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Climate change policy networks: Why and how to compare them across countries

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ABSTRACT

Why do some countries enact more ambitious climate change policies than others? Macro level economic and political structures, such as the economic weight of fossil fuel industries, play an important role in shaping these policies. So do the national science community and the national culture of science. But the process by which such macro-structural factors translate into political power and national climate change policies can be analyzed through focussing on meso level policy networks. The Comparing Climate Change Policy Networks (COMPON) research project has studied climate change policy networks in twenty countries since 2007. Along with some findings, this paper presents some methodological challenges faced and the solutions developed in the course of the project. After a presentation of the project, we first outline some practical challenges related to conducting cross-national network surveys and solutions to overcome them, and present the solutions adopted during the project. We then turn to challenges related to causal explanation of the national policy differences, and propose Qualitative Comparative Analysis as one solution for combining different levels of analysis (macro and meso) and different data types (quantitative, network and qualitative).

1. Introduction: why study climate change policy networks?

Why have some countries adopted much more ambitious policies to mitigate greenhouse gas emissions than others? The United Nations has strived to create global norms to reduce emissions, but we know surprisingly little about why countries vary so widely in their adherence to these norms. To take just one example of somewhat puzzling national differences, Finland and Sweden have very similar natural environments, standards of living and political systems, but differ greatly in their climate change policies. Sweden's emissions are less than half of Finland's and are trending downwards. Finland is barely living up to its emission reduction commitments to the EU, Sweden has set its own legally binding target to be carbon neutral by 2045 ([1]). What explains these differences?

Different theoretical perspectives offer different answers to this question. Political economists have argued that the economic structures of a country, such as the economic (and, consequently, political) weight of fossil fuel industries, are the primary determinants of its environmental policy [2]. Political scientists emphasize the impact of macro-political polity structures such as degree of democratization [3]. Realist international relations scholars have argued that states only follow global environmental norms to the extent that it is in their national self-interest [4]. Institutionalists argue that the capacity of the national scientific community to certify the validity of anthropogenic climate change, plus the receptivity of the national culture to scientific findings, also help account for the variation in national responses [5].

While all these perspectives obviously have something to contribute to an explanation of the national variation in climate change policy, we argue that each of them also has its drawbacks, which all have to do with focussing on the macro level of analysis. The political economy perspective tends to give excessive weight to economic explanations and assume direct macro-macro causation without much attention to social mechanisms at play at the meso-level. The standard political science perspective is similarly focussed on macro structures. The realist explanation generalizes the idea of self-interested individuals to the macro level. Institutionalist and cultural explanations also focus on national generalizations. To complement the picture, we argue that the study of meso-level policy networks can provide evidence on which of

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these theories is more accurate, or how they combine, in producing national responses. In addition, the pattern of policy-making networks at the meso level may be as important as economic or political factors at the macro level in explaining climate policy outcomes. These can be studied using methods of network analysis.[1]

It may well be true that countries whose economies are more dependent on fossil fuels tend to be less ambitious in their climate change policies than others. While such macro explanations are obviously important, they say nothing about the mechanisms through which the economic weight of the fossil fuel industries results in weak policy outcomes. Consequently, and perhaps even more importantly, they say very little about the prospects of change – other than that a macro level transformation of the entire system is necessary in order to reduce emissions. Research focussing on meso-level policy networks instead sheds light on what organizations exert influence on policymaking, what beliefs they carry, what kind of coalitions these organizations form to push for their agenda, how they are connected to state organizations and how their opponents are organized [6,7]. Identifying these actor constellations makes it possible to assess the prospects of change towards less carbon intensive economic structures.

To give an example, our quantitative analysis of the structure of climate change policy networks in Finland found a strong advocacy coalition consisting of energy intensive industries, trade unions and state organizations, all of which tend to prioritize economic growth over ecological concerns, and a weaker opposing coalition pushing for more ambitious climate change policy [8]. We then conducted further qualitative interviews with key organizations in the network, focussing the questions on potential tensions within the current coalitions (such as rifts between high and low carbon industry organizations) and with emerging new alliances (such as some trade unions joining forces with environmental NGOs) that could lead to transformations in power relations within the network and eventually lead to policy change.

