Explaining the role of private institutions in complex global climate governance: the cases of geoengineering, REDD+, and short-lived climate pollutants

Fariborz Zelli, Lund University

Harro van Asselt, Stockholm Environment Institute

Ina Möller, Lund University

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Disclaimer: This paper is still in a preliminary stage. It develops a conceptual and analytical framework in section 2, which, however, has not yet been applied to the three selected cases. Instead, sections 3-5 present descriptions, but not yet systematic analyses, of the institutional complexity of the three cases. Our apologies for this inconsistency.

1 Introduction

The key objective of this study is to assess and explain the shape of institutional complexity or hybrid multilateralism that characterises selected sub-fields of global climate governance. We understand institutional complexity as a diversity of international institutions that legally or functionally overlap in addressing a given issue area of global governance. They do so while potentially differing "in their character (organizations, regimes, and implicit norms), their constituencies (public and private), their spatial scope (from bilateral to global), and their subject matter (from specific policy fields to universal concerns)" (Biermann et al. 2009, p. 16).

While there are ample analyses of the institutional complexity of the overall climate governance architecture, there are at least two research gaps. First, there is a seeming divide between institutionalist studies that mainly examined international regimes and transnationalist approaches which often excluded these regimes and instead rather focused on emission trading systems, accounting schemes or city networks (cf. Betsill et al. 2005). Bridging or overarching analyses of the mix of public and private institutional arrangements are still the exception. Second, there has been only scant attention for the institutional complexity of specific issues *within* global climate governance.

Against this backdrop, we zoom into global climate governance and its complexity to allow for a manageable analysis of the mix of public and private institutions, or hybrid multilateralism, on specific sub-fields. Instead of scrutinizing the complexity of this field as a whole, we seek to compare institutional complexity and its consequences for three distinct issues of high policy relevance: climate engineering; reducing emissions from deforestation and forest degradation (REDD); and short-lived climate pollutants (SLCPs).

We have selected these cases, since: (1) all of them are highly dynamic areas of international climate policy that have experienced significant institutional development outside of the UNFCCC in recent years; (2) they are relatively new and still represent major gaps in governance research in general and institutional analysis in particular, nonetheless, their development so far allows for crucial research-based insights and lessons; (3) they allow for novel comparative findings, since they vary significantly in the degree of complexity, in particular the number of the major institutions involved in their regulation, and in the level of coherence among these institutions; and (4) they also vary in the constellation of actors (country coalitions) and with different levels of involvement of business and civil society actors.

For each of these issue areas, the article addresses two questions on the shape and causes of the hybrid multilateralism of global climate governance. First, what is the role of private and hybrid authority institutions in complex climate governance architectures? Here we are interested in identifying the functions that private or hybrid arrangements have come to carry out in a governance architecture and how these relate to the roles of public institutions.. Second, what are the underlying causes of institutional complexity within and across the three issue areas? We aim to gain insights into how theoretical approaches, based on problem-structural institutionalism and private governance analysis, can help us address these questions.

Section 2 sketches our conceptual and analytical framework. It introduces, for the first research question, criteria for assessing mixed governance architectures; and, for the second research question, potential explanations of the different architecture mixes, or degrees of complexity, in the three issue areas under scrutiny, based on theories of problem structure and private authority. Sections 3, 4 and 5 provide an explorative application of this framework – a full-fledged application would go beyond the scope of this paper. We identify the roles of private and hybrid authority for the issue areas of REDD, SLCPs, and climate engineering, and then briefly examine the plausibility of the explanatory factors we established in Section 2. Section 6 delivers cross-cutting findings for the three cases.

2 Conceptual and Analytical Framework

2.1 Institutional Complexity and Mixed Governance Architectures

Biermann et al. (2009), argue that institutional complexity – in their terminology: institutional fragmentation – is a structural characteristic of any global governance architecture, but that the degree of fragmentation varies considerably across such architectures. Following the argument that institutional complexity is a matter of degree, the question is what are useful criteria in order to characterise and compare the respective mix between private and public institutions across issue areas.

In the following, we distinguish the following dimensions: 1) centrality of one or several core public institutions, in terms of their functions qua mandate; 2) sources of private authority, and 3) the functional division of labour between public or other private institutions.

With regard to the *centrality* of public institutions, we differentiate roughly between architectures with a core institution, architectures with two or more identifiable cores, and architectures with no clear hierarchy. We build on Biermann et al. (2009) and Keohane and Victor (2011) with their predominantly legal criteria. Biermann and colleagues speak of synergistic fragmentation of a global governance architecture, when almost all countries participate in the core institution in an issue area, and where this institution "provides for effective and detailed general principles that regulate the policies in distinct yet substantially integrated institutional arrangements" (Biermann et al. 2009: 20). Conflictive fragmentation, by contrast, occurs when the institutions in a given architecture are hardly connected or have very different decision-making procedures.

Notwithstanding the value of these typologies and criteria for the first dimension we mentioned above, they do not put emphasis on the specific mix of private and public institutions and the respective functions that each 'camp' mostly performs for a given architecture. For this, we need to look at a second strand of literature that scrutinises the roles of non-state actors and institutions.

One approach to analyzing roles of private authority is to ask *why* non-state actors have taken on a governing role. Green (2014: 33-36) distinguishes two *sources* of private authority, delegated and entrepreneurial, depending on the origin of authority. Either a private institution has been instructed to create rules, set standards or perform other governance functions on behalf of the governed or a public institution; or a private institution has taken entrepreneurial initiative on its own to set rules or standards. By "the governed", she refers to "those who obey" authority, meaning here those who adopt the rules of private actors who project this authority (ibid.: 29).

This distinction, we hold, is connected to the centrality of a public institution in the area. If there is such a dominant institution, we can expect it to leave only a limited functional space to private institutions and, potentially, to play a role in the assignment of such functions through delegation. On the other hand, where such a dominant institution is missing, private authority institutions might have more space to fill existing governance gaps on their own entrepreneurial initiative. We are aware that our linkage of these two factors, public centrality and sources of private authority, is building on a rather short deduction and needs further theoretical foundation and, ultimately, corroboration through empirical analyses.

This said, Green's distinction of sources is meant for private governance institutions only, not for hybrid ones like public-private partnerships. For these, it will be important to examine where the initiative for cooperation has ultimately come from: from public institutions that seek collaboration to entrust private ones with certain functions (delegated authority); or from private institutions that seek public legitimation and support for their governance initiative (entrepreneurial authority).

A different question is *how* private governance institutions play a role in global governance, either duplicating or replacing public institutions for these functions, or filling the governance gaps they leave. Building on some of the leading literatures on this issue (Abbott and Snidal 2010; Abbott et al. 2015; Biermann and Siebenhüner 2009; Cutler et al. 1999; Pattberg 2005), and in particular on Abbott (2012), we distinguish the following *functions*: setting standards and commitments; sharing information and networking; financing; and operational activities (here in particular: implementing and evaluating). Most of these functions belong to the classical policy cycle known from public institutions or, like financing or knowledge brokering and networking (cf. Christopoulos & Ingold 2015; Stone 2008, 2013), they are relatively easy to identify and delimit.

Table 1 summarises the criteria through which we will assess the institutional complexity of the three selected governance architectures.

Table 1. Dimensions of institutional complexity in mixed architectures.

DIMENSIONS	VALUES
Centrality of public authority	one core institution; two or more identifable cores; no clear hierarchy.
Sources of private authority	delegated; entrepreneurial.
Distribution of functions among public and private institutions	setting standards and commitments; financing; sharing information and networking; operational activities.

2.2 Explaining Different Degrees of Complexity and Architecture Mixes

Having identified dimensions for assessing mixed governance architectures, how can we explain differences across issue areas? For this purpose, we distinguish two types of theory-guided assumptions:

1) those derived from the problem-structural strand of institutionalism, in order to explain the degree of centrality, or lack thereof, of public institutions as well as, to a certain extent, potential sources of private authority;

2) those derived from private authority theory, in order to explain the functional mix between public and private institutions.

We chose the first set of theories, because the considerable variation of institutional complexity across issue areas suggests that the nature of this issue areas may have a causal impact. What is more, as we show in the following, international relations theory has successfully recurred to problem-structural approaches when explaining the shape and likeliness of a public institutions – which insinuates that such theories may also have a word to say about the shape of whole governance architectures or regime complexes.

