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Climate risk perceptions and policy ambition

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Abstract: This article investigates the factors which influence national climate change policy ambition, as they are reflected in states' commitments to reduce greenhouse gas emissions in United National Climate Change (UNFCCC) negotiations. The paper specifically investigates the relationship between policy ambition and public perceptions of the threat posed by climate change employing a 140-country nationally representative dataset of risk perceptions conducted in 2019. The analysis shows that while public opinion does correlate overall with policy ambition across countries, in a sizable minority of countries, public threat perceptions are high while policy ambition is low. In these countries, climate change policy is found to be malign in two senses: first, those policies are not consistent with achieving the global public good of climate change control; and second, in the sense that policies are not aligned with the level of concern of citizens about this issue.

Keywords: climate policy; risk perceptions; policy-making; malign policy; LRF World Risk Poll.

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Biographical notes: Olivia Jensen received her PhD in Development from the London School of Economics. She joined the National University of Singapore in 2014 and was appointed as the Lead Scientist (Climate and Environment) at the LRF Institute for the Public Understanding of Risk in 2019. She works on risk perception and communication among decision-makers and the general public with a particular focus on urban environmental risks.

1 Introduction

The 2021 report of the Intergovernmental Panel on Climate Change (IPCC) (2021) on physical climate change reports that global warming will exceed the 2°C threshold by 2100 unless “deep reductions in carbon dioxide and other greenhouse gas (GHG) emissions occur in the coming decades.” In late 2021, governments participated in the 26th UN Climate Change Conference of the Parties (COP 26) to review and potentially accelerate their actions to limit global warming. In the run up to the conference, some governments announced more stretching targets to reduce GHG emissions by 2030, while others retained earlier pledges exhibiting a low level of ambition, committing only to

reduce the carbon intensity of the economy or energy mix and allowing for an increase in absolute national emissions in the coming decade.

Overall, there is a large shortfall between the commitments of governments to reduce emissions in the near-term and the level of policy action necessary to limit global warming. Far from providing for a reduction in emissions at the global level, the pledges made at COP 26 collectively imply an increase in emissions in the next decade. Although actual GHG emissions fell by an estimated 7% in 2020 due to the global COVID-19 pandemic, emissions have grown at an annual average of 1.4% since 2010 and increased at 2.6% in 2019 due to a large increase in forest fires (UNEP, 2020). The emissions dip in 2020 is expected to be fleeting and to have a negligible impact on slowing global warming.

This gap between the level of action which the scientific consensus shows is necessary to avoid catastrophic climate change and the present level of policy action marks climate change as an area of ‘malign’ policy-making – the structure of incentives faced by governments is not conducive to actions which will lead to the desired outcome (Keohane and Victor, 2016). Part of the explanation lies in the nature of climate action as a global public good: the benefits of climate action are non-excludable as all countries will benefit from limiting global warming. This gives each individual country an incentive to free-ride on the efforts of others. Climate policy is a typical ‘tragedy of the commons,’ in that all countries have the same incentive not to cooperate, resulting in under-provision of the global public good. The outcome is “the biggest market failure the world has ever seen” (Stern, 2006).

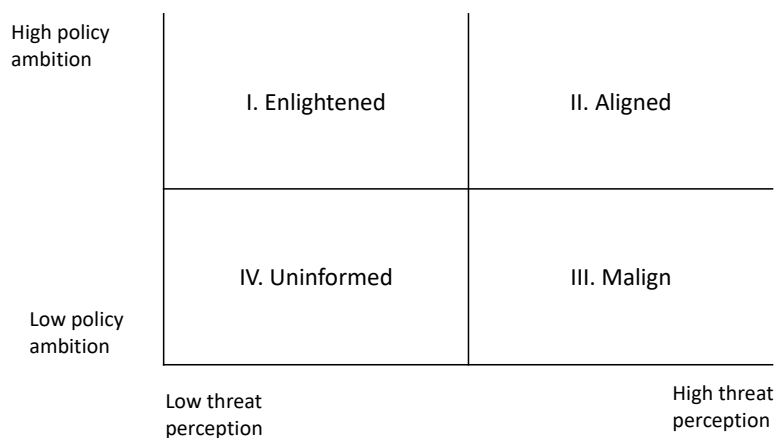
Global collective action problems of this kind are typically overcome only when a single country takes a leadership position. This type of unilateral action can occur if a single country has a significant impact on the collective outcome. Resolution is also possible when the costs of action are relatively low and can be widely distributed, as in the case of international action to control the use of ozone-depleting chemicals which culminated in the Montreal Protocol (Murdoch and Sandler, 1997). Yet, despite its malign characteristics, some countries do adopt more ambitious climate mitigation targets, and there is considerable variation between countries, suggesting that free-riding is not always the dominant factor in determining policy choices in this domain.

One reason for weak policy ambition in some countries could be that national policies simply reflect a low level of concern about the issue among the general public in those nations. In some places, the public may be sceptical about the reality of anthropogenic climate change (Capstick and Pidgeon, 2014) or perceive low risks to their own country from climate change [see Hornsey et al. (2016) for a meta-analysis]. Scholars have argued that the public will tend to under-estimate climate risk because of its abstract, slow-evolving nature and the belief that consequences will be spatially and temporally distant (Weber, 2010). Studies have confirmed this relationship between risk perceptions and psychological distance experimentally (Chu and Yang, 2018). Low-ambition climate policy in these countries would still be malign when considered at the global level but would be aligned with the short-term preferences of voters when considered at the national level.

The possible relationships between public opinion and public policy on climate change can be represented in four quadrants, as shown in Figure 1. Quadrant I ‘enlightened’ countries have high policy ambition with low public threat perception. In these countries, policies are aligned with views on the urgency of global climate action and are not free-riding on the actions of other countries. Quadrant II is the set of countries

in which high threat perceptions of the general public are aligned with high policy ambition. Quadrant III contains the set of countries in which climate policies are malign, both in the sense of Keohane and Victor (2016), that these countries are contributing to the global tragedy of the commons due to their planned increases in emissions, and malign in the sense that policy is not aligned with the general public's view that climate change constitutes a serious threat to the country. States where threat perceptions and policy ambition are both low are located in quadrant IV, 'uninformed'. Policy is in line with public opinion, but both policy and public opinion are inconsistent with the urgency and severity of the global threat of climate change.

