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Climate Change: The Ultimate 'Tragedy of the Commons'?

Jouni Paavola[1]

March 2011

Abstract

The dominant view among scholars and policy makers has been that climate change governance should be based on international agreements which involve most nations. Yet progress in international negotiations has been slow and the effectiveness of governance based on the United Nations Framework Convention on Climate Change (UNFCCC) and its Kyoto Protocol (KP) has been modest. Recent debates have focused on regional, sectoral, building blocks, and other less comprehensive climate change governance strategies. But the wider rationale of moving away from a comprehensive solution to a mosaic of specific ones has received little attention. This paper examines the rationale and potential of institutional diversity and polycentric governance in the area of climate change. The paper argues that polycentric governance of climate change is already a reality, and that voluntary, bottom-up solutions can be comparable in terms of significance and performance with major emitting states. However, voluntary initiatives are likely to be at their best in realising cost-saving mitigation opportunities and thus polycentric climate change governance will also need to involve hybrid and state-based solutions. A key research need is to understand the dynamics of these different kinds of governance solutions.

Keywords: climate change policy, climate change governance, polycentricity

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1. Introduction

The dominant view among scholars and policy makers has been that climate change governance should be based on international agreements, which involve most nations (see e.g. Hare et al. 2010). The United Nations Framework Convention on Climate Change (UNFCCC) and the Kyoto Protocol (KP) are cornerstones of this approach. These kinds of governance strategies face two key hurdles. Firstly, it is difficult to achieve an agreement on commitments to mitigate climate change among large number of nations. Secondly, all agreements need to be implemented through national policies. But top-down governance solutions relying on the central role of state have been a false panacea in the governance of many resources (see Ostrom et al. 2007). It is no surprise, then, that the progress in governing climate change has been slow and that only modest results have been obtained in curtailing greenhouse gas (GHG) emission reductions.

More recently, the debates on climate change governance have centred on the comprehensiveness of feasible agreements (see Kuik et al. 2008). The proponents of comprehensive international agreements remain in one end of the continuum (e.g. Hare et al. 2010). In the other end are those who would not rely on international action (e.g. Rayner 2010). In between are those who consider that progress is best made through regional, sectoral and other less comprehensive governance strategies (e.g. Sugiyama and Sinton 2005; Schmidt et al. 2008; Barrett & Toman 2010; Falkner et al. 2010: 7:). Within each strand, the relative merits of different policy instruments are still debated although carbon markets have already gained a prominent position (Kuik et al. 2008; Bernstein et al. 2010; but see Spash 2010). Another strand of literature has examined voluntary governance solutions that do not centrally rely on the role of the state (Newell 2000; Bulkeley and Betsill 2003; Bäckstrand 2008; Kern and Bulkeley 2009). Much of the existing literature believes that a feasible strategy for climate change governance does exist – the opinion just differs what it is.

This paper investigates the potential of institutional diversity and polycentric governance in the area of climate change. The new institutional literature (e.g. Dolšak and Ostrom 2003; Ostrom 1990, 2005; Ostrom et al. 2002; Young 2002) and governance literature in general (Rhodes 1996; Rosenau 1995) considers the absence of coercive state power as the hallmark of governance. Yet governance is what governments do. The apparent juxtaposition of "governance" and "government" hinges on the conception of government. But rather than being a monolithic external actor, the government could be understood as a set of arenas and instruments of collective action. This viewpoint helps to construe governance as a continuum between state-based solutions and solutions which do not involve the state, with hybrid forms in between (see Lemos and Agrawal 2006; Paavola 2007). That is, environmental governance

could be understood broadly as the establishment, reaffirmation or change of diverse institutions in order to manage the use of environmental resources.

New institutionalism has informed a significant body of research on local common property arrangements and on international environmental conventions (e.g. Dolšak and Ostrom 2003; Ostrom 1990, 2005; Ostrom et al. 2002; Young 2002). Yet its potential is far from exhausted. Understanding the challenges of and solutions for governing large and complex environmental resources such as atmospheric sinks have been identified as key future tasks (Ostrom et al. 1999, 278; Dietz et al. 2003, 1910; Berkes 2008). However, much of the literature still examines relatively simple single-level governance solutions although the governance of large environmental resources is typically based on diverse solutions operating at local, national, international and intermediate levels and across levels simultaneously. This calls for developing analytical ways to address institutional diversity (Ostrom et al. 1999, 278; Ostrom 2005). Some progress towards this direction has been made in the international relations scholarship (see e.g. Keohane and Victor, 2010; Raustiala and Bridgeman, 2007).

