the Intergovernmental Panel on Climate Change (IPCC) is included as a semi-state actor). The variety of authoritative scientific bodies, committees and non-profit organizations distributing these assessments supply a reasonably broad net for capturing problem definitions. Yet all reports were written in English, and the results are limited to the English-speaking discussion on geoengineering.

I follow the analytical framework suggested by Armeni & Redgwell (2015), asking what geoengineering is defined as, why it is considered a problem, how and when the problem should be solved, and who should be responsible. These questions are analyzed for each assessment and systematically compared to find overarching commonalities. A clear answer to each question was frequently provided in the introduction, executive summary, or early parts of the assessment. In the case of the IPCC's 1.5°C report, the analysis focused on the sections discussing geoengineering technologies (Section 1.4: Strengthening the Global Response, and Chapter 4: Strengthening and Implementing the Global Response).

Table 1 provides a summary of the most prominent problem definition in each assessment. These summaries are not comprehensive or complete, but aim to capture the strongest overarching message. They are grouped according to similarity of problem definition and similarity of policy proposal. This means that in problem definition one, reports that expressly refrain from judging the desirability of geoengineering technologies are grouped together with reports that express their possible necessity. The reason for this is that all of these reports strongly recommend dedicated institution building around one or several geoengineering technologies in order to prepare for any eventualities. Furthermore, they do not display the explicit focus on mitigation deterrence or scientific agnosticism that characterize problem definitions two and three.

Studying Institutional Fit

To study the performance of geoengineering problem definitions in a policy making context, I apply a form of deliberative policy analysis as discussed by Frank Fischer in Hajer & Wagenaar (2003). This interpretive approach brings together a wide range of data and emphasizes the assessment of a problem in its particular context. It requires studying deliberations and moments of contestation in the concrete, every-day practices and activities of political decision makers. The method aims to 'tease out' the normative conflicts that underlie different interpretations of the same goal, seeking to enable constructive action based on given circumstances.

The analyzed data includes interviews with government officials, negotiation proceedings, and observations of deliberations. Eight interviews were conducted with government officials from the United States, the United Kingdom, Germany, Sweden, Switzerland, Kenya and China. All interviewees had engaged with geoengineering in the context of their work, and had a good understanding of their government's procedures and positions at both national and international level. Some worked towards informing their government's policy on energy, environment or climate change, others were involved in the negotiations of international environmental agreements.

My questions concerned how the interviewees had become aware of geoengineering, how they perceived it, and the obstacles they encountered in working with it. Questions were asked in a way that encouraged reflection, often probing why certain actions were taken or certain events happened. Although the interviewees did not always know the answer, their speculations provided important insights to norms and expectations held in the policy making context. Due to the research question, my main interest was in the performance of geoengineering problem definitions at the international level. However, the bottom-up nature of the discussion (i.e. states and non-state actors introducing the issue into international fora rather than vice-versa) included analyzing perceptions and expectations at national and sometimes local level. Although low in quantity, these interviews provided valuable insights into policy makers' reasoning around geoengineering.

Proceedings focused on events in which some sort of political engagement with geoengineering took place. Internationally, these are the negotiation of marine geoengineering regulation under the London Convention and the London Protocol (LC/LP), the decision on geoengineering made in the Convention on Biological Diversity (CBD), and the draft resolution on geoengineering discussed in the United Nations Environment Assembly (UNEA). Reports of the Earth Negotiations Bulletin were particularly helpful, but also broader analyses like those provided by Dixon et al. (2014) or Fuentes-George (2017). I also analyzed publicly available documents in which governments explicitly position themselves towards geoengineering in reaction to inquiries from parliament or from the public, as well as recent national climate policies for their reference to geoengineering technologies.

Observations of deliberations took place at conferences and events in which government actors engaged with the geoengineering topic. These include two major scientific conferences; observations made at the United Nations Framework Convention on Climate Change (UNFCCC) COP23; and observations made in attending an internal workshop of the German Agency for the Environment. By 'observations', I mean in-the-corridor conversations with government actors who attended these events, speeches or presentations given by government representatives or advisers, and observations of how government actors engaged with or questioned the geoengineering-related science that was being presented.

To identify areas where institutional fit was lacking, I focused on finding conflicts and inconsistencies in the reasoning of policy makers. These were expressed through reticence, frustration, confusion or emotional reaction. If such conflicts or inconsistencies were recurrent with respect to a particular element of common geoengineering problem definitions, I included this element as a case for further analysis. Each case was then analyzed according to the analytical framework, comprising the scientific problem definition, the institutional context in which it caused conflict, the structure of this conflict, any (suggested) strategies for resolving the conflict, any resulting institutions, and the contextual factors that facilitated or impeded the formation of an institution.

Problem Definitions in Geoengineering Assessments

The analysis of thirteen geoengineering assessments, published by various actors between 2010 and 2019, reveals three overarching problem definitions describing the need to engage with geoengineering technologies (summarized in Table 1.)

The first argues that mitigation is not enough to stop the damaging effects of climate change, and that some form of geoengineering is inevitable. Immediate scale-up of CDR technologies is considered necessary, requiring governance primarily in the form of investment. SRM (prevalently in the form of Stratospheric Aerosol Injection - SAI) is considered as a tool that may be necessary in case of a climate emergency, but that could also be deployed by (other) unilateral actors. The subsequent recommendation is that capacity to manage unilateral or multilateral deployment should be initiated immediately, through both national and international institutions. A moratorium on any kind of geoengineering deployment is dismissed as unrealistic.

The second expresses a warning that geoengineering technologies are a dangerous distraction, with low potential for effectiveness and high risk of preventing a transition away from the use of fossil fuels. A recurring concern in this problem definition is that research and investment in geoengineering will divert valuable resources away from mitigation and adaptation funds needed in the Global South. It also highlights global power imbalances, and the exclusion of poorer and marginalized populations in the decision making process. As a result, it demands absolute prioritization of mitigation and adaptation, an inclusive discussion on the desirability of geoengineering technologies, and a moratorium on the deployment of SAI.

The third recognizes geoengineering technologies as options in the climate change policy portfolio, but highlights the great uncertainties that still characterize these technologies. It refrains from giving direct policy advice beyond the need for more research on the feasibility of different technologies. It tends to emphasize problems of sustainability and equity, rather than the technologies' potential to provide effective solutions. But in the face of mitigation costs and difficulties, it recommends keeping all options open.

