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Exploring Climate and Environmental Policy Preferences - Caught Between Material Needs and Social Approval

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1. Introduction

The Intergovernmental Panel on Climate Change (IPCC) repeatedly emphasizes not only the risk of inaction against climate change for natural and human systems; it also highlights the need for action against those consequences. These already have detrimental impacts on biodiversity, economic activities, and societies at large and are only likely to show more severe effects in the future (IPCC 2023, 2018). In other words, climate change poses yet another set of newly emerging risks for societies. In times of societal challenges citizens and economic actors have repeatedly relied on the state to address these newly emerging risks (Polanyi 1944; Esping-Andersen 1990). Existing institutions, historical legacies, and existing policy regimes in these states determine the available room for action to address climate change as a risk (Mandelli 2023). At the same time, there is broad consensus that policymakers have to play a leading role when trying to limit the rise of global temperatures to a level that is compatible with established ways of living (IPCC 2018).

However, governments are given a mandate by their citizens, thus public opinion about what actions to take on climate change is fundamental to effective policymaking in this field (Bernauer 2013; Drews and Van Den Bergh 2016). In this context, climate policies are often depicted as subject to dynamics of international relations and domestic politics (Aklin and Mildenberger 2020; Colgan et al. 2021). On an international level, climate politics is often depicted as a public good game (Hardin 1971; Ostrom 2000), where the cooperation of actors is conditional on the cooperation of pivotal actors, that is, high emission countries. In light of only mixed evidence for this assessment, domestic political dynamics have moved into the center of attention. In this debate the high costs involved in effective climate action are frequently highlighted. Those costs translate, however, only to uncertain benefits in the future, thus providing limited electoral incentives for policymakers (Colgan et al. 2021; Aklin and Mildenberger 2020; Pralle 2009). This focus on domestic politics has consolidated the role of public support for climate action as not only a sufficient, but a necessary condition in established democracies for any serious ambition to limit the global rise in temperatures to the 1.5 °C agreed on in the Paris Agreement (IPCC 2018).

Among the multitude of factors driving climate policy support (Drews and Van Den Bergh 2016), risks related to the natural and political consequences of climate change receive increasingly more attention (Leiserowitz 2006; van der Linden 2015; Mumpower et al. 2016; Hasanaj and Stadelmann-Steffen 2022). Ever more frequent extreme weather events exemplify the potential threat changes to the global climate can have at the regional level. For example, Austria was hit by heavy rainfall in autumn 2024. Severe damages to the railway infrastructure not only required considerable investments in repairs estimated at around 100 million euros; it also disrupted supply chains and commuting routes creating additional costs and consequences for economic stakeholders as well as citizens. While the direct effects of such events are geographically concentrated, their broader implications can affect a wide range of stakeholders in society. Thus, the degree to which this risk is present adds to the probability with which these risks will have negative consequences for stakeholders such as citizens, i.e. their vulnerability (Heltberg et al. 2009; Otto et al. 2017; IPCC 2023). That is also why recent notions of vulnerability go beyond looking at only the natural consequences of climate change.

Gaikwad et al. (2022) establish the distinction between *climate change vulnerability* as exposure to the natural consequences of climate change and *policy vulnerability* as exposure to the indirect effects of climate policies. Examples of the former include exposure to rising sea levels or extreme weather events such as droughts or heavy rainfalls, as briefly exemplified above. Policy vulnerability can include, for example, labor market risks originating in efforts to transition economic systems to a more sustainable mode of operation (for a broader overview, see Markkanen and Anger-Kraavi 2019). The consequences of this transition, however, are not straightforward to predict, as its effects can differ greatly by affected regions (Rodríguez-Pose and Bartalucci 2024).

Consider for example workers in the automotive sector. The green transition is likely to trigger a higher demand for electric vehicles as opposed to traditional combustion engines. While displacement of these jobs is plausible given the international competition in the automotive sector, it is also plausible that a considerable amount of these workers can switch to jobs which require similar skill but produce output with a better impact for the global climate. However, the degree to which such a switch is possible can depend fundamentally on the potential overlaps of skills between green and non-green occupations (Lazear 2009; Gathmann and Schönberg 2010).

The labor market implications of a green transition require a reliable and robust measure of affected sectors, occupations, and individuals. Identifying these sectors has been a challenge for cross-sectional analyses of green labor market developments (JRC 2021). One major impediment for these comparisons are rooted in methodological difficulties to find a reliable measurement for labor market consequences in the green transition (Bachelot 2024). This, in turn, creates impediments for effective climate policy design that is sensitive to the regional and personal nuances of potential beneficiaries. Ultimately, this exemplifies that the green transition can trigger broad demands for policy action to address newly emerging social risks (Esping-Andersen 1990; Armingeon and Bonoli 2006; Häusermann 2012; Mandelli et al. 2024).

At the same time, major natural consequences of climate change require effective policy action to reduce the long-term risk of climate change, as well as to address its short-term consequences. While each of these aspects distinctly shapes how citizens evaluate climate policies, they have the potential to create cross-pressures for citizens and create novel challenges for policymakers (Gaikwad et al. 2022). There is an objective side to climate change and policy vulnerability (Stokes 2016; Oatley 2023; Colantone et al. 2024), yet an accurate, objective assessment of risk a difficult task for experts, let alone laypersons (Quoß 2025). Thus, adding subjective perceptions of different types of vulnerability to this debate offers valuable insights into citizens' more affective preference formation process (Chung and Mau 2014; Walpole and Wilson 2021b; Hansson 2010; Tversky and Kahneman 1974). Moreover, an assessment along these lines allows for a better understanding of what it is exactly that citizens think about, when they expect negative effects from the consequences of climate change and climate policies. This offers a nuanced picture of citizens' perceived vulnerability to the climate crisis, complements objective accounts, and, ultimately, allows for a more thorough investigation of drivers for support or opposition.

Policy responses addressing these risks and corresponding cross-pressures must deal with the long-term as well as the short-term consequences of climate change and the policies designed to address this challenge (IPCC 2018). Climate policy can be categorized exactly along these lines: On the one hand, *mitigation policies* are designed to reduce the level of emissions of greenhouse gases (GHG) in the atmosphere in the long term. These policies aim to achieve this goal via different mechanisms, that is, by incentivizing climate-friendly behavior or by penalizing emission intensive activities. Policies of the former kind are referred to as *pull mitigation* policies, those of the latter kind as *push mitigation* policies (Ejelöv et al. 2022).

Adaptation policies, on the other hand, aim to reduce immediate negative consequences from, for example, extreme weather events, thereby providing relief for the short-term risks of climate change (Ejelöv et al. 2022; Orlove 2022). Such policies tend to be tailored to the needs of specific vulnerable regions or communities and are consequently harder to classify (Orlove 2022; Wilson et al. 2020). Nevertheless, one intuitive distinction here concerns the source of the risks: natural consequences require established or innovative adaptation policies, taking into account regional particularities and needs. Indirect political consequences call for *eco-social policies* reducing social risks such as unemployment or energy poverty in the green transition (Bohnenberger 2023; Zimmermann and Graziano 2020; Gough 2016).

This selection equips policymakers with a broad set of possible options to address the root causes of climate change as well as its immediate natural and political consequences (Wicki et al. 2019). Exploiting this set of instruments by combining different types of policies in comprehensive packages is shown to increase policy support effectively (Wicki et al. 2020; Fesenfeld et al. 2020; Fesenfeld 2022). In this context, research on welfare state policies suggests that policy packages tailored to the specific needs and risks of citizens are more likely to garner support, even though individuals tend to assess possible trade-offs between policy types (Häusermann et al. 2019). One prerequisite for the successful design of climate policy packages are insights on citizens' material and non-material concerns (Gaikwad et al. 2022). However, it remains unclear if such tailoring of policies is sufficient to encourage highly vulnerable citizens to embrace an otherwise costly climate policy package, especially if non-material concerns are prevalent.

This is where non-material incentives become relevant. Climate change and effective climate policies must come with fundamental changes of behaviors and norms guiding these behaviors might accompany such policies in the long run (Kinzig et al. 2013; IPCC 2018). In the short run, established social norms on climate change related behavior affect support for climate and environmental policies (Andre et al. 2024; Sparkman et al. 2021; Huber et al. 2018; Farrow et al. 2017; Alló and Loureiro 2014). These norms or behavioral and normative guidelines are accompanied by social approval or sanctions (Elster 1989; Ostrom 2000; Bicchieri 2017). Moreover, they are not isolated from the material aspects mentioned above. Conversely, they can jointly affect citizens' preference formation process, whereby the results depends on the potential costs and benefits of norm-compliance (Nyborg 2018; Berger et al. 2023).

Consider, for example, policies that try to encourage (or enforce) a shift from animal-based to plant-based diets as a way to reduce the harmful climate impacts from agriculture. If a majority of citizens' deems such a switch normatively valuable and people are aware of this normative expectation, social pressure or the desire to gain social approval might change behavioral habits and preferences. However, such a change of behaviors and preferences might entail prohibitive costs arising from, for example, more expensive substitute products. In such cases, the material disadvantages associated with climate policies might offset any potential gain in social approval and discourage a shift to more sustainable behavior or preferences.

With increasingly visible natural consequences of climate change and accelerating efforts for a green transition of economic systems, vulnerabilities towards these risks and perceptions thereof are only likely to increase. However, there remain gaps in research on the objective and subjective dimensions of climate change related risks, especially with respect to the political consequences, as described above. At the same time, normative guidelines about what is approved climate change related behavior in society are likely to become increasingly salient. The latter has been assessed in isolation, yet research investigating the interaction between material and non-material drivers for climate policy preferences is scarce. In this cumulative dissertation I address this relationship with the aim of getting a better understanding of the following overarching research question:

RQ: *How do citizens include their material needs and desire for social approval in their climate policy preference formation process?*

As has been outlined above, this research question touches upon a range of sub-fields, in which there remain open questions:

RQ1: *How can the impacts on a green transition for labor market participants be assessed?*

RQ1.1: What is the role of skill-transferability for labor market participants in the green transition?

RQ2: *How do citizens perceive vulnerability towards the natural and political consequences of climate change?*

RQ2.1: What are the vulnerabilities driving opposition to which type of climate policy?

RQ2.2: What role does compensation play when addressing these vulnerabilities?

RQ3: *How do normative beliefs interact with policy vulnerability when shaping climate policy preferences?*

RQ3.1: Does high vulnerability offset positive effects from belief updates about normative expectations?

RQ3.2: What role does the type of policy play in this relationship?

The three empirical papers included in this dissertation address these questions by elaborating, first, on objective and subjective measures of vulnerability. Additionally, they focus on the effect of the latter on empirically established dimensions of climate policy. Lastly, the interaction between normative expectations about climate-friendly behavior and perceptions of policy vulnerability is scrutinized. In light of recent and salient public debates about the costs of climate policy, unveiled economic vulnerabilities through dependence on fossil fuels, and frequent civil protests across Western European countries, the empirical effort in this thesis should facilitate broader conclusions that go beyond the studied cases.

In the first paper of this dissertation, I elaborate on workers' labor market prospects in the green transition and address how such insights can aid in the design of effective policy interventions. In doing so, I circumvent prevalent methodological difficulties when analyzing the greening of labor markets and offer a more nuanced way to assess potential movements between green and non-green sectors (*RQ1* and *RQ1.1*). Empirical work in this paper is based on analysis of secondary textual data provided by the International Labor Organisation (ILO) for the International Standard Classification of Occupations (ISCO), the Occupational Network's (O*NET) extension of the Standard Occupational Classification (SOC) as well as the European Standard Classification of Occupations (ESCO) (ILO 2023; O*NET 2023; Dierdorff et al. 2009; European Commission 2022). The proposed methodology is showcased using data from the European Social Survey (ESS) (N = 36,212) (European Social Survey European Research Infrastructure (ESS ERIC) 2024).

The second paper of this dissertation is dedicated to the role of perceptions of vulnerability to climate change, its political consequences, and different dimensions of climate policies for citizens support for costly climate policy. This allows to address the potential benefits of including tailored compensation for immediate risks into climate policy packages (*RQ2*, *RQ2.1*, and *RQ2.2*). The hypotheses generated in the second paper are tested by relying on original data from a conjoint experiment collected in Germany (N = 2,958).

Lastly, paper three elaborates on the potential conflict between social approval and material needs. By empirically addressing a moderation effect of policy vulnerability on a belief update of normative expectations, I explicitly test a potential trade-off of these aspects in citizens' preference formation processes (*RQ3*, *RQ3.1*, and *RQ3.2*).The third paper is based on a two waves of data collection, implementing a pre-registered survey experiment (N = 3,078 Wave 21; N = 2,978 Wave 24) in the framework of the Austrian National Election Study (AUTNES) (Partheymüller et al. 2024).

Table 1 provides an overview of the papers included in this dissertation. All papers contribute to the open questions in the literature on drivers for climate policy preference formation empirically and theoretically along the following lines:

1. *Introducing an indicator for green skill transferability:* The main contribution of the first paper is of a methodological nature: I offer a continuous indicator to determine the degree of green skill-transferability between green and non-green occupations which directly compares task contents of these jobs based on sentence embeddings (Reimers and Gurevych 2019; Devlin et al. 2018).

2. *Green labor market transformations:* This adds to the our understanding of the political consequence of climate change and offers a novel approach to assess social risks originating in a transition to a more sustainable economy, thereby adding to the broader literature on the political consequences of labor market transformations (Autor et al. 2003; Autor and Dorn 2013; Iversen and Soskice 2001; Lazear 2009; Rueda 2014; Armingeon and Bonoli 2006; Thewissen and Rueda 2019).

3. *Perceived climate change and policy vulnerability:* I shed light on the subjective dimension of vulnerability as a component of individuals more affective decision making process (Walpole and Wilson 2021b; Tversky and Kahneman 1974). Given potential cross-pressures stemming from the natural and political risks of climate change (Gaikwad et al. 2022), shedding light on the more value-laden component of risk (Hansson 2010) offers valuable insights into citizens preference formation process in light of newly emerging risks (Chung and Mau 2014; Marx and Picot 2020).

4. *Implications of climate policy dimensions:* I am able to demonstrate that citizens distinguish between more or less intrusive policies aiming at reducing climate change in the long run and policies that tackle the immediate natural and social consequences of climate change and policies designed to address them. The dimensionality of climate policies has distinct consequences for citizens level of support.

5. *Compensation of risks has its limits:* Implementing a conjoint experiment, I highlight that these policy packages, when bundled in comprehensive packages can increase policy support (Wicki et al. 2020; Fesenfeld 2022; Wicki et al. 2019). However, this effect is limited for citizens' who perceive themselves to be highly vulnerable towards the natural consequences of climate change. This illuminates the role of perceptions of climate change and policy vulnerability in this decision making process and establishes potential levers as well as limits of established instruments for policymakers to garner mass support for costly climate policies.

6. *Types of policy vulnerability:* I provide a more nuanced understanding of citizens vulnerability perceptions regarding the indirect consequences of climate policies. As has been pointed out, these individuals are only marginally responsive towards direct compensation. Applying an extended operationalization to measure perceived policy vulnerability across economic, inflation, and lifestyle concerns offers a more comprehensive understanding of this factor (Mau 2023).

7. *Policy vulnerability as impediment for social norm interventions:* I elaborate on a potential trade-off between the social approval gained from complying to social norms implementing a survey experiment in Austria. Thereby, I explicitly address the role of social norms and highlight the potential trade-off between material needs and social approval when citizens update their beliefs about what is appropriate behavior in society (Nyborg 2018; Berger et al. 2023).

8. *The limits of social norms for behavioral change:* While the general positive effect of social norms is re-established, the main contribution of this paper is showing that this effect is not uniform across policy dimensions. This highlights the potential of social norms for behavioral change but points out the limitations of this approach (Sparkman et al. 2021). This adds to a rich literature on the effects of social norms on public goods more broadly (Elster 1989; Cialdini et al. 1990; Ostrom 2000; Bicchieri 2017; Constantino et al. 2022) and on climate change related and environmental behavior more specifically (Schultz et al. 2007; Alló and Loureiro 2014; Farrow et al. 2017; Huber et al. 2018).

To sum up, in this dissertation I aim to provide a more nuanced understanding of new eco-social risks in the face of climate change and a potential green transition. In doing so, I distinguish between objective and subjective drivers of these risks in order to tap into a more affective realm of preference formation. Entering this realm also allows to gauge the interaction between material and non-material drivers of climate policy preferences using established interventions in behavioral public policy research.

The remainder of this dissertation is structured as follows: In the next sections I elaborate on the consequences of climate change for our understanding of social risks and link this to factors driving climate policy support established in the literature. Subsequently, I provide an outline of the empirical strategies applied in the different papers including the data collection procedure, the statistical methods as well as a justification for the case selection. The following three sections then include the papers as submitted to/published in international journals in the field. The final section is dedicated to a discussion of the overarching research question of this dissertation, a reflection on the potential limitations of this thesis in addition to an outline of avenues for future research in this direction.

Table 1: Overview of dissertation papers

Paper	**Title**	**Co-Author(s)**	**(Prospective) Publication**	**Status**
1	Who is transitioning to green? Introducing a text-based indicator to measure green skill transferability		Ecological Economics	Published 16 February 2026
2	Winning Over the Vulnerable? Perceived Vulnerability, Tailored Policy Packages, and Support for Climate Action	Reto Bürgisser	Socio-Economic Review	Under review
3	The Cost of Compliance - Normative Beliefs and Climate Policy Vulnerability		Political Behavior	Under review

2. Theoretical Framework

The long- and short-term consequences of climate change, be they environmental or political, will have visible effects on natural and human systems (IPCC 2018). Such fundamental challenges historically required effective risk mitigation strategies by state actors in order to alleviate negative consequences for citizens (Polanyi 1944). In the following, I elaborate on the similarities between the consequences of climate change and those of social risks previously on the agenda of welfare states (Mandelli et al. 2024; Mandelli 2023; Zimmermann and Graziano 2020; Gough 2016). By doing so I contribute to a debate about the toolkit at the disposal of policymakers when designing and implementing climate policies, highlight how their characteristics affect policy support, and if a combination of policies translates to distinct patterns of support. Lastly, I address the question of the interaction between the material factors embodied in eco-social risks and normative expectations regarding climate change related behavior.

2.1. Climate Change and Emerging Social Risks

The history of newly emerging social risks has been accompanying the evolution of the welfare state since its early stages. In these early stages, Polanyi (1944) links the need for state intervention to the extensive commodification of labor. The latter triggered a need for insurance against the threat of job loss, which could otherwise have devastating consequences for a growing labor force. With rapidly growing levels of prosperity and corresponding advances in life-expectancy, welfare state responses increasingly took these developments into account. As Esping-Andersen (1990) highlights, alleviating risks such as old age or deteriorating health through pension or healthcare systems have been defining characteristics of welfare state regimes, albeit following very different approaches across nations.

Nevertheless, with shifts in societies and labor force composition as well as changes in industrial systems, new social risks have been added to the agenda of welfare states (Armingeon and Bonoli 2006). More specifically, precarious employment relations, unequally distributed care responsibilities, and changes in the skill requirements of industries all emerge as new risks. This necessitated further adjustments of policy responses by welfare states – or even the development of innovative measures. In light of novel challenges to the basis of the welfare system, such as the financial crisis 2008, regimes adjusted and evolved into distinct combinations of more or less expansive and retrenching regimes (Häusermann 2012). Thereby they seemed to remain reactive instead of proactive and partially limited in their scope (Crouch and Keune 2012). The evolution of, on the one hand, social consumption policies, aiming at compensation and insurance in the short term (Huber and Stephens 2015). On the other hand, social investment policies target education and long-term development (Gingrich and Ansell

2015). Both social policy types further accentuated domestic disputes about the allocation of resources to address social risks (Beramendi 2015). In this context, more vulnerable groups are shown to express demand for compensation policies, while more affluent and less exposed citizens emphasize policies of social investment (Iversen and Soskice 2001; Kitschelt and Rehm 2006; Rehm 2009). This brief summary of states' responses to old and new social risks highlights that the notion of risk has been adapted to new developments that have rendered welfare state intervention necessary (for a more detailed summary see Mandelli et al. 2024; Mandelli 2023).

There are multiple reasons to consider climate change as a new social risk: First, the scientific consensus that the causes for climate change are a result of societal action is clear. Second, increasing visibility of the consequences of climate change for different stakeholders embed these impacts in social systems. Third, rising demand for climate policies to deal with these consequences highlight their political relevance. Accordingly, Mandelli et al. (2024) argue that the notion of social risks can be plausibly extended to this area, as the proportion of people affected by natural and political consequences of climate change is likely to rise (see also Gough 2016). In other, words, if an extreme weather event such as a drought affects "only" uninhabited regions of a single country at one point in time, it is questionable if this event requires a social response as there is no evident collectively generated or experienced risk. However, the social character of climate change related risk needs to be acknowledged if certain densely populated regions are repeatedly affected by, for example, floodings. Thus, in a context where climate change repeatedly leads to human, physical, and economic losses and damages, societies are likely to demand political actions to deal with those consequences.

Following this logic, (Mandelli et al. 2024) coin the term *socio-ecological risk* as a new facet of social risks which requires state responses. It is defined as a function of environmental hazards, reliance on activities or resources that are harmful to the environment, individuals vulnerability and the degree policy reactions are able to alleviate some of the above factors (Mandelli et al. 2024: 21). The drivers of vulnerability - "one's state of poverty, job precarity, material deprivation, health precariousness or social exclusion" (Mandelli et al. 2024: 21) not only resemble drivers of old and new social risks. There are also considerable overlaps with those factors frequently listed when addressing vulnerability to the direct and indirect consequences of climate change.

Assessments of vulnerability typically include a notion of negative (individual) consequences in the face of a hazardous event. The latter have consequences for the well-being of affected individuals or societies more broadly (Heltberg et al. 2009; Jurgilevich et al. 2017). This can also be expressed as the "susceptibility" to experience adverse consequences of climate change (Walpole and Wilson 2021a). Vulnerability is thus, not only determined by the existence of a risk, but also by the likelihood to be negatively affected by this risk. Otto et al. (2017: 1653) emphasize that factors such as age, health status and/or impediments, race/ethnicity, socio-economic status, and access to resources, both material and non-material, aggravate existing vulnerabilities. Citizens' climate change vulnerability has received considerable attention with a focus on the economic cost and political implications of extreme weather events (López-Feldman and González 2024; Taylor et al. 2014). Newman and Noy (2023), for example, show that the majority of the annual cost of extreme weather events that are linked to climate change stems from a loss of human life. Kotz et al. (2024) highlight that the annual economic cost societies are going to face due to climate change related damages by far exceed the cost of climate policy. Thus, in light of threats of the natural consequences of climate change to the physical and economic livelihoods of societies, assessing these risk as eco-social risks seems plausible.

Simultaneously, a growing literature deals with the indirect distributional effects stemming from climate policies designed to address the root causes of the global rise in temperatures, that is, the degree of policy vulnerability (Gaikwad et al. 2022). For example, Markkanen and Anger-Kraavi (2019), elaborate on the indirect effects of climate change policies across a range of inequality indicators and the potential for distributive conflict (Aklin and Mildenberger 2020; Colgan et al. 2021). They argue that, for example, policies targeting the energy efficiency of residential buildings or bans for combustion engines are not likely to trigger large conflicts. Nevertheless, they should take the socio-economic status of affected households into account in order to prevent backlash against climate action. The potential for conflict is much higher for large-scale renewable energy projects or efforts to preserve or restore carbon sinks. Here, extensive stakeholder involvement is key to prevent a potential backlash and ensure beneficial outcomes for affected stakeholders (see also Orlove 2022; Smith 2017; Martinez-Fernandez et al. 2010). These potential distributional consequences of climate policies highlight the social character associated with risks associated to climate policy. However, highly detailed insights on what drives concerns of stakeholder are necessary for policymakers in order to draft publicly acceptable policy proposals.

So far, much of the debate around policy vulnerability is focused on the labor market implications of a green transition and efforts to identify vulnerable segments and regions (see for example Graham and Knittel 2024; Lim et al. 2023; Rodríguez-Pose and Bartalucci 2024; McDowall et al. 2023). One aspect of this debate is about the identification and accurate classification of occupations with a positive or a negative environmental impact, that is, green and brown jobs (Stanef-Puică et al. 2022; Bohnenberger 2022). Definitions of green and brown vary widely. They include top-down or output-oriented definitions where occupations in industrial sectors are classified with respect to the environmental impacts of the whole sectors or with respect to the impact of the goods and services they produce (JRC 2021). These approaches are complemented by bottom-up definitions, where occupations are classified with respect to the skills required to perform tasks in green jobs (OECD 2023; Bluedorn et al. 2023; Vona et al. 2019; Consoli et al. 2016; Vona et al. 2018; Bachelot 2024).

More recently, this debate started to scrutinize greenness also in terms of similarity between green and non-green tasks. This line of research aims to shed light on the labor market prospects for individuals in fossil fuel dependent, brown sectors, when moving to green sectors (Bowen et al. 2018; Rutzer et al. 2020; Lobsiger and Rutzer 2021; Lazear 2009). These insights not only help to predict workers' labor market trajectories in economic transitions; they also provide crucial information on how to make a green transition also just (Martinez-Fernandez et al. 2010; Sulich et al. 2020; ILO 2015b). Consider the example of an electrical engineer working in a fossil fuel dependent power plant. Naturally, some of the skills required in this occupation will be specialized and tailored to the specific job. However, it is plausible to assume that a range of skills translates more or less easily from a fossil fuel dependent power plant to the renewable energy sector (Lim et al. 2023; Gathmann and Schönberg 2010; Zaussinger et al. 2025). Illuminating workers' transferability of skills allows to gauge the potential risk of citizens in the face of economic shifts. This, in turn, offers a way to predict the citizens' demand for insurance against the negative labor market consequences of a green transition in the form of social policy (Iversen and Soskice 2001; Autor et al. 2003; Busemeyer and Tober 2022; Gingrich 2019; Thewissen and Rueda 2019; Häusermann et al. 2016).

Nevertheless, this debate is facing methodological difficulties that impede comparisons of potential labor market impacts of a green transition across economic contexts. These difficulties are predominantly rooted in a reliance of results for the US context, which are difficult to transfer accurately to the European context. This lack of accuracy complicates detailed analyses of the potential labor market consequences for individuals in non-green jobs who could more or less easily transition to green occupations. To address these issues, Paper 1 of this dissertation aims to provide an answer to the following research questions:

RQ1: *How can the impacts of a green transition for labor market participants be assessed?*

RQ1.1: What is the role of skill-transferability for labor market participants in the green transition?

While labor market concerns can be a primary concern for citizens, it is plausible to assume that the potential negative indirect effects of climate policy for citizens are more diverse (Heddesheimer et al. 2025; Mau 2023; Schaffer 2024). Consequently, this line of research has been extended to reflect citizens' material as well as non-material aspects. Going beyond labor market consequences, Stokes (2016) finds causal evidence that the exposure to renewable energy projects leads to a political backlash in subsequent elections. In a similar vein, Colantone et al. (2024) document a backlash effect against a car ban in the city of Milan among those affected, which resulted in electoral success for the radical right, albeit without harming the incumbent (see also Stutzmann 2025). Voeten (2024) finds a similar effect with respect to a policy increasing the tax on natural gas consumption, which results in a higher likelihood to vote for the radical right if the effects are directly observable on renters' utility bills (for the case of a coal phase-out see Egli et al. 2022). Adding to this line of research, Schaffer and Magyar (2024) construct an index summarizing citizens' car usage, their status as owners or renters of housing, and the age of their residence building to capture policy vulnerability. They find that the latter decreases support for climate policy expansion but that these effects can be mitigated by, for example, political trust.

Both, the natural as well as the political consequences of climate change, can have affect citizens in isolation. Yet, increasingly frequent extreme weather events as well as political actions create geographical areas, where citizens are exposed to a certain degree of cross-pressure. Oatley (2023) describes how the transition of industrial systems from a carbon based economy in combination with increasing occurrences of natural risks of climate change shapes political behavior in the United States. The key argument here is that citizens form their climate policy preferences depending on the expected cost of climate policies and the expected threat of climate change. Expanding on the notion of cross-pressure, Gaikwad et al. (2022) show that citizens' dominant types of vulnerability determine their preferences for policy responses contingent on their specific needs. More specifically, these individuals have a higher demand for compensatory policies addressing their natural and political vulnerabilities.

It remains, however, doubtful if citizens can always accurately assess the level of objective risk of, for example, being affected by a flooding or losing their jobs (Quoß 2025; Chung and Mau 2014). The subsequent preference formation process might incorporate other aspects than only objective information (Gärtner and Schoen 2021). As Hansson (2010) points out, risk has an objective as well as a subjective component (see also Marx and Picot 2020). Rational calculations and precise assessments of outcomes is not always a feasible option when individuals form their preferences or make their decisions (Arrow 1982). Thus, heuristics, or cognitive short-cuts typically provide some assistance in this process (Tversky and Kahneman 1974). Scrutinizing citizens' perceptions of risk and vulnerability, therefore, allows to tap into this more intuitive decision making process and to consider risk perceptions as part of individual belief systems (Converse 2006; Wilson et al. 2019; Walpole and Wilson 2021b). Such perceptions are shown to affect not only outcomes such as subjective well-being, but also have repercussions for political attitudes regarding welfare state policies (Chung and Mau 2014). Marx (2014), for example, assesses the effect of subjective labor market insecurity on social policy preferences and finds that the former translates to higher demand for redistribution and resembles results obtained from research on industrial and occupational risk (Iversen and Soskice 2001; Rehm 2009).

Similarly, subjective perceptions of climate change related risks have received considerable attention. van der Linden (2015) discusses that these perceptions of risk are influenced much more by an experiential/affective and a socio-cultural/normative component than socio-demographic characteristics (see also Leiserowitz 2006; Walpole and Wilson 2021a). Perceived risk of or vulnerability to climate change has also been shown to constitute a robust predictor for climate policy preferences (Drews and Van Den Bergh 2016). Zahran et al. (2006) demonstrate that subjective measures of climate change vulnerability appear to explain a higher degree of variation in policy preferences than objective measures. In a similar vein, Mumpower et al. (2016) show that psychometric factors, such as the perceived natural consequences of climate change, not only are highly predictive of perceived climate change related risk; they also demonstrate that the latter has significant effects on the preferred level of resources dedicated to act against climate change and its consequences.

Research on the subjective dimension of climate change related risk and vulnerability has been increasing. Yet, there still remains a gap with respect to the subjective dimensions of climate change vulnerability, policy vulnerability and the perceived cross-pressure resulting from both. Shedding light on this more value-laden component of risk promises important insights into the drivers of climate policy preference formation. Moreover, it offers a way to assess citizens' non-material concerns when they evaluate the consequences of climate policy for themselves or their community. Consequently, the first part of Paper 2 of this dissertation aims to shed light on the following research questions:

RQ2: *How do citizens perceive vulnerability towards the natural and political consequences of climate change?*

RQ2.1: What are the vulnerabilities driving opposition to which type of climate policy?

Lastly, the focus on perceived vulnerability creates insights for policymakers when assessing the causes of public resistance to costly climate action and how to address those, for example, with a careful selection of suitable policies. However, designing these policies requires a detailed understanding of the potential (dis-)incentives associated with different types of climate policy.

2.2. Tailoring Policies to Vulnerabilities

"Climate-related risks for natural and human systems are higher for global warming of 1.5°C than at present, but lower than at 2°C [...]. These risks depend on the magnitude and rate of warming, geographic location, levels of development and vulnerability, and on the choices and implementation of adaptation and mitigation options. (IPCC 2018: 5)

Adaptation and mitigation policies are fundamental dimensions of climate policy. Adaptation policies, on the one hand, are concerned with the immediate effects of climate change (and climate policy). This type of policy aims to provide short-term relief and to prevent future damages from the consequences of climate change (Orlove 2022). Yet, depending on the severity of climate change and the resources available, there are limits to societies' adaptive capacities (IPCC 2018). Mitigation policies, on the other hand, target the root causes of climate change, namely, the concentration of greenhouse gas emissions in the atmosphere. To achieve this goal, effective mitigation requires wide ranging transformations of existing infrastructure, consumption, and behavioral patterns (IPCC 2018). These two policy directions entail a trade-off, as they are essentially competing for resources with each other (Tol 2005).

On a more abstract level, this set of policies can be linked to a collective action problem, where coordination among all players would increase pay-offs, but a lack of coordination leads to collectively disadvantageous outcomes (Hardin 1971). Mitigation policy is thereby considered a contribution to a public good, as it offers non-exclusive benefits. Adaptation efforts are highly context dependent and exclusive to benefiting stakeholders, thus resembling a private good. This dilemma has received some attention with respect to nation states as actors (Hasson et al. 2010). (Aklin and Mildenberger 2020), however, point out that an analysis of global climate action through the lens of a collective action problem treats nation states as black boxes and disregards potential domestic distributive conflicts. In other words, while international climate action is often characterized by the choice between local adaptation and global mitigation, it is not the only determining factor, for why nations choose to act on climate change. As has been pointed out above, policy action fundamentally depends on public support for specific policies. Thus, in light of scarce resources, decisions for one policy type over another is also shaped by distributive conflict, which is inherently political (Aklin and Mildenberger 2020; Colgan et al. 2021).

Depending on the material implications of these policies, support may vary. Wicki et al. (2019) elaborate on this design aspect when assessing the instruments at the disposal of policymakers. They distinguish between push and pull mitigation – coercive and non-coercive – climate policies. The goal of push policies is to make emission-intensive behavior less attractive, for example through taxation. Pull policies incentivize climate-friendly activities, for example by subsidizing investments in renewable energy sources. Wicki et al. (2019) further distinguish between non-market-based/command-and-control and market-based policy instruments. The former veil the potential cost for the consumer to a certain degree whereas the latter are comparatively transparent in that regard. For example, it is hard to assess the direct cost of restrictions for cars with combustion engines, but comparatively straightforward to evaluate the cost of a tax on high-emission cars. Ejelöv et al. (2022) assess this potential dimensionality in more detail and demonstrate that citizens' observed attitudes constitute three distinct dimensions of climate change mitigation policy: (1) a push policy factor that includes measures such as emission requirements, energy taxes or congestion pricing; (2) a pull policy dimension which comprises instruments such as tax deductions for renewable energy production, subsidies for energy storage, or free parking for zero-emission cars; (3) an information policy dimension including measures such as energy and climate counseling, energy labeling or information on the origin of food (Ejelöv et al. 2022: 539).

Given the implicit costs or benefits underlying each of these policy types, citizens' are very likely to respond to these incentive structures when forming their policy preferences (Binelli and Loveless 2025). In this vein, Schaffer (2024) shows that citizens' preferences for climate change mitigation policies are negatively affected by information about the negative consequences of these measures while preferences for redistribution policies increase. Huber et al. (2020) address this question for the field of transportation and find that citizens consider measures such as road pricing – a classic push policy – to be effective. However, they also deem them highly intrusive and unfair, which in turn affects their level of policy support. Similarly, Fesenfeld et al. (2020) find a strong difference in support levels for climate policy packages when taxes on meat and fish products are included as opposed to, for example, discounts on vegetarian food options. However, Fesenfeld et al. (2020) also conclude that the way potential revenues from climate policy are spent, affects public support for costly climate policies. In other words, if policy proposals also offer alleviation for short-term vulnerabilities of climate change and climate policy, support for comprehensive climate action is likely to increase.

Addressing the short-term consequences of climate change and climate policy is the purpose of adaptation policies. However, in light of differential impacts of climate change and climate policy across geographical regions and political systems, adaptation policies tend to be much harder to classify than mitigation policies. Orlove (2022) retraces the concept of adaptation as adjustment of societies to expected or unexpected alterations in natural systems or societies in order to alleviate new or existing risks. Thereby, he distinguishes multiple categories of this concept: adaptation can be either (1) anticipatory of or reactive to hazards, (2) led by private or public initiatives, (3) be focused on autonomous projects as opposed to planned structural changes, and lastly (4) happen incrementally, project by project or (5) in a transformational manner embedded in broader pathways that outline a long-term strategic road map (Orlove 2022; Wilson et al. 2020).

The notion of vulnerability is thereby central to the development of effective adaptation policies, as vulnerability is increasing across a range of factors such as health, basic infrastructure or economic systems (IPCC 2023; Fankhauser 2017). Zooming in to the latter Day et al. (2019) outlines several adaptation options that range from technological adjustments, for example, energy efficient cooling systems, over behavioral changes, such as job switches, to structural investments in climate resilient city planning. Such measures can address looming productivity losses associated with rising temperatures. However, as (Singh et al. 2022) points out, the framing of adaptation efforts as, for example effective and/or normatively desirable is likely to affect the success of such policy proposals. In light of the specificity of adaptation measures, research on adaptation policy preferences tends to be focused on geographic regions and/or economic sectors (see for example Meyerhoff et al. 2021; Landauer et al. 2014). This suggests that taking regional and personal vulnerabilities into account is key when trying to assess citizens' preferences, particularly for adaptation policies. Gaikwad et al. (2022) focus on this aspect of regional climate change and policy vulnerability and find that the prospect of labor market vulnerability leads to higher demand for direct compensation policies, whereas citizens living in flood zones have stronger preferences for adaptation measures than the general population.

In light of the multiple direct and indirect risks of climate change and climate policies, comprehensive packages can facilitate the implementation of effective climate action by taking into account short- and long-term effects (Heyen and Wicki 2024). Bergquist et al. (2020), for example, highlight that combining climate policies with economic and social policies increases the support for comprehensive policy packages. As has been briefly touched upon, reuse of revenues gained from costly climate policies to mitigate negative effects are effective ways to generate support in such packages (Fesenfeld et al. 2020; Drews and Van Den Bergh 2016). Including measures such as reuse of revenues for infrastructural projects or information campaigns to reduce uncertainty increase support for climate change mitigation policies that have costly consequences for consumers (Wicki et al. 2020). Similarly, Fesenfeld (2022) shows that adding compensatory measures in the form of, for example, financial support, increases support for climate policy packages overall. However, as (Edenhofer and Genovese 2025) point out, the success of compensatory measures depends on characteristics such as (1) their encompassing nature, in the sense that they are sensitive to specific vulnerabilities, (2) administrative feasibility, (3) citizens' ability to observe the positive effects of a policy, and (4) credibility in the form of a binding legal framework. However, designing these policy solutions requires detailed knowledge of the drivers of vulnerability on a personal and/or regional level (Häusermann et al. 2019).

Summing up, climate change and climate policies have distinct direct and indirect effects, which can be visible in the short and the long term. Thereby, mitigation policy strategies aiming at addressing the root causes of climate change create distinct incentive structures for a range of stakeholders. Given high immediate costs and uncertain future benefits, politicians might refrain from implementing these policies for electoral reasons despite their necessity (Luo et al. 2026). Depending on the policy type, voters' evaluations of climate policies depends on the immediate costs and benefits involved with effective climate action. Some of these costs could be addressed by including compensatory measures in a policy package to increase support. However, ever more frequent and catastrophic extreme weather events as well as more serious efforts to foster a green transition pose complex challenges for policymakers. These can result in a high degree of risk exposure to natural risks as well as significant transformations of industries and labor markets. Accordingly, vulnerabilities to climate change and climate policies are likely to rise, which makes adaptation to these short-term consequences necessary. This, in turn, requires deep knowledge about the drivers of vulnerability for a range of stakeholders in order for the policies to be effective. This is why the second part of Paper 2 complements the first part by addressing the following research question:

RQ2.2: What role does compensation play when addressing these vulnerabilities?

Nevertheless, the aforementioned potential for distributive conflict for resources in the field of climate policy – and with respect to other policy fields – puts constraints on policymakers (Tol 2005; Aklin and Mildenberger 2020; Armingeon and Bürgisser 2021; Colgan et al. 2021). Accordingly, material compensation might not always be a feasible option, which renders alternative levers to increase policy support increasingly important.

2.3. Social Approval versus Material Needs

As has been pointed out above, the framework of the collective action problem has received considerable attention when analyzing environmental or climate change related behaviors and preferences. The choice between adaptation and mitigation efforts thereby is subject to resource constraints, conditional cooperation of international partners, and domestic distributive conflicts (Tol 2005; Aklin and Mildenberger 2020; Colgan et al. 2021). Moving from the national to the individual level, there is evidence that the same choice set of the collective action problem offers some valuable insights for individual behavior (Cloos et al. 2025; Goeschl et al. 2020; Hansson 2010).

Consider, for example, the case of a homeowner in an urban region frequently affected by heatwaves. One option to address their problem is by investing in an air conditioning system to keep the temperature in the flat at a reasonable level. This would provide immediate relief from unbearable temperatures in the unit. However, in the long term, rising energy demand due to air conditioning increases emissions on an aggregate level. One alternative way to address this problem would be to coordinate with other homeowners in the residence building. Jointly investing in insulation, energy efficient heating and/or cooling systems shares the cost and benefits. However, this type of coordination can be unfeasible or the costs prohibitive. Consequently, individuals might choose to invest in the short-term solution anyway as frequent heat-waves do not allow for a comfortable standard of living otherwise. This example highlights how short-term adaptation can be rational and effective on an individual level, but might aggravate the problem on a collective level (Auerswald et al. 2018). Additionally, in light of high exposure, vulnerability, and prohibitive costs, choosing the fast, individual solution might remain the only feasible choice for affected citizens.

The individual costs and benefits associated with collective and individual action are one decisive factor for contributions to public goods (Hardin 1971). Yet, as Ostrom (2000) demonstrates, the preference formation process in the public good game is strongly affected by contextual factors, such as social norms (Reuben and Riedl 2013). Contradicting predictions from rational choice models, individuals are shown to contribute repeatedly and substantially to public goods. This is especially the case following experiences of cooperation and the possibility of communication. What is more, individuals use their own resources to sanction individuals who do not conform to existing contribution norms (Ostrom 2000; Fehr and Gächter 2000: 141 f.). This highlights that existing beliefs and contextual aspects can fundamentally affect how social norms influence pro-social behavior and preferences (Andor et al. 2020).

Nyborg (2018) develops a theoretical model to address this interaction more explicitly. She highlights that any individual's contribution to a public good might not only be dependent on the material costs and benefits involved in this decision; it also depends on established social norms and the potential utility that individuals derive from complying with or disregarding said norm. In other words, citizens might carefully evaluate the potential cost associated with a behavioral change when following an established norm (Nyborg 2018). The latter point is crucial: adjusting to alternative behavior despite potential economic losses is contingent on the (perceived) established norm in society. In this vein Berger et al. (2023) argue that depending on the costs involved with a decision as well as the collective consequences of the very same, pro-environmental behavior becomes more or less likely following the diffusion of a social norm.

Consider the example of citizens' facing the choice of switching from a combustion engine to an electric vehicle. Up until recently, the latter choice has been associated with a considerable price premium. In this case, switching from a combustion engine to a climate-friendly alternative entailed potentially prohibitive economic costs. If support for and acceptance of vehicles with combustion engines is the established norm in society, switching seems to be an unlikely choice. However, the opposite might be true if acquiring an electric vehicle comes with substantial social approval at more competitive price-levels. Evidently, the outcome in this scenario depends on the prevalent social norm as well as the costs associated with a behavioral adjustment (Berger et al. 2023; Nyborg 2018). However, not all norms are the same (Jacobson et al. 2011).

Elaborating on different types of norms, (Bicchieri 2017) defines (1) empirical norms as social expectations about approved behavior guiding individual actions (Bicchieri 2017: 19). (2) Social norms then are social expectations about empirical norms as well as a normative obligation to adhere to this norm (Bicchieri 2017: 35).[2]. Bicchieri (2017) emphasizes the importance of individual expectations about established empirical and social norms in society. While the latter are sometimes observable, individuals rely on their beliefs about these norms when forming their preferences. Thereby, norms, or individual expectations thereof, guide individual behavior and preferences through a mechanism of social sanctions or social approval (Elster 1989).

[2]These types of norms are also often referred to as descriptive norms regarding frequently observed behavior and injunctive norms as behavior that is generally approved of in society (Cialdini et al. 1990; Krupka and Weber 2013)

In other words, if individuals believe that most people in their community use public transportation, they might conform to this behavior. This might be even more likely if a majority of people in their community not only use public transportation, but deem it normatively important to do so and sanction individuals who do not conform to an established behavioral guideline. However, according to Cialdini et al. (1990), the degree to which norms affect behavior fundamentally depends on their salience, that is, how much people are aware of these informal guidelines. Yet, this awareness can be misguided. For example, if a parking lot is littered extensively, individuals might perceive this as signal that littering is the established behavioral norm. They might choose to conform to it, even though they personally or their community at large might disapprove of this practice. However, if this disapproval is veiled and individuals have pro-littering normative expectations, they might act accordingly. This is also referred to as pluralistic ignorance (Bicchieri 2017; Rimal and Real 2005; Constantino et al. 2022).

Changes of norms and behaviors are necessary for effective climate action in the long term (IPCC 2018). Norm change, however, is not an easy and short-term endeavor (Bicchieri 2017). Still, acknowledging norm change as a long-term task (Kinzig et al. 2013) does not mean that there do not exists other ways of exploiting normative expectations to garner support for climate change policies. Social norms and perceptions of the very same are not always congruent. While an established environmentally harmful behavior might be widespread, this behavior need not be what citizens deem as normatively desirable. Targeting this level of pluralistic ignorance aids in making pro-climate norms more salient. Thereby, it offers a way to explore the effects of (perceived) social norms on citizens' climate change related behaviors and preferences (Constantino et al. 2022; Bursztyn and Yang 2022).

Established norms are known to have an effect on climate change related attitudes and behaviors (Chan et al. 2022; van der Linden 2015). Experimentally correcting normative misperceptions and tackling pluralistic ignorance is an established driver of pro-social behavioral intentions (Constantino et al. 2022; Yamin et al. 2019; Farrow et al. 2017; Alló and Loureiro 2014; Legros and Cislaghi 2020; Kinzig et al. 2013). Schultz et al. (2007), for example, show that individuals adjust their energy consumption to average levels in their neighborhood after receiving corresponding information – even if that adjustment increased consumption. However, when including a message about the normative evaluations of energy saving, such a boomerang effect disappears (but see Richter et al. 2018; Rinscheid et al. 2021). Similarly, (De Groot and Schuitema 2012) highlight that it is possible to garner support for intrusive and costly push mitigation policies. The necessary condition is that a social norm intervention indicates majority support for said policy. Yet, Smith et al. (2012) argue that the degree to which empirical and normative guidelines are aligned further determines the effectiveness of a social norm intervention. They show that potentially conflicting messages reduce the effect of norm interventions on pro-social outcomes. (Jacobson et al. 2011) describe the different channels through which empirical or social norms can affect individual behavior. Thereby they highlight that the former lead individuals to adjust their behavior to reflect the norm more accurately, while the latter triggers a response more strongly related to social approval (see also Niemiec et al. 2020).

However, the nature of the effect of a norm intervention also fundamentally depends on its design (Constantino et al. 2022; Bicchieri and Dimant 2022). Sparkman and Walton (2017) highlight that already an observed trend can be sufficient to affect pro-social behavioral intentions – even though the norm is not yet established among a majority in a community. But such an effect is not guaranteed. Paul Fesenfeld et al. (2023), combine multiple messages about empirical norms, role models and potential health benefits in one treatment and do not find an effect on policy support. Focusing on climate change policy more generally, Mildenberger and Tingley (2019) show that there is a general underestimation of pro-climate attitudes and preferences. Citizens, then, are more likely to support climate action after these misperceptions are addressed (see also Drews et al. 2022). Similarly, Andre et al. (2024) show that correcting an underestimation of a social norm or an empirical expectation not only increases support for climate change mitigation policies. It also fosters pro-environmental behavioral intentions, especially among those citizens with strongly biased perceptions. Huber et al. (2018) distinguish between institutional normative signals and behavioral norms of car owners. They find that only the combination of both norms increased the willingness to pay for emission offsetting among subjects.

Summing up, social norm interventions are an established cost effective lever for pro-social behavioral change. Nonetheless, the degree to which this is possible depends on multiple factors: the first is the established empirical or social norm in society. If such a norm promotes behavior that is harmful to the environment, this will be the likely outcome when making the norm more salient. The second driver are citizens' expectations of social norms. If the prevalence of a pro-climate norm is greatly overestimated, highlighting such a norm can lead to a backlash effect – and vice versa. Lastly, adjustments of behaviors and preferences might entail significant economic cost, which can be exacerbated by existing vulnerabilities. If those costs exceed the benefits gained from adhering to a social norm, the latter might be not a feasible option for citizens. Thereby, more or less intrusive and costly climate policies might trigger different responses by citizens. To elaborate on this relationship, Paper 3 addresses the following research questions:

RQ3: *How do normative beliefs interact with policy vulnerability when shaping climate policy preferences?*

RQ3.1: Does high vulnerability offset positive effects from belief updates about normative expectations?

RQ3.2: What role does the type of policy play in this relationship?

Pursuing these questions allows to disentangle the interaction between the value of social approval and the potential moderation of personal cost in this decision making process. This, in turn, illuminates potential levers for policymakers when looking for policy packages that take citizens' vulnerabilities into account. More generally, such an assessment sheds light on the material and non-material considerations of citizens when they form their preferences in light of newly emerging risks.

3. Empirical Approach

This dissertation is composed of three distinct paper trying to shed light on the material and normative drivers of climate policy support. Paper 1 scrutinizes the labor market consequences of a green transition, explicitly focusing on a more policy-driven eco-social risk. In doing so, this paper aims to circumvent previous methodological difficulties encountered in this line of research. It offers a novel methodological approach to address the labor market consequences of the green transition. For this purpose, I utilize textual data on the task-contents of green and non-green occupations as well as survey data. I showcase the validity of this indicator in an application to a selection of European countries. Summing up, Paper 1 introduces an indicator to assess the consequences of a green labor market transition on a cross-sectional level combining data from international occupational classification systems. This facilitates reliable comparative studies of the effects of a green transition.

Paper 2 goes beyond objective assessments of climate change and policy vulnerability and investigates citizens' perceptions thereof. It constitutes change of perspectives that allows to gain a well-rounded understanding of citizens' affective and intuitive drivers in their decision making process. This nuanced approach is paired with a detailed assessment of the dimensionality of climate policies in order identify strategies for policymakers to garner support for costly climate policies. Paper 3 extends the notion of perceived vulnerability, thereby investigating exclusively perceived policy vulnerability across different types of outcomes. This serves as a proxy for potential costs citizens expect when they consider adjusting their behavior or preferences following a social norm intervention. In Papers 2 and 3 I develop a theoretical mechanism to investigate citizens' climate policy preference formation processes and test expectations derived from this exercise using original survey data collected for this purpose in Germany (Paper 2) and Austria (Paper 3).

In both papers I rely on experimental data which allows to test causal mechanisms about the effects of policy packaging as well as the potential effects of a social norm intervention. The case study design is especially useful for this purpose as it allows to take the particularities of any case into account, when selecting, for example, realistic policy proposals. However, given the similarity of economic and climate change related challenges in multiple western European countries, it is reasonable to assume a certain degree of generalizability of the findings.

3.1. Case Selection

The case selection of this dissertation is on the one hand motivated by an effort to facilitate cross-sectional analyses of labor market consequences in the green transition. On the other hand, the papers in this dissertation aim to contribute to the understanding of the causal mechanisms driving climate policy formation in light of perceived vulnerabilities as normative expectations. Consequently, Paper 1 offers a cross-sectional perspective of occupations listed in the Standard Occupational Classification (SOC), which is used in the United States as well as the International Standard Classification of Occupations (ISCO), widely applied in OECD countries and Europe. Doing so allows for the development of an indicator for a wide range of industrialized countries, which facilitates comparative analyses of green labor market developments. The application of this indicator is focused on European countries. This underlines the advantages of the approach developed in Paper 1 in comparison to previous approaches which suffered from methodological difficulties and subsequently potentially biased results.

The focus of Paper 2 is to assess the potential effects of perceptions of climate change and policy vulnerability on climate policy support. Additionally, this paper addresses the question of a potential causal effect of different policy packaging strategies on the level of support for comprehensive climate action. This paper analyses the case of Germany as the third largest economy globally and the largest economy in Europe, with a politically influential industrial sector. Over the last years, Germany's industrial sector has proven to be vulnerable to strong fluctuations on the energy markets due to a reliance on cheap fossil energy sources from Russia. Moreover, established Germany's industry struggles with the outlook of a green transition and repeatedly voices strong opposition against, for example, the ban of combustion engines. Additionally, Germany has been frequently affected by extreme weather events such as the floodings in Ahrtal 2021 or the southern parts of Germany Bavaria and Baden-Württemberg in 2024. Both aspects contribute to a certain degree of vulnerability among the German population towards the natural as well as the political consequences of climate change.

