

## Climate Policy Ambition: Exploring A Policy Density Perspective

Schaub, Simon; Tosun, Jale; Jordan, Andrew; Enguer, Joan

Veröffentlichungsversion / Published Version

Zeitschriftenartikel / journal article

### Empfohlene Zitierung / Suggested Citation:

Schaub, S., Tosun, J., Jordan, A., & Enguer, J. (2022). Climate Policy Ambition: Exploring A Policy Density Perspective. *Politics and Governance*, 10(3), 226-238. <https://doi.org/10.17645/pag.v10i3.5347>

### Nutzungsbedingungen:

Dieser Text wird unter einer CC BY Lizenz (Namensnennung) zur Verfügung gestellt. Nähere Auskünfte zu den CC-Lizenzen finden Sie hier:

<https://creativecommons.org/licenses/by/4.0/deed.de>

### Terms of use:

This document is made available under a CC BY Licence (Attribution). For more information see:

<https://creativecommons.org/licenses/by/4.0>

Article

## Climate Policy Ambition: Exploring A Policy Density Perspective

Simon Schaub<sup>1</sup>, Jale Tosun<sup>1,2,\*</sup>, Andrew Jordan<sup>3</sup>, and Joan Enguer<sup>1</sup>

<sup>1</sup> Institute of Political Science, Heidelberg University, Germany

<sup>2</sup> Heidelberg Center for the Environment, Heidelberg University, Germany

<sup>3</sup> Tyndall Centre for Climate Change Research, University of East Anglia, UK

\* Corresponding author ([jale.tosun@ipw.uni-heidelberg.de](mailto:jale.tosun@ipw.uni-heidelberg.de))

Submitted: 29 January 2022 | Accepted: 14 April 2022 | Published: 21 September 2022

### Abstract

National policy ambition plays a central role in climate change governance under the Paris Agreement and is now a focus of rapidly emerging literature. In this contribution, we argue that policy ambition can be captured by the level of national policy activity, which in accordance with the existing literature should be referred to as “policy density.” In this study, we measure climate policy density by drawing on three publicly available databases. All three measurements show an upward trend in the adoption of climate policy. However, our empirical comparison also reveals differences between the measurements with regard to the degree of policy expansion and sectoral coverage, which are due to differences in the type of policies in the databases. For the first time, we compare the patterns of policy density within each database (2000–2019) and reveal that while they are different, they are nonetheless potentially complementary. Since the choice of the database and the resulting measurement of policy density ultimately depend on the questions posed by researchers, we conclude by discussing whether some questions are better answered by some measurements than others.

### Keywords

climate policy; policy density; policy instruments; policy outputs

### Issue

This article is part of the issue “Exploring Climate Policy Ambition” edited by Elina Brutschin (International Institute for Applied Systems Analysis) and Marina Andrijevic (International Institute for Applied Systems Analysis).

© 2022 by the author(s); licensee Cogitatio (Lisbon, Portugal). This article is licensed under a Creative Commons Attribution 4.0 International License (CC BY).

### 1. Introduction

Two recent developments in climate politics have moved national climate policies and their “ambition” into the limelight. First, the entry into force of the Paris Agreement in 2015 meant that the nationally determined contributions are defined as the main mechanism for discerning a country’s level of climate ambition. After 2015, state-level actors in general and national governments in particular have played an even more important role in steering climate governance (Jordan & Huitema, 2014a, 2014b; Tobin, 2017).

Second, because of NGOs and social movements such as Fridays for Future, policymakers are under more political pressure to increase the ambition level of national policies (Jordan et al., 2022; Little, 2020). These actors

do not only protest for more ambitious climate action but also resort to other means such as climate change litigation. A particularly prominent case is the lawsuit filed against the oil company Shell by Friends of the Earth Netherlands and six other Dutch NGOs. Likewise, in 2021, Fridays for Future appealed to Germany’s Constitutional Court with the goal of exerting pressure on policymakers to take more ambitious climate action. In both cases, the courts ruled in favour of the plaintiffs and asked for more ambitious national action.

While there is agreement that climate policy refers to policy measures (adopted by the legislature or the executive; e.g., Fankhauser et al., 2016) that aim at limiting or reducing greenhouse gas (GHG) emissions (Iacobuta et al., 2018; MacNeil, 2021), somewhat surprisingly, academics and practitioners lack a shared understanding

of what “climate policy ambition” means. From a conceptual viewpoint, many policy analysts would equate the “level of ambition” with the “stringency” (Knill et al., 2012) of the policy measures adopted. In the case of climate policy, this means an assessment of how rapidly and/or firmly they are expected to facilitate GHG reductions (Schaffrin et al., 2015; Tobin, 2017).

However, it is widely acknowledged that gathering such data is difficult in practical terms, especially when it covers many countries and extends over long periods of time. So, what alternatives exist to measure climate policy ambition? A proposal put forth by Knill et al. (2012) and adopted in the literature on climate policy (see, e.g., Eskander & Fankhauser, 2020; Le Quéré et al., 2020; Schaffrin et al., 2015) is to equate ambition with “policy density” (that is, the number of policies or policy instruments). In this article, we suggest that measurements based on the notion of policy density can be constructed based on existing databases that include information on policies and/or policy instruments.

In the remainder of this article, we concentrate on three of the most well-known and authoritative extant databases: the Climate Change Laws of the World database (CCLW), produced by the Grantham Research Institute on Climate Change and the Environment at the London School of Economics and Political Science (Townshend et al., 2011b); the Climate Policy Database (CPD) published by the NewClimate Institute (2022); and the Policies and Measures Database (PMD), provided by the International Energy Agency (IEA) and the International Renewable Energy Agency (IRENA). The overall question we aim to explore is: How complementary are the different density measurements that can be derived from the different datasets? In the sections that follow, we first clarify how each database conceives of “policy,” then identify the data in each that is most relevant to “density,” and extract that data from each database. Then we explore what patterns are revealed for the period 2000–2019. The final section concludes and identifies future research needs.

## 2. Climate Policy Ambition: A Density Approach

In our understanding, climate policy ambition does not refer to individual policy instruments such as emission reduction regulations but to “bundles” or “portfolios” of policy goals, laws, and policy instruments as the research on policy design has highlighted (see Howlett & Mukherjee, 2014). One way to make sense of these bundles is to relate them to the concepts of policy density and policy stringency as put forth by Knill et al. (2012). Conceptually, policy density captures the policy activity level and internal differentiation of a policy field in terms of the policy instruments it comprises. To operationalize this concept, Knill et al. (2012) rely on the number of policies or instruments.

By contrast, policy stringency captures the degree to which the policy instruments adopted require target

groups to change their behaviour. For example, providing subsidies for electric vehicles constrains the individuals’ behaviour to a lesser degree than making the purchase of electric vehicles mandatory. The second dimension of policy stringency refers to the scope of a policy. To come back to the previous example, governments could make the purchase of electric vehicles mandatory in all cases or only for a subset such as brand-new ones. In the first case, the policy instrument would be stricter than in the latter. This coding was applied to climate policy by Schaffrin et al. (2015), for example. Another approach to assess climate policies’ stringency is to evaluate to what degree they contain durability and flexibility devices, which prevent policies from being dismantled and simultaneously enable adjustments in case of changes in circumstances (Jordan & Moore, 2022).

With both policy density and stringency, information on all relevant policies and policy instruments can then be used to construct aggregate-level measurements of policy ambition. The measurements can be constructed to capture the number of policy instruments at one point in time or an accumulated number. The latter corresponds to a measurement of the total policy stock as it changes over a given period of time.