In the related body of literature on polycentricity (e.g. E. Ostrom 2009, 2010a, 2010b; V. Ostrom 1972; V. Ostrom et al. 1961), polycentric order has been defined as "one where many elements are capable of making mutual adjustments for ordering their relationships with one another within a general system of rules where each element acts with independence of other elements" (V. Ostrom 1999, 57). Polycentric order is likely to emerge in a bottom up way when diverse actors around a phenomenon like climate change seek to realise diverse benefits (or to avoid diverse costs) that accrue on different scales (see E. Ostrom 2009). As Ostrom (ibid.) remarks, mitigation actions do not only generate global benefits in terms of reduced greenhouse gas emissions and reduced rate of climate change: they also create co-benefits

such as better air quality, reduced reliance on fossil fuels, reduced exposure to their price fluctuations, improved energy security and so on. These benefits can be a sufficient motivation for mitigation actions although not perhaps on a comprehensive scale.

A myriad of voluntary climate change initiatives indeed already exist. For example, the Cities for Climate Protection (CCP) programme and the Sustainable Cement Initiative (SCI) represent substantial greenhouse gas emissions, comparable to those of major emitting states as will be discussed later in the paper in greater detail. These initiatives have been successful in reducing GHG emissions or slowing their growth compared to business as usual. However, tentative evidence suggests that voluntary initiatives may be at their best in or limited to realising cost-saving emission reductions. Therefore, state-based and hybrid governance solutions may be needed to complement the voluntary ones in order to stabilise the atmospheric concentrations of GHGs at a safe level. That is, institutional diversity is likely to characterise climate change governance and it will emerge both through bottom-up and top down processes.

In what follows, the second section will examine climate change as a resource use problem – that of unsustainable use of global atmospheric sinks for greenhouse gases. The third section looks at the international efforts to respond to climate change to date. The fourth section looks at climate change governance from the viewpoint of the literature on polycentricity. The fifth section reviews to what extent polycentric governance already characterises climate change and what can be said of its track record and potential.

2. Climate change as a problem

Stern Review (2007, 27) considers climate change "as the market failure on the greatest scale the world has seen". The language of market failure and externalities is indeed widely applied to climate change. However, this paper draws from the literature on the management of common-pool resources (see Ostrom 1990; Ostrom et al. 2002; Ostrom 2005; Berkes 2008; Poteete, Janssen and Ostrom 2010) to examine climate change as a problem in the sustainable use of atmospheric sinks for greenhouse gases (GHGs).

Atmospheric sinks for GHGs can be understood as a common-pool resource (CPR) just like an aquifer or a fishery (Paavola 2008b). Sinks are stock resources which provide a flow of sink services. Aquifers and fisheries have a relatively well-understood capacity to generate a flow of resource units. Watercourses, air basins and global atmospheric sinks have a comparable capacity to absorb pollutants which is replenished by natural processes. Atmospheric GHG sinks fulfil the first condition of being a CPR because the use of units of sink services is rival or subtractable (see Ostrom 1990): a unit used by one user is not available to others. A key challenge in governing atmospheric sinks for GHGs is the same as with all other CPRs: to constrain their use so as to prevent their destruction. A derivative task is to distribute the sustainable capacity to provide sink services among the competing users. Determining and dividing up sustainable sink capacity is obviously wrought with uncertainty in practice, but so is that of the sustainable yield of fisheries, for example.

Atmospheric GHG sinks also fulfil the second condition of being a CPR because it is difficult to exclude unauthorised users from using them (Paavola 2008b). The users of GHG sinks range from large coal powered electricity generation plants to families driving a car or keeping cattle. The size of the sink, the range of activities that make use of it, and the large number of users make it difficult to monitor the use of the sinks, and to exclude unauthorised

users. The absence of clear borderlines and perfect mixing of emissions of GHGs in the atmosphere contribute to the difficulty of exclusion (Ostrom 1990).

Because of foregoing resource attributes, atmospheric sinks may experience the ultimate "tragedy of the commons" (Hardin 1968). This is because users have incentives to use sink service units before other users make them unavailable. Because of the difficulty of exclusion, they can also do so. When everybody acts on their own self-interest rather than exercises a constraint to conserve global GHG sinks, the tragedy is nigh. Although Hardin has later (1998) been optimistic about the emergence of a constraint in the use of global atmospheric sinks, progress to date has been modest as will be discussed below.

