

A Polycentric Approach to Global Climate Governance

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Abstract

As international climate negotiations under the UNFCCC have adopted the goal to limit the increase in global mean temperature to well below 2° C, a highly differentiated—but largely uncoordinated—global climate governance system has emerged. Although coordinated global *collective* action for mitigating climate change sufficiently to meet the 2°-C goal is still lacking, a multitude of multilateral, minilateral, transnational, national, subnational, and nonstate actors have emerged. This article offers a critical specification of the attempt by Elinor Ostrom and those influenced by her in the literature to conceptualize this climate governance reality as a *polycentric* approach. We claim that the concept of polycentricity offers high descriptive value for understanding the horizontal and vertical differentiations of current climate governance, and present systematic analysis of a polycentric approach to deliberately enhance the design of the emerging global climate governance architecture. To systematize the Ostromian literature on polycentric climate governance, we identify and specify four key features for climate mitigation governance and their related mechanisms: an emphasis on *self-organization*, a recognition of *site-specific conditions*, the facilitation of *experimentation and learning*, and the building of *trust*. After discussing objections to a polycentric approach, we conclude by tentatively evaluating its potential to enhance the effectiveness of climate mitigation, and identify central tasks for the efficient design of a polycentric global climate governance regime.

It is widely recognized that mitigating climate change requires some form of global collective action. However, current global collective action is insufficient to achieve the goal of limiting global warming to well below 2° C (UNEP 2016). Nevertheless, much climate mitigation action currently can be observed worldwide. *International multilateralism*, with the UNFCCC and the Conferences of Parties at its core, remains a central—but not exclusive—forum for global climate governance. Other actors and fora are also contributing to a dynamically evolving web of policies at different scales and on different governance levels. In

* We thank Ottmar Edenhofer for valuable discussions of climate governance approaches; Michael Jakob for reviewing an earlier version of the text; and three anonymous reviewers and the GEP editors for offering comments and suggestions that were helpful in clarifying the argument.

bi- and *minilateral agreements*, such as the US-China climate agreement and the EU, G7, or G20 commitments, many nation-states coordinate and mutually foster their climate policies (Falkner 2016; Rayner and Jordan 2013). *Subnational governments* unilaterally drive policy change (e.g., Hakelberg 2014; Urpelainen 2009), and self-organize into *transnational networks* such as C40 or ICLEI to commit to specific climate and energy targets, introduce review schemes, and organize policy transfer (Bulkeley et al. 2014; Hoffmann 2011). Regardless of the new evolving cast of governance actors (Newell et al. 2012), *nation-states* and their governments remain key actors in climate governance. They not only engage in international mini- and multilateralism, but also commit to a growing number of unilateral national climate policies (Dubash et al. 2013) or provide support for a rising number of nonstate initiatives (Hickmann 2016)—led, for instance, by business, civil society groups, or individuals (e.g., Partzsch and Ziegler 2011; UNEP 2015). As is prominently illustrated by an encyclical of Pope Francis (2015), religious groups also contribute to the emerging climate governance regime, created globally by a multitude of actors at different scales, in different localities, and on different policy levels (from local to international).

Traditional approaches to climate governance largely abstract from this growing structural diversity, focusing mainly on nation-states as the only relevant actors for governance design. For almost three decades, classical *top-down approaches* have emphasized the global character of the climate change problem and identified international multilateralism, seen as cooperative effort between nation-states, as the central and most appropriate forum for climate governance (Hare et al. 2010). Other, more *decentralist approaches* to climate governance go beyond this idea of top-down centralization, but still keep a strict focus on nation-states in the international arena, emphasizing their individual and often diverging incentive structures (Barrett 2005; Carraro 2003). Building largely on the classical theory of collective action from economic rational-choice theory, those conceptualizations assume nonexistent or weak incentives for international cooperation. Rational, self-interested nation-states are seen to be stuck in a prisoner's dilemma situation, and restructuring incentives to mitigate free-riding incentives via institutional design is known to be difficult (Edenhofer et al. 2015). Even though the diversity of actors and subsidiary policy levels is increasingly being recognized in global politics, the two traditional approaches are still dominant in informing research on governance responses in the field of climate mitigation (IPCC 2014).