Figure 1 Climate policy and public threat perceptions typology



This paper explores these possible configurations empirically, using climate perceptions data from a global survey and national pledges (as of late 2021) in international climate change negotiations under the United Nations Framework Convention on Climate Change (UNFCCC).

Section 2 of the paper reviews studies on climate policy, focusing on mitigation (reducing GHG emissions). Section 3 gives a brief introduction to the structure and terminology employed in the international climate negotiations to provide the context for the selection and interpretation of the policy indicator used in the quantitative analysis. Section 4 sets out the analytical approach. Section 5 presents the results, which are discussed further in Section 6. Section 7 concludes with recommendations for engagement and directions for future research.

2 Literature review

Studies have noted the wide variation in climate policy targets and policy impacts (measured in terms of emissions trajectories) between countries with apparently similar macroeconomic and developmental characteristics (Lachapelle and Paterson, 2013) and even between countries within the same negotiating blocs in international agreements (Tobin et al., 2018).

A number of studies have examined the link between climate policy and economic development, usually measured in terms of GDP or GDP per capita. Countries at higher

levels of economic development have more resources to invest in new technologies, to cover the costs of policy transitions and to compensate groups bearing the costs of transition and so may adopt more ambitious policies. On the other hand, advanced economies may also face higher opportunity costs because of sunk investments in high-emissions assets, more entrenched interest groups and greater challenges in changing high-energy lifestyles. Countries with lower per capita GDP may face fewer transitions and sunk costs but much higher opportunity costs from limiting future energy use. Empirical work on this relationship between GDP and climate policy has not resolved the question. For example, Tobin (2017) examined climate policy adoption in highly industrialised countries and found a positive correlation with GDP within this group of countries but this relationship does not appear to hold with broader country samples. Madden (2014) found a negative relationship between GDP per capita and climate policy adoption; other studies found no significant relationship in either direction (Bättig and Bernauer, 2009; Kammerer and Namhata, 2018).

A second factor which may influence policy ambition is differences in expected ‘co-benefits’ of climate action. Co-benefits refer to the positive impacts of policies to reduce GHG emissions on other policy goals (IPCC, 2014). For example, co-benefits of increasing renewable energy production may include the expansion of national green technology industries, contributing to GDP growth and exports. The co-benefits associated with a reduction in the use of fossil fuels for power generation include improvements in air quality and thus improved public health and greater national energy security for countries which are net fossil-fuel importers (IPCC, 2014; Thurston, 2013). High co-benefits from mitigation may incentivise countries to adopt more ambitious emissions reductions targets (Dolšák, 2009).

The co-benefits will be weighed against the costs of action, which may vary considerably between countries. National economies have different capacities and costs associated with GHG emissions mitigation options such as increasing the proportion of renewables in the energy mix, reducing emissions from industrial processes, potential to electrify transportation and industrial processes, the characteristics of the existing building stock, land use, agriculture, forestry; and potential to reduce waste and increase efficiency across sectors and for carbon capture and storage. However complete and reliable data on the required investments and their associated costs are limited (Masseti et al., 2017). Estimates of the net macroeconomic effects of climate mitigation are also highly sensitive to the treatment of uncertainty (Drouet et al., 2015) and to the selection of the discount rate (Ricke et al., 2018). The share of fossil fuels in the fuel mix may be used as a partial proxy for the costs of action.

The prevailing level of fossil fuel consumption (Keohane and Victor, 2016) and the contribution of fossil fuels to energy generation (Bättig and Bernauer, 2009) are also potentially significant factors influencing policy decisions but it is not clear which direction this relationship will take. If emissions per capita are high, the marginal cost of reducing emissions may be lower and the range of policy options available may be greater than in countries where per capita emissions are already low. This relationship was tested empirically by Nachmany et al. (2014) and Fankhauser et al. (2015), who found that countries with higher emissions have more climate change legislation, regulation and policy on average. Lachapelle and Peterson (2013) found a significant negative correlation between carbon intensity and emissions trend in the 1997–2008 period, such that countries with high carbon intensity at the baseline underwent lower emissions growth in the following decade.

States may also be differentially motivated to mitigate climate change because of their vulnerability to the impacts of climate change such as increasing the frequency and severity of heatwaves, wildfires, drought, floods, storms and other extreme weather events and sea level rise (IPCC, 2014). Countries which are expected to suffer the most dramatic consequences, like the submersion of small island developing states, may be motivated to set an example to other countries in their climate commitments even if their own contribution to global emissions is insignificant.

Another set of factors potentially driving climate policy relates to domestic political, economic and institutional characteristics. Studies addressing links between policy and institutions have focused mainly on democracy and institutional veto points. Democracies are found to perform better in terms of political commitment to climate change mitigation (Bättig and Bernauer, 2009) and climate legislative record (Fankhauser et al., 2015), and on emissions trajectories in the 1997–2008 period (Lachapelle and Paterson, 2013) as well as on environmental policy (Neumayer, 2002). Democracies are found to have higher environmental quality (Bernauer and Koubi, 2009; Ward, 2008) and demonstrate more international commitment to environmental protection (Roberts et al., 2004; Neumayer, 2002). Madden (2014), meanwhile, investigates the role of veto points and finds a negative and significant relationship between the number of veto points and states' legislative record on climate. This relationship is confirmed by Fankhauser et al. (2015) who finds a significant positive effect of unified government on the climate legislative record. Despite this, studies incorporating political variables found limited explanatory power (Lachapelle and Paterson, 2013).

Further institutional characteristics with a potential connection to climate policy include the political orientation of the governing party, the influence of interest groups (Mathys and de Melo, 2011) and policy coalitions (Knox-Hayes, 2012), which are in turn related to the contribution of oil and gas to the macroeconomy (Madden, 2014). Left-wing governing parties are associated with better environmental regulatory performance (Neumayer, 2003) and a similar relationship was found for ambitious climate policy in a study employing qualitative comparative analysis (Tobin, 2017).

In the context of international negotiations, countries' incentives to commit to more ambitious policies relate not just to their domestic conditions but also to their incentives to cooperate – or not – with other states. This is most clearly demonstrated in the European Union (EU). Despite different economic and emissions profiles, EU members negotiate collectively in the UNFCCC. Inevitably, membership of the EU is found to have a strong influence on climate policy (Jänicke and Wurzel, 2019) as it does on environmental policy generally (Lieberink et al., 2009). The influence of the EU appears to extend to states which have strong trading links with the bloc, through the European Free Trade Area, or are engaged in the EU accession process (Dolšák, 2013). More subtle but still important influence occurs through repeated interaction between states, as Kammerer and Namhata (2018) show in their study of adoption of mitigation policy. More broadly, there is evidence of regional convergence among states on environmental policy (Tosun and Knill, 2009; Holzinger and Knill, 2004). On the other hand, it is important to note that there remains considerable divergence between countries within the same negotiation bloc at the UNFCCC (Lachapelle and Paterson, 2013; Tobin et al., 2018).