When exclusion costs are low, challenges of rival consumption are typically resolved by establishing private ownership and deciding on who is entitled to what. Markets can then allocate resources to their most valuable uses. But private ownership is not feasible when exclusion costs are high, as is the case with global atmospheric sinks and other common pool resources. Alternatives for governing global atmospheric sinks as the same as for other CPRs and include collective ownership and management (which may involve the use of markets), voluntary agreements to constrain the use of atmospheric sinks for GHGs, and widely shared values with associated individual behaviour change to reduce GHG emissions. These alternatives may co-exist as parts of wider polycentric governance strategy for climate change.

The challenges of governing atmospheric GHG sinks are also shaped by the attributes of their users which determine the starting point for collective action aimed at establishing or modifying governance institutions, shape the costs of acting collectively, and influence what

governance solutions can be agreed upon. The prospects of collective action are also shaped by political-economic factors and current patterns in the use of atmospheric sinks for GHGs. One of the most important aspects of global political-economic order is the role of states in representing users of global atmospheric sinks within their territories. International law treats states as equal, sovereign actors in international affairs. This formal equality contrasts with their unequal capacities and developmental attainments. Most developed countries have high levels of per capita income and strong, capable states. In the developing world, many states are weak and some dysfunctional, and they have been unable to promote income growth and wellbeing among their citizens. Many developing country states also have weaker capacity to forward their (and their citizens') interests in international negotiations.

States' economies exhibit different degrees of complexity which affects their vulnerability to climate change impacts. Most developed countries have complex economies which offer many sources of income and are which more resilient during periods of stress. Economies of many developing countries depend on primary production and are exposed to substantial climatic and economic risks. Because of underdeveloped financial and insurance sectors in many developing countries, people cannot insure their assets and stand to lose them when disasters occur (Paavola & Adger 2006; Paavola 2008a). In developed countries, income is not sensitive to extreme weather events such as the European heat wave of 2003 although it caused substantial asset losses. In contrast, extreme weather events such as hurricanes can tax over 10 percent of the GDP of a low-income country (Linnerooth-Bayer et al. 2005). The differences in vulnerability are even more significant in terms of loss of life. For example, hurricane Andrew killed 23 people in Florida in 1992 while a comparable typhoon killed over 100,000 people in Bangladesh the year earlier (Adger et al. 2005). Brooks et al. (2005)

suggest that educational attainment, health status, and quality of governance explain much of the difference in mortality due to natural disasters between countries.

Heterogeneities in the global community such as the ones discussed above make it difficult to agree on how to govern the use of atmospheric sinks for GHGs. Developed countries have invested in energy-intensive lifestyles, technologies, and infrastructure, which make CHG reductions time-consuming and expensive. At the same time, developed countries have capacity to avoid adverse consequences of climate change, as well as to recover from them. Furthermore, they form a relatively homogeneous and powerful negotiation block, which has experience from collective action in other contexts. Developing countries – particularly the least developed countries – have contributed little to climate change because of their limited energy use and reliance of renewable sources of energy. But their economic development requires increasing energy use and GHG emissions. At the same time, developing countries are highly vulnerable to adverse climate change impacts. Finally, developing countries form a large and heterogeneous negotiation block, with members from oil producing countries to small island states that are threatened with inundation by the rising sea levels.

There are, of course, more coalitions in climate change negotiations than just developed and developing countries, and the contours between and within the groupings are far more complex than the discussion above suggests. But even this narrow account highlights that in the light of the literature on common-pool resources, there are significant obstacles for acting collectively to govern atmospheric sinks. The following brief account on the progress to date in international climate change negotiations underscores this.

3. Conventional view of climate change governance and its record

Several lines of reasoning lead to the view according to which climate change governance has to be negotiated by the states, codified as multilateral environmental agreements, and implemented through national legislation. Firstly, research in environmental science has sought to understand phenomena such as climate change and the loss of biodiversity through lenses of "global environmental change" and "earth systems theory" (see Steffen et al. 2004; Vitousek et al. 1997). This kind of "analytical globalisation" of environmental change easily leads to a view that feasible responses to global problems also must be global in nature.

Secondly, scholarship in international relations, particularly the realist tradition and in neoliberal institutionalism provides a justification for "statism". Realism extends rational choice reasoning to the international system. Other actors are considered irrelevant to explaining outcomes in regime-building processes. Self-interested states will agree to take collective action on an issue like climate change only if all parties to the agreement benefit either directly, or via side-payments or benefits made available by those who do directly benefit from an agreement (e.g. Sprinz and Vaahtoranta 1994; see also Barrett and Toman 2010). Yet all such international agreements lack power to enforce their provisions and need to be implemented through top-down processes which involve enactment and enforcement of national legislation.