On the other hand, was we further argue below, different strands of regime theory focus too strongly on the role of public institutions and leave a theoretical gap when it comes to explaining the emergence and functions of private and hybrid arrangements. Here, private authority approaches come closest to filling this gap.

As for public centrality and sources of private authority, one theoretical approach that lends itself as a potential explanation focuses on the substantive or material nature of the issue area to be regulated. Rittberger and Zürn (1990, 1991, 1992) distinguish different types of conflicts among actors according to the object of contention. Based on earlier typologies by Aubert (1963) and Kriesberg (1982), Rittberger and Zürn (1990: 31-32) differentiate between conflicts over values, conflicts over means and two types of conflicts of interests.

Conflicts over means and values are both classified as dissensual conflicts, as actors disagree on the collective subject of the conflict: whereas in the first case, actors share a common goal but disagree on the means to pursue it, conflicts over values are based on "incompatible principled beliefs regarding the legitimacy of a given action or practice" (Hasenclever, Mayer and Rittberger 1997: 63).

Conflicts of interest, on the other hand, are consensual, as actors value the same scarce good. It is exactly this congruence of interests that makes these actors competitors for the good in question. Rittberger and Zürn (1990: 31-32) further differentiate conflicts of interest according to the nature of the contentious goods. They distinguish between absolutely assessed goods like clean air or an intact ozone layer (where actors tend to consider only their own shares and gains in these goods; in short: 'How much do I get?') and relatively assessed goods such as fisheries or plant genetic resources (where relative shares and gains matter: 'How much more or less than the others do I get?') (cf. Efinger, Rittberger and Zürn 1988).

This said, hardly any issue area is marked by only one type of conflict. Instead, for an appropriate characterization of a subject matter according to problem-structural theory, one should go through all four types of conflict and identify potential aspects that fall under each of them. This ideally leads to just one type of conflict being more at the core of the issue area than others. But even if two types of conflict are equally prevailing, this may still allow for a prediction, if they have similar assumed consequences.

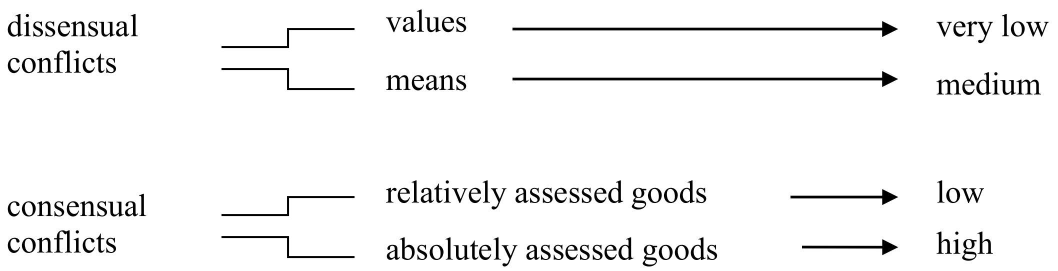

Figure 1. Objects of Contention and their Regime-Conduciveness

(Sources: Efinger, Rittberger and Zürn 1988: 92; Rittberger and Zürn 1990: 29)

Based on the fourfold typology of objects of contention, the Tübingen scholars expect different degrees of regime-conduciveness for each type. They assume that actors will more easily cooperate in conflicts over means and absolutely assessed goods, as these situations imply a less asymmetrical constellation of preferences. Their rating of regime-conduciveness reads – from high to low: conflicts over absolutely assessed goods, conflicts over means, conflicts over relatively assessed goods, conflicts over values (see Figure 1).

Underdal subsumed these four types into his core distinction between benign and malign problems. He understands the political malignancy of a problem as "a function of the configuration of actor interests and preferences that it generates" (Underdal 2002: 15). In other words, he adds game-theoretical or situation-structural aspects to the problem-structural approaches, holding that *certain constellations of preferences correspond to certain types of contested objects*:

- *Malign problems* are characterized by their incongruity (i.e. the relationship of competition among actors) and their asymmetry (i.e. the incompatibility of values or negative correlation of interests across parties). More precisely, Underdal (2002: 21) names the following characteristics of incongruity problems:
  - Essence of problem = distortion of incentives;
  - risky consequences of unilateral cooperative moves;
  - likely manipulation or coercion in the course of negotiations; and
  - persisting incentives for unilateral defection even after an agreement could be struck.

In light of these features, the notion of malign problems incorporates the types of conflicts over values and conflicts over relatively assessed goods (problem-structural approach) as well as collaboration and suasion situations (situation-structural approach).

- *Benign problems* in turn are characterized by:
  - Essence of problem = imperfect information or communication failure;
  - no risky consequences of unilateral cooperative moves (apart from transaction costs of own efforts);
  - integrative negotiations; and
  - no incentives for unilateral defection from an agreed solution.

By stressing symmetrical interests and values, the type of benign conflicts covers Rittberger's and Zürn's conflicts over means and conflicts over absolutely assessed goods. Furthermore, with their relatively high potential for efficient cooperation, benign conflicts comprise major elements of the situation-structural types of assurance and coordination situations (Underdal 2002).[1]

Following this line of thought, we derive a first set of hypotheses, which will guide our explorative analysis of the three selected cases (and which could be tested in-depth in follow-up studies):

I. Benign problems tend to feature a centrality of a (near-universal) public institution that takes over the key functions for regulating the issue area (e.g. overarching decision-making and core funding). They will leave less functional space for private institutions and rely on delegated authority.

Malign problems tend to feature multiple or no public institutional cores. The resulting space and governance gaps call for other types of institutions (smaller public ones, private ones) to fill the significant governance gaps through entrepreneurial authority.

These hypotheses help us mostly to predict the first dimension of public centrality, and also tendencies towards sources of private authority (delegated or entrepreneurial), but they do not give us more than a tendency about the particular functions that are taken over by private

[1] Still, it may be difficult to qualify a governance problem with certainty as benign or malign according to the above characteristics, since at least some of them leave room for interpretation. Ultimately then, a thorough analysis should assess whether relevant actors *perceive* a problem as, for instance, implying risky consequences or manipulated negotiations (cf. Hajer 1993; Schmidt 2008; Wagenaar 2011). Such a perception-based approach also puts higher demands on the research process. For our own explorative illustration in this paper, we have to skip this step and have to rely on our own assessment of the factors listed above.

authority institutions. For a more specific explanation, the literature on private authority provides us with a helpful approach that goes beyond the mere nature of an issue area in question – but is nonetheless related to it.

Green (2014: 40-52) names both the demand for private authority (by the governed) and the supply of private authority as main explanatory factors for its emergence – and for the performance of particular functions. Adapting Green's distinctions for supply and demand sides, we introduce two further sets of hypotheses to explain the functional mix in complex governance architectures.

II. Private authority institutions tend to perform specific functions *when there is a demand of the governed for*:

- lowering transaction costs: through orchestrating, knowledge brokering, soft rule / standard-setting, and financing;
- enhancing credibility of commitments: through knowledge brokering and evaluating;
- providing first mover advantage on a policy problem, i.e. allowing those actors moving first to set expectations for the outcome: through soft rule / standard-setting and implementing,
- enhancing reputation: through soft rule / standard-setting and implementing.

Private authority institutions tend to perform specific functions *when they provide a supply of*:

- expert opinions: for knowledge brokering and evaluating;
- political experience; legal or moral authority: for orchestrating, soft rule / standard setting and implementing;
- financial capacities and economic experience: for financing and trading.

Unlike the first two sets of assumptions, these hypotheses cover relatively short causal chains, with the dependent variable (distribution of functions among private and public institutions) explained by functional gaps (demand side) and functional qualities (supply side). In other words: while problem structure provides us with a more fundamental scope condition, supply and demand are of more immediate causal character.

What is more, demand and supply can – certainly not only, but partly – be seen as a function of the nature of the problem to be regulated. As assumption I above states, certain governance gaps may go back a malign problem structure. And the different demands that Green identifies partly correspond with specific governance gaps – jurisdictional, cognitive / operational, incentive-related – that have been identified in the literature on international regimes (Brühl 2003). In the same vein, Green makes clear that private institutions will only be chosen to perform these functions "when IOs cannot supply the equivalent benefits" (ibid.: 47) – in other words, when significant public governance gaps occur.

Bearing this qualification in mind, the factors of demand and supply rather play the role of intervening variables in our analytical framework that are, at least in part, influenced by the problem structure – apart from, certainly, various other rival explanations that would need to be controlled for, e.g. knowledge or power structures (see Figure 2 for an overview of the analytical framework).

