

D2.1

Literature Review and Integrative Framework of Determinants of Public Acceptance and Social Feasibility of Climate Policies

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Author(s):	Uyanga Turmunkh, Max Callaghan, Ivan Savin
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Glossary

<i>Abbreviation</i>	<i>Full term</i>
CA	Consortium Agreement
CO	Project Coordinator
CB	Coordination Board
GA	Grant Agreement
SH	Stakeholders
WP	Work Package
WPL	Work Package Leader

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Executive Summary

Nations' differing experiences of success and failure to adopt climate policies underscore the importance of policy design and communication in increasing public support or, at the least, in preventing widespread backlash among the public. Understanding better the factors that may potentially shape the public's attitude is therefore crucial for policymakers to be able to successfully introduce and implement ambitious climate policies.

Research literature in social sciences that investigates the potential determining roles of different factors for the public's climate policy support has begun to appear in the early 2000s and has grown steadily over the past two decades. This report (i) gives an integrative framework of determinants of climate policy support that this literature has identified and investigated, and (ii) provides a review, based on a structural topic modelling analysis, of the extant research landscape in this area.

A systematic search query was developed to identify all relevant studies across multiple disciplines. The search via the query conducted in January 2024 returned 3986 unique studies. The initial screening of these studies for eligibility criteria was conducted using a machine learning (ML) assisted approach. Specifically, 200 documents were selected at random and screened manually at the title and abstract level. Subsequently, we trained a ML model on the initial set of inclusion/exclusion decisions to predict the relevance of unscreened documents. These documents were then screened in descending order of relevance. After 800 documents had been screened, the model was retrained using the additional screening decisions. Then, new predictions were made for the remaining unscreened documents and further documents were screened until the pre-defined stopping criterion was reached. The initial screening resulted in a final sample of 519 studies identified as relevant.

Two types of analyses were conducted on the final set of studies. Firstly, a random subset of 298 studies was reviewed manually by a team of contributors. The aim of this analysis was to construct a narrative framework of the main potential determinants of public support for climate mitigation policy that the scientific literature has identified and investigated. Then secondly, a structural topic modelling (STM) analysis was conducted on the full set of papers in order to review the entire research landscape.

Based on the manual reviews, we report that in the extant scientific literature on determinants of public support for climate policies three broad categories of determinants can be identified. The potential determinants that the literature focuses most on concern design characteristics of particular climate policies and the public's perceptions of the policies' impacts. The second group of determining factors that the

scientific literature focuses on are the individual, socio-psychological and socio-economic characteristics of citizens, such as their basic personal values, their general worldviews, their levels of concern about climate change, as well as different lifestyle factors such as their carbon dependence. Finally, the third group of factors includes contextual factors, in particular, the degree to which individuals are exposed to extreme weather events and their experiences or expectations about larger economic, geopolitical, and health events.

The STM analysis yielded 15 main topics, along which the research in this area can be organised. The most prevalent topics that the literature focuses on include “public opinion about climate change” and “climate change awareness and consequences” (literature looking at the determining role of individuals’ opinions about climate change phenomenon itself and their level of support for climate policy). The other prevalent topics are “trust in government and party preference” (studies looking at the role of political ideology and trust in government), “perceived effects of climate policy” (studies looking at the perceptions of the climate policy and how it shapes support), “carbon tax acceptance” (studies focused on acceptance of carbon taxation or carbon pricing), “role of framing and communication” (studies focused on the role of frames and communication in shaping policy support), “energy transition” (studies focused policies targeting energy sources and transition away from fossil fuels), and “climate action” (studies focused on socio-psychological and cognitive factors explaining support for climate action).

Furthermore, the STM analysis also explored how topic prevalence changed over time. In the earlier years, the topical focus of this literature tended to orient towards the relationship between individuals’ beliefs about the severity of climate change phenomenon and the extent to which they support climate action. Over time the topical focus has shifted towards determining roles of deeper socio-psychological characteristics of individuals and more policy-specific characteristics such as different design features of policies, as well as citizens’ perceptions of those policy characteristics.

1 Introduction

Since the Paris Agreement has set the goal to limit global warming to 1.5 to 2 degrees Celsius, 130 countries have committed to carbon neutrality (as of 2023).¹ The EU, in particular, has outlined in its European Green Deal an ambitious goal of achieving carbon neutrality by the year 2050, with the intermediate goal of reducing greenhouse gas (GHG) emissions by at least 55% below their 1990 levels by the year 2030. Many countries have yet to set in motion policies that will enable them to meet their ambitious commitments. The prospect for such policies to pass and be implemented effectively depends to a large extent on whether the populations in these countries will approve of them. The issue of popular acceptance of ambitious climate policies (and thus, their political feasibility) is a relevant and important issue also for the EU, which has already legislated its 2030 and 2050 climate goals into legally binding provisions, because achieving the significant reductions in emissions that are prescribed by the legal provisions will involve yet-to-be-implemented major shifts in the economic structures of the EU nations.

Already in Europe and beyond some proposed climate policies had to be scaled down or abandoned altogether as a result of outspoken public opposition to them. For instance, the Yellow Vest protests against the planned increase in the French gasoline tax in 2018 forced the government to halt the tax increase. In the Netherlands, the government's efforts to meet its emissions reduction obligations through policies targeting the agricultural sector--the country's largest source of GHG emissions--has been met with vociferous opposition from Dutch farmers, whose discontent has led to a shift in the political power structure of the country, putting in the first place the newly formed Farmer-Citizen Movement Party (the main channel of the rural anger at the planned policies for reducing agricultural emissions) in the March 2023 provincial elections and the Euro-skeptic Party for Freedom in the national election of November 2023. In Germany, the population's discontent with the country's energy policy has been cited as the main force driving German voters to reject pro-environment parties in the most recent European Parliament elections.

There are many potential explanations for why populations of different countries may hold differing attitudes toward similar policies. If policymakers wish to form accurate predictions about the reactions of the public, it is important to understand what may drive a given population to support or oppose a proposed policy. Even more important for policymakers may be to better understand the factors that help explain why and how attitudes of the population shift depending on the design features of different policies that otherwise have the same objective. In sum, in order for policymakers to be able to

¹ Source: Net Zero tracker page www.zerotracker.net.

design policy features in ways that can prevent widespread public opposition it is crucial that they understand the factors that shape the public's perceptions of policies.

Policy acceptance is a complex issue, as amply illustrated by the case of carbon taxation. Putting a Pigouvian price on carbon is considered by far the most cost-efficient (and effective) policy instrument for achieving reductions in GHG emissions. In January 2019, a group of 3554 economists (that included 27 Nobel prize winners) made a public statement calling for an adoption of carbon taxation. Their statement noted, *"A carbon tax offers the most cost-effective lever to reduce carbon emissions at the scale and speed that is necessary."*² Nevertheless, among the general populations of many countries taxing carbon remains to be one of the least supported (or most opposed) policy options (e.g., Dechezleprêtre et al. 2022), and this is notwithstanding overwhelming popular support across nations for the need to take decisive action to fight climate change. The divergent practical experiences with policy proposals of carbon taxation in different countries also speak to the complexity of the issue of public acceptance. For instance, while Australia and France failed to pass (or increase) carbon taxation in the face of strong public backlash, similar policies (with varying specific features) have been successfully implemented in Finland, Sweden, Switzerland, and Canada.

In the EU, the climate policy package reflects the policymakers' awareness of the potentially disruptive effects that the green transition may impose across different countries and also across different groups with the same countries. Already the policy instruments such as the Just Transition Mechanism (providing targeted support to regions, industries, and workers facing the greatest challenges) and the Social Climate Fund (providing direct income support for vulnerable households) provide a framework for tackling discontent and opposition that may arise especially from groups and countries that stand to share relatively high burdens of transitioning to a low carbon economy. However, there is still much room for translating or incorporating these instruments into the specific national emission reduction policies.

The different experiences of success and failure underscore the importance of policy design and communication in increasing public support or, at the least, preventing strong opposition among the public for the introduction and implementation of effective climate policies. The scholarly community recognizes the complexity of this issue and the importance of better understanding the factors that drive populations' attitudes toward climate policies. Scientific research looking into this question has been continually growing since the early 2000s when first such studies began to appear.