A further explanation is that nations may be motivated to commit to ambitious policies because of a sense of historic responsibility for global warming. This approach of

‘common but differentiated responsibility’ for climate action has been a core principle of international climate negotiations (see Section 3). States which accepted this principle and began the process of emissions reductions while the protocol was in operation may face fewer obstacles to continuing with policies of emissions reductions in the subsequent rounds of international negotiation.

In summary, national attributes potentially influencing climate policy ambition identified in the literature include: level of economic development, co-benefits (air quality, energy security), fossil fuel intensity of power generation, energy intensity of the economy, institutional characteristics (democracy), exposure to natural disasters and membership of a negotiating bloc.

The possible role of public opinion in explaining policy ambition has not previously been explored empirically. This may be due to the lack of comparable cross-country data. Although national-level surveys on public perceptions of climate change risks and responses have been conducted with increasing frequency and depth since the 1990s, these have largely been conducted in the USA and to a lesser extent in other advanced economies. More national-level studies are now being conducted in other countries (Wang and Zhou, 2020) and in multiple countries using the same survey instrument (Kvaløy et al., 2012; Lewis et al., 2019).

Those multi-country studies that are available show high concern about climate change over several decades, but with considerable variability among countries and fluctuations over time. Already in 1992, a survey of 24 countries found that pluralities in each of these countries viewed climate change as a subject of concern, with just over half of all respondents at an international level rating it as a ‘very serious’ problem (Brechin, 2003; Dunlap, 1998). By 2009, a majority of respondents in 17 of the 25 countries surveyed in the Pew Research Center’s (2009) Global Attitudes Project believed global warming to be a very serious problem. However, the Pew surveys found some countries reporting sharp increases and others sharp decreases in the percentages of people considering climate change to be a ‘very serious’ problem. For example, in Brazil, the proportion answering ‘very serious’ rose from around 50% in 2009 to 90% in 2020. On the other hand, sharp declines in belief in and concern about anthropogenic climate change occurred between 2007/2008 and 2010 in the USA and Western Europe (Leiserowitz et al., 2013).

Cross-national examination of the relationship between climate concern and policy has been held back by the absence of truly comparative data as the questions posed in surveys differ in terms of the risk object (the source of the risk – ‘global warming’, ‘anthropogenic climate change’, and ‘natural disasters’), the risk target (who or what is at risk – the individual, locality, country or globe) and the nature of the risk perception (worry, risk rating, probability, severity of consequences, etc.). The LRF World Risk Poll, conducted worldwide in 2019, addresses the gap in comparable international data on climate risk perceptions and provides an opportunity to examine the role of public opinion in greater depth. The World Risk Poll data are discussed further in Section 4.

3 Context: international climate negotiations

Policy actions on climate change can be divided into two categories: ‘mitigation’ actions and ‘adaptation’ actions. In this context, ‘mitigation’ refers to prevention, i.e., reductions in GHG emissions with the aim of limiting future climate change, while ‘adaptation’

refers to investments in infrastructure and other policy interventions to reduce the harmful impact of higher temperatures, sea level rise and extreme weather associated with climate change. Our focus here is on mitigation, which is characterised by the public good challenges introduced above. National mitigation efforts are reflected in the commitments that states make in the international climate negotiations and implemented in a variety of national laws, executive orders and policy documents (Nachmany et al., 2014).

The 1992 UNFCCC marked the beginning of international negotiations on climate change. This agreement established the principle of common but differentiated responsibility, distinguishing between industrialised countries which contributed to emissions historically and were the largest emitters at the time of the negotiations, and other countries. This distinction was operationalised in the Clean Development Mechanism (CDM) established in the 1997 Kyoto Protocol. Under the protocol, binding emissions reductions targets were applied only to 43 industrialised countries at the baseline year of 1992.

Negotiations at the end of the initial Kyoto Protocol commitment period failed to establish a new set of targets which would form the basis for the operation of the CDM. At the 2009 Copenhagen Conference of the Parties (COP), states were unable to agree on binding GHG reductions and negotiations subsequently shifted to voluntary emissions reduction commitments. States agreed instead to propose intended Nationally Determined Contributions and to make a “fair and ambitious mitigation contribution, according to their national circumstances” (United Nations, 2009)]. The INDCs were put forward by all parties to the agreement, including low income countries, thus marking a break with the differentiation principle of the Kyoto Protocol. However, developing countries argued that they should not commit to emissions reductions. Rather, they would seek to strike a balance between emissions control and economic growth. India’s INDC submission states this objective explicitly: “Nations that are now striving to fulfill [sic] this ‘right to grow’ of their teeming millions cannot be made to feel guilty of their development agenda as they attempt to fulfill [sic] this legitimate aspiration” (Government of India, 2016). Developing states also argued that they did not have adequate financial resources to carry out adaptation and mitigation programs and so many distinguished in their INDC between unconditional reductions commitments and more ambitious commitments which would be conditional on the receipt of financial support from other parties.

Within the UNFCCC negotiations, states organise themselves into negotiating groups representing common interests. In the current round of negotiations, the world’s biggest emitters are organised into four negotiating groups: the EU, whose 28 countries adopt a common negotiating position; non-EU industrialised countries of the Umbrella Group (which includes Australia, NZ, Canada, the USA, and Russia); OPEC members; and the BASIC negotiating group made up of Brazil, China, India and South Africa. Collectively, these countries accounted for 78.5% of total global GHG emissions in 2020. The Environmental Integrity Group is a small group of industrialised countries with lower emissions (Switzerland, South Korea and others). Developing countries negotiate as the G77 and as smaller groupings including the small island (developing) states and least developed countries. With the exception of the EU, the negotiating groups do not adopt a common position and there is considerable variation among the nature and scope of commitments made by states within the same negotiating group.