Finally, as in any scientifically realist research design that seeks, there are rival factors that may also influence the shape of an institutional architecture, or that may already have an impact on supply of and demand for private authority. Jordan et al. (2015, p. 979) summarize some of these factors currently debated in the literature on transnational governance: "most scholars are still identifying potential sub-categories of motivation, including moral concerns, fear of new regulation (or the opportunity to secure first-mover advantages by shaping it), the pursuit of direct financial rewards, indirect or 'non-climate' benefits (for example, reputational enhancement), and the satisfaction of consumer expectations."

To probe this framework for the three cases in question, we will have to suffice with a legal and institutional qualitative analysis for each case, and an explorative comparison across cases along the criteria mentioned above. The scope of this paper and the current state of our research does not allow for a more in-depth study. In addition, the relative novelty of all three issue areas sets limits to our period of observation. Problem structures are not fixed, but may change over time, depending on shifts in values or interests. Such changes may not be visible yet in the short period of institutionalization that the three issue areas have undergone. So for practical matters we will analyse the current 'snapshots' of all three architectures.

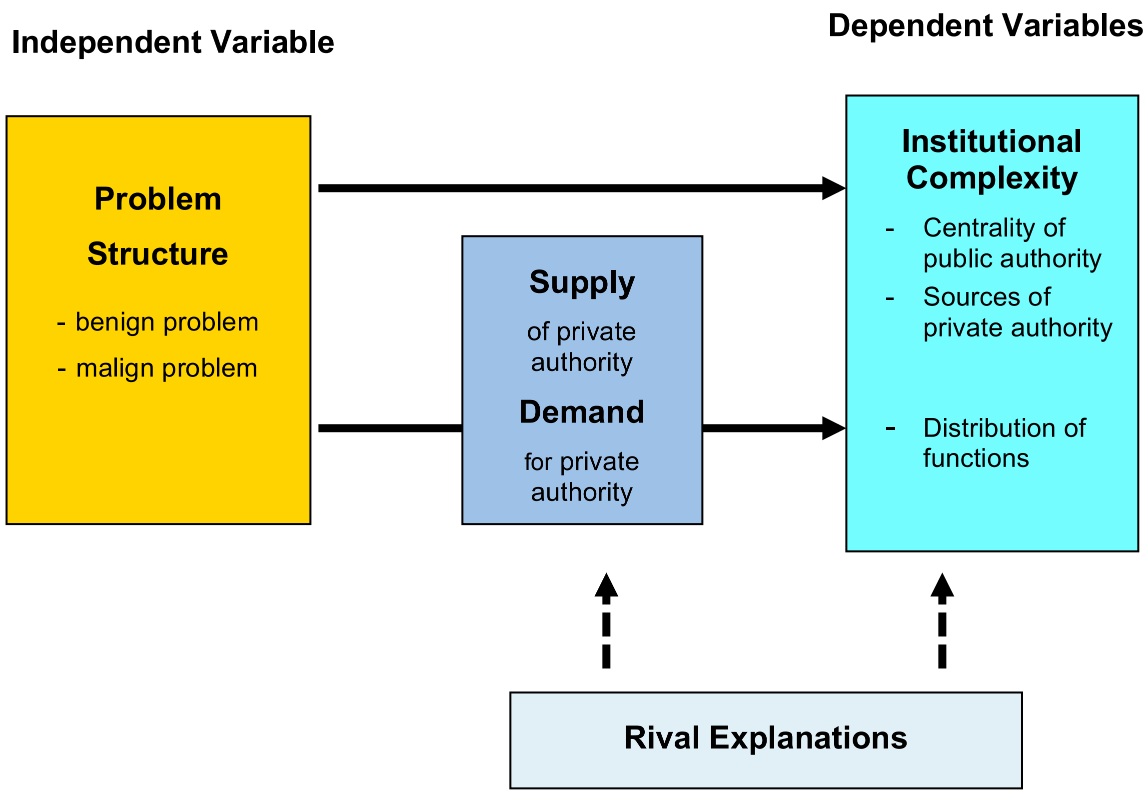

Figure 2. Overview of the Analytical Framework

Our limited application of the above framework for all three cases is as follows:

- We will assess the benignancy or malignancy of each problem structure, asking to what extent it carries elements of each type of consensual and dissensual conflict listed above. We will not rely on the perceptions of key actors, but instead build this assessment on our own preliminary deductions and the major literatures on the issue in question.
- We will assess the supply and demand structures for private authority in the same way, again relying on deduction and secondary literature instead of a bottom-up and in-depth research process.
- We will describe the dependent variable in terms of the factors listed in Table 1 above – with emphasis on centrality and functional distribution among key

institutions, while identifying sources of authority would demand a more thorough analysis.

3 The Institutional Complexity of REDD Governance

REDD: Incentives and many open questions

REDD ('Reducing Emissions from Deforestation and Forest Degradation') is one of the major elements in a series of incentive-based mechanisms for environmental governance that have been developed in the last 15 to 20 years (Bernstein 2002). Proponents of REDD seek to provide significant economic incentives for the sustainable use and conservation of forests while also reducing the drivers of deforestation and forest degradation.

However, the heated international debate about REDD in climate negotiations and other arenas leaves open questions about REDD's social, economic and environmental consequences. At the time of writing, a number of key aspects still need to be specified and clarified, including inter alia: what constitutes adequate safeguarding; how countries will be held accountable for achieving it; what are overarching conditions for the allocation of funds; which approaches to measurement, reporting and verification (MRV) should be prioritized.

Despite this inconclusiveness and uncertainty, a large number of developing countries, including those with the world's largest shares of tropical forests, have begun to create institutional and programmatic infrastructures based on REDD. The global REDD architecture is only gradually taking shape at UNFCCC meetings, while at same time, a series of international REDD (funding) initiatives emerged outside of the UNFCCC umbrella. These national and international approaches coincide with a variety of processes that stakeholders have initiated at the regional and local levels, including different arenas of self-organization and a growing number of very diverse pilot projects (Wertz-Kanounnikoff / Angelsen 2008).. Altogether, these endeavours have created an intricate patchwork of multi-level governance with diverse top-down and bottom-up processes and institutions operating in parallel.

REDD in international climate negotiations

The 1992 Earth Summit in Rio led to the creation of important global environmental governance institutions. Apart from the UNFCCC, two other initiatives that more directly focus on forest protection were established after the summit: the legally binding Convention on Biological Diversity (CBD), which entered into force in 1993, and the Intergovernmental Panel on Forests, which was succeeded in 2000 by the United Nations Forum on Forests (UNFF) (Scholz 2004).

While the UNFCCC negotiations predominantly address afforestation or deforestation with regard to biomass and carbon stocks, the UNFF and the CBD address the sustainable use of forests and forest protection to conserve biodiversity. Since their inception, these two institutions have not attained their goals of reducing or avoiding deforestation and biodiversity loss in absolute terms. Nevertheless, the two institutions remain the chief global forums on forest protection – with sometimes tense relations with the UNFCCC (Kim 2004; Rosendal 2001).

Apart from exchanges of information, UNFCCC and CBD have not achieved a stronger cross-institutional coordination of their activities on deforestation, notwithstanding the establishment of an Ad-hoc Technical Expert Group under the CBD (AHTEG). Pistorius and Schmitt (2013) find that both institutions could benefit from more synergetic exchanges following their poor collaboration on REDD. This particularly applies to CBD decisions to provide voluntary guidance for REDD countries, along with criteria and indicators that could be used for national safeguard information systems (SIS).

During and after the negotiations of the Kyoto Protocol in 1997, the UNFCCC increasingly referred to the role of forests. The Protocol's list of policies and measures for helping parties to meet their emission reduction commitments include the "protection and enhancement of sinks and reservoirs of greenhouse gases" and more specifically, the "promotion of sustainable forest management practices, afforestation and reforestation" (Art. 2.1.a.ii). Before the 13th Conference of the Parties (COP) in December 2007, forests and other types of biomass were mostly treated in GHG inventories for calculating the emission reduction targets of industrialized countries that were set by the Kyoto Protocol.

Only the alarming rates of global deforestation have made the international community recognize the central role that tropical forests play in mitigating climate change. In 2005, a group of developing countries rich in tropical forests, led by Costa Rica and Papua New Guinea, proposed REDD at international climate negotiations. Two years later, COP 13 delegates decided to develop a framework to compensate developing countries for protecting their forests. A COP decision noted that deforestation and forest degradation contribute to climate change and affirmed "the urgent need to take further meaningful action to reduce emissions from deforestation and forest degradation".[2] Parties further admitted that reducing deforestation-related emissions requires stable financial resources.