² "Economists' Statement on Carbon Dividends," The Wall Street Journal, January 17, 2019. Source: <https://clCouncil.org/economists-statement/>.

1.1 Evidence synthesis to date

In a paper published in the journal *Climate Policy*, Drews and van den Bergh (2015) reviewed this literature and identified three broad categories of determinants:

1. **Social-psychological factors.** The extant literature then had uncovered fairly robust correlations between two sets of social-psychological factors on one hand and the extent to which members of the general public supported climate policy. Firstly, people's political orientation, their worldviews and basic personal values were found to correlate with their approval of climate policy in that people with left-wing political orientations, people holding egalitarian rather than hierarchical worldviews, people who held strong biospheric values, and people who were concerned about the humankind's exploitation of the natural world tended to more strongly support climate policies. Secondly, the literature had shown that the degree to which people believed that climate change was happening due to human activity and an issue of concern tended, unsurprisingly, to support more policies to reduce emissions.
2. **Policy design characteristics.** As noted by Drews and van den Bergh (2015), the extant literature then included relatively few studies that examined the extent to which different design features of policies shaped the degree to which the public supported the policy. Generally, the existing studies then (a) either tended to contrast non-coercive policies (such as, soft regulations, encouragement of voluntary change in behaviour, subsidies) against coercive policies (such as, hard regulations, taxes), finding that the public tended to support more the non-coercive policies; (b) or they looked at the relationship between people's perceptions of the policies (in particular, in terms of the policies' impacts on emissions, their costs, and their fairness) and their support for the policies. Furthermore, a few studies had looked at the support levels for different revenue recycling options for policies that would raise revenue, such as carbon tax. Their convergent finding was that earmarking of the revenue for environmental purposes was by far the most strongly supported option. The findings about support for universal or targeted carbon dividends were mixed.
3. **Contextual factors.** At the time of the review of Drews and van den Bergh (2015) there was very little research and evidence on the role of various contextual factors, such as exposure to extreme weather events or experience of a major economic, geopolitical, or health crisis. By far, the most robustly established relation was that people who tended to trust their governments and the policy-making process also tended to support more the climate policies coming from those governments.

More recently, three other evidence synthesis papers have been published, which have a narrower scope, focusing specifically on carbon pricing policies. In the context of carbon pricing, Maestre-Andrés et al. (2019) review the research evidence on perceived fairness, concluding that in the general population there is a high concern about distributional fairness of carbon pricing and low trust in good use of revenues. A somewhat puzzling finding in this literature, however, is that although perceived distributional unfairness of carbon pricing (with lower-income households potentially subjected to much higher burdens than higher-income households) is often cited as a reason for opposing such policies, when asked directly, the public generally prefers spending the revenue for environmental projects rather than for re-distributive efforts to mitigate regressive effects of the policy.

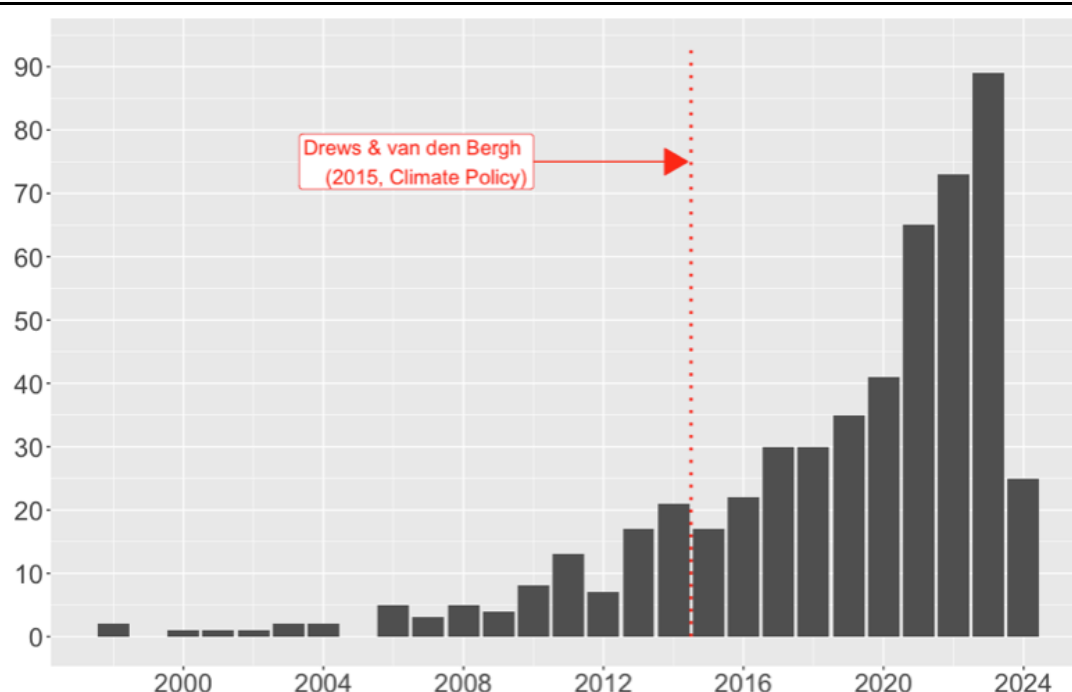
Also in the context of carbon pricing policies, Bergquist et al. (2022) have conducted a meta-analysis of the evidence on potential determinants of support for carbon taxation. Their review focuses on an important issue for policy design: it quantifies the relative importance of different determining factors. The authors conclude that among the different personal, policy-specific, and contextual factors, by far the most important determining factor for how much the public may support or oppose a carbon tax is the perceived fairness and perceived effectiveness of this policy. Other social-psychological factors such as individuals' personal values, their beliefs about the phenomenon of climate change were found to be less important. Finally, the role of various socio-demographic characteristics such as age and gender was found to be unimportant. Thus, in the case of carbon taxation, Bergquist et al.'s (2022) meta-analysis highlights the important role of communicating clearly to the general public the expected impacts of the policy on emissions, as well as taking care in incorporating design features that help reinforce the policy's perceived fairness, in garnering support for the policy among the general population.

Valencia et al. (2023) focus on the evidence in the literature with regard to revenue recycling options for carbon pricing policies. Their review and meta-analysis of quantitative evidence on relative popularity of different revenue recycling options concludes that introducing some form of revenue recycling tends to increase support for carbon pricing. Furthermore, spending the revenues on environmental projects was found to be the only recycling option which significantly increases support compared to revenue going to the general government budget. In particular, universal or targeted repayment of the revenue back to the population was not found to significantly increase support for carbon pricing. Finally, the authors suggest that revenue recycling may be even more important for increasing support in countries outside of North America and Europe.

1.2 Aims of this report

As shown in **Figure 1.2**, since the publication of the systematic review by Drews and van den Bergh (2015), the literature on determinants of the public's support for climate policies has grown significantly. Thus, this report aims to capitalise on the large body of new research that has appeared since then. Although the more recent reviews discussed above consider some of the later research, owing to their focus on some specific policies, the recent reviews do not incorporate evidence on other types of climate policies.

Figure 1.2. Number of publications by year on the topic “determinants of public support for climate policy”.



The aim of this report is to synthesise the large body of scientific literature that has investigated to date the determinants of the public's support or opposition towards climate policies, from the most general policy framings such as national emissions reductions targets or general policy packages to the more specific policies targeting particular products, industries, and behaviours. Specifically, this report **(i) gives an integrative framework of determinants of climate policy support** (Section 4 “Integrative Framework of Determinants”), which constitutes an update of the framework identified in Drews and van den Bergh (2015), and **(ii) provides a review, based on a structural topic modelling analysis, of the research landscape to date** in this area (Section 5 “Topic Modelling Analysis”).