Table 1: Problem definitions used in geoengineering assessments

Summary of Problem Definition	2010–2012	2015–2017	2018	2019	Policy Proposal
1: Geo-engineering may be inevitable, we need to prepare for it.	**Bipartisan Policy Center 2011:** Climate remediation is characterized by uncertainties in risk, cost and physical limitations, but may be needed in case of emergency.	**US National Academy of Sciences 2015:** Mitigation will not be enough. Large-scale CDR is needed. Albedo modification is still uncertain, but could be needed (or used by others) in the event of a climate emergency.	**UK Royal Society 2018:** Emissions reductions will not be enough. GGR technologies are needed in the second half of the century, but are not yet well under-stood. .... **Chhetri et al. 2018:** The growing conversation about SRM calls for robust anticipatory governance, no matter whether one supports or disapproves of the technology.	**Stavins & Stowe 2019:** It is a matter of time before countries or other actors attempt to deploy solar geo-engineering. .... **C2G2 2019**: The urgency of climate change makes consideration of geo-engineering necessary, but raises concerns about ecological impacts, moral hazard, institutional lock-in and unilateral deployment, requiring governance.	Invest in and up-scale CDR technologies. Build knowledge, institutions and capacity at multiple levels to prevent or manage unilateral or multilateral use of SRM (excluding a moratorium).
2: Geo-engineering is a dangerous distraction, we should not count on it.	**ETC group 2010:** If rich governments and industry warm to geo-engineering as a solution to climate change,	**Wetter & Zundel 2017:** Geo-engineering is being normalized as virtually inevitable by an	**EASAC 2018:** The lack of recognition in public and political debate about the severity of emission reductions	**CIEL 2019:** Geo-engineering technologies, both CDR and SRM, rely on and cater to the interests and infrastructure of	Place all efforts on mitigation. Allow for some geo-engineering research, but only in combination with inclusive

	their money and technologies will no longer be available for adaptation and mitigation in the Global South.	exclusive group of experts, while developing countries, indigenous peoples and local communities are left voiceless.	required to reach 2°C or 1.5°C could be due to over-optimistic expectations about CDR technologies.	the fossil fuel industry. They also carry high risks and prevent systemic change.	international discussions on the realistic role of these technologies. Enable a moratorium on outdoor experimentation and deployment.
3: Geo-engineering is an existing option, with many uncertainties.	**IPCC working group 2012:** The ambiguity around geoengineering makes productive discussion difficult. Risks and impacts should be assessed within a context of risks and impacts of climate change and other responses such as mitigation and adaptation.	**EuTRACE 2015:** Despite increasing presence in conversation, it is not clear whether climate engineering can ever be used to reduce climate change, for both physical and social reasons.	**IPCC 2018:** Achieving the 1.5°C target will be subject to high costs. Using CDR or SRM may reduce those costs, but could have serious implications for sustainable development and are subject to knowledge gaps.		Keep all options open, maintain a holistic perspective, fill knowledge gaps in order to facilitate decision making.

The first commonality of these problem definitions is their conceptualization of geoengineering. All reports, even those that use a different name, discuss deliberate, large-scale interventions into natural systems in order to counteract climate change. Similarly, all reports categorize these interventions into CDR and SRM (although different terms are used as titles). The trend has been to increasingly separate the two groups, for example by writing separate reports or not using an overarching term. Nevertheless, common concerns in terms of side-effects on social and ecological systems, feasibility of deployment at scale, institutional lock-in, and distraction from mitigation and adaptation persist for both categories.

A second commonality (visible in the first and second problem definition) is the urgency with which international governance is advocated for. In the first problem definition, urgency for up-scaling CDR is rationalized based on predictions made by the IPCC. Urgency for SRM governance is rationalized through the hazard of unilateral deployment and anticipated loss of control. International institutions – ranging from deliberative fora to nuclear proliferation-like treaties – are recommended as a way to build capacity for managing potential unilateral or multilateral deployment. In the second problem definition, urgency is rationalized based on the threat of geoengineering technologies being normalized, and the need for an inclusive and diverse discussion. Existing international institutions are called upon to put the potential of geoengineering technologies into a realistic perspective, and ensure that any large-scale experimentation or deployment is prohibited in the absence of an inclusive decision making process.

A third commonality is the narrative of geoengineering involving trade-offs, although their nature varies from definition to definition. The first identifies a trade-off between risk of damage from climate change, and risk of damage from geoengineering. The second identifies a trade-off between considering geoengineering as a policy option, and the capacity to realize meaningful mitigation and adaptation. The third identifies a trade-off between the anticipated costs of climate mitigation, and potential negative effects of a technology on sustainable development. The desirability of an individual technology is the result of how large the respective trade-off is perceived to be. Problem definition one tends to have a comparably positive view on BECCS and SAI, as avoiding damage from climate change is considered a priority. Problem definition two dismisses BECCS and SAI for their potential to distract from mitigation and adaptation, while highlighting the benefits of approaches that encourage a transition away from fossil fuel use. Problem definition three remains agnostic in the absence of scientific evidence about the effects of geoengineering technologies on sustainable development, but prefers solutions that promise cost-reduction and co-benefits. How these problem definitions play out in an institutional context is considered in the following section.

Dissonances in Institutional Fit

In-depth interviews with policy makers from seven different countries, together with observations of deliberations amongst government actors and relevant negotiation proceedings, reveal that some common elements of geoengineering problem definitions meet barriers in the policy-making context. Particularly important are dissonances with those elements that are widely shared across problem definitions: conceptualization, urgency, and trade-offs.

Scientific Conceptualization and the Global Legal Architecture

One area where institutional fit seems problematic is between the scientific conceptualization of geoengineering (CDR and SRM) and the global legal architecture. The CDR/SRM demarcation separates technologies according to the manner in which they affect radiative forcing and has fundamentally shaped the scientific and popular understanding of what geoengineering is (Gupta & Möller 2019). Because of its consistent use in assessments like those above, policy makers share this definition and use it in their deliberations about the issue. Yet when it comes to governance questions, the cases below show that other demarcations – notably method of deployment, scale, impact and jurisdiction – play a more important role.