Another example of how macro-level analyses can be complemented by studying meso-level policy networks is our recent study comparing Finnish and Swedish climate policy [1]. A focus on macro-level institutions would classify both countries as corporatist. Corporatist countries have often found to be ambitious in their environmental policies due to their consensualism and inclusive nature [9]. However, climate policy in Sweden is much more ambitious than in Finland. By focusing on meso-level policy networks, we show that in Sweden the climate change policy network is more consensual and more inclusive, whereas in Finland collective bargaining organizations (business peak organizations and trade unions) play a strong role at the expense of environmental NGOs. Thus, even though both countries are corporatist at the macro-level, one factor explaining the differences in their policies are the differences in their meso-level policy networks. Such differences would remain invisible without policy network analysis.

Within the wider research field of sustainability transitions, including energy transitions, the advantage of the policy network perspective is that it directs attention to politics and policymaking. As [59] argue, transition studies have often focussed on the technological or institutional levels, paying relatively little attention to the fact that changes in policies and politics are essential preconditions of most socio-technical transitions (see also Meadowcroft [10]). Coalitions of political actors (such as NGOs, governmental agencies, private businesses) can play a major role overcoming resistance to energy regime changes [11]. Policy network analysis maps the actors and their

relations in a policy subsystem and is therefore a good complement to the studies of socio-technical transitions, where the role of actors and politics has been to some extent neglected.

Analyzing policy networks can, thus, add an important contribution to comparative studies in the fields of sustainability transitions and climate change politics. One of the challenges of such comparative research is that collecting data on policy networks is labor intensive. While macro indicators related to national differences in policy change readily available from sources such as the World Bank, data on meso-level policy networks needs to be collected through means such as surveys. Moreover, selecting the organizations to survey and later analyzing the data greatly benefits from knowledge of each national political context. International research funding schemes that would fund such an effort in a medium N sample of 10+ countries are rare.

One way of overcoming these difficulties, faced by many scholars engaged in the comparative study of energy transitions and climate change, are informal research networks. The idea is that scholars agree on a joint research agenda, establish national teams and apply for funding from national science funders. This paper reflects on the experiences of one such network, COMPON (Comparing Climate Change Policy Networks). Our aim is to outline what we have learned in terms of methodological challenges and solutions, for the benefit of those who wish to engage in similar studies in the field of energy and climate change research in the future (or who are interested in joining the COMPON effort).

The paper proceeds as follows. In Section 2, we briefly present the COMPON project and its achievements to date, focussing on the methodological and organizational challenges and lessons learned. In Section 3, we discuss the practical challenges of conducting cross-national network surveys, including network boundary specification, collecting survey data, selecting the sample and measuring the dependent variable – climate change policy performance. In Section 4, we discuss the challenges related to explaining differences in policy performance, and propose Qualitative Comparative Analysis as one possible solution. In conclusion, we sum up what we have learned so far, and propose directions future research.

2. The COMPON project and its accomplishments to date

The COMPON project was initiated in 2007 by Jeffrey Broadbent and collaborators. Theoretically and methodologically, the project builds on the pioneering work by Knoke et al. [12] on cross-national comparison of policy networks (see Broadbent [5] for the history of development of this approach). Over time, the project has grown to include teams working on twenty countries, mostly located in North America, Europe, and East Asia [13]. The country selection varies from world leaders in ambitious climate policy to the laggards. It includes different world regions and levels of economic development, major emitters as well as minor players, and different polity types from the most pluralist to the most corporatist, as characterized by Lijphart [14]. Medium-N research designs like this one are best suited for analyzing meso-level mechanisms, such as those related to policy networks. This is because they allow for relatively detailed tracing of policy processes and mechanisms within the country cases, as well as generalization based on cross-case comparisons (see Ragin [15]). The design thus goes beyond single case studies that present important findings but do not allow for much generalization. At the same time, the design is a departure from large-N quantitative studies, which are good at cross-case generalization, but pay limited attention to within-case dynamics.