The voluntary, state-specific negotiating structure has generated a complicated patchwork of commitments, ‘Nationally Determined Contributions’ under the Paris Agreement (Table 1). The majority of countries have committed to emissions reductions, either in absolute terms or relative to a ‘business as usual’ (BAU) forecast and most refer to a target year of 2030. Some submissions contain additional targets for 2025 and for later dates. Among the absolute reductions commitments, most, including those of the European countries, refer to baseline year of 1990, but some umbrella country commitments refer instead to a 2005 base. The assumptions used for constructing BAU forecasts were not standardised and some countries lacked the capacity to produce emissions forecasts and received assistance from donors in order to do so (Tobin et al., 2018). A third type of commitment refers to reductions in carbon or emissions intensity, i.e., the implied emissions of each unit of output, and a final type of commitment is limited to adopting policies and taking actions, without specific reference to emissions.

Table 1 NDC parameters

<i>Parameter</i>	<i>Category</i>	<i>Sub-category</i>	<i>Note</i>
Commitment type	Emissions reduction	Absolute	Baseline year: 1990/2005
		Relative	Reduce future emissions compared to a business as usual scenario
	Carbon/emissions intensity		Expressed per unit of GDP
	Policy and actions		E.g., increasing share of renewables in power generation
	Emissions peak		Expressed in volumetric terms or year
Target year	2025/2030	Additional intermediate targets for 2025	
		Additional long-term targets for 2050, e.g., carbon neutrality	
Conditionality	Conditional/unconditional		Conditional on external support, e.g., international financial and technical assistance for the decarbonisation of power generation or industrial sector
			Most countries which express a conditional target also provide an unconditional target
Inclusions/exclusions	Inclusions		Sectors: commitments specific to sectors, e.g., power, transport, industry
			Carbon sinks, e.g., increasing forested areas
	Exclusions		Sectors: land use, agriculture excluded
			Pollutants: non-CO ₂ GHG excluded

The most common type of pledge is a conditional reduction in emissions based on a 'business as usual' scenario expressed as a proportion of BAU emissions in the target year of 2030. A second large group of countries have made pledges to reduce absolute emissions expressed as a percentage of emissions in a baseline year of 1990, or less frequently 2005. A small number of countries including China and India made pledges to reduce the carbon intensity of the economy. A fourth group of countries only made pledges to make policy changes such as increasing the share of renewables in the power generation.

Despite their complexity, the voluntary national pledges under the Paris Agreement offer a more promising indicator of policy ambition for cross-national comparison than those available previously under the differentiated commitment structure for industrialised and developing countries (Keohane and Victor, 2016). However, the diversity of pledge types under the Paris Agreement poses difficulties for the selection of a suitable metric for policy ambition. The data and approach are discussed in the next section.

4 Data and method

Turning first to the public perceptions data: We employ data from the LRF World Risk Poll which provides exceptionally broad international coverage of climate threat perceptions. The survey was conducted worldwide from May 2019–January 2020 in 142 countries/territories with a sample size of approximately 1,000 people per country. A larger sample was taken in China and India (3,000 respondents) and Russia (2,000 respondents). National samples are representative of the resident adult population in rural and urban areas. Surveys were conducted by telephone or via face-to-face interviews. The survey questionnaire was translated into the major conversational languages of each country/territory in which the survey was administered (Lloyds Register Foundation, 2020a). Overall, the data from the World Risk Poll are of high quality with very few missing values. Unusually, the quality of the data for developing countries is of the same quality and consistency as the data from high income countries (Lloyds Register Foundation, 2020b).

To capture the individual's perceptions of the threat from climate change, we employ responses to the survey question: "do you think that climate change is a threat to the people in this country in the next 20 years?" Four possible responses were recorded: 'a very serious threat', 'a somewhat serious threat', 'not a threat at all', and 'do not know'. We employ the percentage of 'very serious' responses out of all responses for that country, including 'do not know', as our metric of public threat perception.

Data on policy ambition is drawn from country pledges under the international climate negotiations recorded in the IGES NDC Database (IGES, 2021). The database summarises the main climate pledges from each NDC concerning mitigation and adaptation. The database is updated regularly as countries renew their pledges. The August 2021 version of the database was used for this analysis.

As noted above, the diversity in type of pledges poses a challenge for comparative analysis. One approach would be to compare the depth of emissions cuts calibrated to a single reference year. Under this approach, countries making absolute reductions pledges would all be considered to be more ambitious than those making other types of pledges.

However, this approach ignores differences in costs of emissions reductions across countries. The same reduction pledge might imply much more ‘policy work’ in a country with low wealth, high growth and few opportunities for the development of renewables, than in a country with a declining emissions trajectory and access to emissions-reductions technologies. In order to take this into account, we can compare ambition for each pledge type separately, or we can compare the reductions relative to the country’s chosen benchmark, considering that a 20% reduction compared to BAU for a developing country is similar in terms of policy work to an absolute reduction of 20% for a developed country. We present both approaches below.

Table 2 Variables

<i>DV</i>		<i>Source/note</i>
Policy ambition	National emission reduction commitment	‘Policy and action’ pledges are recorded as an emissions reduction of 0%
<i>IV</i>		<i>Source/note</i>
Public concern about climate change	Proportion of people who consider climate change to be a ‘very serious threat to people in this country in the next 20 years’	LRF World Risk Poll
Economic development	GDP per capita (latest)	World Development Indicators
Co-benefit: air quality	PM 2.5 mean annual exposure (2017)	World Development Indicators
Co-benefit: energy security	Net oil imports (2019)	IEA
Energy transition cost	Proportion of fossil fuels in power generation (2019)	IEA
Energy intensity of economy	TFC/GDP (2019)	IEA
Natural disaster impacts	Number of people affected by hydro and meteorological disasters in the last 10 years as a proportion of population	EMDAT
Democracy	Political rights and civil liberties score (2020)	Freedom house. The possible value range is 0–100, with 0 indicating an absence of democracy and civil liberties and 100 indicating the highest level of political rights and civil liberties.
EU member	Country was/was not a member of the European Union in 2021	

The minimum unconditional emissions reduction commitment by 2030 relative to benchmark is used as the main indicator of policy ambition. The metric has a possible value range of 0–100, with 0 indicating no commitment to reduce emissions and 100 indicating a commitment to eliminate emissions (this can include carbon capture and storage).