Policy density and policy stringency are interrelated measurements (Schaffrin et al., 2015). Policy stringency cannot be assessed if no policies or policy instruments are adopted. From this perspective, in comparison to policy density, policy stringency provides a more granular measurement of climate policy ambition. However, a key issue—which has both significant theoretical and empirical implications—is whether such granularity is always absolutely necessary given the relative difficulty of collecting reliable data.

In this article, we concentrate on climate policy density as one way of measuring climate policy ambition. A government’s willingness to address climate change is reflected by policy activity. Thus, in our understanding, the higher the policy density (i.e., the greater the number of policy measures in place) the higher the level of climate ambition.

Clearly, policy density is an indicator of climate ambition. Depending on the operationalization approach and the databases used, we could obtain different empirical measures of climate policy ambition, which could lead to different conclusions when used for analytical purposes or deriving policy prescriptions. Therefore, in this article we provide a comparative assessment of the patterns of policy density revealed by different databases.

## 3. Climate Policy Databases

In this section, we summarise three popular climate policy databases. Furthermore, we compare the empirical data contained within each in order to set the stage for the construction of our policy density measurements.

### 3.1. *The Climate Change Laws of the World Database*

The CCLW database comprises national-level climate change acts from 1947 until 2021 for 197 countries plus the European Union. As of 2020, the database included 1,801 laws on climate change mitigation. The collection of climate legislation originates from a collaboration between the Grantham Research Institute on Climate Change and the Environment and GLOBE International with the aim to help legislators transform a set of agreed legislative principles on climate change into nationally appropriate legislation (Townshend et al., 2011a). Different authors have used it to evaluate global progress in adopting climate policies (Averchenkova & Bassi, 2016; Dubash et al., 2013; Iacobuta et al., 2018; Mehryar & Surminski, 2021; N. M. Schmidt & Fleig, 2018; Townshend et al., 2011b, 2013), to understand the political economy of passing climate laws (Eskander & Fankhauser, 2020; Fankhauser et al., 2016) and/or to identify good practice in climate change governance (Averchenkova et al., 2017).

The CCLW database collects climate laws mostly from official sources such as government websites, parliamentary records, and court documents with the aim of being as comprehensive as possible (Grantham Research Institute on Climate Change and the Environment, 2022). The selection of policies is limited to legal documents adopted by decision-making bodies. This coding decision has the advantage that the database comprises climate policy outputs only. From a methodological viewpoint, this entails that the individual data points are homogenous and therefore comparable across countries and over time. Therefore, this dataset lends itself to assessing both policy dynamics and global patterns of climate policy.

A limitation is that it covers only climate laws which are still in force. Although the database was recently modified to provide the history of law—including its amendments—repealed laws are excluded (Eskander & Fankhauser, 2020; Grantham Research Institute on Climate Change and the Environment, 2022). In fact, this particular coding decision has an important consequence for the temporal dynamics of the data provided by the CCLW database since it only captures the expansion of climate policy but not its dismantling, which is, however, a potentially important form of policy change (Burns & Tobin, 2020; Jordan et al., 2013).

### 3.2. *The Climate Policy Database*

The CPD comprises data on national climate change mitigation policy and is collected by the NewClimate Institute, supported by PBL Netherlands Environmental Assessment Agency and Wageningen University and Research (NewClimate Institute, 2022). The database was originally compiled to track policy adoption and detect gaps in climate policy (Nascimento et al., 2022). Several authors have used it to analyze patterns of climate policy adoption (Iacobuta et al., 2018) and the

impact of mitigation policies on GHG emissions (Fekete et al., 2021; Giarola et al., 2021; Roelfsema et al., 2018, 2020).

The database is composed of data retrieved from a large number of sources, including Climate Watch, the IEA/IRENA Policy Database, and the CCLW (NewClimate Institute, 2022). The latest release was published in 2020 and includes 4,924 mitigation policies for 196 countries covering an observation period from 1927 to 2020 (i.e., nearly three times as many policies compared to the CCLW in the same observation period). The data is most complete for the G20 countries (NewClimate Institute, 2022), which one could see as a limitation, at least at first glance. However, the G20 countries account for the lion's share of global GHG emissions and, therefore, giving priority to this group is plausible.

Although there is still a large share of missing years for repealed policies, the database, by construction, provides information on the year of adoption as well as the year in which a policy measure ended. The latter is particularly important for investment programs and financial instruments that typically run for a fixed period of time. This not only facilitates measuring policy density comprehensively over time but also gauging the extent of policy dismantling (and therefore a reduction in policy density).

One major limitation is that it does not further define what types of policy it includes. Therefore, it is not possible to differentiate between binding laws or non-binding acts without additionally coding manually the information provided by the corresponding short description (Iacobuta et al., 2018).

### 3.3. *The Policies and Measures Database*

The PMD brings together a collection of mostly energy-related climate policy measures. It is assembled and maintained by the IEA and the IRENA (IEA, 2022). The database as it exists today is the result of a long-standing collection effort dating back to 1999, drawn from various other databases and information provided by national governments and partner organizations and analyses carried out by the IEA and IRENA. The data included in the database is periodically reviewed by the national governments (IEA, 2022). The database was originally developed to provide policy data for scenario analyses in the *World Energy Outlook*, the IEA's flagship publication (IEA, 2021). Today, it offers an established data source for studies focusing on decarbonization-related policy measures (Le Quéré et al., 2019; Wang & Chen, 2019). It has also been used to address more specific research questions such as the outcomes of renewable energy incentives (Bölük & Kaplan, 2022), the clean energy transition (Müller et al., 2021), and the diffusion of renewable energy policies (Baldwin et al., 2019). The data coverage of the PMD is similar to that of the CPD since it also comprises both binding formal laws and additional policy measures and programs of which some are also of a voluntary character.

The main advantage of the PMD is that it provides the most homogenous set of climate policy measures because of its focus on the energy sector. In addition, it provides detailed information on the type of instruments comprising a given policy, which allows a more fine-grained evaluation of policy instrument mixes.

A limitation compared to the other databases is that the PMD comprises information on mitigation policies only. Furthermore, while the database provides information on the current status of a policy measure (i.e., whether it is still in force or not), it does not list the year in which a policy ended, which also hampers the empirical assessment of policy dismantling.

### 3.4. The Climate Policy Databases: A Comparison

Table 1 gives an overview of the three databases, which can be used to construct different kinds of policy indicators. We contend that all are suitable for constructing a density-based indicator of climate policy ambition. However, of the three, only the CPD contains information on the year in which a policy measure was dismantled. It is important to have access to an additional database that includes this information because the CCLW and the PMD do not allow for identifying when a given policy was terminated. By checking the correlation between the three climate policy density indicators, we will be able to determine to what extent the operationalization approach of the CCLW and PMD could result in overestimating the level of climate policy ambition.

In addition to the points discussed above, Table 1 reveals that the coverage of sectors varies across the databases as does the coverage of policy instruments; both are of interest when constructing a density-based measurement. The CCLW differentiates between the greatest number of sectors, whereas the CPD offers the most granular coding of climate policy measures. The PMD differs in that it explicitly focuses on the energy sector coverage.