Contrary to both these—admittedly stylized—traditional approaches to global climate mitigation governance, a growing body of academic literature reflects the increasing empirical dynamics of climate governance, promoting or analyzing different conceptualizations of its vertical and horizontal forms of differentiation. Some authors diagnose a shift away from the centrality of the UNFCCC to an ongoing “fragmentation” of climate governance. This approach particularly focuses on horizontal differentiation at the international level (Biermann et al. 2009; Zelli and van Asselt 2013). Keohane and Victor

(2011) reject the idea of a single coherent regime for climate change, and stress instead the notion of a “regime complex for climate change,” which “emerged as a result of many choices ... at different times and on different specific issues” (7). Others have analyzed new global actors, mechanisms, and interlinkages (Biermann and Pattberg 2012) or the growth of transnational climate change governance (Abbott 2014; Andonova et al. 2009; Bulkeley et al. 2014). Given this strongly differentiated governance realm, some have claimed that an “anarchic inefficiency” dominates, “featuring a diverse set of players whose roles are largely uncoordinated between each other” (Held and Hervey 2011, 97). More recently, some authors have started elaborating different attempts to actively manage uncoordinated efforts to reduce such potential inefficiencies—for example, through linking or “orchestration” by traditional actors such as international organizations and committed states (Hale and Roger 2014).

Elinor Ostrom dedicated her later work to climate change and suggested readopting “polycentricity” as “a useful analytical approach for understanding and improving efforts to reduce the threat of climate change” (Ostrom 2010b, 552). However, while the term is frequently employed as a metaphor to describe the empirical multitude of actors involved in natural resource, environmental, and climate governance at different scales (a polycentric *structure of existing climate governance*), it often remains unclear which *specific effects* of policies and governance attempts can be captured by deliberately employing the concept of polycentricity in a different sense—that is, as a specific *approach to perceiving, designing, and implementing climate governance*. Specifying the latter understanding of polycentric climate governance might help enhance current and future governance design, leading to a functional question: What are the mechanisms through which a polycentric approach to climate governance might increase the effectiveness of climate mitigation action in terms of emission reductions—especially as compared to the two traditional, nation-state-centered approaches to climate governance design?

Against this background, we here examine what specifically constitutes a “polycentric approach to climate mitigation governance,” in more precise terms than those suggested by Elinor Ostrom’s later writings. Which features and specific underlying mechanisms could make such an approach better suited not only to *understand*, but ultimately to *enhance*, mitigation governance, as Ostrom claimed? To address these questions, we seek to clarify what a discrete polycentric approach to climate governance constitutes, beyond sheer metaphorical and descriptive reference to the increasingly diversified structure of climate governance, with its multiple actors. Because the terminology of polycentricity is used with differing degrees of precision, we look into its historical genesis and attempt to offer a more coherent, systemized application of the terminology and the associated mechanisms for enhancing climate governance in practice. This methodological approach is qualitative in nature, based on conceptual and terminological analysis built on interpretive, and partly genealogical, use of the core literature on polycentricity and climate mitigation

governance. To illustrate the approach, we apply its conceptual insights empirically, and conclude with a tentative assessment of the potential of a polycentric approach to inform and thus ultimately induce more ambitious emission reductions than have been enabled by traditional, nation-state-centered approaches to climate mitigation governance.

Terminological Origins and Developments

In the 1940s and 1950s, Michael Polanyi analyzed “polycentric tasks” in a number of articles (collected in Polanyi 1998), referring to problems of balancing a large number of elements—ranging from mathematically calculable displacements of multiple connected, interdependent dots in a graphical network, up to the noncalculable manageability of complex social tasks. By first calculating the displacements of each center with respect to the others, and then adjusting each actor’s own actions with regard to a specific task in relation to the actions of other relevant actors, an approximate polycentric *order* can be realized (Polanyi 1998, 213). According to Polanyi, even living organisms solve polycentric tasks by “achieving a balance by reacting to the whole range of impulses that reach it from all the ‘centres’” (Polanyi 1998, 217). By evaluating these impulses, each “center” or actor produces a solution to the polycentric task—or “achieves, at any rate, a measure of success in this direction” (Polanyi 1998, 217).

Vincent Ostrom and colleagues (1961) adopted the terminology of polycentricity in the context of metropolitan governance to describe a system “of (1) many autonomous units formally independent of one another, (2) choosing to act in ways that take account of others, (3) through processes of cooperation, competition, conflict, and conflict resolution” (Ostrom 2014, 46). The idea is again that the management of social tasks within a plurality of inter-related units should start from the individual centers when organizing its own actions and relationships with the other units involved in a common task. Vincent Ostrom and his colleagues showed that, for the example of US metropolitan areas, under certain conditions such attempts can generate better community management than the hitherto predominant standard mode of centralized organization.