For most cases, the first phase of the project was the media discourse network analysis, which has resulted in most of the published output of COMPON to date. Each case focused on national newspaper outlets, representing a range of more liberal, conservative and economic orientations. While traditional newspaper readership has been declining for many years, largely due to the increasing use and popularity of social media, large "legacy" news outlets continue to serve as important

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[1] "Macro" level phenomena generally refer to phenomena at large scales, such as the societal level. Often this is contrast with the micro level, which are phenomena at the individual or small group level. Meso level is an intervening level, and refers to things like organizational and interorganizational processes. One argument we make is that macro level patterns are sometimes a consequence of decisions and actions by meso-level actors. In the energy sector this might include phenomena such as framing energy issues, campaigns about particular energy policies, or pressure put on governments through interorganizational meetings and forums, and lobbying.

spaces for key actors to engage with each other in publicly visible policy debate. These legacy outlets are also important as agenda-setting media that provide content for social media news consumption [16,17]. Several complementary layers of media analysis were carried out. First, teams looked at changes in the news share of climate change news stories over the period 1997–2010. News share refers to the percentage of all stories published that focus on climate change. Second, a frame analysis approach was used to code climate change stories for the period 2007–2008. This was a peak period of coverage in most cases, which was driven by the constellation of the buzz around the Al Gore movie, *An Inconvenient Truth,* the release of the fourth IPCC Assessment Report, by the Nobel Prize awarded to the IPCC and Al Gore and by preparations for the 2009 Copenhagen UNFCCC conference (COP 15). Content was coded to thematic frames. Coding also focused on the scale of the news narrative, or whether the story primarily concerned climate change debate at the international, national, or subnational level. Third, a more detailed Discourse Network Analysis was carried out for the same peak period. Discourse Network Analysis connects news sources (individuals and organizations) to discursive themes in order to highlight how different actors align with each other through shared agreement or disagreement with key climate change discourses [18,19]. Fourth, and finally, some teams incorporated a layer of more inductive qualitative analysis using NVIVO qualitative analysis software in order to take a closer look at particular issues of interest they wished to examine in greater depth.

A significant body of work has been published that focuses on the media frame analysis or discourse network analysis. This includes single case studies of Greece [20], Portugal [21]; Mexico [22], Germany [23], Canada [24–27], Ireland [28] and South Korea [29] and the United States [30]. This body of work also includes a multi-case comparison on the US, Canada, India and Brazil [58] and another one focused on Asian COMPON cases, including China, India, Japan, South Korea and Taiwan. This analysis shows how UN membership enhances the news share and importance given to the issue of climate change in various societies across Asia, and identifies the unique trajectory of China, which largely ignored the issue until the early 2000s, but where climate change has attained very high media visibility in recent years [31].

A recent article by Broadbent et al. [13] is worth considering in greater depth, as it draws together several key findings from the cross-national comparative analysis of media discourse frames. This article also represents a large-team collaborative effort at co-authoring and sharing results from across the case studies. In terms of news share, the COMPON cases tend to follow similar trajectories with an overall trend of increasing media visibility from 1997 to 2010, punctuated by peaks driven primarily by global political events, such as the launch of IPCC reports or Conference of the Parties (COP) meetings. Overall, media discourse does not easily or simply align with whether a county is a high-emitter or strong performer in terms of climate change mitigation. Rather, the global field of COMPON cases is marked by a complex set of tensions that include the degree to which news discourse reflects the scientific consensus that climate change is real, human-caused and requires political action, and the geographical and political scale of climate change impacts. In general, countries that have managed to reduce their emissions are those where newspaper frames support mitigation policies, accept climate science and are orientated to the global level of climate politics and ecological risks.

The policy network data collection and analysis was the second phase of the COMPON project. The core data for the policy analysis consists of surveys of the 50–100 most influential organizations in the climate change policy domain of each country (for details on the process of selecting these influential organizations to be surveyed see subsection "collecting survey data" below). The questionnaire focuses on inter-organizational networks of collaboration and information flows (including connections to international institutions), as well as beliefs on climate change, including acceptance of the UN-set norms for emission reduction.

As many teams are still working on policy network analysis, much less has been published on this dimension of COMPON, nor has there yet been a large-scale collaborative analysis of the global field comparable to the media analysis carried out by Broadbent et al. [13]. Still, several studies looking at the policy networks in single countries have been published. In South Korea, Yun et al. [32] find a binary political alignment with a weaker environmental coalition and a stronger growth coalition. In the US, Jasny et al. [33] find that the clustering of communication networks among politicians and scientists creates an "echo chamber" effect that reinforces political polarization, contributing policy paralysis at the national level. In Finland, Gronow and Ylä-Anttila [8] find a strong coalition of businesses, governmental organizations, trade unions and political parties that prioritizes economic over ecological values, and has considerable influence on national climate policy.