At COP 15 in Copenhagen in December 2009, REDD was identified as a key instrument for preventing dangerous climate change. However, the failure of the Copenhagen summit to produce a successor to the Kyoto Protocol postponed an initial agreement on REDD. To circumvent the UNFCCC deadlock and maintain momentum, representatives of 55 countries met in Oslo in May 2010 to found the REDD+ Partnership. They pledged a total of USD 4 billion in fast-start financing for REDD measures in the period from 2010 to 2012. The partnership eventually grew to 76 member countries by the time of its final meeting in late 2014.

The fruits of Oslo provided new impetus for holding REDD discussions under the UNFCCC umbrella. At COP 16 in Cancún in December 2010, parties finally managed to adopt a first agreement on REDD, which was regarded as a major breakthrough by delegates, NGOs and scholarly observers (IISD 2010; CIFOR 2010). The Cancún Agreement invites developing countries to prepare national REDD action plans, establish national reference levels or, as interim solutions, sub-national reference levels. Industrialized countries, on the other hand, are requested to support REDD through multilateral and bilateral channels. In other words, unlike the Kyoto Protocol's project-level Clean Development Mechanism (CDM), REDD was established as a voluntary, national government-driven mechanism to mitigate concerns about leakage and accounting. The '+' was added to REDD to reflect the inclusion of forest conservation and management and carbon stock enhancement (McDermott et al. 2012, 120).

Appendix I of the Cancún Agreement also included a list of social and environmental safeguards to be respected when implementing REDD activities. In addition to poverty alleviation and the conservation of biodiversity, the safeguards refer to aspects of social inclusion and good governance, such as the consistency of participation and transparency, as well as indigenous and local rights. Concrete references to monitoring practices like remote

[2] FCCC/SBSTA/2007L.23Add.1/Rev.1.

sensing or on-site inventories, however, were not included. While the 2011 Durban Agreement further elaborated the potential shape and content of national safeguard information systems, there was no progress at COP 18 in Doha in November 2012, leaving "unclear what constitutes adequate safeguarding or how countries will be held accountable for achieving it" (ibid.; see also Pistorius / Schmitt 2013).

In November 2013, COP 19 sought to partly close this gap by adopting a set of decisions under the Warsaw Framework for REDD+, backed by combined pledges of USD 280 million from the United States, United Kingdom and Norway. According to the framework, to be eligible for performance-based financing, governments must provide a summary every two years about how they are complying with the REDD safeguards agreed in Cancún. Country delegates also agreed to define drivers of deforestation, devise systems for measurement, reporting and verification (MRV), and establish baseline reference levels (Dechert 2014). However, the framework's vague phrasing leaves various loopholes. Complying with the safeguards or reporting on how they are being respected is not compulsory, and least developed countries can technically choose if and when they will even provide a summary. Likewise, preferences or guidelines for certain types of MRV systems were missing.

At COP 20 in Lima in December 2014, countries tried to concretize some of these aspects for the design of SIS. They also discussed a more holistic approach combining mitigation and adaptation measures for sustainable forest management. However, both of these REDD-related talks at Lima ended without specific results.[3]

Beyond the UNFCCC: Major partnerships and funding institutions

Against the backdrop of inconclusive UN climate negotiations, a series of other institutions have addressed REDD and MRV-related issues outside the umbrella of the UNFCCC (cf. Corbera / Schroeder 2011; Thompson et al. 2011). Given REDD's incentive-based nature, financing initiatives are central. This includes established financial mechanisms like the Global Environment Facility, and regional banks that administer their own funding mechanisms such as the Amazon Fund or the Congo Basin Forest Fund. In addition, three major multilateral REDD funding initiatives have been created: the Forest Carbon Partnership Facility (FCPF) of the World Bank, launched at the UNFCCC–COP 13 in 2007; the Forest Investment Programme (FIP); and UN–REDD (United Nations Collaborative Programme on Reducing Emissions from Deforestation and Forest Degradation) Programme.

In 2008 the Food and Agricultural Organization of the United Nations (FAO), the United Nations Environment Programme (UNEP) and the United Nations Development Programme (UNDP) launched **UN–REDD**, the first institution to conduct nationwide programmes. UN–REDD supports readiness activities and supports governance, stakeholder participation and local capacity development, such as for MRV. In 2010, Indonesia, Tanzania and Vietnam had already completed their National Joint Programmes and started their first REDD initiatives. By January 2015, a total of USD 217.7 million had been deposited by contributing countries for programmes in partner countries. The major share of this money, USD 183.5 million, came from Norway alone.[4]

At the time of writing, the **FCPF** was facilitating cooperation between donors and the governments of 36 developing countries, and funding the preparations for national REDD strategies through 'Readiness Proposals'. The facility "serves the dual goal of building

[3] http://www.redd-monitor.org/2014/12/09/what-came-out-of-lima-cop20-on-redd-part-1-reddlock/, accessed 29/01/2015.
[4] http://www.climatefundsupdate.org/listing/un-redd-programme, accessed 29/01/2015.

capacity for implementing REDD+ in developing countries through the establishment of national monitoring systems, management systems and stakeholder consultation arrangements (through its Readiness Fund), and testing the feasibility of performance-based payments through pilot activities (through its Carbon Fund)" (McDermott et al. 2012,122). A total of USD 280.6 million had been deposited for the facility by January 2015, nearly half of this, USD 129.3 million, by the German government.[5]

Several regional developing banks, including the Inter-American Development Bank, and a few bilateral donors created the **Forest Investment Programme** (FIP), a multi-trust fund in the World Bank's Strategic Climate Fund. The FIP seeks to support capacity development and measures for implementing REDD. As of January 2015, the programme had received pledges of USD 530 million, all of which have been deposited, Norway (USD 142 million) and the UK (USD 162 million) being the major contributors.[6]

Next to these multilateral bodies, a series of **bilateral activities** (by Norway, Germany, and Japan in particular) contribute significantly to REDD financing. Voluntary **carbon markets** also provide funding for REDD pilot projects (Hamilton / Chokkalingam / Bendana 2010; Intergovernmental Taskforce 2010). But while such markets raised about USD 700 million in 2008, only a fraction of this sum was associated with REDD projects. However, other market-based approaches, and careful linking of domestic and sub-national markets, could considerably boost these figures in the next years. One example is the Governors' Climate and Forests Task Force (GCF) that included 19 states and provinces in seven different countries in September 2013. The GCF seeks to link REDD activities in various countries with tropical forests to climate change legislation in California, "thereby paving the way for a regulated REDD+ carbon market" (McDermott et al. 2012, 122).

The picture becomes even more complicated when **other institutions and treaties** that relate to it REDD but do not primarily focus on it are taken into account. A full depiction of the broader institutional embeddedness is beyond the scope of this article. But two examples for bilateral treaties, both for the case of Peru, quickly illustrate the importance of such agreements: The country's bilateral trade agreements with both the European Union (EU) and China explicitly mention links between forests and climate change, and a direct reference is made to REDD in the EU–Peru agreement. This practice of including environmental concerns in commercial agreements can have mixed implications, such as facilitating general environmental safeguards or further commodifying environmental goods and services (Bernstein 2002).

The proliferation of institutions has created a very complex governance architecture for REDD (cf. Gupta et al. 2013). This complexity poses challenges to governmental and non-governmental actors who try to follow the debates, decisions and opportunities. Institutional complexity – combined with institutional overlaps at the domestic and sub-domestic levels – overwhelms actors with less-developed organizational or financial capacities who can barely follow the various discussions.

The institutional complexity also raises questions of duplication and coordination deficits, including for safeguards and allocation mechanisms (cf. Pistorius / Schmitt 2013; Pokorny et al. 2013; Savaresi 2013). A first attempt to address this complexity and to enhance cross-institutional coherence on MRV and related questions has failed. The **REDD+ partnership** aimed to be transformed into a UNFCCC mechanism that can play a strong coordinative role.

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5 http://www.climatefundsupdate.org/listing/forest-carbon-partnership-facility, accessed 29/01/2015

6 http://www.climatefundsupdate.org/listing/forest-investment-program, accessed 29/01/2015.

However, this institutional step was never accomplished and the partnership instead held its final meeting in Lima in November 2014.