For the regression analysis, a standard cross-sectional multiple linear regression is used to estimate the model:

$$y_i = \alpha + \beta T_i + \gamma X_i + \varepsilon_i$$

where y_i indicates the national emission reduction commitment in country i , T_i indicates proportion of people in a country who consider climate change to be a serious threat, and X_i includes indicators for a set of variables for other factors potentially influencing climate policy derived from the literature review. These are the level of economic development is measured using GDP per capita. We expect to find a positive correlation with policy ambition, while bearing in mind the range of results found in previous studies. Co-benefits are captured through two variables, air quality (to capture environmental health co-benefits) and net oil imports (energy security co-benefits). Higher levels of air pollution and higher net oil imports are expected to be correlated with higher policy ambition. Costs of the energy transition are captured in the share of fossil fuels in electricity supply; economy-wide transition costs are captured with a variable measuring the energy intensity of the economy (total final energy consumption/GDP). A higher proportion of fossil fuels and higher energy intensity are expected to be associated with lower policy ambition. Vulnerability to natural disasters is reflected in a variable of proportion of the population harmed by disasters in the last decade. Higher vulnerability is expected to correlate positively with policy ambition. Finally, democracy is measured with freedom house political rights and civil liberties scores.

5 Results

5.1 Descriptive statistics

National pledges are summarised in Table 3. The data suggest that countries with higher levels of economic development and lower levels of expected growth in the medium-term are more likely to make absolute reduction; countries with higher levels of economic development and higher GDP growth forecasts are more likely to make commitments to reduce emissions intensity, while countries at lower income levels with higher growth expectations are more likely to commit to relative emissions reductions. This is the largest group of countries but they have much lower emissions (38% of the emissions of the countries making absolute reductions commitments). Figure A1 in Appendix shows the distribution of the policy ambition variable.

Table 3 Emissions commitments and economic development

	<i>No. of countries</i>	<i>CO₂ emissions (2018)</i>	<i>Per capita GDP (average)</i>	<i>GDP growth forecast (average)</i>
Absolute reduction	34	13.95kt	\$26,011	3.26
Relative reduction to BAU	56	5.26kt	\$10,263	4.52
Emissions intensity	8	13.20kt	\$24,177	4.11
Policies	10	0.45kt	\$14,151	4.12
Other/incomplete	3			

Table 4 Threat perceptions by country grouping

	<i>Very serious threat</i>	<i>Somewhat serious threat</i>	<i>Not a threat at all</i>	<i>Do not know</i>	<i>Range (very serious threat)</i>
World	49%	27%	11%	13%	15–87%
EU	56%	32%	7%	4%	25–85%
OECD	56%	31%	9%	4%	25–87%
BRIC	35%	27%	15%	23%	22–71%
LDC	44%	22%	12%	22%	15–78%
OPEC	41%	27%	15%	16%	21–75%
GCC	28%	26%	21%	25%	21–34%

Notes: EU: European Union, 27 members; OECD: 38 members; BRIC: Brazil, Russia, India and China; LDC: Least Developed Country, 46 countries; OPEC: Organization of Petroleum Exporting countries, 15 members; GCC: Gulf Cooperation Council, six countries.

Turning to the climate threat perceptions data, we find a wide range in threat perceptions across countries, with the proportion of the population considering climate change to be a very serious threat ranging from 15% to 87% (Table 3). 49% of all responses to the survey were ‘very serious’; aggregated at the national level, the largest number of countries have serious threat responses in the 50–60% bracket (Figure 2). Looking at groupings of countries, we find a similar wide range in the EU and OECD. This similarity is perhaps not very surprising given the considerable overlap between these two groups of states but the EU has a reputation for more ambitious climate policies than other rich countries, so we might expect to see a narrower range in public opinion. We also note that there is wide variation in the balance of public opinion on the climate threat in OPEC countries, there is a much narrower range and lower upper bound in public opinion in the Gulf states. In the GCC, the highest proportion of people considering climate change a threat is only 34%, despite the states’ exposure to high temperatures and their economic dependence on fossil fuels.

Figure 2 Threat perceptions distribution (see online version for colours)

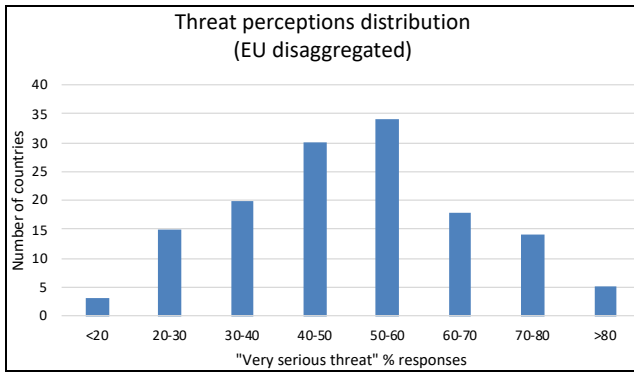
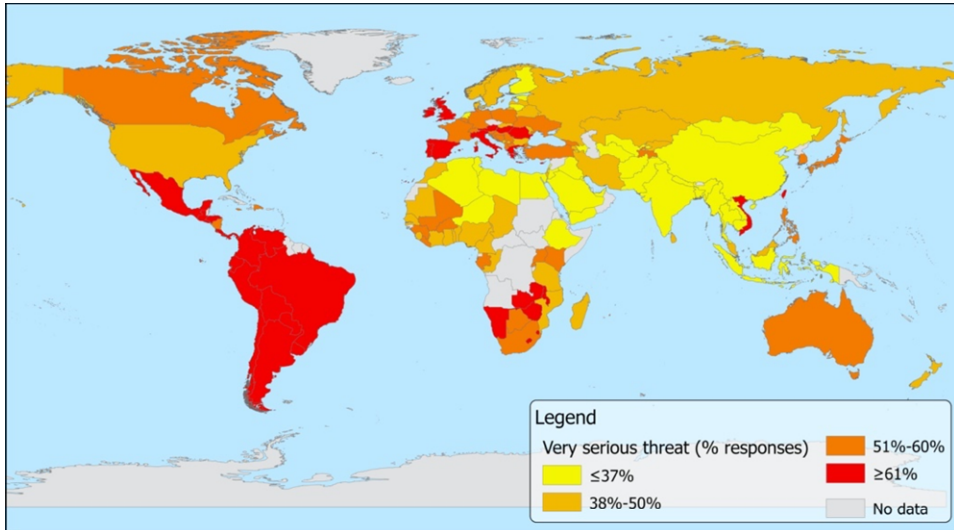