## 4. A Comparison of Policy Density Derived From the Databases

To construct the density measurements, we cumulate the number of policies countries adopted in a given year over time. Our sample comprises 44 countries that are members of the Organization for Economic Cooperation and Development (OECD) together with Brazil, Russia, India, Indonesia, China, and South Africa. We chose the OECD countries as a comparatively homogeneous group of industrialized countries with large CO<sub>2</sub> emissions and for which there is good data availability. Brazil, Russia, India, Indonesia, China, and South Africa have been added to incorporate countries with rising CO<sub>2</sub> emissions. We compare our policy density measurements for the time period from 2000 to 2019. The first measurement of policy density in 2000 includes the number of policies adopted between 1927 (the first year the databases

report a climate policy) and 1999 to incorporate previous policy activity. The measurements constructed based on the CCLW and the PMD are limited to policy expansion as these databases do not provide information on the year policies stopped being in force. The measurement based on the CPD also includes information on policies dismantled during the observation period, i.e., policies repealed in a year  $t$  are removed from the density measurement in year  $t + 1$ .

### 4.1. General Measurements of Climate Policy Density

Together, the measurements are based on yearly data for the 44 countries, which equals 880 observations and corresponds to the  $N$  reported in Table 2. The descriptive statistics suggest that major differences exist between the CCLW on the one hand and the CPD and the PMD on the other. In particular, the larger values for the mean and median for the CPD and the PMD measurements indicate that a greater number of climate policies are covered by the latter two databases. This can be explained by the CCLW's focus on formal policymaking and its outputs. Unlike the other two databases, it covers only entire climate laws, not single policy instruments and programmes. The US has the highest density scores in 2019 based on the CPD and the PMD (equalling 366 and 245, respectively), whereas the score is highest for Spain in 2019 based on the CCLW (equalling 33). When comparing the CPD and the PMD, the two times larger median values for the PMD are striking in comparison to nearly equal means, which points towards a strong presence of outliers in the CPD.

Figure 1 illustrates the values of the three policy density measures and shows how they changed between 2000 and 2019. Figure S1 in the Supplementary File offers insights into the mean policy density. Figures S3 to S13 present the density measurements for each country. The median number of policies has increased steadily for all three measurements despite having started with different absolute levels in 2000. The CPD derived measurement shows a sharp increase in 2009, but the measurements constructed by using the CPD and the PMD data are more similar concerning their slope as well as in relation to their distribution over time. The density measurement based on the CCLW data produces a curve that is much flatter than for the previous two.

Despite the similarities between the CPD and the PMD data, the differences may arise from the fact that the CPD-derived measurement incorporates repealed policies. To assess to what extent this explanation may account for the curve of the CPD measurement it appears useful to compare the number of adopted and dismantled policies per year.

As Figure 2 reveals, the number of new policies adopted exceeds the number of repealed policies, and this holds true across the entire observation period. Nevertheless, this finding must be read with caution since the CPD provides the years in which policies were

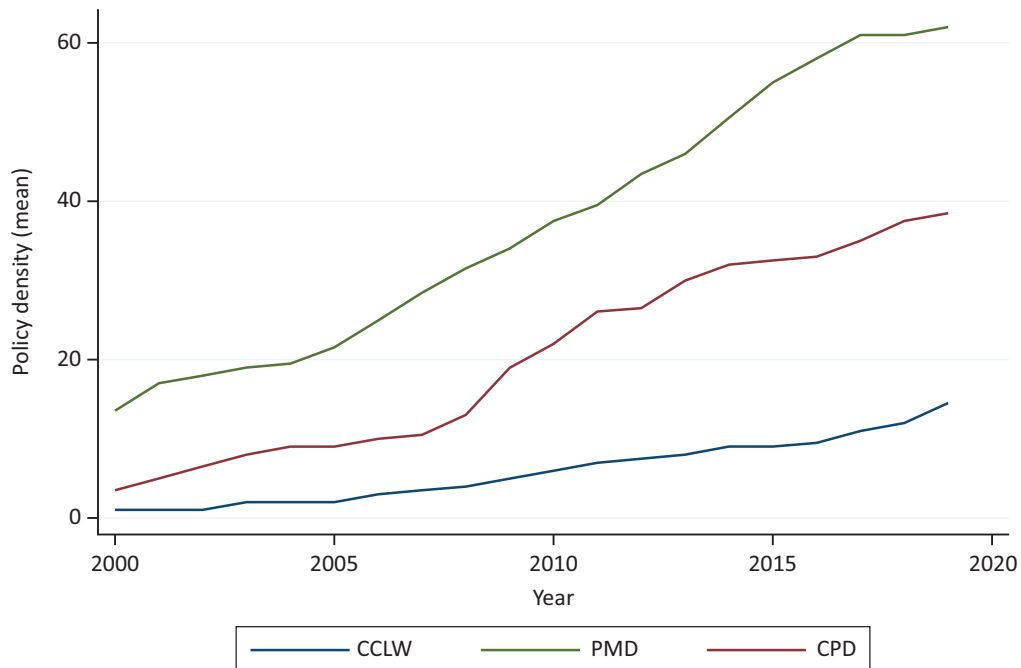
**Table 1.** Overview of the three databases.

Database	CCLW	CPD	IEA PMD
Overview	Climate-change related laws collected from official sources, such as government websites, parliamentary records, and court documents	Climate policies compiled from official sources and several other climate policy databases	Mostly energy-related climate policies and measures, compiled from data supplied by member governments, partner organizations, and IEA's own analysis; Governments may review the database periodically
Countries studied	197, including the European Union as a cluster	196	195
Scope	All national-level legislation and executive orders on climate change mitigation, adaptation, damage, and loss or disaster risk management	Climate change policies adopted by the end of 2020 by the G20 economies and non-comprehensive policy data for the rest of the countries. Also provides non-comprehensive data on the subnational level	Government outputs to reduce GHG emissions, improve energy efficiency, and support the development and deployment of renewables and other clean energy technologies, at national, state/provincial, city/municipal, and international levels
Time period	Date of adoption and date of amendment	Date of adoption, date of amendment, and end date of implementation	Year entered into force
Policy objective	Mitigation and adaptation	Mitigation and adaptation	Mitigation
Sectoral coverage	Agriculture; Land Use, Land-Use Change and Forestry (LULUCF); Buildings, Residential and Commercial; Energy; Health; Industry; Public Sector; Transport; Waste; Water; Economy-wide	Agriculture and Forestry; Buildings; Electricity and Heat; Industry; Transport; General (Economy-wide)	Agriculture; Buildings; Electricity and Heat; Industry own use; Manufacturing; Transport; Economy-wide; (based on authors' own aggregation of categories)
Policy instruments	Direct investment; Economic; Governance; Information; Regulation	Barrier removal; Climate strategy; Economy instruments; Information and Education; Policy support; Regulatory instruments; Research and Development Deployment; Target; Voluntary approaches	Climate strategy; Economic instruments; Regulatory instruments; Information and Education; Voluntary instruments; (based on authors' own aggregation of categories)
Data maintenance	Updated in real-time	Updated periodically; yearly static databases provided since 2019	Updated periodically
Host/Owner	Grantham Research Institute on Climate Change and the Environment (2022)	NewClimate Institute (2022)	IEA (2022)