The London Convention and Protocol

The first case discussed here is the negotiation of the LC/LP amendment on marine geoengineering. In 2013, parties adopted an amendment that restricts the use of ocean fertilization to well-controlled scientific experiments. The process around this amendment was first initiated in 2007, in reaction to a private company’s announcement that they would carry out ocean fertilization experiments off of the coast of Galapagos. Although negotiations were initiated in response to a single technology, the advocates who brought the topic to an international agenda framed the procedure as a form of 'geoengineering'. As Fuentes-George (2017) lays out, this was a strategic way of defining the experiments as a global threat and thereby raising concerns amongst the international community. Already here, problem definition played an important role in bringing the subject to the political agenda.

The CDR/SRM demarcation inherent to the geoengineering problem definition caused some difficulty in the resulting negotiations, as it wasn't clear how these groups would fit the Protocol's mandate. A Swedish negotiator explained that "the concern was firstly not to overstep the mandate of the cooperation globally, and secondly to bring about a generic formulation. That means of course that the way [that geoengineering is] formulated in the London Protocol is not necessarily how someone would define it more broadly". Negotiators eventually agreed that only technologies which added substances to the marine environment could be included in the amendment, due to the Protocol's mandate being about marine dumping. The new term - 'marine geoengineering' - was different from the CDR/SRM demarcation often used to define geoengineering, in that it had to distinguish according to method of deployment and jurisdiction rather than the technologies' way of affecting radiative forcing.

Figure 2: Lack of fit between scientific problem definition and mandate of London Protocol & London Convention

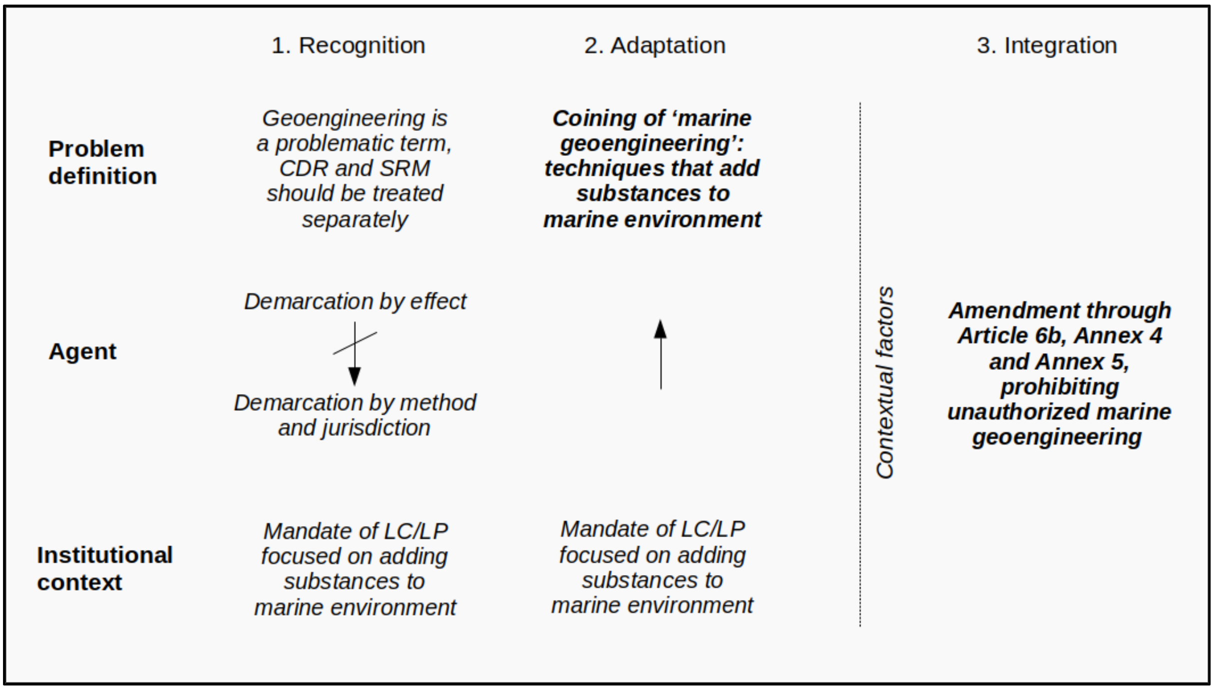


Figure 2 schematically visualizes this case according to the analytical framework. It provides a clear example where the problem definition was adapted by participating policy makers in order to fit a relatively static institutional context - the mandate of the LC/LP. Contextual factors that facilitated the creation of a new institution included a shared perception that ocean fertilization had negative impacts on the environment and a feeling of relevance due to the fact that ocean fertilization efforts (by private actors) had already taken place. The result was a consensus amongst negotiating parties that uncontrolled ocean fertilization efforts should be prevented.