Figure 3 provides a spatial representation of public threat perceptions by country. The pattern observed is the contrary of what would be expected if people were well informed and primarily concerned about threats related to heat and water scarcity, as countries

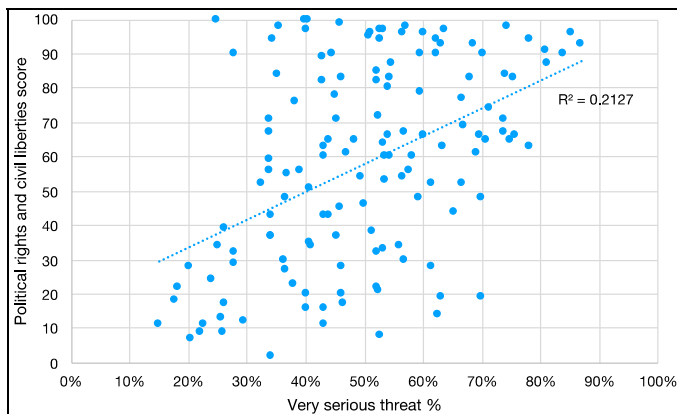
which already experience high average temperatures and water stress show generally lower levels of concern about climate change threats than countries in temperate regions. Latin America stands out for its consistently high level of concern across countries, while Europe and southern Africa also have clusters of countries where high threat perceptions are particularly prevalent.

Figure 3 Global climate threat perceptions (see online version for colours)



Threat perceptions are not correlated with GDP per capita. There is a weak positive correlation with political rights and civil liberties: greater political rights are associated with higher threat perceptions (Figure 4). This relationship may be explained by better access to information in traditional and social media, or driven by underlying differences in values, trust in science or other institutions.

Figure 4 Climate threat perceptions and political rights correlation (see online version for colours)



5.2 Bivariate correlations

We examine next the relationship between policy ambition, public opinion and other national characteristics identified in the literature. The results of analysis of variance tests are shown in Table 5. For the purposes of this section of the analysis, all pledge types are considered together, using the proportional reduction commitment in the NDC regardless of baseline as the measure of policy ambition. Data for EU countries is disaggregated, leaving a sample of 109 countries for which all variables are available.

Table 5 ANOVA (response variable: climate change policy ambition)

	<i>Df</i>	<i>Mean sq.</i>	<i>F value</i>	<i>Pr(>F)</i>
CC threat perception	1	0.151	5.374	0.022**
PM 2.5 mean exposure	1	0.517	18.374	0***
Net oil imports	1	0.192	6.8	0.01***
Share of fossil fuels in power generation	1	0.243	8.643	0.004***
Democracy rating	1	0.258	9.174	0.003***
Natural disaster impacts	1	0.114	4.052	0.047**
Residuals	109	0.028	NA	NA

Notes: Signif. codes: 0.001 '***', 0.01 '**' and 0.05 '*'.

Analysed individually, measures of CC threat perception, air pollution, energy security, energy transition cost, democracy and natural disaster impacts are all significantly related to climate policy ambition.

Figure A2 in Appendix shows the bivariate correlation between policy ambition and threat perception broken down by pledge type. There is a weak positive correlation for relative pledges, a weak negative correlation with emissions intensity targets, and no correlation for absolute pledges or policies and actions pledges (scored as a '0' level of ambition).

5.3 Regression analysis

In order to examine the relative explanatory power of the variables, regression analysis is conducted. Table Y reports the results of the regression analysis. The base model shows the significant correlation between CC threat perception and policy ambition when no additional variables are include. However, model 1 shows that this relationship is not robust to the inclusion of GDP per capita.

Model 2 is the main model which contains all variables of interest. In this model, the significant factors driving climate policy ambition are: net oil imports, fossil fuel share and the impact of natural disasters. These variables take the expected signs. Countries with high disaster impacts are more likely to have high policy ambition. The effect size is small but highly significant. Countries which import oil and could benefit from higher energy security by reducing oil use are more ambitious, while countries with high energy transition costs related to high fossil fuel share in energy generation are less ambitious. This latter effect is significant at the 5% level and has a much larger coefficient. Overall, model 2 explains just over 25% of the variance in policy ambition between countries. Although this is a relatively low level of explanatory power, it is not surprising that

different factors are driving policy across countries given the complex nature of climate change policy's costs and benefits.

Model 3 includes a dummy for EU status. The dummy variable for EU membership is significant as expected due to the bloc's common negotiating position, but the direction and level of significance of the effects found in model 2 are all shown to be robust to the inclusion of the dummy variable.

Table 6 Regression coefficients

<i>Term</i>	<i>Base model</i>	<i>Model 1</i>	<i>Model 2</i>	<i>Model 3</i>
CC threat perception	0.22689*** (0.10730)	0.19147** (0.110957)	-0.181495 (0.123173)	-0.131643 (0.117908)
GDP per capita		2.31e-06*** (1e-06)	1e-06 (1e-06)	0 (1e-06)
PM 2.5			-0.001683 (0.001062)	-0.001452 (0.001012)
Net oil imports			0.000371** (2e-04)	0.000324** (0.00019)
Fossil fuel share			-0.123475** (0.057409)	-0.093904** (0.055195)
Democracy			0.001947 (0.00082)	0.001097 (0.000815)
Disasters			0.000131*** (9.2e-05)	0.000177*** (8.9e-05)
EU member (dummy)				0.181386***
(Intercept)	0.24030*** (0.05882)	0.2057*** (0.058598)	0.398*** (0.100742)	0.381707*** (0.095861)
Adj. R ²	3.28%	9.00%	25.17%	32.4%
N	132	130	109	108

Notes: SE reported in parentheses. Signif. codes: 0.01 '***' and 0.05 '**'.

6 Discussion

The analysis confirms that climate policy in many countries is malign, both in the sense of being inadequate to address the threat of the climate crisis at the global level and in the sense that climate policies in many countries do not reflect well the level of concern that citizens of countries have about this issue. Other factors, including the predominance of fossil fuels in the energy mix and dependence on oil imports and exposure to extreme weather appear to be driving policy choices more strongly than public threat perceptions. Furthermore, a large share of the policy differential between countries remains unexplained by the factors identified, suggesting that country-specific factors are often dominant.