Notwithstanding such challenges, the REDD financing architecture also creates more opportunities for countries to seek funding from various sources for different phases (preparation, implementation and results-based actions). Table 2 illustrates how, for instance, Peru has benefited from this diversity.

Table 2. Different funding sources of REDD in Peru (authors; based on: Che Piu and Menton 2013, 54).

Source	Document or Project	Phase	Volume in US$ millions
FCPF	R-PP (approved in 2011)	REDD+ preparation phase	3.8
FIP	Investment Plan (in preparation since December 2012)	REDD+ implementation phase	50
UN-REDD	Strengthening capacities of Indigenous People for their informed participation in the design and implementation of the REDD+ mechanism in Peru	REDD+ preparation phase	0.155
FAO-Finland	Project on a national forest inventory and sustainable forest management	REDD+ preparation phase	4
Germany	Project on support for REDD implementation in Peru (initiated in 2012)	REDD+ preparation phase	7.1
Norway, Germany	Climate and forest partnership	REDD+ preparation phase REDD+ implementation phase	300 (Norway) + unspecified amount (Germany)
Japan	Support for PNCB	Support for forest conservation	50
Gordon and Betty Moore Foundation	Project on technical, scientific and institutional capacity development for REDD implementation	REDD+ preparation phase	1.9

4 The Institutional Complexity of SLCP Governance

SLCPs: Sources, impacts and abatement

As their name suggests, short-lived climate pollutants have in common that, in comparison with gases such as carbon dioxide (CO_2), they have a shorter atmospheric lifetime. This, in turn, suggests that the climate response following emission reductions will be faster. Although SLCPs are commonly discussed as a group, it is useful to draw out their individual characteristics, in terms of their sources, their impacts (both on climate change mitigation as well as other impacts), and the abatement options.

Black carbon (or soot) is not a greenhouse gas, but it is an important driver of global warming: it absorbs sunlight and generates heat; it reduces the ability of snow and ice to reflect sunlight; and it affects cloud formations. Black carbon only stays in the atmosphere for a few days. Although black carbon emissions in the past originated from Western Europe and North America in the past, they have increasingly shifted to developing countries, with ~25 to 35% of emissions stemming from China and India alone (Ramanathan and Carmichael 2008). But also in other regions, including South East Asia, Latin America and equatorial Africa black carbon emissions are on the rise.

Reducing black carbon emissions would bring about near-term climate benefits, with Shindell et al. (2012) estimating that a mix of technical and regulatory measures would lead to 0.19°C of avoided warming by 2050. In addition, addressing black carbon can help avoid regional warming, notably in the Arctic and the Himalayan Plateau. The longer-term climate benefits of black carbon are less straightforward, with recent studies suggesting that the effects of black carbon measures in the long term may be negligible. Such findings heavily depend on assumptions about the action taken on CO_2: since black carbon is often a result of the same processes that lead to CO_2 emissions, measures addressing the latter will limit the effect of black carbon measures (Bowerman et al. 2013; Rogelj et al. 2014).

In addition to climate benefits, reducing black carbon is expected to lead to other benefits, especially for human health and food security. For instance, UNEP and WMO (2011, 193) estimate that measures to address black carbon "could avoid 2.4 million premature deaths (within a range of 0.7–4.6 million)". Moreover, such measures would also lead to significant benefits in terms of agricultural productivity, with Shindell et al. (2012) estimating that a small set of technical measures can already lead to enhanced crop yields of several millions of tons.

Another SLCP, methane, is also a potent greenhouse gas, with a global warming potential 34 times that of CO_2 (Myrhe et al. 2013, 714) and an atmospheric lifetime of about 9.1 years. In addition to its natural causes (notably emissions from wetlands), anthropogenic methane emissions are generated by a variety of activities, such as fossil fuel (coal, oil and natural gas) production, distribution and consumption, agricultural activities such as livestock breeding and rice production, landfills and – to a smaller extent – wastewater treatment (UNEP and WMO 2011, 44-45).

Methane emissions are also responsible for another SLCP, tropospheric ozone (not to be confused with stratospheric ozone, which helps prevent dangerous ultraviolet radiation, and which can be found at higher altitudes in the atmosphere). Unlike other SLCPs, tropospheric ozone is not directly emitted, but is created through a chemical reaction involving sunlight and precursors which, in addition to methane, include nitrogen oxides, carbon monoxide and other non-methane volatile organic compounds. Reducing methane will also help reduce tropospheric ozone, as it is responsible for about two-thirds of tropospheric ozone production (UNEP and WMO, 59).

The near-term climate benefits of addressing methane are significant, with measures to reduce methane emissions estimated to lead to avoided warming of about 0.28°C by 2050 (Shindell et al. 2012). Although also the longer-term climate benefits of methane emission reductions will depend on action on CO_2, methane mitigation strategies are also considered to be essential for staying below a 2°C temperature rise above pre-industrial levels in the long run (Rogelj et al. 2014).

The non-climate benefits of methane mitigation materialize largely through its indirect impact on tropospheric ozone. Also here the impacts can be measured both in terms of human health and agricultural productivity (Shindell et al. 2012).

Finally, HFCs are chemicals that are used as a substitute for ozone-depleting substances. While they are used in only a limited set of products, their use is rising (see Figure 2). This is all the more important, since the global warming potential of some HFCs outstrips that of CO_2 significantly, sometimes by several thousands (Xu et al. 2013).

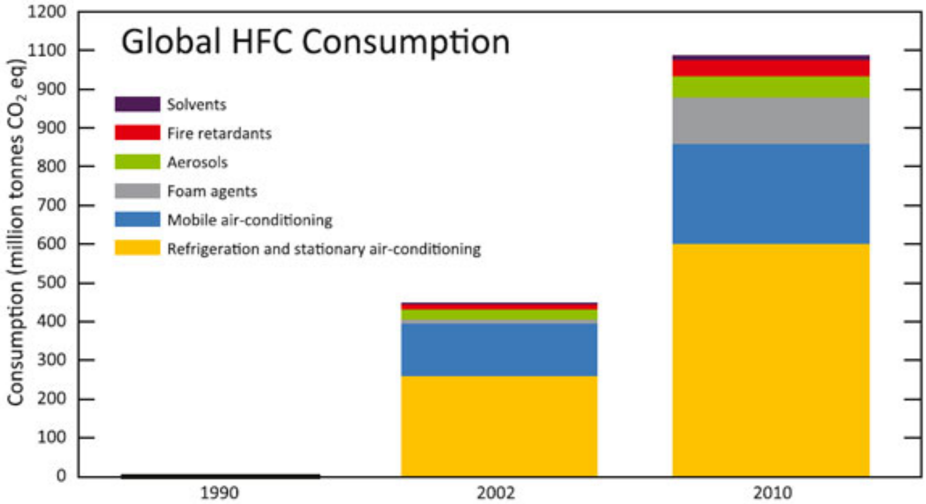

Figure 3. HFC sources and consumption over time. (Source: UNEP 2011b, 16).

Given the high warming contribution of rising HFC emissions, measures to abate them hold significant potential to avoid warming in the near- and long-term. Table 3 offers a summarizing overview of the main features of the various SLCPs.

Table 3. Characteristics of SLCPs.

	Black carbon	Tropospheric ozone	Methane	HFCs	Sources
Main anthropogenic emission sources	Resident biofuel and coal cooking and heating; Diesel engines; Open biomass burning	Not directly emitted, but a result of a reaction between ozone precursors	Fossil fuel extraction; Agriculture; Sewage and waste	Air conditioning and refrigeration; Mobile air conditioning; Foam agents; Aerosols; Fire extinguishers and solvents	CCAC 2014; UNEP 2011a; UNEP and WMO 2011
Atmospheric lifetime	3-8 days	4-18 days	9.1 years	1.5-222 years, depending on the type of HFC; 15 years average	CCAC 2014; Hartmann et al. 2013
Near-term climate impacts of mitigation action	Measures can reduce warming by 0.19°C by 2050	--	Measures can reduce warming by 0.28°C by 2050	0.1°C by 2050	Shindell et al. 2012; Xu et al. 2013
Longer-term climate impacts of mitigation action	- Under a 2°C scenario: 0.1°C - Under a “no mitigation” scenario: <0.05°C	--	- Under a 2°C scenario: 0.7°C - Under a “no mitigation” scenario: <0.4°C	- Under a 2°C scenario: 0.2°C - Under a “no mitigation” scenario: 0.1°C	Rogelj et al. 2014
Non-climate benefits of mitigation action	Human health improvements; Enhanced crop yields	Human health improvements; Enhanced crop yields	See tropospheric ozone (with methane being the main precursor)	--	Shindell et al. 2012; UNEP and WMO 2011

Mapping the institutional complexity for SLCPs

This section offers a short, non-exhaustive overview of the main international institutions governing SLCPs to date, outlining some of the main actions taken to date. Table 4 gives an initial overview of the institutions discussed below.