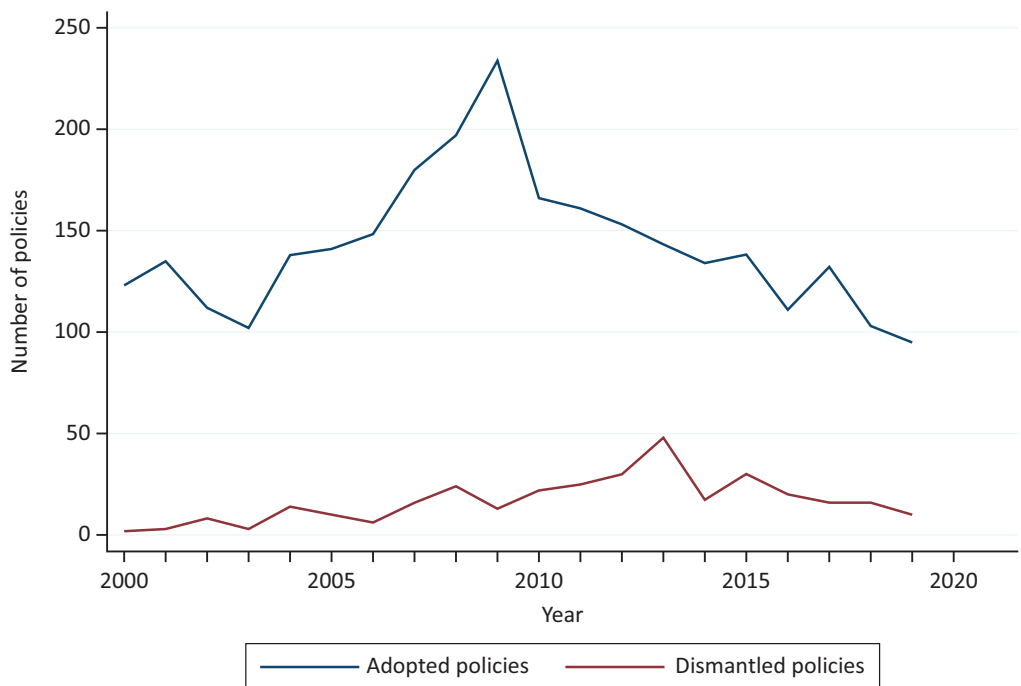
**Table 2.** Descriptive statistics on policy density measurements.

	<i>N</i>	Mean	Median	<i>SD</i>	<i>CV</i>	Min	Max
CCLW	880	6.43	5	5.84	0.91	0	33
CPD	880	40.80	15	56.57	1.39	0	366
IEA PMD	880	44.85	33	43.09	0.96	0	245





**Figure 1.** Comparison of median policy density over time.



**Figure 2.** The number of policies adopted and dismantled per annum (2000–2019) based on the CPD.

repealed for only half of the cases, which means that for 530 out of 881 policies, which have been repealed or superseded, the end date is unknown.

When inspecting the same data broken down for individual countries (Figures S14 to S24 in the Supplementary File), we can see that policy dismantling is more frequent in some countries than in others. Australia is one of the countries that stands out as being especially prone to dismantle climate policies, which has

already been discussed in the existing literature and explained in terms of changes in the ideological composition of different governments (see, e.g., Crowley, 2013).

Overall, the three policy density measures correlate. Pearson’s  $r$  is greatest when correlating measurements based on the CPD and the PMD with each other ( $r = 0.841$ ). The high correlation coefficient indicates that the data used for constructing these two density measurements are quite similar. When correlating the

measurement based on the CCLW data with that based on the CPD, we obtain a moderate correlation coefficient ( $r = 0.410$ ), and the same goes for the correlation with the measurement based on the PMD data ( $r = 0.486$ ).

The correlations are lower when we compute them separately for each year (see Table 3). This is worth reporting because of the way the density measurements are constructed, i.e., as cumulative counts, which are likely to be affected by time trends. Therefore, when removing the time trend, the correlation coefficients become much smaller when comparing the CCLW with the other two databases. In fact, the associations are quite weak with coefficients mostly below 0.3 and not statistically significant for many years. However, these measurements become more similar over time with slightly increasing coefficients. On the other hand, density measures based on the CPD and PMD remain highly correlated and statistically significant when comparing them separately for each year.

Another noteworthy observation is that differences between the policy density measures vary between countries, as shown in Figures S3 to S13 in the Supplementary File. To give an example, density measures based on the CPD and PMD in Spain mostly overlap and deviate from the one based on the CCLW. However, when looking at Finland, the density measures based on the CPD and CCLW are very similar and deviate from the density measurement based on the PMD. The question arises whether this is due to inconsistencies within the databases or whether countries actually differ in the types of policies they adopt.

To conclude, our analysis shows major differences in policy density between the CCLW on the one hand, and the CPD and the PMD on the other. Using the former or the latter may either lead to under- or to over-estimating the level of climate policy ambition. Therefore, we suggest that cross-checking measurements could be important to assess the validity of the data.

#### 4.2. Sector-Specific Measurements of Climate Policy Density

In this section, we provide sector-specific measurements of climate policy density. We consider this an important aspect since climate policy has predominantly been associated with energy policy. However, policymakers have begun to think of decarbonisation (and hence climate policy) in much broader terms (Jordan et al., 2022) and to adopt measures that target all sectors, including agriculture and transport.

As highlighted in Table 1, the three databases categorize climate policy sectors in different ways. In the case of the PMD, there is no clear categorization of climate policies. Therefore, we assigned policies to a sectoral categorization used by the IEA to differentiate between different sources of GHG emissions based on the information provided by the database.

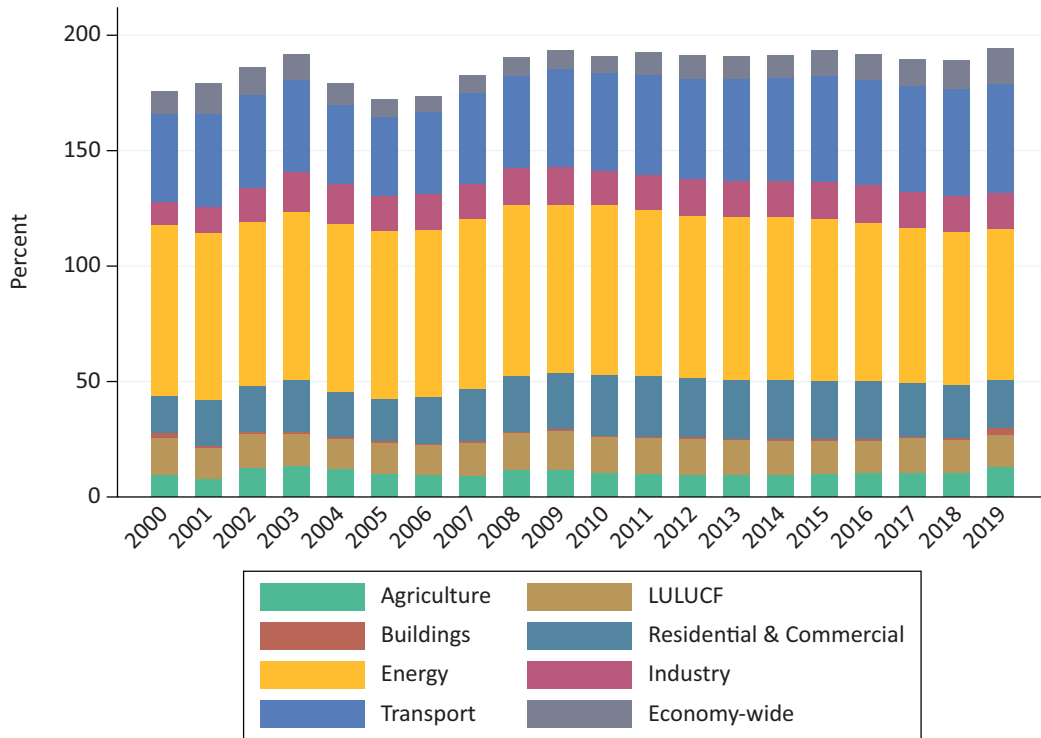
Figure 3 gives an overview of the policy density for each sector. For instance, 10% of all mitigation policies included in the CCLW in the year 2000 targeted the agriculture sector (on this more specifically, see N. M. Schmidt, 2020). The largest share of policies in the