Thirdly, public finance reasoning supports "maximal multi-lateralism". From its viewpoint, internalisation of an externality or the provision of a public good should take place at a scale encompassing all affected parties (see Musgrave and Musgrave 1976, 613-615; Tiebout 1956). In case of climate change, this would mean all who have to share the burden of mitigation, who benefit from mitigation actions, and who bear the burden of having to adapt

to residual climate change impacts. That is, most if not all states should be involved in negotiations on climate change governance. There are of course counter-arguments – I will return to some based on transaction cost reasoning later in the paper.

Substantial mitigation of greenhouse gas emissions is possible. Already known technological solutions can deliver the GHG emission reductions needed to stabilise their atmospheric concentrations at 450-550 ppm (Pacala and Socolow 2004). These reductions can also be delivered at a reasonable cost. Stern (2007, xvi) argues that stabilising the GHG concentrations at 500-550 ppm by 2050 would cost 1 percent of the global GDP. In contrast, he (2007, iv) estimates that "the overall costs and risks of climate change will be equivalent to losing at least 5% of global GDP each year, now and forever. If a wider range of risks and impacts is taken into account, the estimates of damage could rise to 20% of GDP or more." About a third of the emission reductions needed by 2030 would save rather than cost money (Enkvist et al. 2007). Yet it has been difficult to reach an international agreement on GHG emission reductions.

The United Nations Framework Convention for Climate Change (UNFCCC) was adopted in 1992 as the key international response to climate change. The Kyoto Protocol (KP) adopted in 1997 established emission reduction commitments for carbon dioxide, methane, nitrous oxide, hydrofluorocarbons, perfluorocarbons and sulphur hexafluoride emissions for 37 industrialized countries and the European Community, or the so called "Annex 1" countries. Parties to KP committed themselves to an overall 5 % GHG emission reduction from 1990 during 2008-2012.

The GHG emissions of Germany, United Kingdom and Sweden were already 10-20 % below those of the Kyoto base year in 2008 (EEA 2010, 22). In the same year, GHG emissions of many countries of the former Soviet Union and of countries with economies in transition were 25-60 % below their 1990 levels because of the collapse of their economies and manufacturing (EEA 2010, 22). But greenhouse gas emissions were 32.2 % and 42.3 % higher in Portugal and in Spain in 2008 than they had been in 1990 (EEA 2010, 22). Emissions also grew in Australia, Japan and the United States by 15-25 % from 1990 to 2004 (UNDP 2007, 310-315). For comparison, carbon dioxide emissions of Brazil, India and China, who were not parties to KP, increased by 60-110 % from 1990 to 2004 (UNDP 2007, 310-315).

The "safe" level of 2-3 degrees of global warming would require the stabilisation of atmospheric GHG concentrations at 400-500 ppm (Mastrandrea and Schneider 2004), which would in turn require 50-85% reduction in GHG emissions by 2050 from 2000 (IPCC 2007). Kyoto Protocol cannot deliver this because too few countries participate in emission reduction, because the countries that do participate have too lax targets (which are not even complied with), and because too many sources of GHGs remain outside its scope. There have been calls to involve major developing economies in emission reduction because of their substantial total emissions. But some major developing economies such China, Iran and South Africa also already have higher per capita GHG emissions (UNDP 2007) than the globally available per capita emissions consistent with the stabilization of atmospheric GHG concentrations at a safe level. Land use and land use change, deforestation, aviation and marine bunker fuels, and carbon leakage associated with the consumption of imports from non-Annex 1 countries to Annex 1 countries are examples of issues that remain wholly or largely unaddressed by the current climate change regime.

To conclude, the UNFCCC process has produced policy outputs but it has failed to tackle climate change seriously. In a recent article, Barrett and Toman (2010, 68) suggest (referring to research by Velders et al (2007)) that the Montreal Protocol which was adopted in 1987 to reverse the depletion of the ozone layer has achieved four times greater GHG emission reductions than the Kyoto Protocol. Montreal Protocol was of course easier to negotiate as the depletion of the ozone layer involved fewer parties, mitigation costs were lower, and the same substances that deplete ozone layer are also greenhouse gases (see Cole 2009). In what follows, I will discuss how the literature on polycentricity helps to open up the notion of climate change governance and to highlight that some progress is perhaps being made in tackling climate change.

4. Polycentric climate change governance

Whilst it was suggested above that climate change can usefully be understood as a problem of using a common-pool resource, the global atmospheric sinks for greenhouse gases, the problem of governance solution as a whole is distinct from decisions on the quality of CPR. Stable climate is a public good (just like water or air quality where pertinent sinks are also CPRs) because its use is not rival, and because it is difficult to exclude users from it once it is provided. Already Samuelson (1954) suggested that markets do not make available an optimal amount of public goods and that they should be publicly provided. But public provision of stable climate is not trivial - it should happen at a spatial scale which encompasses all affected parties (Musgrave and Musgrave 1976, 613-615). That is, the provision of stable climate should happen globally.