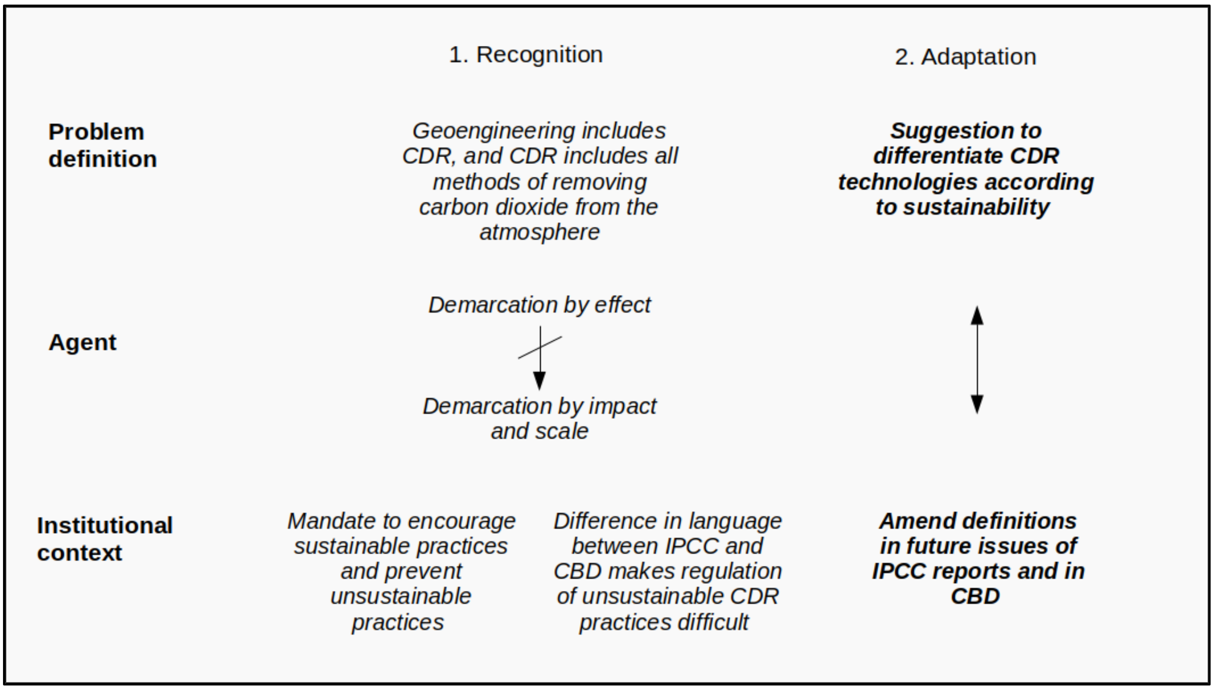
The Convention on Biological Diversity

A similar lack of institutional fit was discussed during a geoengineering governance workshop where German officials were preparing a political position for international negotiations. In the process, some participants expressed concern regarding the CDR category used in the IPCC's 1.5°C report. At stake were the differences between reforestation and the restoration of natural ecosystems on the one hand, and afforestation or large-scale industrial systems like BECCS on the other. On the one hand, the institutional context of these policy makers emphasized the encouragement of sustainable practices and the prevention of unsustainable ones. On the other, the CDR category made it difficult to distinguish between those approaches that promised ecological and social benefits (small scale, nature based solutions), and those that were perceived to have negative effects on humans and ecological systems (large-scale systems with heavy impacts on social and ecological dimensions).

The differences in technologies summarized as CDR were also relevant with respect to regulation of geoengineering under the CBD. In 2010, the CBD's parties had adopted decision X/33, in which they restricted the use of geoengineering to small-scale scientific experiments in controlled settings. Counter-intuitively, the Convention's decision to discourage geoengineering, in combination with the IPCC's decision to include reforestation and restoration as a form of CDR (and therefore geoengineering), could make ecosystem restoration relevant to the CBD's decision. The decision asks governments to ensure that 'no climate-related geo-engineering activities** that may affect biodiversity take place' – a formulation that does not by default exclude restoration attempts. Conversely, the IPCC's definition makes it difficult to use the CBD's decision to regulate those types of CDR that are seen as problematic. Suggestions for ameliorating this situation were to make sure that the IPCC's future definitions would differentiate CDR technologies according to their ecological and social sustainability, and to introduce a corresponding amendment to the CBD's decision.

The observations used for this case are a snapshot of the reasoning process that took place amongst a small group of like-minded policy makers developing a strategy for international engagement. An institutional output could therefore not be observed; instead, the relevant outputs of the workshop are depicted in Figure 3. In this case, the re-definition of CDR technologies according to sustainability aspects was relevant both for the participants' shared problem definition and for the institutional context. By aiming to introduce a sustainability dimension to the CBD's and the IPCC's definition of geoengineering technologies, the officials intended to re-shape the global institutional context in order to facilitate regulation according to the expectations of their national context.

Figure 3: Lack of fit between scientific problem definition and mandate to encourage sustainable practices



Interviews with policy makers clarify the dissonance between scientific demarcation and legal architecture. The widely used CDR and SRM categories include both local and familiar techniques easily managed within national territory, as well as large-scale interventions with transboundary effects. Interviewees mentioned different techniques that were already in use, but would fall under the current definition of geoengineering due to their physical mechanism (some forms of cloud seeding, and the enhancement of natural carbon sinks). The question then arose how to draw a distinction between technologies that were perceived as ethically and ecologically problematic, and those that were considered conventional activities.[3]

This mismatch between scientific distinction and political priorities resonates with what has been found in comparable studies. In his analysis of interviews with experts advising the European Union, Himmelsbach (2018) writes that "this discrimination between CE proposals according to the degree of control, or, as one might argue, ontological complexity, cuts against the conventional distinction between the technological families of carbon management and solar radiation management. [...] It does, however, align with concerns about which technologies might be governable on a national level and which ones would require multilateral cooperation" [128]. For this reason, experts as well as policy makers would benefit from

[3] The reason why this problem is not commonly recognized is because SRM tends to be equated with SAI – one approach to increase global reflectivity associated with high impact, high effectiveness and high risk. When considering other techniques, such as increasing the reflectivity of roads and buildings, impacts and risks are much more similar to approaches like soil-carbon sequestration or reforestation.

critically assessing the available technology categories with respect to their potential for governability.

Urgency in the Face of Novelty and Reputation

A second area where institutional fit seems problematic is the urgency narrative invoked to advocate for geoengineering governance. In problem definition one, SRM (equated with SAI) is characterized as a free-driver problem in which high impact and low cost could lead to unilateral deployment without global consent. It is therefore imperative that countries form global institutions to prevent this (Stavins & Stowe 2019). A softer version of this argument states that SRM is becoming so present on the scientific agenda that the concerns associated with it demand robust governance infrastructure at all levels (Chhetri et al. 2018).

In problem definition two, geoengineering (especially SRM, but also some forms of CDR) is characterized as a highly uncertain or undesirable policy option that is becoming normalized through scientific engagement. This normalization requires urgent attention by states and international organizations to avoid 'sleepwalking toward a geoengineered future' (Wetter & Zundel 2017, 5), or to place the 'seriously over-optimistic' expectations linked to CDR in a more realistic perspective (EASAC 2018, iv). The case below describes how the plea to initiate geoengineering governance has faced barriers with respect to novelty of the idea and concerns for state reputation (Figure 4).