2 Methodology

2.1 Eligibility criteria for inclusion and exclusion

The aim of this literature review is to cover all scientific literature that provides empirical insight into the determinants of the public's support for (or opposition to) climate mitigation policies. In particular, this review considers:

- All possible potential determinants, including, among others, individual, group, policy-related, and environmental determinants;
- All potential types of climate policies, including, among others, general emission reduction targets (target-setting, such as “net zero by 2050”, is interpreted as a type of policy), general climate policy packages, as well as policies targeting specific industries, groups, or products;
- All real or hypothetical policies (designed by researchers in the context of the study);
- All international, national, municipal, or local and communal policies;
- All correlational or causal studies;
- All methods of measuring support for (or opposition to) climate mitigation policies, including, among others, introspective attitudinal measures that use Likert-type scales, willingness-to-pay measures, self-reported or real voting decisions or voting intentions, as well as hypothetical or real choices indicating preferences for policies; and
- All types of samples, including general population samples, student samples, and specific groups such as farmers, climate experts, policy-makers, etc.

The exclusion criteria for the review are developed along two dimensions: (1) scope of the study and (2) type of data used in the study:

2.1.1 *Exclusion criteria based on scope*

The review only considers studies whose explained variables include people's attitude toward climate mitigation policies. Specifically, the following types of studies are excluded:

- Studies whose explained variables do not contain individuals' attitudes toward a climate mitigation policy are excluded. For the purpose of the review, we define as a climate mitigation policy all policies that explicitly refer to climate mitigation or emissions reduction or enhancement of carbon sinks (i.e. anything that absorbs carbon from the atmosphere) as a goal;
- Studies that consider adaptation policies only (and not a single mitigation policy) are excluded;
- Studies whose explained variable is the public's attitude toward climate change (but not the public's attitude toward a particular climate policy) are excluded;

- Studies whose explained variable is the public's responsiveness to a climate policy (but not their support for or opposition to the policy) are excluded;
- Studies that consider the public's attitude toward only individual or private climate mitigation actions (without also looking at policy support) are excluded;
- Studies that consider support for pro-environment parties or politicians or studies that consider individuals' attitude toward political (but essentially private) actions such as participating in climate protests or signing a petition urging climate action are excluded;
- Studies that consider people's attitude toward specific technologies or products without mentioning any policy are excluded; and finally,
- Studies that consider willingness-to-pay for carbon offsets when flying are excluded, as this is considered a private action rather than support for mitigation policy. However, studies that consider willingness-to-pay for particular policies (e.g., WTP for a community reforestation project, WTP for a net-zero target) or for reducing carbon in general (e.g., WTP for reducing 1 tonne of CO₂) are included.

2.1.2 Exclusion criteria based on type of data used

The review only considers studies based on individual-level observations collected via a survey or an experiment. As long as the unit of observation is individual decision-maker or individual household, data can also be obtained from third-party survey organisations. Specifically, the following types of studies are excluded:

- Studies that use aggregate-level observations only are excluded;
- Qualitative studies are excluded. This means that studies that are based on semi-structured or unstructured interviews or focus group discussions are excluded;
- Studies that rely on sampling based on authors' own social networks are excluded; and,
- Studies that use as data people's social media posts or comments on message boards are excluded.

2.2 Literature search strategy

2.2.1 Search query

In order to identify the literature that meets the above-specified eligibility criteria, a 4-part search query was developed. The search query consisted of four parts connected with a logical "AND" operator:

1. The first part of the query aimed at identifying studies that examine the public's or citizens' attitudes. It consisted of a set of fixed, two-to-three word expressions such as "public preferences", "public opinion", "public acceptance", "public attitude", "people's attitude", "citizen preferences", and "voter approval".

2. The second part of the query aimed at identifying studies addressing climate mitigation policies. This part of the query contained expressions related to climate mitigation, such as “climate policy”, “climate mitigation”, “decarbonising”, “limiting emissions”, “tackle climate change”, and “curbing GHG”.
3. The third part of the query complemented the second part in that it consisted of a set specific policy instrument expressions, such as “taxes”, “labelling”, “border adjustment”, “regulating”, “quota”, and “standard”.
4. Finally, the fourth part of the query was designed to identify the studies that use individual-level data collected through a survey or an experiment. This part thus consisted of expressions related to data and samples, such as “experiment”, “experimental”, “panel”, “survey”, and “sample”.

The full sets of expressions composing the 4-part query are reported in **Appendix A**.

2.2.2 Screening strategy

The 4-part query was used to conduct a search of SCOPUS in January 2024. After removing duplicates, the query resulted in 3986 studies. The initial screening of the studies was conducted using a machine learning (ML) assisted approach. Specifically, 200 documents were selected at random and screened by teams of two independent coders at the title and abstract level, in batches of 50. In cases where the two coders disagreed, a resolution was reached by discussing with the entire screening team, made up of 4 contributors. Subsequently, we used ML-prioritised screening (O'Mara-Eves et al. 2015) to reduce the screening burden.

A distilBERT model (Sanh et al. 2019) was fine-tuned using the initial set of inclusion/exclusion decisions, made by teams of coders, to predict the relevance of unscreened documents. These documents were then screened in descending order of relevance, with each coder screening 200 documents. After these 800 documents had been screened, the model was retrained using the additional screening decisions. Then, new predictions were made for the remaining unscreened documents and a further 100 documents were screened by 1 coder. The screening progress is shown in **Figure 2.2.2a**.

We used the stopping criterion defined in (Callaghan & Müller-Hansen 2020) to calculate the probability of missing substantial numbers of studies at the point at which we stopped screening. The stopping criterion works by calculating a *p-score*, corresponding to the probability of observing the sequence of past inclusion/exclusion decisions, had a given recall target not been reached. This p-score has been shown to be conservative, due to the assumption that previously screened documents were as likely to be relevant as unscreened documents (whereas in fact we selected those that our classifier deemed more likely to be relevant).

Figure 2.2.2a. Screening Progress.

Note: The number of relevant documents identified over time (left panel), and the rolling average (window length=50) proportion of relevant documents (right panel).

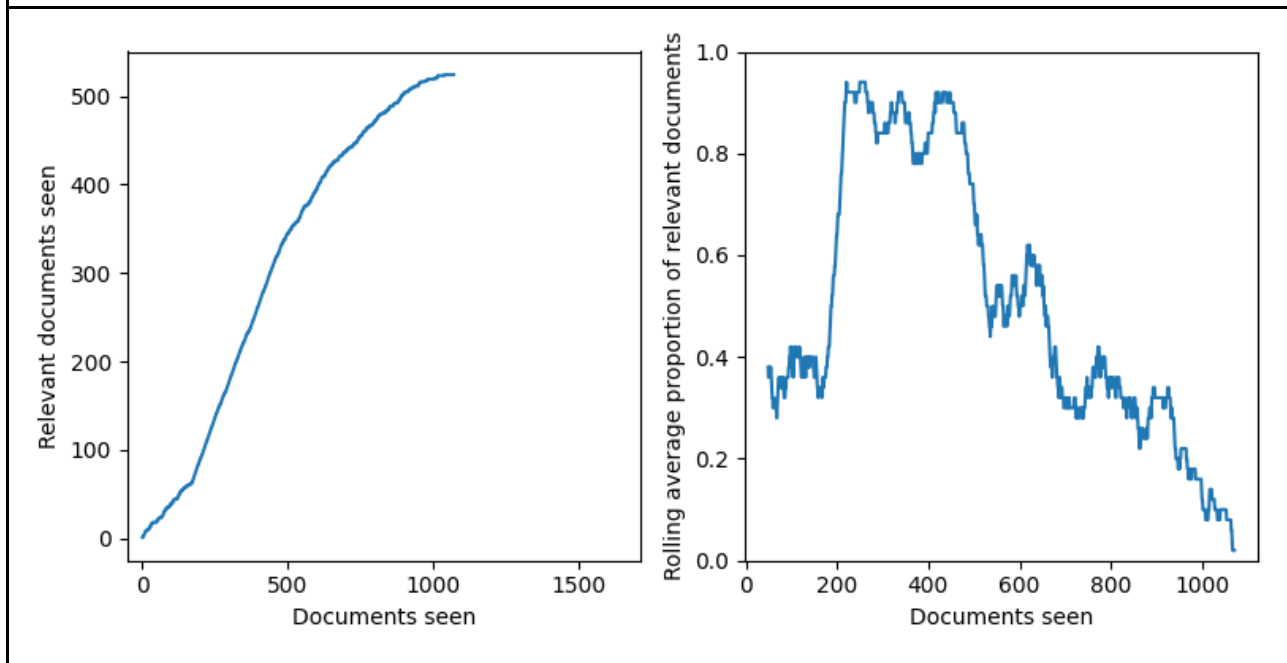


Figure 2.2.2b shows the p-score for different target levels of recall. We can therefore reject a null hypothesis that we have missed more than 10% of relevant documents with high confidence ($p < 0.05$). We can also state that we are unlikely ($p = 0.44$) to have observed the previous sequence of inclusion/exclusion decisions had we missed more than 3% of relevant documents.