The German political discourse over the last years has frequently been characterized by debates about potential reforms of the German debt brake ("Schuldenbremse") in the face of structural challenges to the country. One prominent example of this debate circled around the climate and transformation fund ("Klima und Transformationsfond" - KTF), which was supposed to serve as the primary fiscal policy tool of the German coalition to finance the green transition. It included extensive subsidies for industry, infrastructure, homeowners, and municipalities. It includes specific policy proposals and allocates financial resources for each sector for the years 2024 to 2027. In total the financial means were estimated at around 211.8 billion euros, with an extra 60 billion euros coming from repurposed means reserved during the pandemic. The latter sparked strong controversies within the coalition, consisting of Social Democrats, the Green Party, and the Liberal Party, and across the broader party spectrum. In late 2023 the German constitutional court ruled that the allocation of the additional means was in violation of the German debt brake, leading to a substantial lack of financial resources. More recently, the newly elected chancellor Friedrich Merz of the center-right CDU secured a parliamentary majority for a reform of the debt brake to finance military and infrastructural projects, contradicting earlier promises during the election campaign. This reform also includes an additional 100 billion euros for climate change policies, which was negotiated into the deal by the greens in exchange for the necessary votes for a two-thirds majority.

Paper 3 focuses on citizens' perceptions of policy vulnerability and social norms in Austria. In it I aim to isolate a potential moderation effect of vulnerability on an experimental treatment of normative expectations of climate friendly behavior. Austria has experienced frequent extreme weather events, most notably the floodings in 2024 which lead to vast economic damages. Damages of the railway infrastructure in the eastern part of the country are estimated to amount to 1.3 billion Euros. What is more, the strong reliance of the Austrian economy on the tourism sector, especially in winter, makes it strongly susceptible to the economic risk posed by the natural consequences of climate change. Additionally, Austria is traditionally viewed as an export-oriented country with strong ties to the German car manufacturing industry. Similar to Germany, Austria also heavily relied and continues to rely on fossil fuel from Russia. This contributes to vulnerability to energy price shocks, embodied, for example, in high inflation rates.

In light of the difficulties observed in the German industry, economic actors in Austria have repeatedly called for an alternative course in the field of climate policy. The current course was said to put too much pressure on Austria's economic heavyweights. This opposition was especially pronounced during the coalition between the center right People's Party ("ÖVP") and the Green Party, also leading to intra-coalition conflicts. Those conflicts culminated in the pivotal vote of the green minister for climate protection for the EU's renaturation law against the opposition of its coalition partner. Differences in opinions about climate change related behavior also came to the fore when salient climate protests targeted cultural institutions as well as infrastructure. This triggered both, support for the protest as well as harsh criticism including calls for more severe punishment among political actors in Austria. More recently, multiple climate policy measures implemented by the former coalition have been retrenched in light of the budgetary constraints faced by the current coalition consisting of the People's Party, the Social Democratic Party ("SPÖ") as well as the Liberal party ("NEOS"). These cuts include multiple subsidies for renewable energy production as well as the direct compensation for Austria's carbon tax and have been very salient in the recent political discourse.

The described susceptibility to climate change and policy-related risk render Germany and Austria ideal settings to assess the research questions regarding perceptions of climate change and climate policy vulnerability. Simultaneously, the challenges described above are similar to those faced by a broad range of western democracies: multiple crises require strong financial commitments to investments in, for example, military infrastructure. This puts constraints on the budgetary possibilities of states in other areas. At the same time, the natural consequences of climate change are observable more frequently and with higher intensity, aggravating a potential conflict of resources between adaptation and mitigation policies. These shared challenges guarantee a certain degree of external validity that allows to draw conclusions that go beyond the two cases analyzed in Papers 2 and 3 of this dissertation.

3.2. Data and Operationalization

The data used in this dissertation combines secondary data as well as original survey data. For the construction of a green skill transferability indicator in Paper 1, I rely on detailed descriptions of task associated with certain occupations. Those descriptions include tasks that have not been classified as green (N = 18,494) as well as those classified as green (N = 1,377) in an ongoing effort by the Occupational Network (O*NET). This collection dates back to initial work conducted by Dierdorff et al. (2009) for a description of the labor market in the US using the SOC. To extend this analysis to other economies, I rely on task descriptions provided by the International Labor Organization (ILO) and their collection of tasks for 427 occupations (N = 3,256) (ILO 2023) as well as the collection of green skills and knowledge concepts by the European Standard Classification of Occupations (ESCO) (N = 591) (European Commission 2022). In addition to these sources of textual data, I apply the indicator to the 11th round of the European Social Survey (ESS) (European Social Survey European Research Infrastructure (ESS ERIC) 2024). I reduce the dataset to working individuals only and merge it with industry-level data on greenhouse gas (GHG) emission accounts provided by Eurostat (eurostat 2025). This results in a dataset comprising N = 36,212 individuals in 23 countries and 22 industries. Section 4 provides a detailed theoretical and empirical account of the indicator and its application.

In Paper 2 I rely on an original data collection effort funded by the University of Zurich's UZH Global Strategy and Partnership funding scheme, the Department of Political Science at the University of Zurich as well as the Vienna Doctoral School for Social Science. The survey was fielded in cooperation with Bilendi relying on their online panel of voting-age citizens in Germany. After excluding speeders this resulted in a sample of N = 2,958 respondents. This data collection effort offers information on climate policy preferences across multiple dimensions including push mitigation, pull mitigation, adaptation, and eco-social policies. Survey respondents indicated their approval of three to five policies per dimension on a 11-point scale ranging from 0 (low support) to 10 (high support). Push mitigation policies include carbon pricing and reductions of fossil fuel subsidies as well as bans of oil and gas heating systems, combustion engines or short-distance flights. Pull policies include subsidies for renovation of buildings and for renewable energy sources in addition to investments in public transport and e-mobility. Adaptation to the natural consequences of climate change include policies such as investments in flood prevention systems or in crisis-resilient infrastructure as well as a reversal of soil sealing. Lastly, eco-social policies include retraining programs for workers in carbon-intensive sectors, lump-sum payments for unemployed people from these sectors, and a rent-bonus for poorly insulated homes.

In addition to that, I probe citizens' perceived vulnerability to climate change and climate policy to analyze distinct vulnerability profiles: those highly vulnerable to either one of the sources of risk as well as those under cross-pressure from both (Gaikwad et al. 2022). Vulnerability thereby is assessed as the perceived likelihood of experiencing negative consequences should a risky event occur (Walpole and Wilson 2021a,b; Wilson et al. 2019). Respondents are asked to indicate their perceived likelihood of being negatively affected by either the natural consequences of climate change, or the indirect effects of climate policy. Answers for both types of vulnerability are measured on an 11-point scale ranging from 0 (not at all likely) to 10 (very likely). This variable is the main independent variable in Paper 2 and is used to construct distinct groups of individuals with low vulnerability in both categories, high climate change or high policy vulnerability, and those individuals who perceive themselves to have a high cross-pressure from both sources. Potential concerns about the endogeneity of this variable are addressed by implementing a residualization approach. Respondents additionally had the opportunity to voice their concerns about either one of those sources of vulnerability in an open-ended question. More details on the measurement of other covariates included in the analysis in Paper 2 can be found in Section 5.

The data for the survey experiment included in Paper 3 was collected in the Framework of the Austrian National Election Study (AUTNES) (Partheymüller et al. 2024). The experimental design relied on data collection from Wave 21 conducted in July/August 2024 (N = 3,078) and was implemented in the post coalition formation Wave 24 in March 2025 (N = 2,978). The core of this survey experiment is a normative belief update built on representative data from Wave 21. The question design to assess normative expectations is built on the approach by Bicchieri (2017) and asks respondents in Wave 21 if they personally think how often they should reduce their consumption of meat and dairy products and save energy (see also Krupka and Weber 2013; Andre et al. 2024). Responses are measured on a 5-point scale from 1 (always) to 5 (never) and subsequently aggregated to construct three bins (always/most of the time, sometimes, rarely/never) to indicate the personal normative expectations of Austrians with regard to these climate related behaviors.

In wave 24 respondents are asked to indicate their normative expectations of climate friendly behavior. Subsequently they are confronted with an information treatment illustrating the observed value in the population. Treatment assignment as well as prior beliefs serve as two main independent variables. The third main regressor is built on an extension of the operationalization of perceived policy vulnerability implemented in Paper 2. Instead of focusing on a general negative impact of climate policy, respondents are asked to indicate their perceived likelihood of experiencing negative consequences of climate policy across three areas: (1) the general economic development in Austria, (2) the level of prices for everyday goods as well as (3) citizens' general way of life, capturing non-materialistic aspects that affect citizens climate policy support (Mau 2023). As in Paper 2 perceived policy vulnerability is measured on an 11-

point scale ranging from 0 (not at all likely) to 10 (very likely). All three items are summarized into an additive index to capture a wide range of sources of policy vulnerability.

Together with the variables described above, this index is used as an explanatory factor to indicate policy support for climate change mitigation policies. The questions to assess preferences towards these policies distinguish between the established push and pull dimension. The answers range from 1 (strongly in favor) to 5 (strongly against). Pull policies include an increase of the carbon price, an increase of the mineral oil tax, higher taxes for meat and dairy products, and lower subsidies for the production of these products. Pull policies include subsidies for the exchange of heating systems, a reduction of the value added tax on renewables, meat free meals in public canteens, and labels on the ecological impact of products on packaging. Responses are subsequently summarized into indices indicating support for climate policies in the field of energy policy or food/agricultural policy. For a more nuanced assessments additional indicators distinguishing between the push and pull dimensions are constructed for each policy field. A detailed description on the experimental design for Paper 3 is provided in Section 6.

3.3. Methodological Approach

Generally, in all three papers I apply statistical methods to test my theoretical expectations using the data and variables described above. However, as Paper 1 focuses on a methodological contribution, hypothesis-testing is only secondary. The main focus is on an application of a Large Language Model (LLM) using the Sentence BERT-Approach (Bidirectional Encoder Representation of Transformers) provided by Reimers and Gurevych (2019) and building on the approach by Devlin et al. (2018). This method allows to construct high-dimensional representations of words and sentences in a corpus that takes the context these expressions appear in into account. Subsequently, I calculate the cosine similarities between the representations of each green and non-green task before proceeding to aggregate the results to an interpretable indicator ranging between 0 and 1. To test the performance of this indicator I compute OLS regression models with country fixed-effects to assess the relationship between green skill transferability and emission intensity in certain sectors.

The empirical part in Paper 2 consists of two separate inference strategies. To assess general support for climate policy dimensions the results from an exploratory factor analysis are extracted to construct normalized policy support indicators (Costello and Osborne 2019). These indices are subsequently used as main outcome variables in OLS regressions with heteroskedasticity robust standard errors. The second part employs a fully randomized conjoint experiment as proposed by Bechtel and Scheve (2013) and Hainmueller et al. (2014).

The experimental design in Paper 3 allows for a similar estimation strategy. I compute OLS regressions with heteroskedasticity robust standard errors to assess general preferences for climate change mitigation policies following a normative belief update. In order to gauge the preferences for specific policies, I additionally computed ordered logit models including the treatment and different dimensions of climate policy vulnerability in the models. Table 2 provides a summary of the data sources as well as the methods used in this dissertation. Table 2 provides an overview of the empirical approach chosen in the three papers of this dissertation. A more detailed description of the methods used in each of the papers included in this dissertation can be found in Sections 4, 5, and 6.

Table 2: Data sources and methods used in this dissertation

Paper	Case	Data/Datasource	Method
Paper 1	Cross-sectional	O*Net Task Descriptions N = 19,871 ILO Task Descriptions N = 3,256 ESCO Green Skills and Knowledge Concepts N = 591	SBERT Cosine-similarities
		ESS Round 11 N = 36,212 Eurostat GHG Accounts By country and economic sector N = 594	Fixed-effects estimation
Paper 2	Germany	Original Data collection N = 2,958	Exploratory factor analysis OLS regression Conjoint experiment
Paper3	Austria	AUTNES Wave 21 N=3,078	Descriptive statistics
		AUTNES Wave 24 N = 2,978	Survey experiment OLS regression Ordered logistic regression

4. Paper 1: Who is Transitioning to Green? Introducing a Text-Based Indicator to Measure Green Skill Transferability

4.1. Introduction

A transition to sustainable and climate friendly economic activities is dependent on costly climate and environmental policies across most economic sectors (IPCC 2018). Such a transition will affect communities heavily reliant on carbon-intensive occupations (Kotz et al. 2024; McDowall et al. 2023; Rodríguez-Pose and Bartalucci 2024; Vandeplas et al. 2022). To ensure that jobs are in line with climate goals, but also that jobs are decent with a prospect to workers and affected communities more broadly is fundamental to a just transition (Bolet et al. 2024; Smith 2017; ILO 2015b; Cedefop – European Centre for the Development of Vocational Training. 2012; Sulich and Zema 2018).

This paper makes a contribution the green dimension of this just transition. Much of the discussion about the potential labor market consequences of a switch from green to brown jobs, that is, jobs with a positive or negative environmental impact (Bradley et al. 2025; Bohnenberger 2022; Stanef-Puică et al. 2022; Kozar and Sulich 2023; Vona et al. 2015; Dierdorff et al. 2009; OECD 2023). However, assessing the labor market consequences of a green transition in a dichotomous manner veils overlaps between environmentally friendly and other occupations. While we know what it takes, to label a job as green or brown, we know much less about what it takes for any worker to go from brown to green (but see Rutzer et al. 2020; Bowen et al. 2018), especially at the cross-sectional level. For example, a phase-out of coal-fired power plants increases the risk of unemployment considerably. However, as demand for energy increases, demand for (skilled) labor for renewable energy production increases. While there might not be a complete overlap, there exist at least some similarities between skills required in green and brown occupations, which could facilitate a smoother transition (Lim et al. 2023).

Skills are an important determinant to assess the consequences of economic transformations for workers (Autor et al. 2003; Acemoglu and Autor 2011; Autor and Dorn 2013). More transferable skills contribute to a lower degree of risk, while a higher degree of skill-specificity can lead to higher exposure to labor market shocks (Iversen and Soskice 2001; Lazear 2009). At the same time, the usefulness of skills has to be considered in light of the background of the workers trying do assigned tasks using their learned skills (Stephany and Teutloff 2024). Skill transferability, understood as the amount of skills individuals transfer between occupations, is frequently used as predictor for labor market mobility in light of economic shocks (Shaw 1987; Ormiston 2014; Nawakitphaitoon 2014), predicting, for example, considerable wage effects for individuals with more or less specific skill-sets (Eggenberger et al. 2022; Lazear 2009). Thus, introducing skill transferability into the analysis the green transition offers pathways to elicit individual pathways to sustainable and decent jobs (Gathmann and Schönberg 2010). However, finding an accurate indicator across occupational classifications remains difficult. Those problems stem from complex aggregation and matching procedures to transfer indicators across occupational classifications, which can lead to significant biases in assessments of green labor market developments (Bachelot 2024).

I contribute to this line of research by introducing a text-based indicator for skill transferability between green and non-green tasks, applicable across occupational classifications. Thereby, I exploit the link between green tasks and skills necessary to perform them (Gathmann and Schönberg 2010; Vona et al. 2019) to analyze the similarity of skill profiles between occupations. This is the first indicator to directly compare the textual similarity of task contents of green and non-green occupations using Large Language Models (LLMs). This methodology augments analyses of the labor market consequences of a green transition in two ways: it complements previous assessments of green economic activities by showing which labor market segments dispose of transferable skill-sets and highlighting similarities between green and non-green occupations. The indicator complements previous assessments of economic sectors in the green transition (Zaussinger et al. 2025; European Commission 2022) by showcasing possible demand for active labor market policies. Herein lies the second contribution: scrutinizing not only which sectors are going to be affected by the green transition, but also how labor market participants can move between sectors offers a promising avenue for future analyses utilizing the proposed methodology.

Empirically, the indicator captures green skill transferability on different levels of aggregation for the Occupational Information Network's extension of the Standard Occupational Classification (O*NET-SOC) as well as the International Standard Classification of Occupations (ISCO). Moreover, it offers a comprehensive assessment of 427 ISCO-08 4-digit occupations without the need of complex and potentially inaccurate crosswalks (De Sario et al. 2023; Bluedorn et al. 2023; OECD 2023; Bachelot 2024). High correlations with indicators assessing the "green potential" of occupations (Rutzer et al. 2020; Lobsiger and Rutzer 2021), speak to the validity of the measure. Lastly, an application of the indicator to the European context reveals promising avenues of future research on sectoral differences of green skill transferability and potential implications for individuals with a varying degree of labor market risk.

I subsequently discuss the role of green skill transferability in the analysis of the just transition. Then, I address methodological problems of previous approaches and describe how the methodology developed in this paper overcomes those problems. In the next step, I showcase the levels of green skill transferability in Europe using data from the European Social Survey (ESS) (European Social Survey European Research Infrastructure (ESS ERIC) 2024). Lastly, I discuss the limitations and implications of the developed indicator for the analysis of labor market consequences of a just transition.[3]

4.2. Green Jobs in the Just Transition

Integrating economic, social, and environmental progress is a prerequisite to achieving sustainable development goals as a just transition (Sulich et al. 2020; ILO 2015a). Detailing out existing needs and characteristics of all stakeholders involved is essential to ensure a successful transition (Smith 2017; Bolet et al. 2024). Although these characteristics are not restricted to the environmental aspects of labor market development, these constitute a significant dimension in this dynamic. Nevertheless, multiple definitions of green jobs makes a systematic analysis challenging (Cedefop – European Centre for the Development of Vocational Training. 2012).

Most assessments of green jobs highlight their link to decarbonization (Stanef-Puică et al. 2022) or their macro- versus micro-level impacts (Bohnenberger 2022). UNEP et al. (2008: 3) provide an early definition of green jobs as "work in agricultural, manufacturing, research and development (R&D), administrative, and service activities that contribute substantially to preserving or restoring environmental quality." Since then, multiple definitions focusing on economic sectors or individual job profiles have emerged (JRC 2021; OECD 2023). Industry and output based definitions of green jobs can be misleading given that jobs concerned with environmental sustainability (e.g., sustainability managers) can also be found in high-pollution sectors. Yet, occupations with little environmental impact (e.g., administrative occupations) can be labeled green, just because they happen to in, for example, the renewable energy sector (Rutzer et al. 2020).

Scrutinizing the level of skills and tasks when identifying green jobs – the bottom-up approach – offers some advantages: it links tasks and individual skills to the environmental impact of occupations where these skills are needed. This link can be exploited to highlight necessary characteristics of to succeed in any green occupation (Vona et al. 2018, 2019). Moving into that direction, the European Commission (2022) offers a machine-learning based classification of green skills with subsequent manual validation in the European Classification of Occupations, Skills and Competences (ESCO).[4] Building on the ESCO framework and following a bottom-up approach, Zaussinger et al. (2025) introduce four empirically grounded

[3] This paper has been published in Ecological Economics: https://doi.org/10.1016/j.ecolecon.2026.108950.

[4] Green ESCO skills and knowledge concepts are defined as "the knowledge, abilities, values and attitudes needed to live in, develop and support a society which reduces the impact of human activity on the environment". Brown skills are defined as "knowledge and skills that increase the impact of human activity on the environment", and white skills as knowledge and skills "which do not increase nor reduce the impact of human activity on the environment" (European Commission 2022).

categories to assess any occupations exposure to the green transition and distinguish between (1) neutral occupations, (2) low-carbon occupations, (3) high-carbon occupations where a successful transition seems likely, and (3) high-carbon occupations where such a transition is not feasible. While Zaussinger et al. (2025) take skill-overlap into account, they do not compare tasks contents of any occupation directly.

While green skills are by definition highly prevalent in green occupations, this does not mean that they are exclusive to them (Rutzer et al. 2020; Bowen et al. 2018). Critique on the bottom-up approach focuses on its emphasis on job titles and on insensitivity towards occupational changes over time (Villani et al. 2025). However, remaining on the level of tasks and skills addresses these concerns. Some skills required to perform non-green tasks might be very similar to green tasks. Scrutinizing this similarity elicits greenness across occupations and might facilitate a just transition for a broader range of workers (Bowen et al. 2018; Martinez-Fernandez et al. 2010). This augments the bottom-up definition of green jobs by further eliciting skill requirements in the green transition (Bradley et al. 2025).

4.3. The Case for Green Skill Transferability

The role of skills during economic transformations has been studied extensively (Autor et al. 2003; Acemoglu and Autor 2011; Lazear 2009). Skills-based hiring has been documented for different types of labor market transformations including the green transition (Bone et al. 2025). In this debate, Stephany and Teutloff (2024) highlight how the complementarity of skills can strengthen the design of labor market policies that take into account, facilitate smoother job transitions. In the context of the green transition (Bowen et al. 2018) highlight the skill-similarity in green versus non-green jobs, leading to a smoother transition for workers. Thus, when talking about green skills and tasks it seems increasingly important to assess, which of workers' existing skills and tasks can be transferred to sustainable economic activities. In other words, a higher degree of transferability between skills required in a brown job might allow for an easier transition towards a green job, which are documented to often come with advantages such as a wage premium (Bluedorn et al. 2023; OECD 2023).

Shaw (1987: 704) assesses skill transferability as the "proportion of investment in occupation i which is transferred to occupation j" and measures this using individuals' occupational tenure records. Ormiston (2014) operationalizes skill transferability based on how knowledge, skills, and abilities acquired in one occupation can be transferred to another. Unfortunately, there are some problems related to the operationalization of these approaches (Nawakitphaitoon and Ormiston 2016): the approach based on occupational tenure does not correct for higher turnover rates between certain (low-skilled) occupations introducing biases. The approach based on knowledge, skills, and abilities does not take the applicability of certain skills of one occupation in another into account (Nawakitphaitoon and Ormiston 2016). Eggenberger et al.

(2018) focus on the (mis-)match between skills obtained in job training programs and skills required in the labor market. Extending this approach and directly linking workers' skills to tasks performed in occupations, Eggenberger et al. (2022) show that workers with highly specific skills suffer more from negative demand shocks while benefiting more from positive ones.

In this paper, I follow the task-based approach of skill transferability formalized by Gathmann and Schönberg (2010). Here, the similarity of tasks performed in an old occupation compared to a new one is considered a key indicator of skill transferability, which significantly predicts labor market outcomes after job displacements, such as wage premiums. This links bottom-up definitions of greenness to the general discussion of skill transferability and its potential effects on workers' labor market outcomes. There is a considerable degree of skill transferability between green and non-green jobs, which might facilitate workers' transitions from brown to green jobs, albeit restricted by geographic mobility (Lim et al. 2023; Henning et al. 2025; Niang et al. 2024; Gore and Hollywood 2009). Focusing on skill transferability offers insights on the workers' movements between sectors with more or less environmental impact. Table 3 addresses the theoretical relationship between these concepts building on categories for occupational exposure to the green exposure put forward by Zaussinger et al. (2025). Workers in low-carbon sectors might benefit from sectoral developments in addition to personal characteristics. Unfortunately, workers in high-pollution occupations might be much more exposed to sectoral shifts and the specificity of their skills. Given the disproportionate pressure on these workers, skill transferability might be the determining factor for labor market participants: while up-/re-skilling can be a plausible solution for employees in high-carbon jobs with high skill transferability, this might not be an option for workers in the same sector with low skill transferability. Skill transferability as an additional theoretical dimension can thus help shed light on these nuances.

Table 3: Skill transferability and occupational exposure to the green transition

	Neutral	Low-carbon	Viable to transition	Unviable to transition
High skill transferability	High-demand skills Occupation not affected Risk only partially related to green transition	High-demand skills High-demand occupation No increased risk	High-demand skills Uncertainty regarding occupation Increased risk and high mobility	High-demand skills Low-demand occupation High risk and high mobility
Low skill transferability	Low-demand skills Occupation not affected Risk only partially related to green transition	Low-demand skills High-demand occupation No increased risk	Low-demand skills Uncertainty regarding occupation Increased risk and low mobility	Low-demand skills Low-demand occupation High risks and low mobility

4.4. Measuring the Greening of Labor Markets

Emerging green skills have received considerable attention, mostly relying on the groundwork laid out by Dierdorff et al. (2009) and O*NET for the SOC (Consoli et al. 2016; Vona et al. 2018, 2019; Bluedorn et al. 2023; De Sario et al. 2023). Unfortunately, applying these results to other occupational classifications comes at the cost of accuracy. The main problem stems from aggregation-procedures across different occupational classifications, which increases inaccuracies simply by overestimating the greenness in specific categories (JRC 2021). Take the example of "chief executives" and "chief sustainability officers" as discussed by Vona et al. (2019): the latter can reasonably be considered a green job, the former not necessarily. However, simply averaging established greenness scores for both occupations leads to an overestimation of this value for the summary category "chief executives". This issue could be resolved by using fine-grained occupational weights, which are, however, often not available on a fine grained-level to allow for reliable cross-sectional analyses.

Bachelot (2024) highlights major inaccuracies even of elaborate attempts of cross-walking indicators from the SOC to the ISCO based on aggregation: 8-digit O*NET SOC greenness scores have to be aggregated to the 6-digit SOC level, which is a first source of potential bias. Subsequently, many-to-many matchings between the European ISCO-08 (4-digit) and the SOC (6 digit) pose a challenge to accurately translate greenness scores from one context to another. Finally, in light of data restrictions another aggregation step might be necessary to link greenness scores to occupational data available only on the ISCO-08 3-digit level (see also JRC 2021). Consequently, using this procedure comes with the risk of misrepresenting greenness of jobs in labor markets relying on other classifications than the SOC.

Janser (2018) investigate the greening of jobs in Germany by developing an indicator derived from a dictionary-based quantitative text analysis of tasks, classifying tasks either as green or non-green and computing a continuous greenness score. The results suggest that there is a poignant increase in green tasks per occupation and that this increase is not restricted to explicitly "green" occupations. This, in turn, indicates, that there exist similarities between green tasks and tasks that have not yet been classified as such. Building on this approach, Bachmann et al. (2024) distinguish between "within-effects" describing the growth of green tasks within occupations, and "between-effects", addressing the growth of green sectors relative to non-green occupations. They suggest that both effects are significantly contributing to the greening of the German labor market. However, the chance for a successful transition to a green economy is much smaller for employees in sectors heavily relying on fossil fuels. The approach by Zaussinger et al. (2025), lastly, combines sectoral information and skills-based assessments of occupations potential exposure to the green transition. While this offers valuable insights on how this exposure is structured by existing skill-overlaps, it does not yet take into account how skill-transferability can aid policymakers in exploiting these overlaps.

Given that only few tasks are very occupation specific, a majority may be more easily transferable to a new workplace with a potentially better environmental impact (Bowen et al. 2018). Rutzer et al. (2020) emphasize this point and estimate the potential of any job to execute green tasks based on the skills required for a certain occupation, not just the ones already classified as green. This more granular approach reveals a considerable degree of skill similarity between existing and green jobs but remains limited to the SOC in the US. Building on this methodology Lobsiger and Rutzer (2021) highlight that "there are occupations that do not perform any green tasks, [...] but demand skills similar to occupations that perform green tasks" (Lobsiger and Rutzer 2021: 5). The results suggest a high green potential in the Swiss labor market, especially for younger, male, highly educated labor market participants with a migration background. However, the reliance on cross-walking results from the SOC to ISCO potentially limits the accuracy of the subsequent analysis.

Thus, the methodological difficulties described hamper research efforts on potential the skill transferability between green and non-green occupations. While there are promising approaches, introducing a reliable indicator for green skill transferability can augment assessments of the complementarity of green and non-green skills (Stephany and Teutloff 2024). This, in turn, would allow to gauge how a broader share of workers might be affected by a green transition, which is a prerequisite to ensure a just transition.

4.5. A Text-Based Green Skill Transferability Indicator

The indicator I present in this paper exploits the link between skills and tasks put forward by Gathmann and Schönberg (2010), connecting debates about the green transition to broader debates about the role of skills in economic transformations (Autor et al. 2003). I propose a novel approach relying on cosine similarity scores between green and non-green tasks generated by automated text analysis relying on pre-trained LLMs. More specifically, I rely on the groundwork on green tasks laid out by Dierdorff et al. (2009) (for other use cases see Bowen et al. 2018; Rutzer et al. 2020) and combine it with the European Commission's assessment of green skills to broaden the geographical scope of green tasks (European Commission 2022; Villani et al. 2025).

The corpus compiled for this purpose consists of 1,377 unique green tasks collected by O*NET (O*NET 2023) as well as 591 skills and knowledge concepts generated by (European Commission 2022), resulting in 1,968 descriptions of skills and tasks. The contents of these descriptions typically imply a set of skills required to perform certain tasks. Consider for example the green task "Enter local soil, water, or other environmental data into adaptive or web-based decision tools to identify appropriate analyses or techniques". While there is a clear link to the environmental impact of this task, it also implies data collection and analysis skills. Given that the task collections provide a comprehensive assessment of certain occupations, some task descriptions refer to more general tasks without a clear association to the green transition..[5]

By automatically coding the corpus using ChatGPT's 4.1 model tasks of a more general kind are excluded from the analysis. The LLM was prompted to assess the collection of green tasks and code general tasks without explicit associations to the green economy as non-green.[6] The final collection of green tasks comprises 1,730 unique tasks. I rely on non-green task descriptions provided by O*NET, which comprises 18,494 tasks for 969 occupations on the 8-digit level as well as the structure and definitions of the ISCO-08 (ILO 2023), which offers an assessment of ISCO-08 categories from the 1-digit up to the 4-digit level. In total it encompasses 437 occupations of which 427 have detailed task descriptions consisting of 3,256 tasks matched to specific occupations (see also Granata and Posadas 2024). [7]

More specifically, I implement the approach described by Reimers and Gurevych (2019), who offer a way to create meaningful sentence embeddings (SBERT) (see also Devlin et al. 2018) and who provide a computational framework with pre-trained LLMs for python, which are suitable for a range of tasks (SentenceTransformers). [8] The key advantage of this approach is that instead of comparing vectorized values of individual words in sentences, SBERT allows to create meaningful vectorized representations of sentences based on a pre-trained model (Wang and Dong 2020). These representations can subsequently be compared using cosine-similarity scores (Reimers and Gurevych 2019).[9]

I rely on the pre-trained versions of the models provided in the SentenceTransformers framework to encode all elements in the different corpora of tasks statements. [10] This results in a multidimensional vector representation of each green and non-green task. In the next step, I compute the cosine similarity for each non-green task and each green task sentence embedding. For the US context this results in an 18,494*1,730 matrix and for the ISCO framework in a 3,256*1,730 matrix of cosine similarity scores ranging between 0 and 1. Each cell in these matrices indicates the relative similarity of a non-green task to a green task.[11]

[5]Examples of these tasks include "Develop testing procedures", or "Supervise the work of subcontractors or consultants to ensure quality and conformance to specifications or budgets."

[6]The exact prompt and the codebook used for this process can be found in Appendix A.1. To validate these results, all tasks have been hand-coded by a student assistant following the same instructions to assess model performance. Detailed metrics are reported in Appendix A.1 Table A. 1.

[7]The categories without task descriptions are summary categories and military occupations. The corresponding ISCO-08 codes are 1439, 3139, 3435, 5249, 7319, 8189, 0110, 0210, 0310.

[8]More details can be found here https://www.sbert.net/index.html (last accessed 30th March 2024).

[9]Given the comparatively small amount of textual data used in this paper, pre-training and fine-tuning of natural language processing models appears to offer only a very limited improvement in their performance (Bosley et al. 2023).

[10]For more details on the steps for this procedure see Appendix A.1.

[11]The code used for this procedure as well as the resulting cosine-similarity matrices are available here: https://osf.io/zaq6p/?view_only=2aeac11ffa004c2d916040716254ae36.

For example, let's consider the green task "make special pickups of recyclable materials such as food scrap, used oil, discarded computers, or other electronic items". This task only has a 0.0511 cosine similarity with the non-green SOC task "study different tree species' classification, life history, light and soil requirements, adaptation to new environmental conditions and resistance to disease and insects". However, the same task has a 0.65 cosine similarity with the non-green SOC task "load debris and refuse onto trucks and haul it away for disposal". Arguably, the task of studying tree species might seem more related to the environment than picking up and throwing away refuse. However, in terms of task content, the latter is much closer to the green task of making special pickups for recycling purposes. This example highlights that the results produced by the approach above report the relative similarity of one non-green task over another when compared with a green task. Additionally, it emphasizes that there exist similarities between tasks classified as green and others eliciting skill-similarities between green and non-green occupations which have previously been overlooked but might facilitate the transition from green to non-green occupations.

Aggregating these similarity scores across all possible tasks would introduce a considerable degree of bias, as any non-green task could have a non-zero similarity to any green task. Take the example of managerial tasks, which might differ greatly from tasks performed by low-skilled service workers. While both occupational categories might credibly engage in green tasks, a high degree of similarity between these tasks is doubtful. Thus, including potentially green but completely unrelated tasks into the aggregation for managerial occupations would introduce a downward bias. [12] In order to minimize this bias, I aggregate similarity scores for each task based on the average of the 20 most similar tasks for SOC and on the eight most similar tasks for ISCO. These numbers approximately correspond to the average number of tasks per occupation in each classification as can be seen in Table 4. Moreover it is reasonable to assume that the average number of tasks used for aggregation corresponds to a realistic number of tasks workers actually have to do in their respective jobs. This procedure yields a similar distribution for both classifications presented in Figure 1 and Table 4. Skill transferability for SOC tasks ranges between 0.11 and 0.79 for values aggregated to the task level. As for ISCO, skill transferability per task ranges between 0.12 and 0.76.

To aggregate similarity scores to the occupation level I sum up the skill transferability scores of all tasks linked to a specific occupation and divide this score by the total number of tasks of that occupation (Vona et al. 2018). The total number of tasks per occupation for SOC ranges between 1 and 40, for ISCO it ranges between 2 and 14 (on a 4-digit level). This results in similarly distributed skill transferability scores per occupation between 0.26 to 0.68 for the SOC and 0.24 to 0.71 for the ISCO (see Figure 1 and Table 4).

[12] A similar argument could be made for using a similarity threshold to aggregate the results. This procedure naturally truncates the assessment and prevents a full investigation of green skill transferability across a wider range of occupations. See Appendix A.3 for summary statistics using different aggregation thresholds to illustrate these consequences.

Table 4: Aggregated Cosine similarity scores by task and occupation

	Aggregated by Task						
	Min	Median	Mean	Max			
SOC	0.108	0.482	0.477	0.789			
ISCO-08	0.124	0.475	0.470	0.763			
	Aggregated by occupation						
	Min	Median	Mean	Max	Task min	Task mean	Task max
SOC	0.263	0.479	0.481	0.679	1	19.09	40
ISCO-08	0.243	0.472	0.469	0.711	2	7.63	14

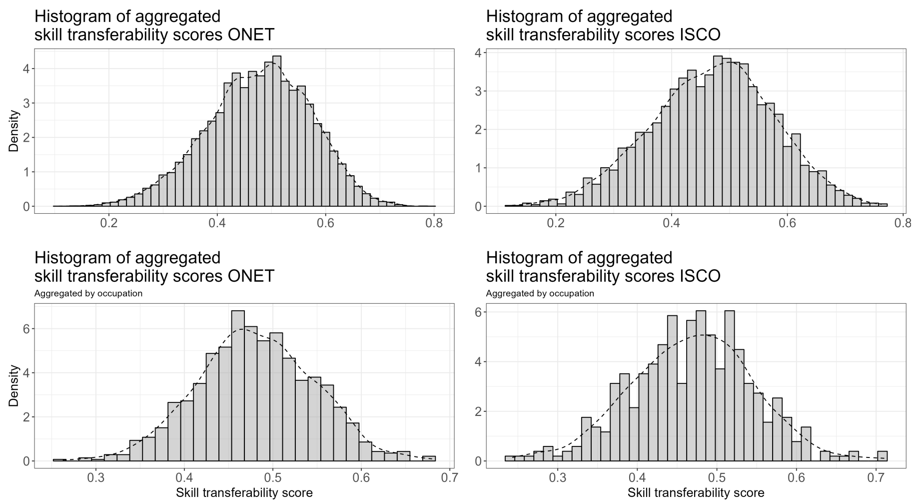

Figure 1: Skill transferability scores between non-green skills and green skills based on the 20 most similar green tasks for O*NET and the 8 most similar green tasks for ISCO. Aggregation on the occupational level is based on averaged similarity scores across all tasks for a specific occupation.

The resulting indicator is sensitive to the specifics of every occupation. Even evidently very environmentally friendly occupations such as Environmental Engineers (ISCO-08 4-digit code 2143; skill transferability score of 0.711 see Table 5 below) do not get assigned a perfect green skill transferability score, as not every skill in this occupation is necessarily connected to a positive environmental impact. For example, the rather general task *"obtaining, updating, and maintaining plans, permits, and standard operating procedures"* has a green skill transferability score of 0.635 when considered in the context of the other green tasks and skills. However, it is considerably lower than the green skill transferability score of 0.747 of the task *"advising corporations and government agencies of procedures to follow in cleaning up contaminated sites to protect people and the environment"* for the same occupation.

Table 5 reports the top and bottom 10 ISCO-08 occupations in terms of green skill transferability scores on a 4-digit level. It assigns high values to evidently green occupations such as “Environmental Protection Professionals” or “Environmental Engineers”. At the same time, it captures occupations which might not be labeled as green but can have a positive impact on the environment such as “Refuse Sorters” or "Garbage and Recycling Collectors". Moreover, it identifies non-green occupations which can be plausibly linked to having little environmental impact and thus skill transferability such as “Actors” or “Telephone Switchboard Operators”. Other occupations which might not have a positive environmental impact yet share some green tasks with greener occupations such as “Petroleum and Natural Gas Refining Plant Operators” (ISCO-08 code 3134) are only on rank 37. Thus, while a certain degree of skill transferability is plausible, such occupations are not equivalent to apparently environmentally friendly occupations. This illustrates that the green skill transferability score offers a key advantage: due to its focus on similarities of tasks and skills between occupations it enables a thorough investigation of the complementarity of green and non-green skills (Stephany and Teutloff 2024).

Table 5: Top and bottom 10 ISCO jobs based on their skill transferability score

Rank	ISCO-08	Job Title	Green Skill Transferability
1	2143	Environmental Engineers	0,711
2	2133	Environmental Protection Professionals	0.705
3	3257	Environmental and Occupational Health Inspectors and Associates	0.675
4	3131	Power Production Plant Operators	0.667
5	9611	Garbage and Recycling Collectors	0.656
6	9612	Refuse Sorters	0.684
7	3143	Forestry Technicians	0.635
8	3111	Chemical and Physical Science Technicians	0.635
9	3112	Civil Engineering Technicians	0.616
10	3113	Electrical Engineering Technicians	0.616
		Bottom	
418	3431	Photographers	0.310
419	4212	Bookmakers, Croupiers and Related Gaming Workers	0.297
420	2643	Translators, Interpreters and Other Linguists	0.289
421	5169	Personal Services Workers Not Elsewhere Classified	0.288
422	4131	Typists and Word Processing Operators	0.285
423	2653	Dancers and Choreographers	0.280
424	4223	Telephone Switchboard Operators	0.277
425	5241	Fashion and Other Models	0,266
426	2655	Actors	0,255
427	2652	Musicians, Singers and Composers	0,243

Comparing these results to the prediction of the green potential of occupations conducted by Lobsiger and Rutzer (2021) in the Swiss context (although on the ISCO-08 3-digit level) leads to similar results, as can be seen in Appendix A.2 Table A. 3. The correlation of 0.56 between the two indicators is positive and statistically significant.[13] The methodological differences and the cross-walk of results from the SOC framework to the ISCO framework can explain some of these differences (Bachelot 2024). Circumventing these problems is the unique strength of the proposed methodology and allows to directly compare task contents to produce meaningful assessments of occupations skill similarity.

The same level of nuance is observable for the O*NET-SOC classification. The SOC-O*NET occupation "First-Line Supervisors of Agricultural Crop and Horticultural Workers" (45-1011.07; skill transferability score of 0.573) has 24 tasks. The very general task *"Estimate labor requirements for jobs and plan work schedules accordingly"* receives a low green skill transferability score of 0.462. The task *"Plan or supervise infrastructure or collection maintenance functions, such as planting, fertilizing, pest or weed control, or landscaping"* is more directly associated to the environment and receives a very high score of 0.679.

Table 6 reports the top and the bottom 10 SOC occupations based on their green skill transferability score. The bottom 10 show an illustrative picture of occupations with a low level of green skill transferability. Those cases are not about jobs having a bad environmental impact, but rather about no environmental impact and include occupations such as “Proofreaders and Copy Markers” or “Dancers”. It’s intuitive that occupations such as “Environmental Scientists and Specialists, Including Health” or “Recycling and Reclamation Workers” have a high level of green skill transferability. Nevertheless, high-carbon occupations that potentially share tasks with green occupations such as “Petroleum Engineers” rank on 54th place in this assessment.

There is a fairly strong and statistically significant correlation between the measure for skill transferability and the measure for green potential (about 0.59) by Rutzer et al. (2020). In light of the methodological differences between the two approaches - Rutzer et al. (2020) are predicting green potential based on skills and tasks rather than directly comparing task contents - some deviations seem plausible. A detailed comparison of the rankings of occupations in terms of their green potential and skill transferability can be found in Appendix A.2 Table A. 2.[14]

The results of the comparisons presented above highlight the added value of the indicator developed in this paper: it introduces a robust assessment of similarity between green and non-green skills based on tasks which serves as a plausible indicator for green skill transferability (Gathmann and Schönberg 2010). Moreover, it allows to augment existing analyses of the green transition, by adding an additional dimension for potential labor market outcomes following economic transitions. To showcase potential applications it seems appropriate to as-

[13]Using the text-based approach, it is not possible to compute a skill transferability score for 45 summary categories on the ISCO 08 3-digit level.

[14]It was not possible to calculate a green skill transferability score for 28 summary categories for the 6-digit level of the SOC.

Table 6: Top and bottom 10 O*NET-SOC jobs based on their skill transferability score

Rank	O*NET_SOC	Job Title	Green Skill Transferability
1	19-2041.00	Environmental Scientists and Specialists, Including Health	0,679
2	11-9121.02	Water Resource Specialists	0,675
3	13-1199.01	Energy Auditors	0,672
4	11-3051.03	Biofuels Production Managers	0,651
5	51-9199.01	Recycling and Reclamation Workers	0,65
6	29-9011.00	Occupational Health and Safety Specialists	0,649
7	51-8099.04	Hydroelectric Plant Technicians	0,647
8	17-2199.03	Energy Engineers	0,645
9	17-2199.11	Solar Energy Systems Engineers	0,643
10	19-2041.03	Industrial Ecologists	0,638
		Bottom	
960	29-1024.00	Prosthodontists	0,327
961	43-9081.00	Proofreaders and Copy Markers	0,326
962	27-4032.00	Film and Video Editors	0,314
963	27-2011.00	Actors	0,312
964	23-2091.00	Court Reporters	0,31
965	27-2041.04	Music Composers and Arrangers	0,31
966	27-2032.00	Choreographers	0,298
967	27-2042.01	Singers	0,292
968	27-2042.02	Musicians, Instrumental	0,287
969	27-2031.00	Dancers	0,263

sess the distribution of green skill transferability across sectors exposed to the green transition in Europe.

4.6. Showcasing Green Skill Transferability in Europe

The goal of this section is to showcase potential avenues for future applications of the proposed methodology for research on the green and just transition of labor markets. I rely on data collected in the 11th round of the ESS (European Social Survey European Research Infrastructure (ESS ERIC) 2024). This dataset allows to take full advantage of the granularity of the green skill transferability indicator on the 4-digit level. Additionally, it contains information on the industrial sector individuals are employed in. The dataset is restricted to working respondents. To get a first descriptive impression on the theoretical relationship between skill transferability and environmental impact of occupations, I merge this dataset with data on greenhouse gas (GHG) emissions on the industry level provided by eurostat (2025).[15] Addi-

[15] According to eurostat (2025) greenhouse gases comprise the following: CO2, N2O in CO2 equivalent, CH4 in CO2 equivalent, HFC in CO2 equivalent, PFC in CO2 equivalent, SF6 in CO2 equivalent, NF3 in CO2 equivalent.

tionally, I merged the dataset with the skill-based classification of the exposure of occupations to the green transition developed by Zaussinger et al. (2025) to assess the relationship put forward in Table 3. The final dataset contains 36,212 respondents across 22 industries in 24 countries.[16]

A first relationship suggested by Figure 2 is that skill transferability appears to be relatively pronounced in sectors with a high amount air emissions such as "water supply; sewerage, waste management and remediation activities" (E), "Mining and quarrying" (B), or "agriculture, forestry and fishing" (A). However, other sectors with less environmental impact such as "administrative and support service activities" (N) or "activities of households as employers [...]" (T) also show a comparatively high degree of green skill transferability. Sectors such as "arts, entertainment and recreation" (R) or "other service activities" (S) are very plausibly linked to a small degree of green skill transferability. This result is corroborated by an OLS estimation with heteroskedasticity robust standard errors and country fixed-effects of green skill transferability on the logarithm of country-industry specific GHG emissions as outlined in Table 7.[17] In other words, for a 10 % increase in GHG emissions, green skill transferability increases by 0.018. The R2 implies that a fairly large amount of variation in the green skill transferability score is explained by country-sector GHG emissions.

[16] The countries are Austria, Belgium, Switzerland, Cyprus, Germany, Spain, Finland, France, Greece, Croatia, Hungary, Ireland, Island, Italy, Lithuania, the Netherlands, Norway, Poland, Portugal, Serbia, Sweden, Slovenia, Slovakia, and UK.

[17] Country-industry level results are reported in Appendix A.3 Figure A.3.

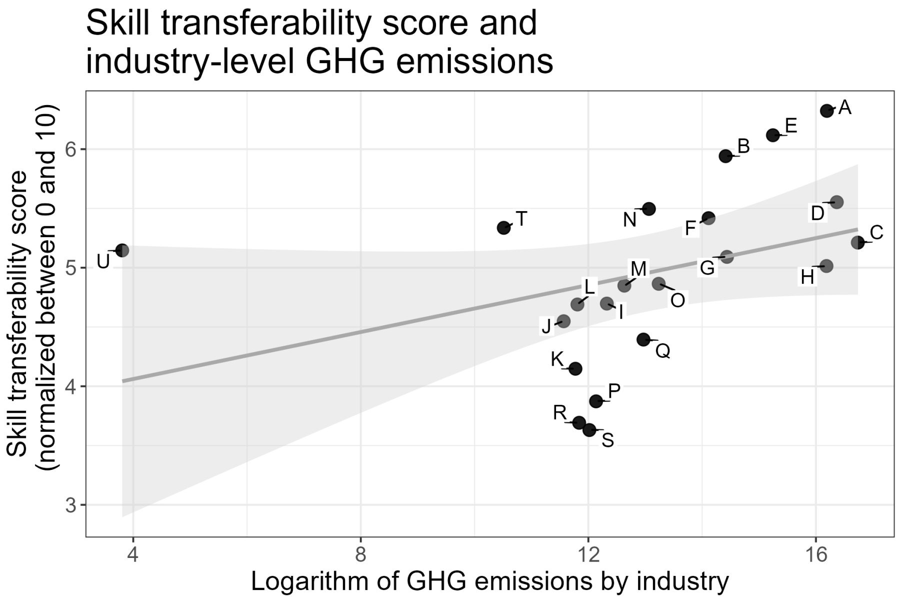

Figure 2: Skill transferability scores across industries in the ESS Round 11. Skill transferability scores are normalized be tween 0 and 10. Emissions are illustrated as the logarithms of greenhouse gas accounts per industry. The shaded area indicates the 95% confidence intervall. Industries are classified according to NACE Rev. 2. A - Agriculture, forestry and fishing; B - Mining and quarrying; C – Manufacturing; D - Electricity, gas, steam and air conditioning supply; E - Water supply; sewerage, waste management and remediation activities; F – Construction, G - Wholesale and retail trade; repair of motor vehicles and motorcycles; H - Transportation and storage; I - Accommodation and food service activities; J - Information and communication; K - Financial and insurance activities; L - Real estate activities; M - Professional, scientific and technical activities; N - Administrative and support service activities; O - Public administration and defense; compulsory social security; P – Education; Q - Human health and social work activities; R - Arts, entertainment and recreation; S - Other service activities; T - Activities of households as employers; undifferentiated goods- and services-producing activities of households for own use; U - Activities of extraterritorial organizations and bodies

Table 7: OLS estimation of green skill transferability on GHG emissions by country-industry combination; country fixed-effects

	Green skill transferability
(Intercept)	2.213***
	(0.497)
GHG emissions by country-industry	0.184***
	(0.036)
Country FE	YES
N	432
R2	0.234
R2 Adj.	0.191
AIC	1062.1
BIC	1163.9

+ $p < 0.1$, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

In order to explicitly address the potential relationship put forward in Table 3, I construct two groups distinguishing between high and low skill transferability by choosing the cut-off at the third quartile. This rather strict categorization yields the results depicted in Table 8. The results for skill transferability in neutral occupations plausibly indicate only a low level of green skill transferability, while it is high for employees in low-carbon occupations. The comparison between those high-carbon occupations which are unviable to transition and those which are offers policy-relevant implications: Workers in the latter do not seem to dispose of a high degree of green skill transferability and might therefore be more dependent on sectoral performance in the green transition (Bachmann et al. 2024). This illustrates a challenge for policymakers: The majority of workers in these occupations is not likely to make the transition based on their existing skill sets and might have to go through lengthy and potentially expensive reeducation programs in order to ensure their future labor market participation. However, the viability for transition of their occupation and sector offers a general perspective for their transition.

Table 8: Skill transferability and occupational exposure to the green transition

	Neutral	Low-carbon	Viable to transition	Unviable to transition
High skill transferability	29.08	74.67	27.29	100
Low skill transferability	70.92	25.33	72.71	0

Workers, who cannot rely on the transition of their occupations, appear to have a good chance of transferring their skills to new, greener occupations. This begs the question of who these individuals are and how to understand their exposure to the green transition.[18] Figure 3 allows to gauge this question in more detail, following the operationalization for social class put forward by Oesch (2006). Green skill transferability seems highest among individuals in low-carbon sectors and those high-carbon sectors which are unviable to transition. This is particularly pronounced in the higher-grade service class and the unskilled workers class. Skill-specificity in occupations of skilled workers which might impede a transition to other jobs (see also Lazear 2009) as compared to higher grade service workers or lower skilled counterparts. This could pose a severe policy challenge to up-/re-skill workers with a set of skills suitable for only a narrow set of occupations. However, in light of the potential growth of the low-carbon sector, this may prove to be a way forward for the employees in these industries (Bachmann et al. 2024).

[18] Table A. 6 in Appendix A.3 provides an overview of these occupations and their corresponding green skill transferability score.

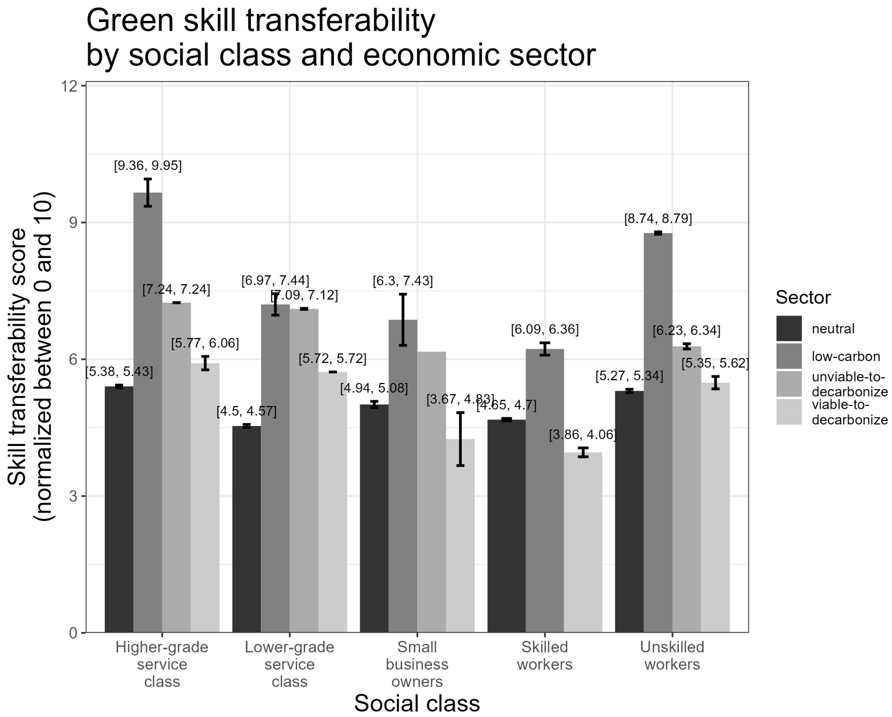

Figure 3: Skill transferability scores across social class and industries, following Oesch (2006). The classification of sectors is based on Zaussinger et al. (2025). Values in brackets indicate 95 % confidence intervals.