Table 4. Institutions governing SLCPs.

Institution	Year	Membership	Scope	Legal status	Public/ private	Objective	Governance functions
Montreal Protocol	1987	197 parties	Global	Legally binding instrument	Public	Protect the ozone layer	Financing; Goal setting; Information sharing; Rule development
LRTAP Convention (Gothenburg Protocol)	1979 (1999)	51 parties	Regional	Legally binding instrument	Public	Protect the environment against air pollution	Information sharing; Rule development
IMO	1948	171 members		Employs legally binding instruments	Public	Ensure safety and security of shipping; prevent marine pollution by ships	Information sharing; Rule development
Arctic Council	1996	8 Arctic states (plus 12 non-Arctic states as observers)	Regional	Not legally binding	Public	Discuss Arctic issues (mainly related to environment/ sustainable development)	Agenda-setting; Information sharing
CCAC	2012		Global	Not legally binding	Public-private	Promote action to address SLCPs	Agenda-setting; Information sharing; Implementation
GMI	2004 (as Methane to Markets)	42 countries (plus the European Commission), and 1300+ non-state actors	Global	Not legally binding	Public-private	Reduce methane emissions; enhance methane recovery; use methane as clean energy resource	Information sharing; Financing; Implementation
UNFCCC	1992	196 parties	Global		Public	Avoid dangerous climate change	Financing; Information sharing; Rule development

The potential role of the **Montreal Protocol** in reducing HFCs has received much attention in recent years. The use of HFCs has grown rapidly following their adoption as a substitute for chlorofluorocarbons (CFCs), an ozone-depleting substance and hydrochlorofluorocarbons

(HCFCs), itself a transitional chemical that helps with phasing out CFCs. Depending on the growth projections used, HFCs could contribute to annual greenhouse gas emissions between 3.5-8.8 Gt CO_2-eq. by 2050 (UNEP 2011a, p. 22). While HFCs are powerful greenhouse gases, they do not contribute to ozone depletion, meaning that they are not regulated by the Montreal Protocol. As greenhouse gases, HFCs fall within the purview of the UNFCCC, and they are explicitly listed in Annex A of the Kyoto Protocol; however, specific measures to address them have not been adopted in the climate regime.

Since 2009, Micronesia, Canada, Mexico and the United States have proposed amendments to the Montreal Protocol to address this gap. These proposals have gained significant traction through the 2011 Bali Declaration (signed by 112 countries), a reference in the Rio+20 outcome document, a statement of intent at the 2013 G20 meeting, and bilateral talks between the US and China and India in the same year. For some parties, however, there remain concerns about the availability and the costs of alternatives for HFCs in different sectors. Nevertheless, the signals coming out of the November 2014 meeting of the parties to the Montreal Protocol have been positive, signalling a broader consensus that agreement on a HFCs phase out under the treaty may be within reach.

The **Convention on Long-Range Transboundary Air Pollution** (LRTAP) is a regional agreement adopted under the auspices of the UN Economic Commission for Europe (UNECE). Initially established to tackle the acid rain problem, it has grown to cover a variety of local and regional air pollutants through its eight protocols. The Convention and its protocols provide for national emission ceilings, and have put in place an extensive monitoring system. The Convention has 51 parties hailing from the EU, Eurasia (including Russia) and North America (the US and Canada).

Some of the Convention's protocols target SLCPs. The 1988 Sofia Protocol on nitrogen oxide and the 1991 Geneva Protocol on volatile organic compounds, for example, aim at reducing emissions of substances that are precursors of tropospheric ozone. More importantly, the LRTAP has made significant developments in the regulation of black carbon emissions. In 2009, an Ad Hoc Expert Group on Black Carbon was created under the 1999 Gothenburg Protocol to Abate Acidification, Eutrophication and Ground-level Ozone to examine the options for addressing black carbon. The report of the Expert Group in 2010, stressing the health and climate benefits of tackling black carbon, indicated that additional measures in a variety of sectors in the UNECE region up to 2020 could reduce black carbon emissions by 40% (UNECE 2010), and suggested amending the Gothenburg Protocol to include black carbon. In May 2012, the 25 Parties to the Protocol (which include the EU, the US and Canada) agreed on a set of amendments. As a first step, a guidance document to assist Parties in identifying control techniques for black carbon emissions was developed in 2012 (UNECE 2012). This was followed by guidelines for reporting on emissions under the Gothenburg Protocol that also apply to black carbon emissions. This will facilitate the development of black carbon emission inventories at the national level (UNECE 2013).

The **Kyoto Protocol** suggests that the regulation of emissions from international shipping should be dealt with in the context of the **International Maritime Organization** (IMO). A wide range of treaties has been adopted under the auspices of the IMO, including the 1973/1978 International Convention for the Prevention of Pollution from Ships (MARPOL Convention). Although the Convention initially did not cover air pollution, a new Annex VI was agreed in 1997 to cover a range of air pollutants.[7] Although these pollutants did not

[7] Annex VI has 75 Parties, representing almost 95% of world shipping tonnage. See Summary Status of Conventions, at http://www.imo.org/About/Conventions/StatusOfConventions/Pages/Default.aspx.

include greenhouse gases, a resolution was adopted in the same year to study shipping emissions and consider mitigation strategies.[8]

The IMO's Marine Environment Protection Committee (MEPC) is the primary body responsible for matters relating to environmental pollution from ships. In 2010, Norway, Sweden and the United States proposed to discuss black carbon emission reductions from shipping in the Arctic (IMO 2010). This proposal launched discussions which currently take place under the MEPC's sub-committee on Pollution Prevention and Response, focusing specifically on: (i) the definition of black carbon; (ii) measurement methods; and (iii) possible control measures. As of 2014, the sub-committee had not yet reached agreement on a definition (although it had narrowed down to two options), thereby also stalling agreement on measurement methods and control measures.

In 2013, several NGOs suggested to include provisions on black carbon in an International Code for Ships Operating in Polar Waters (the 'Polar Code'), which was under discussion in the IMO's Maritime Safety Committee (IMO 2013). While the mandatory Polar Code was adopted in November 2014 and includes environmental provisions, the MEPC decided to await the outcomes of its own sub-committee first, meaning that the Code does not address black carbon.

Various studies highlight the specific impacts of SLCPs on the Arctic (e.g. UNEP 2011a; World Bank and ICCI 2013). SLCPs have become an emerging issue for the **Arctic Council**, a high-level forum bringing together eight Arctic states. Although the Council was set up to discuss various Arctic issues, it has had a strong focus on environmental issues.

In 2009 a Task Force on Short-Lived Climate Forcers was established, with an initial focus on black carbon. It produced a report in 2011, recommending the Arctic Council to take a leadership role by sharing information about black carbon emissions and adopting measures for various emitting sectors (e.g. transportation; residential heating) (Arctic Council 2011a). The Council's 2011 Nuuk Declaration encouraged the Arctic states to implement its recommendations to reduce black carbon emissions (Arctic Council 2011b). The Task Force's scope broadened to include methane, with a subsequent report suggesting that significant methane mitigation options were feasible, and recommending the Arctic states to develop and share black carbon inventories (Arctic Council 2013a). The latter recommendation was embraced in the 2013 Kiruna Declaration.[9] Moreover, the declaration established a new Task Force for Action on Black Carbon and Methane to develop arrangements for these SLCPs (Arctic Council 2013b). This task force coordinates with the Council's Arctic Monitoring and Assessment Programme (AMAP), which is simultaneously carrying out scientific assessments on black carbon, methane and tropospheric ozone.

The emerging understanding of the benefits of rapid action on SLCPs led several countries (Bangladesh, Canada, Ghana, Mexico, Sweden and the US) to launch the **Climate and Clean Air Coalition** (CCAC) in 2012. The Coalition's aims are to raise awareness on SLCPs, enhance and develop actions at the national and regional level, promote best practices, improve scientific understanding on SLCPs, and mobilize resources for actions.