2.2.3 Data collection process

The initial screening reduced the number of studies to a final sample of 519 studies classified as relevant. In order to construct a narrative map of the main potential determinants of the public's support for or opposition to climate mitigation policy, a team of 15 contributors reviewed a subset of these studies manually. The manual review consisted of 4 steps, summarised in **Figure 2.2.3**. Finally, a topic modelling analysis was performed on the full set of 519 studies.

Figure 2.2.2b. Stopping criteria.

Note: The p-score for the null hypothesis that the given recall target has been missed, for each recall target at intervals of 0.05. P-scores are calculated using the *buscarpy* package: <https://buscarpy.readthedocs.io>.

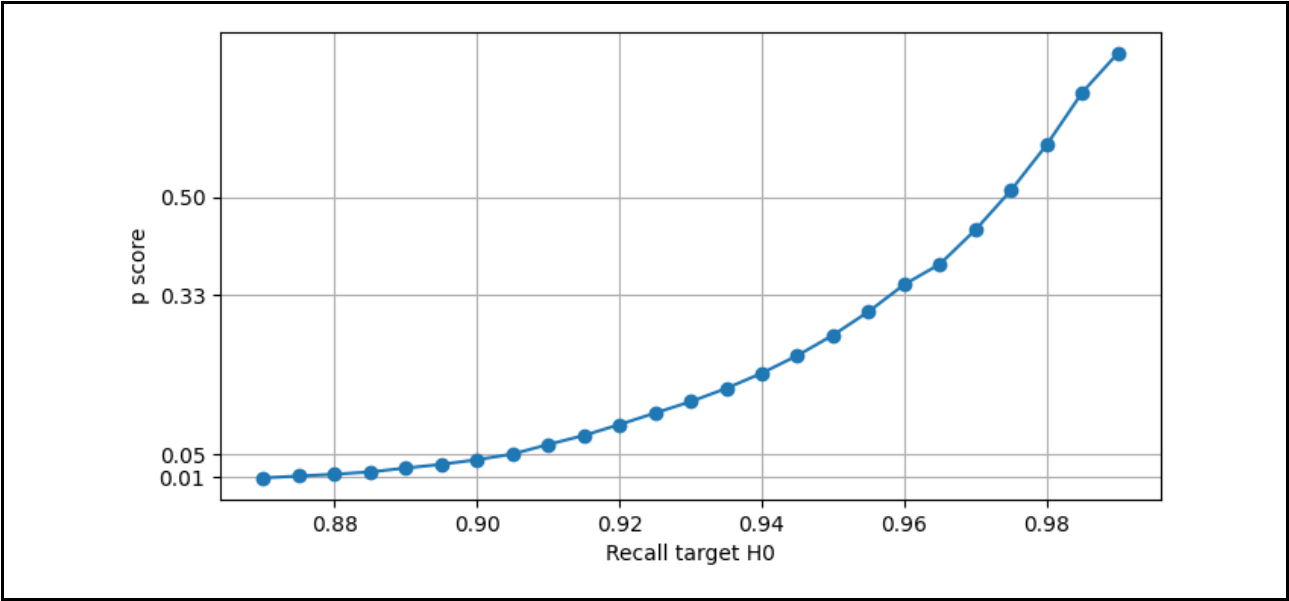


Figure 2.2.3 Summary of Manual Review Process.

Review step:	Variables generated:
Step 1. Eligibility criteria check for inclusion or exclusion	
Step 2. Qualitative summary of paper	<ul style="list-style-type: none">• Research question• Main finding• Policy implication
Step 3. Dependent variable and sample	<ul style="list-style-type: none">• Climate policy(ies) studied• Sample type and size• Data collection year(s)• Data collection country(ies)• Method of measuring support
Step 4. Independent variables and analysis type	<ul style="list-style-type: none">• Analysis type (correlational vs. causal)• Main determinant(s) of support

3 Selected papers

The sample includes 519 studies over the period between 1998 and 2024. As a result, we obtained the distribution over time demonstrated in **Figure 3a**. As can be seen from the figure, the number of studies on the topic of the public’s acceptance of climate mitigation policies has increased significantly over the last two decades, starting from approximately 10-20 at the beginning of the 2000s and reaching a yearly average of over 80 by 2023. Thus, much new insight has been published since the last time this literature was reviewed and the body of evidence synthesised in Drews & van den Bergh (2015). The aim of this report is to update the synthesis of the literature by incorporating the large body of more recently published studies.

Figure 3a. Number of studies published in our sample over time.

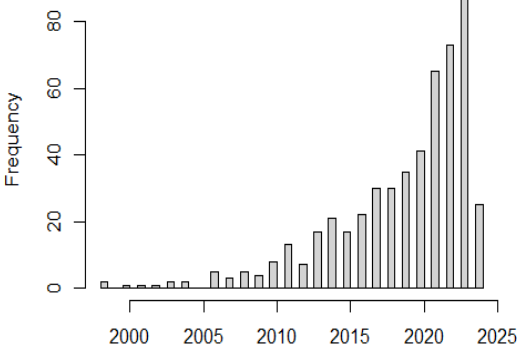


Table 3 lists ten journals that appear most often in our sample. As can be seen from the table, these are major cross-disciplinary outlets that cover environmental policy-relevant social sciences such as economics, political science, and psychology. By far the largest numbers of studies on the topic of public acceptance of climate policy have been published in *Climatic Change*, *Energy Policy*, and *Energy Research and Social Science*. Conditional on being published, the studies with the most citations appeared in *Nature Climate Change*.

If we look at the coverage of countries where authors of studies in our sample were affiliated, we observe a list of 59 countries (**Figure 3b**) with the United States leading by a large margin, and further followed by Switzerland, the United Kingdom, Germany and Sweden. Compared to the literature landscape covered in Drews & van den Bergh (2015), which was dominated by evidence from Western countries, the current sample includes more studies published by authors in non-Western countries’ institutions and, thus, more evidence on the public’s attitudes toward climate policy going beyond Western countries.

Figure 3b. Country coverage of author affiliations.

Note: The heatmap shows the global coverage where the studies with authors affiliated at more than one unique country are equally split between those countries.