There exists considerable green skill transferability, particularly in high GHG emission intensive industries in Europe. While a lack of transferable skills might not pose a big threat to labor market participants in already low-carbon occupations, the same cannot be said for individuals working in high-carbon occupations. Sectoral trends might determine the labor market consequences of workers in high-carbon sectors where a green transition is viable. Nevertheless, a majority in these occupations does not display a high degree of skill transferability, which poses a major challenge for policy-makers. Considering this challenge in terms of the class structure highlights that a certain degree of skill specificity could be the driver behind considerable differences across social classes. A rigorous test of these tentative implications is a promising future avenue for research.

4.7. Discussion and Conclusion

To understand the drivers behind a successful and just transition to a sustainable economy, it is necessary to better understand what makes jobs green and decent. The ensuing debate about the greenness of jobs has led to a range of efforts to establish a quantitative indicator to determine the environmental impact of specific occupations across contexts (Dierdorff et al. 2009; Vona et al. 2018; Janser 2018; Bachmann et al. 2024). Yet there remains an empirical gap: similarities between existing jobs and those that are likely to increase in light of a green transition remain veiled (Bowen et al. 2018; Rutzer et al. 2020; Lobsiger and Rutzer 2021). Studies investigating the similarity between green and non-green occupations seek to complement these assessments and provide an additional level of detail to the analysis of labor market consequences in the green transition (Granata and Posadas 2024; Bowen et al. 2018; Rutzer et al. 2020).

Following the task-based ethos of this line of research (Gathmann and Schönberg 2010; Vona et al. 2018), I introduce a robust indicator for green skill transferability as a complementary predictor for labor market mobility in the green transition. This allows to investigate how workers' skills from an old, non-green jobs, could potentially facilitate a transition to a new, green occupation. This enables an investigation into what it takes to go from non-green to green. By directly comparing task contents associated with green and non-green occupations utilizing SBERT (Reimers and Gurevych 2019) the proposed methodology circumvents potentially problematic aggregation and cross-walking procedures, benefiting especially cross-sectional research (JRC 2021; Bachelot 2024). The resulting indicator offers skill transferability scores for a wide range of occupations up to an 8-digit (O*NET-SOC) and 4-digit ISCO-08 level.

This comes with several advantages: Not only is it possible to analyze characteristics of labor market participants in Europe on a 4-digit ISCO-08 level without the need for cross-walks; the indicator can also be applied to complement assessments of the exposure of economic sectors to the green transition (Zaussinger et al. 2025). The results suggest that there exists a considerable degree of skill transferability especially in high-carbon sectors. However, low green skill transferability in sectors with a highly negative environmental impact requires potentially expensive and expansive labor market policies in order to ensure a just transition for affected workers.

The presented approach comes with some limitations that offer a range of opportunities and advantages for future research. First, it is important to highlight that the green skill transferability indicator developed in this paper has the potential of only increasing in precision as the corpora of tasks (green and non-green) associated to occupations increase in size. Text-mining approaches to continuously extend the collection of tasks associated with specific occupations can address concerns about the static nature of a bottom-up approach (Villani et al. 2025). Combining this with machine learning techniques to classify online job advertisements and corresponding tasks is a promising extension of the approach developed in this paper (Boselli et al. 2018).

Second, the empirical validation of the indicator presented in this paper would greatly benefit from more detailed explorations of fine-grained data on labor market participation and mobility. This would enable to connect to long tradition of research on labor market effects of economic transformations that often employs task-based measures, such as the routine task index (Autor and Dorn 2013; Goos et al. 2014), to analyze outcomes for individuals and economies (Iversen and Soskice 2001). Building on this, the indicator introduced in this paper offers a way to analyze workers' potential to move between sectors differently exposed to the green transition. Since skill transferability is known to improve labor market outcomes (Ormiston 2014; Gathmann and Schönberg 2010; Shaw 1987), applying this indicator to panel data with fine-grained information on workers occupations could clarify the role of green skill transferability in greening economies at national and regional levels. This is a promising avenue for future research as it directly assesses the causal role of skill transferability in the green transition. Moreover, such an exercise enhances potential predictions of workers' labor market trajectories in this specific economic transformation, thereby offering valuable insights for the design of active labor market policies.

However, while green and non-green tasks often overlap (Lim et al. 2023), geography can limit workers' access to green jobs (Niang et al. 2024). Examining green skill transferability may reveal how non-green local economies shift toward sustainability and broaden stakeholder inclusion, which is a prerequisite just transition (Bolet et al. 2024; Smith 2017). Future research can benefit from scrutinizing the spatial distribution of labor market risks associated with the green transition. This harbors additional potential to uncover the drivers of opposition to the latter as mapping regions with respect to their exposure to the green transition and their potential to transfer existing skills to new sectors can highlight where green labor market in- and outsiders are concentrated. Moreover, it offers insights on how these citizens form their preferences, thereby connecting to a broad literature on labor market polarization (Häusermann et al. 2015; Rueda 2014; Goos et al. 2014). Ultimately, the combination of spatial and temporal assessments of green skill transferability allows to further elaborate on fundamental questions of the causal relationship between workers' skill sets and their labor market prospects in the green transition.

Lastly, the paper's results highlight how policymakers can address labor market challenges from climate policy, especially in high-carbon sectors (Vandeplas et al. 2022). A key task is aligning existing skills with green ones through targeted re- and upskilling (OECD 2024; Stephany and Teutloff 2024; Buyukyazici and Quatraro 2025). The indicator developed here helps assess green skill transferability, enabling more tailored policies. Rather than one-size-fits-all approaches, it points to realistic training opportunities—such as upgrading waste workers' recycling knowledge for the circular economy—while avoiding mismatches like retraining them for ESG management. As noted by Ormiston (2014), minimizing skill obsolescence requires matching retraining to workers' current skills and available jobs. The proposed methodology can thus guide policymakers in designing effective reeducation for workers most affected by the green transition.

5. Paper 2: Winning Over the Vulnerable? Perceived Vulnerability, Tailored Policy Packages, and Support for Climate Action

5.1. Introduction

The need for rapid and far-reaching climate action is widely recognized and requires rapid and decisive decarbonization. However, this transformation is not only a technological or economic challenge but also a political one, as ambitious climate policy depends on sustained public support (Drews and Van Den Bergh 2016). A key condition for such support is how governments manage the vulnerabilities generated by climate change and the policies designed to address it (Gaikwad et al. 2022; Bolet et al. 2024).

Climate change generates *climate vulnerability* through its physical impacts, such as more frequent and severe floods, heatwaves, droughts, and storms (IPCC 2023). These consequences threaten human lives, ecosystems, and entail substantial social and economic costs (Otto et al. 2017; Newman and Noy 2023; Kotz et al. 2024; Waidelich et al. 2024). To mitigate these vulnerabilities, governments must act swiftly and decisively to achieve deep decarbonization (IPCC 2023), while simultaneously improve measures to adapt to a warming planet.

At the same time, decarbonization generates *policy vulnerability* through the socioeconomic disruptions associated with mitigation policies. These include industrial restructuring, job losses in carbon-intensive sectors, rising energy prices, and lifestyle constraints on consumption (Graham and Knittel 2024; Rodríguez-Pose and Bartalucci 2024). In practice, governments have largely relied on pull-mitigation policies that incentivize demand for low-carbon alternatives (“carrots”), while more punitive push-mitigation measures (“sticks”) remain less common (Luo et al. 2026). A key reason is the potential for backlash: push policies impose visible upfront costs on politically organized incumbent industries and price-sensitive voters and are therefore particularly prone to meet political resistance among firms, workers, and fossil-dependent communities (Egli et al. 2022; Gazmararian and Krashinsky 2023; Voeten 2024; Oatley 2023; Dickson and Hobolt 2025; Stutzmann 2025).

Recent literature has increasingly studied how *objective* vulnerability to climate change (Zahran et al. 2006; Brody et al. 2008; Elgin 2014) and to climate policies (Bechtel et al. 2019; Markkanen and Anger-Kraavi 2019; Gaikwad et al. 2022; Hasanaj and Stadelmann-Steffen 2022) shapes climate preferences. We instead focus on *perceived* vulnerability. Despite some work on perceived climate risk (Zahran et al. 2006; Mumpower et al. 2016; Leiserowitz 2006), we know little about how people perceive their own vulnerability.

This gap matters because most models of political behavior assume that objective vulnerability shapes attitudes through subjective perceptions. Yet empirical evidence shows only a weak relationship between objective and perceived vulnerability (Quoß 2025), and objective indicators explain less variation in climate policy support than perceived vulnerability (Zahran et al. 2006). More broadly, extensive research has shown the relevance of perceptions in understanding policy support and political behavior (Weber 2017; Willis et al. 2022; Stoetzer et al. 2026) and that objective exposure influences attitudes only insofar as citizens interpret and internalize it (Ahrens 2024). Understanding perceived vulnerability is therefore central to explaining climate policy support and designing effective climate policy packages.

Focusing on perceptions also enables a broader conceptualization of vulnerability. Objective indicators capture specific risks, such as heatwaves, flooding, or job loss in particular sectors, whereas perceived vulnerability encompasses diffuse and multidimensional concerns. We elicit these perceptions through open-ended survey questions that allow us to capture citizens' first-order beliefs (Ferrario and Stantcheva 2022). Subsequently, drawing on research on risk perceptions by Walpole and Wilson (2021a,b), we propose a novel operationalization of perceived vulnerability: the self-reported likelihood of being negatively affected by the impacts of climate change or the consequences of climate policies. This approach provides a more comprehensive account of how citizens evaluate personal risks and how these evaluations affect climate policy support.

Understanding perceptions alone, however, is insufficient. Building durable support for costly mitigation also requires strategies to address perceived vulnerabilities through tailored compensation. As deep decarbonization will require moving beyond pull-mitigation policies toward more intrusive push-mitigation policies (Luo et al. 2026), such compensation strategies become increasingly important to prevent political backlash against climate policy.

Most existing research on compensation centers on carbon taxation. Carbon taxes are often unpopular because their benefits are diffuse and long-term, while their costs are immediate and tangible, particularly for vulnerable households (Beiser-McGrath and Busemeyer 2024). Extensive research shows that lump-sum compensation through revenue recycling can partially offset these burdens and increase public support (Beiser-McGrath and Bernauer 2019; Gaikwad et al. 2022; Bürgisser et al. 2024). However, we know little about whether more targeted forms of compensation that go beyond lump-sum compensation associated with carbon taxation can similarly increase support for costly mitigation.

We address this gap by drawing on the literature on eco-social policy mixes (Gough 2013; Zimmermann and Graziano 2020; Mandelli 2022; Bohnenberger 2023; Cotta 2024) and policy packaging (Wicki et al. 2019, 2020; Fesenfeld et al. 2020; Bergquist et al. 2020; Fesenfeld 2022; Heyen and Wicki 2024). We examine whether tailored compensation —- beyond lump-sum transfers —- can increase support for ambitious climate policy. Specifically, we focus on two key dimensions of contemporary climate policy that complement push- and pull-mitigation: (i) *adaptation* policies, which reduce vulnerability to climate change (e.g., climate-resilient infrastructure or flood prevention), and (ii) *eco-social* policies, which cushion the socio-economic risks of decarbonization (e.g., financial compensation or retraining for affected workers or income-based subsidies for renters in energy-inefficient housing). We argue that such measures can provide immediate compensation for those who perceive themselves as vulnerable, thereby increasing support for ambitious climate action. To our knowledge, no study systematically evaluates those policies' capacity to generate public support.

We test our expectations using an original survey of eligible voters in Germany in early 2024 (N = 2,958). Germany is an ideal case given its ambitious yet politically contest climate policy agenda. The survey first measures perceived vulnerabilities and we link these perceptions to climate policy support. The second part features a conjoint experiment in which participants randomly evaluate climate policy packages combining push- and pull-mitigation, adaptation, and eco-social policies to assess whether tailored compensation can increase support for costly mitigation policies.

Our findings are threefold. First, open-ended responses show how individuals describe their vulnerability to climate change and climate policy in their own words, supporting a more comprehensive measure of vulnerability. Second, perceived policy vulnerability reduces support for mitigation, while perceived climate vulnerability increases it. In general, perceived vulnerability boosts demand for policies that address immediate climate impacts. Third, climate policy packages designed to compensate citizens for perceived vulnerabilities increase support for mitigation, although mainly among those vulnerable to climate change rather than those vulnerable to climate policy. For citizens with high perceived policy vulnerability, more intrusive mitigation policies remain unpopular. This highlights the limits of compensation and a dilemma for policymakers: Compensating for the immediate effects of climate policies is insufficient to gain support from those who feel vulnerable to climate policies themselves.[19]

5.2. Theory

5.2.1. Vulnerability to Climate Change and Climate Policy

In the context of climate change, vulnerability refers to the risk of "falling below benchmark levels of well-being should a risky event occur" (Heltberg et al. 2009: p. 93). *Climate change vulnerability* captures the susceptibility to personally experience adverse consequences of climate change, such as more frequent extreme weather events, sea-level rise, droughts, or heatwaves, which can endanger health and well-being. By contrast, *policy vulnerability* denotes the susceptibility to the negative consequences of the green transition (Gaikwad et al. 2022),

[19]This paper is under review at Socio-Economic Review.

including job losses in carbon-intensive industries, higher energy prices, or inequitable resource distribution.

Research typically operationalizes these vulnerabilities using objective indicators, such as exposure to extreme weather or employment in vulnerable industries. Most prominently, Gaikwad et al. (2022) study climate and policy vulnerabilities in the United States and India by comparing respondents in coal-dependent regions and climate-exposed areas to populations in less directly affected regions. They show that the type of vulnerability shapes policy preferences in distinct ways. Subsequent research further shows that policy vulnerability is not limited to specific dimensions of labor market risk. Rather, it is more broadly associated with status concerns that extend beyond material employment risks (Schaffer and Magyar 2024). Climate and policy vulnerability are therefore multidimensional and not exclusively material: identity-based considerations and related social attachments shape how communities evaluate compensation for climate policy costs borne by themselves or their in-group (Gaikwad et al. 2022). This interpretation is consistent with Mau (2023), who argue that fears of losing established ways of life can trigger resistance to climate policy.

Yet objective exposure does not translate mechanically into political preferences. Climate-related risks are characterized by uncertainty, and subjective assessments are often shaped by intuitive and affective processes rather than purely rational evaluations (Weber 2017; Kahneman 2013). Although objective and subjective risks are interrelated (Chung and Mau 2014), insecurity is not reducible to observable conditions but also depends on individual experiences and coping capacities (Hansson 2010). Individuals frequently struggle to incorporate objective probabilities into decision-making (Arrow 1982). In the climate domain, evidence is mixed: some studies find that experiencing extreme weather increases perceived risk (Zanocco and Sousa-Silva 2023), while others detect no lasting effects on policy preferences (Gärtner and Schoen 2021). Recent evidence even points to weak or negative correlation between perceived and actual extreme weather exposure (Quoß 2025), raising concerns about using objective experiences as proxies for perceptions.

We do not seek to resolve the debate between objective and subjective measures. Instead, we explicitly focus on *perceived* climate and policy vulnerability. Based on Walpole and Wilson (2021a), we define perceived vulnerability as an individual's estimation of the likelihood of being negatively affected by a given risk. This conceptualization encompasses both the impacts of climate change and the consequences of climate policy.

Our focus on perceptions complements existing work on objective indicators, such as exposure to weather events or employment in carbon-intensive sectors. However, vulnerabilities to climate change and climate policy are multidimensional and extend beyond such narrow objective indicators to broader socioeconomic insecurities and status concerns that are difficult to operationalize objectively. Focusing on perceptions allows for a more comprehensive account of how personal risk assessments translate into climate policy preferences.

Moreover, research more broadly shows that subjective perceptions often matter more for political attitudes and behavior than objective indicators (Chung and Mau 2014; Willis et al. 2022; Stoetzer et al. 2026). In particular, objective risk exposure only translates into policy demand when it is reasonable to assume that individuals are aware of their risk exposure (Ahrens 2024). Emphasizing subjective vulnerabilities thus not only complements research on objective measures but also provides a more comprehensive account of how citizens experience and respond to the risks associated with climate change and the green transition.

5.2.2. Perceived Vulnerability and Climate Policy Preferences

Given the urgency of far-reaching climate action, the design of comprehensive and effective policy packages is a pressing challenge. Following Ejelöv et al. (2022), we distinguish between *pull-mitigation* policies, which incentivize demand for climate-friendly alternatives through subsidies, feed-in tariffs, public procurement, or public investments, and *push-mitigation* policies, which penalize environmentally harmful practices via carbon pricing, bans, or regulation. Push measures are generally perceived as less acceptable than pull measures, as they are seen to constrain individual freedoms more directly (Eriksson et al. 2006; Drews and Van Den Bergh 2016; Wicki et al. 2019).

Beyond mitigation, climate policy responses also address the immediate consequences of climate change and climate policies (Mandelli et al. 2024; Markkanen and Anger-Kraavi 2019). *Adaptation policies* seek to mitigate these climate-related consequences, but their success depends on long-term planning, the inclusion of vulnerable stakeholders, and sensitivity to local contexts (Orlove 2022; Wilson et al. 2020). This contextual specificity makes adaptation policies difficult to classify, as they often address highly localized consequences (Biesbroek and Delaney 2020). In doing so, however, they offer specifically tailored responses to vulnerabilities arising from the natural consequences of climate change. Common examples include flood prevention, coastal protection, or measures to reduce urban heat islands (Meyerhoff et al. 2021; Singh et al. 2022).

Eco-social policies, by contrast, aim to cushion the socio-economic risks of the green transition. Rooted in debates on sustainable welfare (Zimmermann and Graziano 2020; Mandelli 2022; Bohnenberger 2023; Cotta 2024), they have gained increasing prominence. The design and feasibility of eco-social policies depends on the welfare regime in which they are embbeded (Mandelli 2023). Accordingly, eco-social policies can be either integrated into existing institutions – contingent on their capacity – or designed from scratch. Thereby it is important to consider the extent to which such policies address social and ecological risks simultaneously.

Typical examples include retraining programs for fossil fuel workers, lump-sum transfers to offset economic hardship, or assistance with rising energy costs for vulnerable households.

Distinguishing between push and pull mitigation, adaptation, and eco-social policies allows us to assess the multidimensional structure of public support for climate action. It also helps to identify how vulnerability profiles shape policy preferences. For some groups, tailored adaptation or eco-social measures may provide essential relief; others may prioritize long-term mitigation, either because they feel less exposed to transition risks or seek to avert future climate damage. Recognizing the multidimensionality of climate policy thus enables a more precise analysis of the trade-offs citizens face when forming preferences under different vulnerability conditions.

In line with recent assessments of vulnerability and policy demand (Gaikwad et al. 2022), we expect vulnerable individuals to prefer compensation through adaptation or eco-social policy over mitigation measures. However, preferences should vary with the source of vulnerability. Those highly vulnerable to climate change are likely to favor adaptation over eco-social policies and may also support mitigation, as the underlying risks are driven by the climate crisis itself. By contrast, citizens facing policy vulnerability should favor immediate eco-social policies over adaptation and are more likely to oppose mitigation, since such measures can intensify their short-term risks.

Hypothesis 1. *Perceived climate change vulnerability increases support for adaptation and mitigation policies.*

Hypothesis 2. *Perceived policy vulnerability increases support for eco-social policies and decreases support for mitigation policies.*

However, resource scarcity intensifies the competition between mitigation and adaptation policies (Tol 2005), reinforcing preferences for short-term over long-term measures and undermining support for long-term mitigation policies. When individuals face both immediate risks from climate change and adverse effects from climate policies, this trade-off might become more pronounced (Beiser-McGrath and Bernauer 2024; Beiser-McGrath and Busemeyer 2024). We thus expect those experiencing high perceived vulnerability to both climate change and climate policy to favor short-term compensatory solutions (Gaikwad et al. 2022).

Hypothesis 3. *Perceived vulnerability to both climate change and climate policy increases support for adaptation and eco-social policies and decreases support for mitigation policies.*

5.2.3. Compensating Vulnerabilities in Policy Packages

Although mitigation policies are essential to address the climate crisis, their benefits are diffuse and realized only in the long-term (Hasson et al. 2010), while their costs are immediate and tangible. Recognizing this intertemporal trade-off and the distributive implications of climate action, governments and scholars have increasingly turned their attention to strategies for sustaining support for ambitious climate measures, particularly among vulnerable groups.

One prominent compensation strategy has centered on carbon taxation. Carbon taxes are often unpopular because their benefits are long-term and diffuse, whereas their costs are immediate and highly visible, particularly for lower-income and otherwise vulnerable households (Beiser-McGrath and Busemeyer 2024). Revenue recycling addresses this imbalance by returning tax revenues directly to citizens, typically through lump-sum transfers, thereby (partially) offsetting regressive effects and reducing net financial losses for vulnerable groups. A growing body of research demonstrates that such lump-sum compensation can partially mitigate distributional burdens and increase public acceptance (Beiser-McGrath and Bernauer 2019; Gaikwad et al. 2022; Bürgisser et al. 2024).

Yet while we know a great deal about lump-sum compensation in the context of carbon taxation, we know far less about broader strategies that provide more tailored support to vulnerable groups. As climate policy must expand in scope and ambition to achieve substantial emission reductions (Luo et al. 2026), compensatory mechanisms are likely to become increasingly important for maintaining political support, particularly among vulnerable groups. However, existing research offers limited empirical evidence on forms of compensation other than carbon tax revenue recycling as tools to bolster support for costly mitigation measures.

We therefore examine whether tailored eco-social and adaptation policy packages can strengthen support for far-reaching climate action among vulnerable individuals. Building on the emerging literature on eco-social policy (Gough 2013; Zimmermann and Graziano 2020; Mandelli 2022; Bohnenberger 2023; Cotta 2024), we conceptualize eco-social packages as combinations of mitigation policies and eco-social policy instruments designed to cushion the socioeconomic risks of decarbonization. Such measures may include targeted income support, retraining programs for displaced workers, or subsidies for low-income households facing higher energy costs. By directly addressing the material consequences of climate policy, eco-social policies seek to reduce policy-induced vulnerability. Complementary adaptation policies, such as investments in climate-resilient infrastructure or disaster preparedness, aim to reduce exposure to the physical risks of climate change itself. Together, these instruments offer a coherent framework for compensating both policy and climate vulnerabilities.

Our argument also builds on the literature on policy packaging (Wicki et al. 2019, 2020; Fesenfeld et al. 2020; Bergquist et al. 2020; Fesenfeld 2022; Heyen and Wicki 2024), which shows that bundling policies can reshape policy trade-offs (Armingeon and Bürgisser 2021) and increase support for otherwise unpopular measures. Carefully designed packages can broaden coalitions by compensating potential losers, signaling fairness, and reducing perceived distributive injustice. The key logic is that support for intrusive mitigation can be strengthened when its indirect socioeconomic effects are explicitly addressed and targeted assistance is offered to vulnerable groups (Markkanen and Anger-Kraavi 2019; Beiser-McGrath and Bernauer 2019; Heyen and Wicki 2024; Bürgisser et al. 2024).

We build on this rationale and argue that adaptation and eco-social policies can serve as immediate compensation for individuals who feel highly vulnerable to climate change, climate policy, or both. By explicitly addressing short-term climate and policy consequences, such packages reduce the perceived trade-off between ambitious mitigation and personal vulnerability. In this way, explicitly compensating for short-term consequences should enhance support for costly mitigation measures.

Table 9: Perceived vulnerability and expected effects of compensation

	Low policy vulnerability	**High policy vulnerability**
Low climate change vulnerability	Package support not contingent on compensation	Eco-social compensation leads to higher support for costly package
High climate change vulnerability	Adaptation leads to higher support for costly package	Comprehensive compensation leads to higher support for costly package

Table 9 summarizes our expectations across vulnerability profiles. For citizens with low perceived vulnerability in both domains, support for mitigation should be relatively insensitive to compensation. Among individuals with high policy vulnerability but low climate vulnerability, eco-social compensation should increase support by alleviating fears of socioeconomic disruption. In contrast, among those with high climate vulnerability but low policy vulnerability, adaptation measures should raise support by addressing environmental risks. Finally, for cross-pressured individuals who perceive high vulnerability in both domains, comprehensive packages that combine adaptation and eco-social compensation should be most effective in generating support for costly mitigation. Put differently, we argue that the better compensation is tailored to climate change or climate policy related vulnerability, the higher the support for a climate policy package, even if it entails additional cost.

Hypothesis 4. *Including adaptation and eco-social policy in a policy package increases support for costly mitigation among individuals with a high degree of perceived vulnerability.*

5.3. Research Design

5.3.1. Case Selection

We selected Germany due to its prominent climate policy discourse and frequent exposure to natural disasters. Climate policy has become highly salient in recent years, with major initiatives under discussion and implementation – creating a conducive environment for studying public preferences. At the core is the revised 2021 Climate Change Act, passed by the Grand Coalition, which mandates a 65 percent reduction in greenhouse gas emissions by 2030 and climate neutrality by 2045. While the Act sets overarching goals, the Climate Action Program specifies concrete measures. Meeting these goals requires a dramatic acceleration in emissions reductions – more than doubling the current pace by 2030 and nearly tripling it by 2045.

Since 2022, Germany's main financial instrument for the green transition has been the Climate and Transformation Fund (KTF), a federal special fund (*Sondervermögen*), financing initiatives such as building renovations, industrial decarbonization, renewables expansion, and electromobility. The fund was planned to allocate €211.8 billion for 2024–2027, largely from EU-ETS revenues, national carbon pricing, and over €60 billion in unused COVID-19 relief funds. However, in late 2023 the Constitutional Court ruled that reallocating the latter violated constitutional rules, creating a major funding gap and intensifying political debate over the KTF's future.

Despite these shortfalls, the KTF's specificity allows us to link survey policy proposals directly to ongoing public debate. The salience of these debates also suggests a reasonable degree of public awareness of climate policy measures. At the same time, Germany exemplifies a broader dilemma faced by industrialized countries: reconciling ambitious long-term climate strategies with fiscal constraints, shifting security concerns, and economic pressures. Germany's response – including a temporary relaxation of the debt brake and an additional 100 billion euros for climate-related measures – illustrates how such tensions play out. While the instruments and political context are distinct, the challenges policymakers confront extend well beyond Germany, allowing our findings to speak to a wider set of cases.

5.3.2. Survey Design

To test our expectations, we conducted a preregistered survey experiment in February and March of 2024 in Germany, which had been reviewed and approved by our respective Ethics Committees.[20] We recruited 2,958 eligible voters from Germany from a large online panel provided by Respondi/Bilendi. By relying on quota sampling based on age, gender, and education, our sample broadly aligns with the demographic margins of the voting-age population

[20] See preregistration: https://osf.io/ph7wt/?view_only=5b22fe5ccce54d2f8080540afa222a54

in Germany across these three variables, with cross-quotas for age and gender. Details on the operationalization of all variables are provided in Appendix Table A. 8, with descriptive statistics in Appendix B.2.

Perceived Climate Change and Policy Vulnerability

At the very beginning, respondents answered an open-ended question asking them to describe the potential risks and concerns they associate with climate change and the measures taken to combat it. This was intended to capture first-order concerns and beliefs prior to structured items. We then measured perceived climate change and policy vulnerability following Walpole and Wilson (2021b), who define vulnerability ("susceptibility") as the perceived likelihood of personally experiencing negative consequences of a risk. This approach emphasizes citizens' evaluations of potential adverse effects of both climate change and climate policies.

Perceived climate change vulnerability was measured by asking respondents, on a 0–10 scale (0 = very unlikely, 10 = very likely), how likely they believe climate change impacts (e.g., heat waves, flooding, water shortages) will negatively affect them. Using the same scale, perceived policy vulnerability was measured by asking how likely respondents thought climate policies would negatively affect them. This operationalization provides a broader understanding of vulnerability, moving beyond labor market risks or abstract concern about climate change (Gaikwad et al. 2022; Schaffer and Magyar 2024).[21]

Multidimensional Policy Preferences

We evaluated citizens' policy preferences across four dimensions: push-mitigation, pull-mitigation, adaptation, and eco-social policy. Respondents first answered an open-ended question about their views on climate policy and the measures they believe policymakers should implement. This was followed by a battery of closed-ended items, where support for specific policies was rated on a 0–10 scale (0 = strongly against, 10 = strongly in favor). Each dimension included at least three policies. pull-mitigation covered subsidies for building renovations and renewables, and investments in public transport and electromobility. push-mitigation comprised bans on oil and gas heating systems, combustion engines, and short-distance flights, as well as an increase in the CO2 tax. Adaptation reflected salient German challenges, including flood prevention, resilient infrastructure, and measures to reverse soil sealing. Eco-social policies included retraining programs, compensation for displaced fossil fuel workers, and rent subsidies for residents of energy-inefficient housing. While the pull-mitigation items align closely with current KTF priorities, the push-mitigation, adaptation, and eco-social items reflect ongoing political debates in Germany and have yet to be implemented.

To validate these categories, we conducted an exploratory factor analysis (EFA) (Costello and Osborne 2019). The results, presented in Appendix Table A. 10, confirm that the items load onto separate factors, indicating that the four types of policies represent distinct dimensions of support. Further details on the procedure and factor structure are provided in Appendix B.2. The resulting factor scores, standardized to unit variance, serve as the dependent variables in the subsequent regression analyses.

[21] To further probe perceptions, respondents also evaluated potential negative consequences at the regional and national levels to capture sociotropic considerations. The results for all three levels are very similar (see Appendix Figure A.8.

5.3.3. Conjoint Experiment

To assess the ability of eco-social policy packages to increase support for costly climate policies, we conducted a conjoint experiment. Table 10 displays the attributes and levels of this design. The first four attributes are related to the four theoretical dimensions of policy responses (push-mitigation, pull-mitigation, natural adaptation, and eco-social policy). To avoid a free-lunch situation and to address the pressing question of fiscal resources, we also included a financing dimension in the conjoint experiment.

We followed the fully randomized approach proposed by Bechtel and Scheve (2013) and Hainmueller et al. (2014) to implement the conjoint experiment. We presented each respondent with 5 different choice tasks. To contextualize the conjoint experiment, respondents were asked to envisage possible packages of policy measures to counter climate change and its consequences, as well as proposals for financing these measures. For each paired policy proposal, we collected data on two primary variables: a choice variable, indicating which of the two policy packages a respondent selected, and a rating variable, reflecting how much each respondent likes each of the two packages on an 11-point scale. An example of the tasks presented to the respondents can be found in the Appendix B.1 Figure A.5.

Table 10: Attributes and levels of the conjoint experiment

Attribute	**Attribute levels**
Promotion of climate-friendly activities (pull-mitigation)	Subsidies for energy-efficient renovations Subsidies for renewable energy production Investments in public transport infrastructure Investments in e-mobility and charging infrastructure Status quo
Reduction of climate-damaging activities (push-mitigation)	Ban of oil and gas heating Ban of internal combustion engines Ban of short-distance flights Status quo
Buffering the natural consequences of climate change (adaptation)	Investments in flood prevention Investments in disaster-resilient infrastructure Investments in reversal of soil sealing Status quo
Cushioning the social consequences of climate policies (eco-social policy)	Retraining programs for workers in fossil-fuel industries Financial compensation to fossil-fuel workers who lose their jobs Income-based subsidies for renters in non-energy-efficient housing Status quo
Financing	Increase CO2 tax Reduction of fossil fuel subsidies Increase of government debt Increase of general income tax Budget cuts in other areas

While both offer valuable insights, we will mainly focus on the rating variable, as it provides a more granular assessment of respondents' preferences. Unlike a binary choice, the rating variable captures the intensity of liking or disliking each package. This approach enables respondents to express more nuanced preferences, such as strong approval or disapproval of both packages, which binary choices cannot reflect. Consequently, this method offers a more accurate depiction of public preferences, including negative sentiments, which is essential for identifying policy improvement areas and understanding public resistance.

5.4. Results

5.4.1. Perceived Vulnerability to Climate Change and Climate Policy

Because the few existing studies on perceived vulnerability focus primarily on climate-change impacts and rely exclusively on closed-ended questions, we begin by examining how individuals describe their own vulnerability to both climate change and climate policy in their own words. To this end, we invited respondents at the beginning of the survey to articulate their perceptions in an open-ended question. Building on emerging work in economics (Ferrario and Stantcheva 2022), such open-ended measures are well suited to capture what comes to mind when citizens reflect on complex risks and to elicit their "first-order beliefs" about how they expect to be affected by climate change and climate policies. This approach therefore taps into behaviorally relevant and politically consequential reasoning that is difficult to observe using standard survey instruments.

Moreover, open-ended responses can illuminate the diverse sources underlying vulnerability perceptions. For instance, it remains unclear whether citizens primarily consider material consequences -— such as exposure to heatwaves or potential job loss -— or whether they also reflect on non-material concerns, including constraints on consumption, dissatisfaction with politics, or distrust in policymaking processes. By systematically assessing these responses, our analysis provides detailed insight into the foundations of perceived vulnerability and helps advance future conceptualization and measurement of the concept.

To analyze these responses, we adopted the method proposed by Gilardi et al. (2023), who show that ChatGPT outperforms traditional crowd-working approaches in zero-shot annotation and classification tasks. The classification scheme was developed from a manual coding of about one-third of the sample and extends beyond a simple policy vs. natural vulnerability distinction. Multiple category assignments per response were allowed, although most answers fell into a single category. Details on the classification exercise are reported in Appendix B.2.

Figure 4 presents the distribution of responses to the open-ended vulnerability question. The most frequently cited source concerns natural consequences, with 1,411 statements referring to extreme weather, rising sea levels, and related environmental impacts. The second largest category (512 statements) reflects vulnerability to climate policies, including worries about economic costs, regulatory changes, and potential job loss. Additional responses mentioned concerns related to political instability and governance (263 responses), physical and mental health risks (210 statements), migration or

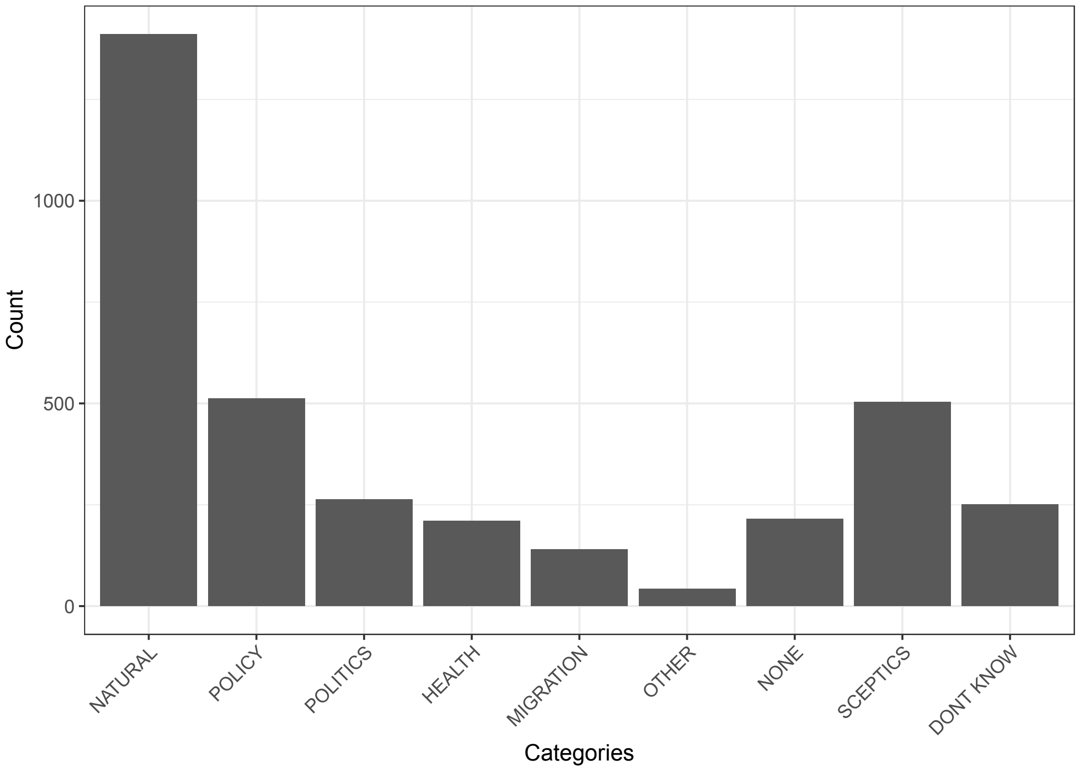

Figure 4: Distribution of responses in the open-ended vulnerability question

displacement (140 statements), while 42 responses referred to other less common vulnerabilities. Notably, 215 respondents reported no perceived vulnerability, 504 respondents expressed skepticism about climate-related impacts, and 251 respondents indicated uncertainty or insufficient information about their own vulnerability. Overall, these responses suggest that material consequences of climate change and climate policy play a central role in shaping perceived vulnerability. At the same time, they also reveal a broader range of concerns that extend beyond egotropic material considerations toward more diffuse insecurities associated with climate change.

A closer examination of the open-ended responses among individuals who perceive themselves as highly vulnerable suggests that fears of downward social mobility partly underpin concerns about climate policy. Respondents frequently refer to job loss and financial strain: "People lose their jobs and cannot pay for the forced measures" or"unreasonably expensive measures will put many people in financial difficulties that threaten their very existence." Such concerns appear to shape distinct attitudes towards climate policy among highly policy-vulnerable, with some rejecting climate action altogether: "No political measures. This has always negative consequences on the life of the people."

Beyond material concerns, several respondents also view ambitious climate policies as intrusive "patronizing the citizens", "meddling with their way of life" by imposing changes in consumption habits. One respondent warned that this could ultimately "lead to the population turning away from politics". While egotropic material concerns are clearly salient, these responses also suggest that poliy-vulnerable citizens perceive climate policy as disruptive to established behavioral norms and value systems.

This duality of material and non-material concerns is less evident among citizens who perceive themselves as highly vulnerable to climate change. The responses instead reveal pronounced worry about extreme weather events, their immediate consequences, and potential effects on future generations. As one respondent noted: "We will have to deal with a lot of storms, forest fires, floods, too hot summers, melting polar caps, and a lot of other terrible things and there should be some measures now to stop this at least a little bit. The following generations will otherwise have very bad times and every person on this planet should do everything possible to stop this a little bit." Such fears are often coupled with criticism of insufficient policy responses: "Natural disasters, there are no real actions against it or they are too slow." Some respondents also refer to biodiversity loss, food scarcity, and threats to personal health: "Loss of nature and living beings. Extinction of species. More natural disasters. Unbalanced climate. Unbearable living conditions. Substantial physical restrictions. No future for the world." Overall, material concerns seem to be the key driver of perceived climate vulnerability. Nevertheless, recurring references to future living conditions also point to concerns about intergenerational justice.

Cross-pressured citizens express concerns that combine material concerns with reflections on policy effectiveness and global climate action. Many express skepticism toward climate policies, for example: "I think it is wrong and not effective to force people to do something for the climate with forced measures." At the same time, respondents acknowledge the severe consequences of climate change, such as "mass migration, too hot summers, scarcity of water, wildfires, floods, natural disasters" alongside fears of "economic downfall and impoverishment of big parts of the population." What distinguishes this group is the relatively frequent references to international action, climate justice, and the distribution of costs. To quote one respondent: "As long as the whole world does not participate for example India or China, it will be difficult. Similarly, I mainly see big companies to be forced to act. Us small citizens in Germany cannot slow down climate change." Compared to those who are primarily climate- or policy-vulnerable, cross-pressured citizens recognized both the risk of climate change and the need for global action, yet they remain particularly concerned about the immediate consequences of climate policy and – maybe to a lesser extent – climate change.

Turning to the close-ended measures, the upper panel of Figure 5 shows that both climate and policy vulnerabilities are widespread. Perceived climate vulnerability is left-skewed, whereas perceived policy vulnerability is more evenly distributed, suggesting that citizens differentiate between the two. Their correlation is only 0.051, reinforcing the view that they represent distinct dimensions. At the same time, overlaps exist when operationalized as in Table 9, as shown in the lower panel of Figure 5. Although a relative majority does not report high vulnerability (threshold of 7 on an 11-point scale), sizeable shares perceive high vulnerability in one or both domains, with some experiencing cross-pressures. Detailed summary statistics for these groups are reported in Appendix B.2, Table A. 9.

These insights into how citizens assess their vulnerability to climate change and climate policy support our broad operationalization of perceived vulnerability in closed-ended questions. While material concerns shape these perceptions, less tangible concerns about inequality, social mobility, and climate governance appear to structure them as well. Our closed-ended items are designed to capture this complexity. At the same time, we acknowledge that such a broad operationalization of perceived vulnerabil-

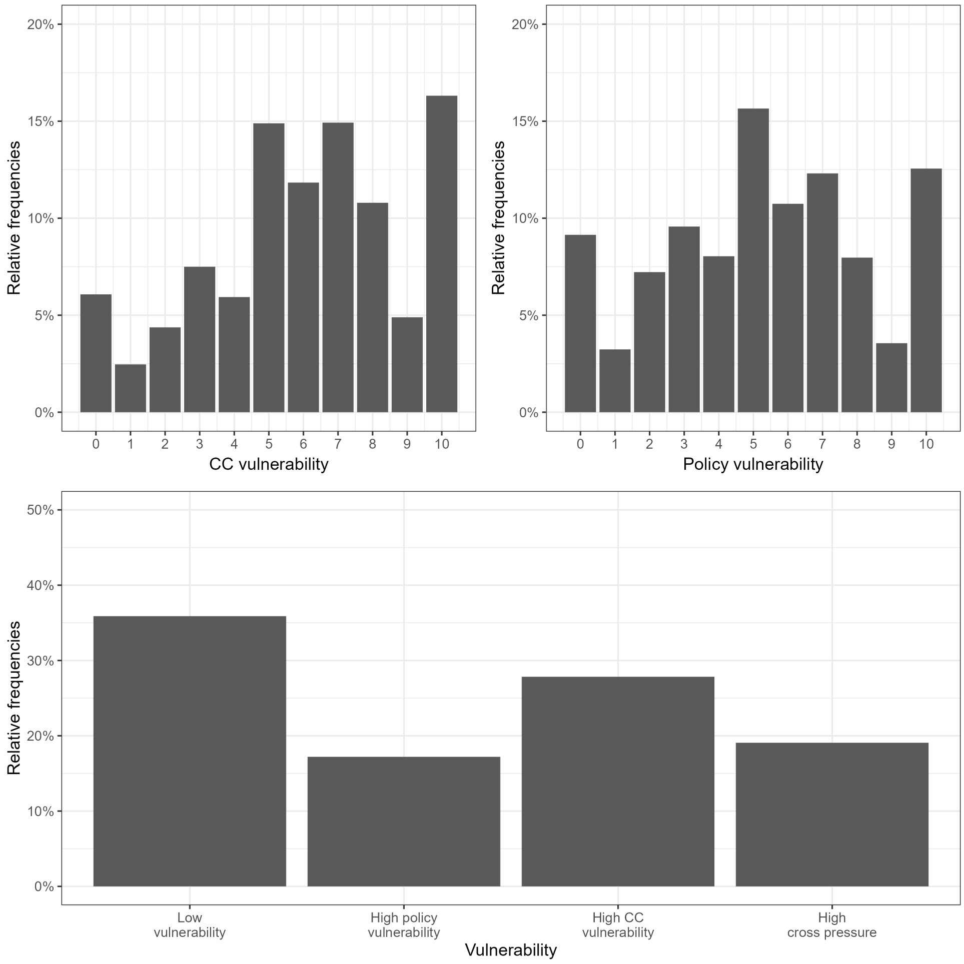

Figure 5: Subjective assessment of climate change and policy vulnerability, full population.
Notes: High vulnerability categories in the low panel are constructed using a threshold of 7 on an 11-point scale.

ity raises potential concerns about endogeneity. To address this issue, we implement a residualization approach to validate the results presented in the next section.

5.4.2. Perceived Vulnerability and Climate Policy Preferences

This section examines how perceived vulnerabilities relate to policy preferences. We derived three hypotheses. First, perceived climate vulnerability is positively associated with support for both adaptation and mitigation. Second, perceived policy vulnerability increases demand for eco-social policies and reduces support for mitigation. Third, cross-pressured individuals prefer short-term risk compensation over long-term mitigation. To test these hypotheses, we estimate OLS regressions with robust standard errors. We control for political ideology, a key predictor for climate attitudes, as well as age, education, income, and gender.

The results in Figure 6 largely support the first two hypotheses. Perceived climate vulnerability is positively associated with support for push- and pull-mitigation as well as adaptation. By contrast, perceived policy vulnerability is linked to opposition to mitigation, especially intrusive push measures.

Contrary to expectations, however, policy vulnerability is not consistently associated with greater support for eco-social policies.

Overall, citizens who feel exposed to climate risks favor both short- and long-term risk reduction through adaptation and mitigation. Those who feel vulnerable to climate policy primarily oppose mitigation and show limited demand for compensation. The pattern is more nuanced for cross-pressured individuals: they express stronger support for adaptation and somewhat higher support for eco-social policies than low-vulnerability respondents, while opposing push mitigation. No consistent relationship emerges for pull mitigation.[22].

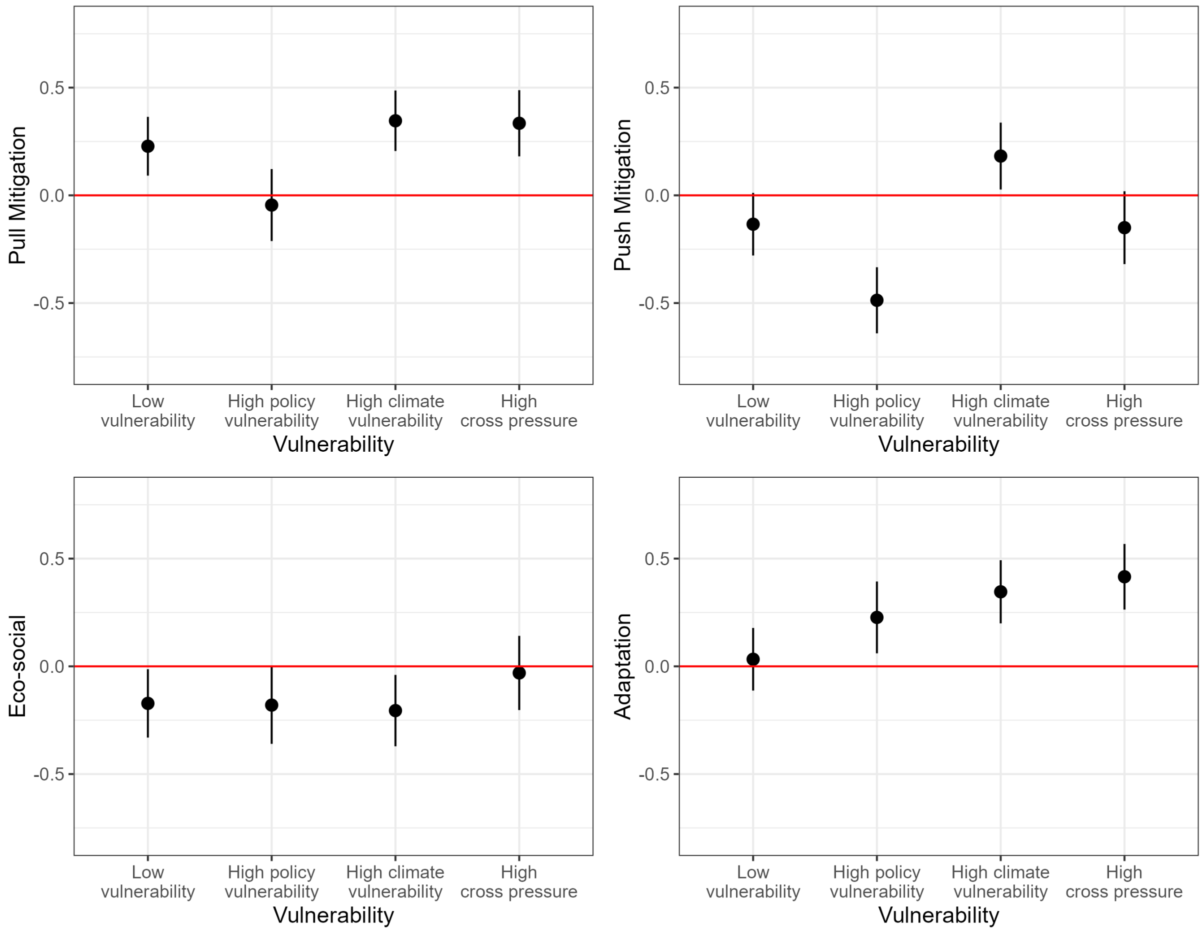

Figure 6: Perceived vulnerability types and policy preferences
Notes: The dependent variables are standardized factor scores for climate policy support with a variance of 1. High vulnerability categories are constructed using a threshold of 7 on an 11-point scale.

To address potential endogeneity concerns, we re-estimated our models using a residualization approach. Specifically, we regressed all control variables on the survey items of perceived policy and climate change vulnerability and then used the resulting residuals as predictors of policy support (see Appendix B.3 for detailed results). The results are robust to this strategy, supporting our argument that perceived vulnerability operates as a distinct predictor (Hansson 2010; Leiserowitz 2006; van der Linden 2015; Weber 2019).

[22]Detailed results on each policy dimension using a continuous vulnerability indicator are reported in Appendix B.3 Figure A.13

Substantively, support for mitigation depends on the type of policy and perceived vulnerability. Cross-pressures from high perceived climate and policy vulnerability generate opposition to intrusive push measures, whereas support for less intrusive pull measures remains possible. High perceived policy vulnerability primarily fuels opposition to intrusive mitigation, while climate vulnerability fosters support for both mitigation and adaptation. This underscores the need to distinguish both between different components of perceived vulnerability and across dimensions of climate policy and creates a dilemma for policymakers, who must implement potentially necessary but unpopular policies (De Groot and Schuitema 2012; Luo et al. 2026).[23]

5.4.3. Perceived Vulnerability and Policy Packages

In the next step, we explore whether policy packages that compensate for the immediate impacts of climate change (via adaptation) and climate policy (via eco-social measures) can increase support for costly mitigation. Figure 7 presents the marginal means based on the rating variable. The results are robust to using the choice outcome and estimating ACMEs (see Appendix B.4). Overall, respondents display clear preferences across policy types. pull-mitigation measures receive the highest ratings, followed by adaptation measures, eco-social policy measures, and, lastly, push-mitigation measures.

Within the mitigation category, pull policies centered on investments and subsidies, such as support for public transport, renewable energy production and building renovations, are substantially more popular than prohibitive push policies, such as bans on oil and gas heating and internal combustion engines. Two exceptions are the relatively unpopular investments in electromobility and the comparatively popular ban on short-distance flights. Overall, respondents clearly prefer positive incentives that expand green technologies and infrastructure over restrictive measures that restrict current lifestyles. These patterns align with broader observations that governments tend to avoid highly intrusive push measures (Luo et al. 2026).

Adaptation measures also receive consistently strong support. Investments in flood prevention, disaster-resilient infrastructure, and soil-sealing reversal all resonate with respondents, reflecting a desire for short-term, proactive strategies that reduce the immediate impacts of climate change and increase the likelihood that policy packages are rated highly.

Eco-social policy measures are likewise evaluated positively. All three enjoy higher support than the absence of compensation, with the rent bonus for poorly insulated homes proving most popular. Measures targeting workers affected by climate action through compensation and retraining programs for fossil-fuel workers receive somewhat less support but still outperform the baseline. Overall, respondents value policy packages that enhance economic security and job opportunities, underscoring the importance of a just transition in building public backing for climate action.