While COMPON provides an ambitious and productive framework for cross-national comparative research, the scope of the project has also presented unique organizational challenges. Project funding has varied by case, with some teams working through a large NSF grant from the United States, obtained by Broadbent and Fisher, and others working from funding secured in their own countries. Due to the processes and uncertainties involved in grant applications, this has meant that data collection has started at different times for different cases, and with varying degrees of research support. This means that from its inception COMPON has been characterized by: 1) an ambitious geographical and methodological scope that has necessitated methodological exploration, reflexivity, and social learning across teams over the ten-year lifespan of the project; and 2) challenges of moving data collection and analysis forward across many teams working with varying timelines and research resources.

These organizational challenges were addressed through ongoing work on research design across periodic research meetings, often held in conjunction with conferences where members of multiple teams were present. In addition, multi-day research workshops have been held periodically at various teams' home universities. Individual team members have also done extended research visits at other teams' home institutions. Earlier in the project these periods of intensive collaboration led to developing common protocols for the different layers of media analysis and a common core set of policy network survey questions that could be implemented by all teams. This ensured comparability across teams, while also allowing individual teams the flexibility to localize their work on the project by adding additional survey questions, levels of media analysis, or forms of data collection depending on their national context and available resources. This also included developing shared strategies for sampling and constructing media databases, as well as sampling frames for the policy network survey. As the data collection progressed, these intensive workshops and meetings also included drafting shared protocols to address needs for collaborative data storage and sharing, ensuring adherence to sometimes differing research ethics and confidentiality requirements for participants in different societies, and reaching a common understanding for issues like co-authorship. As more teams completed their media and policy network analyses, these intensive periods of in-person collaboration turned to focus on issues like collaborative data cleaning and reviewing data coding to ensure comparability for cross-case analysis. The data cleaning was done in a manner that maximizes the amount of retained data, i.e. when some country teams had added some questions to our common core survey, the data on those questions from that country was kept in the file that combines data from all countries. This choice resulted in a slightly more complicated dataset structure but kept as much data as possible.

Over a period of a decade, these periods of intensive discussion, supplemented by virtual meetings via Skype, have become vital sites for collaborative research design and analysis that has helped address many of the organizational challenges of the project. However, some of the other challenges have been more intractable. This is particularly the

case for the varying timelines of the policy network surveys for the different cases, as policy network actors work within climate change policy fields that are evolving and being shaped by key national events, such as elections and changes of government, as well as international events, such as the release of new IPCC reports, debates and decisions at various Conference of the Parties (COP) meetings. The issue of differing timelines remains a limitation of the informal research network approach that needs to be considered in interpreting and publishing our results.

3. Practical problems of conducting cross-national network surveys and some solutions

3.1. Network boundary specification

We now turn to practical problems faced in designing and implementing network surveys in several countries. We begin with a problem common to all social network analysis, the boundary specification problem [34]. This problem has to do with where the boundaries of the network should be set and it comes down to answering the question: what is the population that one is interested in? This decision essentially determines the size and composition of the sample. In policy network analysis, the goal is usually mapping a whole network – "the set of ties among all pairs of nodes in a given set" ([35], p. 26). It is the constellation of the relations of these actors that is presumed to have an effect on policy. The boundary of the network essentially determines the population under study. The whole network in our case consists of the climate policy subsystem in each case country. When data is collected by surveys, the final dataset will not, obviously, include this entire population due to some members of it not answering the survey. We address the consequences of this fact below in the subsection on response rates.

But which actors are part of this subsystem? This decision determines the boundary of the network [35]. It is common to identify two different approaches in social network analysis for making this decision. In the realist option, the people or organizations under study are allowed to decide for themselves whether they identify with a certain group (which is then analysed as a network). The realist approach has the downside that certain actors, perhaps for strategic reasons, can deny being part of a policy subsystem, even if we have some theoretical criteria which says that they should be included. Thus, it can then be difficult to decide who to listen to in these cases. The other option is the nominalist approach which lets the researcher decide on the inclusion of actors based on pre-existing theoretical criteria[2]. We used a combination of the nominalist and the realist approach. In policy network analysis, a general criterion for whom to include in the network is to target those actors that have a stake or interest in having an effect on the policy conducted within this particular field of policy [36]. These are typically organizational actors, such as governmental ministries, NGO's, business enterprises, and research institutes. We identified these actors in several ways, including nominations by a panel of experts, mentions in printed sources (newspaper articles, organizational charts, trade magazines) and research publications [12]. In the interview stage, interviewees were presented with the resultant roster of organizational names but they could also name additional organizations.