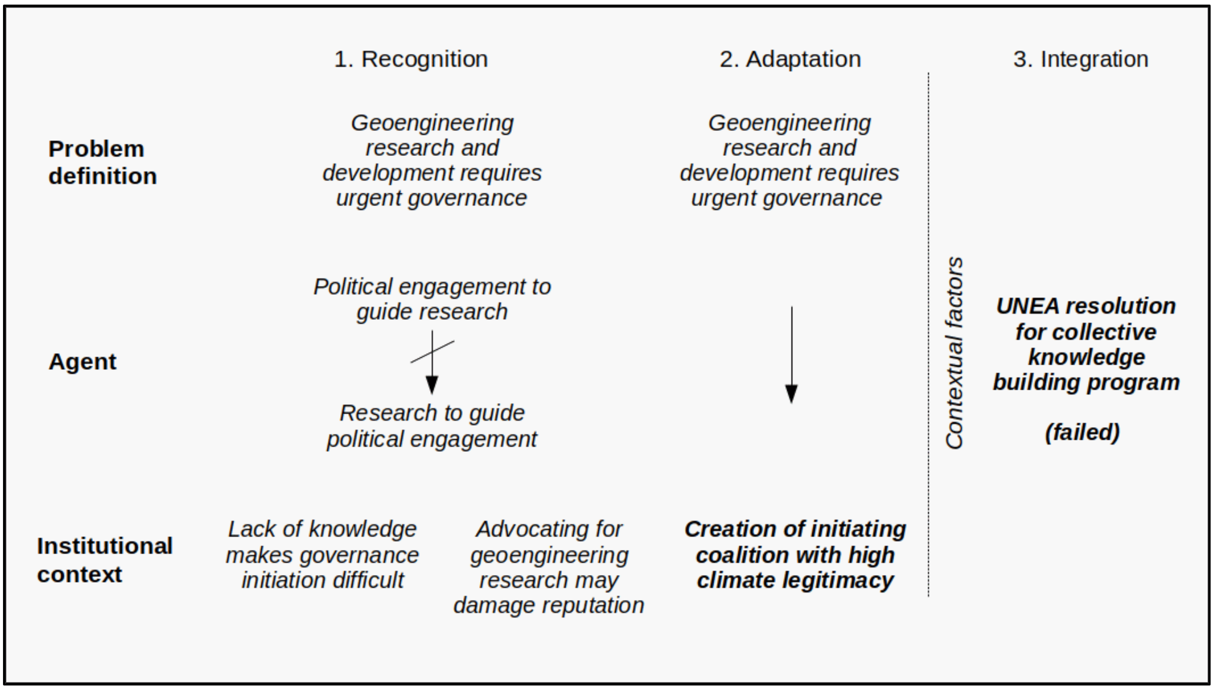
The novelty of geoengineering on the climate policy agenda and its accompanying scientific uncertainty makes it difficult for policy makers to determine whether geoengineering is indeed an issue that deserves political attention. Evidence can be found both in government position papers and interviews with policy makers. Thus, German and UK government responses to inquiries made by parliamentarians or members of the public name lack of scientific consensus as the main reason why governments refrain from judging (Bundestag 2018), or engaging in a 'rational debate on' (BEIS 2018a) the merits or risks of geoengineering technologies. Government officials from countries as different as Kenya, Switzerland and China explained that they attended scientific conferences because they were looking to better understand the status of contemporary research. They usually concluded that the scientific discussions were still very confused.

For some, historical tensions between North and South further reinforced the novelty barrier. A Kenyan climate negotiator explained that the novelty of SRM and its ideational origins in the Global North were likely to make developing countries suspicious. Because of negative experiences with promises made and broken in the past, they lacked the trust needed to address geoengineering of their own accord. Comparable concerns were expressed by a policy maker representing the Small Island Developing States (SIDS) at a scientific conference. She explained how the 1.5°C target had been advocated for by SIDS in the midst of destructive hurricanes. SRM however had never been part of the debate, and was unlikely to be supported in her cultural context. Both officials also stated that the lack of capacity in developing countries to deal even with the most immediate threats of climate change made it questionable whether they could substantially engage with something like SRM at all.

Next to novelty, the hubris and risk that is widely associated with geoengineering (in particular SRM) poses a threat to countries' reputation. Officials from European countries like Germany, the UK and Switzerland expressed concern about how their government might be perceived if it showed too much enthusiasm for SRM technologies. A Swiss diplomat explained that it "wouldn't be bad" if the world community could create clarity and decide what kind of research should be allowed. But he also stated that this would be very difficult for a single state to do, and that "immediately, there would be countries that say this is a cheap exit, that you want to neglect your mitigation obligations, and solar radiation management is an easy way to do that."

Because of such reputation concerns, all interviewees thought that state-supported SRM research or governance could only be initiated by an actor with substantial climate legitimacy. German officials thought it would take a collective like the EU, or a diverse coalition of states from around the world, to bring the issue forward. A scientific advisor from the UK suggested that such legitimacy might lie with the small island states or the least developed countries, who were very serious about climate change. He said he would be very surprised though, if the UK took on this issue itself.

Figure 4: Lack of fit between urgent governance call by governance advocates, and novelty and reputation concerns amongst policy makers



Adaptation of the institutional context to support knowledge production while minimizing reputational damage could be observed in March 2019, when Switzerland introduced a draft resolution on geoengineering governance to UNEA. This resolution was backed by a curious assortment of countries from around the world, none of them major powers, and several of them least developed countries. The resolution draft was modest, refraining from any policy suggestions. Instead, it cited the function of UNEA to "ensure that emerging environmental problems of wide international significance receive appropriate and adequate consideration by Governments" and suggested a knowledge gathering exercise to inform further engagement with the topic (UNEA 2019).

Despite the efforts of Switzerland and others to create institutional fit, discrepancy in the preferences of Parties was too high to allow for an adoption of the resolution. Particularly the draft resolution's association of geoengineering with "potential global risks and adverse impacts on environment and sustainable development" and "lack of multilateral control and oversight" was distasteful to countries that build their climate policies on BECCS or other forms of carbon capture. Saudi Arabia argued that grouping CDR with SRM would lead to disproportionate restrictions for carbon capture technologies. The US wanted to place both CDR and SRM on par with mitigation and adaptation, characterizing each as a potential 'climate strategy' (Corry 2019). Although the resolution went through several drafts, persistent lack of agreement eventually lead to its withdrawal from the negotiation table.