Preferences over financing mechanisms are more constrained. Policy packages funded through targeted budget cuts or the reduction of fossil fuel subsidies receive stronger support than those relying on

[23] We find no support for our fifth preregistered hypothesis, which predicted that individuals on the right with low policy vulnerability would show weaker support for all types of climate policy. Generally, ideology is only weakly correlated with perceived vulnerability.

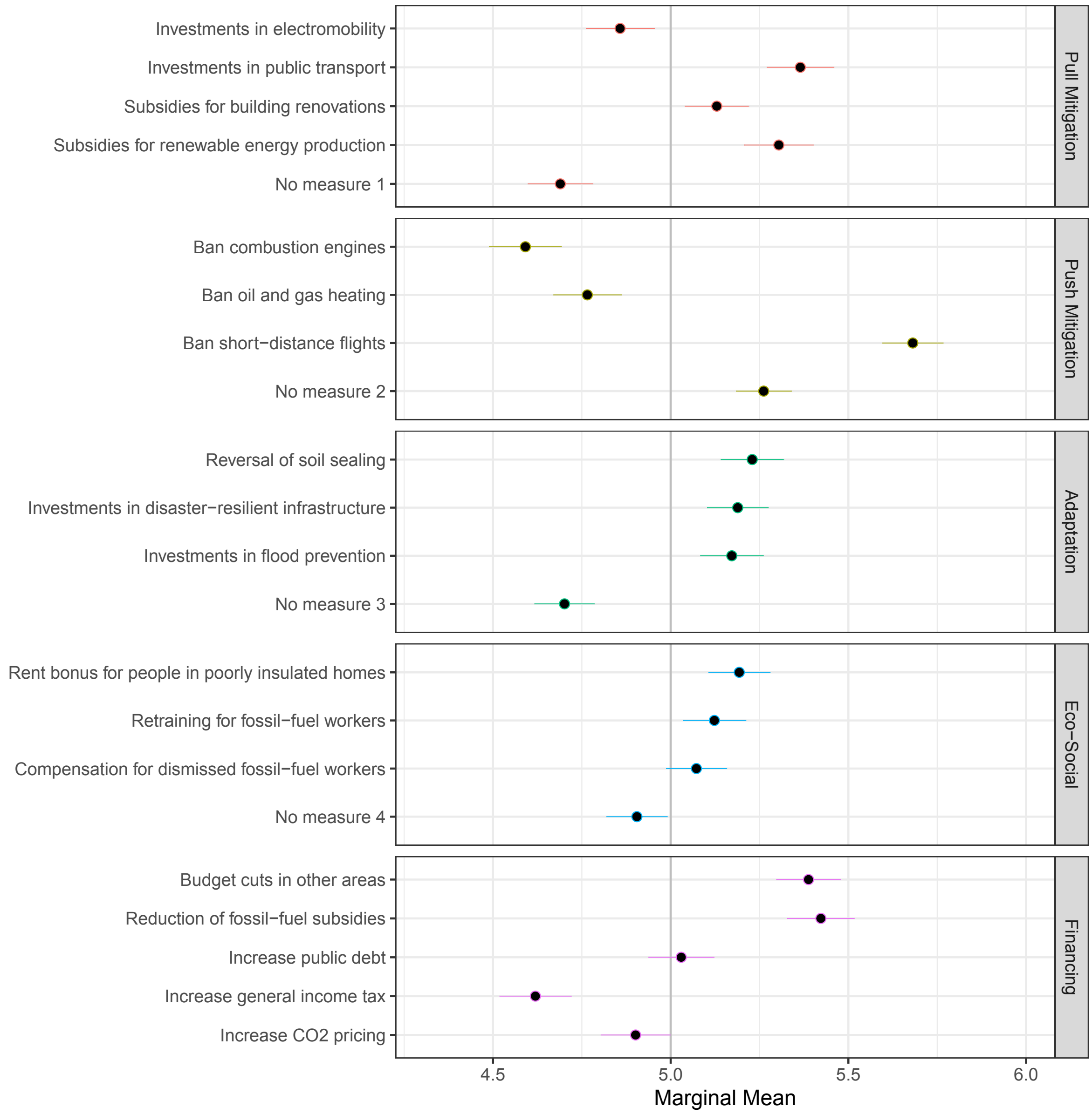

Figure 7: Marginal means with rating variable, full population

higher income taxes or CO2 prices. Public debt garners moderate support. This pattern reflects a preference for targeted rather than broad-based revenue instruments. At the same time, it highlights the political difficulty of financing ambitious climate policies: cutting fossil fuel subsidies faces entrenched interests (Cory et al. 2021; Stokes and Stokes 2020; Genovese 2019), while in countries such as Germany fiscal rules like the debt brake limit borrowing.

While these aggregate results indicate that short-term adaptation and eco-social policies enhance overall public support, our central hypothesis assumes that these strategies also bolster support among individuals who perceive themselves as particularly vulnerable. To address this, Figure 8 presents marginal means disaggregated by vulnerability types. The reference group, citizens with low perceived climate and policy vulnerability, shows moderate support for all policies, with approval levels mostly around the midpoint of 5, indicating lukewarm endorsement.

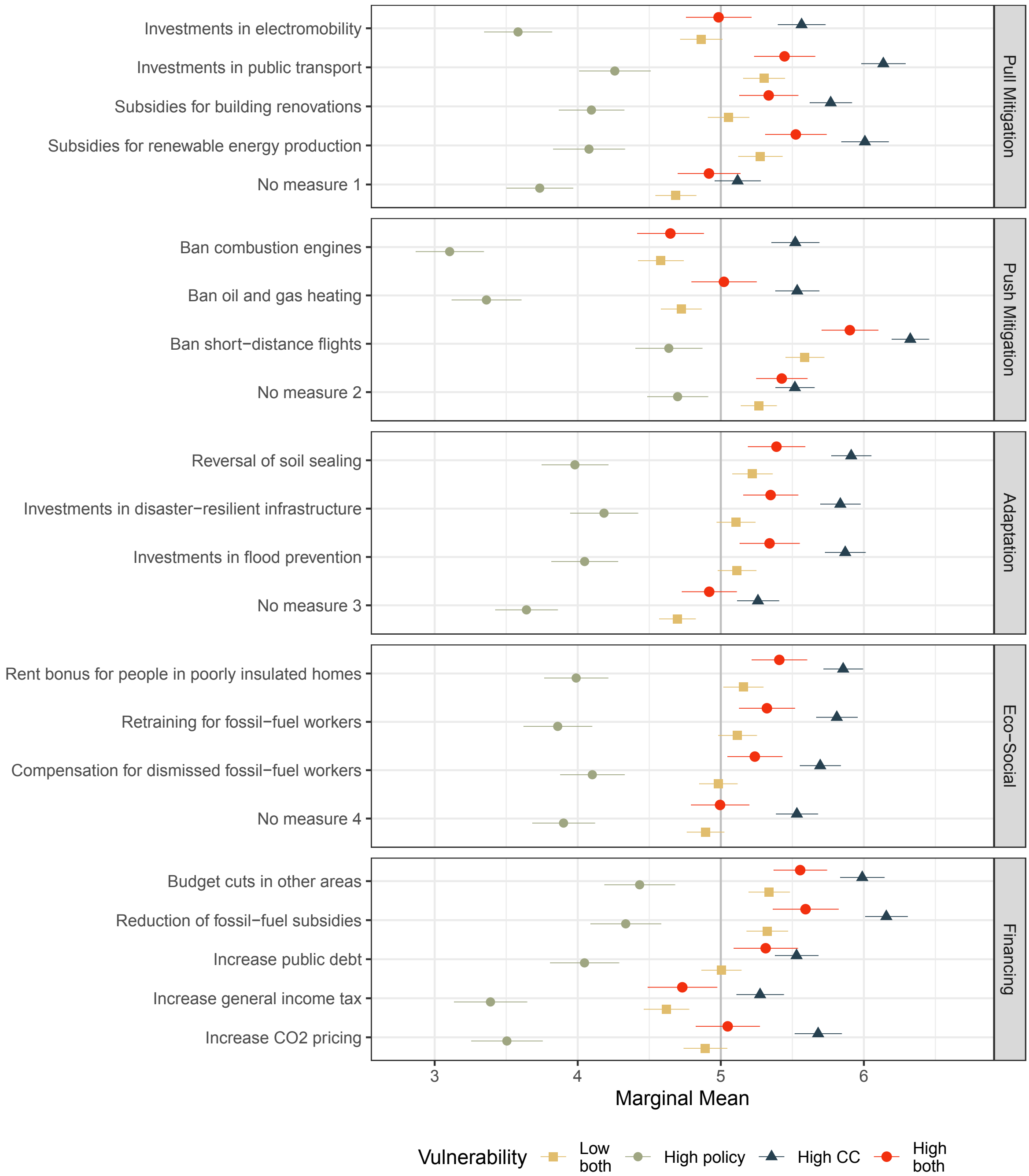

Figure 8: Marginal means with rating variable, by vulnerability type

A markedly different pattern emerges among individuals with high perceived policy vulnerability. This group exhibits the lowest support across virtually all measures, with ratings consistently below the approval threshold. Within this generally skeptical group, comparatively higher evaluations are reserved for packages that avoid further push-mitigation measures or only ban short-distance flights. All financing options are particularly unpopular, highlighting a pronounced reluctance to shoulder the financial costs of climate policy

In contrast, individuals with high perceived climate vulnerability show the strongest support across all measures, particularly for adaptation and eco-social policies. Their robust support highlights the importance they attach to comprehensive policy responses. Finally, cross-pressured individuals display mixed support for various policy measures. Their preferences typically fall between those with low vulnerability and those with high climate vulnerability. They tend to favor most pull-mitigation measures but remain skeptical of push measures. However, their support for a policy package increases when it includes adaptation and/or eco-social policies.

Our hypothesis posits that incorporating adaptation and eco-social policies into a comprehensive policy package can increase support for costly mitigation among individuals with high perceived vulnerability. To assess this relationship, we compute average conjoint ratings depending on whether packages included no adaptation or eco-social measures ("No compensation"), only adaptation measures ("Adaptation"), only eco-social policy measures ("Eco-Social"), or adaptation and eco-social measures ("Both"). Figure 9 (left panel) shows that packages combining both receive the highest ratings overall, while packages without any compensatory measures receive the lowest. Notably, even the inclusion of adaptation measures alone significantly increases support relative to packages lacking compensatory components.

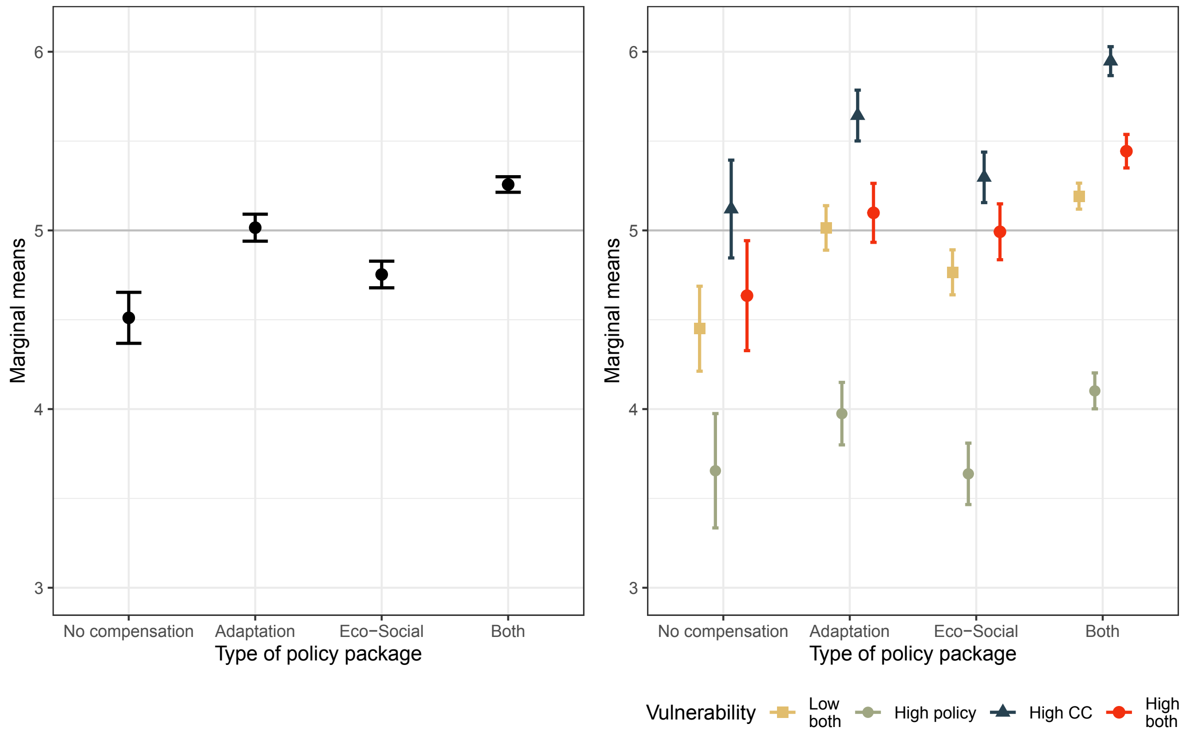

Figure 9: Rating of policy packages, overall (left) and by vulnerability type (right)

The right panel of Figure 9 disaggregates average package ratings by vulnerability profile. The results indicate that combining adaptation and eco-social policies in a package significantly increases support for costly mitigation among individuals with high perceived vulnerability. In particular, respondents with high perceived climate vulnerability and those experiencing cross-pressures assign markedly higher ratings to packages that include both compensatory components compared to those without such measures. These findings suggest that comprehensive packages integrating adaptation and eco-social cushioning are especially effective among citizens who perceive themselves as exposed to climate-related risks or both.

At the same time, individuals with high perceived policy vulnerability remain comparatively difficult to persuade. Although compensation slightly improves their evaluations, their overall support for long-term mitigation policies remains consistently low. Even tailored policy packages that explicitly address socioeconomic concerns only modestly mitigate their resistance, highlighting the limits of compensation in assembling broad coalitions for ambitious climate action.

5.5. Conclusion

The climate crisis has already visible effects on citizens daily lives, creating novel vulnerabilities that require carefully designed policy responses. However, opposition to these responses – especially to more punitive push-mitigation policies – remains high and presents a challenge to policymakers. Given the complex nature of risks associated with climate change and the green transition, a solid understanding of citizens' vulnerabilities in this domain is paramount. This includes a thorough investigation of citizens' perceived vulnerability. Focusing on perceptions not only deepens our understanding of risk-related drivers of climate policy preferences but also enables more comprehensive and tailored policy design that addresses short-term needs while advancing collective long-term goals.

Effective policy packages ideally combine compensation for immediate consequences, such as flood risks or energy poverty, with long-term climate policies aiming at emission reductions. By incorporating vulnerability perceptions into such packages, policymakers can help anticipate political backlash and present sustainable pathways for a just transition. In principle, we expect that such carefully designed packages should dampen opposition among vulnerable groups and foster broader support coalitions for effective climate action.

Our findings provide only partial support for this expectation. Perceived vulnerabilities are multifaceted, encompassing material concerns about extreme weather events, rising prices, and personal health, consistent with established drivers (Otto et al. 2017). At the same time, respondents also highlight non-material concerns, such as generational fairness and perceived agency in policymaking, to play a key role in their thought process about vulnerability to climate change and climate policy. This multidimensionality of vulnerability perceptions reveals the complexity involved in designing adequate policy responses and underscores the need to move beyond mere lump-sum payments for carbon taxation.

This compensation strategy proves effective for climate vulnerable and cross-pressured individuals, whose support for costly climate policy packages increases when additional compensation measures are included. In contrast, individuals with high perceived policy vulnerability remain resistant. They reject all types of mitigation policies and their associated costs, and tailored compensation does little to shift their support. Although policy packaging and eco-social policies have been identified as a promising strategy to address distributive concerns, our findings indicate that their effectiveness is limited. Compensation for the effects of climate policies appears insufficient to persuade those who feel vulnerable to climate policies. This underscores the limits of compensation and raises the question of why they fail.

This limitation aligns with research emphasizing the role of community identity in shaping citizens' climate policy preferences, particularly in vulnerable regions (Gaikwad et al. 2022; Gazmararian 2024; Tallent 2025). Studies of structural change show that job loss and regional decline often generate status loss, resentment, and a diminished sense of recognition – grievances that material compensation alone cannot resolve(Hochschild 2018; Lamont 2023). Consistent with this literature, our open-ended responses suggest vulnerable citizens are not only concerned about material aspects of income and employment – addressed through compensation in our conjoint experiment – but also with perceived lifestyle constraints and feelings of paternalism.

Our analysis is a first step towards a more systematic and multidimensional measurement of subjective risk perceptions. Future research should refine measures of perceived vulnerability to distinguish between concerns about job loss, rising energy costs and perceived intrusiveness of policies in daily life. This would enable a more precise analysis of risk sources and allow for detailed analysis about the links between perceived and objective indicators.

Overall, our results suggest that effective climate policy requires more than material compensation. Addressing non-material grievances and strengthening political inclusion may be equally important for building durable support. In line with recent evidence that symbolic policies that convey meaningful signals despite limited material impact can increase public support (Tallent et al. 2026), future research should assess alternative strategies beyond compensation, such as greater transparency, access to information, or enhanced citizen involvement in policymaking, to foster acceptance of economic restructuring and changing consumption patterns.

6. Paper 3: The Cost of Compliance: Normative Beliefs and Climate Policy Vulnerability

6.1. Introduction

Tackling climate change requires effective and far reaching policies that will affect established consumption patterns, social and behavioral norms, and economic structures (IPCC 2018). One prerequisite for the implementation of such policies is broad support by the public (Bernauer 2013; Drews and Van Den Bergh 2016). Policymakers have a range of instruments at their disposal to increase support for climate policies (Wicki et al. 2019). Among these instruments, social norm interventions stand out as a low-cost measure with a comparatively high impact on citizens' climate related behaviors and attitudes (Yamin et al. 2019; Farrow et al. 2017; Alló and Loureiro 2014; Kinzig et al. 2013).

Social norms provide guidelines for acceptable behavior in societies. Non-compliance typically involves some type of sanctions, while complying with a social norm can grant a certain degree of social approval (Elster 1989; Nyborg 2018). Nevertheless, norms are not always transparent and citizens' expectations about these norms are decisive for their behavior and preferences (Constantino et al. 2022; Mildenberger and Tingley 2019). These expectations about norms can deviate from actual social norms - often referred to as pluralistic ignorance (Bicchieri 2017; Bursztyn and Yang 2022). Social norm interventions aim to update this difference between beliefs about norms and established norms and thus foster pro-social outcomes such as climate friendly behavior or attitudes.

However, this updating process does not happen in a vacuum (Berger et al. 2023; Bayes and Druckman 2021; Legros and Cislaghi 2020; Mullinix 2016; Jost et al. 2022). Climate policies can have potentially severe negative side effects for citizens. In this context, Gaikwad et al. (2022) coin the term *policy vulnerability* to describe exposure to, among others, the labor market consequences of climate policies, which subsequently affects political preferences (Schaffer and Magyar 2024; Hasanaj and Stadelmann-Steffen 2022; Colantone et al. 2024; Voeten 2024; Stutzmann 2025). Thereby, citizens' expectations of potential negative outcomes of climate policies play a fundamental role in their preference formation process (Beiser-McGrath 2025; Beiser-McGrath and Bernauer 2024; Wilson et al. 2020).

The question guiding this paper is how citizens factor in these potential negative effects of climate policy when they process new normative information. Consider the example of an established social norm to use public transportation to commute. If citizens value the approval of their peers, they will most likely choose this option. However, such a switch to public transport can entail a critical amount of extra time per day spent commuting. This inconvenience might offset any gain in social approval that comes complying with a norm. In other words, I ask whether citizens consider a potential trade-off between the gain in social approval and the material costs from changing their attitudes towards climate policies after learning about a norm.

I do not postulate a zero-sum game between material needs and social approval when citizens process normative information and form their policy preferences. Conversely, both considerations coexist in this process and shape how citizens process normative information (Berger et al. 2023). Thus, in line with previous research I conjecture that normative belief updates generally increase support for climate policies (Alló and Loureiro 2014; Farrow et al. 2017). Yet, the main theoretical argument is that the effectiveness of this intervention depends on the material impact of the specific policy in question (De Groot and Schuitema 2012). On the one hand, this means that this effect is less pronounced for more intrusive climate policies such as taxes as compared to less intrusive ones such as subsidies. On the other hand, citizens' expectations of negative policy effects likely moderate this relationship. In other words, I argue that citizens take the material implications of potential preference adjustments into account when they process normative information. That is, they weigh the potential gain in social approval from complying with a norm against the potential cost involved with changing their preferences (Berger et al. 2023; Nyborg 2018; Burke and Young 2011).

I test these hypotheses in a pre-registered belief updating experiment in the framework of the Austrian National Election Study (AUTNES) (N = 2,978) (Partheymüller et al. 2024) across two policy fields, namely, energy policy and agricultural/food policy. The panel study allows to test the proposed mechanism in a representative sample without the need for deception and to go beyond student samples frequently used in this line of research. The findings suggest, generally, that the effect of a normative belief update is contingent on the design of the policy in question. This intervention is not sufficient to garner support for intrusive mitigation policies but helps to do so for less intrusive ones. Moreover, expected vulnerability to climate policies reinforces the proposed trade-off between material and non-material benefits when processing normative information. However, this effect pertains to policy fields with more tangible consequences for citizens' daily lives.

In the remainder of this paper I, first, develop my theoretical argument and derive my hypotheses drawing on research on social norms and public opinion on climate policy. Subsequently, I elaborate on the research design, present the main results and an exploratory analysis of different types of expected policy vulnerability. To conclude, I discuss the findings and limitations of this study and sketch avenues for further research.[24]

6.2. Theory

6.2.1. Social Norms and Behavioral Change

There is a wide range of research analyzing the effects of social norms on climate policy preferences (Andre et al. 2024; Rinscheid et al. 2021; Niemiec et al. 2020; De Groot and Schuitema 2012; Wilson et al. 2020). Drawing on research from social psychology, social norms can be understood as a mutual but informal agreement, guiding individual behavior, which is "sustained by [...] approval and disapproval [of others]" (Elster 1989: 99). They consist of an *empirical expectation* of certain behaviors or attitudes in addition to a *normative expectation* about the approval of the same behaviors and attitudes (Bicchieri 2017; Krupka and Weber 2013). Given possible sanctions or approval by their peers, citizens are likely to adjust their behaviors to observed normative expectations if the latter are salient and create awareness for the existence of a norm (Bicchieri 2017; Cialdini et al. 1990). For example, a majority

[24] This Paper is under review at Political Behavior.

in the population is convinced that taking trains instead of short-distance flights is good. Knowing about this expectation can render traveling by train a preferred choice. Yet, normative beliefs need not foster climate friendly behavior or, more generally, pro-social behavior (Richter et al. 2018; Rinscheid et al. 2021). If a critical mass of individuals thinks that taking short-distance flights is perfectly in line with societal expectations, such behavior will be the likely outcome (Sparkman et al. 2021; Sparkman and Walton 2017). These expectations have real life consequences, yet citizens rarely learn about their accuracy. Drews et al. (2022), for example, highlight that opposition to carbon taxes is generally overestimated, by opponents as well as undecided citizens, while supporters underestimate the likelihood of them representing a majority.

This underscores that personal expectations can be misguided and deviate from the actual norm supported by a majority in society (Bursztyn and Yang 2022; Krupka and Weber 2013). This difference between normative expectations and observable norms in the population has been exploited extensively to foster pro-social outcomes. As Mildenberger and Tingley (2019) point out, updating citizens' beliefs about established expectations of climate friendly behavior increases support for climate policies. With respect to climate friendly behavior, Schultz et al. (2007) demonstrate that providing information about energy consumption as well as approval of energy saving behavior shifts citizens' behavior towards more energy saving (Cialdini 2007; Andor et al. 2020). In a similar vein, Huber et al. (2018) show that multiple norm signals can significantly increase the willingness to engage in costly climate-friendly behavior such as carbon offsetting (Niemiec et al. 2020).

While the positive effect of social norm interventions on pro-social outcomes is well-documented (Farrow et al. 2017), such belief updates can also backfire. Richter et al. (2018) document an increase in climate unfriendly consumption choices following a social norm intervention. Berger et al. (2023) formalize this argument and argue that the baseline distribution of social preferences, in addition to the costs of a behavioral adjustment, is decisive to tip behavior into a climate-friendly direction. In other words, if the prevalent norm promotes behaviors or preferences that are harmful to the environment or if citizens overestimate the level of a pro-climate norm, adjustments to a non-pro-social outcome are possible (Rinscheid et al. 2021; Schultz et al. 2007). However, results on this backlash effect are mixed. Exploiting differences between empirical and normative expectations, Andre et al. (2024) show that a positive effect of a norm update pertains to citizens who underestimate the prevalence of a given norm. Providing such information for citizens who overestimate such a norm has no effect.

Building on this body of evidence, I hypothesize that updates to normative expectations lead to higher support for climate policies. However, depending on citizens' prior beliefs, an update of an underestimation (overestimation) of normative expectations leads to a higher (lower) to an increased (decreased) support for climate change mitigation policies.

Hypothesis 1. *Updating an underestimation (overestimation) of normative expectations leads to an increase (decrease) in support for climate change mitigation policies.*

As mentioned above, citizens' might take the material consequences of any adjustment of their behaviors or preferences into account when deciding to follow a norm (Berger et al. 2023; Nyborg 2018).

With respect to climate policy, this means that citizens might evaluate any normative signal in light of the intrusiveness of the policy as well as their expectations of any negative personal impacts.

6.2.2. Material Consequences of Climate Policy and the Warm Glow of Social Approval

Intrusive Policy Design Features

Costly mitigation policies offer (global) non-exclusive benefits in the long term, but fewer directly observable benefits in the short term (Bernauer 2013). Moreover, material impacts of climate change and climate policy render the potential costs of effective climate action salient in a domestic politics arena and thus further politicize climate policy (Aklin and Mildenberger 2020; Colgan et al. 2021). For example, if greenhouse gas emissions are reduced through a CO2-tax, benefits are not restricted to the country implementing this tax, while costs are. Similarly, subsidizing renewable energy sources aims for long-term returns, but can burden current public budgets of any nation implementing such a strategy.

This difference between incentives for climate-friendly behavior as well as sanctions for behavior exacerbating climate change has recently received more scholarly attention (Heyen and Wicki 2024) distinguishing between *push mitigation* and *pull mitigation* policies (Ejelöv et al. 2022). Generally, push mitigation policies are found to be less popular as they aim to limit behavior that is harmful to the environment by restricting the actions of citizens. Conversely, pull policies are often considered less intrusive as they incentivize climate friendly behavior with fewer direct costs (Ejelöv et al. 2022; De Groot and Schuitema 2012; Wicki et al. 2019). The former include bans, taxes or restrictions of GHG intensive activities, while the latter focus on subsidies or tax rebates to foster climate friendly behavior.

The direct or indirect material impacts of climate policy can tip public preferences in favor or against mitigation policies (Markkanen and Anger-Kraavi 2019; Drews and Van Den Bergh 2016). The more intrusive such policies are perceived, the lower citizens' support (Huber et al. 2020). As Berger et al. (2023) note, citizens may consider these additional costs, when they evaluate a normative signal. These signals can be less convincing when such costs are present, as complying with a norm might be less important, when the material disadvantages become too high (Lindenberg and Steg 2007).

Given the higher intrusiveness of push policies relative to pull policies, I conjecture that the effect of a belief update differs for these dimensions. In more detail, support for push mitigation policies might be less affected by a belief update as compared to pull mitigation policies. The additional cost renders a normative signal less important. This effect might be different for individuals who overestimate the prevalence of a social norm. More specifically, I expect support for intrusive push policies to decrease in a stronger way among these individuals as compared to pull mitigation policies. Similarly, a positive effect of a norm update on policy preferences should be less pronounced for more intrusive push policies.

Hypothesis 1a. *A positive effect of an update to an underestimation of normative expectations is stronger for pull mitigation policies than for push mitigation policies.*

Hypothesis 1b. *A negative effect of an update to an overestimation of normative expectations is stronger for push mitigation policies than for pull mitigation policies.*

Expectations of Policy Vulnerability

While policy design is one aspect of the material costs of climate policy, citizens' expectations of these negative impacts have received considerable attention and are shown to affect citizens' attitudes towards climate policy significantly (Beiser-McGrath and Bernauer 2024; Beiser-McGrath 2025). This line of research builds on the distinction between *climate change vulnerability*, on the one hand, to describe vulnerability to natural consequences of the climate crisis. On the other hand, *policy vulnerability* refers to, for example, detrimental labor market outcomes for individuals triggered by climate policies (Gaikwad et al. 2022). However, the notion of policy vulnerability also entails additional economic costs or non-material impacts on a person's way of life (Schaffer 2024; Voeten 2024; Mau 2023). Colantone et al. (2024), for example, show that individuals who are negatively affected by a ban of cars in the city of Milan are more likely to vote for parties heavily opposing climate and environmental policies (for electoral consequences see also Stokes 2016; Stutzmann 2025).

Objective vulnerability and subjective expectations are linked as well as interdependent (Chung and Mau 2014). Hansson (2010) argues that risk, as a source of vulnerability for individuals, is constituted by a fact-laden and a value-laden component – two sides of the same coin. Focusing on subjective expectations, the value-laden component of risk, allows to assess citizens' intuitive or affective decision-making processes (Wilson et al. 2019; Marx and Picot 2020; Chung and Mau 2014). In this vein, Walpole and Wilson (2021a) argue that expected vulnerability (or susceptibility) offers considerable explanatory power when understanding citizens' assessments of risks as a component of their belief systems (van der Linden 2015).

So far, however, assessments of expected policy vulnerability have been scarce (Hasanaj and Stadelmann-Steffen 2022; Beiser-McGrath 2025). I contribute to this line of research, by focusing on citizens' expectations of climate policy vulnerability. For this purpose, I adapt the operationalization developed by Walpole and Wilson (2021a) to the case of climate change mitigation policy. Subjective policy vulnerability is then defined as citizens' expected likelihood of experiencing negative indirect effects from climate policy. These expectations can be present in the socio-tropic area of general economic development, and more ego-tropic areas such as susceptibility to rising prices or a non-material area such as citizens' way of life (Mau 2023).

Summing up, material cost and expected negative effects of climate policy can affect how citizens' process normative information (Berger et al. 2023; Burke and Young 2011). Moreover, high expected vulnerability to climate policies is likely to increase these individual-level costs. A trade-off between material and non-material interests might moderate the way normative information is being processed (Walpole and Wilson 2021a; Mullinix 2016). Accordingly, citizens might weigh new information on climate change related social norms with respect to the potential cost that comes with an adjustment of their preferences (Nyborg 2018; Constantino et al. 2022). van der Linden (2015) finds a positive relationship between empirical and normative expectations about climate friendly behavior and individual risk perceptions. In a similar vein, Chan et al. (2022) highlight that high exposure to the natural risks of climate change has a negative impact on the effect of empirical and normative expectations on climate policy support. It is plausible to assume that this moderation effect also holds for climate policy related risks, where intrusive mitigation policies are likely the source of these vulnerabilities (Gaikwad et al. 2022; Huber et al. 2020).

Thus, when processing novel normative information, citizens are expected to consider the specific policy in question in addition to their expectation of policy vulnerability. In other words: citizens might choose to adjust their beliefs in order to gain social approval. Yet, this adjustment can affect individuals' material well-being, which might limit the effect of a normative belief update (Berger et al. 2023; Nyborg 2018). For example, no matter how important sustainable dietary habits seem to be for a significant proportion of the majority, citizens' might willingly forego the non-material benefits of norm compliance, if the subjective individual cost of behavioral change is too excessive. Figure 10 reflects this relationship visually.

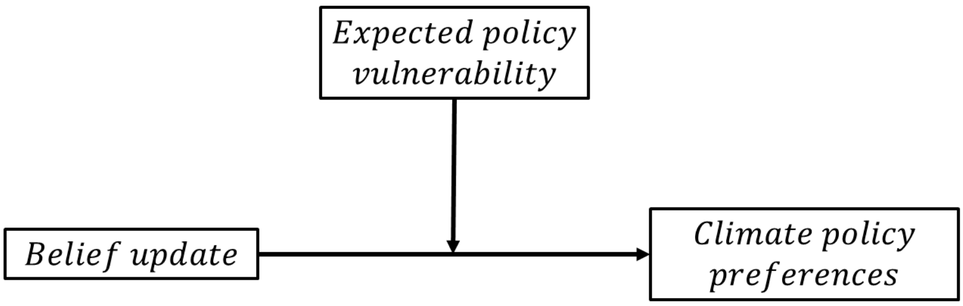

Figure 10: Graphical illustration of the relationship between empirical and normative expectations and climate policy preferences in light of a belief update. Policy vulnerability moderates this relationship.

Nevertheless, as for example De Groot and Schuitema (2012) show, providing information about prevalent pro-environmental norms can shift citizens' behavioral intentions and preferences into this direction, even for unpopular policies. Thereby, norms need not necessarily be upheld by an absolute majority of a certain group (Sparkman et al. 2021). Sparkman and Walton (2017) suggest that it is sufficient if a pro-social trend is observable and communicated to individuals.

Consequently, I conjecture that a high degree of expected policy vulnerability likely negatively moderates the effect of an update of normative expectations. This is because the consequences of an adjustment of behaviors or preferences might increase citizens' vulnerability and reduce the gain from social approval (Berger et al. 2023; Nyborg 2018; Burke and Young 2011). Put differently: policy vulnerable citizens are less likely to support mitigation policies after receiving information about the prevalence of normative expectations in the population. This might be especially true for more intrusive and costly push mitigation policies.

Hypothesis 2a. *A positive effect of a belief update on mitigation policy preferences is weaker for individuals with high policy vulnerability than for those with low policy vulnerability.*

Hypothesis 2b. *A negative effect of a belief update on mitigation policy preferences is stronger for individuals with high policy vulnerability than for those with low policy vulnerability.*

Summing up the above, material considerations about the costs of climate policies drive citizens' preferences and trigger resistance to comprehensive climate action. While normative expectations about climate change shape these preferences, there might be a cost of compliance to these norms. Citizens might then factor in these material consequences when processing novel information. In other words, citizens' expectations of policy vulnerability appear to be a plausible moderator for the relationship between normative beliefs and climate policy preferences, but this might be contingent on the type of policy under question.

6.3. Research Design

6.3.1. Case Selection

Studying how normative expectations interact with expected policy vulnerability calls for a context with a salient climate policy debate, visible climate-related norms, and a real risk of costs from the green transition. Austria fits these criteria for a range of reasons: first, the former coalition government was formed by the conservative People's Party together with the Green Party. While this coalition has implemented a range of climate and environmental policies between 2019 and 2024, frequent and public disagreements about the intrusiveness and potential economic cost associated with far-reaching climate action contributed to this issue's salience. For example, the People's Party's opposed the European Union wide ban of new registrations of combustion engines starting from 2035. Similarly, the Greens ignored the protest of its coalition partner when the Green minister for climate protection voted in favor of the European Union's proposal for a nature restoration law in the European Council, thereby being pivotal for the passing of this law. Moreover, recent budgetary constraints and potential austerity measures, prompted a phase-out of climate policies such as subsidies for renewable energy production or tax benefits for electric vehicles. Given the frequent and public debates, it is reasonable to assume that there exists some knowledge about climate policies and their potential consequences in the population.

Second, Austria has been experiencing comparatively frequent and visible protests by climate protection movements such as *Fridays For Future* or *Last Generation*, which have sparked public debates about the nature of climate protest and political responses to protesters and their demands. Reactions to these protests differed across the political spectrum: radical right and right-wing parties called for harsher legal punishment of protesters while center-left parties voiced disagreements about the methods of protest paired with an understanding of the demands. Thus, it is fair to assume that there exist different expectations about what is appropriate (climate-friendly) behavior and its importance.

Thirdly, while there are some particularities that make the Austrian case worth studying, the country is facing similar challenges as other western European nations. These similarities ensure a certain degree of generalizability of the results: first, financial restrictions in light of multiple (geo-)political crises challenge the implementation of effective and costly climate policy in the short term. Second, the political consequences of a green transition put important economic sectors, such as the automotive industry, under pressure to adapt in time or face economic decline. Accordingly, there is a lively political debate about how to assist a range of economic sectors in making the green transition smoother or pause it altogether.

Lastly, Austria has been relying heavily on cheap fossil fuel from Russia, which limited the urge to invest in renewable energy and other mitigation policies. Following Russia's attack on Ukraine, Austria—as many other European countries—experienced significant insecurity in energy supply, which translated into sharp increases in energy prices and contributed substantially to rising inflation. Similarly, disruptions to global agricultural markets, rising input costs for farmers, and higher food prices placed the agricultural sector and food policy at the center of public debate. These developments have likely increased citizens' awareness of the vulnerability of both sectors and may have sensitized them to the risks associated with policy interventions aimed at accelerating the green transition. Consequently, it is plausible to assume that Austrian citizens perceive both energy and food policy not only through an environmental lens but also in terms of their implications for household budgets, employment prospects, and economic stability.

6.3.2. Data and Methods

Experimental Design

To test the hypotheses put forward above, I conduct a preregistered belief updating experiment focusing on citizens' normative expectations about climate friendly behavior (Andre et al. 2024; Huber et al. 2018; Schultz et al. 2007).[25] In a first step, I gauge respondents' expectations about negative consequences of climate policies, that is, their expected policy vulnerability. I assess vulnerability with respect to the general economic development, rising prices of everyday goods, and their general way of life. Vulnerability is thereby operationalized as the perceived likelihood to experience adverse outcomes should a risky event occur (Walpole and Wilson 2021a). This approach extends previous assessments of vulnerability to offer a more nuanced overview of expected negative policy effects. Responses to all three items are summarized in an additive index with a maximum of 1 (very high expected policy vulnerability) and a minimum of 0 (very low policy vulnerability). Cronbach's alpha for this index is at 0.81, indicating a high consistency of the construct. Following the pre-registration this index is transformed to a dummy variable with values above 0.7 indicating a high degree of policy vulnerability and everything below indicating a low degree, thus applying a comparatively restrictive operationalization of the moderator variable.

[25] The experimental design received full ethics approval by the Ethics Review Board at the Department of Government, University of Vienna. Please find the pre-registration here: https://osf.io/q8t6j/?view_only=a2e162da232643c5976ce13f0bb0e6ae.

The second step consists of an (unincentivized) elicitation of Austrian citizens' beliefs about normative expectations.[26] I broadly follow the approaches of Bicchieri (2017) and Andre et al. (2024) to elicit beliefs: I ask individuals to express their expectations about the prevalence of normative beliefs in the field of energy saving and consumption of animal based products (see also Andre et al. 2024).[27] This allows to associate the behaviors included in the norm elicitation tasks with specific climate policies. For each policy field I construct a variable indicating if respondents' guesses were above, below or in the range of the value indicated by the treatment.

In a third step, respondents are randomly allocated into one of three treatment groups. Table 11 provides an overview of these different groups. The control group is asked to provide an estimation about both normative expectations on energy saving and the consumption of animal-based products. The food treatment group is asked to indicate their normative expectations regarding the latter, while the energy treatment group is asked to indicate their normative expectations about energy saving. Subsequently, respondents in the three groups receive either no information (control group), information about the consumption of meat and animal products (food treatment) or about energy saving behavior (energy treatment). The treatment design builds on data collected in AUTNES Wave 21 (N = 3,078) (Partheymüller et al. 2024) and allows a treatment without deception.[28] The data collected include normative evaluations of respondents' behavior in the realm of energy saving and a reduction of consumption of animal based products. In more detail, the respondents were asked how often they think that they personally should save energy or reduce consumption of meat and dairy products.[29]

Table 11: Treatment groups and descriptions

Group	Treatment	Sample Size
Control	No Treatment	N = 978
Meat Treatment	Information about normative expectations regarding consumption of animal products in Austria	N = 995
Energy Treatment	Information about normative expectations regarding energy saving in Austria	N = 1,005

The treatment design is kept very simple and displays visually the share of respondents who think they should behave in a climate friendly manner, as can be seen in Figure 11. They are compared to those respondents who would do so only sometimes to almost never and those who do so sometimes. This information is presented in the form of a hypothetical news brief with a headline and a short description. The framing of each treatment does highlight whether a certain behavior is favored by an absolute majority or if it is a belief a relative majority is subscribing to. This treatment design helps to

[26] See Appendix C.1 Table A. 19 for a detailed account of survey items.
[27] See examples in the Appendix C.1 Table A. 19.
[28] See Appendix C.1 Table A. 19 for details.
[29] See Appendix C.1 Table A. 19 for the exact wording.

understand how norms about a specific climate friendly behavior translate to policy preferences in the same field. This adds additional nuance to this mechanism compared to previous approaches, which focused on mitigation policies generally (Andre et al. 2024).

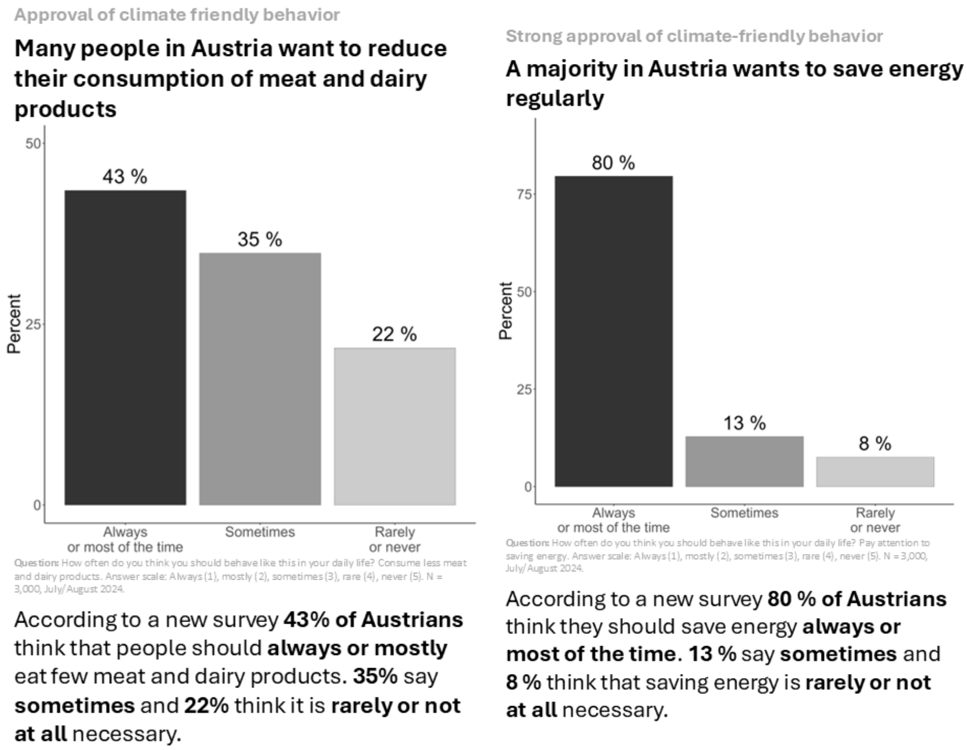

Figure 11: Treatment design for information regarding normative expectations for reduction of consumption of meat and dairy products and energy saving based on data from AUTNES Wave 21 (N = 3,078) (Partheymüller et al. 2024). Data weighted by socio-demographic characteristics and political attitudes. In the survey respondents saw a colorized visualization taking into account potential issues of eyesight.

Climate Policy Preferences

I focus on energy as well as food and agricultural policy. The energy and agriculture sectors remain among the largest contributors to Austria's greenhouse gas emissions and are therefore central to any credible strategy for climate change mitigation (European Commission 2023). Decarbonization efforts in these sectors are widely regarded as indispensable for meeting national and European climate targets, as they directly affect emission-intensive processes related to energy production, heating, mobility, and food production. At the same time, both sectors are deeply embedded in everyday economic activity and private consumption. As a result, energy and food policy represent two key arenas in which the objectives of climate mitigation intersect with concerns about economic security, affordability, and individual lifestyle choices.

Despite these similarities, energy and agriculture differ markedly in the types of restrictions they potentially impose on economic and lifestyle choices, which may lead to distinct political dynamics. Climate mitigation in the energy sector can increase short-term costs for consumers through higher energy prices or required investments in heating and mobility. However, offer long-term benefits, such as energy independence, lower operating costs, and innovation-led growth. Therefore, restrictions in the energy sector are often perceived as indirect and mediated through markets and technology, even if they substantially affect everyday practices like commuting or home heating.

By contrast, agriculture and food policy are more directly linked to individual consumption patterns and cultural norms. Policies aimed at reducing emissions from agriculture can be interpreted as direct constraints on dietary choices and traditional ways of life. Unlike energy policy, where substitution through new technologies is often emphasized, food policy touches upon deeply ingrained habits, identities, and moral considerations. This direct connection to lifestyle choices may generate stronger emotional responses and a higher potential for political resistance, even when the economic costs are comparatively modest.

Against this backdrop, respondents are asked to indicate their preferences for push and pull mitigation policy related to agricultural/food policies and energy policy. Agricultural/food policies include taxes on meat and dairy products, reductions of subsidies for their consumption, meat free meals in public canteens, and provisions of information about the ecological footprint on packaging. Energy policies include an increase of a carbon tax, subsidies for the exchange of heating systems, a reduction of the value added tax for renewable energy and an increase of the mineral oil tax. Generally, this selection of policies allows for an analysis of more or less intrusive climate policies.[30]

Policy items are recoded such that higher values indicate higher support. They are then summarized into additive indices for overall mitigation policy support, as well as support for push and pull mitigation policies respectively. This is a suitable operationalization as the primary focus of interest in this study is on the differences between more or less costly and intrusive policies. Given the low number of missing values per policy item (< 10 % per item/group) I linearly interpolate any missing values for the policy support indices. [31]

Estimation Strategy

Successful randomization of the experimental treatment allows the estimation of the treatment effect by OLS-estimation with heteroskedasticity robust standard errors when using the additive policy support indices as dependent variables. I interact the policy vulnerability indicator as well as a variable measuring prior normative beliefs with a variable indicating the assignment to any of the three treatment groups. The control group serves as the reference group. Following the pre-registration, I conduct an exploratory analysis for each climate policy item in the dataset and each type of perceived policy vulnerability. For this analysis I construct high-vulnerability dummy-variables for each type of policy vulnerability (cut-off at 7 on an 11-point scale) and compute ordered logit models to estimate policy support contingent on treatments and degrees of policy vulnerability.

The results from the randomization procedure suggest no significant differences between treatment groups in the full sample (N = 2,978) along the lines of age, gender, income and education. Moreover the treatment groups are balanced with respect to political ideology and climate change concern.[32]

[30] See Appendix C.1 Table A. 19 for details.

[31] The recoding of the expected policy vulnerability indicator as well as respondents' prior normative expectations into categorical variables does not affect the results.

[32] See Appendix C.2 Table A. 20.

Following a manipulation check after the treatment the subsequent analysis is conducted only with respondents who passed this manipulation check (N = 2,398) as this ensures that the respondents updated their beliefs about the prevalence of a normative expectation in the population. Reducing the sample to those who passed the manipulation check yields differences among treatment groups regarding the level of climate change concern as well as the perceived policy vulnerability.[33] Consequently, all models are estimated including respondents' political ideology and climate change concern, in addition to controls for socio-demographics such as age, gender, and place of residence.[34,35]

6.4. Results

6.4.1. Vulnerability, Normative Expectations, and Policy Support

The distribution of citizens' normative expectations suggests that they have misperceptions of normative guidelines in the Austrian population. This may be because they have wrong priors or are simply unaware of such a norm. Figure 12 illustrates that citizens tend to underestimate the observed value of normative approval regarding climate friendly behaviors such as saving energy and reducing the consumption of animal-based products. Based on the data collected in AUTNES Wave 21 (Partheymüller et al. 2024), roughly 43 % of the people in Austria think they should reduce their consumption of meat and dairy products, while roughly 80 % think that they should save energy. On average, respondents underestimate these levels, as the average expectation for a reduction of animal-based products lies between 31-40 % and the average expectation for energy saving lies between 41-50 %.

[33] See Appendix C.2 Table A. 21.

[34] Except for the baseline effect of a belief update on agricultural/food policies, results are largely consistent when estimating these models with the unrestricted sample. For Details see C.3 Tables A. 30, A. 31, A. 32.

[35] There appear to be no significant differences across treatment groups for this variable, as can be seen in C.2 Table A. 20.

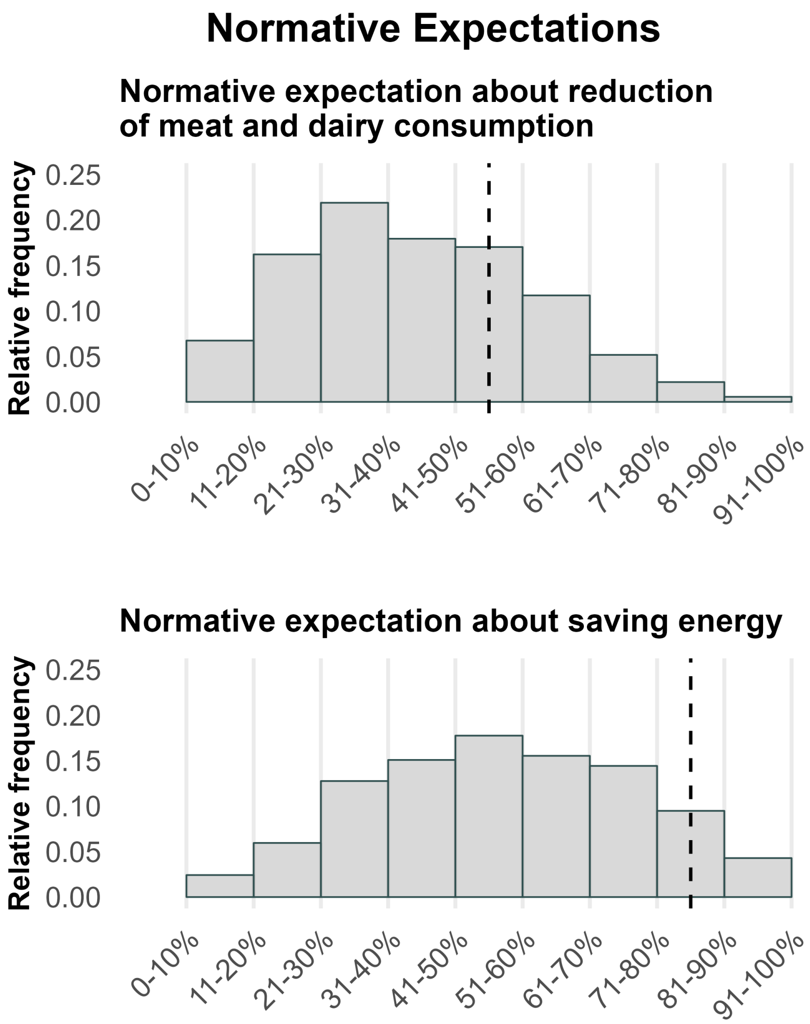

Figure 12: Normative expectations regarding energy saving and the reduction of consumption of meat and dairy products in the Austrian population. The dashed line indicates the observed value which lies at 43 % for meat and dairy product consumption and at 80 % for energy saving.

The distribution for expected policy vulnerability, illustrated in Figure 13, is skewed to the right, indicating a generally high level of expected vulnerability. However, a sizable portion – roughly 35 % of all respondents – perceive themselves to be highly vulnerable towards climate policies reporting values above the third quartile. In other words, these respondents expect that negative consequences due to climate policy on the general economic situation, the level of prices, and their personal way of life are very likely.[36]

[36]Detailed results for each of these areas can be found in Appendix C.2 Figure A.19.