3.2. Collecting the survey data

We present the Finnish survey as an example of how the network

boundary specification was done.[3] To select the organizations to be surveyed, we relied on a combination of literature reviews, expert assessment and media analysis. First, a preliminary list of respondents, representatives of national organizations with a stake in climate change policy in Finland, was compiled based on previous research and knowledge of Finnish climate change policy. The list was then presented to four experts representing different types of organizations. Some changes were made following the suggestions of these experts. Furthermore, in order to make sure that our list did not preclude any important actors, we cross-checked our list with the help of computer-assisted analysis of media data on climate change. The media data consisted of 729 newspaper articles on climate change published between 1997 and 2013 in Helsingin Sanomat, Finland's most widely circulated newspaper. The algorithm listed all proper nouns in this media data and we used it to check whether we had missed any important organizations that had a say in the media. A comparison of our list organizations with this computer-generated list did not lead to any new changes. Using the type of three-step process described above, combining previous research, experts and media reporting, is advisable because it will likely result in a list that includes the most important actors. These are the actors that policy network analysis is usually interested in; marginal actors that do not show up in any of these steps are not likely to have strong effects on policy [37]. A disadvantage of this strategy focussing on the most influential actors is that in cases where actors in the margins of policy networks or newly emerging actors do manage to have influence on policy, these effects may be missed. A strategy we used to mitigate this risk was to complement the organization roster in the survey form with an open list where respondents could add names of organizations we had not included.

Our final list included 96 organizations. This list determined the organizations listed in our questionnaire for the network-related questions. This type of fixed list, or roster, is usually used when one has a sense of the boundaries of the network [38]. All the COMPON surveys had at least three network-related questions and some country teams added extra network-questions. The three core questions asked the respondent to check off from the list organizations that the respondent organization: 1) collaborates with on a long-term basis, 2) thinks of as influential in the climate change policy-making process, and 3) gets scientific information from in relation to climate change policy.

The nodes in our analysis were organizations, but ultimately an individual has to act as the respondent for each organization. The individual respondents that we targeted were either in charge of climate-related issues or environmental policy in general. The survey asked these people to represent the policies and views, or "institutional thinking" ([39], p. 550), of their organization rather than reporting their personal views. This is a standard procedure in policy network research when questionnaires are used for obtaining data [36].

3.3. Response rates

All survey research faces the problem of response rates. There is an additional problem that answering network surveys can be tedious because the respondent has to answer each network question in relation to all the nodes listed in the roster. We tried to maximize the response rate by making the questionnaire relatively short and easy to follow. Three network questions were included and they were presented side by side in the questionnaire with a roster of 96 organizations. A research assistant contacted respondents first by phone and then sent a link to an online survey. When necessary, this was followed up by several emails and phone calls.

The response rate was 83% in Finland and as high as 88% in South

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[2] In addition to realist and nominalist approaches, there is also the snowball method. In this case, the researcher has a pre-existing idea on whom to include in the network but these initial respondents are asked to name additional people (or organizations) that they think are a part of this group. The downside of the snowball method is that if the initial starting point is somehow biased, it will probably show in the end result (see [38]).

[3] One can of course use other methods besides surveys for collecting policy network data, for example, pre-existing archival data or interviews. In what follows we discuss gathering data with a questionnaire.

Korea [32]. However, the same approach was applied in the Swedish case and the response rate was only 70%. In the context of ordinary surveys, all of these rates would be considered high, but the issue of missing data is more pressing for network research because certain nodes may be crucial to the operation of the political subsystem. It is very difficult or even impossible to impute missing network data. A possible solution could be to check whether, for example, governmental organizations have links to certain kinds of organizations on average and then decide on this basis that such links will be imputed for governmental organizations with missing responses.

However, there is no way of making sure that these sorts of imputations are justified (the ties that governmental organizations have might vary). For this reason it is preferable to maximize response rates by sticking to the essential questions and shortening the questionnaire as much as possible. However, if all else fails and one ends up with a low response rate, it is still possible to analyse the ego networks of those respondents that are well represented in the data. It is common, for example that representatives of NGO's are over-represented as respondents, especially compared to business organizations. In such a case, analysing the ego networks of NGO's will still yield results, even though the whole-network perspective is lost.