While the barriers of novelty and reputation concerns only become visible through careful deliberative analysis, the urgency narrative is pervasive amongst officials who engage with the subject. This highlights an important tension. On the one hand, policy makers buy the urgency narrative, expressing the need for early international governance. On the other hand, they say that the state of scientific knowledge is too preliminary to even qualify for political discussion.[4] Concerns for reputation add another layer of complexity. Environmentally concerned and technologically advanced countries fear reputation costs if they engage too positively with geoengineering. Developing countries lack scientific capacity and trust in new promises promoted by western scientists. Yet with the recent breach of geoengineering at UNEA, the problem of uncertainty becomes less pronounced. The Swiss initiative has opened a path for larger, more powerful actors to enter the arena. These no longer need to fear for their reputation and can point to the failed UNEA resolution as an issue that deserves further discussion. How deliberations on this front will continue remains to be seen.

Risk-Risk Narratives and the Evolving Norms of Environmental Governance

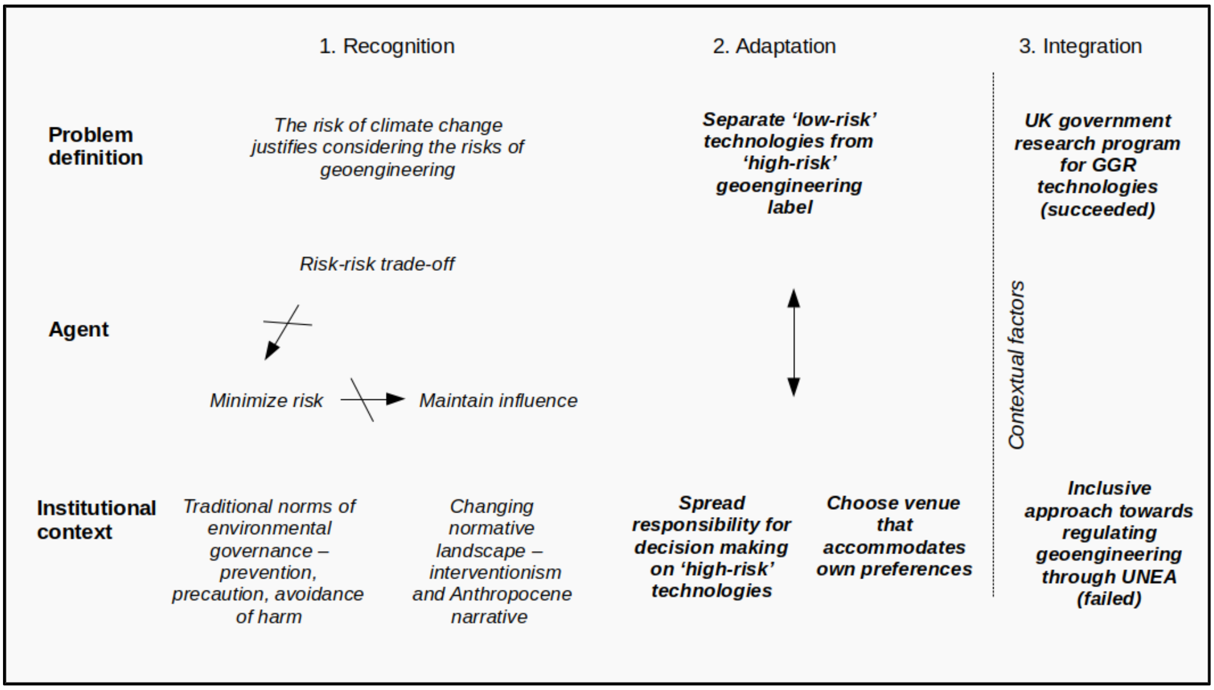
A third area where institutional fit poses difficulties concerns the trade-off language used in many geoengineering problem definitions. Particularly the risk-risk trade-off between damage from climate change and damage from geoengineering technologies used in problem definition one is a difficult sell amidst traditional principles of environmental protection. Norms like

[4] The outcome of this chicken-and-egg problem is also likely to depend on how much influence policy entrepreneurs like the 'Carnegie Climate Geoengineering Initiative' (C2G2) or the Heinrich Böll Stiftung/ETC group will have in convincing governments to take action. The urgency of geoengineering governance seems to be most actively conveyed through non-profit organizations like these (albeit using different problem definitions) and both were present at the UNEA conference.

preventive action, precaution, polluter pays and the responsibility to avoid transboundary harm constitute an influential normative infrastructure that decision makers have learned to navigate over many years (Beyerlin 2008). At the same time, the normative expectations at international level are changing. This signifies barriers to geoengineering governance in two ways: a lack of fit between the risk-risk problem definition and the precautionary principle, but also a conflict between the normative contexts of different countries (Figure 5).

Particularly in a European context, the risk-risk narrative of geoengineering stands in stark contrast to traditions of minimizing or avoiding risk in environmental policy. For example, policy makers in Germany face an institutional legacy of norms that emphasize minimization of ecological harm and that are sceptical of large-scale technological or interventionist solutions (e.g. nuclear power or genetic modification). Meanwhile, policy makers in China or the US work in a context that encourages technological solutions and that have a history of large scale environmental interventions.

Figure 5: Lack of fit between risk-risk narrative and normative context of global environmental governance



Falkner & Buzan (2019) remind us that despite the overall institutionalization of environmental protection as a primary global norm, the types of policies through which this norm should be realized is increasingly open for debate. This development was also evident to political agents who engaged in international environmental politics. In a discussion amongst German policy makers, experienced international negotiators pointed out that using the precautionary principle to justify strict regulation or a moratorium on geoengineering (as desired by their national counterparts) would alienate other states and come with a risk of losing influence on the shape of the agenda. The UNEA deliberations discussed earlier provide evidence in kind, where resistance to the precautionary principle language was met by surprise (Goering 2019). In order to exert influence and maintain goodwill, asking the scientific community to cast light on critical aspects of geoengineering technologies was thought to be more effective. In this way, concerns could be expressed based on scientific fact rather than on normative principle.[5]

Addressing geoengineering in a governance context where risks are not well received can be done in different ways. One strategy is to separate individual technologies from the geoengineering concept entirely. More concretely, governments are careful to avoid these terms in their climate strategies, and those technologies with a high-risk profile (SAI or ocean iron fertilization) are excluded from national government activity. A clear example can be found in the UK government's policy towards CDR. In a prestigious investment programme financed by the UK natural environment research council, CDR is re-named 'Greenhouse Gas Removal' (GGR) and divorced from the geoengineering label. While the technologies subsumed under GGR remain the same as under CDR, the term 'geoengineering' or 'climate engineering' is omitted. In this form and with reference to the Paris Agreement, GGR has become an official part of the UK's clean growth strategy (BEIS 2018b).