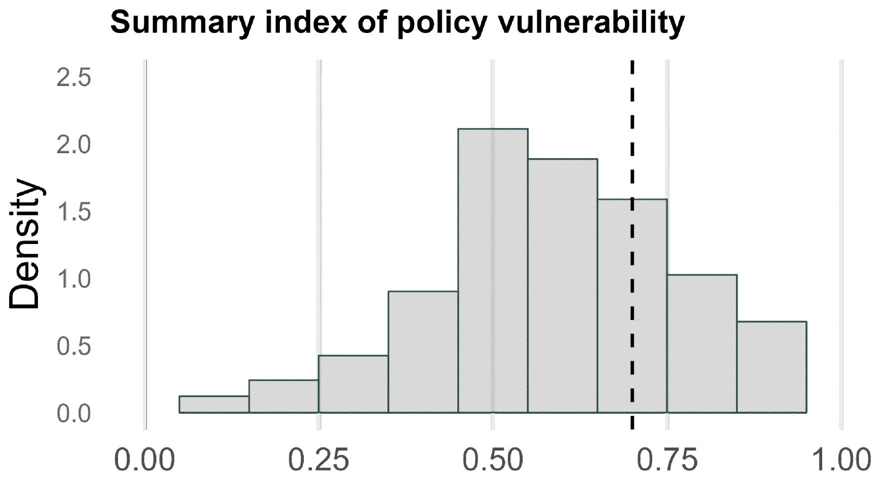

Figure 13: Additive policy vulnerability index, combining perceptions of climate policy vulnerability regarding the general economic development, prices for everyday goods, and the personal way of life. Vertical line indicates the cut-off chosen for the operationalization.

However, the potential impacts of these policies depend on the specific policy in question. Policy support broadly aligns along the lines of push and pull mitigation policies, whereby the latter are more popular than the former, as can be seen in Figure 14. For agricultural/food policies it is clearly visible that higher taxes on meat and dairy products or a reduction of subsidies is less popular than a comparatively less intrusive information campaign on meat and dairy product packaging. Interestingly, meat free meals in public canteens are similarly unpopular, even though the direct impacts of this policy would be restricted to the public sector. For the field of energy policy the patterns of support are much clearer: tax rebates for renewable energy and subsidies for the exchange of heating systems are considerably more popular than increases of the CO2-tax or the mineral tax. Summing up and in line with previous research, the descriptive findings suggest that less intrusive policies such as subsidies or information campaigns are more popular than more intrusive policies such as tax increases.[37] Together with normative expectations that deviate from observed values in the population as well as a high degree of expected policy vulnerability, these descriptive statistics illustrate a good starting point for a belief update.

[37] See Appendix C.2, Figures A.20 and A.21 for subgroup results.

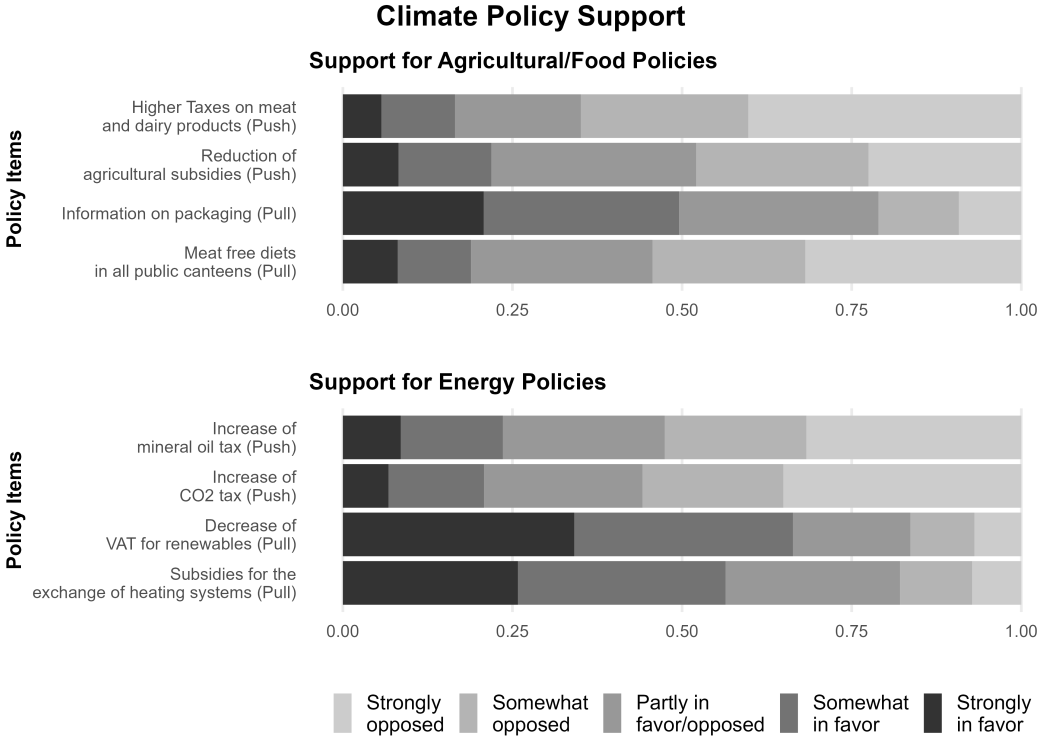

Figure 14: Support for climate policies in the field of energy and agricultural/food policy.

6.4.2. Normative Information and Policy Preferences

Instead of focusing on overall climate friendly behavior the experimental design in this paper allows to scrutinize normative expectations for specific climate related behaviors and to link these norms to distinct policy fields. The first panel in Figure 15 reports the average marginal effects of a normative belief update regarding the reduction of meat and dairy consumption and energy saving on the general support for climate change mitigation policy. The second panel breaks this effect down by push and pull mitigation policies. With respect to overall policy support, such an update has a significant positive effect on mitigation policy preferences in the field of energy policy. The positive effect on agricultural/food-related policies is significant only at the 10 % level.[38] This provides some support for the generally positive effect of social norm interventions on climate policy preferences.

However, when zooming in on the dimensionality of climate policy in the lower panel of Figure 15, one clear picture emerges: the effect of a normative belief update pertains to support for less intrusive pull policy measures, which is broadly in line with the hypotheses.[39] In other words, the potential gains from adhering to social norms affect only the support for those policies positively, which do not introduce new taxes or reduce existing subsidies. This highlights an important qualification for normative information interventions: the material implications of any policy appear to impact the effectiveness of such an intervention as citizens seem to be engaging in a trade-off calculation with respect to the indirect effects of push mitigation policies.

[38]Detailed results can be found in Appendix 3:app:results Table A. 22.
[39]For detailed results see Appendix C.3 A. 25.

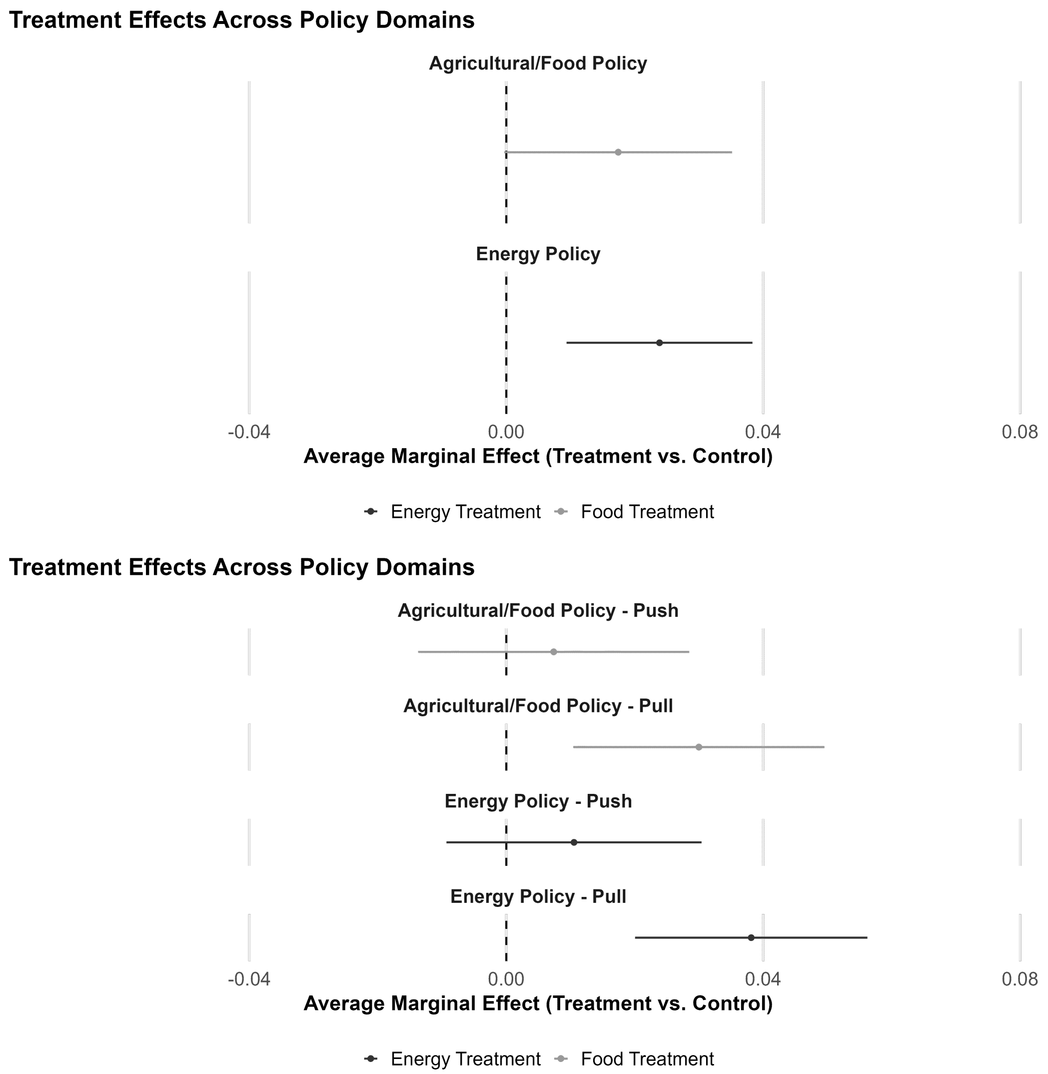

Figure 15: Average marginal effects of normative belief updates on overall policy support in the upper panel. Average marginal effects of normative belief updates on push and pull mitigation policy support in the lower panel. Based on OLS regressions with heteroskedasticity robust standard errors. Control variables include expected policy vulnerability, ideology, climate change concern, age, gender, residence and education.

As argued above, this effectiveness might be contingent on citizens' prior beliefs about the prevalence of any norm: a backward movement towards less climate friendly behavior is possible for citizens who have overbearing expectations about such a norm. Conversely, the effect of a normative belief update should be particularly effective for those who underestimate such a norm. While the total number of individuals overestimating the prevalence of a social norm is low in the field of energy policy, it is substantial for food and agricultural policy (see Figure 12). Thus, there is potential for these heterogeneous treatment effects. Nonetheless, the upper panel in Figure 16 indicates that the degree of over- or underestimation does not have a consistent effect on policy support for overall mitigation policy.

This result is further corroborated when looking at specific dimensions of climate policy and the role of prior beliefs about social norms in the lower panel of Figure 16: The effect of a normative belief update on climate policy support is not affected by prior beliefs about the prevalence of a social norm, regardless of the policy dimension in question. Consequently, this offers no support for the second set of hypotheses.[40] This aligns with previous finding highlighting the salience of a norm as opposed to citizens' beliefs about the very same (Cialdini et al. 1990; Sparkman et al. 2021). In other words, the salience of a norm can be sufficient to impact policy preferences, while prior beliefs do not necessarily affect the latter.

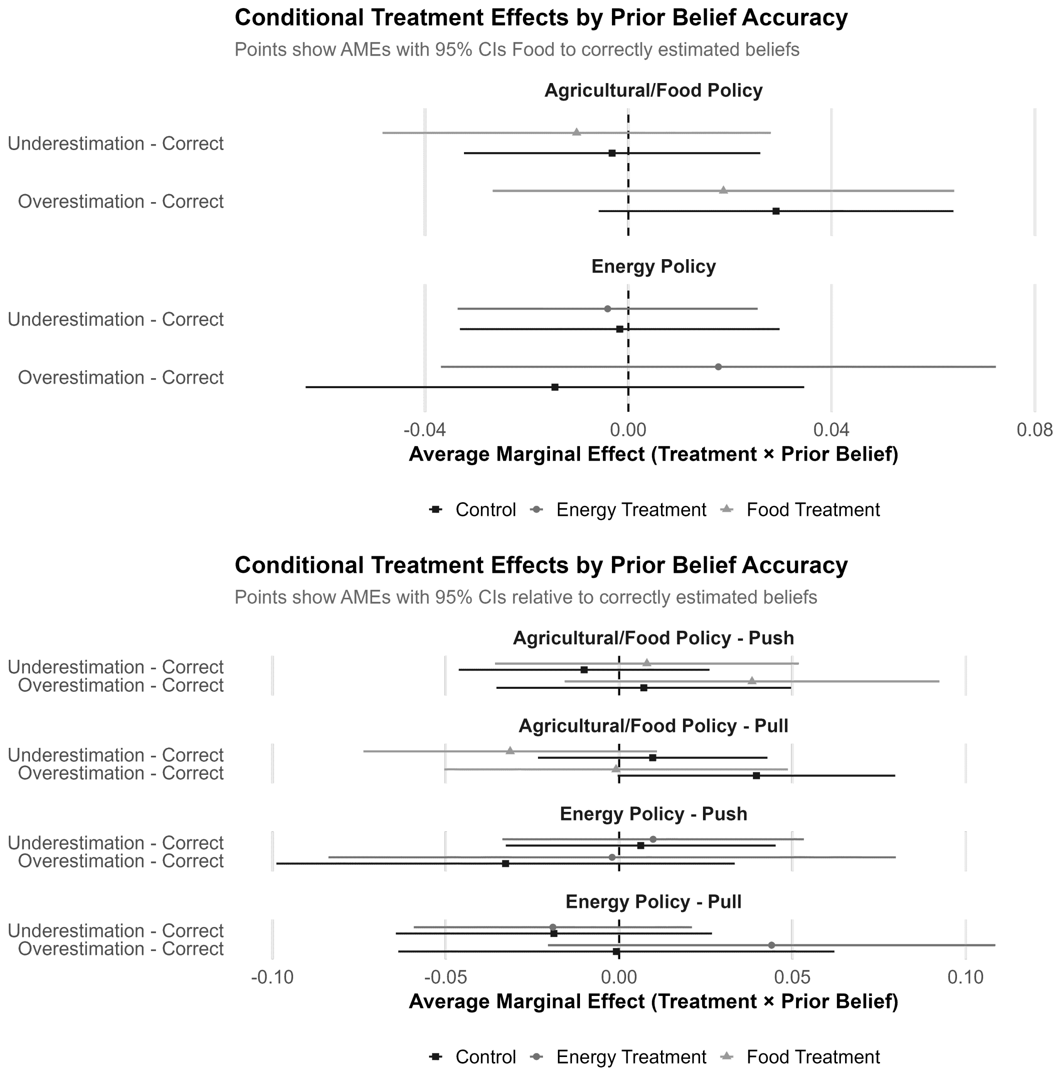

Figure 16: Average marginal effects of normative belief updates on overall policy support interacted with prior normative beliefs in the upper panel. Average marginal effects of normative belief updates interacted with prior normative beliefs on push and pull mitigation policy support in the lower panel. Based on OLS regressions with heteroskedasticity robust standard errors. Control variables include policy vulnerability, ideology, climate change concern, age, gender, residence and education.

Overall, these results provide some support for the baseline hypothesis that updating normative beliefs increases policy support for climate change mitigation policies, albeit only for less intrusive ones. Furthermore, citizens factor in the potential material impacts of climate change mitigation policies. However, there is no evidence that citizens' prior beliefs about these specific behavioral norms affect

[40]For detailed results see Appendix C.3 Table A. 26.

the direction of this effect, indicating that the saliency of any norm might be more relevant than prior beliefs.

6.4.3. Expected Vulnerability and Normative Information

Across all models presented so far, citizens who expect themselves to be highly vulnerable against climate change policies show lower support for the very same, especially if those policies are about increasing taxes or reducing subsidies, i.e., more intrusive push policies. This negative association between mitigation policy support and expected policy vulnerability is not surprising; after all, this type of policy is the main driver of negative indirect effects of policy. However, there remains the question of how citizens process normative information in light of their expected vulnerability. The upper panel in Figure 17 reports the average marginal effects of a treatment interacted with a high policy vulnerability dummy variable on general mitigation policy support.[41] The overall negative association of policy vulnerability with policy support is also visible across policy fields. Yet, citizens who expect themselves to be highly vulnerable do not seem to process normative information differently when forming preferences about general mitigation policies. In other words, this corroborates existing results that policy vulnerability is a significant predictor for climate change mitigation policy. However, citizens do not seem to include this factor into their preference formation process for general mitigation policies after receiving a normative belief update. This contradicts the second set of hypotheses for mitigation policies generally.

[41] See Appendix C.3 Table A. 24 for detailed results.

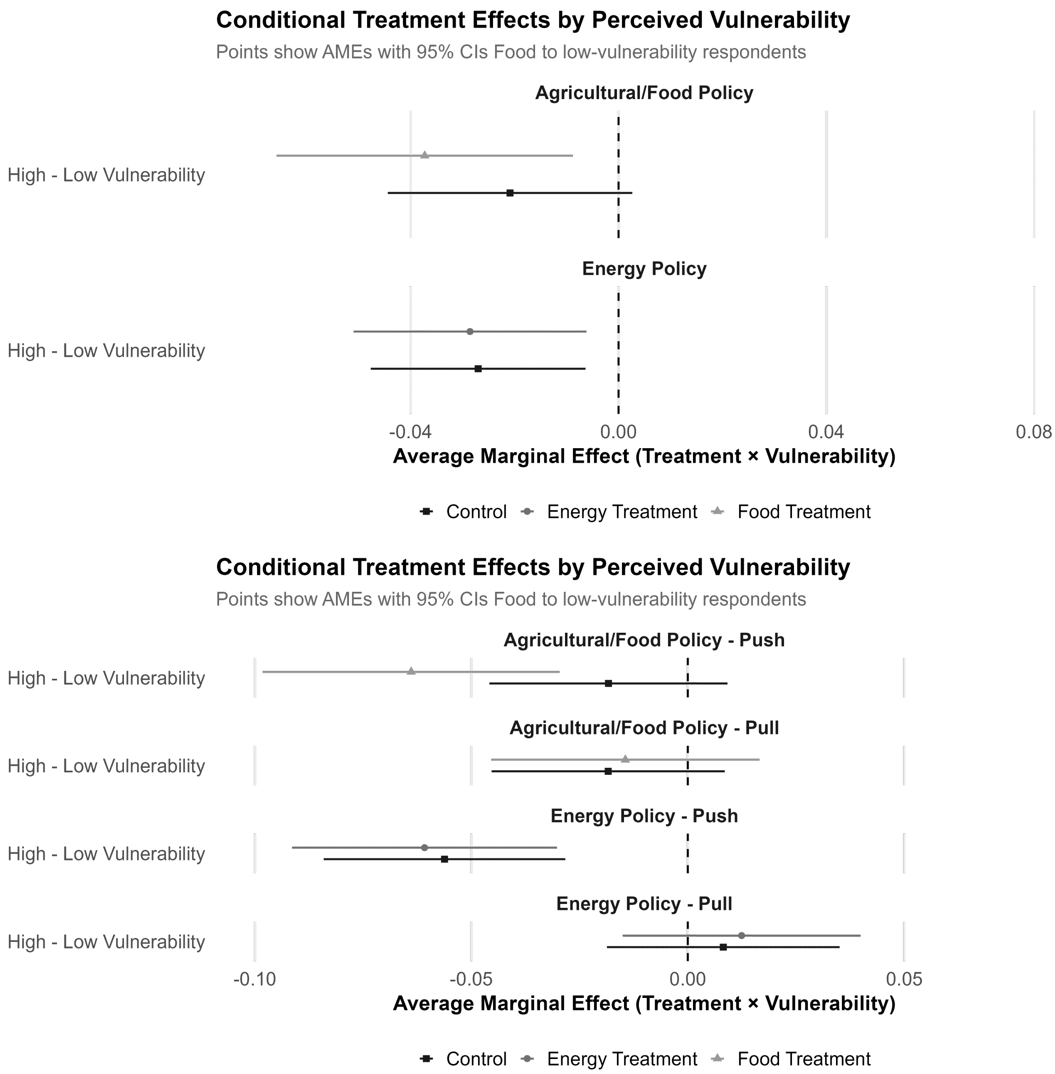

Figure 17: Average marginal effects of normative belief updates interacted with policy vulnerability on overall policy support in the upper panel. Average marginal effects of normative belief updates interacted with policy vulnerability on push and pull mitigation policy support in the lower panel. Based on OLS regressions with heteroskedasticity robust standard errors. Control variables include policy vulnerability, ideology, climate change concern, age, gender, residence and education.

However, an interesting picture emerges when looking more closely at the different policy dimensions in the lower panel of Figure 17. It is unsurprising that this effect is mostly visible for push mitigation policies. However, it is only statistically significant for agriculture/food-related push policy measures.[42] This suggests that citizens' expected policy vulnerability negatively moderates a normative belief update regarding the reduction of consumption of animal-based products and offers partial support for the last set of hypotheses. Thus, citizens seem to take their perceived cost into account when evaluating a normative signal before adjusting their preferences, but only for more intrusive policies. Theoretically, this indicates a reinforcing effect of material costs implicit to policy design features and expected policy vulnerability: The more intrusive a policy and the higher the expected negative effects of the very same are, the smaller will be the effect of a normative belief update. However, this effect

[42]For detailed results see Appendix C.3 Table A. 27.

appears to be contingent on the specific policy field. In other words, material considerations can affect the way in which citizens process novel normative information, but only in policy fields which are very tangible. In such fields, material concerns might add to citizen's worries about their established way of life as well as cultural norms and traditions. Thus, the potentially intangible benefits of social norm compliance seem to be insufficient to overcome these concerns.

It is important to consider this in the context of this study and the specific policy fields under scrutiny. Costs for both, energy and meat and dairy products, can be very salient aspects - and have been so in the Austrian political discourse. However, laypeople might not engage in comparisons of energy prices as frequently as in comparisons of costs for meat and dairy products. Thus, if climate policies cause price hikes for the latter, the effects might be more visible in citizens' daily lives. Consequently, they might weigh very visible policy consequences – and their expected disadvantages – more strongly when processing normative information.

Overall, these findings provide partial support for the proposed trade-off between material and non-material motivations when citizens process novel information. Policy vulnerability does moderate the effect of a normative belief update on policy support, at least in those policy areas which might have very visible effects on the daily lives of citizens. Thus, there seems to be a cost of compliance to normative expectations considered by citizens in some areas. However, this cost is rooted in policy design features and subsequently reinforced by citizens' expectations of their vulnerability. To illuminate this relationship in a bit more detail, the next section engages in an exploratory analysis of specific policies and distinct types of expected policy vulnerability.

6.4.4. Exploratory Analysis: Types of Vulnerability and Policy Support

Citizens' expectations of vulnerability can span material as well as non-material concerns. While some might worry about the general economic development, others might be more concerned about the negative indirect effects of climate policies on the level of prices or their personal way of life. In order to get a better understanding of how citizens incorporate these expectations into their thought process I computed ordered logit regression models to illustrate the effect of each dimension of policy vulnerability on the support for single policy items in light of a normative belief update.[43]

The results from this exercise largely corroborate the findings reported above: The treatment effect of a normative belief update pertains to those policies which are potentially less intrusive for citizens. With respect to agricultural and food policies, this means that only the labeling of packaging – arguably the least intrusive one – is positively affected by a normative belief update. For energy policy, the support for subsidies for the exchange of heating systems and for lower taxes on renewable energy sources are positively affected by a normative belief update, the latter only at the 10 % level. Across all policies, the dominant type of policy vulnerability seems to be citizens' concerns about the effect of climate policies on the price-level.

[43] Detailed results can be found in Appendix C.3 Table A. 28 and Table A. 29.

To provide more details about this relationship, Figure 18 reports the predictions of support levels for agricultural and food policies conditional on the degree of expected policy vulnerability with respect to rising prices. The results show that the probability of opposing a policy generally decreases following a normative belief update and the probability for support increases. Interaction effects are insignificant, yet this result seems to be more pronounced for highly vulnerable individuals, especially with respect to policies that introduce new taxes or cut subsidies. Generally, high expected vulnerability leads to more opposition towards climate policies, especially more intrusive ones. A normative belief update does not significantly affect preferences for those policies, which have potentially costly consequences for citizens' lives. It does, however, affect the general support level of especially less intrusive policies like labeling of food packaging.[44]

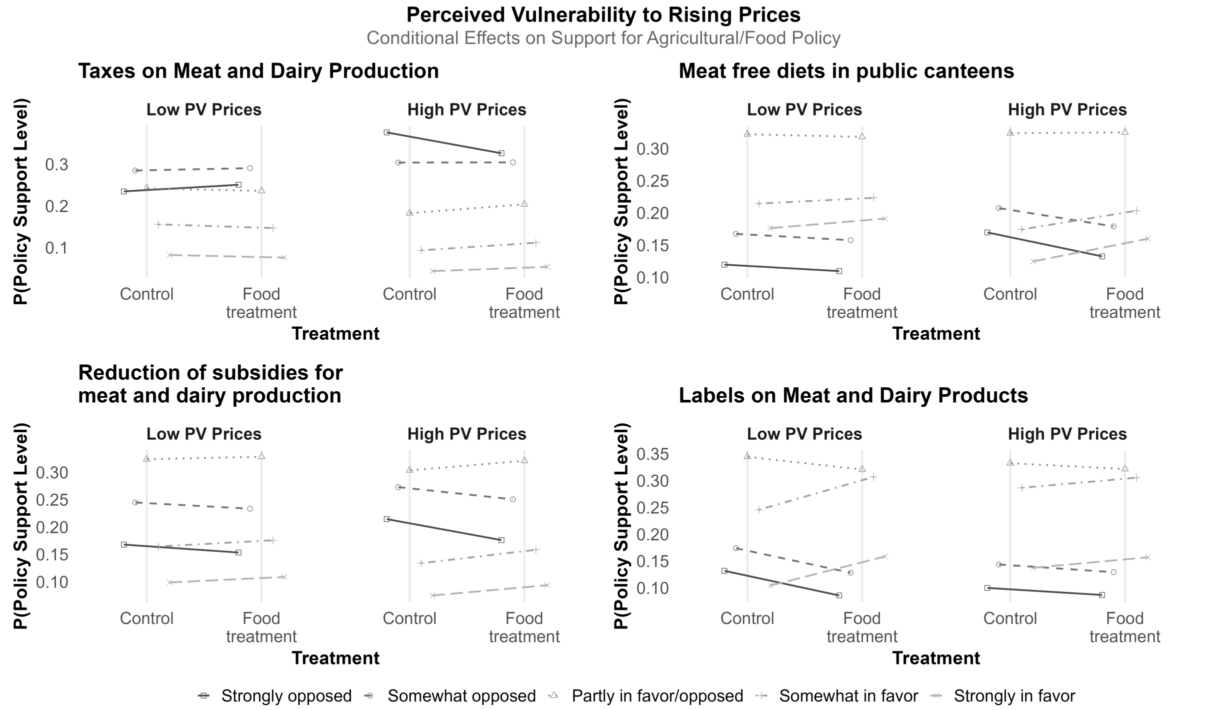

Figure 18: Ordered logit estimation of food and agricultural policy support on experimental treatment interacted with perceived policy vulnerability regarding rising prices. Control variables include normative beliefs, ideology, climate change concern, age, gender, residence and education.

Differential responses to push and pull policies are very evidently corroborated for energy policies. There are no differences between treatment groups for the former. However, the probability to support pull mitigation policies is positively affected by a normative belief update. There are no significant interaction effects between the treatment and the different types of policy vulnerability. Yet, as before, expected vulnerability to rising prices is the main factor related to opposition to push mitigation policies such as tax increases as can be observed from Figure 19. Interestingly, this image is reversed for pull policies like subsidies for the exchange of heating systems or tax benefits for renewable energy production. A higher level of expected vulnerability to rising prices leads to an increase of the support for any of these policies. The latter might be motivated by citizens' preferences for financial assistance

[44]Detailed results of the estimation and different types of vulnerability can be found in C.3 Table A. 28 and Figures A.22 and A.23.

to bear the costs of the energy transition. Thereby, citizens seem to disregard the potential effects of such policies on the rate of inflation and thus the source of their vulnerability (see C.3 Table A. 29 and Figures A.22 and A.23 for detailed results of the estimation and different types of vulnerability).

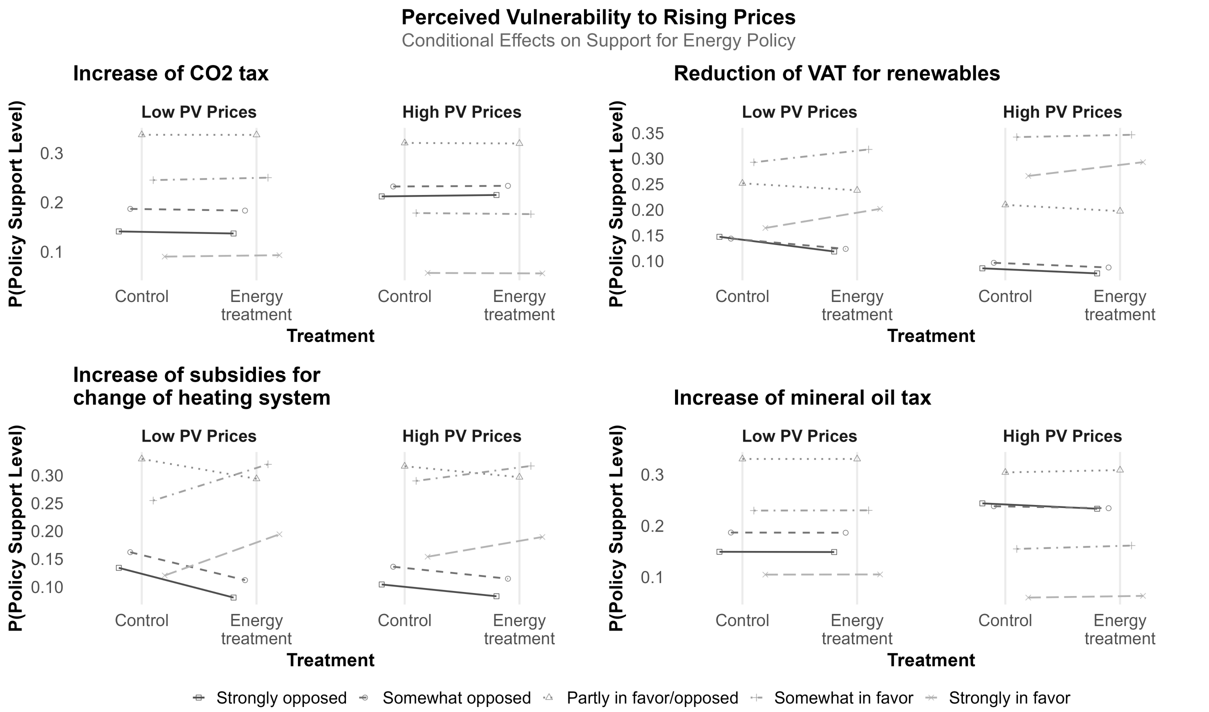

Figure 19: Ordered logit estimation of energy policy support on experimental treatment interacted with perceived policy vulnerability regarding rising prices. Control variables include normative beliefs, ideology, climate change concern, age, gender, residence and education.

This exploratory analysis raises some interesting questions regarding different expectations of policy vulnerability: While these can span multiple areas, citizens' concerns about rising prices due to climate policies are the driving factor for support or opposition to any of them. This has to be considered in the context of this paper. Most policies included in the analysis included a financial component. Moreover, Austria's rate of inflation has been well above average European levels during the time of the survey.

6.5. Conclusion

Effective and sustainable climate action requires the cooperation and approval of the public (Bernauer 2013; Drews and Van Den Bergh 2016). Social norms are an established instrument to foster pro-social outcomes in the toolkit of policymakers. Yet, these outcomes can have detrimental material consequences for citizens and therefore affect the way they process new normative information (Berger et al. 2023; Nyborg 2018). This potential trade-off between material and non-material drivers has so far received little attention. In this study, I shed light on the relationship between normative beliefs, the material implications of climate policy as well as citizens expectations about their own exposure to these implications.

The results of a belief updating experiment in Austria show that the design of climate policies has a significant impact on the effectiveness of a social norm update. In more detail, such an update proves to be less effective for more intrusive push mitigation policies as compared to pull mitigation policies. Moreover, citizens' expectations of their own policy vulnerability towards these intrusions reinforce opposition for push policies with arguably very tangible effects despite normative incentives. In other words, not only are citizens aware of the material implications of different types of climate policy when they choose to adjust their preferences after learning about a norm; they also take the likelihood of being personally negatively affected by such a policy into account, if these impacts have direct relevance to their lived experience. In this setting, citizens disregard the social norm in favor of their material concerns.

Conversely to the expectations, I find that prior expectations about the prevalence of social norms has no impact on the effect of a belief update. This underscores the notion that norms are sometimes unknown to citizens. Consequently they do not have strong priors when evaluating new normative information. In such cases, it seems to be that the salience of a norm is sufficient to shift attitudes towards climate policies. Put differently: if citizens are not aware how their peers feel about a change in dietary habits, they might evaluate novel information about that from a fairly neutral standpoint. These results contribute to a long line of research on the Focus Theory of Normative Conduct (Cialdini et al. 1990). While social norms and citizens' beliefs about the very same are important determinants for the effectiveness of any norm intervention, it is fair to assume that not everybody has explicit normative expectations about every (climate-related) behavioral field.

There are several limitations to this study, which also provide promising avenues for future research. Austria as a case has a range of similarities with other western European nations. Nevertheless, it has also been subject to (far) above average levels of inflation over the last year. This, in turn, might contribute to a heightened sensitivity towards potentially rising prices among citizens. Testing the hypotheses put forward in this paper in a broader set of countries could proof to be a promising comparative investigation.

Second, the measurement of normative beliefs relied on a very broad conceptualization of the in-group of respondents, i.e., "people in Austria". Future research will benefit from relying on normative expectations from more specific in-groups of citizens in their region or community (Constantino et al. 2022). Citizens might have a higher incentive to comply to such a specific norm and thus value corresponding information differently (Bicchieri 2017). Additionally, comparing the effect of a normative belief update (injunctive norm) to those of an empirical belief update (descriptive norm) would test an additional lever to garner policy support for costly policies (Cialdini 2007; Krupka and Weber 2013).

Lastly, the selection of policies investigated in this paper is strongly focused on taxes and subsidies. Thus, it might be insightful to extend this selection to other policies with no budgetary implications as well as to other policy fields. Including policies such as restrictions or bans might help provide a better understanding of the mechanism involved. Moreover, vulnerability is often associated with demand for short-term compensation. Consequently, it would be worthwhile exploring the effects of normative belief updates on comprehensive policy packages that include compensation for specific types of vulnerabilities.

This study's findings have important implications for future research and policymakers: first, while social norm interventions are still a comparatively cost-effective tool, their impacts on preferences for more intrusive policies seems to be limited. It is, nevertheless, promising that normative information indicating support from "only" a relative majority in the population can positively impact mitigation policy preferences – even in a field that is as emotionally charged as dietary habits. Second, citizens are aware of the material impacts of climate policy and have influential expectations about these. Consequently, future research and policy proposals have to take the material impacts of behavioral adjustments into account when scouting potential levers to increase mass support (Gaikwad et al. 2022). Both, push and pull mitigation policies are required for a successful green transition, however, support for the former does not come without a proper assessment of the concerns of vulnerable groups. Lastly, it would be promising to scrutinize the effects of different types of perceived policy vulnerability on a broader range of policies, which might trigger different areas of policy vulnerability. This might help to better understand the trade-offs between material and non-material drivers of climate policy preferences. Doing so, offers a lever to tailor compensation packages to the needs of these citizens. This is one of the key instruments at the disposal of policymakers to anticipate and mitigate political backlash.

7. Summary and Discussion

The goal of this dissertation is to shed light on the material and non-material drivers of climate policy preferences in light of the natural and political consequences of climate change. The overarching research question guiding this thesis asks:

RQ: *How do citizens include their material needs and desire for social approval in their climate policy preference formation process?*

To address this question, the papers included in this cumulative dissertation each focus on different aspects in this overarching research question. The aim is to deliver a comprehensive assessment of the influence of material needs and social approval on citizens' preferences in selected western European democracies. Paper 1 focuses exclusively on potential labor market implications of the green transition. Such assessments have been plagued by a lack of universally applicable indicators to scrutinize these implications on a fine-grained level (Bachelot 2024; JRC 2021). Thus, the research questions guiding this paper are

RQ1: *How can the impacts on a green transition for labor market participants be assessed?*

RQ1.1: What is the role of skill-transferability for labor market participants in the green transition?

In order to answer these questions, I construct a novel indicator measuring the potential skill transferability between green and non-green jobs. So far, related indicators focused on a distinction between green and brown occupations, that is, occupations with a positive or negative environmental impact. Furthermore, they suffer from a lack of applicability across occupational classifications which makes cross-sectional analyses of the green labor market transition and its political consequences impractical. Green skill transferability is understood as the degree to which employees can use skills form a previous occupation to do tasks in any future occupation (Shaw 1987). This concept has been frequently described as a determining factor for labor market mobility as well as the potential gains and losses from job switches (Gathmann and Schönberg 2010; Autor et al. 2003; Lazear 2009; Ormiston 2014). Moreover, the degree to which skills are a risky investment on the part of the employee affects the latter's subsequent demand for compensation by the welfare state (Iversen and Soskice 2001).

Research on different economic transitions, such as automation, has frequently analyzed the consequences of changes to requirements of different skills and tasks (Goos et al. 2014; Im 2021; Busemeyer and Tober 2022). Similarly, such indicators have been developed and applied in the context of the green transition (Vona et al. 2018, 2019; Bowen et al. 2018; Rutzer et al. 2020). The developed indicator complements the distinction between green and brown jobs by addressing the question what it takes to go from green to brown. Shedding light on the skill requirements for a successful green transition of labor market participants allows for a more fine-grained analysis of the occupational consequences of this economic transformation. Additionally, it links research on the green transition to assessments of other economic transitions.

The indicator builds on an analysis of textual data provided by the O*NET (2023) as well as the ILO (2023) and European Commission (2022). In more detail, I use the SBERT framework to compute cosine similarities between green and non-green tasks (Reimers and Gurevych 2019). This enables an aggregation of similarities between green and non-green tasks to a detailed level of occupations included in widely used occupational classification schemes such as the SOC and ISCO. It furthermore eliminates the need for complex and impractical cross-walks of indicators from one classification to another. Such attempts frequently come at the cost of accuracy and can introduce biases in the subsequent analysis of labor market developments (Bachelot 2024). Moreover, the methods used to construct this indicator allow for future extensions using text mining and unsupervised learning techniques to collect and classify tasks associated with green or brown occupations (Boselli et al. 2018).

Showcasing the distribution of green skill transferability using data from the ESS (European Social Survey European Research Infrastructure (ESS ERIC) 2024) merged with GHG-emissions data from eurostat (2025) provides a first illustration of the distribution of the status quo across European economic sectors and within occupational classes. The results suggest that green skill transferability is highest in high-emission sectors. However, this includes those sectors with low transition potential, which implies a tension between sectoral and individual transition prospects. In light of potential green labor market transformations, employees with low skill transferability in carbon-intensive sectors will pose a major challenge for policy makers: demand for their skills is likely to go down and necessitating expensive and expansive re- and upskilling initiatives. Lastly, green skill transferability seems to be concentrated among members of high and low occupational classes. This might imply that the skill specificity in, for example, the skilled working class might turn out to pose a risk for their labor market prospects in a green transition.

Summing up, Paper 1 contributes to extant research on potential labor market consequences of the green transition in three key ways: (1) a novel, universally applicable indicator allows for a detailed estimation of potential labor market mobility in the green transition. The methodology behind the indicator reduces the need for complex and inaccurate cross-walking procedures between occupational classifications addressing the first research question guiding this paper. (2) Focusing on the notion of skill transferability sheds light on the intersections between green and brown jobs. This has not only important implications for the estimation of labor market outcomes of employees across occupational classes. It also aides policymakers when designing effective labor market policies to mitigate potentially harmful occupational effects of a green transition. (3) Introducing this task-based measure of skill transferability allows to link the debates between different economic transitions more closely. This provides an answer to the second research question of this paper. Accordingly, future research can focus on potentially cross-pressured groups who face risks from, for example, automation as well as the green transition.

However, while objective (labor market related) risks play an important role for citizens preference formation (Rehm 2009), there is a subjective side to individual risk assessment (Hansson 2010; Marx and Picot 2020). Given the complexity of climate change related risks and their potential outcomes, objective perceptions of potential consequences of these risks seem to be a challenging task for experts, let alone laypersons (Quoß 2025; Gärtner and Schoen 2021; Arrow 1982; Weber 2018). Tapping into the subjective dimension of risk and vulnerability allows thus to channel the affective side of citizens' assessments of vulnerability (Walpole and Wilson 2021b). Paper 2 is the first paper of this dissertation to delve into this question by explicitly assessing the relationship between citizens' perceptions of vulnerability and their climate change policy preferences. This paper is guided by the following research questions:

RQ2: *How do citizens perceive vulnerability towards the natural and political consequences of climate change?*

RQ2.1: What are the vulnerabilities driving opposition to which type of climate policy?

RQ2.2: What role does compensation play when addressing these vulnerabilities?

Following previous research the theoretical framework in this paper builds on the notion that climate change and climate policies create distinct vulnerabilities. Furthermore, these vulnerabilities can overlap and result in cross-pressures where citizens will likely face natural and political consequences of climate change (Gaikwad et al. 2022; Oatley 2023). However, perceptions of climate change related risks and corresponding vulnerabilities can include a multiplicity of factors, such as floods, heat waves, or droughts as well as labor market risks, economic transformations or changes to established ways of life (Mau 2023). These aspects can all simultaneously contribute to citizens' perceptions of vulnerability.

Consequently, the first task of this paper is to illuminate these perceptions which allows to address the research questions put forward above. To do so, the survey used to collect the data for the empirical analysis in Paper 2 in Germany included open-ended questions about citizens perceptions of vulnerability, allowing to assess citizens' "first-order beliefs" (Ferrario and Stantcheva 2022).[45] These answers were subsequently classified using the approach by Gilardi et al. (2023) which utilizes Large Language Models (LLMs) to classify corpora of text into multiple categories. The results show that concerns about health, a lack of information or skepticism regarding climate change are prevalent among citizens. Moreover, they highlight the multidimensionality of vulnerability perceptions, including material and non-material concerns. The closed-ended survey items used to measure climate change and policy vulnerability build on the measurement strategy by Walpole and Wilson (2021a). Vulnerability is assessed as the perceived likelihood of experiencing negative consequences should a risky event occur (Walpole and Wilson 2021b; Wilson et al. 2019). The closed-ended survey items are able to predict meaningful answers in the categories for climate change or climate policy related vulnerabilities from the open-ended questions, thereby validating the measure. Additionally, applying a residualization approach addresses concerns about potential endogeneity in the variable.

Following this nuanced assessment of vulnerability perceptions, Paper 2 addresses the dimensionality of climate policy. This approach builds on findings for push and pull mitigation policies (Ejelöv et al. 2022). Yet, this investigation is extended to policies addressing the short-term consequences of climate change, that is, adaptation and eco-social policies (Orlove 2022; Tol 2005). To address this question of dimensionality EFA is applied (Costello and Osborne 2019) to multiple policy batteries investigating citizens' attitudes towards climate policies. This approach offers empirical evidence for the four theorized dimensions of climate policy.

[45]The survey, the experimental design as well as the expectations have been pre-registered and received ethics approval by the institutional review boards at the University of Vienna as well as the University of Zurich.

The factor loadings from this procedure subsequently serve as the dependent variable for an analysis of the association between the perceptions of vulnerability and support for each policy dimension. This analysis suggests, that, in line with the expectations put forward in Paper 2, high perceived climate change vulnerability is associated with higher support for both, mitigation policies as well as adaptation policies. High perceived policy vulnerability, conversely, is associated with lower support for mitigation policies as the main driver of policy related vulnerabilities. Compared to citizens' with a low degree of climate change or policy vulnerability, vulnerable citizens' are more in favor of policies addressing the short-term consequences of climate change than of policies tackling the root causes of the very same. This corroborates the dilemma for policymakers, who want to find a way to make unpopular policies popular (De Groot and Schuitema 2012).

The main question of the paper, however, is on the effect of tailored compensation to address individual vulnerabilities on policy support. One established way to attempt to garner mass support for comprehensive and potentially intrusive climate policies is by way of policy packaging (Heyen and Wicki 2024). Thereby, support for comprehensive climate policy packages increase if the latter span multiple policy fields (Bergquist et al. 2020) and are specialized on climate policy (Wicki et al. 2020; Fesenfeld et al. 2020; Wicki et al. 2019). Tailoring policy packages to the needs of vulnerable individuals to provide some type of compensation is shown to increase support (Häusermann et al. 2019; Fesenfeld 2022). Following this rationale, the survey used for data collection in Paper 2 included a conjoint experiment addressing the question if policy packages including tailored adaptation or eco-social policy measures increases support among highly vulnerable citizens.

The findings from this experiment support the notion that, generally, including policies that address the short-term consequences of climate change increases the support for comprehensive climate policy packages. However, these results differ according to citizens' vulnerability profiles. Policy support of citizens with a low degree of vulnerability is not affected by adaptation or social policy in particular. Among those citizens who perceive themselves to be vulnerable to the natural consequences of climate change, support significantly increases when including adaptation policies. A similar picture emerges for cross-pressured citizens, even though they are more sensitive to the inclusion of intrusive mitigation policies. The same cannot be said for policy vulnerable citizens: Their opposition to climate policy cannot be reduced by any short-term policy included in the policy packages.

In summary, Paper 2 contributes to the literature on climate policy support and climate change vulnerability in three ways: First, it provides a nuanced assessment of perceptions of climate change related vulnerabilities by introducing a novel operationalization using open-ended as well as closed-ended survey items. This allows to get a better understanding of citizens' affective dimension of risk assessment, i.e. a more value-laden component (Hansson 2010), which is an important explanatory factor for policy support (Marx and Picot 2020; Chung and Mau 2014; Weber 2018). This detailed assessment of vulnerability offers a nuanced answer to the first research question of this paper. Second, it highlights the potential (dis-)incentives for citizens provided by different dimensions of climate policies. While these incentives have already been discussed with respect to push and pull mitigation policies (Ejelöv et al. 2022), such a discussion has been largely absent for adaptation and social policies (Gaikwad et al. 2022: but see). Juxtaposing the dimensionality of climate policy with different types of vulnerability then reveals interesting patterns of support for each dimension respectively. Lastly, in line with previous research, this paper shows that the inclusion of policies tailored to the specific needs of citizens can generally increase support for comprehensive climate policy packages. However, it also highlights that this is not the case for every type of vulnerability: while climate change vulnerable and cross-pressured citizens react positively to the inclusion of adaptation and social policies, this is not the case for the policy-vulnerable, who turn out to be much harder to convince. This answers the second research question of this paper and motivates additional research on vulnerable subgroups in the population.

Accordingly, it seems appropriate to address the motivations and drivers of resistance of policy vulnerable citizens in more detail. This helps to highlight strategies that can aid in garnering support for comprehensive climate action even among those citizens. Social norm interventions are among these strategies to increase climate friendly preferences and behavior in a very cost-effective manner (Farrow et al. 2017; Constantino et al. 2022). However, there appears to be a plausible trade-off between the social approval gained from complying to a climate friendly social norm and the material cost involved when changing preferences and behavior to do so (Nyborg 2018; Berger et al. 2023). Consequently, Paper 3 is guided by the following research questions:

RQ3: *How do normative beliefs interact with policy vulnerability when shaping climate policy preferences?*

RQ3.1: Does high vulnerability offset positive effects from belief updates about normative expectations?

RQ3.2: What role does the type of policy play in this relationship?

Social norms are understood as societal informal guidelines that shape individual behavior through social approval or sanctions (Elster 1989). Ostrom (2000) highlights that norms can motivate behavior that would not be considered rational, i.e. contributions to a public good and that failing to comply to a social norm is frequently punished in societies. Bicchieri (2017) addresses the mechanisms behind the effectiveness of social norms in more detail and argues that individual behavior is guided by empirical and normative expectations about what is established and approved behavior in society (Mildenberger and Tingley 2019). Such behavior is often misguided in a way that individuals follow a norm that they perceive to be in place, while the actual norm is very different from this perception - also known as pluralistic ignorance (Bicchieri 2017).

Information treatments are frequently utilized to correct these misperceptions and to foster climate friendly behavior and preferences, or pro-social behavior more generally (Cialdini 2007; Schultz et al. 2007; Krupka and Weber 2013; Drews et al. 2022). However, adjustments of behaviors and preferences can come at a cost for individuals, that might outweigh any gain in social approval stemming form norm compliance (Nyborg 2018; Berger et al. 2023). Consider the example of a coal worker evaluating policies for the phase-out of fossil fuels. There might be a majority of citizens supporting such a phase-out, which creates a certain degree of social pressure. However, if supporting such a policy leads to unemployment, it is very unlikely that the coal worker will by swayed to support the policy, despite a majority in society being in favor of it. In other words, a normative belief update might be ineffective, if the cost of compliance becomes to high.

To address this relationship, I conduct a pre-registered survey experiment in the framework of the Austrian National Election Study in March of 2025 building on data from a previous wave in July/August of 2024 (Partheymüller et al. 2024). The experimental design follows previous belief updating experiments and presents information about normative expectations in society to respondents in the sample (Andre et al. 2024; Krupka and Weber 2013; Legros and Cislaghi 2020). The distinguishing feature of the treatment in this experiment is that it focuses on specific types of climate friendly behavior, namely energy saving and a reduction of meat and dairy products. This allows to link the treatment to specific climate policies in a certain field such as energy policy and food and agricultural policy, speaking to the importance of the design of belief updates (Bicchieri and Dimant 2022; Sparkman et al. 2021). Furthermore, mitigation policies in these fields are separated into push and pull mitigation policies, indicating more or less costly indirect policy effects.

It is plausible to assume that each of these policy fields are fairly tangible for the citizens' and policies in those fields can have visible effects on their daily lives. This tangibility is also likely to create a certain perception of potentially (negative) effects of climate policy in each field. To capture these perceptions more comprehensively I extend the measure of vulnerability employed in Paper 2 to a wider area of potential climate policy vulnerability (Walpole and Wilson 2021a,b). More specifically, respondents are asked to assess the probability of negative consequences of climate policy on the economic development, the price-level of everyday goods, and citizens' personal way of life.

The findings of this experimental study corroborate the established positive effect of normative belief updates on climate policy preferences (Andre et al. 2024). However, this effect is heavily dependent on the type of policy in question: while the treatment is effective for less intrusive pull policies, it proofs to be ineffective for more intrusive push policies, which runs counter to previous findings in the field (De Groot and Schuitema 2012). Extant research reported mixed effects of prior beliefs about social norms on a normative belief update. If the established norm in society is far less environmentally friendly than the normative expectation, this would in some cases lead to a backlash effect (Rinscheid et al. 2021; Richter et al. 2018), whereas in others there would be no effect (Andre et al. 2024).

In Paper 3, there is no evidence for a moderation effect of original beliefs about social norms on the treatment and mitigation policy preferences. In other words, individuals normative priors lead neither to a backlash effect nor higher support for climate policies after a belief update. This suggests that the salience of a norm is decisive for its effects, while prior beliefs seem to be secondary in that matter (Cialdini et al. 1990). Lastly, a negative moderation effect of policy vulnerability is contingent on the type of policy in question: There is no evidence for this effect for pull policies and for push policies this effect seems context dependent. Anticipated effects of mitigation policies seem to be more tangible for food and agricultural policies than for energy policies. Accordingly, high perceived policy vulnerability has a negative moderation effect on the belief update for push policies in this field. Put differently, price hikes for a favorite dish might be more visible than changes to monthly energy bills, thus rendering a normative signal less effective.