Tying in with Vincent Ostrom’s early deliberations, the concept of polycentricity was subsequently used to analyze collective-action problems within the Ostroms’ research program at the Workshop in Political Theory and Policy Analysis, started in 1973 at Indiana University (see Aligica and Tarko 2012 for an in-depth analysis of the development of polycentricity research at the workshop). A large-scale program of case and comparative studies of local common-pool resource management was also initiated at the workshop (Ostrom 1990; see also Keohane and Ostrom 1995). In her later work, Elinor Ostrom re-adopted the terminology with regard to climate change (Dietz et al. 2003; Ostrom 2009; Ostrom 2010a; Ostrom 2010b; Ostrom 2012), explicitly identifying

the important lesson of polycentricity research, that “relying entirely on international efforts to solve global climate problems needs to be rethought” (Ostrom 2012, 356). As part of Ostrom’s insights on self-organization for sustainable resource management at the *local* level, she argued in the case of global commons management against the prevalent prediction “that only two state-established institutional arrangements—centralized government and private property—could sustain commons over the long run” (Dietz et al. 2003, 1907). Instead, she referred to a number of local, national, and regional policies and other individual climate-relevant actions, highlighting the potential to create and exploit co-benefits at multiple scales and levels to incentivize climate mitigation. As an institutionalist highlighting the interconnectedness of different societal arenas, Ostrom repeatedly stressed that multilateral policies are necessary, but not sufficient, to address the global collective-action problem of climate change mitigation (Ostrom 2010b, 555; Ostrom 2012, 366). Instead, she emphasized that “a multi-scale approach to the problem of climate change would be more effective and encourage experimentation and learning” (Ostrom 2010a). It would seem unwise to wait until an international agreement had been reached to implement mitigation policies at subglobal levels. At the very least, an international agreement would need to rely on domestic policies and institutions to actually implement emission reductions (Ostrom 2010b, 550).

Some authors have further developed Ostrom’s polycentric account, relating the concept to other research streams and elaborating on different components and applications in the context of climate governance. Focusing on the international level, Galaz et al. (2012) draw on network research to elaborate on polycentricity as a matter of degree to explain the relational character and diverging densities of (policy) networks. Paavola (2012) highlights the role of hybrid and voluntary forms of climate governance as an important part of a wider polycentric governance strategy for climate change, characterized by an increasing institutional diversity at all policy levels. Sovacool (2011) shows, in four case studies of effective climate and energy governance, how individual polycentric components can successfully alleviate collective-action dilemmas. Araral (2014) stresses that a descriptive polycentric perspective on environmental governance recognizes the diversity of potentially useful institutional arrangements better than traditional state-led and market instruments—including the diversity of multilevel, multipurpose, multisectoral, and multifunctional units (see especially p. 14). Abbott (2014) favors horizontal and vertical linkages of transnational climate institutions, while preserving their generally valuable diverse and decentralized polycentric order. Cole (2015) highlights the advantages of a polycentric approach to climate policy, focusing primarily on the pivotal role that higher levels of mutual trust between representatives from major emitting nations can play in fostering mitigation policies. And Jordan et al. (2015) critically discuss promising strands of the literature on new, dynamic forms of climate governance, but call for scientific and political efforts to strengthen the understanding and effectiveness of the rather diverse polycentric patterns.

Characterizing a Polycentric Approach to Climate Governance

The choice of analytical tools for analyzing complex societal structures is critical for considering and prioritizing response actions. While we remain aware of the intellectual proximity of polycentricity research to aspects of specific established social-science theories in different fields (e.g., agency-based rational choice and institutionalist theories), our aim here is not to contextualize it within social-science theory generally, but is limited to the construction of a systematized approach to questions of climate governance design. Building on the terminological background and referred literature, we summarize a stylized polycentric approach to climate governance in terms of *actor focus*, *problem perception*, and the corresponding *governance vision*. Each of these areas differs substantially from traditional approaches to climate governance and helps to inform the different forms of action specified in the following discussion of our approach's main features.

Concerning *actor focus*, in contrast to the focus in traditional approaches on nation-states and their cooperation deficits, a polycentric approach explicitly takes into account the empirical structural diversity of climate governance and broadens the analysis to the governance tasks of multiple self-governing authorities—from small to large scale, from the local to the trans- and international levels, and from general-purpose central governments to highly specialized agencies (Aligica 2003). This expansive actor focus is a key innovation for enhancing climate governance design by incorporating individuals and families, local governments, networks of local governments, nongovernmental and private actors, states or provinces, regions, national governments, and minilateral clubs, as well as international regimes and institutions (Ostrom 2009).

Instead of underlining the cooperation dilemma primarily at the international level, the main *problem* addressed in this approach is the self-organization and ongoing coordinative adaptation of these multiple actors. Although the existence of the general cooperation dilemma is not negated as such, a polycentric approach claims that individual action and cooperation can be realized through a multitude of actors—in their specific contexts and in policy arenas where free-rider incentives are nonexistent, less prevalent, or easier to overcome than has been perceived on the global level.

The governance *vision*, from this perspective, is to create an adaptive system of multiple self-governing units of different scale at different levels, interacting with each other and realizing their site-specific capabilities for a common goal—in this case “climate mitigation,” as represented, for instance, by the internationally agreed-upon target of well below 2° C. In consequence, the focus on governance and policy implementation fundamentally changes relative to mainstream approaches to climate governance design, striving here for different individual and common contributions, mutually coordinated for the creation and maintenance of an adaptive institutional setting. As Galaz et al. (2012) have described, such coordinated attempts can vary in degree: from

loose information-sharing and mutual adjustment, through to increasingly formalized coordination initiatives, including monitoring systems, policy experiments, and perpetual institutionalized mechanisms of problem solving or conflict resolution. To better specify the potential enhancements of an increasingly polycentric approach to climate mitigation governance, we pinpoint what we consider its four main features and their underlying climate governance mechanisms.