As an interviewed official explained, the only reason why the UK government has a public statement on geoengineering at all is because citizens and NGOs sometimes write letters of concern to their politicians (see BEIS 2018a). These concerns are commonly motivated through fears of so-called 'chemtrails' – a conspiracy theory about governmental climate and mind control, allegedly evident in the condensation trails of conventional aeroplanes. As Cairns (2016) discusses, this conspiracy theory has important implications for trust and justification in the governance of SRM technologies, and provides further motivation to divorce government policy from the geoengineering terminology.

While the separation approach works for technologies that are not (yet) considered overly risky, technologies with a public high-risk profile need to be addressed differently. As discussed earlier, most governments do not have a position on the governance of 'ontologically complex' technologies like SAI yet, also because the issue is very new on the governmental agenda. But when encouraged to give an opinion on how governance might take place, officials react by emphasizing wide-spread participation. Some highlight the need for authority and social control in the face of unilateral deployment. Others highlight ethics, stating that those affected by the intervention should have a voice in the governance procedure. Still others express concerns that interventions should be sustainable, and therefore adhere to collectively determined standards. It is interesting to note that rather than highlighting effectiveness and efficiency in the governance of SRM, which would call for a mini-lateral option (Victor 2009), all policy makers that I spoke to expressed a preference for multilateral solutions.

[5] The direct interaction with scientists in question and answer format was also highlighted by other policy makers as particularly helpful. One interviewee described the UNFCCC's structured expert dialogue as "the best thing I have ever experienced in the climate negotiations".

Where negotiation should take place is a different question, and depends somewhat on the individual decision makers' institutional context. Agents versed in global environmental governance know that there are variations in the normative underpinnings of different international fora, and can anticipate where their own institutional contexts are likely to be mirrored. Choice of venue is therefore a way of adapting the institutional context to enable fit with a preferred problem definition. For example, negotiators in the CBD can take a more sceptical stance towards geoengineering than negotiators in the UNFCCC, as the foundational norms of these institutions differ with respect to what is considered appropriate. McGraw (2002) notes that the CBD prioritizes national sovereignty and an ecosystem based approach, while the UNFCCC prioritizes global cooperation and a science based approach. Furthermore, the CBD has a history of restrictively regulating geoengineering research and deployment through Decision X/33, while the UNFCCC allows considerable space for CDR through Article 4.1 of the Paris Agreement.

An example of differences in the institutional venue preference of policy makers can be found in the proceedings of the CBD's COP10, where negotiators discussed a possible geoengineering moratorium. Attending members of the Earth Negotiations Bulletin noted that while some participants took the issue very seriously, muttering that 'there are real issues at stake here', others downplayed the process and argued that 'the real decisions will be taken in other fora, most notably the UNFCCC' (IISD 2010). Legitimation and de-legitimation of these fora can be observed again and again at various geoengineering events and conferences. While sceptics uphold the CBD's decision X/33 as an already existing de facto moratorium, supporters deny its significance on the basis that it is not legally binding.

Existing norms of global environmental governance constitute important structures in the practical assessment of geoengineering governance. It is surprising that they are not more front and centre in the corresponding academic literature. With some notable exceptions (Brent et al. 2015, Talberg et al. 2018), norms are mostly addressed as something that still needs to be developed in order to govern emerging technologies. Yet the work that existing norms do in steering government behaviour determines which debates and discussions can be initiated in the first place. Instead of assuming a blank slate, future governance assessments could profit from taking into account the power of contextual values and principles.

Conclusion

What is needed to make geoengineering technologies governable? I argue that in order to answer this question, researchers need to study the way in which scientific problem definitions match the institutional context of policy makers. My analysis indicates that there are at least three areas where common elements of geoengineering problem definitions conflict with the institutional setting of policy makers, and provides examples of how policy makers act as agents in creating institutional fit.

Firstly, the ubiquitous demarcation between technologies according to their manner of affecting radiation balance (CDR and SRM) makes it difficult to regulate according to politically relevant dimensions such as scale, impact, method of deployment and jurisdiction. More useful is the focus on individual technologies. These can be evaluated according to politically relevant criteria, including economic co-benefits and social, political and environmental compatibility. For now, this is particularly important for CDR, which is reaching political agendas through the conclusions and models of the IPCC. The technologies in this group have very different levels of normative acceptability, but are often presented as exchangeable. An individualized approach enables better integration with other types of climate policies and facilitates governance within existing regulatory structures.

Secondly, the urgency with which governance is advocated for conflicts with scientific and political uncertainties, making it difficult for policy makers to take initiative. While scientific uncertainty impedes the formation of an internal political position, political uncertainty evokes concerns for reputation and relations with other actors. The draft resolution on geoengineering governance recently discussed at UNEA may have mitigated this problem, as countries were compelled to take a political stance. We can expect that more powerful countries will begin engaging in the debate soon.

Thirdly, the trade-off narratives in geoengineering problem definitions require experience in navigating the normative structures of global environmental governance. Traditional principles of precaution and prevention seek to stop environmental harm from happening, rather than risking one kind of harm to avoid another. But these traditional environmental ideals are increasingly being questioned, and policy makers need to strategically choose both problem definition and venue if they want to maintain control of political developments. One way of navigating this complex situation is for negotiators to discuss their concerns in a dialogue with scientists from multiple disciplines. The UNFCCC's structured expert dialogue provides a good model for this.

References

Allan, Bentley. B. 2017. Producing the Climate: States, Scientists, and the Constitution of Global Governance Objects. International Organization 71(1): 131–162.

Anshelm, Jonas & Anders Hansson. 2014. The Last Chance to Save the Planet? An Analysis of the Geoengineering Advocacy Discourse in the Public Debate. Environmental Humanities 5(1): 101–123.

Armeni, Chiara & Catherine Redgwell. 2015. International legal and regulatory issues of climate geoengineering governance: Rethinking the approach. Climate Geoengineering Governance Working Paper Series 021.

BEIS 2018a. The Clean Growth Strategy. London: Department for Business, Energy & Industrial Strategy.

BEIS 2018b. Geo-Engineering: The Government's View. London: Department for Business, Energy & Industrial Strategy.