Summing up, Paper 3 contributes to the research on social norms and the material consequences of climate change in three distinct ways: First, I provide a broader assessment of perceived policy vulnerability covering socio-tropic concerns about the economic development in the country, material ego-tropic concerns about price-levels as well as non-material implications of climate policies on citizens' way of life. This allows to shed light on the tangible and intangible affective drivers of climate policy preference formation (Walpole and Wilson 2021a; Gaikwad et al. 2022; Mau 2023). The second contribution of this paper is to assess the effectiveness of social norm interventions on climate policy support in light of potentially intrusive policies. Social norms remain a cost-effective intervention to increase policy support. However, the results of this paper indicate that these effects are limited to less intrusive policy instruments. This has significant implications for policymakers seeking accessible ways to garner support for comprehensive climate policy and provides an answer to the second research question of this paper. Lastly, to delve into the latter aspect this paper considers citizens' perceptions of policy vulnerability in the updating process. Garnering mass support for climate policy is particularly hard for citizens' who expect negative personal consequences of climate policies. Not only might these citizens disregard the normative signal that comes with a social norm intervention. They might also weigh their potential personal cost higher than any benefit from social approval when forming their climate policy preferences (Nyborg 2018). Thus, by scrutinizing policy vulnerability as a potential moderator of a normative belief update, I provide a nuanced answer to the first research question of this paper.

8. Conclusion and Limitations

Adjusting to the natural and political consequences of climate change will require far reaching transitions in established ways of living, thereby affecting collective behavior as well as social norms (IPCC 2018). Dealing with these risks in the short and the long term is likely to have significant impacts on the organizational structure of societies as a whole. In light of this fundamental transition, far-reaching political actions are required. Public support is a necessary condition for effective climate action, at least in democratic societies (Bernauer 2013). Consequently, it is essential to shed light on the drivers of climate policy preferences. This dissertation is guided by the question of how citizens consider their material needs and their desire for social approval when they form their preferences regarding climate change policies.

In the framework of this dissertation, the natural and political consequences of climate change are understood as an addition, and in some cases reinforcements, to existing old and new social risks. Research on the responses to newly emerging (social) risks by welfare regimes have a long tradition (Polanyi 1944). While the post war period has been shaped by social risks such as unemployment, old age, and health (Esping-Andersen 1990; Armingeon and Bonoli 2006), post-capitalist societies have been shaped by other risks such as care responsibilities, precarious labor market positions or obsolete skills (Beramendi et al. 2015). The causes of these risks vary from the commodification of labor, over socio-demographic changes in the composition of the labor force all the way to the policy responses. Thus, their collective character is what characterizes these risks as social. Drawing the comparison to the natural and political consequences of climate change, Mandelli et al. (2024) argues that the social character of climate change related risks stems on the one hand, from anthropogenic climate change. On the other hand policy responses to alleviate these natural risks pose a distinct source of risk. As such they constitute a novel category of eco-social risk that can be analyzed in the framework of the welfare state.

Following this tradition of research, I elaborate on different drivers of eco-social risks and citizens' perceptions of the very same. This serves to illuminate material and non-material factors in individuals' climate policy preference formation process. A large part of the existing research focuses on the labor market consequences of a green transition. Thereby, cross sectional comparisons aim to uncover common trends in different labor markets applying a classification of green and non-green jobs (Bluedorn et al. 2023; OECD 2023; De Sario et al. 2023). However, such comparisons suffer from methodological problems which lead to biased results with respect to both long-term developments of greenness as well as labor market effects of green occupations (Bachelot 2024; JRC 2021). Moreover, the distinction between green and brown jobs might be a promising starting point for analyses of green labor market developments. Yet, it might veil the potential similarities between green jobs and occupations not classified as such. Consequently, recent approaches increasingly scrutinized the potential similarities between green and non-green jobs in order to better illuminate the potential for labor market mobility between these groups (Bowen et al. 2018; Rutzer et al. 2020; Lobsiger and Rutzer 2021).

However, these approaches suffer from biases stemming from a lack of indicators that can be easily applied across occupational classifications. Thus, the main contribution of this dissertation in this regard is the construction of an indicator that enables cross-sectional comparisons on a fine-grained level of occupational classifications. Regardless, one major limitation of this contribution is the reliance on a static corpus of task descriptions to compute similarity scores between green and non-green tasks tied to occupations (Villani et al. 2025). In light of dynamic developments of economic sectors and corresponding adjustments of economic actors, a more flexible source for the comparison between green and non-green task might uncover important labor market trends in the recent years (Bachmann et al. 2024). One way to circumvent this problem could be to mine online task descriptions from job advertisements, classify the occupations as well as the tasks associated to the occupations using supervised machine learning and large language models (Boselli et al. 2018).

In light of complex interactions of different sources of risks, laypersons might have a hard time to correctly assess their degree of vulnerability to objective risks associated with climate change or policies designed to address it (Quoß 2025; Gärtner and Schoen 2021; Arrow 1982). While objective sources of risk are significant predictors of citizens' behavior in times of economic transformations, subjective perceptions of these risk offer valuable explanatory power for citizens' preference formation process (Marx and Picot 2020; Leiserowitz 2006; Chung and Mau 2014; Weber 2018, 2017). One limitation of this dissertation is that it does not directly assess the joint effect of objective risks and subjective assessments thereof in the preference formation process. Connecting these two sides of the same medal (Hansson 2010) is a promising avenue for future research.

However, understanding these more affective and intuitive reactions of individuals to newly emerging risks offers valuable insights on the potential policy solutions they might demand or reject (Zahran et al. 2006; van der Linden 2015). Furthermore, this perspective allows to delve into a broader, material and non-material set of potentially relevant sources of individual vulnerabilities Mau (2023); Hasanaj and Stadelmann-Steffen (2022). Consequently, detailed knowledge about the drivers of perceptions of climate change related risks allows to develop policy instruments that are able to garner mass support for comprehensive policy action. Among these policy instruments, tailoring policy solutions to the specific needs of citizens in the form of comprehensive policy packages has been proven to be an effective tool to garner mass support for costly and intrusive policies (Heyen and Wicki 2024; Wicki et al. 2019; Häusermann et al. 2019).

In this dissertation, I shed light on the subjective dimensions of climate change related vulnerability. Moreover, I address the potential of policy packaging as an instrument to mitigate negative effects of this vulnerability on public support for effective climate action. In doing so, I contribute to a growing literature aiming to understand the effects of direct an indirect consequences of climate change on public support for climate policies (Schaffer and Magyar 2024; Stokes 2016; Hasanaj and Stadelmann-Steffen 2022). Furthermore, focusing on the distributional impacts of climate change as a source of social risks allows to anticipate potential sources of a political backlash against climate policies (Gaikwad et al. 2022; Colantone et al. 2024; Voeten 2024; Stokes 2016).

While citizens' material concerns are a significant factor for their climate policy preferences, this dissertation seeks to connect material concerns to non-material factors that drive such preferences. Focusing on the affective side of citizens' risk perceptions allows to link this aspect of material concern in light of climate change related consequences to other socio-psychological drivers of climate policy preferences. Among those drivers, social norms have received considerable attention (Farrow et al. 2017; Alló and Loureiro 2014; Constantino et al. 2022). As Ostrom (2000) pointed out, social norms play a vital role when individuals decide to contribute to a public good, such as climate change mitigation efforts (Kinzig et al. 2013; Bicchieri 2017). Informing citizens about the existence of climate related social norms is a frequently used instrument to foster climate friendly behavior and preferences (Schultz et al. 2007; Andre et al. 2024). The reasoning behind these interventions is that the more salient a norm is, the more likely individuals are to follow it (Cialdini et al. 1990).

However, Nyborg (2018) describes a plausible trade-off between the non-material benefits citizens receive from complying to social norms and the material cost that could accompany an adjustment of their behaviors and preferences. For example, there might be a consensus in society that energy-efficient renovation efforts are important. In this setting, homeowners are likely to adjust their behaviors accordingly. However, such efforts come with considerable material costs, which might exceed any gain in social approval form complying to the norm. In that case, homeowners might refrain from adjusting their behavior in the direction of a social norm, even though they might risk social sanctions.

The lack of an assessment of in-group specific norms is one limitation of this dissertation as the more an individual can relate to a specific group for which such a norm is present, the higher its potential impact (Ostrom 2000; Bicchieri 2017). Instead of focusing on the general population, regional or community-based information about social norms might be more effective to foster climate friendly preferences. Still, the findings in this dissertation corroborate the positive effect of social norm interventions, albeit with important qualifications with respect to climate policy design and citizens' perceived personal cost. This has implications for policymakers who seek to implement a larger set of tools to garner mass support for comprehensive climate action. Support for such policies can increase with accompanying measures such as information about social norms. Yet, the potential material cost involved will very likely require some type of compensation tailored to the specific needs of citizens.

Naturally, this dissertation comes with a set of limitations that go beyond the ones described above. The indicator developed in Paper 1 needs to be validated using long-term, fine-grained labor market data in order to accurately capture green labor market developments across different contexts. Thereby, it seems promising to link the labor market risks or opportunities stemming from the green transition to other drivers of labor market insecurity such as automation. This would help create a clear picture of occupational consequences of different economic transitions.

Paper 2 and Paper 3 in this dissertation are quantitative case studies conducted in Austria and Germany. This comes with two caveats: (1) the macroeconomic and ecological context of the selected cases is similar to other western European democracies and allows for some confidence regarding the external validity of the findings in this dissertation. Nevertheless, there is a considerable dependence on traditional car manufacturing industries in both countries. Such a dependence might lead to a heightened sense of specific types of policy vulnerability. Moreover, the reliance on formerly inexpensive fossil fuel from Russia led to a considerable exposure to the price shocks in the energy sector. This might also contribute to a higher degree of sensitivity to the political implications of climate change.

In light of the importance of a nuanced assessment of these perceptions of vulnerability, (2) the quantitative study design does only allow for a limited scrutiny of this nuance on an individual level. Consequently, future research should extend, on the one hand, case selection to a wider set of countries, including those from the global south with a considerably higher level of climate change vulnerability. This would introduce more variation in the exposure to the natural or the political consequences of climate change in these settings. Moreover, it would be advisable to implement a mixed methods design. Such an approach allows to investigate the sources of different vulnerabilities especially in those communities, who are particularly exposed to climate change related risks, in much greater detail. Additionally, these insights could illuminate very community-specific empirical and normative expectations that guide certain climate change related preferences and behavior. Both aspects can aid policymakers in crafting climate policy packages that aim at a reduction of GHG emissions in the long-run while simultaneously addressing the immediate impacts of climate change in the short-run.

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A. Paper 1 Appendix

A.1. Methodological approach

A.1.1. Evaluation of task content using ChatGPT

Following Gilardi et al. (2023) I utilized ChatGPT 4.1 to evaluate the contents of task associated with green occupations. This helped distinguish between actual green tasks and tasks of general nature that are also present in green occupations. The following prompt was used for this purpose:

Green jobs can be classified based on the tasks and skills required for a specific occupation. For each task or skill in this sample, follow the following instructions:

1. Carefully read the text of the task or skill, paying close attention to details.
2. Classify the task or skill into one of the topics defined below.
3. Indicate the reasoning behind your decision in one short sentence.
4. List your classification before your reasoning, separated by a semicolon.
5. Do not repeat the task or skill in your output.

GREEN – Tasks or skills that include one ore more of the following keywords or extensions thereof: Sustainab*, Environment*, Green*, Solar*, Geotherm*, Bio*, Hydro*, Eco*, Wind*, Carbon * Emi*, Global warming, Climat* * chang*, Resourc*, ESG, Electric* * driv*, Carbon footprint, Fuel cell*, Carbon *, Photovoltaic*, Climat*, Soil*, Mitigat*, Adapt* ,Pollutant * ,Qualit * Standard*, Weatheriz*, Weather*, Insulat*, Thermal*, Heat * exchang*, Hybrid*, Landfill*, Recycl*, Recover*, Rehab*, Convert*, Remed*, Clean*, Regen*, Remov*, Reclaim*, Restor*, Cycl*, Salvag*, Repair*, Retrofit*, Conserv*, Energy * Sav*, Avoid * wast*, Reduc* * wast*, Minimiz* * wast*, Energy * efficien*, Water * resource,Watershed*, Water * pollut*, Ozone-deplet*, Preserv*, Energy * us*, Energy * improv*, Reduc*, Reduc* * Emi*, Regulat*, Water * consum*, Power * Sav*, Wastewater, Water suppl*, Protect*, Decontaminat*, Contain*, Dispos*, Protect*

NON-GREEN – tasks or skills that are of general nature and do not include any of the following keywords or extensions thereof: Sustainab*, Environment*, Green*, Solar*, Geotherm*, Bio*, Hydro*, Eco*, Wind*, Carbon * Emi*, Global warming, Climat* * chang*, Resourc*, ESG, Electric* * driv*, Carbon footprint, Fuel cell*, Carbon *, Photovoltaic*, Climat*, Soil*, Mitigat*, Adapt* ,Pollutant * ,Qualit * Standard*, Weatheriz*, Weather*, Insulat*, Thermal*, Heat * exchang*, Hybrid*, Landfill*, Recycl*, Recover*, Rehab*, Convert*, Remed*, Clean*, Regen*, Remov*, Reclaim*, Restor*, Cycl*, Salvag*, Repair*, Retrofit*, Conserv*, Energy * Sav*, Avoid * wast*, Reduc* * wast*, Minimiz* * wast*, Energy * efficien*, Water * resource,Watershed*, Water * pollut*, Ozone-deplet*, Preserv*, Energy * us*, Energy * improv*, Reduc*, Reduc* * Emi*, Regulat*, Water * consum*, Power * Sav*, Wastewater, Water suppl*, Protect*, Decontaminat*, Contain*, Dispos*, Protect*: "

Subsequently a student assistant was tasked with validating these results, following the same instructions. More specifically, they were asked to classify each task in the corpus as either green or non-green. Analogous to the automated prompt, the student assistant was asked to provide a short statement on hard-to-classify tasks and explain their rationale. Table A. 1 reports the precision, recall and F1-score of this approach. All metrics indicate good performance of the automated classification approach. Given the rather imbalanced nature of the dataset, the high F1-score is particularly encouraging for future applications of this methodology.

Table A. 1: Classification performance metrics

Task	Precision	Recall	F1-score
Green Task Classifcation	0.977	0.899	0.936

A.1.2. Applying SBERT to Task Statements

To calculate sentence embeddings I rely on the framework provided by Reimers and Gurevych (2019). Reimers and Gurevych (2019) point out that comparing sentences using a conventional BERT framework is computationally expensive, which is why they create a more efficient way of comparing sentences relying on siamese network architecture, which allows to create vectorized representations of a predetermined size. This makes the SBERT framework especially useful for semantic similarity tasks. In light of the textual data at hand (task statements in English) it is not necessary to use a computationally more involved model for multilingual comparisons. Thus, I rely on the "all-mpnet-base-v2" general purpose model. This model has been trained on 1,170,060,424 training tuples and is explicitly designed to encode and compare sentences or short paragraphs. The maximum word length for inputs is 384 words (longer texts are truncated). For comparisons I constructed a similarity score with the smaller, thus computationally faster “all-MiniLM-l6-v2” model. Both models lead to reasonable and similar results. However, the larger model allows for a more nuanced assessment of tasks. All results presented are therefore based on this model. For more details consult `https://huggingface.co/sentence-transformers/all-mpnet-base-v2`.

To obtain the similarity scores between green and non-green tasks have been taken:

1. Create lists of non-green tasks for the SOC-O*NET 8-digit level (N=18,494) and the ISCO 4-digit level (N=3,256). Each row corresponds to one task in the data-frame.
2. Create list of exclusively green tasks (N=1,730). Each row corresponds to one task in the data-frame.
3. Load the SentenceTransformer framework and define the model used to encode the tasks in the lists ("all-mpnet-base-v2").
4. Encode non-green and green tasks to get vectorized representations.
5. Calculate cosine similarities of each encoded vector representation of each task. For the SOC this results in a 18,494*1,730 matrix and for the ISCO this results in a 3256*1,730 matrix.
6. *If necessary:* Transpose the matrices such that rows indicate non-green tasks and columns green tasks.
7. For each non-green task iterate through each green task similarity to identify the 20 most similar green tasks for the SOC as well as the 8 most similar green tasks for the ISCO.
8. Take the average of the 20 (SOC)/8 (ISCO) most similar green task to obtain the green skill transferability score for each task.
9. Match each task and its skill transferability score with its occupation in the SOC and ISCO respectively (multiple matches are possible).
10. Take the simple average of skill transferability scores over the total number of tasks by occupation to obtain an occupation specific skill transferability score.

A.2. Comparison to other indicators

A.2.1. Green Potential SOC by Rutzer et al. (2020)

Table A. 2: SOC 6-digit green potential (Rutzer et al. 2020) and skill transferability scores, including rankings

SOC	Occupation	Green Potential Rutzer et al. (2020)	Rank	Green Skill Transferability	Rank
19-2041	Environmental Scientists and Specialists, Including Health	0.78	12	0,659018178	1
51-9199	Production Workers, All Other	-	-	0,650325032	2
29-9011	Occupational Health and Safety Specialists	0.66	36	0,649454489	3
19-2043	Hydrologists	0.89	2	0,637019107	4
19-4093	Forest and Conservation Technicians	0.57	79	0,63375518	5
51-8031	Water and Wastewater Treatment Plant and System Operators	0.6	63	0,626333148	6
47-4011	Construction and Building Inspectors	0.67	30	0,61873108	7
19-1032	Foresters	0.64	41	0,616475892	8
47-4041	Hazardous Materials Removal Workers	0.46	171	0,614457466	9
17-2081	Environmental Engineers	1	1	0,611332161	10
19-3051	Urban and Regional Planners	0.64	42	0,608365443	11
19-1023	Zoologists and Wildlife Biologists	0.69	27	0,607177118	12
49-9081	Wind Turbine Service Technicians	0.57	85	0,606843737	13
19-4031	Chemical Technicians	0.35	319	0,606484931	14
51-9192	Cleaning, Washing, and Metal Pickling Equipment Operators and Tenders	0.23	559	0,602092893	15
51-8013	Power Plant Operators	0.3	405	0,598184328	16
19-2021	Atmospheric and Space Scientists	0.55	91	0,597657296	17
17-2051	Civil Engineers	0.86	4	0,596195485	18
11-3051	Industrial Production Managers	0.7	26	0,592142427	19
11-9041	Architectural and Engineering Managers	0.8	9	0,591803535	20
49-9098	Helpers–Installation, Maintenance, and Repair Workers	0.35	329	0,591564049	21
17-2071	Electrical Engineers	0.61	50	0,590463813	22
17-2161	Nuclear Engineers	0.77	13	0,589596632	23
51-8021	Stationary Engineers and Boiler Operators	0.47	163	0,589541153	24
17-1012	Landscape Architects	0.76	15	0,588190446	25
17-2151	Mining and Geological Engineers, Including Mining Safety Engineers	0.84	6	0,588129886	26
51-9011	Chemical Equipment Operators and Tenders	0.41	237	0,584793041	27
19-1013	Soil and Plant Scientists	0.61	52	0,583778159	28
41-3099	Sales Representatives, Services, All Other	0.58	70	0,583745627	29
17-2021	Agricultural Engineers	0.84	5	0,58361117	30
17-2171	Petroleum Engineers	0.84	7	0,583575735	31
19-2031	Chemists	0.55	92	0,582600708	32
19-4051	Nuclear Technicians	0.52	117	0,582236927	33
49-2094	Electrical and Electronics Repairers, Commercial and Industrial Equipment	0.61	57	0,58168118	34
45-2011	Agricultural Inspectors	0.46	167	0,581386842	35
51-8011	Nuclear Power Reactor Operators	0.58	73	0,581305981	36
19-1020	Biological Scientists	-	-	0,580776501	37
51-8012	Power Distributors and Dispatchers	0.48	152	0,580688204	38
33-3031	Fish and Game Wardens	0.47	158	0,580035232	39
11-3011	Administrative Service Managers	0.4	238	0,579353617	40
51-8099	Plant and System Operators, All Other	0.61	58	0,579151904	41
19-4091	Environmental Science and Protection Technicians, Including Health	0.72	21	0,578169464	42
19-2042	Geoscientists, Except Hydrologists and Geographers	0.8	10	0,577612482	43
49-9043	Maintenance Workers, Machinery	0.4	253	0,577610646	44
17-3022	Civil Engineering Technologists and Technicians	0.71	25	0,576112813	45
53-1021	First-Line Supervisors of Helpers, Laborers, and Material Movers, Hand	0.45	198	0,575647549	46
29-9012	Occupational Health and Safety Technicians	0.57	80	0,575407582	47
51-1011	First-Line Supervisors of Production and Operating Workers	0.31	376	0,575016225	48
19-4021	Biological Technicians	0.4	245	0,574902953	49
49-1011	First-Line Supervisors of Mechanics, Installers, and Repairers	0.67	31	0,574485304	50
19-1031	Conservation Scientists	0.61	53	0,573391009	51
53-7081	Refuse and Recyclable Material Collectors	0.31	382	0,573171698	52

Table A. 2: SOC 6-digit green potential (Rutzer et al. 2020) and skill transferability scores, including rankings

SOC	Occupation	Green Potential Rutzer et al. (2020)	Rank	Green Skill Transferability	Rank
53-1031	First-Line Supervisors of Transportation and Material Moving Machine and Vehicle Operators	0.31	379	0,572929747	53
19-4041	Geological and Petroleum Technicians	0.53	106	0,571343134	54
37-1012	First-Line Supervisors of Landscaping, Lawn Service, and Groundskeeping Workers	0.45	184	0,571014634	55
17-3021	Aerospace Engineering and Operations Technologists and Technicians	0.57	77	0,570007448	56
47-5081	Helpers–Extraction Workers	0.42	221	0,569790547	57
11-9121	Natural Sciences Managers	0.64	37	0,568947784	58
11-9021	Construction Managers	0.83	8	0,568237042	59
53-7073	Wellhead Pumpers	0.34	351	0,56815577	60
51-9012	Separating, Filtering, Clarifying, Precipitating, and Still Machine Setters, Operators, and Tenders	0.36	310	0,567585905	61
53-7051	Industrial Truck and Tractor Operators	0.31	381	0,566904724	62
49-9041	Industrial Machinery Mechanics	0.46	175	0,566393467	63
53-5031	Ship Engineers	0.53	110	0,566282218	64
51-8091	Chemical Plant and System Operators	0.35	330	0,566150958	65
53-7072	Pump Operators, Except Wellhead Pumpers	0.43	214	0,565269946	66
11-9161	Emergency Management Directors	0.55	88	0,565032731	67
11-9013	Farmers, Ranchers, and Other Agricultural Managers	0.66	32	0,564929415	68
17-2141	Mechanical Engineers	0.76	16	0,564006562	69
17-2041	Chemical Engineers	0.88	3	0,56306137	70
17-2111	Health and Safety Engineers, Except Mining Safety Engineers and Inspectors	0.75	17	0,562435371	71
53-7063	Machine Feeders and Offbearers	0.23	562	0,562213188	72
49-3041	Farm Equipment Mechanics and Service Technicians	0.45	196	0,561329889	73
33-2022	Forest Fire Inspectors and Prevention Specialists	0.61	56	0,56009348	74
49-9062	Medical Equipment Repairers	0.45	197	0,559782562	75
17-3025	Environmental Engineering Technologists and Technicians	0.64	40	0,559202779	76
19-3099	Social Scientists and Related Workers, All Other	0.75	19	0,558367915	77
45-4011	Forest and Conservation Workers	0.58	71	0,557961505	78
51-9023	Mixing and Blending Machine Setters, Operators, and Tenders	0.4	258	0,557830864	79
13-1021	Buyers and Purchasing Agents, Farm Products	0.57	74	0,557806964	80
33-9011	Animal Control Workers	0.27	470	0,557670204	81
17-1011	Architects, Except Landscape and Naval	0.76	14	0,557194992	82
45-2091	Agricultural Equipment Operators	0.28	449	0,556990627	83
17-3023	Electrical and Electronic Engineering Technologists and Technicians	0.45	181	0,556664694	84
49-3042	Mobile Heavy Equipment Mechanics, Except Engines	0.54	101	0,556424967	85
49-9071	Maintenance and Repair Workers, General	0.4	254	0,556306283	86
11-9141	Property, Real Estate, and Community Association Managers	0.6	60	0,556273015	87
17-3026	Industrial Engineering Technologists and Technicians	0.52	114	0,555534576	88
51-2092	Team Assemblers	0.18	662	0,554849149	89
53-7061	Cleaners of Vehicles and Equipment	0.24	533	0,55452753	90
45-2092	Farmworkers and Laborers, Crop, Nursery, and Greenhouse	0.25	499	0,554320746	91
13-1081	Logisticians	0.61	48	0,554108125	92
47-2073	Operating Engineers and Other Construction Equipment Operators	0.49	137	0,554037698	93
53-7071	Gas Compressor and Gas Pumping Station Operators	0.49	142	0,552590748	94
37-3013	Tree Trimmers and Pruners	0.4	247	0,551093354	95
51-9051	Furnace, Kiln, Oven, Drier, and Kettle Operators and Tenders	0.18	666	0,551078457	96
37-2011	Janitors and Cleaners, Except Maids and Housekeeping Cleaners	0.2	596	0,550997591	97
45-1011	First-Line Supervisors of Farming, Fishing, and Forestry Workers	0.51	127	0,550751923	98
33-1021	First-Line Supervisors of Firefighting and Prevention Workers	0.53	107	0,550719006	99
51-8092	Gas Plant Operators	0.48	153	0,550595604	100
43-1011	First-Line Supervisors of Office and Administrative Support Workers	0.29	420	0,550517438	101
11-3071	Transportation, Storage, and Distribution Managers	0.51	122	0,550490984	102
19-1012	Food Scientists and Technologists	0.61	51	0,549816156	103

Table A. 2: SOC 6-digit green potential (Rutzer et al. 2020) and skill transferability scores, including rankings

SOC	Occupation	Green Potential Rutzer et al. (2020)	Rank	Green Skill Transferability	Rank
53-6051	Transportation Inspectors	0.48	154	0,549410446	104
47-1011	First-Line Supervisors of Construction Trades and Extraction Workers	0.67	29	0,548977346	105
19-3092	Geographers	0.45	182	0,548666514	106
49-3053	Outdoor Power Equipment and Other Small Engine Mechanics	0.37	289	0,548340844	107
13-1051	Cost Estimators	0.78	11	0,548266643	108
17-2131	Materials Engineers	0.64	39	0,54757806	109
11-9199	Managers, All Other	0.61	47	0,547417408	110
47-2072	Pile Driver Operators	0.42	219	0,547195797	111
17-3027	Mechanical Engineering Technologists and Technicians	0.57	78	0,546812293	112
13-1111	Management Analysts	0.47	155	0,546343646	113
11-9151	Social and Community Service Managers	0.29	408	0,545996138	114
43-5111	Weighers, Measurers, Checkers, and Samplers, Recordkeeping	0.2	605	0,545688473	115
51-3093	Food Cooking Machine Operators and Tenders	0.14	730	0,545441121	116
47-2111	Electricians	0.57	82	0,545112179	117
33-9092	Lifeguards, Ski Patrol, and Other Recreational Protective Service Workers	0.13	737	0,545063367	118
37-1011	First-Line Supervisors of Housekeeping and Janitorial Workers	0.35	323	0,544996494	119
49-3031	Bus and Truck Mechanics and Diesel Engine Specialists	0.46	174	0,544988222	120
19-2099	Physical Scientists, All Other	0.63	43	0,544782539	121
51-4051	Metal-Refining Furnace Operators and Tenders	0.23	556	0,544465182	122
19-1022	Microbiologists	0.47	157	0,544299945	123
17-3029	Engineering Technologists and Technicians, Except Drafters, All Other	0.59	64	0,543562732	124
25-9021	Farm and Home Management Educators	0.51	126	0,543503392	125
49-9021	Heating, Air Conditioning, and Refrigeration Mechanics and Installers	0.63	45	0,543269286	126
51-2022	Electrical and Electronic Equipment Assemblers	0.23	554	0,54313678	127
17-2011	Aerospace Engineers	0.58	67	0,542798813	128
53-7011	Conveyor Operators and Tenders	0.19	637	0,54242132	129
47-3016	Helpers–Roofers	0.4	250	0,542013014	130
53-7064	Packers and Packagers, Hand	0.2	614	0,541829838	131
51-8093	Petroleum Pump System Operators, Refinery Operators, and Gaugers	0.42	224	0,541020983	132
11-1011	Chief Executives	0.71	24	0,539673335	133
53-7121	Tank Car, Truck, and Ship Loaders	0.46	177	0,539511441	134
17-2199	Engineers, All Other	0.72	20	0,539446835	135
19-3011	Economists	0.52	116	0,538541613	136
33-2011	Firefighters	0.49	134	0,537711995	137
19-4011	Agricultural and Food Science Technicians	0.42	217	0,537166788	138
15-1111	Computer and Information Research Scientists	0.51	124	0,535893938	139
51-9021	Crushing, Grinding, and Polishing Machine Setters, Operators, and Tenders	0.37	294	0,535403572	140
27-1025	Interior Designers	0.63	44	0,535318925	141
51-3091	Food and Tobacco Roasting, Baking, and Drying Machine Operators and Tenders	0.27	477	0,535032014	142
47-2132	Insulation Workers, Mechanical	0.35	327	0,534555198	143
49-9031	Home Appliance Repairers	0.39	268	0,534306939	144
33-2021	Fire Inspectors and Investigators	0.59	65	0,533553687	145
13-1023	Purchasing Agents, Except Wholesale, Retail, and Farm Products	0.57	75	0,532960535	146
49-9099	Installation, Maintenance, and Repair Workers, All Other	0.63	46	0,532697492	147
31-9093	Medical Equipment Preparers	0.27	468	0,532600348	148
11-3131	Training and Development Managers	0.36	296	0,532513093	149
37-3011	Landscaping and Groundskeeping Workers	0.31	373	0,532365552	150
53-7032	Excavating and Loading Machine and Dragline Operators	0.42	226	0,531977308	151
33-9032	Security Guards	0.22	574	0,53191441	152
47-5071	Roustabouts, Oil and Gas	0.29	423	0,531796345	153
17-2112	Industrial Engineers	0.58	68	0,531648495	154
11-9031	Education and Childcare Administrators, Preschool and Daycare	0.25	485	0,531295492	155
37-2021	Pest Control Workers	0.46	166	0,530475102	156
19-4061	Social Science Research Assistants	0.45	183	0,530466311	157
47-2071	Paving, Surfacing, and Tamping Equipment Operators	0.36	304	0,530318227	158

Table A. 2: SOC 6-digit green potential (Rutzer et al. 2020) and skill transferability scores, including rankings

SOC	Occupation	Green Potential Rutzer et al. (2020)	Rank	Green Skill Transferability	Rank
43-5061	Production, Planning, and Expediting Clerks	0.37	280	0,530300191	159
11-1021	General and Operations Managers	0.52	111	0,530267924	160
11-9111	Medical and Health Services Managers	0.35	315	0,530145719	161
51-9061	Inspectors, Testers, Sorters, Samplers, and Weighers	0.25	508	0,529054756	162
19-2012	Physicists	0.69	28	0,528718916	163
47-2061	Construction Laborers	0.45	185	0,528334452	164
49-3051	Motorboat Mechanics and Service Technicians	0.49	140	0,527717026	165
13-1041	Compliance Officers	0.46	164	0,527640697	166
33-9099	Protective Service Workers, All Other	0.39	264	0,527139471	167
11-3061	Purchasing Managers	0.6	59	0,52713379	168
19-4099	Life, Physical, and Social Science Technicians, All Other	0.48	146	0,526223651	169
49-2095	Electrical and Electronics Repairers, Powerhouse, Substation, and Relay	0.51	129	0,526111453	170
49-2011	Computer, Automated Teller, and Office Machine Repairers	0.3	401	0,525922923	171
27-1021	Commercial and Industrial Designers	0.46	165	0,525592423	172
19-3094	Political Scientists	0.34	338	0,525002083	173
39-1021	First-Line Supervisors of Personal Service Workers	0.27	473	0,524482151	174
49-9092	Commercial Divers	0.54	103	0,524067414	175
51-9198	Helpers–Production Workers	0.19	635	0,523925827	176
49-3011	Aircraft Mechanics and Service Technicians	0.52	121	0,522932226	177
49-2097	Audiovisual Equipment Installers and Repairers	0.43	212	0,52271068	178
17-3011	Architectural and Civil Drafters	0.58	69	0,522142132	179
41-1011	First-Line Supervisors of Retail Sales Workers	0.28	446	0,522130723	180
47-4099	Construction and Related Workers, All Others	0.72	23	0,521672289	181
41-9031	Sales Engineers	0.57	81	0,52107098	182
35-9021	Dishwashers	0.27	471	0,520846131	183
53-3032	Heavy and Tractor-Trailer Truck Drivers	0.36	312	0,520510405	184
29-1131	Veterinarians	0.3	392	0,520353134	185
47-4051	Highway Maintenance Workers	0.54	100	0,520298971	186
53-3033	Light Truck Drivers	0.29	430	0,520235131	187
49-3043	Rail Car Repairers	0.42	222	0,519899867	188
51-4041	Machinists	0.3	403	0,519854865	189
21-1091	Health Education Specialists	0.24	511	0,519840554	190
43-5032	Dispatchers, Except Police, Fire, and Ambulance	0.4	248	0,519245086	191
37-2012	Maids and Housekeeping Cleaners	0.2	597	0,519033043	192
11-3021	Computer and Information Systems Managers	0.43	202	0,519030024	193
51-9111	Packaging and Filling Machine Operators and Tenders	0.24	526	0,518972793	194
19-1011	Animal Scientists	0.66	34	0,518968257	195
39-2021	Animal Caretakers	0.22	575	0,518941034	196
27-3031	Public Relations Specialists	0.34	341	0,518721647	197
47-2152	Plumbers, Pipefitters, and Steamfitters	0.57	83	0,518637396	198
37-3012	Pesticide Handlers, Sprayers, and Applicators, Vegetation	0.36	300	0,518397013	199
49-2091	Avionics Technicians	0.45	193	0,518267593	200
45-2093	Farmworkers, Farm, Ranch, and Aquacultural Animals	0.33	358	0,518044135	201
17-2121	Marine Engineers and Naval Architects	0.75	18	0,517931998	202
13-1161	Market Research Analysts and Marketing Specialists	0.34	335	0,517726976	203
53-7111	Mine Shuttle Car Operators	0.2	615	0,517470529	204
31-1015	Orderlies	0.05	793	0,51739989	205
53-7031	Dredge Operators	0.33	363	0,517218542	206
47-4071	Septic Tank Servicers and Sewer Pipe Cleaners	0.47	161	0,517048819	207
19-2032	Materials Scientists	0.66	35	0,516880521	208
47-2131	Insulation Workers, Floor, Ceiling, and Wall	0.37	284	0,516653403	209
33-1012	First-Line Supervisors of Police and Detectives	0.39	263	0,516462053	210
25-4013	Museum Technicians and Conservators	0.41	229	0,516450265	211
19-1042	Medical Scientists, Except Epidemiologists	0.54	96	0,516255438	212
47-5021	Earth Drillers, Except Oil and Gas	0.42	220	0,516146881	213
49-9091	Coin, Vending, and Amusement Machine Servicers and Repairers	0.4	255	0,515859358	214
51-2021	Coil Winders, Tapers, and Finishers	0.27	475	0,515826029	215
47-5013	Service Unit Operators, Oil and Gas	0.49	139	0,515798074	216
11-9032	Education Administrators, Kindergarten through Secondary	0.4	239	0,515406561	217
17-1022	Surveyors	0.66	33	0,51425108	218
33-3052	Transit and Railroad Police	0.33	356	0,514220046	219
47-3015	Helpers–Pipelayers, Plumbers, Pipefitters, and Steamfitters	0.45	191	0,51405769	220

Table A. 2: SOC 6-digit green potential (Rutzer et al. 2020) and skill transferability scores, including rankings

SOC	Occupation	Green Potential Rutzer et al. (2020)	Rank	Green Skill Transferability	Rank
29-2056	Veterinary Technologists and Technicians	0.24	521	0,513843203	221
53-7041	Hoist and Winch Operators	0.24	532	0,513726959	222
51-9041	Extruding, Forming, Pressing, and Compacting Machine Setters, Operators, and Tenders	0.23	558	0,513622323	223
53-7062	Laborers and Freight, Stock, and Material Movers, Hand	0.23	561	0,513532584	224
47-4021	Elevator and Escalator Installers and Repairers	0.57	84	0,513058838	225
53-6041	Traffic Technicians	0.57	87	0,512728548	226
13-1199	Business Operations Specialists, All Other	0.61	49	0,512162272	227
19-1041	Epidemiologists	0.4	243	0,510808133	228
17-2061	Computer Hardware Engineers	0.52	113	0,510667426	229
11-2021	Marketing Managers	0.43	201	0,510186693	230
49-2098	Security and Fire Alarm Systems Installers	0.45	195	0,510076772	231
49-3023	Automotive Service Technicians and Mechanics	0.46	173	0,510038094	232
11-9051	Food Service Managers	0.28	433	0,509685887	233
31-9096	Veterinary Assistants and Laboratory Animal Caretakers	0.18	649	0,50968381	234
41-1012	First-Line Supervisors of Non-Retail Sales Workers	0.47	159	0,509527508	235
53-6031	Automotive and Watercraft Service Attendants	0.36	313	0,509288741	236
51-4061	Model Makers, Metal and Plastic	0.29	428	0,509283484	237
51-9191	Adhesive Bonding Machine Operators and Tenders	0.24	529	0,509182495	238
25-4012	Curators	0.4	246	0,509080628	239
47-5041	Continuous Mining Machine Operators	0.36	305	0,50901758	240
53-3031	Driver/Sales Workers	0.28	461	0,508151225	241
51-4052	Pourers and Casters, Metal	0.17	685	0,508041449	242
49-3092	Recreational Vehicle Service Technicians	0.43	213	0,507999398	243
47-2211	Sheet Metal Workers	0.45	190	0,507620766	244
15-1133	Software Developers, Applications	0.39	260	0,507545519	245
35-1012	First-Line Supervisors of Food Preparation and Serving Workers	0.31	372	0,507529655	246
11-9081	Lodging Managers	0.35	314	0,507271323	247
41-4011	Sales Representatives, Wholesale and Manufacturing, Technical and Scientific Products	0.54	97	0,507226937	248
33-9031	Gambling Surveillance Officers and Gambling Investigators	0.3	394	0,506975955	249
49-2022	Telecommunications Equipment Installers and Repairers, Except Line Installers	0.39	267	0,506954302	250
35-1011	Chefs and Head Cooks	0.34	343	0,506935649	251
39-9032	Recreation Workers	0.23	548	0,506820746	252
49-9012	Control and Valve Installers and Repairers, Except Mechanical Door	0.53	109	0,50642474	253
51-9193	Cooling and Freezing Equipment Operators and Tenders	0.34	350	0,506389469	254
51-4193	Plating Machine Setters, Operators, and Tenders, Metal and Plastic	0.36	309	0,506386125	255
51-6062	Textile Cutting Machine Setters, Operators, and Tenders	0.28	456	0,506116464	256
15-2031	Operations Research Analysts	0.57	76	0,50581783	257
11-3121	Human Resources Managers	0.37	270	0,505778941	258
51-2031	Engine and Other Machine Assemblers	0.37	292	0,505690266	259
15-1151	Computer User Support Specialist	0.23	535	0,505434788	260
13-2061	Financial Examiners	0.45	179	0,505329756	261
11-2011	Advertising and Promotions Managers	0.2	584	0,505180892	262
51-4191	Heat Treating Equipment Setters, Operators, and Tenders, Metal and Plastic	0.25	502	0,504878784	263
45-3011	Fishers and Related Fishing Work	0.34	344	0,504060651	264
13-1141	Compensation, Benefits, and Job Analysis Specialists	0.34	334	0,503998722	265
53-7033	Loading Machine Operators, Underground Mining	0.28	463	0,503842741	266
33-3051	Police and Sheriff's Patrol Officers	0.3	393	0,503329146	267
49-9095	Manufactured Building and Mobile Home Installers	0.58	72	0,503088097	268
53-5022	Motorboat Operators	0.42	225	0,503077636	269
29-1031	Dietitians and Nutritionists	0.3	391	0,502381234	270
49-9051	Electrical Power-Line Installers and Repairers	0.37	290	0,502113999	271
33-1011	First-Line Supervisors of Correctional Officers	0.28	445	0,501870959	272
43-5071	Shipping, Receiving, and Inventory Clerks	0.25	498	0,501504841	273
47-2151	Pipelayers	0.48	149	0,501398324	274
15-1143	Computer Network Architects	0.55	89	0,501299094	275
15-2091	Mathematical Technicians	0.23	536	0,501026421	276
41-9011	Demonstrators and Product Promoters	0.2	601	0,500036313	277
47-3013	Helpers–Electricians	0.37	286	0,499861279	278
43-9061	Office Clerks, General	0.14	728	0,499715662	279

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SOC	Occupation	Green Potential Rutzer et al. (2020)	Rank	Green Skill Transferability	Rank
43-3061	Procurement Clerks	0.28	447	0,499471222	280
11-2022	Sales Managers	0.49	131	0,499082295	281
51-9121	Coating, Painting, and Spraying Machine Setters, Operators, and Tenders	0.24	527	0,49895775	282
39-3093	Locker Room, Coatroom, and Dressing Room Attendants	0.1	778	0,498660924	283
49-3052	Motorcycle Mechanics	0.4	252	0,498409465	284
53-3011	Ambulance Drivers and Attendants, Except Emergency Medical Technicians	0.19	636	0,497742763	285
43-5011	Cargo and Freight Agents	0.36	302	0,497249711	286
49-9044	Millwrights	0.54	102	0,497112048	287
25-1194	Career/Technical Education Teachers, Postsecondary	0.19	620	0,496772425	288
53-4031	Railroad Conductors and Yardmasters	0.31	380	0,496570492	289
11-3031	Financial Managers	0.45	178	0,496471591	290
51-2023	Electromechanical Equipment Assemblers	0.27	476	0,496307686	291
13-1074	Farm Labor Contractors	0.24	510	0,496299906	292
39-7011	Tour Guides and Escorts	0.11	764	0,496159258	293
15-1142	Network and Computer Systems Administrators	0.4	242	0,496123876	294
47-2181	Roofers	0.47	160	0,49612286	295
53-5011	Sailors and Marine Oilers	0.33	362	0,495978284	296
17-3013	Mechanical Drafters	0.54	94	0,495976162	297
19-3022	Survey Researchers	0.4	244	0,49594498	298
53-5021	Captains, Mates, and Pilots of Water Vessels	0.46	176	0,49592883	299
41-4012	Sales Representatives, Wholesale and Manufacturing, Except Technical and Scientific Products	0.41	232	0,495619127	300
53-6011	Bridge and Lock Tenders	0.27	484	0,495548413	301
51-3092	Food Batchmakers	0.23	555	0,494708409	302
51-4072	Molding, Coremaking, and Casting Machine Setters, Operators, and Tenders, Metal and Plastic	0.2	610	0,494627812	303
43-5031	Public Safety Telecommunicators	0.16	707	0,494586782	304
33-3041	Parking Enforcement Workers	0.27	469	0,494539434	305
49-2093	Electrical and Electronics Installers and Repairers, Transportation Equipment	0.52	120	0,494455292	306
13-2011	Accountants and Auditors	0.4	241	0,494406586	307
17-2072	Electronics Engineers, Except Computer	0.54	93	0,494341913	308
41-2022	Parts Salespersons	0.35	325	0,493813839	309
53-7021	Crane and Tower Operators	0.35	331	0,49335094	310
51-6061	Textile Bleaching and Dyeing Machine Operators and Tenders	0.28	455	0,493020595	311
45-4022	Logging Equipment Operators	0.37	281	0,492982583	312
13-1022	Wholesale and Retail Buyers, Except Farm Products	0.43	203	0,492375175	313
49-2096	Electronic Equipment Installers and Repairers, Motor Vehicles	0.45	194	0,49236644	314
15-1132	Software Developers, Applications	0.43	205	0,492346813	315
53-6021	Parking Attendants	0.24	531	0,492020863	316
17-3012	Electrical and Electronics Drafters	0.37	276	0,491838627	317
11-9033	Education Administrators, Postsecondary	0.34	333	0,490948329	318
49-2092	Electric Motor, Power Tool, and Related Repairers	0.48	151	0,49076636	319
47-5012	Rotary Drill Operators, Oil and Gas	0.34	346	0,490097677	320
13-1121	Meeting, Convention, and Event Planners	0.37	272	0,489879679	321
51-6063	Textile Knitting and Weaving Machine Setters, Operators, and Tenders	0.08	787	0,489830619	322
53-1011	Aircraft Cargo Handling Supervisors	0.33	361	0,489665033	323
53-4011	Locomotive Engineers	0.29	431	0,48947006	324
43-4171	Receptionists and Information Clerks	0.1	781	0,489412474	325
51-6011	Laundry and Dry-Cleaning Workers	0.2	612	0,489305503	326
29-2012	Medical and Clinical Laboratory Technicians	0.28	443	0,488412933	327
39-3091	Amusement and Recreation Attendants	0.1	777	0,487820352	328
47-2231	Solar Photovoltaic Installers	0.59	66	0,487734381	329
35-3041	Food Servers, Nonrestaurant	0.1	776	0,487137279	330
29-2054	Respiratory Therapy Technicians	0.2	592	0,486987131	331
27-3042	Technical Writers	0.41	230	0,486947803	332
15-2041	Statisticians	0.42	216	0,486923774	333
13-2021	Appraisers and Assessors of Real Estate	0.53	104	0,486818404	334
35-2012	Cooks, Institution and Cafeteria	0.17	678	0,486695285	335
51-4023	Rolling Machine Setters, Operators, and Tenders, Metal and Plastic	0.27	478	0,486693205	336
53-4013	Rail Yard Engineers, Dinkey Operators, and Hostlers	0.24	530	0,486549819	337

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SOC	Occupation	Green Potential Rutzer et al. (2020)	Rank	Green Skill Transferability	Rank
17-2031	Bioengineers and Biomedical Engineers	0.64	38	0,486488613	338
51-7042	Woodworking Machine Setters, Operators, and Tenders, Except Sawing	0.25	506	0,486246591	339
13-1071	Human Resources Specialists	0.23	534	0,485989249	340
49-9052	Telecommunications Line Installers and Repairers	0.36	307	0,485081411	341
25-1052	Chemistry Teachers, Postsecondary	0.48	147	0,484589123	342
47-3014	Helpers–Painters, Paperhangers, Plasterers, and Stucco Masons	0.35	328	0,484549341	343
53-3021	Bus Drivers, Transit and Intercity	0.27	483	0,484401552	344
21-1094	Community Health Workers	0.23	538	0,484182045	345
11-2031	Public Relations and Fundraising Managers	0.36	295	0,484020645	346
29-1062	Family and General Practitioners	0.19	622	0,483384987	347
41-2021	Counter and Rental Clerks	0.25	495	0,483291519	348
19-3041	Sociologists	0.27	464	0,483202382	349
11-1031	Legislators	-	-	0,483030325	350
27-1012	Craft Artists	0.35	321	0,482940038	351
51-4081	Multiple Machine Tool Setters, Operators, and Tenders, Metal and Plastic	0.28	452	0,482286199	352
13-1011	Agents and Business Managers of Artists, Performers, and Athletes	0.28	434	0,481864661	353
47-2031	Carpenters	0.52	119	0,481115773	354
39-9021	Personal Care Aides	0.1	779	0,480945994	355
47-5042	Mine Cutting and Channeling Machine Operators	0.29	422	0,480864925	356
47-2011	Boilermakers	0.46	168	0,480864833	357
11-3111	Compensation and Benefits Managers	0.34	332	0,480695136	358
17-3031	Surveying and Mapping Technicians	0.52	115	0,480443487	359
25-4011	Archivists	0.33	352	0,480293858	360
51-4022	Forging Machine Setters, Operators, and Tenders, Metal and Plastic	0.29	427	0,480022428	361
19-3032	Industrial-Organizational Psychologists	0.34	337	0,480017031	362
13-2031	Budget Analysts	0.37	273	0,479876012	363
53-2022	Airfield Operations Specialists	0.45	200	0,47986452	364
41-9021	Real Estate Brokers	0.54	98	0,479614735	365
17-3024	Electro-Mechanical and Mechatronics Technologists and Technicians	0.49	132	0,479230127	366
29-2055	Surgical Technologists	0.18	647	0,47862131	367
49-2021	Radio, Cellular, and Tower Equipment Installers and Repairers	0.53	108	0,47857484	368
11-9131	Postmasters and Mail Superintendents	0.41	227	0,478562154	369
25-1064	Geography Teachers, Postsecondary	0.43	207	0,478415167	370
25-1041	Agricultural Sciences Teachers, Postsecondary	0.52	118	0,478234453	371
51-4122	Welding, Soldering, and Brazing Machine Setters, Operators, and Tenders	0.22	580	0,478132006	372
13-1131	Fundraisers	0.43	204	0,478077677	373
49-9096	Riggers	0.37	291	0,477929876	374
35-2021	Food Preparation Workers	0.16	697	0,477742456	375
25-1053	Environmental Science Teachers, Postsecondary	0.49	133	0,477689188	376
25-1043	Forestry and Conservation Science Teachers, Postsecondary	0.61	55	0,477657649	377
25-1051	Atmospheric, Earth, Marine, and Space Sciences Teachers, Postsecondary	0.6	62	0,477523649	378
43-6011	Executive Secretaries and Executive Administrative Assistants	0.19	631	0,477481901	379
13-2099	Financial Specialists, All Other	0.53	105	0,477424963	380
53-3041	Taxi Drivers and Chauffeurs	0.28	462	0,477169072	381
13-1151	Training and Development Specialists	0.19	616	0,477054684	382
53-2011	Airline Pilots, Copilots, and Flight Engineers	0.45	199	0,47635152	383
15-1131	Computer Programmers	0.35	318	0,476040418	384
29-2061	Licensed Practical and Licensed Vocational Nurses	0.11	759	0,475951707	385
27-4013	Radio Operators	0.24	517	0,475930722	386
53-2021	Air Traffic Controllers	0.25	509	0,475895572	387
51-9032	Cutting and Slicing Machine Setters, Operators, and Tenders	0.25	507	0,47585549	388
41-3031	Securities, Commodities, and Financial Services Sales Agents	0.43	209	0,475780602	389
43-4161	Human Resources Assistants, Except Payroll and Timekeeping	0.18	657	0,475757686	390