However, there is no "world government" so the provision of stable climate requires collective action. Olson (1971) argued that collective action is more likely unsuccessful in large groups where actors deem their impact on collective action outcomes small, and as a consequence have a stronger incentive to free ride. This is characteristic of climate change if we consider it a problem for the humanity as a whole. When a large proportion of actors assesses their situation in the way described above, collective action will be undermined.

One way to overcome the problem is to mobilise collective action on a smaller scale. It helps to overcome the incentive to ride free because the impact of each individual on collective action outcomes increases. At the same time, smaller groups may increase the homogeneity of involved actors which should also facilitate collective action. Coordination between groups can be achieved by establishing larger-scale solutions where the groups are represented. Representation treats collective action groups as individuals and reduces the original large numbers situation to a situation of small numbers. That is, multi-level governance solutions are likely to emerge as instruments for facilitating collective action in large groups.

The system of states representing their populations is one possible solution of this kind. However, it is not the only one, and state based solutions do not necessarily come in one size fits all. Ronald Coase's (1937) work on the nature of the firm suggests this already: the scope of any governance solution (in his case the firm) would be determined by the relative transaction costs of carrying out transactions internally and externally. Transaction costs do not favour comprehensiveness to the extreme. Subsequent work in transaction cost economics (e.g. Williamson 1999, 2000 and 2005) highlights that different governance solutions create different incentives and have differential ability to govern different kinds of transactions. The implication of this for climate change governance is that different rationales may exist for

different governance solutions and that they would have different albeit potentially co-existing scopes. That is, multiple non-comprehensive solutions are a more likely outcome to emerge than one, all-encompassing governance solution (for similar argument, see Keohane and Victor, 2010).

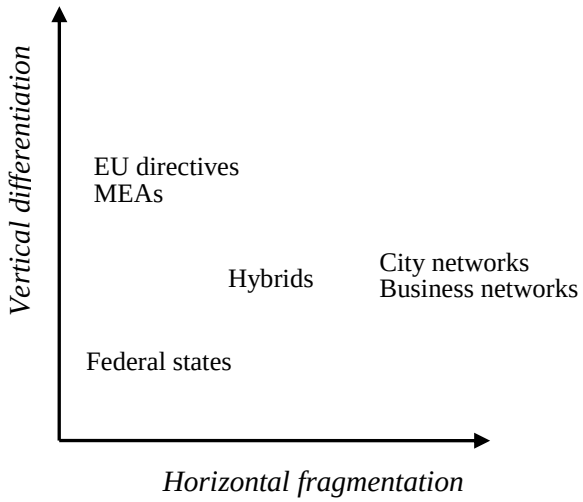
Also theoretical explanations for the emergence of multi-level governance suggest that diverse institutional designs should exist for the provision of public goods such as stable climate (Paavola 2008b). Different governance functions such as provisioning, monitoring and enforcement (Paavola 2007) may have different economies of scale or different optimal scales of operation (V. Ostrom et al. 1961). Collective environmental decisions may be best made at a higher level, while provision of the resource may best be undertaken at a lower level, for instance. This is the rationale for many co-management arrangements. Important here is that the governance cost-based approach points to different kinds of multi-level solutions than the collective action approach. The latter suggests nested governance solutions which are identical otherwise apart from their different scale. The governance cost approach suggests that levels of governance may be functionally differentiated and complementary for a reason.

The literature on polycentricity offers additional insights for understanding institutional diversity in climate change governance. Vincent Ostrom and his colleagues originally proposed the notion of polycentricity to characterise complex metropolitan governance structures that had emerged in the post-war decades for public service delivery in the United States (see Ostrom, Tiebout and Warren 1961; V. Ostrom 1972). These new complex structures did not have a single core which characterised conventional monocentric governmental arrangements. Vincent Ostrom himself defined polycentric order later as “one

where many elements are capable of making mutual adjustments for ordering their relationships with one another within a general system of rules where each element acts with independence of other elements (1999, 57)". The scholarship on polycentricity sought to establish the rationale of such arrangements.

Well until and after Vincent Ostrom's seminal contributions, and those of Tiebout (1956), Coase (1960, 1974) and Buchanan (1965), the government was considered the default provider of public goods and services. Market failure reasoning provided the intellectual justification of this view. Against this background, the key interest of Vincent Ostrom was the horizontal dispersion of authority to govern. It was at the time a novel phenomenon, one which the established notions of government and governance were not well placed to account for. But vertical structuring of governance is also involved in the examples Ostrom et al. (1961) and Ostrom (1972) discuss.