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[8] http://www.imo.org/OurWork/Environment/PollutionPrevention/AirPollution/Pages/Historic%20Background%20GHG.aspx.

[9] In a separate meeting of Arctic Council environment ministers, it was agreed to submit these inventories under the LRTAP Convention, and circulate them in the Arctic Council (Swedish Ministry of Environment 2013, p. 2).

The CCAC is a non-legally binding, government-led, public-private partnership. To date, 44 countries (as well as the European Commission) have joined the Coalition, including both developed and developing countries (although major economies such as Brazil, China, India and South Africa are not partners). The Coalition is administered by UNEP, and provides for the active participation of non-governmental organizations, including international organizations (e.g. the World Health Organization, the United Nations Development Programme and the World Bank), environmental and scientific organizations, and the private sector.

The CCAC encourages actions by the partners through initiatives focused on: (1) heavy-duty diesel vehicles; (2) brick production; (3) the municipal solid waste sector; (4) promoting HFC alternatives; (5) methane and black carbon emissions from oil and natural gas production; (6) agriculture; and (7) household cooking and domestic heating. In addition, three crosscutting initiatives have been established for financing, national planning, and regional assessments. The initiatives generally focus on specific SLCPs in targeted sectors. While it does not act as a funding platform, a Trust Fund has been established through which specific programs decided by the Coalition can be funded. By the end of 2013, about US$46 million was pledged for 2012-2015 (CCAC 2013).

The **Global Methane Initiative** evolved from an earlier public-private partnership, Methane to Markets, which was launched in 2004. The initiative has been joined by 42 countries from the developed and developing world, as well as the European Commission. The GMI aims to reduce methane emissions, enhance methane recovery, and use methane as a clean energy resource. The initiative is country-driven, with its Steering Committee consisting of country representatives. Through the GMI, partner countries voluntarily commit to developing improved emissions estimates; promoting public-private collaboration on methane emission reductions, recovery or use; identifying and address barriers to investments; and developing and implementing action plans with concrete activities. In addition to the partner countries, over 1300 non-state actors – including the private sector and NGOs – participate through a 'Project Network'.

The GMI's activities are organized along various methane-emitting sectors, including agriculture, coal mines, municipal solid waste, oil and gas, and wastewater, with sub-committees established for each of these areas. The US has played a major role in starting and continuing the initiative, with the country contributing roughly $74.4 million between 2005-2012 (US EPA 2013). This role is reflected by the fact that the US Environmental Protection Agency chairs its Steering Committee and actively participates in several sub-committees.

The overview thus far shows that there is much institutional activity outside of the **UNFCCC** on SLCPs. Yet this does not mean that the UNFCCC plays no part at all. Methane and HFCs act as greenhouse gases, and are therefore implicitly covered by the UNFCCC;[10] moreover, they are explicitly mentioned in the Kyoto Protocol's basket of greenhouse gases. Although the Protocol's basket approach – as opposed to a gas-by-gas approach – has deflected attention away from these gases, with most parties' focus being firmly on CO_2 (Gillespie 2003), basic obligations apply to all greenhouse gases, such as their reporting in national inventories and national communications (and measures to abate them). For instance, Annex I parties have to present disaggregated data on HFC and methane emissions in their annual inventories (IPCC 1999). In other words, reporting on these SLCPs under the climate regime is by now a well-established practice.

[10] Tropospheric ozone is also a greenhouse gas; however, it is not directly emitted into the air, but rather created through chemical reactions.

The UNFCCC does not include all methane emissions, however, as some emissions – e.g., resulting from the thawing of permafrost – are due to natural activities, and parties' reporting obligations are limited to anthropogenic activities. Nonetheless, parties could still raise issues related to methane emissions reporting under the Convention (Wold et al. 2014).

In addition to reporting, activities to reduce emissions from methane and HFCs have been triggered through the Kyoto Protocol's Clean Development Mechanism (CDM). The mechanism's use for reducing HFC emissions was heavily criticized, as implementing HFC projects (specifically, projects to destroy HFC-23) became a profitable activity, meaning that credits emerging from these projects flooded the international carbon market.[11] Following a ban by the EU of these credits in 2013, demand for HFC credits dropped significantly.

Although concrete options to address either HFCs or methane under the UNFCCC remain to be agreed, discussions continue both in the pre-2020 and the post-2020 context.[12]

Disentangling the web: Distinguishing individual SLCPs

The overview thus far shows that there is no lack of institutional activity on SLCPs. Indeed, it shows that states and non-state actors are actively pursuing options to address each SLCP in several forums. What also emerges from the discussion thus far is that, with the notable exception of the CCAC, SLCPs are rarely discussed together as a group. Some institutions focus only on one SLCP, such as black carbon (LRTAP Convention; IMO), HFCs (Montreal Protocol) or methane (GMI); some discuss black carbon and methane in conjunction (Arctic Council). These practices suggest that irrespective of their commonalities, governments approach SLCPs in a disaggregated fashion. Indeed, there may be valid reasons for this disaggregated approach, as also highlighted in the discussion of features of SLCPs above:

- The sources of SLCPs vary, both geographically and in terms of sectors. This will make some institutions more relevant, depending on membership and sectoral coverage. For instance, as black carbon is emitted by shipping, the IMO has started discussions on control measures; yet such discussions are unlikely to also cover other SLCPs, such as methane and HFCs.
- Tackling different SLCPs will lead to different non-climate mitigation benefits. This, in turn, may have implications for which international institutions are relevant. For instance, health and food security benefits has raised the interest of the World Health Organization and the Food and Agriculture Organization, respectively. Yet such interest may not extend to other SLCPs, such as HFCs.

The point here is not to suggest that SLCPs do not have many common characteristics and therefore can or should not be addressed in conjunction. However, understanding the unique features of each SLCP may help to better understand whether and how different international institutions can work in a mutually supportive way to address both SLCPs and CO_2.

[11] The criticism aimed at HFC-23 projects was not limited to the volume of credits, but also concerned the perverse incentives provided by the CDM. There was evidence that project developers increased HCFC-22 production (of which HFC-23 is a by-product) just to earn more credits from further HFC-23 destruction (Schneider 2011).
[12] See, e.g., http://unfccc.int/files/bodies/awg/application/pdf/adp2-6_summary_report_nonco2.pdf.

5 The Institutional Complexity of Climate Engineering Governance

Climate Engineering: Technologies and ethics

Climate Engineering describes a range of technological approaches to intentionally alter the Earth's atmosphere at a global scale, with the aim of reducing the impacts of global warming. It is generally subdivided into two distinct groups of technologies: Solar Radiation Management (SRM) and Carbon Dioxide Removal (CDR).

The general aim of SRM is to increase the amount of sunlight that is reflected from the Earth. It covers approaches such as placing mirrors into the Earth's orbit (Seifritz, 1989), increasing marine cloud albedo (Latham, 2002), increasing the reflectivity of crops (Ridgwell, Singarayer, Hetherington, & Valdes, 2009) or urban areas (Akbari, Menon, & Rosenfeld, 2009), modifying high-altitude ice (cirrus) clouds (Mitchell & Finnegan, 2009) and injecting reflective particles into the Earth's atmosphere (Crutzen, 2006). Its advocates argue that SRM serves as fast and effective solution to avoid climate catastrophes or 'tipping points', such as the melting of the polar ice sheets. Opponents point out that SRM does not address other important effects of climate change such as ocean acidification; that the side effects of SRM (e.g. change of weather and rain patterns) could eventually be worse than the effects of global warming; and that SRM is an end-of-pipe solution par-excellence. Nevertheless, it is not generally advocated as 'the' solution to climate change, but rather as a way to gain time while other solutions that focus on reducing greenhouse gases in the atmosphere (through systemic change in the production of energy, reformation of land use and CDR) are implemented.

Meanwhile, the aim of CDR is to capture CO_2 from the atmosphere through more or less artificial means, ranging from afforestation over enhancement of algae growth in the oceans (Smetacek & Naqvi, 2008), geological weathering (Schuiling & Krijgsman, 2006) to the capture of CO_2 straight from the air using machines (Keith, Ha-Duong, & Stolaroff, 2005; Lackner et al., 2012). CDR is generally less controversial than SRM, and is seen as a necessary component of climate policy. While methods like afforestation and the restoration of natural carbon sinks are often not even thought of as climate engineering (although they technically are, if done at large scales), technologies such as Carbon Capture and Storage (CCS) and ocean enrichment strategies to promote algae growth are criticised for their unpredictable effects on geological and ecological systems. Moreover, it is argued that CDR is too slow to prevent imminent climate catastrophes such as the melting of the polar ice caps. Both sets of technologies have been questioned due to their ethical implications and the fact that they may distract from the more important strategy of reducing anthropogenic CO_2 emissions.