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SOC	Occupation	Green Potential Rutzer et al. (2020)	Rank	Green Skill Transferability	Rank
29-2034	Radiologic Technologists and Technicians	0.18	645	0,475703565	391
47-3011	Helpers–Brickmasons, Blockmasons, Stonemasons, and Tile and Marble Setters	0.37	285	0,475561792	392
49-9097	Signal and Track Switch Repairers	0.47	162	0,47519859	393
33-9021	Private Detectives and Investigators	0.41	231	0,474479045	394
11-9061	Funeral Service Managers	0.42	215	0,474148294	395
29-2051	Dietetic Technicians	0.18	646	0,473800691	396
43-5021	Couriers and Messengers	0.19	630	0,473771555	397
39-9041	Residential Advisors	0.2	599	0,473397203	398
19-1021	Biochemists and Biophysicists	0.54	95	0,473344011	399
43-9011	Computer Operators	0.33	357	0,473200004	400
53-6061	Passenger Attendants	0.14	731	0,472645548	401
29-1065	Pediatricians, General	0.2	590	0,472585919	402
19-1029	Biological Scientists, All Other	0.48	145	0,472364366	403
29-1126	Respiratory Therapists	0.18	644	0,472309586	404
25-1054	Physics Teachers, Postsecondary	0.51	125	0,472129615	405
25-1113	Social Work Teachers, Postsecondary	0.17	671	0,472080681	406
43-6014	Secretaries and Administrative Assistants, Except Legal, Medical, and Executive	0.18	659	0,471871543	407
25-1031	Architecture Teachers, Postsecondary	0.61	54	0,471814802	408
17-1021	Cartographers and Photogrammetrists	0.47	156	0,470929167	409
25-1032	Engineering Teachers, Postsecondary	0.72	22	0,470628258	410
53-4021	Railroad Brake, Signal and Switch Operators	0.3	407	0,470473325	411
25-1071	Health Specialties Teachers, Postsecondary	0.3	386	0,470091208	412
51-9123	Painting, Coating, and Decorating Workers	0.13	744	0,469833777	413
25-1067	Sociology Teachers, Postsecondary	0.17	670	0,469710486	414
27-1027	Set and Exhibit Designers	0.43	208	0,46965582	415
25-1042	Biological Science Teachers, Postsecondary	0.36	298	0,469412464	416
43-5041	Meter Readers, Utilities	0.49	136	0,469078487	417
53-2012	Commercial Pilots	0.39	269	0,468921593	418
51-4111	Tool and Die Makers	0.3	404	0,468886449	419
53-3022	Bus Drivers, School or Special Cliente	0.13	745	0,468785518	420
45-4021	Fallers	0.16	708	0,468764941	421
39-6011	Baggage Porters and Bellhops	0.13	740	0,468554505	422
25-1061	Anthropology and Archeology Teachers, Postsecondary	0.22	565	0,468500871	423
15-1199	Computer Occupations, All Other	0.48	143	0,468437207	424
25-4021	Librarians	0.28	439	0,468230814	425
43-9111	Statistical Assistants	0.4	249	0,467464134	426
35-9011	Dining Room and Cafeteria Attendants and Bartender Helpers	0.17	680	0,467433156	427
49-9061	Camera and Photographic Equipment Repairers	0.3	402	0,467321308	428
25-1081	Education Teachers, Postsecondary	0.19	619	0,467104381	429
25-1021	Computer Science Teachers, Postsecondary	0.31	366	0,466930194	430
51-4011	Computer-Controlled Machine Tool Operators, Metal and Plastic	0.41	236	0,466874309	431
35-3021	Combined Food Preparation and Serving Workers, Including Fast Food	0.19	628	0,466519874	432
29-2041	Emergency Medical Technicians and Paramedics	0.29	415	0,465862034	433
41-9041	Telemarketers	0.17	681	0,465785518	434
25-1192	Family and Consumer Sciences Teachers, Postsecondary	0.23	541	0,465387085	435
27-1023	Floral Designers	0.14	714	0,465321447	436
33-3012	Correctional Officers and Jailers	0.19	625	0,465035911	437
29-1063	Internists, General	0.23	545	0,464986905	438
39-7012	Travel Guides	0.25	494	0,464897187	439
25-1062	Area, Ethnic, and Cultural Studies Teachers, Postsecondary	0.1	769	0,464794698	440
51-4021	Extruding and Drawing Machine Setters, Operators, and Tenders, Metal and Plastic	0.18	663	0,464376472	441
41-9091	Door-to-Door Sales Workers, News and Street Vendors, and Related Workers	0.25	496	0,463922334	442
41-9022	Real Estate Sales Agents	0.49	135	0,463903853	443
19-4092	Forensic Science Technicians	0.43	206	0,463775697	444
35-2011	Cooks, Fast Food	0.18	651	0,463039789	445
29-2033	Nuclear Medicine Technologists	0.29	414	0,463012641	446
29-2032	Diagnostic Medical Sonographers	0.17	674	0,462911932	447
21-1093	Social and Human Service Assistants	0.12	746	0,462845295	448
31-9092	Medical Assistants	0.18	648	0,462779725	449

Table A. 2: SOC 6-digit green potential (Rutzer et al. 2020) and skill transferability scores, including rankings

SOC	Occupation	Green Potential Rutzer et al. (2020)	Rank	Green Skill Transferability	Rank
47-5031	Explosives Workers, Ordnance Handling Experts, and Blasters	0.46	172	0,462741436	450
51-9022	Grinding and Polishing Workers, Hand	0.28	459	0,462714673	451
45-3021	Hunters and Trappers	0.43	210	0,462700187	452
31-9095	Pharmacy Aides	0.17	677	0,462595316	453
33-9091	Crossing Guards and Flaggers	0.19	626	0,462380068	454
25-2032	Career/Technical Education Teachers, Secondary School	0.48	148	0,462295143	455
51-4194	Tool Grinders, Filers, and Sharpeners	0.25	503	0,46208876	456
25-1063	Economics Teachers, Postsecondary	0.39	262	0,462015578	457
51-6064	Textile Winding, Twisting, and Drawing Out Machine Setters, Operators, and Tenders	0.22	581	0,46194287	458
25-1065	Political Science Teachers, Postsecondary	0.18	640	0,461914826	459
25-1126	Philosophy and Religion Teachers, Postsecondary	0.08	782	0,461792431	460
25-1111	Criminal Justice and Law Enforcement Teachers, Postsecondary	0.34	339	0,461731847	461
51-2011	Aircraft Structure, Surfaces, Rigging, and Systems Assemblers	0.4	256	0,461689107	462
19-3091	Anthropologists and Archeologists	0.39	261	0,461466431	463
43-4151	Order Clerks	0.41	233	0,461355955	464
13-1075	Labor Relations Specialists	0.39	259	0,460930848	465
43-4051	Customer Service Representatives	0.16	706	0,460866078	466
29-2091	Orthotists and Prosthetists	0.28	444	0,460767148	467
51-7041	Sawing Machine Setters, Operators, and Tenders, Wood	0.2	613	0,460649303	468
25-1011	Business Teachers, Postsecondary	0.31	365	0,460559122	469
51-9031	Cutters and Trimmers, Hand	0.18	665	0,460156345	470
13-2051	Financial and Investment Analysts	0.51	123	0,459780682	471
25-1082	Library Science Teachers, Postsecondary	0.28	438	0,459528653	472
25-1122	Communications Teachers, Postsecondary	0.2	585	0,459517122	473
25-1125	History Teachers, Postsecondary	0.1	771	0,459376411	474
25-1112	Law Teachers, Postsecondary	0.24	514	0,459282803	475
51-2041	Structural Metal Fabricators and Fitters	0.34	349	0,459000107	476
53-4012	Locomotive Firers	0.29	432	0,458756978	477
19-2011	Astronomers	0.6	61	0,458576609	478
25-1193	Recreation and Fitness Studies Teachers, Postsecondary	0.27	467	0,458296262	479
25-2022	Middle School Teachers, Except Special and Career/Technical Education	0.29	410	0,458140913	480
51-9196	Paper Goods Machine Setters, Operators, and Tenders	0.23	560	0,458124135	481
35-2013	Cooks, Private Household	0.25	492	0,457855326	482
35-2015	Cooks, Short Order	0.14	724	0,457840612	483
53-4041	Subway and Streetcar Operators	0.17	687	0,457597583	484
25-2023	Career/Technical Education Teachers, Middle School	0.31	367	0,457361966	485
51-4121	Welders, Cutters, Solderers, and Brazers	0.28	453	0,457120298	486
39-1012	Slot Supervisors	0.24	522	0,457003654	487
47-5011	Derrick Operators, Oil and Gas	0.37	288	0,456716496	488
25-2031	Secondary School Teachers, Except Special and Career/Technical Education	0.2	587	0,456612903	489
23-2011	Paralegals and Legal Assistants	0.23	540	0,45636008	490
53-2031	Flight Attendants	0.04	797	0,456264514	491
23-1011	Lawyers	0.41	228	0,456244156	492
51-9141	Semiconductor Processing Technicians	0.16	710	0,456163013	493
25-1124	Foreign Language and Literature Teachers, Postsecondary	0.07	788	0,456044833	494
25-9031	Instructional Coordinators	0.35	320	0,45591849	495
25-2011	Preschool Teachers, Except Special Education	0.08	783	0,455770884	496
25-1066	Psychology Teachers, Postsecondary	0.17	669	0,455738396	497
25-1022	Mathematical Science Teachers, Postsecondary	0.28	437	0,4555824	498
25-9011	Audio-Visual and Multimedia Collections Specialists	0.3	387	0,455416333	499
45-4023	Log Graders and Scalers	0.37	282	0,455392805	500
25-3021	Self-Enrichment Teachers	0.14	713	0,455213656	501
25-3011	Adult Basic Education, Adult Secondary Education, and English as a Second Language Instructors	0.16	692	0,454891742	502
11-9039	Education Administrators, All Other	-	-	0,454690605	503
35-3022	Counter Attendants, Cafeteria, Food Concession, and Coffee Shop	0.17	679	0,454634243	504
21-1023	Mental Health and Substance Abuse Social Workers	0.11	755	0,454513003	505
41-2031	Retail Salespersons	0.23	549	0,454479097	506
43-5081	Stock Clerks and Order Fillers	0.17	683	0,454449718	507

Table A. 2: SOC 6-digit green potential (Rutzer et al. 2020) and skill transferability scores, including rankings

SOC	Occupation	Green Potential Rutzer et al. (2020)	Rank	Green Skill Transferability	Rank
47-2221	Structural Iron and Steel Workers	0.39	266	0,454282009	508
51-4035	Milling and Planing Machine Setters, Operators, and Tenders, Metal and Plastic	0.22	579	0,4538909	509
13-1031	Claims Adjusters, Examiners, and Investigators	0.4	240	0,453597942	510
51-4034	Lathe and Turning Machine Tool Setters, Operators, and Tenders, Metal and Plastic	0.2	608	0,45355869	511
33-3021	Detectives and Criminal Investigators	0.37	279	0,453038635	512
21-1015	Rehabilitation Counselors	0.13	733	0,452725086	513
35-9031	Hosts and Hostesses, Restaurant, Lounge, and Coffee Shop	0.18	652	0,452708673	514
51-7011	Cabinetmakers and Bench Carpenters	0.4	257	0,452636531	515
33-9093	Transportation Security Screeners	0.14	723	0,452512008	516
29-2052	Pharmacy Technicians	0.13	736	0,451970653	517
23-1021	Administrative Law Judges, Adjudicators, and Hearing Officers	0.31	364	0,451712328	518
15-1121	Computer Systems Analysts	0.37	274	0,451631239	519
39-2011	Animal Trainers	0.35	324	0,451192917	520
25-2021	Elementary School Teachers, Except Special Education	0.18	641	0,451177719	521
43-6013	Medical Secretaries and Administrative Assistants	0.04	796	0,45053924	522
25-1072	Nursing Instructors and Teachers, Postsecondary	0.19	618	0,450306668	523
51-9122	Painters, Transportation Equipment	0.28	460	0,450196827	524
51-4192	Layout Workers, Metal and Plastic	0.37	293	0,450120668	525
43-9071	Office Machine Operators, Except Computer	0.18	660	0,450022168	526
21-1012	Educational, Guidance, and Career Counselors and Advisors	0.22	563	0,449733388	527
15-2011	Actuaries	0.52	112	0,449645699	528
35-2014	Cooks, Restaurant	0.2	595	0,449409216	529
29-1064	Obstetricians and Gynecologists	0.2	589	0,449234192	530
19-3093	Historians	0.3	385	0,44901034	531
15-1122	Information Security Analysts	0.45	180	0,448846153	532
25-1121	Art, Drama, and Music Teachers, Postsecondary	0	798	0,448678279	533
13-2052	Personal Financial Advisors	0.35	317	0,448667473	534
43-4181	Reservation and Transportation Ticket Agents and Travel Clerks	0.2	604	0,448493343	535
39-9011	Childcare Workers	0.14	726	0,448459309	536
31-1014	Nursing Assistants	0.07	790	0,44838338	537
51-4031	Cutting, Punching, and Press Machine Setters, Operators, and Tenders, Metal and Plastic	0.27	479	0,448083629	538
43-4031	Court, Municipal, and License Clerks	0.22	578	0,447658015	539
25-2053	Special Education Teachers, Middle School	0.24	515	0,447644021	540
25-2012	Kindergarten Teachers, Except Special Education	0.16	691	0,447284588	541
51-4033	Grinding, Lapping, Polishing, and Buffing Machine Tool Setters, Operators, and Tenders, Metal and Plastic	0.27	480	0,447043502	542
31-2012	Occupational Therapy Aides	0.11	762	0,446823681	543
29-2011	Medical and Clinical Laboratory Technologists	0.31	371	0,446710791	544
43-4111	Interviewers, Except Eligibility and Loan	0.12	752	0,446013682	545
25-2051	Special Education Teachers, Preschool	0.22	566	0,446013072	546
43-4071	File Clerks	0.18	656	0,445649436	547
51-3011	Bakers	0.19	634	0,445146102	548
25-2054	Special Education Teachers, Secondary School	0.22	567	0,445121947	549
25-2052	Special Education Teachers, Kindergarten and Elementary School	0.17	672	0,444739657	550
25-9041	Teacher Assistants	0.1	772	0,444588433	551
49-3021	Automotive Body and Related Repairers	0.31	374	0,443890176	552
39-4031	Morticians, Undertakers, and Funeral Arrangers	0.3	395	0,443743705	553
47-2161	Plasterers and Stucco Masons	0.45	189	0,443455447	554
23-1022	Arbitrators, Mediators, and Conciliators	0.25	486	0,443409302	555
25-4031	Library Technicians	0.11	756	0,442495444	556
51-6031	Sewing Machine Operators	0.13	742	0,442105956	557
21-1021	Child, Family, and School Social Workers	0.14	712	0,441975887	558
43-4081	Hotel, Motel, and Resort Desk Clerks	0.27	474	0,441970825	559
21-1022	Healthcare Social Workers	0.04	795	0,441616137	560
49-9045	Refractory Materials Repairers, Except Brickmasons	0.28	451	0,441422987	561
51-6091	Extruding and Forming Machine Setters, Operators, and Tenders, Synthetic and Glass Fibers	0.13	743	0,441277774	562
51-9082	Medical Appliance Technicians	0.36	311	0,440627691	563
27-1011	Art Directors	0.3	388	0,440622294	564

Table A. 2: SOC 6-digit green potential (Rutzer et al. 2020) and skill transferability scores, including rankings

SOC	Occupation	Green Potential Rutzer et al. (2020)	Rank	Green Skill Transferability	Rank
43-4061	Eligibility Interviewers, Government Programs	0.12	751	0,440315727	565
47-4091	Segment Pavers	0.45	192	0,440273699	566
27-3021	Broadcast News Analyst	0.33	353	0,440092241	567
25-1123	English Language and Literature Teachers, Postsecondary	0.1	770	0,439934241	568
39-1011	Gaming Supervisors	0.27	472	0,439651126	569
47-3012	Helpers–Carpenters	0.46	170	0,439500762	570
43-9051	Mail Clerks and Mail Machine Operators, Except Postal Service	0.19	633	0,439430681	571
47-5061	Roof Bolters, Mining	0.36	306	0,438820216	572
23-2093	Title Examiners, Abstractors, and Searchers	0.27	466	0,438732585	573
43-5053	Postal Service Mail Sorters, Processors, and Processing Machine Operators	0.12	753	0,438396204	574
51-3021	Butchers and Meat Cutters	0.29	426	0,438324625	575
41-3011	Advertising Sales Agents	0.29	418	0,438168745	576
19-3031	Clinical, Counseling, and School Psychologists	0.13	732	0,437780369	577
31-1013	Psychiatric Aides	0.11	761	0,437663478	578
31-9097	Phlebotomists	0.19	624	0,437469989	579
31-9099	Healthcare Support Workers, All Other	0.16	696	0,43743356	580
31-2021	Physical Therapist Assistants	0.2	594	0,437400575	581
51-4012	Computer Numerically Controlled Machine Tool Programmers, Metal and Plastic	0.42	223	0,437377024	582
43-4011	Brokerage Clerks	0.23	551	0,436816418	583
43-4121	Library Assistants, Clerical	0.17	682	0,436238293	584
47-2021	Brickmasons and Blockmasons	0.51	128	0,436219901	585
29-1141	Registered Nurses	0.14	719	0,436089474	586
27-2023	Umpires, Referees, and Other Sports Officials	0.25	488	0,435873471	587
45-2021	Animal Breeders	0.39	265	0,435773593	588
25-1191	Graduate Teaching Assistants	0.2	586	0,435683049	589
47-2141	Painters, Construction and Maintenance	0.49	138	0,435626664	590
51-3022	Meat, Poultry, and Fish Cutters and Trimmers	0.25	501	0,435591664	591
21-2021	Directors, Religious Activities and Education	0.13	734	0,435553923	592
29-1171	Nurse Practitioners	0.14	720	0,435070207	593
27-1026	Merchandise Displayers and Window Trimmers	0.22	568	0,434855305	594
49-9064	Watch and Clock Repairers	0.29	424	0,434499231	595
21-1011	Substance Abuse and Behavioral Disorder Counselors	0.19	617	0,434487449	596
31-2022	Physical Therapist Aides	0.1	775	0,434275541	597
43-2011	Switchboard Operators, Including Answering Service	0.08	786	0,433864647	598
51-2091	Fiberglass Laminators and Fabricators	0.36	308	0,433741828	599
29-2053	Psychiatric Technicians	0.14	721	0,43325353	600
41-3021	Insurance Sales Agents	0.29	419	0,432852542	601
47-4031	Fence Erectors	0.37	287	0,432510371	602
29-1124	Radiation Therapists	0.14	717	0,432061661	603
51-9151	Photographic Process Workers and Processing Machine Operators	0.24	528	0,431710546	604
21-2011	Clergy	0.24	512	0,431140319	605
39-6012	Concierges	0.16	703	0,430551958	606
47-2042	Floor Layers, Except Carpet, Wood, and Hard Tiles	0.43	211	0,429649305	607
35-3031	Waiters and Waitresses	0.13	738	0,429213932	608
47-4061	Rail-Track Laying and Maintenance Equipment Operators	0.48	150	0,428945947	609
29-1123	Physical Therapists	0.17	673	0,428517047	610
51-7031	Model Makers, Wood	0.33	360	0,42770871	611
51-5112	Printing Press Operators	0.28	454	0,427642568	612
41-2011	Cashiers	0.19	629	0,427577198	613
15-2021	Mathematicians	0.55	90	0,427558034	614
43-6012	Legal Secretaries and Administrative Assistants	0.17	684	0,427552396	615
27-4011	Audio and Video Technicians	0.2	588	0,42740569	616
43-3051	Payroll and Timekeeping Clerks	0.2	603	0,427181188	617
29-1051	Pharmacists	0.25	490	0,427119213	618
41-3041	Travel Agents	0.3	397	0,426626528	619
51-4071	Foundry Mold and Coremakers	0.16	709	0,42641154	620
27-4021	Photographers	0.19	621	0,426195261	621
39-9031	Exercise Trainers and Group Fitness Instructors	0.1	780	0,42595603	622
51-4062	Patternmakers, Metal and Plastic	0.2	609	0,425767443	623
43-5051	Postal Service Clerks	0.29	421	0,425499861	624
21-1013	Marriage and Family Therapists	0.1	766	0,425347394	625

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SOC	Occupation	Green Potential Rutzer et al. (2020)	Rank	Green Skill Transferability	Rank
27-4012	Broadcast Technicians	0.36	299	0,425158287	626
51-7021	Furniture Finishers	0.28	457	0,425140136	627
27-1022	Fashion Designers	0.37	277	0,424692067	628
51-3023	Slaughterers and Meat Packers	0.2	606	0,424488149	629
15-1141	Database Administrators	0.34	336	0,423820558	630
45-2041	Graders and Sorters, Agricultural Products	0.18	661	0,423737207	631
27-2022	Coaches and Scouts	0.29	412	0,423725114	632
47-2121	Glaziers	0.45	187	0,423526147	633
31-1011	Home Health Aides	0.17	676	0,423522081	634
23-1023	Judges, Magistrate Judges, and Magistrates	0.27	465	0,423089871	635
29-1061	Anesthesiologists	0.24	518	0,422110423	636
51-9195	Molders, Shapers, and Casters, Except Metal and Plastic	0.3	406	0,421943353	637
29-1067	Surgeons	0.24	519	0,421915839	638
49-9011	Mechanical Door Repairers	0.51	130	0,421581737	639
13-2072	Loan Officers	0.28	436	0,421500833	640
29-2031	Cardiovascular Technologists and Technicians	0.08	785	0,421220631	641
29-2071	Medical Records and Health Information Technicians	0.11	760	0,42052278	642
21-1092	Probation Officers and Correctional Treatment Specialists	0.16	689	0,420517892	643
31-2011	Occupational Therapy Assistants	0.2	593	0,420019492	644
29-1066	Psychiatrists	0.13	735	0,418891525	645
43-4021	Correspondence Clerks	0.23	552	0,418718205	646
29-1122	Occupational Therapists	0.2	591	0,418508418	647
29-9092	Genetic Counselors	0.17	675	0,417634168	648
31-9091	Dental Assistants	0.12	749	0,417066922	649
49-3022	Automotive Glass Installers and Repairers	0.25	500	0,416414267	650
27-1024	Graphic Designers	0.18	642	0,41604464	651
13-2081	Tax Examiners and Collectors, and Revenue Agents	0.3	383	0,416032644	652
51-7032	Patternmakers, Wood	0.28	458	0,41592441	653
29-1071	Physician Assistants	0.22	570	0,414887455	654
51-4032	Drilling and Boring Machine Tool Setters, Operators, and Tenders, Metal and Plastic	0.24	525	0,414487108	655
29-1021	Dentists, General	0.37	278	0,414176301	656
43-3031	Bookkeeping, Accounting, and Auditing Clerks	0.22	577	0,41407914	657
27-3022	Reporters and Correspondents	0.31	369	0,413883076	658
39-3021	Motion Picture Projectionists	0.16	699	0,413642873	659
23-1012	Judicial Law Clerks	0.23	539	0,413501447	660
51-5113	Print Binding and Finishing Workers	0.27	481	0,412012566	661
43-3011	Bill and Account Collectors	0.23	550	0,411559113	662
51-6021	Pressers, Textile, Garment, and Related Materials	0.18	664	0,411558497	663
29-1181	Audiologists	0.22	571	0,410562453	664
43-3021	Billing and Posting Clerks	0.2	602	0,40989088	665
27-2012	Producers and Directors	0.31	368	0,409008864	666
43-2021	Telephone Operators	0.14	727	0,408791894	667
51-6093	Upholsterers	0.29	429	0,408492917	668
49-3093	Tire Repairers and Changers	0.41	235	0,408118717	669
39-3031	Ushers, Lobby Attendants, and Ticket Takers	0.18	654	0,407962411	670
47-2171	Reinforcing Iron and Rebar Workers	0.41	234	0,4076056	671
13-2041	Credit Analysts	0.36	297	0,407473446	672
29-1161	Nurse Midwives	0.16	694	0,406649491	673
25-2059	Special Education Teachers, All Other	0.23	543	0,406575275	674
43-9021	Data Entry Keyers	0.24	524	0,405909177	675
21-1014	Mental Health Counselors	0.1	767	0,40589317	676
29-1069	Physicians and Surgeons, All Other	0.31	370	0,405712598	677
27-3043	Writers and Authors	0.25	489	0,405371559	678
27-1013	Fine Artists, Including Painters, Sculptors, and Illustrators	0.25	487	0,40444498	679
39-4021	Funeral Attendants	0.22	576	0,403898992	680
25-3099	Teachers and Instructors, All Other	0.23	544	0,403055177	681
11-9071	Gambling Managers	0.37	271	0,402638526	682
39-3092	Costume Attendants	0.16	700	0,402476622	683
29-1127	Speech-Language Pathologists	0.06	792	0,402410338	684
39-4011	Embalmers	0.23	547	0,402133481	685
15-1152	Computer Network Support Specialists	0.37	275	0,401994127	686
29-9091	Athletic Trainers	0.25	491	0,401473358	687
51-6041	Shoe and Leather Workers and Repairers	0.17	686	0,40100339	688
51-6042	Shoe Machine Operators and Tenders	0.25	504	0,40088814	689

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SOC	Occupation	Green Potential Rutzer et al. (2020)	Rank	Green Skill Transferability	Rank
43-3071	Tellers	0.16	705	0,40017166	690
47-2142	Paperhangers	0.45	188	0,398721914	691
29-2099	Health Technologists and Technicians, All Other	0.19	623	0,398138546	692
47-2081	Drywall and Ceiling Tile Installers	0.45	186	0,397794954	693
51-5111	Prepress Technicians and Workers	0.2	611	0,397678625	694
49-3091	Bicycle Repairers	0.49	141	0,397469347	695
29-1128	Exercise Physiologists	0.33	355	0,397024552	696
51-9071	Jewelers and Precious Stone and Metal Workers	0.27	482	0,396962738	697
15-1134	Web Developers	0.3	384	0,396844007	698
13-2053	Insurance Underwriters	0.18	638	0,396459092	699
27-3011	Broadcast Announcers and Radio Disc Jockeys	0.18	643	0,396131619	700
43-3041	Gambling Cage Workers	0.18	655	0,395445977	701
51-6052	Tailors, Dressmakers, and Custom Sewers	0.12	754	0,395102206	702
43-5052	Postal Service Mail Carriers	0.18	658	0,394759166	703
51-9083	Ophthalmic Laboratory Technicians	0.22	583	0,3942295	704
29-1199	Health Diagnosing and Treating Practitioners, All Other	0.16	695	0,393528136	705
31-9094	Medical Transcriptionists	0.05	794	0,392935455	706
29-2092	Hearing Aid Specialists	0.22	572	0,392441341	707
47-2053	Terrazzo Workers and Finishers	0.42	218	0,392422443	708
27-2021	Athletes and Sports Competitors	0.34	340	0,392267141	709
47-2082	Tapers	0.37	283	0,392085505	710
49-9094	Locksmiths and Safe Repairers	0.57	86	0,391987784	711
43-9041	Insurance Claims and Policy Processing Clerks	0.19	632	0,391802782	712
49-9063	Musical Instrument Repairers and Tuners	0.34	347	0,390448363	713
13-2082	Tax Preparers	0.29	409	0,390367616	714
43-4141	New Accounts Clerks	0.24	523	0,390262468	715
47-2051	Cement Masons and Concrete Finishers	0.46	169	0,389940696	716
27-4031	Camera Operators, Television, Video, and Film	0.14	716	0,389333519	717
27-3041	Editors	0.3	389	0,388961273	718
49-9093	Fabric Menders, Except Garment	0.31	375	0,388684723	719
27-3012	Public Address System and Other Announcers	0.16	693	0,388210561	720
13-2071	Credit Counselors	0.28	435	0,388105672	721
35-3011	Bartenders	0.25	493	0,387768196	722
47-2022	Stonemasons	0.54	99	0,387454103	723
51-6092	Fabric and Apparel Patternmakers	0.25	505	0,38698555	724
13-1032	Insurance Appraisers, Auto Damage	0.35	316	0,386972203	725
29-1125	Recreational Therapists	0.07	789	0,386135908	726
29-1023	Orthodontists	0.29	413	0,385717357	727
29-1151	Nurse Anesthetists	0.24	520	0,385244338	728
41-2012	Gambling Change Persons and Booth Cashiers	0.2	600	0,383068299	729
29-1041	Optometrists	0.34	342	0,382956111	730
51-9081	Dental Laboratory Technicians	0.22	582	0,381746245	731
39-5011	Barbers	0.12	750	0,378444481	732
51-2093	Timing Device Assemblers and Adjusters	0.31	377	0,378368398	733
39-5012	Hairdressers, Hairstylists, and Cosmetologists	0.29	417	0,378264611	734
29-2021	Dental Hygienists	0.11	758	0,37655877	735
43-9022	Word Processors and Typists	0.13	741	0,375923406	736
47-2043	Floor Sanders and Finishers	0.34	345	0,375682866	737
29-1011	Chiropractors	0.28	440	0,373124407	738
47-2044	Tile and Stone Setters	0.36	303	0,372645071	739
39-5094	Skincare Specialists	0.16	702	0,372541671	740
29-2081	Opticians, Dispensing	0.29	416	0,371741367	741
27-1014	Special Effects Artists and Animators	0.24	516	0,370936145	742
43-4041	Credit Authorizers, Checkers, and Clerks	0.3	398	0,370009621	743
47-5051	Rock Splitters, Quarry	0.23	553	0,368745622	744
39-5092	Manicurists and Pedicurists	0.14	725	0,366689989	745
43-4131	Loan Interviewers and Clerks	0.28	448	0,366660364	746
33-3011	Bailiffs	0.18	650	0,3665373	747
29-9099	Healthcare Practitioners and Technical Workers, All Other	0.22	573	0,363587033	748
29-2057	Ophthalmic Medical Technicians	0.14	722	0,363356511	749
29-2035	Magnetic Resonance Imaging Technologists	-	-	0,362595777	750
41-9012	Models	0.16	704	0,361671352	751
27-4014	Sound Engineering Technicians	0.33	354	0,361044195	752
43-9031	Desktop Publishers	0.3	399	0,360869385	753
27-3091	Interpreters and Translators	0.1	773	0,357521426	754
51-9197	Tire Builders	0.18	668	0,355934909	755

Table A. 2: SOC 6-digit green potential (Rutzer et al. 2020) and skill transferability scores, including rankings

SOC	Occupation	Green Potential Rutzer et al. (2020)	Rank	Green Skill Transferability	Rank
31-9011	Massage Therapists	0.12	748	0,35300686	756
47-2041	Carpet Installers	0.35	326	0,349709638	757
39-5093	Shampooers	0.16	701	0,347778664	758
51-6051	Sewers, Hand	0.11	765	0,347488531	759
51-9194	Etchers and Engravers	0.18	667	0,345453322	760
19-3039	Psychologists, All Other	0.16	688	0,344815126	761
39-3012	Gambling and Sports Book Writers and Runners	0.13	739	0,343064162	762
39-5091	Makeup Artists, Theatrical and Performance	0.3	396	0,341225719	763
29-1081	Podiatrists	0.23	546	0,340913692	764
39-3011	Gambling Dealers	0.18	653	0,340464546	765
29-1022	Oral and Maxillofacial Surgeons	0.28	441	0,339728373	766
29-1024	Prosthodontists	0.28	442	0,327294739	767
43-9081	Proofreaders and Copy Markers	0.14	729	0,325582025	768
27-2041	Music Directors and Composers	0.14	715	0,319852907	769
27-4032	Film and Video Editors	0.22	569	0,314312569	770
27-2011	Actors	0.06	791	0,311698906	771
23-2091	Court Reporters	0.16	690	0,310339979	772
27-2032	Choreographers	0.11	757	0,298364628	773
27-2042	Musicians and Singers	0.12	747	0,287493938	774
27-2031	Dancers	0.08	784	0,262506476	775
17-3019	Drafters, All Other	0.48	144	-	-
47-3019	Helpers, Construction Trades, All Other	0.4	251	-	-
37-3019	Grounds Maintenance Workers, All Other	0.36	301	-	-
27-1029	Designers, All Other	0.35	322	-	-
49-9069	Precision Instrument and Equipment Repairers, All Other	0.34	348	-	-
47-5049	Underground Mining Machine Operators, All Other	0.33	359	-	-
51-4199	Metal Workers and Plastic Workers, All Other	0.31	378	-	-
29-1029	Dentists, All Other Specialists	0.3	390	-	-
45-4029	Logging Workers, All Other	0.3	400	-	-
27-1019	Artists and Related Workers, All Other	0.29	411	-	-
51-2099	Assemblers and Fabricators, All Other	0.29	425	-	-
45-2099	Agricultural Workers, All Other	0.28	450	-	-
41-9099	Sales and Related Workers, All Other	0.25	497	-	-
25-1069	Social Sciences Teachers, Postsecondary, All Other	0.24	513	-	-
15-2099	Mathematical Science Occupations, All Other	0.23	537	-	-
25-1199	Postsecondary Teachers, All Other	0.23	542	-	-
51-6099	Textile, Apparel, and Furnishings Workers, All Other	0.23	557	-	-
23-2099	Legal Support Workers, All Other	0.22	564	-	-
37-2019	Building Cleaning Workers, All Other	0.2	598	-	-
51-3099	Food Processing Workers, All Other	0.2	607	-	-
35-2019	Cooks, All Other	0.19	627	-	-
21-1099	Community and Social Service Specialists, All Other	0.18	639	-	-
39-3019	Gambling Service Workers, All Other	0.16	698	-	-
21-1019	Counselors, All Other	0.14	711	-	-
29-1129	Therapists, All Other	0.14	718	-	-
39-3099	Entertainment Attendants and Related Workers, All Other	0.11	763	-	-
21-1029	Social Workers, All Other	0.1	768	-	-
27-3099	Media and Communication Workers, All Other	0.1	774	-	-

A.2.2. Green Potential ISCO by Lobsiger and Rutzer (2021)

Table A. 3: ISCO 3-digit green potential (Lobsiger and Rutzer 2021) and skill transferability scores, including rankings

ISCO	Occupation	Green Potential Lobsiger and Rutzer (2021)	Rank	Green Skill Transferability	Rank
213	Life science professionals	0.59	13	0,632783346	1
961	Refuse workers	0.27	77	0,598601627	2
313	Process control technicians	0.49	25	0,58696896	3
611	Market gardeners and crop growers	0.33	61	0,58360516	4
311	Physical and engineering science technicians	0.58	14	0,579149853	5

Table A. 3: ISCO 3-digit green potential (Lobsiger and Rutzer 2021) and skill transferability scores, including rankings

ISCO	Occupation	Green Potential Lobsiger and Rutzer (2021)	Rank	Green Skill Transferability	Rank
314	Life science technicians and related associate professionals	0.68	10	0,578727492	6
214	Engineering professionals (excluding electrotechnology)	1	1	0,57230453	7
621	Forestry and related workers	0.34	57	0,559134215	8
211	Physical and earth science professionals	0.76	2	0,558881004	9
312	Mining, manufacturing and construction supervisors	0.75	5	0,553811878	10
613	Mixed crop and animal producers	0.35	54	0,546555259	11
911	Domestic, hotel and office cleaners and helpers	0.1	154	0,545994764	12
132	Manufacturing, mining, construction, and distribution managers	0.72	7	0,544424542	13
631	Subsistence crop farmers	0.15	130	0,542482663	14
131	Production managers in agriculture, forestry and fisheries	0.76	3	0,539321683	15
216	Architects, planners, surveyors and designers	0.71	8	0,539096928	16
932	Manufacturing labourers	0.15	131	0,537231636	17
811	Mining and mineral processing plant operators	0.39	46	0,536590111	18
612	Animal producers	0.43	40	0,535968297	19
633	Subsistence mixed crop and livestock farmers	0.19	114	0,535461578	20
931	Mining and construction labourers	0.41	42	0,530556462	21
324	Veterinary technicians and assistants	0.13	144	0,528298871	22
632	Subsistence livestock farmers	0.23	90	0,528211402	23
834	Mobile plant operators	0.27	80	0,526709332	24
818	Other stationary plant and machine operators	0.18	120	0,526627636	25
215	Electrotechnology engineers	0.73	6	0,522059012	26
921	Agricultural, forestry and fishery labourers	0.22	97	0,518498111	27
143	Other services managers	0.53	19	0,517871933	28
515	Building and housekeeping supervisors	0.1	155	0,515960396	29
432	Material-recording and transport clerks	0.16	127	0,515606151	30
121	Business services and administration managers	0.43	41	0,515315446	31
634	Subsistence fishers, hunters, trappers and gatherers	0.33	62	0,514671496	32
111	Legislators and senior officials	0.6	12	0,514255087	33
142	Retail and wholesale trade managers	0.57	15	0,511729279	34
723	Machinery mechanics and repairers	0.46	29	0,510908683	35
812	Metal processing and finishing plant operators	0.19	115	0,509948265	36
112	Managing directors and chief executives	0.68	9	0,509840361	37
821	Assemblers	0.27	78	0,509367451	38
752	Wood treaters, cabinet-makers and related trades workers	0.31	67	0,509121834	39
242	Administration professionals	0.53	17	0,508971218	40
741	Electrical equipment installers and repairers	0.51	20	0,50886308	41
122	Sales, marketing and development managers	0.49	23	0,507539356	42
622	Fishery workers, hunters and trappers	0.43	38	0,502573764	43
315	Ship and aircraft controllers and technicians	0.33	60	0,502392094	44
141	Hotel and restaurant managers	0.28	73	0,500497108	45
817	Wood processing and papermaking plant operators	0.15	134	0,498723054	46
742	Electronics and telecommunications installers and repairers	0.48	27	0,4983543	47
835	Ships' deck crews and related workers	0.31	65	0,497164162	48
813	Chemical and photographic products plant and machine operators	0.35	53	0,496213801	49
712	Building finishers and related trades workers	0.44	35	0,495570076	50
134	Professional services managers	0.3	69	0,495307184	51
816	Food and related products machine operators	0.18	117	0,494315682	52
512	Cooks	0.17	125	0,493553298	53
541	Protective services workers	0.2	108	0,492493518	54
321	Medical and pharmaceutical technicians	0.13	146	0,4917469	55
522	Shop salespersons	0.24	87	0,487782365	56
941	Food preparation assistants	0.16	128	0,486546063	57
243	Sales, marketing and public relations professionals	0.36	52	0,486010466	58
225	Veterinarians	0.27	75	0,48596666	59
232	Vocational education teachers	0.28	72	0,484930067	60
713	Painters, building structure cleaners and related trades workers	0.32	63	0,484925787	61
833	Heavy truck and bus drivers	0.22	98	0,483099572	62
912	Vehicle, window, laundry and other hand cleaning workers	0.14	138	0,479223988	63

Table A. 3: ISCO 3-digit green potential (Lobsiger and Rutzer 2021) and skill transferability scores, including rankings

ISCO	Occupation	Green Potential Lobsiger and Rutzer (2021)	Rank	Green Skill Transferability	Rank
133	Information and communications technology service managers	0.43	37	0,478129003	64
814	Rubber, plastic and paper products machine operators	0.2	109	0,477859715	65
212	Mathematicians, actuaries and statisticians	0.49	24	0,477675891	66
933	Transport and storage labourers	0.29	70	0,477468929	67
332	Sales and purchasing agents and brokers	0.43	36	0,475760323	68
832	Car, van and motorcycle drivers	0.18	118	0,47352772	69
511	Travel attendants, conductors and guides	0.11	150	0,469562533	70
962	Other elementary workers	0.06	165	0,469258956	71
334	Administrative and specialized secretaries	0.01	171	0,464894826	72
521	Street and market salespersons	0.21	103	0,464725928	73
532	Personal care workers in health services	0	172	0,464391576	74
335	Regulatory government associate professionals	0.25	83	0,462786655	75
754	Other craft and related workers	0.48	28	0,46004082	76
325	Other health associate professionals	0.1	156	0,459181231	77
711	Building frame and related trades workers	0.45	32	0,454361484	78
351	Information and communications technology operations and user support technicians	0.27	79	0,454158128	79
722	Blacksmiths, toolmakers and related trades workers	0.31	66	0,449425139	80
241	Finance professionals	0.34	58	0,448773025	81
224	Paramedical practitioners	0.14	141	0,448197044	82
815	Textile, fur and leather products machine operators	0.16	129	0,445334479	83
251	Software and applications developers and analysts	0.41	44	0,443786635	84
352	Telecommunications and broadcasting technicians	0.3	68	0,440952307	85
952	Street vendors (excluding food)	0.21	102	0,437460226	86
721	Sheet and structural metal workers, moulders and welders, and related workers	0.34	59	0,435159	87
263	Social and religious professionals	0.09	159	0,432302189	88
252	Database and network professionals	0.35	56	0,430956513	89
343	Artistic, cultural and culinary associate professionals	0.4	45	0,428634388	90
341	Legal, social and religious associate professionals	0.04	168	0,427811118	91
323	Traditional and complementary medicine associate professionals	0.11	152	0,427271714	92
333	Business services agents	0.44	33	0,427030238	93
262	Librarians, archivists and curators	0.24	88	0,426821053	94
751	Food processing and related trades workers	0.21	99	0,423557849	95
221	Medical doctors	0.23	95	0,422755843	96
831	Locomotive engine drivers and related workers	0.17	123	0,421665324	97
226	Other health professionals	0.18	116	0,420030408	98
524	Other sales workers	0.18	119	0,418506872	99
231	University and higher education teachers	0.23	89	0,417724531	100
223	Traditional and complementary medicine professionals	0.2	111	0,41696425	101
322	Nursing and midwifery associate professionals	0.02	170	0,41678617	102
331	Financial and mathematical associate professionals	0.24	85	0,415398632	103
951	Street and related service workers	0.21	101	0,414256395	104
233	Secondary education teachers	0.12	147	0,413463842	105
441	Other clerical support workers	0.09	158	0,412812628	106
431	Numerical clerks	0.15	137	0,411260203	107
516	Other personal services workers	0.12	149	0,410865219	108
342	Sports and fitness workers	0.15	135	0,409962973	109
531	Child care workers and teachers' aides	0.04	166	0,40972476	110
513	Waiters and bartenders	0.18	121	0,409590906	111
222	Nursing and midwifery professionals	0.15	136	0,389580262	112
234	Primary school and early childhood teachers	0.08	160	0,388092873	113
422	Client information workers	0.07	163	0,386708589	114
731	Handicraft workers	0.44	34	0,385521428	115
264	Authors, journalists and linguists	0.14	142	0,384836302	116
412	Secretaries (general)	0.07	162	0,384719598	117
235	Other teaching professionals	0.12	148	0,383533126	118
261	Legal professionals	0.25	82	0,37743147	119
753	Garment and related trades workers	0.15	133	0,375443503	120
411	General office clerks	0.23	92	0,372202682	121
732	Printing trades workers	0.19	113	0,35848006	122
523	Cashiers and ticket clerks	0.09	157	0,357076119	123
514	Hairdressers, beauticians and related workers	0.17	124	0,356606702	124
421	Tellers, money collectors and related clerks	0.04	167	0,342199749	125
413	Keyboard operators	0.06	164	0,333750936	126

Table A. 3: ISCO 3-digit green potential (Lobsiger and Rutzer 2021) and skill transferability scores, including rankings

ISCO	Occupation	Green Potential Lobsiger and Rutzer (2021)	Rank	Green Skill Transferability	Rank
265	Creative and performing artists	0.15	132	0,319239477	127
110	Chief executives, senior officials and legislators, nos	0.65	11	-	-
100	Managers, nos	0.53	18	-	-
220	Health professionals, nos	0.2	110	-	-
620	Market-oriented skilled forestry, fishery and hunting workers, nos	0.41	43	-	-
820	Assemblers, nos	0.24	84	-	-
830	Drivers and mobile plant operators, nos	0.23	91	-	-
730	Handicraft and printing workers, nos	0.27	76	-	-
750	Food processing, wood working, garment and other craft and related trades workers, nos	0.24	86	-	-
210	Science and engineering professionals, nos	0.75	4	-	-
200	Professionals, nos	0.37	49	-	-
120	Administrative and commercial managers, nos	0.48	26	-	-
130	Production and specialized services managers, nos	0.54	16	-	-
320	Health associate professionals, nos	0.13	143	-	-
140	Hospitality, retail and other services managers, nos	0.46	30	-	-
930	Labourers in mining, construction, manufacturing and transport, nos	0.27	81	-	-
610	Market-oriented skilled agricultural workers, nos	0.39	48	-	-
600	Skilled agricultural, forestry and fishery workers, nos	0.36	51	-	-
250	Information and communications technology professionals, nos	0.37	50	-	-
720	Metal, machinery and related trades workers, nos	0.39	47	-	-
900	Elementary occupations, nos	0.21	105	-	-
910	Cleaners and helpers, nos	0.14	140	-	-
710	Building and related trades workers, excluding electricians, nos	0.45	31	-	-
700	Craft and related trades workers, nos	0.35	55	-	-
950	Street and related sales and service workers, nos	0.21	100	-	-
630	Subsistence farmers, fishers, hunters and gatherers, nos	0.23	93	-	-
340	Legal, social, cultural and related associate professionals, nos	0.2	106	-	-
330	Business and administration associate professionals, nos	0.28	74	-	-
400	Clerical support workers, nos	0.11	151	-	-
410	General and keyboard clerks, nos	0.1	153	-	-
800	Plant and machine operators and assemblers, nos	0.23	94	-	-
810	Stationary plant and machine operators, nos	0.22	96	-	-
260	Legal, social and cultural professionals, nos	0.19	112	-	-
960	Refuse workers and other elementary workers, nos	0.21	104	-	-
500	Service and sales workers, nos	0.17	126	-	-
510	Personal service workers, nos	0.14	139	-	-
530	Personal care workers, nos	0.02	169	-	-
230	Teaching professionals, nos	0.13	145	-	-
350	Information and communications technicians, nos	0.29	71	-	-
520	Sales workers, nos	0.2	107	-	-
240	Business and administration professionals, nos	0.43	39	-	-
430	Numerical and material recording clerks, nos	0.17	122	-	-
740	Electrical and electronic trades workers, nos	0.5	21	-	-
420	Customer services clerks, nos	0.08	161	-	-
310	Science and engineering associate professionals, nos	0.5	22	-	-
300	Technicians and associate professionals, nos	0.32	64	-	-

A.3. Validation and Robustness

A.3.1. Alternative aggregation thresholds

Table A. 4: Aggregated Cosine similarity scores by task and occupation - no similarity threshold

Aggregated by Task							
	Min	Median	Mean	Max	Task min	Task mean	Task max
SOC	-0.018	0.210	0.209	0.254	1,730	1,730	1,730
ISCO-08	-0.031	0.181	0.181	0.401	1,730	1,730	1,730
Aggregated by occupation							
	Min	Median	Mean	Max	Task min	Task mean	Task max
SOC	0.089	0.205	0.209	0.362	1	21.51	40
ISCO-08	0.065	0.180	0.181	0.356	2	8.37	14

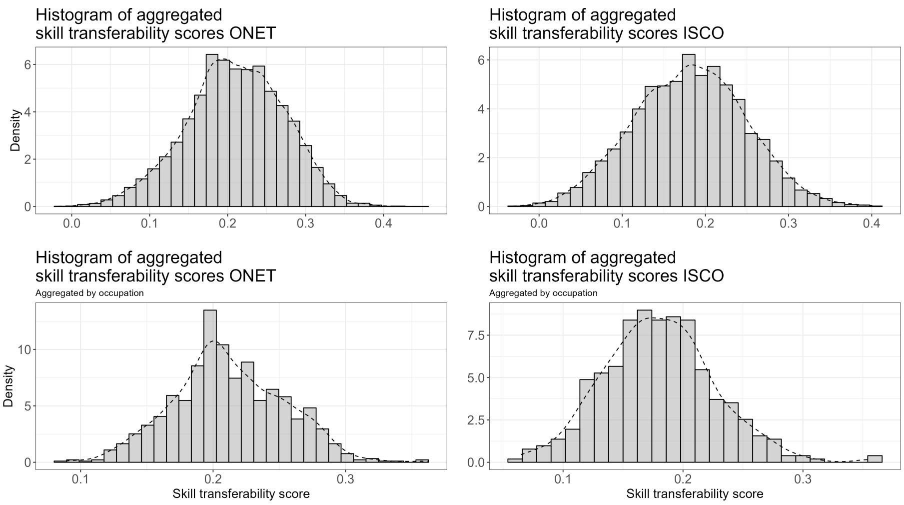

Figure A.1: Skill transferability scores between non-green skills and green skills based all green tasks using no aggregation threshold. Aggregation on the occupational level is based on averaged similarity scores across all tasks for a specific occupation.

Table A. 5: Aggregated Cosine similarity scores by task and occupation - similarity threshold of 0.5 cosine similarity

Aggregated by Task							
	Min	Median	Mean	Max	Task min	Task mean	Task max
SOC	0.500	0.538	0.539	1	0	21.68	623
ISCO-08	0.500	0.525	0.538	0.644	0	13.43	453
Aggregated by occupation							
	Min	Median	Mean	Max	Task min	Task mean	Task max
SOC	0.527	0.545	0.546	0.586	1	21.52	40
ISCO-08	0.515	0.0.541	0.541	0.569	2	8.374	14

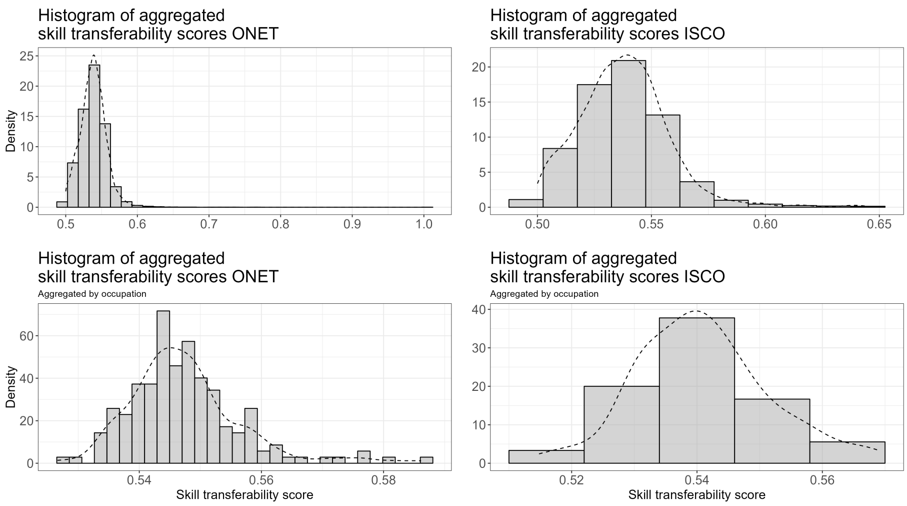

Figure A.2: Skill transferability scores between non-green skills and green skills based all green tasks using an aggregation threshold of 0.5 cosine similarity. Aggregation on the occupational level is based on averaged similarity scores across all tasks for a specific occupation.

A.3.2. Country-industry-level analysis

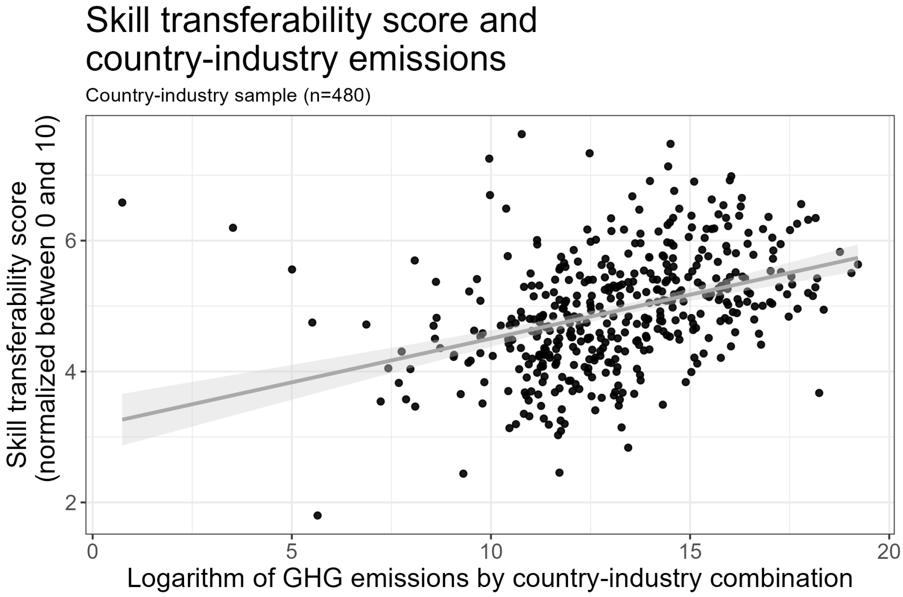

Figure A.3: Skill transferability scores across industries and countries in the ESS Round 11. Skill transferability scores are normalized be tween 0 and 10. Emissions are illustrated as the logarithms of greenhouse gas accounts per industry-country combination. The shaded area indicates 95% confidence intervals.