In light of the foregoing discussion, the degree of horizontal dispersion of authority varies from monolithic governmental solutions to fragmentation of authority (see Figure 1 below). Somewhere in between lie hybrid solutions (see Lemos and Agrawal 2006). Different governance solutions may also exhibit different degrees of vertical differentiation from vertical symmetry to differentiation (see Figure 1). While individual governance solutions characterised by fragmentation of authority could already be considered examples of polycentric governance, institutional diversity – the multitude of diverse governance solutions prevailing simultaneously – would necessarily lead to polycentricity in a wider sense.



Another important attribute of governance solutions is the way in which they emerge: bottom up as a result of voluntary collective action or bargaining, or as a result of top down, mandated processes. Polycentric order may emerge in a bottom up way when diverse actors around a phenomenon such as climate change seek to realise diverse benefits (or to avoid diverse costs) that accrue at different scales (see E. Ostrom 2009). As Ostrom (ibid) remarks, mitigation actions do not only generate global benefits in terms of reduced greenhouse gas emissions and reduced rate of climate change: they also create various co-benefits such as better air quality, reduced reliance on fossil fuels, reduced exposure to their price fluctuations, improved energy security and so on. These benefits can be a sufficient motivation for voluntary mitigation actions, although not perhaps on a comprehensive scale. Top down processes create other governance solutions which increases institutional diversity.

There is thus more to climate change governance than international negotiations and state-based climate change policies. Solutions based on or involving non-state actors also do exist and they are likely to be networks rather than hierarchies or markets, and to exhibit the dispersion of authority and vertical differentiation simultaneously. Hooghe and Marks (2003) also suggest that these "Type 2" governance solutions are likely to be voluntary (negotiated)

and temporary rather than permanent, and to have overlapping rather than exclusive membership. Hybrid governance solutions can involve states and partly rely on their mandatory powers but also grant important role to other actors and voluntary action. They will play a role in the portfolio of governance solutions alongside state-based and voluntary solutions.

In what follows, I will discuss two bottom-up governance initiatives to tease out additional insights into polycentric governance of climate change.

5. Voluntary initiatives and climate change governance

Polycentric climate change governance can involve a variety of actors such as local governments and communities, non-governmental and church based organisations, businesses, and governmental organisations in different combinations and roles. Some of the solutions are limited to one area of activity – local governmental activities or an industry – while others can be more general in nature. Many of these solutions are voluntarily adopted and voluntary to join in, although the act of joining can create responsibilities. The Cities for Climate Protection (CCP) programme and the Cement Sustainability Initiative (CSI) will be discussed below as examples.

Cities for Climate Protection (CCP) programme

Local governments have actively developed and implemented governance solutions for reducing the emissions of greenhouse gases from their jurisdictions. The pioneer in this area has been the International Council for Local Environmental Initiatives with its Cities for Climate Protection (CCP) programme. Others include Climate Alliance, C40 and U.S.

Mayors' Climate Protection Agreement (see Gore 2010; Kern and Bulkeley 2009; Linstroth and Bell 2007; Roman 2010).

ICLEI's Cities for Climate Protection (CCP) programme was launched in 1993. It aimed to enlist 100 municipalities worldwide with joint emissions of 1 billion tonnes of CO2 (ICLEI 1993). The programme also sought to strengthen the local commitment to greenhouse gas emission reduction; to develop and disseminate planning and management tools; to research and develop best practice; and to enhance the national and international ties between municipalities (ibid).

Cities for Climate Protection programme expects those joining it to develop a local action plan to reduce greenhouse gas emissions, to undertake measures to reduce emissions from municipal building stock and vehicle fleets, to undertake public awareness campaigns on climate change, and to join procurement initiatives that seek to create demand for climate friendly products and services. Those joining are also expected to link with developing country and emerging economy country local governments to foster technological and financial transfer (see ICLEI 1993).

The CCP progress report published in 2006 (ICLEI 2006) highlighted that 550 local governments had joined the programme since 1993. Their combined population was a quarter of a billion, or over 4 percent of the global total. The combined GHG emissions from participating local governments were 1.85 billion tons of eCO2, or over 6 percent of the global total (excluding emissions from land use and land use change). That is, the CCP is comparable to large Annex 1 countries such as Germany, Japan and Russia in terms of GHG emissions. The participants reduced their joint emissions by 3 % or 60 million tons of CO2

between 1990-2006. These emission reductions brought substantial savings to participating cities, amounting to about $ 35 per reduced ton of CO2 emissions (ICLEI 2006, 2).