**Table 3.** Correlation between policy density measures.

Year	CCLW and CPD	CCLW and PMD	CPD and PMD
2000	0.153	0.167	0.806***
2001	0.158	0.143	0.809***
2002	0.195	0.203	0.825***
2003	0.160	0.177	0.831***
2004	0.120	0.114	0.846***
2005	0.191	0.123	0.848***
2006	0.161	0.077	0.859***
2007	0.268*	0.189	0.863***
2008	0.300**	0.190	0.875***
2009	0.301**	0.179	0.884***
2010	0.302**	0.239	0.874***
2011	0.315**	0.280*	0.871***
2012	0.285*	0.244	0.864***
2013	0.255*	0.204	0.851***
2014	0.262*	0.218	0.838***
2015	0.316**	0.269*	0.823***
2016	0.341**	0.289*	0.819***
2017	0.327**	0.257*	0.803***
2018	0.357**	0.261*	0.791***
2019	0.333**	0.266*	0.784***
2000–2019	0.401***	0.486***	0.837***

Notes: Reported values are Pearson's  $r$  correlation coefficients; level of statistical significance: \*  $p < 0.1$ , \*\*  $p < 0.05$ , and \*\*\*  $p < 0.01$ .



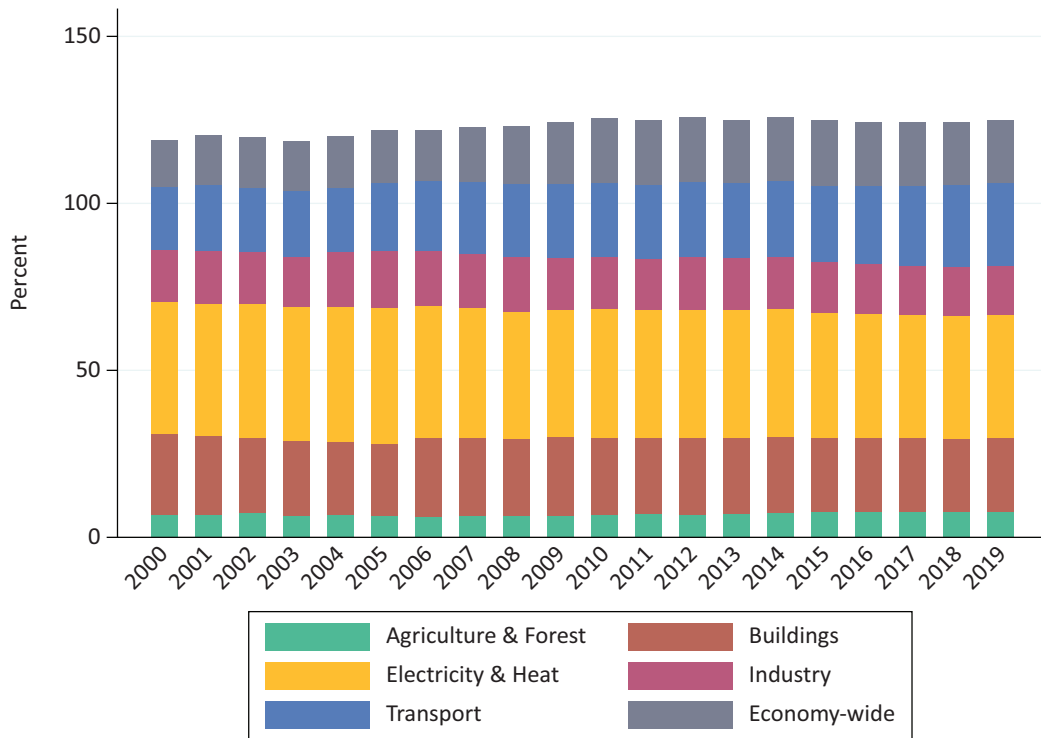


**Figure 3.** The policy density of different sectors based on the CCLW.

CCLW database targets the energy sector, followed by transport and energy efficiency. A noteworthy observation is that the sum of relative frequencies of policies exceeds 100% when taking together all sectors. This is due to the CCLW’s focus on entire climate laws, which

are mostly overarching in nature and address multiple policy sectors.

The coverage of policy sectors by the CPD is similar to that of the CCLW database as shown in Figure 4. Most policies address electricity and heat generation,



**Figure 4.** The policy density of different sectors based on the CPD.

followed by energy efficiency, transport, and industry. Only the share of policies addressing agriculture and forest is significantly smaller in comparison to the CCLW database. Noteworthy is the smaller sum of relative frequencies across sectors, pointing to a larger number of policies targeting only one specific sector. This observation is straightforward to explain since the CCLW database codes climate laws whereas the coding units of the CPD are climate policy instruments, which also explain the higher number of absolute counts with the CPD data as compared to the CCLW data.

When examining policy density across different sectors, the PMD’s central focus on energy-relevant climate mitigation policies becomes even more apparent. Figure 5 shows that the largest proportion of policies included in this database address energy efficiency, followed by electricity and heat, policies related to energy use in the energy industry, transport, and manufacturing. Policies on agriculture and forestry are mostly missing from the PMD. Of all the databases, the PMD is the narrowest in terms of sector coverage, although it is the most comprehensive with regard to the policy measures included. However, considering that climate policy is still dominated by energy policy, the focus of the PMD is nevertheless appropriate.

Overall, Figures 3 to 5 reveal that the sectoral composition of climate policy density has remained stable in the last two decades. The three measurements complement each other because of the differing categorizations they use for assigning climate policy to sectors. The PMD provides a nuanced picture of energy policy, whereas the

other two databases provide insights covering a larger number of sectors.

5. Conclusion

In this explorative study we have presented three extant databases that can be used to construct measurements of climate policy density, which we regard as an important dimension of climate policy ambition. Departing from this overarching argument, we drew on the databases to construct three density-based measurements and compared them. We have shown that all measurements reveal an upward trend with regard to the adoption of climate policy, but that there exist differences in the degree to which the databases aggregated this information. The CCLW database offered the information at the highest level of aggregation and the PMD at the lowest.

From this, we conclude that the empirical information provided by the measurements can be used for different types of research questions perhaps derived from different theories. What we have also shown is that the data included in the datasets are correlated, which suggests that they capture similar concepts. From this, it follows that the three datasets can be used simultaneously in order to check the robustness of analytical findings.

Compared to measuring climate policy ambition by concentrating on the stringency of climate policies, density-based measurements can be more easily constructed from existing databases. However, this does not mean that the conceptualization of climate policy