Features of a Polycentric Approach to Climate Governance

In addition to a strong basic emphasis on *self-organization*, we identify three further important features of a polycentric approach: an emphasis on *site-specific conditions*, including the need for a precise understanding and consideration of individual actors' preferences and competencies, as well as their interactions; an emphasis on enabling *experimentation and learning*, to facilitate more robust, innovate, and adaptive institutional arrangements, as well as to increase knowledge and norms production; and a strong emphasis on *trust* and accompanying practices to enhance trust-building that can help overcome cooperation dilemmas (Table 1). Whereas these systematized features can be found scattered across publications by Ostrom and colleagues (Dietz et al. 2003; Ostrom 2009; Ostrom 2010a; Ostrom 2010b; Ostrom 2012) with different emphases, we have also drawn on the closely related economic literature on environmental federalism (Dalmazzone 2006; Oates 2001; Shobe and Burtraw 2012) and on other stands of literature to specify the effects and mechanisms that describe applications of these features to potential cooperation enhancement and emission saving. Below we illustrate these features and their accompanying effects and mechanisms with examples and considerations related to climate mitigation.

Self-Organization

Self-organization is a key underlying concept in the polycentric literature. Negatively, this is expressed as a normative claim for the *nondomination* of individual or group actors, and positively, as a suggestion to grant local actors the freedom to *set up their own rules* (e.g., as opposed to rule-making by the central state). Next to the basic, normatively laden reference to autonomy and nondomination, we interpret the underlying consequence for designing climate mitigation policies as being a more functional one: in the spirit of the original meaning of "subsidiarity", it is claimed that social problems are best dealt with at the level most closely related to the problem (not necessarily at the most local level). Given a strong interpretation, this reflects a harsh antirepresentation bias in the Ostromian literature, rejecting hierarchies or forms of aloof expertocracy (see, e.g., Dietz et al. 2003, 1910), and instead stressing the potential for empowering the most immediate and most capable governance units on the basis of careful analyses of site-specific conditions. Applying a polycentric approach to climate governance therefore strives to create ownership by individually

Table 1

Main Features and Respective Functional Specifications of a Polycentric Approach to Enhance Climate Governance

<i>Feature</i>	<i>Functional Specification</i>	<i>For Enhanced Cooperation</i>
Self-Organization	<ul style="list-style-type: none"> • NONDOMINATION of individual groups and actors (normative claim) • OWN RULE SETTING for subsidiary actors (as functional claim) 	Deal with social problems at the level most closely related to the specific problem—e.g., via “subsidiarity.”
Site-Specific Conditions	<ul style="list-style-type: none"> • Heterogeneous PREFERENCES • Heterogeneous COMPETENCIES and CONSTRAINTS • Diversity of INTERACTIONS 	Recognize and incorporate site-specific conditions and interactions—e.g., to mitigate prevalent global collective action dilemma.
Experimentation and Learning	<ul style="list-style-type: none"> • Fostering INNOVATION and flexible ADAPTATION • Fostering NORMS and KNOWLEDGE DIFFUSION 	Facilitate enclosed experimentation and increased mutual learning—e.g., creating linkage in the network-like polycentric structure.
Trust	<ul style="list-style-type: none"> • TRUST as a relevant MEANS to foster cooperation • Accompanying practices to disincentivize free-riding (“trust CATALYSTS”) 	Build mutual trust to enhance cooperation—e.g., by implementing trust catalysts.

implementing measures and enhancing cooperation on climate-relevant issues in all subsidiary jurisdictions—not simply by implementing international norms that might trickle down to subsidiary levels. This is also reminiscent of Young’s (2002) notion of matching the problem and solution structures, or Rayner’s (2010) bottom-up approach, albeit from a polycentric perspective. The literature on voluntary public-goods provision has both shown empirical support for the importance of autonomy and nondomination in promoting this process (motivated by

social preferences) and revealed the potential for crowding out such motivations through (public) policies establishing economic incentives (Bowles and Polanía-Reyes 2012). Therefore, this claim is not only normative, but also has implications for governance efficiency and effectiveness, as we discuss next.