Cement Sustainability Initiative (CSI)

Another example of climate change governance is provided by the Cement Sustainability Initiative (CSI), a programme of the World Business Council for Sustainable Development (CSI, 2002) which has been considered a model for the "sectoral" approach to climate change mitigation (Schmidt et al. 2008; Meckling and Chung 2009). The cement industry is a significant GHG emitter: its worldwide CO2 emissions are about 5 % of the global total, making also them comparable to those of Germany, Japan and Russia in 2004 (CSI 2002; UNDP 2007).

CSI was formed by ten large cement manufacturers in 2002 and today its members represent nearly two thirds of the global cement manufacturing capacity outside China (CSI 2009). The CSI aims to increase the cement industry's contribution to sustainable development and the public understanding of that contribution. The agenda for action adopted in 2002 contained six key areas of work which were 1) climate protection; 2) fuels and raw materials; 3) employee health and safety; 4) emissions reduction; 5) local impacts; and 6) international business processes (CSI 2002, 5). The agenda invited other cement producers to join and committed to reporting on the progress in three years' time (ibid.).

GHG emissions of the cement industry originate from the chemical reactions of the key raw material, limestone (50 % of total), fuel used in the manufacturing processes (40% of total), and electricity consumption, transport and other sources (10% of total). Thus its climate protection encompasses raw material considerations (which influence half of emissions), fuel

mix (use of renewable sources of energy or energy derived from waste); process technology and its efficiency, product quality (which influences the use of cement per output unit), logistics and so on (Damtoft et al. 2008).

CSI developed a CO2 protocol for use in defining and making public baseline emissions of involved companies. It facilitated the setting of targets by involved companies against their baseline emissions, and annual reporting of CO2 emissions (CSI 2002, 19-20). The data suggests that CO2 emissions per produced ton of clinker have decreased 6 % between 1990 and 2006. Thermal energy efficiency has improved by 14 percent over the same period. But the emissions of CSI members increased by 35 % because their output grew 50 % in the same period.

The CSI data suggests that "operational optimisation" has limited scope to influence CO2 emissions: it is tied to the technological design of plants. Industry performance improves mainly through the addition of new, efficient plants and decommissioning of old, inefficient plants. Alternative fossil fuels, waste and biomass contribute to fuel mix in different ways in different regions (CSI 2009). Raw material mix, fuel mix, and product choices have substantial potential to reduce CO2 emissions from the industry over the long run.

Key observations

Voluntary climate change governance initiatives such as the CCP and the CSI can cover GHG emissions comparable in terms of magnitude to those of the major Annex 1 countries. CCP has also achieved GHG emission reductions comparable in terms of percentage to those of the major Annex 1 countries and it has done so by saving money to the participants. The CSI has improved performance compared to business as usual in a period when the cement

industry's output grew by 50 percent (CSI 2009). But voluntary initiatives such as CCP and CSI are most likely to realise only those emission reductions which will yield cost savings. This is not insignificant though – as Enkvist et al. (2007) suggest, nearly a third of emission reductions needed by 2030 would actually provide a net benefit.

New forms of climate change governance may also have other, less tangible positive implications. CCP and CSI have established processes for assessing current performance and for setting targets and planning for their attainment. This makes performance transparent and can create stakeholder pressure to its further improvement. CCP and CSI have also identified and disseminated best practice and pursued market creation for new climate friendly products and services. So, over time they may help to bring down the marginal abatement costs of carbon and thus to create new cost-effective measures for reduction of GHG emissions.

But because two thirds of the GHG emission reductions needed by 2030 entail economic sacrifices, there clearly remains a role for conventional state-based solutions as a part of a wider polycentric governance strategy. This raises the question: what should the division of labour be between state-based, hybrid and voluntary governance solutions and how do they interact? Voluntary industry initiatives such as CSI are likely to benefit from international negotiations and agreements because they signal state commitments and provide a basis for longer-term planning and investment in the private sector. State-based governance solutions can also foster and facilitate the functioning of hybrid and voluntary climate change governance initiatives. For example, markets need backing by the states such as legal recognition and enforceability of contracts in courts to be credible and to function. However, the evidence base on the interaction of state-based and other governance initiative largely remains to be generated.