The idea of using climate engineering technologies to address the problem of global warming is not particularly new. First suggestions to combat climate change by increasing the Earth's albedo were published in a US government report in 1965 (President's Science Advisory Committee, 1965), and ideas on capturing CO_2 from the atmosphere and storing it in the oceans were developed in 1977 (Marchetti, 1977). The topic became something of a taboo during the first UNFCCC discussions and the negotiation of the Kyoto Protocol, and only received a reinvigoration of interest in 2006 when Nobel Prize winning atmospheric scientist Paul Crutzen published a seminal article on the possible use of stratospheric sulphur injections to cool the planet (Crutzen, 2006). Since then, publications on climate engineering have soared exponentially (Linnér & Wibeck, 2015). In 2013, climate engineering strategies were mentioned for the first time in the IPCC's fifth assessment report, constituting the final paragraph of working group one's summary for policy makers (IPCC, 2013).

Apart from technology-specific publications, the current debate around climate engineering focuses mainly on the question of whether or not to continue research and, if research is continued, how it should be governed. Linnér and Wibeck (2015) describe the technologies as 'dual high-stake', i.e. technologies involving high stakes in the case of implementation as well as in the case of non-implementation, which is why the discussion has more or less come to a stale mate. Advocates argue for more research on the technology and its effects, opponents argue for a moratorium, but both parties express the need for more research on the 'governance issue'.

Sketching the institutional complexity for climate engineering

Unlike for REDD and SLCPs, international public governance of climate engineering is considered more absent than present – at least, when it comes to an overarching governance institution on the issue. The 1976 Convention on the Prohibition of Military or Any Other Hostile Use of Environmental Modification Techniques (**ENMOD convention**) is possibly the most appropriate existing agreement and broad enough to include climate engineering, but only prohibits 'hostile use' of environmental modification.

However, depending on the type of climate engineering (e.g. CO2 removal; ocean iron fertilisation; solar radiation management), a range of institutions come into play, including, for instance, the Law of the Sea Convention and the Convention on Long-Range Transboundary Air Pollution (LRTAP) (Bodansky 2011). Yet the only international conventions that have actually been used to regulate climate engineering research (in the context of ocean iron fertilization) are the 1996 Protocol to the London Convention regarding marine pollution and the 1992 Convention on Biological Diversity (CBD) (Scott, 2013).

Some government reports and academic articles have tried to develop options and proposals on how work with and improve existing legislation at the international level (Bodle & Oberthür, 2014; Bracmort & Lattanzio, 2013; Wirth, 2013). Others have analysed the probability of possible governance arrangements between states (Lloyd & Oppenheimer, 2014; Ricke, Moreno-Cruz, & Caldeira, 2013). Still others argue that an international agreement on climate engineering will be just as complicated as an international agreement on climate change policy, which is why more focus should be placed on non-state actors and bottom-up development of norms in the process of research (Bellamy, 2014; Victor, 2008).

In any case, the governance landscape of climate engineering has experienced some recent changes in the form of additional institutions aiming to explicitly address the issue of governance – not at an international level, but at a transnational level. These include three types of new institutions in particular. First, an increasing amount of **research groups** have evolved that are being funded to explicitly address the issue of governing climate engineering. Examples are the EuTRACE project and the Oxford Geoengineering Programme.

Second, **non-governmental initiatives** have been launched to increase communication about climate engineering outside of academia, for instance, the Washington Geoengineering Consortium and the Solar Radiation Management Governance Initiative.

A third type of new institutions is also taking place in the form of agreements and **codes of conduct** amongst climate engineering scientists. An example here are the so-called ’Oxford Principles’, which were endorsed by the UK government and the gathering of geoengineering researchers at the Asilomar Conference on Climate Intervention Technologies. Such codes of conducts have also been introduced in in private companies that have attempted to engage in climate engineering technologies, e.g. the company Climos with its code of conduct for ocean fertilization.

6 Conclusions and Outlook

Assessing institutional complexity

This paper could only provide a very preliminary overview of first results of the NAVIGOV project, namely with regard to the assessment of the degree of institutional complexity in the three issue areas. As these assessments have shown, the three issue areas coincide in various regards, e.g.:

- The lack of an institutional core with an overarching mandate for the whole issue area;
- Strong overlaps between environmental institutions of different domains (climate change, biodiversity and forestry for REDD; climate change, ozone, air pollution, maritime pollution for SLCPs; climate change, air pollution and biodiversity for climate engineering).

On the other hands, some clear differences between the issue areas include:

- The number of public international institutions involved (highly advanced for REDD; advanced for SLCPs; and low for climate engineering);
- The level of institutional integration or division of labour evolving (many overlaps and duplications for REDD; a pollutant-based division of labour for SLCP; an unbalanced focus on research governance for climate engineering).

Our next steps will be to systematize the comparison across issue areas, building on the criteria we established in section 2.1 for assessing institutional integration and the mix of public and private institutions in a governance architecture. We hope to come up with more informed observations that can also help us with the research question on causes of complexity – that is, asking how the different degrees of complexity mirror different types of causations.

Explanations of institutional complexity

Following the growing realization that international institutions do not operate in a vacuum, international relations scholars have provided insights on how international institutions interact within and across particular issue areas (Young 2002; Oberthür/Gehring 2006), how transnational actors and institutions add to this ‘complex multilateralism’ (Bäckstrand 2008) and how such interactions can be managed (Oberthür 2009). However, with a few exceptions (Oberthür/Gehring 2006; Zelli 2011), studies of institutional complexity suffice with a simple stocktaking paired with abstract conceptual approaches, and have not heeded the call for more theoretical approaches (Young 2008).

Yet, there is a rich theoretical basis that can be drawn upon, including theories from international relations (e.g. neoliberal institutionalism and social constructivism), law (e.g.

fragmentation of international law) and organization studies (e.g. organizational ecology). These theories can be used to explain the underlying causes of institutional complexity, the behaviour of state and nonstate actors in complex settings, as well as the consequences of complexity. Such insights, in turn, can help inform policy responses (Zelli/van Asselt 2013).

In this paper we introduced a two-step approach (section 2.2), building on problem-structural approaches and the private authority theory. From these literatures we derived assumptions to explain the values we will find in our three case studies for our two sets of criteria (degree of institutional integration and functions of private and public institutions).

In the next version of this paper we will present an application of this framework and hope to shed more light on the reasons for the observed degree of institutional complexity and the roles of private institutions in the fields of REDD, SLCP and climate engineering.

Outlook to further research on complexity and governance architecture mixes

This said, there are of course a large set of further hypotheses that could be derived from different strand of institutionalism and that merit attention and examination in future studies. To give but an illustration: apart from the problem-structural approach we pursued here, scholars may look into the following hypotheses when they seek to explain the degrees institutional complexity:

- Power-based, drawing on neo-realist perspectives (e.g. Benvenisti/Downs 2007): *The more a powerful coalition of countries does not find its interests on an issue realized by existing institutions, the more this coalition tends to create or support alternative ones—thereby increasing the level of institutional complexity.*
- Interest-based, drawing on neoliberal institutionalism (e.g. Keohane/Nye 1977): *The more asymmetric the constellation of interest among key actors on an issue, the lower are chances for regulating this issue comprehensively in a single institution or a small set of institutions—thereby increasing the level of institutional complexity*.
- Norms-based, building on sociological and discursive institutionalism (Zelli *et al.* 2013): *The stronger the conflict among core norms (or the contestation of discourses) on an issue, the higher the chances for this conflict to be reflected in a competing set of institutions—thereby increasing the level of institutional complexity.*

Apart from such classical assumptions, recent progress in institutional analysis points towards more specific factors like, for instance, the solidification of state interests or the substitutability of intergovernmental institutions (Jinnah 2014).

Likewise, there are other types of dependent variables that merit examination, including the consequences of the observed degree of complexity for questions of legitimacy, accountability or effectiveness of a whole governance architecture or particular institutions therein. This perspective would further extend the (assumed) causal chain and put more requirements on a thorough analysis. But it would equip us with a more accurate analytical insight into core aspects of institutions in global governance today, taking their embeddedness in a compex institutional environment more into account.

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