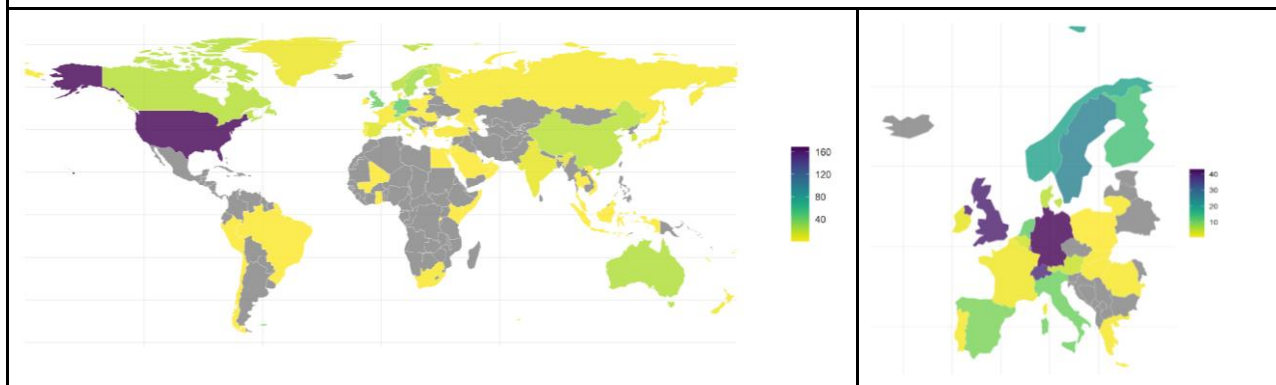


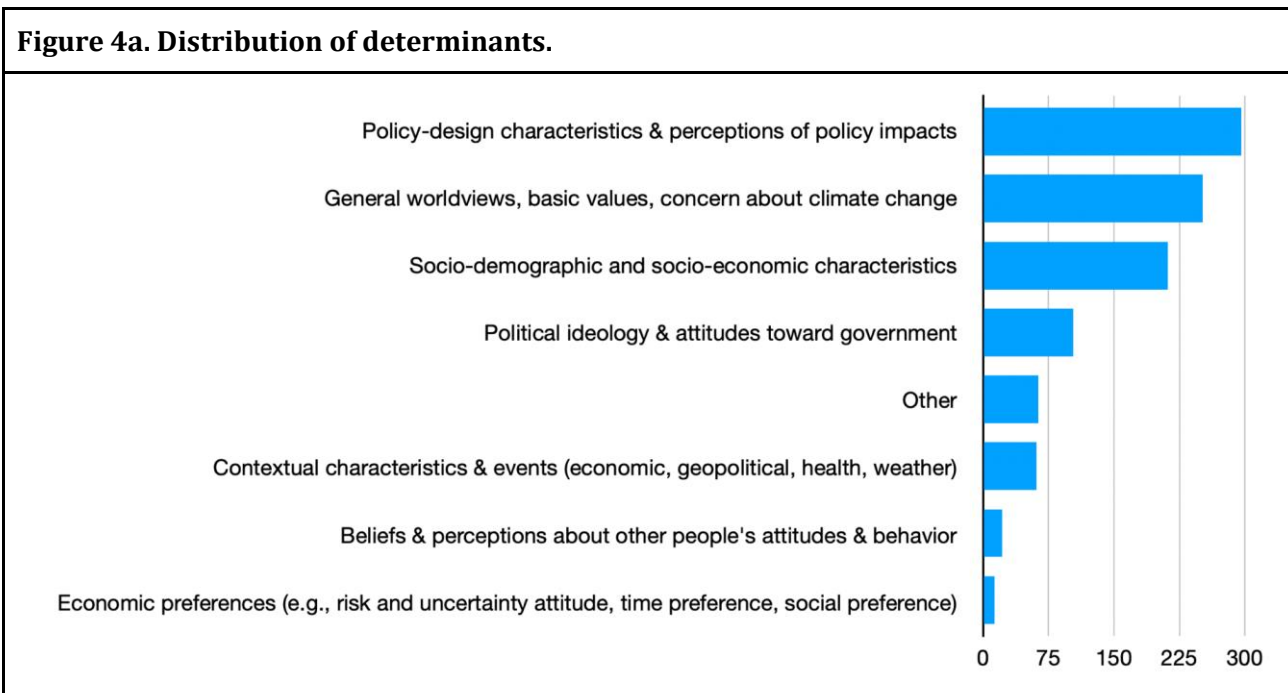
Table 3. Journals with the highest number of publications in our sample.

<i>Journal:</i>	<i>Number of studies published:</i>	<i>Average number of citations per year:</i>
<i>Climatic Change</i>	40	8.92
<i>Energy Policy</i>	35	8.97
<i>Energy Research and Social Science</i>	29	11.56
<i>Ecological Economics</i>	25	10.18
<i>Global Environmental Change</i>	25	13.68
<i>Journal of Environmental Psychology</i>	25	7.42
<i>Climate Policy</i>	23	5.41
<i>Environmental Research Letters</i>	15	7.00
<i>Environmental Politics</i>	12	9.06
<i>Nature Climate Change</i>	11	21.60

4 Integrated Framework of Determinants

In this section, we present an integrated framework of the determinants of the public's attitude toward climate mitigation policy. The results presented in this section are based on the manual reviews of a random subset of 298 studies from the total sample of 519 studies. The manual reviews identified 75 studies as ineligible (failing one or more exclusion criteria specified in Section 2.2), which then resulted in 223 studies.

Figure 4a shows the overall distribution of the different categories of potential determinants considered in the literature as key research questions posed by studies. As can be seen from the figure, by far the most frequently studied category of determinants is “policy-design characteristics and perceptions of policy impacts”. This is a welcome development compared to the state of the research reviewed by Drews and van den Bergh (2015). At the time, as noted by the authors, there were relatively few such studies. Furthermore, in light of the finding of Bergquist et al. (2022) that perceptions of policy characteristics and impacts are the most important determinant of policy support (at least in the case of carbon pricing policies), it is encouraging to see that the research focus reflects the importance of these factors.

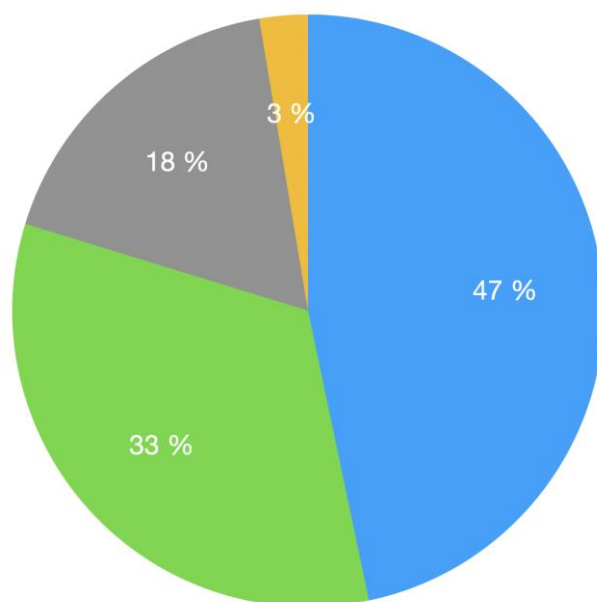


The other most frequently studied categories of potential determinants are person-specific characteristics, such as “worldviews, values, concern for climate change” and “socio-demographic and socio-economic characteristics”. A fair number of studies also look at contextual characteristics such as citizens’ “attitudes toward their governments”, “economic, geopolitical, health, and weather events”, and “beliefs about

others' attitudes and behaviours". Such studies, in particular, looking at contextual factors such as major economic, health or environmental events were virtually absent in the sample of studies reviewed by Drews and van den Bergh (2015).

A further noteworthy development in research since 2015 is shown in **Figure 4b**. The earlier literature on determinants of support was dominated by purely correlational studies, making it difficult to interpret the observed correlations. In the current sample, it can be seen from the figure that over 50% of the investigations use an experimental treatment or an experimental manipulation so that correlations can be unequivocally interpreted as causal effects.

Figure 4b. Causal vs. correlational evidence.



- Correlational only
- Causal effect of a treatment
- Causal effects of determinants through exogenous variation
- Causal effects using econometric techniques

5 Topic Modelling Analysis

This section uses the results of a topic modelling analysis to give an overview of the sample of studies that our systematic search of the literature yielded.

5.1 Structural Topic Modelling (STM) approach

For textual analysis we use titles, abstracts, and keywords of the studies. To reveal hidden structure in our textual data, we use the topic modelling (TM) approach. In simple words, TM clusters words into topics based on how often any pair of words appears in the same texts (Blei 2012; Savin et al. 2023). For example, if we see the words “energy”, “public” and “acceptance” in one of the topics presented in the next section (specifically, topic 12 that we labelled “support for renewables”), it means that these words appear relatively more often in combination with each other and other words from this topic. Compared to simple count of keywords, TM has the advantage of considering words not in isolation, but accounting for their context, which can influence the meaning of the words.

An advantage of structural topic modelling (STM) over classical TM is that it includes additional information about the publications, in our case the year of publication and the number of citations per year. Using additional data as covariates at the stage of estimating a topic model has proven to produce topics with higher predicting power and interpretability (He et al. 2009; Roberts et al. 2014, Speier et al. 2016). We apply STM using the associated R package by Roberts et al. (2019).

A necessary step before building a topic model is pre-processing of textual data. We used the standard steps described in recent literature (Aggarwal, 2018; Uglanova & Gius, 2020; Savin and Teplyakov, 2022). In particular, the text documents were divided into separate elements (tokens), capital letters were replaced, punctuation and stop words were removed, and words converted to their dictionary form using Wordnet-based lemmatization. Words that are too rare (i.e., that appear less or equal to 3 times in all the documents) were subsequently removed. Stable word sequences called n-grams have been additionally formed (e.g., “renewable_energy”, “capture_stporage”). As a result, our final dataset contains 1874 unique words for building a topic model and 40,545 total word occurrences.