From another viewpoint, hybrid and voluntary forms of climate change governance may play an important role in legitimising and mainstreaming climate change to actors participating in them and to external political and economic decision-makers. That is, they may lower the threshold of participating in mitigation activities and increase pressure to make progress in conventional state-based forms of climate change governance. At the same time, voluntary and hybrid forms of climate governance as part of wider polycentric governance strategy offer a decentralised, flexible and incentivised way of learning, innovating and experimenting with promising ways of reducing GHG emissions and targeting R&D investments. This is again an issue of clear importance on which research has remained very thin to date.

What then could a wider polycentric governance strategy for climate change look like, in light of the foregoing conceptual and empirical discussion? As already suggested, bottom-up and top down processes are likely to generate a mosaic of institutional diversity that includes state-based, hybrid and voluntary measures that operate at levels from the local to international and across levels (see table 1). The international cornerstones of climate change governance will continue to play a role and will gradually cover more GHG sources, include more ambitious emission reduction targets and address adaptation and its financing. However, this is likely to happen in a piecemeal and incremental way rather than comprehensively. National climate change and related policies will also develop, both to implement international agreements and to pursue domestic goals. In light of the multiple benefits origins of polycentric governance, voluntary initiatives focused on adaptation to climate change are likely to emerge when the adaptation agenda strengthens (see Table 1). Insurance and risk-sharing arrangements for adaptation are likely to demand public-private cooperation and to be based on hybrid solutions. Public-private cooperation and hybrid

solutions are also likely to underpin mitigation focused activities, particularly those related to carbon markets and experimental technologies such as Carbon Capture and Storage. Regional and local governments will also increasingly be involved in the delivery of mitigation and adaptation through planning, regulation and public service provision.

Table 1: Institutional diversity in polycentric climate change governance

Type & level	Conventional	Hybrid	Voluntary
Global	Kyoto Protocol, Post-Kyoto targets, adaptation funding;	Carbon markets, REDD	Business sector initiatives
Regional	EU-ETS	regional carbon markets; insurance provision and under-writing	Adaptation clearinghouses
National	Climate Change, energy and other legislation	Carbon markets, public-private partnerships in CCS; insurance provision and under-writing	Adaptation networks of local governments
Local	Climate-proofed zoning, property tax regimes, joint mitigation & adaptation	Public-private partnerships	Carbon-neural communities

Although the discussion above has focused on the potential and promises of hybrid and voluntary forms of climate change governance, in is also important to remember that they can have problematic implications. Collaborative industry initiatives may not in reality be open to all and they may result in restraints of competition. Moreover, voluntary initiatives in general are not representative and their accountability remains unclear – these issues are increasingly drawing attention in research (see Unerman and O'Dwyer 2006; Bäckstrand 2008).

6. Conclusions: fostering polycentric climate governance

The governance framework for climate change is still largely in the making but both new institutional arguments about polycentricity and the emerging empirical evidence suggest that institutional diversity will characterise it. The governance framework will partly be based on

the UN Framework Convention for Climate Change (UNFCCC) and the protocols and decisions of parties made under it. However, national policies and regulations, sub-national and local policies and plans, and a variety of hybrid and voluntary initiatives will also play a role in climate change governance. Together these institutional responses will create a wider polycentric governance strategy for climate change which will disperse authority and responsibility.

While the dynamics of different kinds of institutional solutions as part of a wider polycentric governance strategy largely remains to be studied, something can be said about it. Voluntary and hybrid governance initiatives can clearly be comparable to major Annex 1 countries in terms of GHG emissions and emission reduction achievements. While these initiatives will be at their best in realising emission reductions which save money, they can also help to create markets for carbon friendly products and abatement technologies, and help to bring down the marginal abatement cost of carbon over time. However, climate stabilisation will also require emission reductions that will entail economic sacrifices. This means that state based governance solutions will remain a part of the wider polycentric governance strategy.

The question is: how different governance solutions within the wider polycentric strategy will interact? Voluntary solutions may benefit from political commitment which can provide a basis for longer-term planning and investment. State-based governance solutions can also foster hybrid solutions involving markets. Voluntary initiatives may in turn play a role in mainstreaming and legitimising climate change to actors participating in them and to external political and economic decision-makers. They can lower the threshold of participating in voluntary climate change measures and create pressure for making progress in state-based forms of climate change governance. Voluntary and hybrid forms of climate change

governance also offer a decentralised, flexible and incentivised way of learning about low-cost and promising ways of reducing greenhouse gas emissions and targeting R&D investments effectively.

There clearly is an urgent need to improve the evidence base on the performance of non-conventional forms of climate change governance and the interaction of different types of governance solutions that form parts of a wider polycentric governance strategy. The scholarship on common-pool resources and polycentricity is well-placed to make a contribution in this area because it has both conceptual apparatus and comparable empirical evidence to draw from.

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