Site-Specific Conditions

Emphasizing the recognition of site-specific conditions translates into a call for the precise analysis of specific actor and situational characteristics. The very heterogeneous site-specific conditions that are relevant in climate mitigation governance create a “polycentric task” for individual actors who introduce measures to achieve the goal of climate mitigation. Instead of abstracting away from these site-specific conditions (as in traditional nation-state-centered approaches to climate governance), understanding and recognizing the specific capabilities of individual actors and their potential to cooperate (where the *global* dilemma situation does not necessarily reemerge) could enhance progress toward the common goal. In particular, such cooperative action could partly dissolve, and thus mitigate, the globally prevalent dilemma on several other levels. Functionally, three specifications follow: understanding and recognizing the heterogeneous preferences of actors (by asking “who wants to do what?”), their heterogeneous competencies and constraints (by asking “who can do what?”), and their interactions. As we illustrate in the following discussion, each specification can claim to be relevant for enhancing climate mitigation.

Different actor *preferences* relevant to the introduction of mitigation measures are influenced by the specific cost-benefit matrices (including co-costs and co-benefits of mitigation actions) of specific actors. Therefore, tailoring climate policies to site-specific preferences not only avoids the potential inefficiencies of uniform nationally or globally introduced regulations, but also acknowledges the existence of differential preference structures (Dalmazzone 2006, 2). A prominent example of a local co-benefit of greenhouse gas (GHG) mitigation with local public good characteristics is combating local air pollution (McCollum et al. 2013). The expansion of renewable industries is an example of private benefits for related actors (Meckling et al. 2015). Both public and private co-benefits of climate policies can foster awareness and elicit mitigation-supportive preferences that can partly counteract free-rider incentives within climate mitigation. In contrast, coalminers, emission-intensive industries, and fossil-resource exporting nations probably link ambitious climate policies with heavy costs in terms of job losses, competitive pressure, and imminent expropriation, and may require targeted compensation or other policies as means to enable ambitious mitigation. Taking such individual preference structures into account in mitigation governance is important for identifying entry points for effective climate policy design (von Stechow et al. 2015).

In addition, mitigation preferences are shaped by factors beyond the sheer site-specific maximization of static utility functions. Historical experiences—for example, the formation of green movements or singular catastrophic events like the 2011 Fukushima Daiichi nuclear disaster—can also motivate changes in preferences (Welsch and Biermann 2014). The locally or regionally diverging preference structures resulting from different conditions and historical experiences can lead to differences in the preferred—and politically feasible—designs of mitigation policies that take these site-specific features into account.

Closely connected to (and impacting on) the individual preference structures, it is also important to consider site-specific *competencies and constraints*, especially with regard to the political, economic, and social dimensions. In the political context, for example, it can be highly relevant if a mitigation policy is introduced within a federal or unitary political system. The possibility of enacting a climate policy might be limited for subfederal state actors, due to constitutional constraints (Setzer 2015), or dependent on consensus rule, as in parts of the EU climate and energy politics (Fischer 2014). Another important constraint on climate policy is the existence of players with veto power who may block a relevant *political arena*—for instance, the US Republicans and their opposition to committing to ambitious US climate mitigation targets at the federal level (Rabe 2010). The existence of other actors in different arenas who are willing to introduce mitigation policies could bypass such a blockade—for example, US states like California, ambitious cities like those organized in the C40, or nonstate actors who advocate climate action or are committed to mitigation goals on their own. If one actor fails or refuses to act on a problem, others can step in within their jurisdiction, sector, or issue area. *Economically*, path dependencies in transport or energy infrastructure play an important role in restricting options and influencing assessments and decisions about the most appropriate technology, transport, or energy policy. Adapting policies to these site-specific constraints, restructuring subsidies and standards, or exploiting site-specific co-benefits (e.g., enhancing public transport or a clean energy supply) can foster policy implementation despite the given constraints. Since authority for planning and permitting the development of physical infrastructure (relevant to mitigation opportunities on the ground) often lies within local or state jurisdictions, recognition of those actors' conditions is crucial (Burtraw and Woerman 2013). *Societally*, some climate policies exhibit strong goal conflicts. For example, there is significant concern that mitigation efforts will hamper attempts to effectively fight poverty. This tension between economic costs and societal benefits is fundamental in climate politics (within as well as between societies, countries, and regions) but is also expressed differently in every specific context (Dubash 2012). Addressing these conflicts in a site-specific approach—for example, by adapting policies so as to achieve multiple policy goals simultaneously—can foster societal support for ambitious climate mitigation (e.g., Jakob et al. 2014).