There are at least two checks that one can use to assess whether and to what extent the obtained survey responses create a bias in representation of the subsystem. First, it is a good idea to count response rates per organizational sector and compare these rates with each other. If, say, 90% of NGO's took the survey but only 10% of business organizations participated, this has to be borne in mind while conducting analysis and reporting results. Second, if the questionnaire includes a question about the actors that are seen as influential by respondents (as ours did), one can check how many of the most influential organizations are missing from the sample.

Our survey data was collected by national teams of the COMPON research network in each country. These teams obtained their own national funding which has mainly been sufficient for collecting data and producing national case papers. National research funding organizations usually operate at the national level and often seek novel topics and encourage new data collection. This practice makes it difficult to fund a national case that fits into a broad international comparison that employs data already collected in other countries. There are growing calls for social research to move beyond "methodological nationalism" towards more cosmopolitan forms of analysis [40]. However, our experience suggests that current structures of research funding and support create practical challenges to moving beyond methodological nationalism.

A practical lesson that we have learned is that even if funding originates in several national sources, it is a good idea to have some people to be officially in charge of coordinating the whole endeavour. In addition, it can be more challenging to collect policy network survey data in some countries than in others – not just for reasons having to do with funding but for practical reasons as well. In India, for example, due to the nature of administrative institutions and cultural assumptions concerning how the administration should operate, obtaining access into governmental ministries proved to be more difficult than in our other case countries.

3.4. Defining the dependent variable

One important challenge for a study that aims to explain differences in the ambitiousness of climate change policy between countries is defining the dependent variable: what exactly constitutes ambitious climate change policy? Our choice for this purpose is the Germanwatch climate change performance index. In the following, we discuss the reasons for this choice, as well as some of its drawbacks and alternatives.

Initially, we considered simply using a measure GHG emissions or emission trends as a measure of climate change policy performance. We quickly learned, however, that while this may be adequate for some studies, there are several reasons not to settle for this solution. First, today's emission levels are a result of long path dependent processes and policy decisions that may have been made for reasons other than the desire to protect the environment. For example, France's low per capita emissions are at least as much the result of building much nuclear power in the 1960's for reasons other than environmental, as they are a result of climate change policy choices made in the last two decades. Recent emission trends would likely be a better option – but they too have been shaped by factors other than climate policies. Furthermore, some policies may take a long time to have effects, and current emissions trends may not yet reflect the ambitious policy path chosen by some countries.

Thus, we are left with the choice between indices combining information on current emissions, emission trends and current policy output. To our knowledge, three such indices exist: The Germanwatch Climate Change Performance Index [41], the Climate Change Cooperation Index [42], and the Index of Climate Policy Activity [43].

Of these, we chose the Germanwatch index because it is the most readily available, published online every year with little time lag, and available for a period of about a decade. The index combines information on climate policy, emission levels, and emission trends [44]. This index, however, has two drawbacks. First, it combines information on different aspects of the phenomenon, some of which are based on the subjective evaluations of experts in each country. A change in the value of the index in a particular country can reflect changes in any one of these component parts and the value or its change does not reveal which part has changed. This information is available online, but incorporating it does make comparison of countries slightly more complicated. Second, the index is not motivated only by scientific interests. Rather, the Germanwatch NGO aims at pushing countries towards more ambitious policies, which is pursued through media coverage of the annual index publication. This use of the index could result in countries being upgraded or downgraded dramatically from one year to another, especially in response to policy events that have received widespread public attention during the past year. To prevent these year-to-year fluctuations in the index placement from having too much effect on research results we decided to use, for most analyses, the five-year average of the index as a dependent variable to smooth out short term fluctuation.

Two alternative indices are the Climate Change Cooperation index and the Index of Climate Policy Activity. The Climate Change Cooperation (CCC) Index developed by Bernauer and Böhmelt [42] is an attempt to assess the climate policy performance of countries by combining measures of policy output and outcome (emission levels). Unlike the Climate Change Performance Index, it measures climate policy developments based on objective factors, such as ratification of treaties, and covers as many as 172 countries. One of the main reasons we use the Germanwatch index instead of the CCC is that the latter only covers the time period from 1996 to 2008 and thus does not reflect the latest developments in climate policy.

The Index of Climate Policy Activity focusses only on policy output. It measures policy density and intensity [43]. These concepts refer to the number of policy instruments and the content of these instruments. Density is often measured by simply counting different policies put in place related to a certain topic (such as climate change). However, mere density does not account for the content of the policies and therefore the Index of Climate Policy Activity also measure the intensity of policies by focusing on the resources that are invested in specific policy instruments. A simple reason for using the Germanwatch index instead of the CPA is that the latter is not yet publicly available. The authors of the index have informed us that publication of the raw data will take place in 2018, which opens up the possibility to redo some analyses using this new index as the dependent variable.