To determine the optimal number of topics, we ran the model for 3 to 50 topics and recorded model performance on the following metrics (Savin and van den Bergh, 2021):

- held-out log-likelihood (i.e. predictive power of the model),
- exclusivity (degree of overlap between popular words within each topic), and
- semantic coherence (the degree of co-occurrence of words from the same topic in text documents).

Typically, increasing the number of topics tends to increase the model's predictive power and topic exclusivity, but reduces their semantic coherence. In **Appendix B**, we demonstrate that 15 topics allow us to achieve maximum predictive power while reaching high exclusivity and maintaining semantic coherence at a reasonable level.

5.2 STM Results

The resulting topics are presented in Table 5.2a and visualised in Figure 5.2a as word clouds. Furthermore, Figures 5.2b and 5.2c summarise how topic prevalence changed over time, as well as which topics tended to attract a larger number of citations per year (which is indicative of which topics the scholarly research tended to prioritise).

In **Table 5.2a**, next to most frequent and exclusive words for each topic and an illustrative title of a paper with the highest prevalence of the topic, we provide concise topic labels that we have formulated after studying titles, abstracts and keywords of the top twenty documents with highest prevalence of the respective topics.

Topic 1 (Tx henceforth stands for topic x) on “public opinion about climate change” has the largest overall prevalence in our sample of documents (9.9%). This topic, as well as T11 “climate change awareness and consequences”, was one of the dominant topics at the beginning of our sample period (**Figure 5.2b**), indicating that in the early 2000s, research into public attitude towards climate policy focused predominantly on how people’s perception of climate change phenomenon (and its consequences) related to the degree to which people supported or opposed climate policy. However, over time, it can be seen that the share of topics related to people’s perception of climate change and its consequences has fallen (from about 45% to less than 15% today).

A similar observation applies to T6 “contingent valuation studies” and T7 “burden sharing”, indicating that the shares of studies looking at willingness-to-pay for various policies and technologies and at the degree to which the public’s attitude depends on international burden sharing have fallen over time. It should be noted, however, that many studies employing the contingent valuation method may be allocated to other topics such as T4 “carbon tax acceptance” or T9 “energy transition”, which (as described below) have been growing in prevalence. Thus, the fall in the share of T6 “contingent valuation studies” may not necessarily indicate that the method of contingent valuation has fallen in importance. A more plausible interpretation is that the deployment of the contingent valuation method may have shifted from willingness-to-pay for varying technologies towards evaluating support for more structured and more specific policies such as carbon tax or expansion of renewable energies.

Table 5.2a. Main topics in our sample based on titles, abstracts, and keywords.

Note: The terms shown are those that are the most frequent as well as exclusive to each topic. Illustrative titles are chosen from the ten documents with the highest topic prevalence.

	Topic label	Most discriminating terms and illustrative titles	Topic proportion
T1	Public opinion about climate change	risk, china, anxiety, student, scientist, chinese, perception, usa, vulnerability, climate_change, cause, united_state, concern, national, scale, although, temperature, american, questionnaire, germany "Examining differences in public opinion on climate change between college students in China and the USA"	9.9%
T2	Trust in government and party preference	polarization, party, trust, ideology, european, right_wing, populism, populist, opposition, right, political, institution, elite, prioritization, ideological, class, politics, europe, sweden, consensus "Who do you trust? How trust in partial and impartial government institutions influences climate policy attitudes"	9.1%
T3	Perceived effects of climate policy	citizen, rural, policymakers, goal, financial, ambitious, canadian, standard, weak, formation, urban, government, trust, covid_crisis, policy, regulation, norwegian, climate, partisan_cue, bundle "Perceived effects of climate policy on rural areas and agriculture: A rural-urban-divide"	8.8%
T4	Carbon tax acceptance	tax, revenue, pricing, carbon, taxation, pollution, acceptability, fairness, design, revenue_recycle, income, rebate, earmark, tool, economics, scheme, personal, introduce, allocation, reward "Public support for carbon tax in South Korea: The role of tax design and revenue recycling"	8.8%
T5	Role of framing and communication	frame, message, framing, communication, moral, scientific, conservative, loss, participant, read, salient, effect, structural, endorsement, science, threat, test, medium, covid, versus "Moral Frames and Climate Change Policy Attitudes"	8.0%
T6	Contingent valuation studies	wtp, contingent_valuation, willingness_pay, household, electricity, vehicle, fuel, valuation, pay, ghg, willing, per, income, estimate, consumer, choice_experiment, reduction, segmentation, zero, average "Public willingness to pay for hydrogen stations expansion policy in Korea: Results of a contingent valuation survey"	7.0%
T7	Burden sharing and international harmonization	domestic, international, geoengineering, crowd, global, distributional, moral_hazard, experiment, australia, effort, principle, burden, country, voluntary, unilateral, world, field, adaptation, abatement, cost "Do individuals care about fairness in burden sharing for climate change mitigation? Evidence from a lab experiment"	6.9%
T8	Environmental risk and strategy	pro, behavioral_intention, event, intention, attribution, subjective, adaptation, personal, extreme_weather, farmer, responsibility, behavior, wildfire, efficacy, exposure, experience, harm, flood, environmental, predict "Experience of extreme weather affects climate change mitigation and adaptation responses"	6.7%
T9	Energy transition	transition, clean, fossil_fuel, phase, decarbonization, industry, coal, subsidy, gas, green, homeowner, energy, renewable_energy, conjoint, investment, prefer, natural, fund, alternative, heat "A historical turning point? Early evidence on how the Russia-Ukraine war changes public support for clean energy policies"	6.3%

T10	Climate action	emotion, hope, health, story, worry, anger, human, activism, emotional, tourism, action, efficacy, relate, collective, crisis, culture, doubt, cultural, environmentalism, appraisal	5.5%
		"All Hearts and Minds on Deck: Hope Motivates Climate Action by Linking the Present and the Future"	
T11	Climate change awareness and consequences	voter, global_warm, global_warming, weather, price, vote, net_zero, scientific_agreement, experience, delay, election, decision, probability, drought, temporal, immediate, time, party_identification, consequence, political	5.0%
		"How information about likely accomplishments affects willingness to sacrifice to reduce global warming"	
T12	Support for renewables	nuclear, farm, offshore_wind, community, energy, nuclear_power, renewable_energy, local, plant, logit, acceptance, company, production, source, ireland, development, power_plant, net, planning, perception	4.8%
		"Public perception of offshore wind farms in Ireland"	
T13	Transport policy support	transport, travel, transportation, nudge, air, aviation, car, measure, behavioral, road, traffic, sustainable, cluster, city, consumption, fairness, flight, behaviour, mobility, food	4.7%
		"Climate change and air pollution: The connection between traffic intervention policies and public acceptance in a local context"	
T14	Carbon sequestration	land, forest, cdr, sequestration, soil, management, biodiversity, offset, afforestation, reforestation, landowner, program, storage, dioxide_removal, service, urban, agricultural, tree, strategy, carbon	4.4%
		"Perceptions of Utah ranchers toward carbon sequestration: Policy implications for US rangelands"	
T15	Social support of green innovation	technology, smart_meter, wind, deployment, solar, capture_storage, meat, nuclear_power, utilization, capture, power, side, medium, university, location, sustainable, acceptance, innovation, development, grid	4.1%
		"How information, social norms, and experience with novel meat substitutes can create positive political feedback and demand-side policy change"	

To the contrary, the other prevalent topics, such as T2 “trust in government and party preference” (studies looking at the role of political ideology and trust in government), T3 “perceived effects of climate policy” (studies looking at the perceptions of the climate policy and how it shapes support), T4 “carbon tax acceptance” (studies focused on acceptance of carbon taxation or carbon pricing), T5 “role of framing and communication” (studies focused on the role of frames and communication in shaping policy support), T9 “energy transition” (studies focused policies targeting energy sources and transition away from fossil fuels), and T10 “climate action” (studies focused on socio-psychological and cognitive factors explaining support for climate action), are all topics that gained more attention in the scientific literature in recent years.