Understanding and mutually organizing direct *interactions* between the centers in a polycentric climate system will be particularly important for climate governance. This ranges from recognition of institutional integration and the dependencies between different actors (e.g., those within supranational entities such as the European Union; federal states, municipalities, and citizens' initiatives; but also the agencies and organs under the UN umbrella), to the deliberate organization of strategic interactions among actors with different preferences and capabilities (e.g., via transfer and compensation schemes such as climate finance). A polycentric approach to climate governance specifically takes into account these multiple side effects of action that can incentivize or deter the actions of various actors engaged in climate governance. Behavioral changes as well as policies can have adverse as well as beneficial side effects, influencing the behavior of others in ways that can increase or decrease GHG emissions. For example, introducing a regional emission cap can result in emission growth outside the region (*carbon leakage*). Also, in the face of a collective emission cap, subsidiary actors would be unable to achieve additional, unilateral emissions reductions, because this simply frees up emission permits for their use by others, leaving the aggregate emissions as fixed by the cap, unchanged (Burtraw and Woerman 2013; Goulder and Stavins 2011). Recognizing such effects stimulates the search for policy design proposals that will address the effects of such interaction and enable subsidiary jurisdictions to effectively express their preferences. For example, a minimum price in cap-and-trade systems or a carbon tax would enable effective additional emissions reductions by subsidiary actors willing to do so (Williams 2012).

Experimentation and Learning

By taking up the empirical reality of the increasingly interconnected and diversified global climate mitigation governance structure, a polycentric approach emphasizes decentralized experimentation and mutual learning as another central means to deliberately facilitate dynamic governance improvements over time. Further facilitating and actively implementing both independent experimentation and increased exchange and learning can decisively reduce the costs of mitigation and enhance cooperation. This can foster innovation and flexible adaptation in climate mitigation governance overall, as well as the production and diffusion of knowledge and norms.

"Solving collective-action problems is a costly and time-consuming process" (Ostrom, in Aligica 2003, 11). Creating institutions, new technologies, and policies has always had an experimental character. However, while large-scale, top-down experiments can have severe consequences, an increasing number of state and nonstate actors are engaging in policy or technology experiments at a smaller scale and at several policy levels. A polycentric approach to climate governance highlights and deliberately increases the benefits of such interconnected *innovation* processes. Both successful experiments and failures

can foster innovation and create spillover effects in the overall system (Shobe and Burtraw 2012). For example, the German *Energiewende* is not *one single* huge experiment, but an incremental process involving many technological and political experiments. The failures of these experiments, together with the success stories, facilitate innovation and knowledge, policy, and technology transfer, as well as ongoing adaptation of the respective governance designs. As an example, the carbon price drops in the Regional Greenhouse Gas Initiative or the EU Emissions Trading Scheme (ETS) have arguably led to a better understanding of these policy instruments (e.g., Knopf et al. 2014). Today, lessons learned from the EU ETS are helping improve the design of novel ETSs to be adopted elsewhere—for example, in China. A polycentric approach deliberately aims at enhancing this learning curve—for example, by means of orchestration or policy learning. Organizations such as the International Carbon Action Partnership or the World Bank–driven Partnership for Market Readiness focus on fostering such policy diffusion processes related to carbon market design. In a similar vein, renewables technology transfer promotes the implementation of renewable energies around the globe (Steinbacher and Pahle 2016). These explorative and diffusing practices can be driven by state and nonstate actors in various forms so as to foster innovation in several areas, from technology development to the refinement of policies and institutional design (Hoffmann 2011)—all possibly reducing the costs of mitigation. Strengthening and actively implementing these multiple practices from the bottom to the top is of key concern for a polycentric approach and is another distinctive merit, relative to traditional international climate governance approaches.

Closely related, a polycentric approach to climate governance also understands and takes into account the societal relevance of *knowledge and norms* production, evolution, and diffusion. New knowledge can change individual and societal preference structures, and new norms and duties in climate-relevant behavior can arise and diffuse between different groups and actors. Ostrom (2009, 14) repeatedly stressed, for example, the role of individual lifestyle changes, with their potential climate-relevant effects and other accompanying individual and societal co-benefits. Debates within the general public and institutions (such as parliaments), academia, and NGOs (co-)produce knowledge that further catalyzes debate. Such deliberation creates awareness—but also constitutes the precondition for individual and collective genesis of preferences, as well as for preference change (Hulme 2009; WGBU 2011). Deliberately fostering and linking these experimental and diffusion practices is another central virtue of a polycentric approach to climate governance relative to the hitherto dominant focus on intergovernmental processes alone.

Building Trust

Another prominent feature of a polycentric approach, and a recurring element in the Ostromean literature, is the strong emphasis on trust and the accompanying

mechanisms to enhance the building of trust. *Trust* is seen as a very relevant resource for enhancing cooperation (especially for collective-action problems like climate mitigation), which can be built better across personal relationships (especially at lower levels and smaller scales). Instead of abstracting away individual relations as in traditional approaches to global climate governance, where internally homogeneous nation-states or, at most, aggregated societal interest groups are the relevant actors to look at, a polycentric approach emphasizes trust as a product of face-to-face communication and as a means to enhance cooperation—even within international negotiations. Recently, Cole (2015, 15) showed how in a polycentric approach, the enhanced direct communication of individuals positively affects trust levels, which themselves substantially determine levels of cooperation. In addition, a positive experience of cooperation further enhances mutual reputation and trust, resulting in even higher cooperation levels (Cole 2015, 15). Deliberately mainstreaming trust-building in cooperative climate governance design can create benefits both within and beyond international negotiations.