Beyerlin, Ulrich. 2007. Different Types of Norms in International Environmental Law: Policies, Principles, and Rules. In The Oxford Handbook of International Environmental Law, edited by Daniel Bodansky, Jutta Brunnée & Ellen Hey. Oxford: Oxford University Press.

Brent, Kerryn, Jeffrey Mcgee & Amy Maguire. 2015. Does the 'No-Harm' Rule Have a Role in Preventing Transboundary Harm and Harm to the Global Atmospheric Commons from Geoengineering? Climate Law 5(1): 35–63.

Deutscher Bundestag. 2018. Antwort der Bundesregierung auf die Kleine Anfrage der Abgeordneten Lisa Badum, Kai Gering, Steffi Lemke, weiterer Abgeordneter und der Fraktion BÜNDNIS 90/DIE GRÜNEN – Drucksache 19/2586 – Geoengineering und Klimakrise. http://dip21.bundestag.de/dip21/btd/19/031/1903149.pdf.

Cairns, Rose. 2016. Climates of suspicion: 'chemtrail' conspiracy narratives and the international politics of geoengineering. The Geographical Journal 182(1): 70–84.

Chhetri, Netra, Dan Chong, Ken Conca et al. 2018. Governing Solar Radiation Management: Technical report. Academic Working Group on Climate Engineering Governance. Washington DC: Forum for Climate Engineering Assessment, American University.

Corry, Olaf. 2019. Did global governance of geoengineering just fall at the first hurdle? In Harvard Solar Geoengineering Research Blog edited by Holly Buck, Peter Irvine, Ben Kravitz, Andy Parker & Gernot Wagner. https://geoengineering.environment.harvard.edu/blog/perspectives-unea-resolution#OlafCorry.

EASAC. 2018. Negative Emission Technologies: What Role in Meeting Paris Agreement Targets? European Academies Science Advisory Council. Leopoldina, Halle (Saale): German National Academy of Sciences.

Dixon, Tim, Justine Garrett & Edward Kleverlaan. 2014. Update on the London Protocol – Developments on Transboundary CCS and on Geoengineering. Energy Procedia 63: 6623–6628.

Falkner, Robert & Barry Buzan. 2019. The emergence of environmental stewardship as a primary institution of global international society. European Journal of International Relations 25(1): 131–155.

Fuentes-George, Kemi. 2017. Consensus, Certainty, and Catastrophe: Discourse, Governance, and Ocean Iron Fertilization. Global Environmental Politics 17(2): 125–143.

Goering, Laurie. 2019. Proposal for U.N. to study climate-cooling technologies rejected. Reuters.

Gupta, Aarti & Ina Möller. 2019. De facto governance: How authoritative assessments construct climate engineering as an object of governance. Environmental Politics 28(3): 480–501.

Hajer, Maarten & Hendrik Wagenaar. 2003. Deliberative Policy Analysis: Understanding Governance in the Network Society. New York: Cambridge University Press.

Himmelsbach, Raffael. 2018. How scientists advising the European Commission on research priorities view climate engineering proposals. Science and Public Policy 45(1): 124–133.

Huttunen, Suvi, Emmi Skytén & Mikael Hildén. 2014. Emerging policy perspectives on geoengineering: An international comparison. The Anthropocene Review 2(1): 1–19.

IISD. 2010. CBD COP 10 Highlights Friday, 22 October 2010. Earth Negotiations Bulletin 9(539).

Irvine, Peter, Kerry Emanuel, Jie He, Larry W. Horowitz, Gabriel Vecchi & David Keith. 2019. Halving warming with idealized solar geoengineering moderates key climate hazards. Nature Climate Change 9: 295–299.

Kingdon, John W. 1984. Agendas, Alternatives and Public Policies. Boston: Little, Brown and Company.

Lejano, Raul P. & Savita Shankar. 2013. The contextualist turn and schematics of institutional fit: Theory and a case study from Southern India. Policy Sciences 46(1): 83–102.

March, James. G. & Johan P. Olsen. 2011. The Logic of Appropriateness. In The Oxford Handbook of Political Science edited by Robert E. Goodin, 478–493. Oxford: Oxford University Press.

McGraw, Désirée. M. 2002. The CBD – Key Characteristics and Implications for Implementation. RECIEL 11(1): 17–28.

National Academy of Sciences. 2015. Report in Brief: Climate Intervention. Technical report. Washington DC: National Academies Press.

Parson, Edward. A. 2014. Climate Engineering in Global Climate Governance: Implications for Participation and Linkage. Transnational Environmental Law 3(1): 89–110.

Rochefort, David. A. & Roger W. Cobb. 1994. The Politics of Problem Definition: Shaping the Policy Agenda. Lawrence, Kansas: University Press of Kansas.

Rogelj, Joeri, Alexander Popp, Katherine V. Calvin, et al. 2018. Scenarios towards limiting global mean temperature increase below 1.5°C. Nature Climate Change 8: 325–332.

Stavins, Robert N. & Robert C. Stowe. 2019. Governance of the Deployment of Solar Geoengineering. Cambridge, MA: Harvard Project on Climate Agreements.

Talati, Shuchi & Paul Higgins. 2019. Policy sector perspectives on geoengineering risk and governance. Journal of Science Policy & Governance 14(1).

Talberg, Anita, Peter Christoff, Sebastian Thomas & David Karoly. 2018. Geoengineering governance-by-default: An earth system governance perspective. International Environmental Agreements: Politics, Law and Economics 18(2): 229–253.

Royal Society. 2018. Greenhouse Gas Removal. London: The Royal Society & The Royal Academy of Engineering.

UNEA. 2019. Resolution for consideration at the 4th United Nations Environment Assembly: Geoengineering and its governance. https://geoengineering.environment.harvard.edu/files/sgrp/files/draft_unea_resolution.pdf.

Victor, David G. 2009. On the regulation of geoengineering. In The Economics and Politics of Climate Change edited by Dieter Helm & Cameron Hepburn, 325–339. New York: Oxford University Press.

Wetter, Kathy J. & Trudi Zundel. 2017. The Big Bad Fix: Technical report. ETC Group, Biofuelwatch & Heinrich Böll Stiftung. Creative Commons.

Young, Oran. 2002. The Institutional Dimensions of Environmental Change: Fit, Interplay, and Scale. Cambridge, MA: MIT Press.