Figure 5.2a. Word clouds of 15 topics in our sample.

Note: The font size reflects the probability of the respective word given the topic, while darker colour indicates higher exclusivity.



Figure 5.2b. Change in shares of topics in our sample over time.

Note: To establish presence of a nonlinear relation between the period of publication and the topic prevalence, the former is converted into a set of dummies for each year. Coefficients generated by a regression where the outcome variable is the topic prevalence in each publication. An estimate with a 95% confidence interval above zero indicates a significant prevalence of that topic in the respective year.

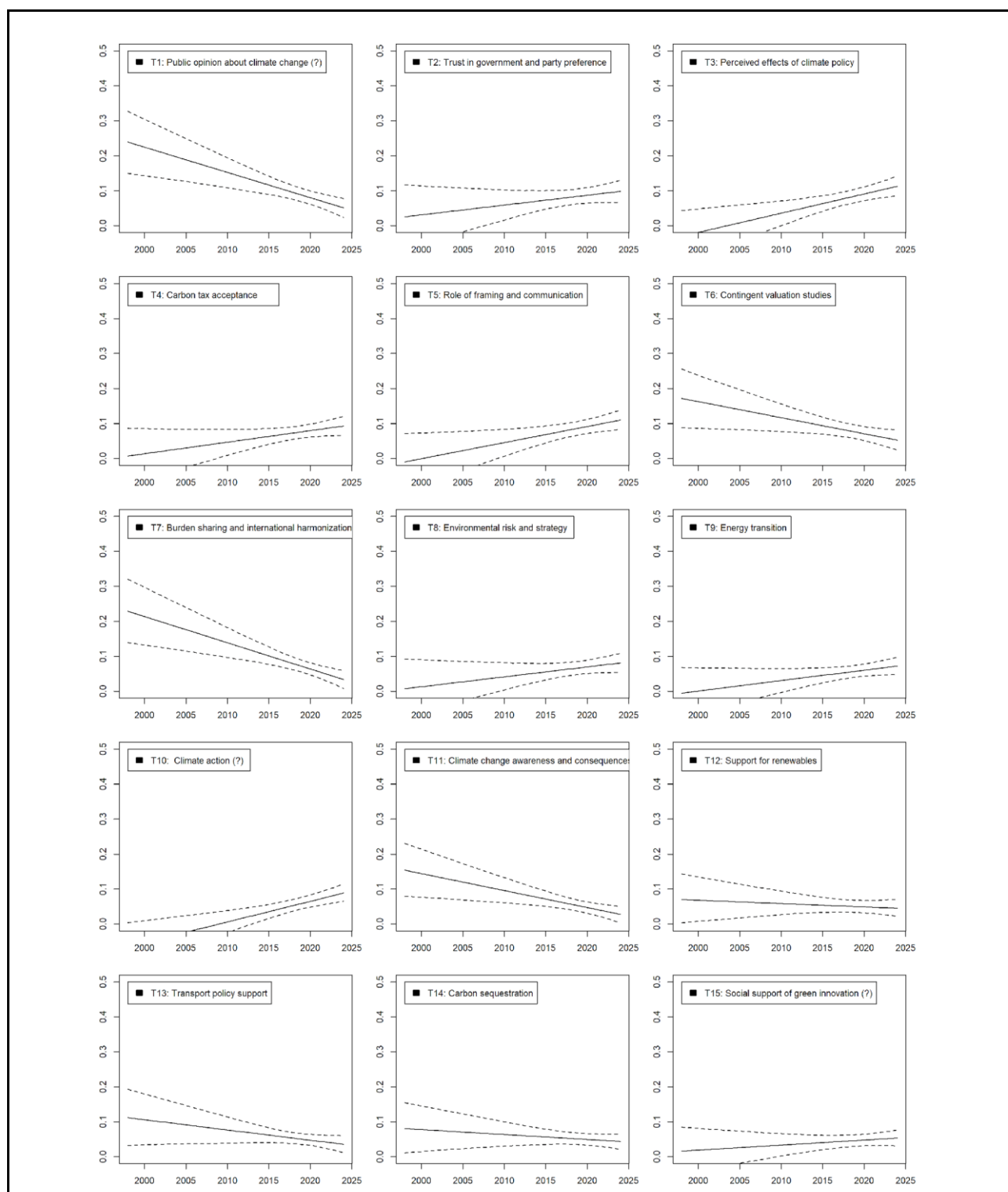
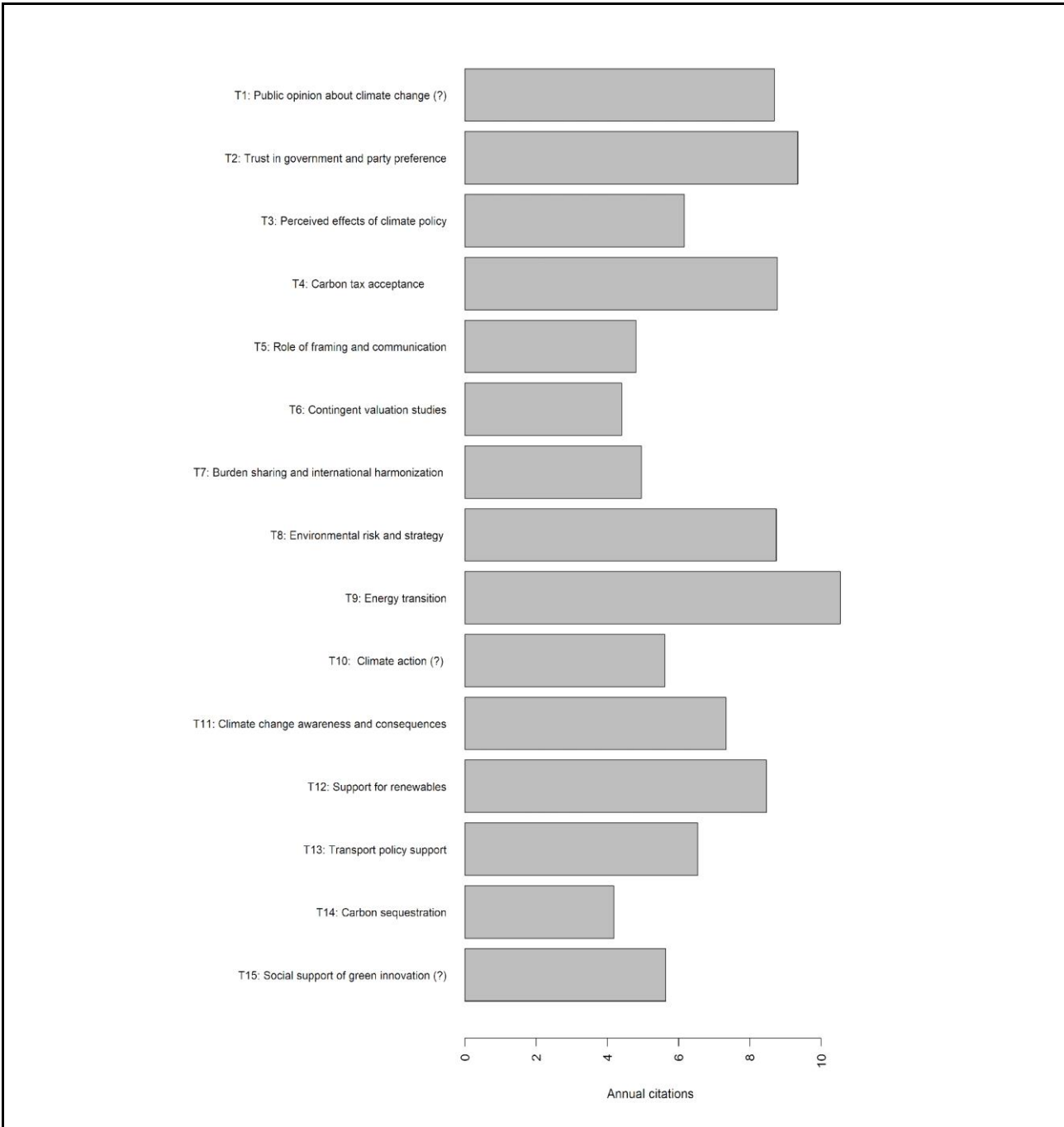


Figure 5.2c. Average number of citations per year per document for each topic.