Because trust has to be built up deliberately in relational structures among a limited number of actors, governance structures can only try to provide an environment conducive to trust-building. In this regard, the Ostromian literature (Ostrom 1990; Stern 2011) stresses the importance of face-to-face communication while also offering several practices, such as monitoring or graduated sanctioning, that can be described as “trust catalysts.” Each of these practices facilitates the building of trust, and thus can contribute to deterring free-riding. Some of these catalyst practices already play important roles in traditional multi-lateral governance approaches and the current UNFCCC architecture—for example, the monitoring and compliance procedures for the Kyoto Protocol, or even the submission of Intended Nationally Determined Contributions prior to the 21st COP in Paris and the future review mechanisms envisioned by the Paris Agreement (Aldy 2014; UNFCCC 2015). Within a polycentric approach, trust catalysts should be strengthened across scales and levels. Within the growing realm of transnational climate governance this is already observable: actors such as cities, regions, or businesses also engage in monitoring and commit to voluntary GHG emission reductions—for example, within the Non-State Actor Zone for Climate Action. Monitoring seems to be an established—but rather weak—practice to enhance the development of trust. Other potentially beneficial practices, such as graduated sanctioning mechanisms or institutionalized conflict resolution mechanisms, are not very well established within the existing climate governance architecture—especially due to up-scaling challenges for the global scale (Stern 2011). Applying a polycentric approach to global climate governance also would not enable implementing such practices on a *global* scale. Nevertheless, it should be understood that established local, national, regional, and to some extent international political institutions, as well as fora such as parliaments, bureaucracies, and local administrations, already serve as institutionalized conflict resolution bodies for their specific issue area or jurisdiction. Even if

they do not necessarily focus on climate alone, they are—and should be, within a polycentric approach—important addressees and fora for mitigating different climate-relevant interests and actions.

Limitations and Challenges to a Polycentric Approach

After reviewing and systematizing some major opportunities and mechanisms of a polycentric approach to climate governance, we turn to its limitations and main challenges for application.

First, one of the most important promises suggested by the preceding analysis is that the fundamental dilemma of strong free-riding incentives, which foil effective global mitigation, might be at least in part mitigated. For example, blocked policy arenas may be circumvented; the perceived existence of co-benefits, as well as bargaining and targeted transfers in strategic interactions, create new incentives for mitigation; experimentation and learning foster the diffusion of knowledge and norms facilitating mitigation; and increasing levels of trust can facilitate cooperation. Still, strong free-rider incentives for some actors will very likely continue to exist. Splintering the problem by extending the set of potentially relevant policy arenas opens up corridors to “exploit” the willingness of a diversity of actors to contribute to the policy solution, but site-specific free-riding incentives, leakage effects, and the persistent resistance of opposing actors are likely to prevail. It seems that scholarship applying a polycentric approach might shed light on the possibilities of minimizing the general dilemma, but this approach cannot completely resolve it.

Second, the costs *and* benefits of an increasingly polycentric approach to climate mitigation governance are difficult to estimate—at least compared to the clearer governance benchmarks formulated, for instance, by top-down approaches. Taking into account a broader group of potentially relevant actors who can contribute to the goal of enhanced climate mitigation comes with a high risk of uncoordinated, or even contradictory, policies and actions. At the same time, the benefits of polycentric initiatives are difficult to aggregate and measure. The German Energiewende, for example—introduced by a single state actor apparently against the predictions of standard, rational-choice collective-action theory—could at one level lead to a few megatons of emission savings, which is projected as the cumulative annual emission savings through renewable energy use in Germany. However, taking into account spillover and transfer effects, including a boost to technology development, global knowledge, and norms diffusion, the benefits initiated by this policy experiment might have a much greater combined effect—although the precise magnitude appears impossible to quantify. Applying a polycentric approach to climate governance should not stall because of a simple “the more the better” logic, but should critically enhance methods, first, to account for the potential side effects of individual mitigation measures and cooperative initiatives, as well as to measure their overall costs and impact transparently.