Finally, for some analyses, it is possible to repeat them using several of the dependent variables described above, and focus on those results

that are the most robust regardless of the way in which climate change policy performance is measured. This is the approach taken by Broadbent et al. [13], who look at the relationship between media framing of climate change and three outcome variables using Qualitative Comparative Analysis (see below for more details).

4. Challenges of causal explanation of policy outcomes and some solutions

Once the challenges concerning data collection and definition of the dependent variable have been overcome, we are faced with the challenge of causal explanation of the country-level outcomes. One obvious solution is to use publicly available datasets on country-level variables and conduct multiple regression analyses. Such macro-structural research is obviously necessary, but does not capture the whole picture of the forces that shape national climate change policies. While macro-structural work shines in its ability to produce generalizable knowledge from cross-case comparisons, its ability to unpack the within-case dynamics leading to outcomes is limited. The inevitably limited number of cases when country differences are analysed – there are, after all, less than 200 countries in the world and not all relevant data is available for all of them – has led some scholars to go as far as to question the usefulness of regression analysis in such studies and call for the use of simpler "low-tech" approaches such as basic tabulations or clustering techniques (see Shalev [45] and other contributions to the same symposium).

Another obvious approach would be to stick to case studies such as those we have described above and aim at theoretical generalizations. Limited comparisons of two to four countries in a more traditional comparative politics vein, which selects cases using established approaches such as the method of difference and method of similarity [46], would enhance the ability of such an approach to produce generalizable knowledge.

A third solution is Qualitative Comparative Analysis (QCA) [15,47]. QCA is a medium-N approach aiming at cross-case generalization through set theoretical thinking that retains attention to within-case dynamics. As we have argued above, it is fruitful to see climate change policy outcomes resulting from the combined effects of macro-structural characteristics of societies and meso-level policy network structures. While some of these can be measured in numeric terms, others may be more qualitative conditions of country cases. The advantage of QCA in such situations is that it allows for an "integrative research design for which various kinds of qualitative and quantitative data sources can be used" ([48], p. 49). Numeric scales, as well as qualitative assessments of various aspects of a country case can be converted to fuzzy set membership scores for QCA. QCA then takes a set-theoretical approach to causal inference, looking at the configuration of conditions that lead to a given outcome [15]. In the studies discussed here, the interest lies in configurations that lead to the outcome "a country enacts ambitious climate change policy", as well as configurations that lead to the opposing outcome.

The outcome variable can be derived from the Germanwatch Climate Change Performance Index (see above). The explanatory variables (or causal conditions in QCA terminology) are of two types. The first type are properties of the meso-level policy networks in each country, such as the centrality and influence of international organizations in the national network, the degree of clustering of the network into competing advocacy coalitions, or the relative influence and resources of pro-environment and pro-economy coalitions. The second type are macro-level variables such as measures of the share of fossil fuel industries and energy intensive industries in each national economy, and national public opinion on climate change. Calibrating these into fuzzy set values for QCA involves considerable interpretative work, comparing the cases to assess the degree to which each causal condition is present or absent in each case. Set-theoretical inference is then carried out and truth tables presented, showing which

combinations of conditions are sufficient for the outcome we are interested in ([49], p. 17).

To date the COMPON project has published one QCA analysis ([13], p. 11). This analysis used newspaper framings as its comparative causal conditions (or independent variables) and used four indicators to establish an outcome condition representing intentional policy-driven mitigation–reductions in carbon dioxide emissions. The newspaper framings were accepting science, attention to global ecological impacts, concern with international negotiations, and support for mitigation policies. Positive values on these four frames were hypothesized to be associated with more successful mitigation outcomes. To assess the mitigation outcome, we used four variables: Kyoto Protocol emissions reduction percent, actual percent emissions change from 1990 to the 2008–12 commitment period, percent difference from target (either exceeding or not meeting), and percent attainment of Kyoto Protocol considering emissions credits (created by funding emissions reductions projects in other countries). Over the 17 country cases included, we were able to find a rough trend of correspondence between number of positives on the causal conditions and the emissions reductions.