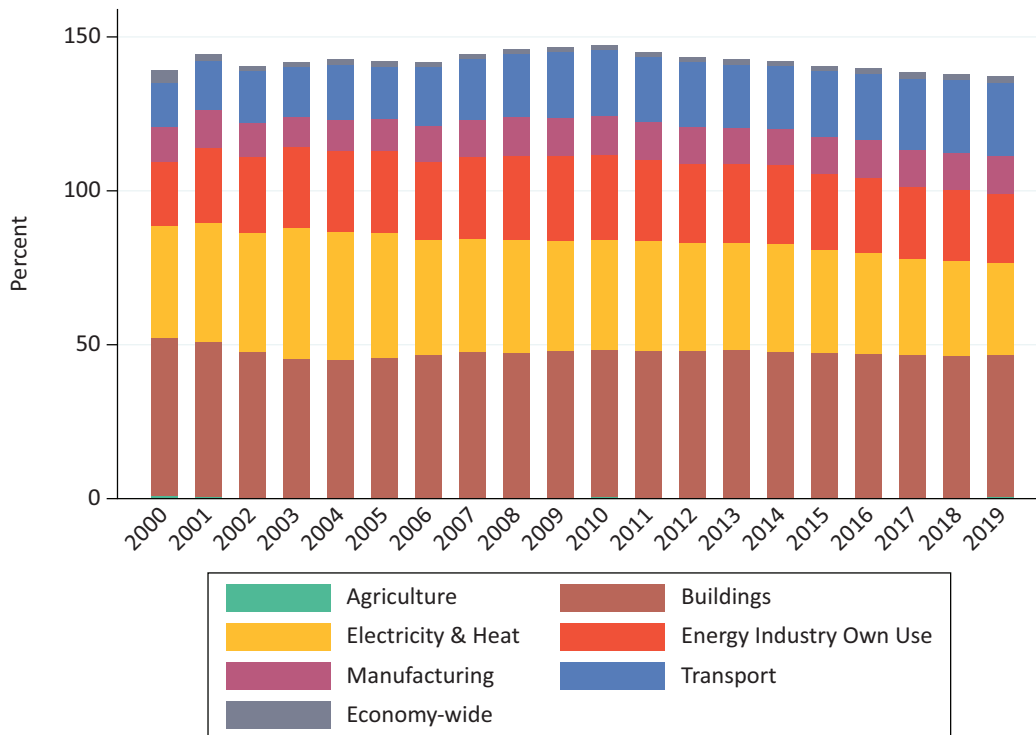


Figure 5. The policy density of different sectors based on the PMD.

ambition as the density of policies or the concrete operationalizations discussed here do not suffer from any limitations or weaknesses. Conceptually, policy density does not capture whether the individual climate policy measures adopted add up to a coherent, consistent, or congruent approach. It is possible that among the set of policies adopted, some involve trade-offs. This is an aspect that deserves enhanced attention when developing the concept of policy density further. In terms of operationalization, one of the main issues with the databases presented here is that we do not have information on how long a given policy measure has been in place. The CPD is the sole exception here, but even it does not provide full information. From this, it follows that there is a need—especially since the ratification of the Paris Agreement—to invest more, both financially but also in terms of collaborative effort, in developing accessible, integrated, and comprehensive databases that capture fully the reality of climate policy ambition.

In a final step, we now allude to some promising new research ideas, discussing each of the databases and their corresponding density measurements in turn.

The measurement based on the CCLW database focuses conceptually on formal policymaking and its outputs. Consequently, it is particularly suitable for assessing how policy and politics matter for climate policy. The most basic question to ask is whether and how the nature and extent of democracy affects climate policy outputs (e.g., Hanusch, 2018), which in the existing literature tends to concentrate on the ratification of international agreements rather than national policy dynamics (for an overview, see Jordan et al., 2022). In this regard, not only the measurement of climate policy but also democratic quality warrants enhanced attention (see Escher & Walter-Rogg, 2018). Along these lines, instead of contrasting the climate policy ambition of democracies versus autocracies, it appears promising to cover all types of political system and assess how far this affects policy outputs or policy outcomes (e.g., GHG emissions). In this context, it should be noted that variations are more pronounced among autocratic systems than democratic ones and that autocratization processes can affect both autocracies and democracies (see Pelke & Croissant, 2021). And what is more, some social movements such as Extinction Rebellion have even called on policymakers in democracies to adopt some more “authoritarian”-style policies such as those that target frequent flyers.

Researchers wishing to apply theories of policy change (e.g., Weible & Sabatier, 2018) may find the CPD-based measurement particularly suitable. The unique feature of the CPD database is that it provides information on the termination of climate policy measures. Thus, it captures empirical cases where countries dismantled their climate policies, such as Australia in 2013 (Crowley, 2017). Therefore, this measurement offers an apt empirical basis for identifying the drivers of policy expansion and policy dismantling. One straightfor-

ward argument here refers to the ideological composition of governments as suggested, for example, by Crowley (2013, 2017) for the specific case of climate policy ambition in Australia, and more generally by Schulze (2021).

Researchers interested in the specificities of policy design (see Howlett & Mukherjee, 2014) such as policy mixes (e.g., T. S. Schmidt & Sewerin, 2019) may find the PMD-based measurement particularly useful. The PMD incorporates single policy measures and programs, which are, compared to comprehensive climate laws, prone to more gradual changes. Therefore, the measurement of policy density based on the PMD allows researchers to grasp incremental changes in climate policy ambition and layering processes, which play an important role in policy design. In this regard, this measurement could be used to assess research questions concerning policy design previously addressed for individual countries (e.g., Koski & Siddiki, 2021) for a larger number of countries and to assess how robust the findings are when the empirical basis is broadened. However, scholars need to bear in mind that the PMD focuses on energy.

Scholars interested in climate policy diffusion—a situation when policy adoption in one country affects adoption in other countries (Biesenbender & Tosun, 2014; Kammerer & Namhata, 2018)—may resort to measurements of policy density based on the PMD or the CPD. Policy diffusion studies typically investigate whether specific policy innovations spread across countries and, thus, cannot directly make use of policy density as a solely quantitative measure of policy activity. However, future studies could incorporate policy density by investigating whether a policy invention, such as the world’s first carbon tax, coincides with its spread to other countries, measured by an increased number of this specific policy instrument (carbon taxes). Both the PMD and the CPD provide detailed information on policy instrument types and would enable such an analysis to be undertaken.

Further research may also shed light on policy dismantling as a form of climate policy ambition. Most empirical research and available databases focus on climate policy expansion. Nevertheless, dismantling certain policies, such as fossil fuel subsidies, may also indicate climate policy ambition (Erickson et al., 2020; Skovgaard & van Asselt, 2019). However, dismantling other policies may hinder climate action, as observed in Australia (Crowley, 2017). Capturing these instances comprehensively would make policy density a more valid measure of policy ambition. In a similar vein, to what degree policy density and policy stringency are interrelated measurements of policy ambition should be explored by further empirical research.

Overall, there exist many possibilities for connecting the measurements presented here with theoretical arguments and stimulating new research perspectives. The density measurements could facilitate a more nuanced understanding of changes in climate policy ambition, informing both theoretical debates and policy

prescriptions with respect to the dominant barriers and enablers.

### Acknowledgments

We thank Brendan Moore for helpful comments on the article. Mona Rouhandeh and Hendrik Blaß deserve credit for data collection. The funding was generously provided by the ERC (via the DeepDCarb Advanced Grant No. 882601). For further details, see the DeepDCarb website (<https://www.deepdcarb.org>)

### Conflict of Interests

The authors declare no conflict of interests.

### Supplementary Material

Supplementary material for this article is available online in the format provided by the authors (unedited).