Note: The number of citations per document belonging to a topic is calculated by multiplying the publication's number of citations per year with the topic prevalence and taking the average. The dashed line indicates the average number of citations per year an article from our sample has received (6.9).



To summarise the time-trends in prevalence of topics within the literature on policy acceptance, in the beginning of our sample period studies tended to focus on the determining role of people’s beliefs about climate change and its consequences for how much they support or oppose climate policy. Over time, the prevalence trend seems to have shifted away from such studies towards studies looking into the role of more specifically policy-oriented perceptions, as well as of more fundamental and deeper explanatory factors.

Table 5.2b. Distribution of the main topics across five main countries of affiliation.

	USA	Switzerland	UK	Germany	Sweden
T1: Public opinion about climate change	15.1	5.3	8.8	7.4	2.8
T2: Trust in government and party preference	9.7	4.1	7.9	7.9	28.8
T3: Perceived effects of climate policy	5.2	15.7	9.1	8.5	8.4
T4: Carbon tax acceptance	4.6	11.6	7.5	12.6	21.1
T5: Role of framing and communication	10.7	6.4	10.7	5.5	1.9
T6: Contingent valuation studies	4.4	1.9	4	10.5	2
T7: Burden sharing and international harmonization	6.5	15	9	8.8	4.6
T8: Environmental risk and strategy	9.5	1.3	6.4	8.7	1.4
T9: Energy transition	6.8	15.8	3.7	4.2	2.1
T10: Climate action	7.1	3.2	5.2	4.2	2.8
T11: Climate change awareness and consequences	6.8	4.7	3.4	5.1	1.9
T12: Support for renewables	2.4	3.2	5.1	3.2	0.4
T13: Transport policy support	2.2	3.7	7.1	7.4	17.9
T14: Carbon sequestration	3.7	5.3	6.7	0.9	0.7
T15: Social support of green innovation	5.3	2.9	5.5	5.1	3.1

Figure 5.2c shows the average number of yearly citations per paper for each topic. The figure shows that prevalence in terms of the number of published studies on the topic is not directly correlated with the attention given to the topic as reflected in the number of citations. For instance, although T9 “energy transition” is not the most prevalent topic in terms of the volume of studies published on this topic, per-paper yearly average citation is the highest for this topic. Other more frequently cited topics include T1 “public opinion about climate change”, T2 “trust in government and party preference”, T4 “carbon tax

acceptance”, T8 “environmental risk and strategy”, and T12 “support for renewables”. To summarise, studies on “energy transition” and “carbon tax acceptance” are among the most prevalent studies and have been growing in prevalence in recent years. Moreover, studies on these topics are also among the most highly cited.

Finally, if we look at which topics researchers affiliated in different countries tended to focus on (**Table 5.2b**), we observe some interesting country-specific variations. For instance, researchers from institutions in Sweden have a strong focus on three topics: T2 “trust in government and party preference”, T4 “carbon tax acceptance”, and T13 “transport policy support”. Research coming from Switzerland also has a strong focus on a specific set of topics, namely: T3 “perceived effects of climate policy”, T7 “international burden sharing”, T9 “energy transition”, and T4 “carbon tax acceptance”. In other countries, including the United States, the United Kingdom, and Germany, the topics are distributed relatively evenly.

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Appendix A: Search Query

The search query consisted of four parts connected with a logical “AND” operator.

Part 1 of the query consisted of the set of expressions including:

- Every possible combination of the words in:

{public, public's, citizen, citizens', voter, voters', popular, mass, residents', policy, climate-policy, climate action, climate-action, people's, carbon-tax, tax, carbon-taxation, taxation}

with words in:

{preference, preferences, attitude, attitudes, opinion, opinions, acceptance, support, acceptability, reaction, reactions, willingness, opposition, oppositions, resistance, approval, approvals, appraisal, appraisals, evaluation, evaluations, valuation, valuations, response, responses, aversion, aversions, concern, concerns};

- A set of specific expressions that typically feature in the literature on public acceptance of policy:

{political acceptance, political acceptability, political feasibility, economic evaluation, economic evaluations, economic valuation, economic valuations, economic value, economic values, wtp, willingness-to-pay, willingness to pay, supporters, opponents};

- Every appropriate combination of the words in:

{preference, preferences, attitude, attitudes, support, acceptance, acceptability, opposition, oppositions, resistance, aversion, aversions, reaction, reactions, opinion, opinions, willingness, appraisal, appraisals, response, valuation, valuations, evaluation, evaluations, concern, concerns}

with prepositional expressions in:

{for, toward, towards, of, to, of the public, by the public, from the public, of the citizens, by the citizens, from the citizens, of citizens, by citizens, from citizens, of voters, by voters, from voters, of the voters, by the voters, from the voters, of residents, by residents, from residents, of the residents, by the residents, from

the residents, of the people, by the people, from the people, of people, by people, from people}; and

- Every appropriate combination of the words in:

{public, citizens, voters, residents}

with verb expressions in:

{prefer, prefers, support, supports, is supportive, are supportive, react, reacts, oppose, opposes, is opposed, are opposed, resist, resists, approve, approves, accept, accepts, value, values, evaluate, evaluates}

Part 2 of the query consisted of the following set of expressions:

{climate mitigation, climate change mitigation, climate-change mitigation, climate measure, climate measures, climate solution, climate solutions, mitigation target, mitigation targets, emissions target, emissions targets, decarbonisation, decarbonization, decarbonising, decarbonizing, mitigating climate change, mitigate climate change, curbing climate change, curb climate change, limiting climate change, limit climate change, reducing climate change, reduce climate change, tackling climate change, tackle climate change, combatting climate change, combat climate change, mitigating global warming, mitigate global warming, curbing global warming, curb global warming, limiting global warming, limit global warming, reducing global warming, reduce global warming, tackling global warming, tackle global warming, combatting global warming, combat global warming, mitigating emissions, mitigate emissions, curbing emissions, curb emissions, limiting emissions, limit emissions, reducing emissions, reduce emissions, tackling emissions, tackle emissions, combatting emissions, combat emissions, mitigating carbon, mitigate carbon, curbing carbon, curb carbon, limiting carbon, limit carbon, reducing carbon, reduce carbon, tackling carbon, tackle carbon, combatting carbon, combat carbon, mitigating co2, mitigate co2, curbing co2, curb co2, limiting co2, limit co2, reducing co2, reduce co2, tackling co2, tackle co2, combatting co2, combat co2, mitigating greenhouse, mitigate greenhouse, curbing greenhouse, curb greenhouse, limiting greenhouse, limit greenhouse, reducing greenhouse, reduce greenhouse, tackling greenhouse, tackle greenhouse, combatting greenhouse, combat greenhouse, mitigating ghg, mitigate ghg, curbing ghg, curb ghg, limiting ghg, limit ghg, reducing ghg, reduce ghg, tackling ghg, tackle ghg, combatting ghg, combat ghg, climate target, climate targets, carbon offset, carbon offsets, subsidies of fossil fuels}

Part 3 of the query consisted of the following set of expressions:

{policy, policies, levy, levies, phase out, phaseout, phase-out, phasedown, phase down, phase-down, moratorium, levying, tariff, tariffs, carbon border adjustment, border carbon adjustment, CBAM, price, prices, pricing, trading, cap and trade, cap-and-trade, tax, taxes, taxation, taxing, ets, regulation, regulations, regulate, regulatory, regulating, quota, quotas, standard, standards, subsidy, subsidies, subsidise, subsidised, subsidized, subsidize, subsidising, subsidizing, label, labels, labelling, action, actions, nudge, nudges, nudging, mandate, mandates, mandating, ban, bans, banning}

Part 4 of the query consisted of the following set of expressions:

{experiment, experiments, respondents, participants, survey, surveys, experimental data, experimental evidence, experimental results, experimental study, experimental studies, data, nationally representative, representative sample, representative samples, sample, samples, dataset, datasets, survey-experiment, survey-experiments, choice-experiments, choice-experiment, study, results, evidence, panel, panels, studies, large-sample}

Appendix B: STM Model Performance Metrics