5. Conclusions: what have we learned

The scope and ambition of the COMPON project, with twenty teams working towards a comparative analysis of climate change policy networks and the related global field of media discourse, has necessitated an exploratory approach to collaborative, multi-case data collection and analysis. This has included large scale research design issues, such as constructing common research questions and strategies for data collection and analysis. It has also included a broad range of technical issues including comparability of response rates, which survey questions have been most salient in different social contexts, and maintaining data comparability while translating research instruments to use in different countries. This has been an emergent process involving ongoing negotiation and social learning from the network of researchers who have contributed to the project. As COMPON reaches its 10-year anniversary, it is an ideal time to engage in methodological reflexivity so that others attempting to embark on similar ambitious initiatives might learn from our process.

At least three productive lines of inquiry could be explored as the COMPON project continues. First, the "global field" constituted by our twenty case studies is very much incomplete and imbalanced, with representation of cases from Europe, East Asia, and North America, but with limited representation from Africa, Latin America, the Middle East, or Southeast Asia. This has partly been the result of the largely ad hoc evolution of COMPON through our research networks and the capacities and interests of the domestic social science research establishments, and partly due to which cases have been supported through research funding. While extending COMPON to new case creates challenges of synthesizing data collected at different points in time, it would be valuable to continue to add new cases to obtain a more complex and holistic understanding of the global field of climate politics. Second, social science research on climate change has typically focused on either the media sphere or the political sphere. There are few examples of analysis of climate politics that adopt a relational approach to synthesizing media discourse analysis and policy network analysis ([50]). COMPON teams have data which would allow this research gap to be addressed and thereby provide significant insight into the social processes whereby visibility, influence, and power flow back and forth between media discourse networks and policy networks. Third, the analysis produced by the COMPON project captures a particular period in the history of climate change policy debate. For many of our case study societies, the social context has shifted in recent years through transitions to new governments with substantially different orientations to the global climate policy regime or the scientific consensus. Furthermore, recent developments such as the Paris COP climate change agreement, the release of the Fifth IPCC Assessment Report, or the

election of Donald Trump in the United States have ripple effects on societies throughout the global field. Future work could also be directed at extending our analysis longitudinally through additional rounds of media and policy network data collection and analysis. Moreover, the use of longitudinal data would allow us to dig much deeper into processes of network formation, distinguishing between social selection and social influence. We would be able to assess, for example, whether organizations choose to collaborate with like-minded or resourceful organizations (social selection) or whether, say, central organizations in the network are able to influence the opinions of others (social influence). This ongoing program of work has significant policy relevance. Increasingly, international scientific bodies like the IPCC are recognizing that the outstanding issues related to climate change are not only technological or scientific, but are largely political and cultural. As such, results from this cross-national comparative research program can feed into IPCC analyses of the social dimensions of climate change. The COMPON approach aligns well with a post-Paris Accord focus on the value of ongoing research that monitors and finds ways to help implement national goals for climate change mitigation.

Finally, COMPON provides a valuable methodological model for social science research on energy more broadly. The social scientific issues associated with climate change and energy are related, as energy production and consumption are intimately bound up with climate change and its potential solutions [51]. Like climate change, addressing the negative social and ecological impacts of energy systems does not only require technological fields of expertise and solutions, but impinges on political, social, and economic spheres [52–55]. Energy transitions are partly determined by political coalitions [11]. Furthermore, the issues and potential solutions related to climate change and energy systems routinely spill out beyond national borders into international spheres of political debate. As such, we need to think creatively about new forms of cross-national or cross-societal analyses that can inform future policy making and action related to energy and climate change. However, there are challenges to undertaking such cross-societal research, as research funding is typically allocated at the national level and single-country case studies are generally easier to carry out. Through our overview of the methodological problems and solutions that have arisen in implementing COMPON, we contribute a methodological framework for cross-national comparative analyses that attends to both the cultural sphere (media discourse networks) and political sphere (policy networks). This framework may be adapted to look at energy systems, such as the persistence of fossil fuel-dominated economies (oil and gas, coal), or the pace and scale of renewable energy transitions across different societies. Just as climate policy responses vary internationally, there are also varying movements towards renewable energy transitions and de-carbonization, or resistance and retrenchment into fossil fuel-based economies. A similar approach to the COMPON model would be applicable for better understanding the interplay of the cultural and political dimensions of energy policy and the transformation of energy systems across different societies.

Acknowledgments

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