### References

- Averchenkova, A., & Bassi, S. (2016). *Beyond the targets: Assessing the political credibility of pledges for the Paris Agreement*. Grantham Research Institute on Climate Change and the Environment; Centre for Climate Change Economics and Policy. <http://eprints.lse.ac.uk/65670>
- Averchenkova, A., Fankhauser, S., & Nachmany, M. (2017). Introduction. In A. Averchenkova, S. Fankhauser, & M. Nachmany (Eds.), *Trends in climate change legislation* (pp. 1–16). Edward Elgar. <https://doi.org/10.4337/9781786435781.00008>
- Baldwin, E., Carley, S., & Nicholson-Crotty, S. (2019). Why do countries emulate each other's policies? A global study of renewable energy policy diffusion. *World Development*, *120*, 29–45. <https://doi.org/10.1016/j.worlddev.2019.03.012>
- Biesenbender, S., & Tosun, J. (2014). Domestic politics and the diffusion of international policy innovations: How does accommodation happen? *Global Environmental Change*, *29*, 424–433. <https://doi.org/10.1016/j.gloenvcha.2014.04.001>
- Bölük, G., & Kaplan, R. (2022). Effectiveness of renewable energy incentives on sustainability: Evidence from dynamic panel data analysis for the EU countries and Turkey. *Environmental Science and Pollution Research International*, *29*, 26613–26630. <https://doi.org/10.1007/s11356-021-17801-y>
- Burns, C., & Tobin, P. (2020). Crisis, climate change and comitology: Policy dismantling via the backdoor? *JCMS: Journal of Common Market Studies*, *58*(3), 527–544. <https://doi.org/10.1111/jcms.12996>
- Crowley, K. (2013). Pricing carbon: The politics of climate policy in Australia. *Wiley Interdisciplinary Reviews: Climate Change*, *4*(6), 603–613. <https://doi.org/10.1002/wcc.239>
- Crowley, K. (2017). Up and down with climate politics 2013–2016: The repeal of carbon pricing in Australia. *Wiley Interdisciplinary Reviews: Climate Change*, *8*(3), Article e458. <https://doi.org/10.1002/wcc.458>
- Dubash, N. K., Hagemann, M., Höhne, N., & Upadhyaya, P. (2013). Developments in national climate change mitigation legislation and strategy. *Climate Policy*, *13*(6), 649–664. <https://doi.org/10.1080/14693062.2013.845409>
- Erickson, P., van Asselt, H., Koplów, D., Lazarus, M., Newell, P., Oreskes, N., & Supran, G. (2020). Why fossil fuel producer subsidies matter. *Nature*, *578*(7793), E1–E4. <https://doi.org/10.1038/s41586-019-1920-x>
- Escher, R., & Walter-Rogg, M. (2018). Does the conceptualization and measurement of democracy quality matter in comparative climate policy research? *Politics and Governance*, *6*(1), 117–144. <https://doi.org/10.17645/pag.v6i1.1187>
- Eskander, S., & Fankhauser, S. (2020). Reduction in greenhouse gas emissions from national climate legislation. *Nature Climate Change*, *10*, 750–756. <https://doi.org/10.1038/s41558-020-0831-z>
- Fankhauser, S., Gennaioli, C., & Collins, M. (2016). Do international factors influence the passage of climate change legislation? *Climate Policy*, *16*(3), 318–331. <https://doi.org/10.1080/14693062.2014.1000814>
- Fekete, H., Kuramochi, T., Roelfsema, M., den Elzen, M., Forsell, N., Höhne, N., Luna, L., Hans, F., Sterl, S., Olivier, J., van Soest, H. L., Frank, S., & Gusti, M. (2021). A review of successful climate change mitigation policies in major emitting economies and the potential of global replication. *Renewable and Sustainable Energy Reviews*, *137*, Article 110602. <https://doi.org/10.1016/j.rser.2020.110602>
- Giarola, S., Mittal, S., Vielle, M., Perdana, S., Campagnolo, L., Delpiazzi, E., Bui, H., Kraavi, A. A., Kolpakov, A., Sognaes, I., Peters, G., Hawkes, A., Köberle, A. C., Grant, N., Gambhir, A., Nikas, A., Doukas, H., Moreno, J., & van de Ven, D.-J. (2021). Challenges in the harmonisation of global integrated assessment models: A comprehensive methodology to reduce model response heterogeneity. *The Science of the Total Environment*, *783*, Article 146861. <https://doi.org/10.1016/j.scitotenv.2021.146861>
- Grantham Research Institute on Climate Change and the Environment. (2022). *Methodology—Legislation*. <https://climate-laws.org/methodology-legislation>
- Hanusch, F. (2018). *Democracy and climate change*. Routledge.
- Howlett, M., & Mukherjee, I. (2014). Policy design and non-design: Towards a spectrum of policy formulation types. *Politics and Governance*, *2*(2), 57–71. <https://doi.org/10.17645/pag.v2i2.149>
- Iacobuta, G., Dubash, N. K., Upadhyaya, P., Deribe, M., & Höhne, N. (2018). National climate change mitigation legislation, strategy and targets: A global update. *Climate Policy*, *18*(9), 1114–1132. <https://doi.org/10.1080/14693062.2018.1489772>