However, it is important to note that the disjuncture between public opinion and policy ambition in the climate domain is not uni-directional and malign, with a majority of the public always considering the threat to be high and policy ambitions always low, as represented in quadrant III of Figure 1. Rather, in a significant minority of countries, public perceptions of climate threats are comparatively low (less than half the population consider climate change to be a serious threat) but policy ambition is high, corresponding to the ‘enlightened’ quadrant I of Figure 1. Table A1 in Appendix shows how countries could be classified into the four quadrants. The threshold value for higher/lower policy ambition used is relative while the threshold value for threat perception is set at 50%. These thresholds are intended to be illustrative. It could certainly be argued that the ‘higher’ ambition policies are not high enough to reduce the risk of catastrophic climate change.

Many, but by no means all, of the quadrant I countries are EU members and non-member countries with close links to the EU. As a bloc, the EU has taken a leading role in climate mitigation efforts, recognising climate action as a global public good, acknowledging the historic contribution of European countries to GHG emissions, and the ability of the bloc to undertake the structural and behavioural changes necessary to achieve reductions. Other countries in this quadrant and their citizens demonstrate the possibility of overcoming the ‘tragedy of the commons’ in relation to climate action.

Quadrant II countries encompass a very wide range of levels of economic development, from high-income service-based economies, where there may be a high level of awareness about climate change due to the media, to low-income agricultural economies, where perceptions of climate risk may be heightened by direct experience. In these countries, the high level of public concern is reflected in their governments’ commitments in the international negotiations.

Quadrant III countries, where policy ambition is low and threat perceptions are high, may be concerned by the direct and opportunity costs of climate mitigation. In these countries there may be potential for policy-makers to secure additional public support by adopting more ambitious climate policies.

In quadrant IV countries, only a minority of residents consider climate change to be a serious threat, even though they include countries where temperatures already frequently exceed human thermal comfort levels (UAE and Bahrain), countries that currently experience extreme water scarcity (Jordan and Libya) and have high exposure to extreme weather events (Myanmar and Bangladesh) (Eckstein et al., 2021). Given the evidence of climate-related risks in these countries, it may be surprising that citizens are not more concerned about climate change. However, it is important to recognise that ‘climate change’ is not experienced directly by people and it is necessary for events like droughts, heatwaves and floods to be interpreted by experts in government agencies, the media or civil society in order for people to understand the connection between weather events and anthropogenic climate change. The low threat perception in these countries may be due to reluctance on the part of government and national media to inform the public about the link between GHG emissions and extreme weather.

This typology can help to inform the selection of interventions by actors who seek to promote more ambitious global climate policy-making in the hope of holding global warming to below 2°C. Efforts to inform, educate and communicate about climate change should be focused in countries in quadrant IV to improve the public’s understanding of the direct and indirect threats to security posed by climate change, and gradually increase pressure on policy-makers to adopt more ambitious policies. In quadrant III countries, the

focus should be on amplifying the weight of public opinion in the climate policy process, informing government agencies about the level of concern among the public and identifying interest groups and veto points constraining the adoption of more ambitious policies. Finally, it is important to recognise that NDCs are not in themselves actions, but rather intentions. Domestic laws and regulations give credibility to NDCs and only with concerted efforts on the part of informed and committed citizens in all countries will policy-makers take the necessary steps to avert catastrophic climate change.

7 Conclusions

This paper adds to previous studies of climate policy by considering the extent to which public opinion is a driver of policy ambition. The level of climate threat perception varies considerably between countries, from a minimum of 15% of the population considering climate to be a serious threat to a maximum of 87% of the population, making it possible to analyse the correlation quantitatively. The correlation is significant, but is not robust to the inclusion of other country-level variables including a measure proxying energy transition costs and a measure of energy security.

Comparing climate policy ambition across countries is extremely challenging because of the range of indicators used to express targets, different baselines and target timelines and the very different costs of transition across countries depending on their level and pattern of development. The approach used in this paper assumes that policy effort is reflected in the proportional reduction of GHG emissions rather than the absolute reduction. In future work, it would be valuable to explore other measures of policy ambition, including absolute reductions and compound policy indices, in order to test the robustness of the results found here. In particular, it would be useful to construct a normally distributed continuous policy variable to support further analysis.

A related but distinct area for future research is the drivers of climate threat perceptions. As noted above, the level of threat perceptions is far from what would be expected given the differences in exposure and vulnerability to climate change across countries. An accompanying paper employs the World Risk Poll data to identify factors correlated with risk perceptions using the individual as the unit of analysis. Future work in this area would ideally test the impact of selected national-level factors which might contribute to the social amplification or attenuation of climate risks while controlling for individual-level attributes.

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Appendix

Figure A1 Distribution of policy ambition variable (see online version for colours)

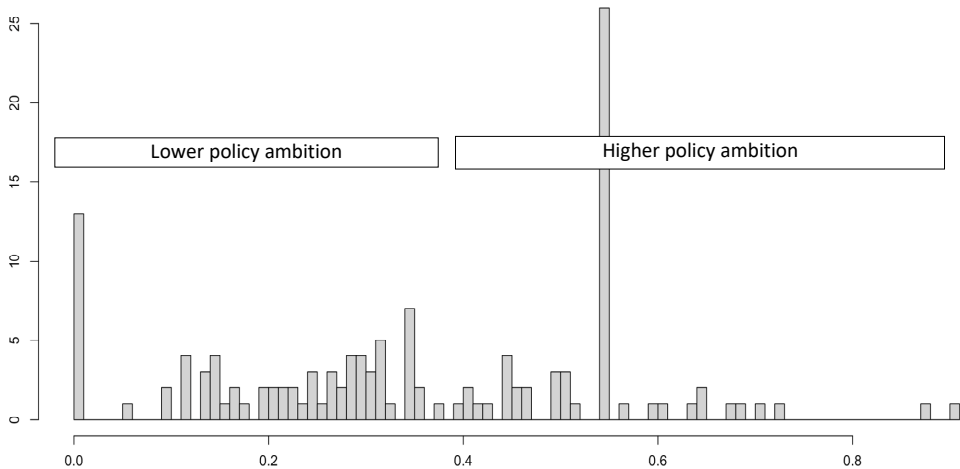
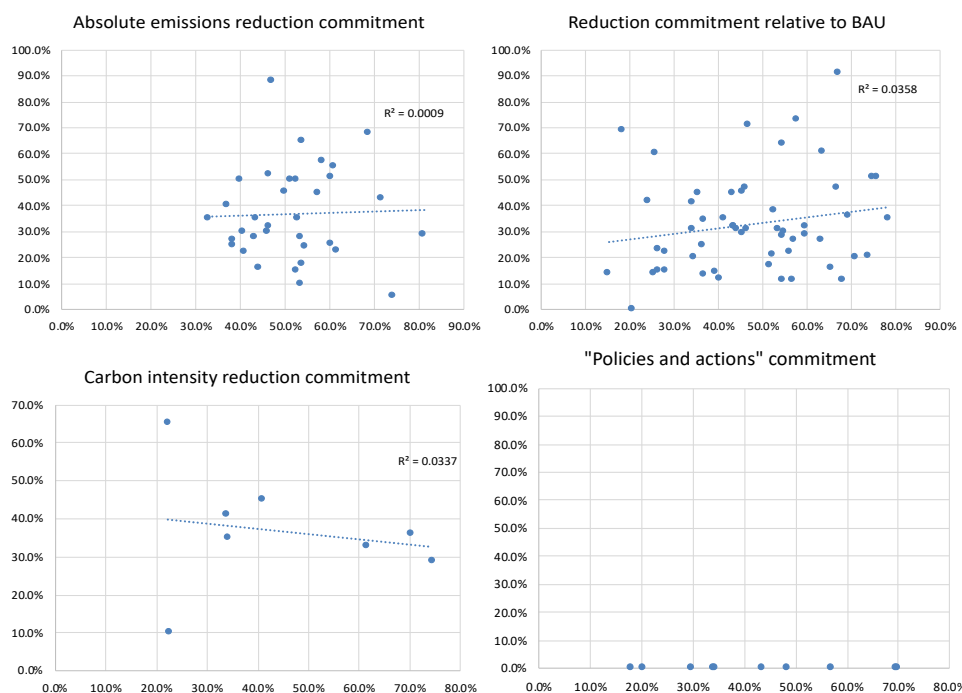