Third, evading veto players who oppose more ambitious climate mitigation, by exploiting the willingness of actors at other levels or in other fora to engage in climate policy to avoid gridlock, might lead to undesirable consequences. Highlighting the potential of sub- and nonstate actors to engage in climate mitigation is a valuable contribution of a polycentric approach, but scholars and practitioners must not disregard the key role of traditional powerful actors with legitimate legal and financial competence, such as sovereign nation-states and intergovernmental organizations. Building trust in several political contexts, sequencing innovative adaptation, and gradually up-scaling the lessons learned might lead to useful complementary action at all levels, but it should especially impact those powerful arenas where gridlock persists, if ambitious climate policy is to be successful. While traditional multilateral approaches to climate governance acknowledge the pivotal role of the nation-state in climate policy, a *pure* emphasis on polycentric differentiation might—from the perspective of ambitious climate mitigation goals—increase the risk of leaving some of the most relevant policy arenas to veto players. For example, California’s engagement as a front runner and driver of climate policies is important for the comprehensive assessment of the overall performance of US climate action, and a polycentric approach better describes and acknowledges these contributions of subnational actors, and the subsequent policy diffusion, than do traditional nation-state-centered perspectives. Still, the US federal level, including its national policies and its role in international negotiations, remains a central policy arena with pivotal legislative and executive functions, a fact that should not get lost in the diffused complexity of a polycentric approach.

Conclusions

So, does a polycentric approach help us *understand* and *enhance* climate governance? In descriptive terms, there is an advantage in being able to account for the increasing number of actors who are relevant to and participate in real-world climate mitigation. Importantly, cognitive models inform action—also with regard to different approaches to climate governance. Acknowledging the increasingly polycentric *structure of* global climate governance is important to better understanding and governing its dynamics. This diversity is not reflected in standard state-centered approaches, which have little to say about these phenomena, leading to poor appreciation of the direct (e.g., emission savings) and indirect (e.g., exploitation of incentives, shifting discourse, and building capacity) contributions that substate actors, nonstate actors, and transnational networks already make. Their action interrelates with, and partly constitutes and affects, the climate pledges and action of traditional nation-state actors. Hence, these diverse other players should be taken into account in both theoretical conceptualizations and policy discourse.

Beyond that, a clear conceptual understanding of the dynamics of climate governance reality enables a deliberate polycentric approach to climate mitigation

governance to “exploit” some of the specific mechanisms identified in this article. Environmental effectiveness might be improved—at least relative to a *purely* inter-governmental multilateral governance approach. This will require the mutual coordination of governance units—for instance, by enabling through tailored policy design a range of actors’ effective expressions of site-specific preferences for climate mitigation under given competencies and constraints; by taking into account the capabilities of national, substate, or nonstate actors to take action, especially where veto players block progress (be this in a policy field, the economic sector, or a societal issue area); by avoiding conflicting policies between policy levels; and by intensifying the mechanisms for experimentation, knowledge transfer, policy diffusion, and trust-building.

As we have discussed, most of these potential enhancements might be challenging to assess in a quantitative, cost-benefit framework. Undoubtedly, *uncoordinated* fragmentation, with counteracting effects of policies and actions, poses a fundamental challenge to the environmental *and* economic performance of a polycentric approach. On the other hand, realization of the site-specific mitigation options of multiple actors, of enhanced coordination, and especially of additional co-benefits will most likely decrease the net costs of achieving a specific level of ambition. Other measures can incentivize further engagement—for instance, with strategic policy design deliberately addressing varying levels of ambition via financial transfers. The development and spread of social norms can raise the (perceived) costs to actors of not taking mitigation measures. Periodic reviews and comparisons across actor types (national contributions, cities, or households) would exploit this mechanism.

As a matter of principle, the implementation of a polycentric approach should be considered *complementary* rather than *antagonistic* to standard approaches, especially to strong multilateralism. There is no persuasive indication that polycentricity as it has been elaborated is equivalent to a strong “local-bottom-up-only” approach. While the actions of networks and of substate and nonstate actors are indeed fostered, and the motivational merits of subsidiary self-organization should not be underestimated, nation-states remain central actors: international multilateralism and regime design will be necessary to address the pervasive cooperation dilemma. Taking advantage of the multitude of individual mitigation contributions, as well as productively organizing the numerous horizontal and vertical interactions, will therefore be critical for realizing and enhancing both environmental *and* cost effectiveness. In this manner, a polycentric approach resonates with other, related contemporary proposals, such as creating links between the UNFCCC and other climate governance initiatives (Betsill et al. 2015), bottom-up efforts (Rayner 2010), or recommendations from the orchestration and building-blocks literature (Hale and Roger 2014).

In sum, a polycentric approach is no silver bullet for realizing collective action and effective mitigation. In this it is like traditional—state-centric top-down or decentralized—approaches to climate governance. The intrinsic difficulty of

abstractly evaluating an increasingly polycentric approach to climate governance means that its general environmental and cost effectiveness should not be overestimated. As Zelli and van Asselt (2013, 7) rightly stress, it is not necessarily true that “the invisible hand of a market of institutions leads to a better distribution of functions and effects ... [than does] a centralized institutional setting.” Nevertheless, our analysis has attempted to illustrate that in the current, highly dynamic transition phase of climate architecture, the changing empirical realities and promising architectural possibilities of an increasingly polycentric system of climate governance must be acknowledged. To echo Polanyi, many actors will have to take up the polycentric task to achieve, at any rate, a measure of collective success.

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