- International Energy Agency. (2021). *World energy model documentation: October 2021*. [https://iea.blob.core.windows.net/assets/932ea201-0972-4231-8d81-356300e9fc43/WEM\\_Documentation\\_WEO2021.pdf](https://iea.blob.core.windows.net/assets/932ea201-0972-4231-8d81-356300e9fc43/WEM_Documentation_WEO2021.pdf)
- International Energy Agency. (2022). *Policies database*. <https://www.iea.org/policies/about>
- Jordan, A., Bauer, M. W., & Green-Pedersen, C. (2013). Policy dismantling. *Journal of European Public Policy*, 20(5), 795–805. <https://doi.org/10.1080/13501763.2013.771092>
- Jordan, A., & Huitema, D. (2014a). Innovations in climate policy: The politics of invention, diffusion, and evaluation. *Environmental Politics*, 23(5), 715–734. <https://doi.org/10.1080/09644016.2014.923614>
- Jordan, A., & Huitema, D. (2014b). Policy innovation in a changing climate: Sources, patterns and effects. *Global Environmental Change*, 29, 387–394. <https://doi.org/10.1016/j.gloenvcha.2014.09.005>
- Jordan, A., Lorenzoni, I., Tosun, J., Enguer i Saus, J., Geese, L., Kenny, J., Saad, E. L., Moore, B., & Schaub, S. (2022). The political challenges of deep decarbonisation: Towards a more integrated agenda. *Climate Action*, 1(1), Article 6. <https://doi.org/10.1007/s44168-022-00004-7>
- Jordan, A., & Moore, B. (2022). The durability–flexibility dialectic: The evolution of decarbonisation policies in the European Union. *Journal of European Public Policy*. Advance online publication. <https://doi.org/10.1080/13501763.2022.2042721>
- Kammerer, M., & Namhata, C. (2018). What drives the adoption of climate change mitigation policy? A dynamic network approach to policy diffusion. *Policy Sciences*, 51(4), 477–513. <https://doi.org/10.1007/s11077-018-9332-6>
- Knill, C., Schulze, K., & Tosun, J. (2012). Regulatory policy outputs and impacts: Exploring a complex relationship. *Regulation & Governance*, 6(4), 427–444. <https://doi.org/10.1111/j.1748-5991.2012.01150.x>
- Koski, C., & Siddiki, S. (2021). Linking policy design, change, and outputs: Policy responsiveness in American state electricity policy. *Policy Studies Journal*. Advance online publication. <https://doi.org/10.1111/psj.12442>
- Le Quéré, C., Jackson, R. B., Jones, M. W., Smith, A. J. P., Abernethy, S., Andrew, R. M., De-Gol, A. J., Willis, D. R., Shan, Y., Canadell, J. G., Friedlingstein, P., Creutzig, F., & Peters, G. P. (2020). Temporary reduction in daily global CO<sub>2</sub> emissions during the Covid-19 forced confinement. *Nature Climate Change*, 10(7), 647–653. <https://doi.org/10.1038/s41558-020-0797-x>
- Le Quéré, C., Korsbakken, J. I., Wilson, C., Tosun, J., Andrew, R., Andres, R. J., Canadell, J. G., Jordan, A., Peters, G. P., & van Vuuren, D. P. (2019). Drivers of declining CO<sub>2</sub> emissions in 18 developed economies. *Nature Climate Change*, 9(3), 213–217. <https://doi.org/10.1038/s41558-019-0419-7>
- Little, C. (2020). The party politics of climate change in Ireland. In D. Robbins, D. Torney, & P. Brereton (Eds.), *Ireland and the climate crisis* (pp. 91–107). Palgrave Macmillan.
- MacNeil, R. (2021). Swimming against the current: Australian climate institutions and the politics of polarisation. *Environmental Politics*, 30(Suppl. 1), 162–183. <https://doi.org/10.1080/09644016.2021.1905394>
- Mehryar, S., & Surminski, S. (2021). National laws for enhancing flood resilience in the context of climate change: Potential and shortcomings. *Climate Policy*, 21(2), 133–151. <https://doi.org/10.1080/14693062.2020.1808439>
- Müller, F., Neumann, M., Elsner, C., & Claar, S. (2021). Assessing African energy transitions: Renewable energy policies, energy justice, and SDG 7. *Politics and Governance*, 9(1), 119–130. <https://doi.org/10.17645/pag.v9i1.3615>
- Nascimento, L., Kuramochi, T., Iacobuta, G., den Elzen, M., Fekete, H., Weishaupt, M., van Soest, H. L., Roelfsema, M., de Vivero-Serrano, G., Lui, S., Hans, F., Casas, M. J. de V., & Höhne, N. (2022). Twenty years of climate policy: G20 coverage and gaps. *Climate Policy*, 22(2), 158–174. <https://doi.org/10.1080/14693062.2021.1993776>
- NewClimate Institute. (2022). *About the database*. Climate Policy Database. <https://climatepolicydatabase.org/about>
- Pelke, L., & Croissant, A. (2021). Conceptualizing and measuring autocratization episodes. *Swiss Political Science Review*, 27(2), 434–448. <https://doi.org/10.1111/spsr.12437>
- Roelfsema, M., Fekete, H., Höhne, N., den Elzen, M., Forsell, N., Kuramochi, T., de Coninck, H., & van Vuuren, D. P. (2018). Reducing global GHG emissions by replicating successful sector examples: The “good practice policies” scenario. *Climate Policy*, 18(9), 1103–1113. <https://doi.org/10.1080/14693062.2018.1481356>
- Roelfsema, M., van Soest, H. L., Harmsen, M., van Vuuren, D. P., Bertram, C., den Elzen, M., Höhne, N., Iacobuta, G., Krey, V., Kriegler, E., Luderer, G., Riahi, K., Ueckerdt, F., Després, J., Drouet, L., Emmerling, J., Frank, S., Fricko, O., Gidden, M., . . . Vishwanathan, S. S. (2020). Taking stock of national climate policies to evaluate implementation of the Paris Agreement. *Nature Communications*, 11(1), Article 2096. <https://doi.org/10.1038/s41467-020-15414-6>
- Schaffrin, A., Sewerin, S., & Seubert, S. (2015). Toward a comparative measure of climate policy output. *Policy Studies Journal*, 43(2), 257–282. <https://doi.org/10.1111/psj.12095>
- Schmidt, N. M. (2020). Late bloomer? Agricultural policy integration and coordination patterns in climate policies. *Journal of European Public Policy*, 27(6), 893–911. <https://doi.org/10.1080/13501763.2019.1617334>
- Schmidt, N. M., & Fleig, A. (2018). Global patterns



- of national climate policies: Analyzing 171 country portfolios on climate policy integration. *Environmental Science & Policy*, 84, 177–185. <https://doi.org/10.1016/j.envsci.2018.03.003>
- Schmidt, T. S., & Sewerin, S. (2019). Measuring the temporal dynamics of policy mixes—An empirical analysis of renewable energy policy mixes' balance and design features in nine countries. *Research Policy*, 48(10), Article 103557. <https://doi.org/10.1016/j.respol.2018.03.012>
- Schulze, K. (2021). Policy characteristics, electoral cycles, and the partisan politics of climate change. *Global Environmental Politics*, 21(2), 44–72. [https://doi.org/10.1162/glep\\_a\\_00593](https://doi.org/10.1162/glep_a_00593)
- Skovgaard, J., & van Asselt, H. (2019). The politics of fossil fuel subsidies and their reform: Implications for climate change mitigation. *Wiley Interdisciplinary Reviews: Climate Change*, 10(4), Article e581. <https://doi.org/10.1002/wcc.581>
- Tobin, P. (2017). Leaders and laggards: Climate policy ambition in developed states. *Global Environmental Politics*, 17(4), 28–47. [https://doi.org/10.1162/GLEP\\_a\\_00433](https://doi.org/10.1162/GLEP_a_00433)
- Townshend, T., Fankhauser, S., Aybar, R., Collins, M., Landesman, T., Nachmany, M., & Pavese, C. (2013). How national legislation can help to solve climate change. *Nature Climate Change*, 3(5), 430–432. <https://doi.org/10.1038/nclimate1894>
- Townshend, T., Fankhauser, S., Matthews, A., Feger, C., Liu, J., & Narciso, T. (2011a). *GLOBE climate legislation study: Technical Report*. GLOBE International; Grantham Research Institute on Climate. <https://core.ac.uk/download/pdf/195495069.pdf>
- Townshend, T., Fankhauser, S., Matthews, A., Feger, C., Liu, J., & Narciso, T. (2011b). Legislating climate change on a national level. *Environment: Science and Policy for Sustainable Development*, 53(5), 5–17. <https://doi.org/10.1080/00139157.2011.604004>
- Wang, H., & Chen, W. (2019). Gaps between pre-2020 climate policies with NDC goals and long-term mitigation targets: Analyses on major regions. *Energy Procedia*, 158, 3664–3669. <https://doi.org/10.1016/j.egypro.2019.01.894>
- Weible, C. M., & Sabatier, P. A. (2018). *Theories of the policy process*. Routledge.

#### About the Authors



**Simon Schaub** is a research fellow at the Institute of Political Science at Heidelberg University. His research centers on environmental and climate policy. He recently finished his PhD on the governance of water pollution by micropollutants and agricultural pollutants. Currently, he is part of the ERC-funded collaborative project DeepDCarb between the University of East Anglia and Heidelberg University, which investigates the politics of decarbonization.



**Jale Tosun** is a professor of political science at Heidelberg University and the editor-in-chief of *Climate Action*. She is also an associate editor of *Policy Sciences* and the executive editor for special issues of the *Journal of Comparative Policy Analysis*. Her research focuses mainly on the comparative study of regulation in areas of environment, energy, and climate change, as well as on distributive conflicts within the European Union and the influence of the EU on regulatory measures in third-party states.



**Andrew Jordan** studies the politics that arise when attempts are made to govern environmental problems using the tools and methods of public policy. He has examined how these different forms of politics have played out in relation to the use of policy instruments, policy coordination across sectors, policy innovation, and policy dismantling. He currently sits on the UK Environment Ministry's (DEFRA) Science Advisory Council: Social Science Expert Group and the editorial boards of *West European Politics*, *Policy Sciences*, and *Environmental Politics*.



**Joan Enguer** is a PhD candidate under the supervision of Prof. Dr. Jale Tosun. He graduated with a double BA in Law and Political Sciences (University of Valencia) and then completed a MA in Secondary Education (University of Valencia), as well as a MA in Political Analysis (Open University of Catalonia). Since April 2021, he is part of the ERC-funded project DeepDCarb. His research focuses on party politics and the sub-national dimension of climate change politics.