Figure A2 Policy ambition and threat perception correlations by pledge type (see online version for colours)

Note: EU aggregated.

Table A1 Country location by policy ambition/threat perception quadrant

	<i>Lower threat perception (< 50%)</i>	<i>Higher threat perception (> 50%)</i>
Higher ambition (% emissions reduction)	Tunisia	Brazil
	Indonesia	Canada
	Cambodia	Gambia, The
	Mongolia	Morocco
	Malaysia	Zambia
	Ghana	Switzerland
	Gambia	Gabon
	Morocco	North Macedonia
	Nigeria	Colombia
	Norway	Malawi

Notes: Threshold values are adopted to illustrate how countries could be classified. The threshold value for higher/lower threat perceptions is set at 50%. In 'higher' threat perceptions countries, if more than 50%, i.e., a majority of the population considers climate change to be a serious threat, the country is classified as having 'higher' threat perception. The threshold value for policy ambition is set at 39%. This value is relative and is established with reference to the distribution of the variable (see Figure A1). The distribution is multi-modal with peaks at 0, 33% and 55%. Countries around the upper mode and above are considered to have 'higher' policy ambition; those around the central mode and below to have 'lower' policy ambition.

Table A1 Country location by policy ambition/threat perception quadrant (continued)

	<i>Lower threat perception (< 50%)</i>	<i>Higher threat perception (> 50%)</i>
Higher ambition (% emissions reduction)	USA	Slovenia
	Finland	Croatia
	Lithuania	Poland
	Estonia	Germany
	Netherlands	Luxembourg
	Denmark	Belgium
	Sweden	France
	Bulgaria	Malta
	Latvia	Austria
	Slovakia	Ireland
	Lao PDR	Hungary
	China	Italy
	Ethiopia	Romania
	Chad	Cyprus
	Moldova	Greece
	(25 countries)	Spain
		Portugal
		Georgia
		El Salvador
		Liberia
		Ukraine
		UK
		Philippines
		Namibia
		(33 countries)
Lower ambition (% emissions reduction)	Egypt, Arab Rep.	Nicaragua
	Myanmar	Bolivia
	Saudi Arabia	Eswatini
	Libya	Chile
	Bahrain	Argentina
	Nepal	Serbia
	Kuwait	Albania
	Mozambique	Panama
	Sierra Leone	Burkina Faso

Notes: Threshold values are adopted to illustrate how countries could be classified. The threshold value for higher/lower threat perceptions is set at 50%. In 'higher' threat perceptions countries, if more than 50%, i.e., a majority of the population considers climate change to be a serious threat, the country is classified as having 'higher' threat perception. The threshold value for policy ambition is set at 39%. This value is relative and is established with reference to the distribution of the variable (see Figure A1). The distribution is multi-modal with peaks at 0, 33% and 55%. Countries around the upper mode and above are considered to have 'higher' policy ambition; those around the central mode and below to have 'lower' policy ambition.

Table A1 Country location by policy ambition/threat perception quadrant (continued)

	<i>Lower threat perception (< 50%)</i>	<i>Higher threat perception (> 50%)</i>
Lower ambition (% emissions reduction)	Uzbekistan	Botswana
	Iran	Honduras
	Afghanistan	Guinea
	Yemen	Bosnia-Herzegovina
	Jordan	Paraguay
	Sri Lanka	Ecuador
	Bangladesh	Turkey
	Iraq	Uganda
	Benin	Mexico
	Pakistan	Singapore
	Algeria	Rwanda
	Mauritania	Guatemala
	UAE	South Korea
	Thailand	Japan
	Kazakhstan	Dominican Republic
	Israel	Vietnam
	Belarus	Australia
	Senegal	Jamaica
	Russian Federation	South Africa
	New Zealand	Uruguay
	Kyrgyz Republic	Senegal
	Lebanon	Mauritius
	Togo	Mali
	Madagascar	Kenya
	Cameroon	Zimbabwe
	Congo, Rep.	Tajikistan
	Niger	Lesotho
	Azerbaijan	(36 countries)
	India	
	Tanzania	
	Montenegro	
	Armenia	
	(41 countries)	

Notes: Threshold values are adopted to illustrate how countries could be classified. The threshold value for higher/lower threat perceptions is set at 50%. In 'higher' threat perceptions countries, if more than 50%, i.e., a majority of the population considers climate change to be a serious threat, the country is classified as having 'higher' threat perception. The threshold value for policy ambition is set at 39%. This value is relative and is established with reference to the distribution of the variable (see Figure A1). The distribution is multi-modal with peaks at 0, 33% and 55%. Countries around the upper mode and above are considered to have 'higher' policy ambition; those around the central mode and below to have 'lower' policy ambition.