A.3.3. Green skill transferability and viability to decarbonize

Table A. 6: Green skill transferability and viability to decarbonize

ISCO-08	ISCO-08 Label	Viability for the green transition	Green Skill Transferability
1322	Mining Managers	unviable-to-decarbonize	0.582
3121	Mining Supervisors	unviable-to-decarbonize	0.576
3134	Petroleum and NaturalGas Refining Plant Operators	unviable-to-decarbonize	0.575
8121	Metal Processing Plant Operators	viable-to-decarbonize	0.567
2146	Mining Engineers, Metallurgists and Related Professionals	viable-to-decarbonize	0.565
9311	Mining and Quarrying Labourers	unviable-to-decarbonize	0.562
8131	Chemical Products Plant and Machine Operators	viable-to-decarbonize	0.554
8112	Mineral and Stone Processing Plant Operators	viable-to-decarbonize	0.543
8114	Cement, Stone and Other Mineral Products Machine Operators	unviable-to-decarbonize	0.539
2114	Geologists and geophysicists	viable-to-decarbonize	0.538
8113	Well Drillers and Borers and Related Workers	unviable-to-decarbonize	0.533
8111	Miners and Quarriers	unviable-to-decarbonize	0.532
3135	Metal Production Process Controllers	viable-to-decarbonize	0.511
2165	Cartographers and Surveyors	viable-to-decarbonize	0.502
8160	Food and Related Products Machine Operators	viable-to-decarbonize	0.494
8171	Pulp and Papermaking Plant Operators	viable-to-decarbonize	0.486
7542	Shotfirers and Blasters	viable-to-decarbonize	0.470
8122	Metal Finishing, Plating and Coating Machine Operators	viable-to-decarbonize	0.452
8141	Rubber Products Machine Operators	viable-to-decarbonize	0.444
7222	Toolmakers and Related Workers	viable-to-decarbonize	0.438
8181	Glass and Ceramics Plant Operators	viable-to-decarbonize	0.426
7315	Glass Makers, Cutters, Grinders and Finishers	viable-to-decarbonize	0.416
8151	Fibre Preparing, Spinning and Winding Machine Operators	viable-to-decarbonize	0.405
7211	Metal Moulders and Coremakers	viable-to-decarbonize	0.377
7314	Potters and Related Workers	viable-to-decarbonize	0.376

B. Paper 2 Appendix

B.1. Survey

B.1.1. Sampling and Bias

Our survey was fielded in Germany in Spring 2024. We recruited 3,000 respondents to participate in the survey. A large online panel provided by *Respondi/Bilendi* was used with tens of thousands of panelists across all age brackets. Respondents were then drawn from a pool of eligible voters in Germany and the sample was broadly representative of all eligible voters based on gender, education, and age, i.e., we introduced quota sampling based on education and age and gender (crossed).

Given our subgroup comparisons, we are particularly interested in having roughly representative income and partisan groups. Even without quota sampling by income and ideology, our sample is fairly representative in terms of both variables. Figure A.4 plots the share of respondents by income decile. Overall, our income variable is almost equally distributed across income deciles, only with a slightly lower representation among lowest and highest income respondents (which are notoriously difficult to capture in an online survey).

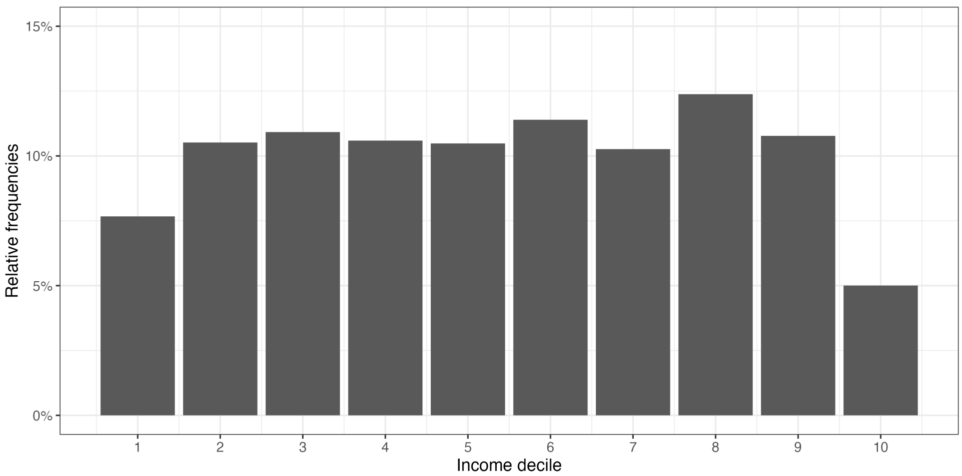

Figure A.4: Income deciles

In addition, we compared the party vote share in the last federal election (September 2021) to the vote choice variable in the survey (which party they stated to vote for in the last general election in September 2021). Table A. 7 shows that the vote shares are fairly accurate.

Table A. 7: Survey vote share versus actual vote share

Party	Election 2021	Survey	Difference
SPD	25.7	21.8	-3.9
CDU/CSU	24.1	22.0	-2.1
Greens	14.8	18.5	+3.7
FDP	11.5	10.6	-0.9
AfD	10.3	12.9	+2.6
Linke	4.9	7.4	+2.5
Other	8.7	6.9	-1.8

B.1.2. Conjoint task

Below we will show you possible policy proposals, to address climate change and its consequences.

We will show you two possible proposal next to each other. For each comparison we would like to know, how much you are in against or in favor of them and which one of the two you would prefer. You can like both proposals or neither one. In any case, please choose the one you prefer the most.

People have different opinions on this topic and there are no right or wrong answers. Please take your time, to read the proposals carefully. In total, we will show you five comparisons of possible policy proposals and ways to finance them.

How would you rate the packages on a scale from 0 (strongly against) to 10 (strongly in favor)?

	Package A	**Package B**
Promotion of climate-friendly activities	No measure	No measure
Reduction of climate-damaging activities	Ban of oil and gas heating	Ban of short-distance flights
Addressing the natural consequences of climate change	Investments in flood prevention	Investments in flood prevention
Addressing the social consequences of climate change	Subsidies for renters in non-energy-efficient housing	No measure
Financing of the package	Budget cuts in other areas	Increase of government debt

Figure A.5: Conjoint task as presented in the survey (translated).

B.1.3. Operationalization

Table A. 8: Operationalization of all variables

Variable	Question wording	Measurement
Natural vulnerability	How likely do you think it is that climate change impacts (heat waves, flooding or water shortages) will have a negative effect on you?	0 very unlikely - 10 very likely
Policy vulnerability	How likely do you think that policies to combat climate change will have negative effects for you?	0 very unlikely - 10 very likely
Vulnerability (open)	Can you please briefly describe what potential risks or concerns you see concerning the consequences of climate change and the measures taken to combat it?	Open text answer
Policy (open)	What specific policy measures would you like to see from German politicians to tackle climate change and its consequences?	Open text answer
Mitigation pull	What is your opinion on proposals to promote climate-friendly activities?	0 strongly against - 10 strongly in favor
Renovations	Subsidies for renovations of buildings	
Renewables	Subsidies for renewable energy production	
Public transport	Investments in public transport	
E-mobility	Investments in e-mobility	
Mitigation push	What is your opinion on proposals to reduce activities that are harmful for the climate?	0 strongly against - 10 strongly in favor
C02 pricing	Increase in C02 pricing	
Fossil subsidies	Reduction of subsidies for fossil fuels	
Heating ban	Ban of oil and gas heating	
Engine ban	Ban of combustion engines	
Flight ban	Ban short-haul flights	
Adaptation	What is your opinion on proposals to address the natural consequences of climate change?	0 strongly against - 10 strongly in favor
Floods	Investments in flood prevention	
Infrastructure	Investments in crisis-resilient infrastructure	
Soil sealing	Reversal of soil sealing	
Eco-Social	What is your opinion on proposals to address the social consequence of climate change?	0 strongly against - 10 strongly in favor
Retraining	Retraining for workers in carbon-intensive sectors	
Compensation	Lump-sum for dismissed workers due to climate mitigation	
Rent bonus	Income-based subsidies for those in poorly insulated homes	
Age	Age in years	Numerical: 18-99
Female	What is your gender?	1 male; 2 female; 3 diverse
Education	Highest level of education that you have achieved so far?	1 primary/lower sec.; 2 secondary; 3 tertiary
Income	Monthly household income, after taxes/compulsory deductions.	1-10 percentiles
Left-right scale	Place yourself on left-right scale	0 (left) - 10 (right)

B.2. Descriptive results

B.2.1. Baseline descriptive statistics of respondents

Table A. 9: Descriptive statistics by vulnerability group

	mean	95 % CI	median	min	max
Income (deciles)					
Low vulnerability	5.637	[5.461; 5.813]	6	1	10
High policy vulnerability	5.523	[5.283; 5.763]	6	1	10
High climate change vulnerability	5.485	[5.292; 5.678]	6	1	10
High cross pressure	5.071	[4.838; 5.303]	5	1	10
Education (1 = primary)					
Low vulnerability	2.149	[2.106; 2.192]	2	1	3
High policy vulnerability	2.104	[2.041; 2.168]	2	1	3
High climate change vulnerability	2.121	[2.074; 2.169]	2	1	3
High cross pressure	2.153	[2.095; 2.209]	2	1	3
Age (in years)					
Low vulnerability	52.06	[51.00; 53.128]	54	18	88
High policy vulnerability	52.26	[50.899; 53.614]	54	18	82
High climate change vulnerability	50.3	[49.084; 51.501]	53	18	87
High cross pressure	50.22	[48.763; 51.677]	52	18	91
Gender (1 = male)					
Low vulnerability	0.516			0	1
High policy vulnerability	0.591			0	1
High climate change vulnerability	0.381			0	1
High cross pressure	0.489			0	1
Left-right self placement (10 = far right)					
Low vulnerability	4.889	[4.786; 4.993]	5	0	10
High policy vulnerability	5.758	[5.591; 5.926]	6	0	10
High climate change vulnerability	4.329	[4.199; 4.458]	5	0	10
High cross pressure	5.023	[4.855; 5.192]	5	0	10

Table A. 10: Exploratory factor analysis with oblique rotation to assess climate policy dimensions

	Push-mitigation	Adaptation	Pull-mitigation	Eco-Social Policy
Increase price on carbon	0.75			
Ban of oil and gas heating	0.88			
Ban of internal combustion engines	0.96			
Investments in flood prevention		0.93		
Investments in disaster-resilient infrastructure		0.88		
Investment in reversal of soil sealing		0.52		
Subsidies for renovations of buildings			0.72	
Subsidies for renewable energy production			0.90	
Investments in public transport			0.63	
Lump sum for dismissed fossil-fuel workers				0.62
Rent bonus for people in poorly insulated homes				0.89
Investments in e-mobility	0.45		0.40	
Eigenvaules	2.48	1.96	1.93	1.26
Proportion of Variance	0.21	0.16	0.26	0.10

B.2.2. Exploratory Factor Analysis

We performed an EFA with oblique (promax) rotation, as there is no reason to assume strict orthogonality between the theoretical dimensions. If we include all policy questions in the analysis, the parallel analysis suggested a solution of five distinct factors, while a scree plot suggested a two-factor solution. Given the low factor loadings (< 0.40) of some items for the fifth factor and our theoretical expectation of four substantive policy dimensions, we opted for a four-factor solution. After excluding items with low factor loadings, the four-factor solution is also suggested by parallel analysis and provides interpretable and theoretically sound dimensions.

Investments in e-mobility appear contentious among German citizens, as reflected in their mixed loadings on both push and pull factors. Despite aiming to encourage environmentally friendly behavior, the policy is highly unpopular, which may explain its ambiguous placement. Most other items align with expected policy dimensions. In the eco-social policy domain, the exclusion of a retraining program due to low factor loadings yields a dimension focused solely on compensatory measures. This supports the idea that the distinction between social investment and compensation also shapes how social and climate policies intersect.

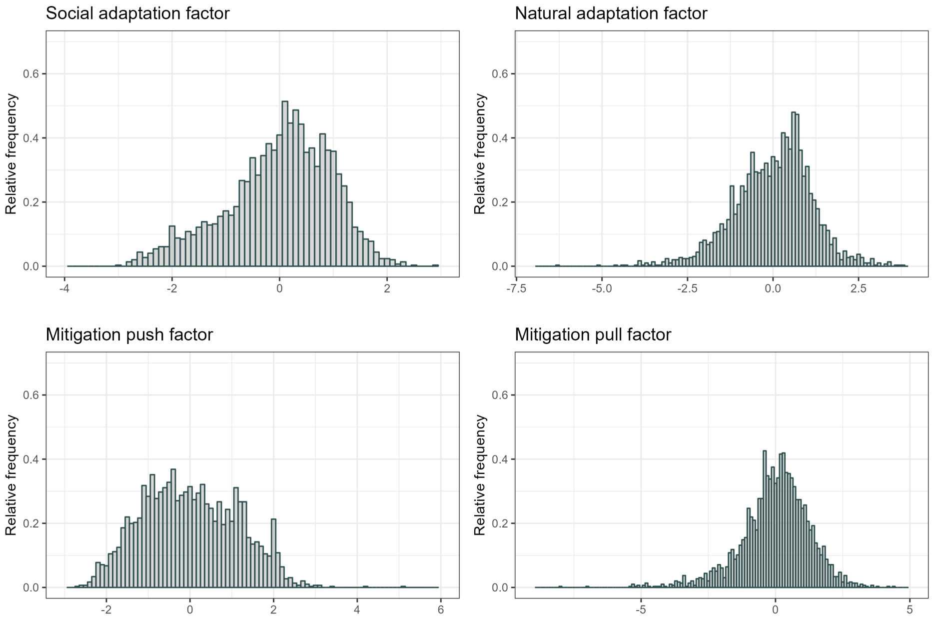

Figure A.6: Distribution of factor scores based on oblique rotation

B.2.3. Analysis of open-ended survey questions

ChatGPT prompt to classify open-ended vulnerability question

The effects of climate change and related policies can have a range of effects on individuals. For each answer in this sample, follow the following instructions:

1. Carefully read the text of the answer, paying close attention to details

2. Classify the answer into one or multiple of the topics defined below.

3. If multiple topics are identified, list those topics separated by a comma.

NATURAL – Environmental disasters related to climate change such as floodings, heat waves, droughts, soil degradation, mass extinction, melting of glaciers or the poles, or increase in the rise of sea levels and global warming. Effects of natural consequences of climate change on the quality of the environment, habitats, farming, and the functioning of the economy.

POLICY – Effects of climate policies on citizens' standard of living, their employment situation, their economic perspectives or their general way of life. General increase in prices. For example, policies can impose prohibitive costs on individuals or industries, which leads to economic losses.

POLITICS – Effects of climate change on global and local conflicts, conflicts over resources, social inequality, overwhelming of the population, political divisions and polarization. Demands for international cooperation.

MIGRATION –Migration movements because of deteriorating living conditions which might preoccupy citizens in host countries for potential refugees.

HEALTH – Deteriorating environmental conditions and changing habitats can lead to diseases, epidemics, a lack of food and therefore famines (e.g. bad air quality). NONE – Climate change and policies designed to address it will not have any negative consequences. Denial or explicit opposition in statements.

SCEPTICS – Statements describing climate change as not real, policies designed to address it as having no effect or serving only a small group of people and being useless only on a regional level. On the other hand, policies might not be enough or take too long to be implemented.

OTHER - Answers that refer to general dangers and/or risks but are not necessarily related to climate change, its consequences and political measures against it.

DONT KNOW - No opinion on this topic, not enough information, nonsensical answers or strings or answers not relevant to the topic.

Validation of Close-Ended Vulnerability Questions

In order to validate our closed-ended measurement of perceived climate change and policy vulnerability we recoded the results from the classification task as binary variables to indicate either climate change vulnerability (category "NATURAL") or policy vulnerability (categories "POLICY" and "POLITICS"). The category NATURAL captured answers mentioning environmental disasters related to climate change such as floodings, heat waves, droughts, soil degradation, mass extinction, melting of glaciers or the poles, or increase in the rise of sea levels and global warming. Effects of natural consequences of climate change on the quality of the environment, habitats, farming, and the functioning of the economy. The category POLICY captured answers about effects of climate policies on citizens' standard of living, their employment situation, their economic perspectives or their general way of life. General increase in prices. For example, policies can impose prohibitive costs on individuals or industries, which leads to economic losses. The category POLITICS captured answers concerning effects of climate change on global and local conflicts, conflicts over resources, social inequality, overwhelming of the population, political divisions and polarization. Demands for international cooperation. See Appendix B.2 for more details. We used results from the first two categorizations for this operation, as most meaningful answers are represented therein. Subsequently we estimated the likelihood of answering in one of those categories based on the closed-ended questions about perceived climate change and policy vulnerability using logistic regression models. We controlled for political ideology, climate change concern, age, gender, income, and education. The results of this estimation are depicted in Figure A.7. Detailed regression results can be found B.2 Tables A. 11 and A. 12.

Unsurprisingly, for the category "NATURAL", the results suggest that respondents who perceive themselves to be highly vulnerable to the natural consequences of climate change are more likely to respond in this category. While other potentially influential variables such as climate change concern do have significant predictive power for this category, we are confident that our measurement of perceived climate change vulnerability is able to capture a distinct phenomenon. A similar conclusion can be drawn for the categories POLICY and POLITICS. While it is plausible to assume that policy vulnerability could be affected by the ideology of citizens, our results suggest that citizens who perceive themselves highly vulnerable to the consequences of climate policy in our closed-ended questions are more likely to respond in the categories "policy" or "politics", even while controlling for their ideology. Summing up, we are confident that we are able to tap into distinct phenomena using our closed-ended survey responses for perceived climate change and perceived policy vulnerability.

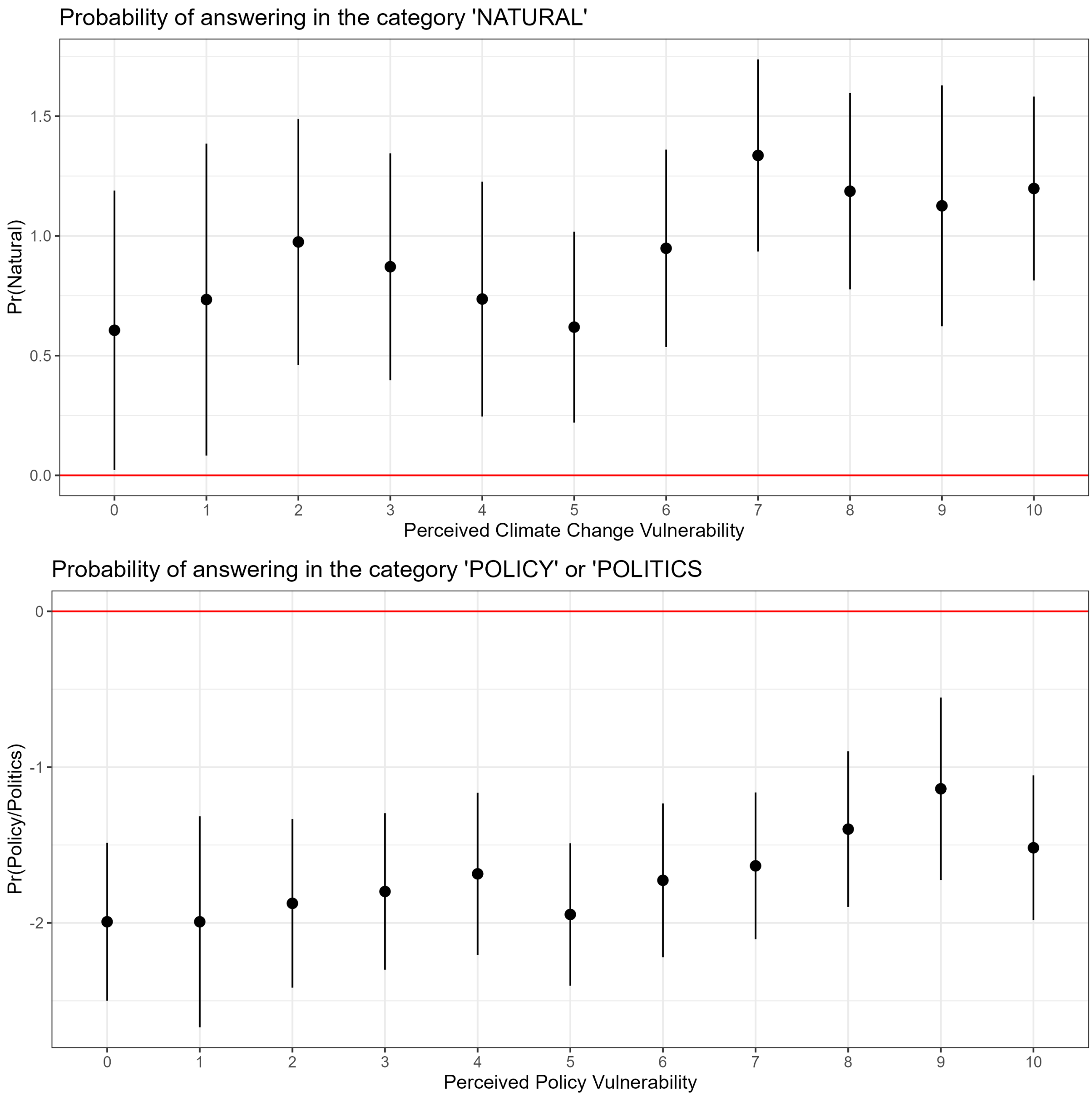

Figure A.7: Predicted probability

Table A. 11: Logistic regression of answering in the category NATURAL; controls for ideology, climate change concern, income, age, education, and gender included

	Predict "NATURAL"
(Intercept)	−0.884*
	(0.352)
Climate vulnerability 1 (ref.: 0 = low)	0.128
	(0.368)
2	0.369
	(0.302)
3	0.265
	(0.291)
4	0.130
	(0.304)
5	0.013
	(0.265)
6	0.342
	(0.272)
7	0.730**
	(0.269)
8	0.581*
	(0.276)
9	0.520+
	(0.314)
Climate vulnerability 10	0.592*
	(0.271)
Ideology: Center (ref.: Left)	0.015
	(0.114)
Ideology: Right	−0.251
	(0.153)
Not at all concerned about Climate change (ref.: Neither)	−2.068***
	(0.321)
Hardly concerned	−0.792***
	(0.177)
Rather concerned	0.372**
	(0.121)
Very concerned	0.687***
	(0.127)
Num.Obs.	2477
AIC	3117.3
BIC	3315.0
Log.Lik.	−1524.630
Std.Errors	HC3

+ $p < 0.1$, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table A. 12: Logistic regression of answering in the category POLICY or POLITICS; controls for ideology, climate change concern, income, age, education, and gender included

	Predict "POLICY"/"POLITICS"
(Intercept)	-1.206^{***}
	(0.346)
Policy vulnerability 1 (ref.: 0 = low)	0.000
	(0.346)
2	0.118
	(0.259)
3	0.194
	(0.238)
4	0.308
	(0.248)
5	0.047
	(0.218)
6	0.266
	(0.230)
7	0.359
	(0.221)
8	0.594^{*}
	(0.239)
9	0.853^{**}
	(0.284)
Policy vulnerability 10	0.475^{*}
	(0.221)
Ideology: Center (ref.: Left)	-0.060
	(0.126)
Ideology: Right	-0.162
	(0.173)
Not at all concerned about Climate change (ref.: Neither)	-0.509^{*}
	(0.234)
Hardly concerned	0.055
	(0.180)
Rather concerned	0.131
	(0.135)
Very concerned	-0.148
	(0.137)
Num.Obs.	2428
AIC	2740.2
BIC	2937.2
Log.Lik.	-1336.087
Std.Errors	HC3

+ $p < 0.1$, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

B.2.4. Perceived vulnerability

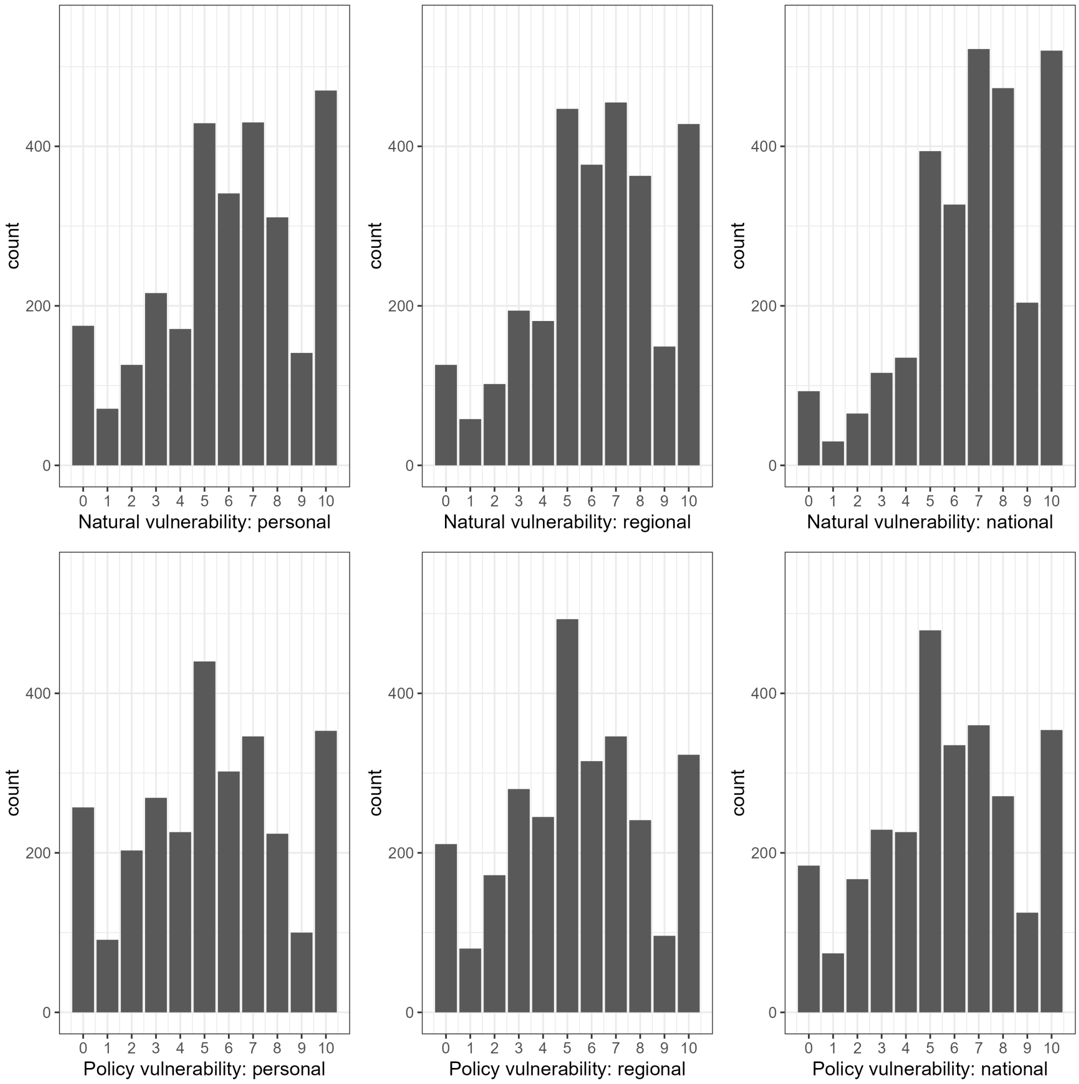

Figure A.8: Perceived climate change and policy vulnerability on a personal, regional, and national level

B.2.5. Positional Policy Support

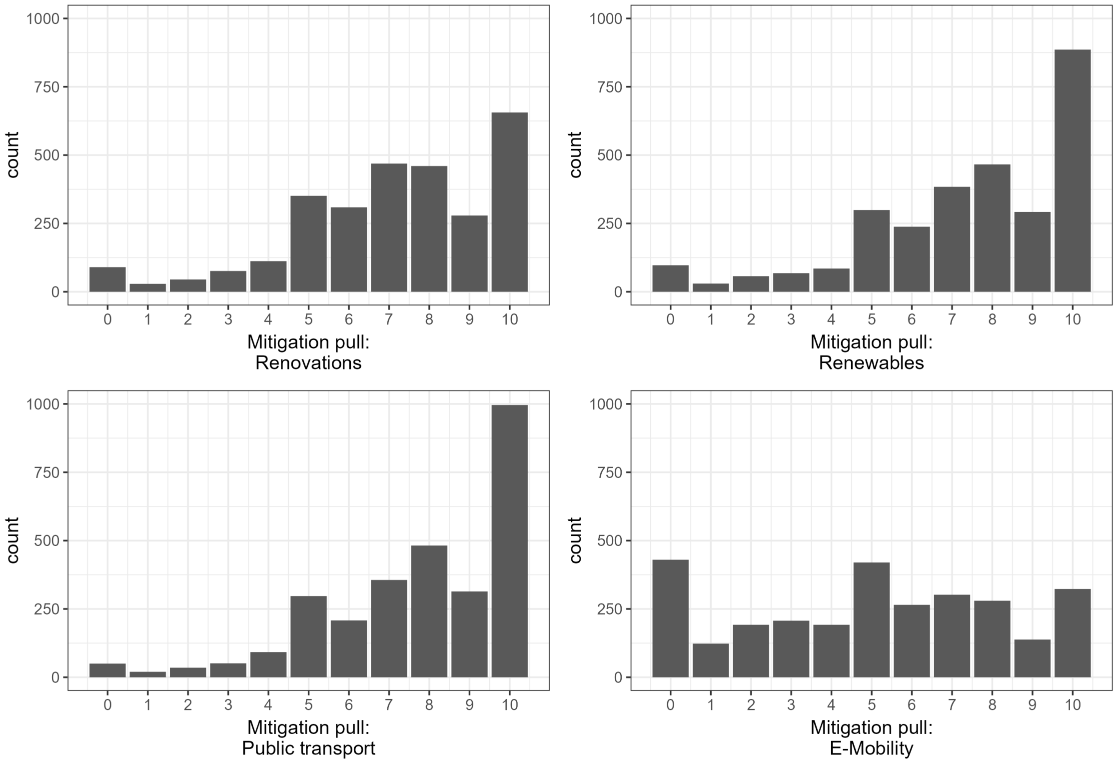

Figure A.9: Support for pull mitigation policies

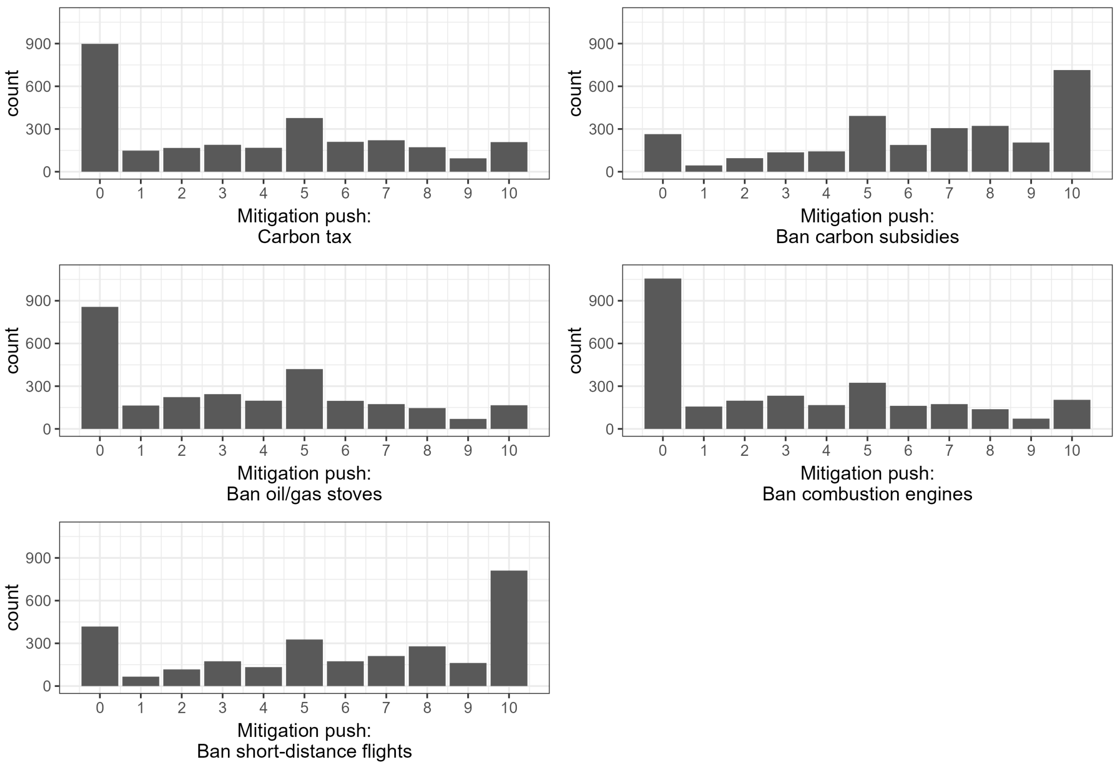

Figure A.10: Support for push mitigation policies

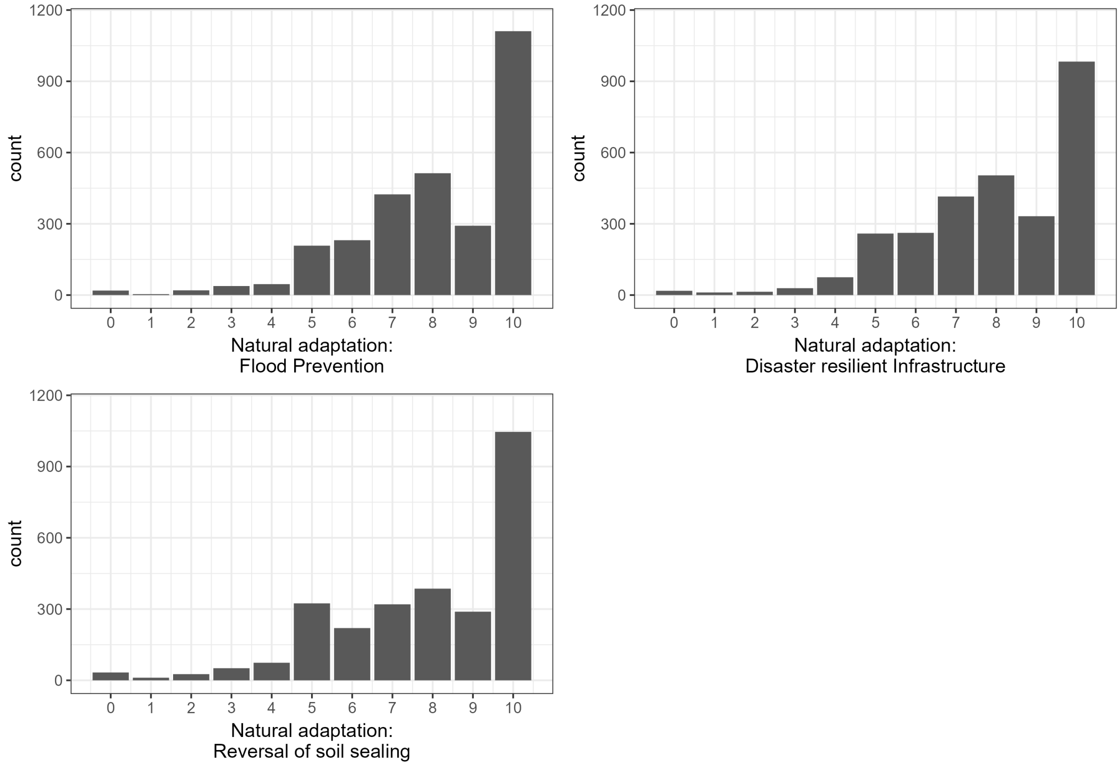

Figure A.11: Support for adaptation policies

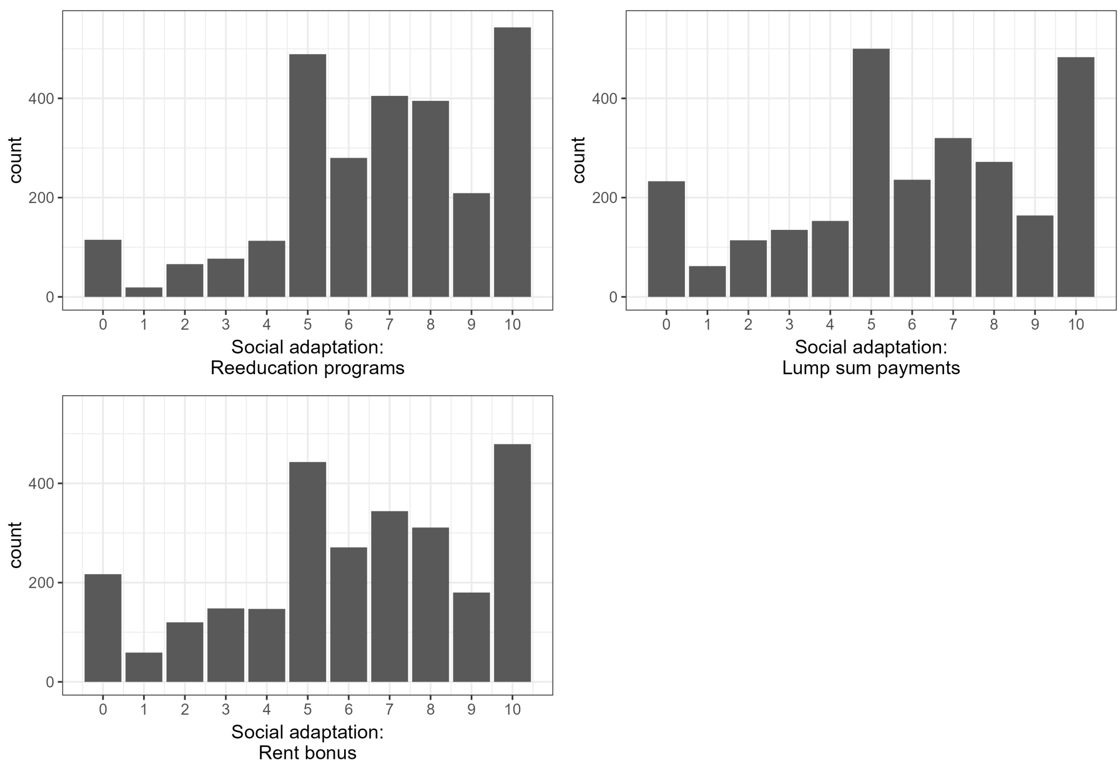

Figure A.12: Support for eco-social policies

B.3. Regression Results

B.3.1. Baseline estimation

Table A. 13: OLS estimation of climate policy support on perceived vulnerability; controls for income, age, education, and gender included

	Pull Mitigation	Push Mitigation	Adaptation	Eco-Social
(Intercept)	−0.817***	0.497***	−0.378*	0.462**
	(0.177)	(0.139)	(0.170)	(0.152)
Policy vulnerability 1 (ref.: 0 = low)	0.012	−0.010	−0.029	−0.047
	(0.133)	(0.131)	(0.118)	(0.138)
2	0.007	−0.085	−0.119	−0.129
	(0.098)	(0.105)	(0.093)	(0.105)
3	0.121	−0.238*	−0.250**	−0.174+
	(0.098)	(0.100)	(0.090)	(0.099)
4	0.068	−0.170+	−0.239**	−0.170+
	(0.094)	(0.098)	(0.092)	(0.099)
5	−0.123	−0.170+	−0.303***	−0.013
	(0.088)	(0.090)	(0.083)	(0.088)
6	−0.056	−0.293**	−0.324***	−0.100
	(0.095)	(0.096)	(0.090)	(0.096)
7	−0.001	−0.431***	−0.282***	−0.027
	(0.092)	(0.094)	(0.085)	(0.093)
8	−0.056	−0.602***	−0.161+	−0.074
	(0.103)	(0.099)	(0.095)	(0.106)
9	−0.271*	−0.496***	−0.030	0.096
	(0.133)	(0.121)	(0.125)	(0.118)
Policy vulnerability 10	−0.387***	−0.604***	0.121	0.052
	(0.105)	(0.093)	(0.097)	(0.099)
Climate vulnerability 1 (ref.: 0 = low)	0.426*	−0.040	−0.265	−0.005
	(0.177)	(0.128)	(0.187)	(0.163)
2	0.240	0.097	0.062	−0.075
	(0.163)	(0.121)	(0.166)	(0.154)
3	0.493***	0.127	−0.223	0.020
	(0.146)	(0.105)	(0.151)	(0.135)
4	0.432**	0.189+	−0.087	0.052
	(0.144)	(0.110)	(0.148)	(0.141)
5	0.439**	0.199*	−0.112	0.135
	(0.135)	(0.095)	(0.138)	(0.125)
6	0.494***	0.384***	−0.017	0.034
	(0.134)	(0.100)	(0.140)	(0.129)
7	0.526***	0.419***	0.086	0.136
	(0.132)	(0.097)	(0.138)	(0.125)
8	0.659***	0.461***	0.067	0.083
	(0.133)	(0.102)	(0.137)	(0.129)
9	0.694***	0.631***	0.144	−0.014
	(0.149)	(0.124)	(0.155)	(0.146)
Climate vulnerability 10	0.697***	0.633***	0.360**	0.103
	(0.130)	(0.098)	(0.134)	(0.123)
N	2585	2585	2585	2585
R2	0.069	0.107	0.146	0.041
R2 Adj.	0.056	0.094	0.134	0.027

+ $p < 0.1$, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table A. 14: OLS estimation of climate policy support of cross-pressured respondents; controls for income, age, education, and gender included

	Pull Mitigation	Push Mitigation	Natural Adaptation	Eco-Social
(Intercept)	−0.409***	0.512***	−0.692***	0.433***
	(0.108)	(0.103)	(0.109)	(0.097)
High policy vulnerability				
(ref.: low vulnerability)	−0.307***	−0.390***	0.190**	0.009
	(0.067)	(0.050)	(0.064)	(0.062)
High climate vulnerability	0.149***	0.337***	0.309***	−0.004
	(0.045)	(0.049)	(0.044)	(0.048)
High cross pressure	0.105+	−0.030	0.376***	0.156**
	(0.054)	(0.058)	(0.051)	(0.055)
N	2585	2585	2585	2585
R2	0.109	0.035	0.088	0.040
R2 Adj.	0.102	0.027	0.081	0.033

+ $p < 0.1$, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

B.3.2. Comprehensive models

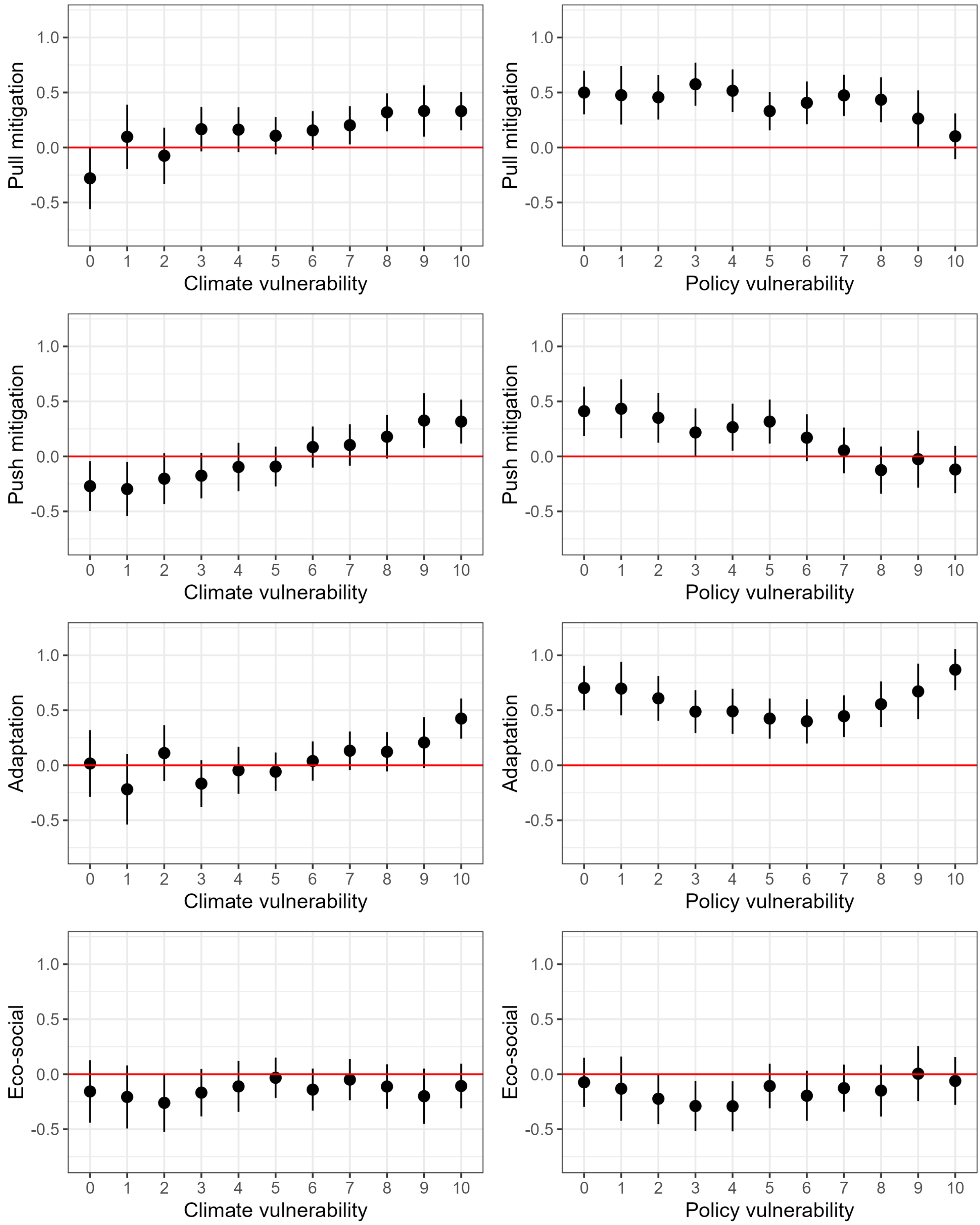

Figure A.13: Perceived vulnerability and support for climate policy dimensions.
Notes: Dependent variables are standardized factor scores for climate policy support with variance 1. Perceived vulnerability is measured on a 0-10 scale, where 0 means low vulnerability.

Table A. 15: OLS estimation of climate policy support on perceived vulnerability; controls for income, age, education, gender, climate change concern, and ideology included

	Pull Mitigation	Push Mitigation	Adaptation	Eco-Social
(Intercept)	−0.623***	0.650***	−0.450*	0.598***
	(0.178)	(0.145)	(0.175)	(0.156)
Policy vulnerability 1				
(ref.: 0 = low)	−0.024	0.023	−0.005	−0.058
	(0.135)	(0.130)	(0.120)	(0.140)
2	−0.043	−0.060	−0.094	−0.150
	(0.098)	(0.105)	(0.094)	(0.106)
3	0.075	−0.193+	−0.214*	−0.216*
	(0.097)	(0.101)	(0.091)	(0.100)
4	0.016	−0.145	−0.212*	−0.218*
	(0.093)	(0.099)	(0.094)	(0.100)
5	−0.169+	−0.094	−0.277***	−0.034
	(0.087)	(0.090)	(0.084)	(0.090)
6	−0.093	−0.240*	−0.302***	−0.122
	(0.094)	(0.097)	(0.092)	(0.098)
	−0.026	−0.356***	−0.256**	−0.053
	(0.091)	(0.094)	(0.087)	(0.095)
8	−0.066	−0.535***	−0.147	−0.076
	(0.103)	(0.101)	(0.098)	(0.108)
9	−0.237+	−0.435***	−0.030	0.078
	(0.131)	(0.122)	(0.125)	(0.120)
Policy vulnerability 10	−0.398***	−0.530***	0.167+	0.012
	(0.105)	(0.095)	(0.099)	(0.101)
Climate vulnerability 1				
(ref.: 0 = low)	0.377*	−0.026	−0.235	−0.050
	(0.177)	(0.127)	(0.191)	(0.165)
2	0.205	0.068	0.095	−0.103
	(0.163)	(0.120)	(0.168)	(0.155)
3	0.447**	0.095	−0.183	−0.011
	(0.145)	(0.106)	(0.153)	(0.136)
4	0.442**	0.174	−0.062	0.046
	(0.144)	(0.112)	(0.151)	(0.144)
5	0.387**	0.178+	−0.074	0.124
	(0.135)	(0.096)	(0.141)	(0.126)
6	0.435**	0.355***	0.023	0.017
	(0.134)	(0.101)	(0.142)	(0.130)
7	0.482***	0.374***	0.116	0.108
	(0.133)	(0.099)	(0.141)	(0.127)
8	0.600***	0.449***	0.107	0.045
	(0.133)	(0.103)	(0.140)	(0.130)
9	0.612***	0.596***	0.191	−0.043
	(0.151)	(0.125)	(0.160)	(0.149)
Climate vulnerability 10	0.611***	0.587***	0.409**	0.049
	(0.130)	(0.100)	(0.138)	(0.125)
Ideology: Center				
(ref.: Left)	−0.064	−0.273***	0.025	−0.111*
	(0.045)	(0.053)	(0.045)	(0.048)
Ideology: Right	−0.327***	−0.273***	0.041	−0.070
	(0.071)	(0.069)	(0.069)	(0.069)
N	2522	2522	2522	2522
R2	0.079	0.121	0.147	0.043
R2 Adj.	0.065	0.107	0.134	0.028

+ $p < 0.1$, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table A. 16: OLS estimation of climate policy support of cross-pressured respondents; controls for income, age, education, gender, climate change concern, and ideology included

	Pull Mitigation	Push Mitigation	Adaptation	Eco-Social Policy
(Intercept)	−0.269*	0.707***	−0.679***	0.520***
	(0.113)	(0.112)	(0.114)	(0.104)
High policy vulnerability (ref.: low vulnerability)	−0.273***	−0.353***	0.194**	−0.008
	(0.067)	(0.051)	(0.065)	(0.063)
High CC vulnerability	0.118**	0.316***	0.313***	−0.033
	(0.046)	(0.050)	(0.045)	(0.050)
High cross pressure	0.107+	−0.016	0.383***	0.141*
	(0.055)	(0.058)	(0.052)	(0.056)
Ideology: Center (ref.: Left)	−0.093*	−0.295***	−0.015	−0.100*
	(0.043)	(0.052)	(0.044)	(0.047)
Ideology: Right	−0.376***	−0.326***	0.019	−0.050
	(0.068)	(0.068)	(0.068)	(0.067)
N	2522	2522	2522	2522
R2	0.054	0.104	0.037	0.110
R2 Adj.	0.046	0.097	0.028	0.102

+ $p < 0.1$, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

B.3.3. Residualization Approach

To account for potential endogeneity in the respondents' perceptions of climate change and policy vulnerability we computed a regression of the latter to variables on the control variables included in the main estimation, namely ideology, education, income, gender, and age. Subsequently, we used the residuals of this estimation as new independent variable for respondents' vulnerability perceptions. To estimate hypotheses 1 and 2 we included the continuous version of this variable in the estimation of policy support. To estimate hypothesis 3 we constructed a variable with four categories analogous to the ones reported in the main text using the 3rd quartile of the residualization-based independent variables.

Table A. 17: OLS estimation of climate policy support applying a residualization approach; controls for income, age, education, gender, climate change concern, and ideology included

	Pull Mitigation	Push Mitigation	Adaptation	Eco-Social Policy
(Intercept)	−0.215*	0.810***	−0.455***	0.536***
	(0.109)	(0.107)	(0.111)	(0.102)
Perceived policy vulnerbaliity	−0.035***	−0.056***	0.010	0.011
	(0.008)	(0.007)	(0.007)	(0.008)
Perceived climate change vulnerability	0.049***	0.066***	0.046***	0.008
	(0.008)	(0.007)	(0.008)	(0.008)
Ideology: Center (ref.: Left)	−0.130**	−0.369***	−0.045	−0.094*
	(0.043)	(0.050)	(0.044)	(0.046)
Ideology: Right	−0.459***	−0.480***	0.008	−0.036
	(0.067)	(0.065)	(0.067)	(0.066)
N	2522	2522	2522	2522
R2	0.063	0.115	0.104	0.035
R2 Adj.	0.055	0.107	0.097	0.027
Std.Errors	HC3	HC3	HC3	HC3

+ $p < 0.1$, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table A. 18: OLS estimation of climate policy support applying a residualization approach; controls for income, age, education, gender, climate change concern, and ideology included

	Pull Mitigation	Push Mitigation	Adaptation	Social Policy
(Intercept)	−0.192+	0.789***	−0.649***	0.534***
	(0.111)	(0.109)	(0.112)	(0.104)
High policy vulnerability (ref.: low vulnerability)	−0.374***	−0.328***	0.308***	0.024
	(0.063)	(0.049)	(0.061)	(0.059)
High CC vulnerability	0.131**	0.320***	0.397***	−0.059
	(0.047)	(0.058)	(0.046)	(0.056)
High cross pressure	0.105	0.003	0.469***	0.132+
	(0.078)	(0.086)	(0.068)	(0.080)
Ideology: Center (ref.: Left)	−0.128**	−0.363***	−0.023	−0.094*
	(0.043)	(0.051)	(0.044)	(0.046)
Ideology: Right	−0.436***	−0.456***	0.006	−0.038
	(0.066)	(0.066)	(0.066)	(0.066)
N.	2522	2522	2522	2522
R2	0.062	0.094	0.122	0.035
R2 Adj.	0.054	0.086	0.114	0.027
Std.Errors	HC3	HC3	HC3	HC3

+ $p < 0.1$, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

B.4. Additional Conjoint Results

B.4.1. AMCEs and Marginal means, full population

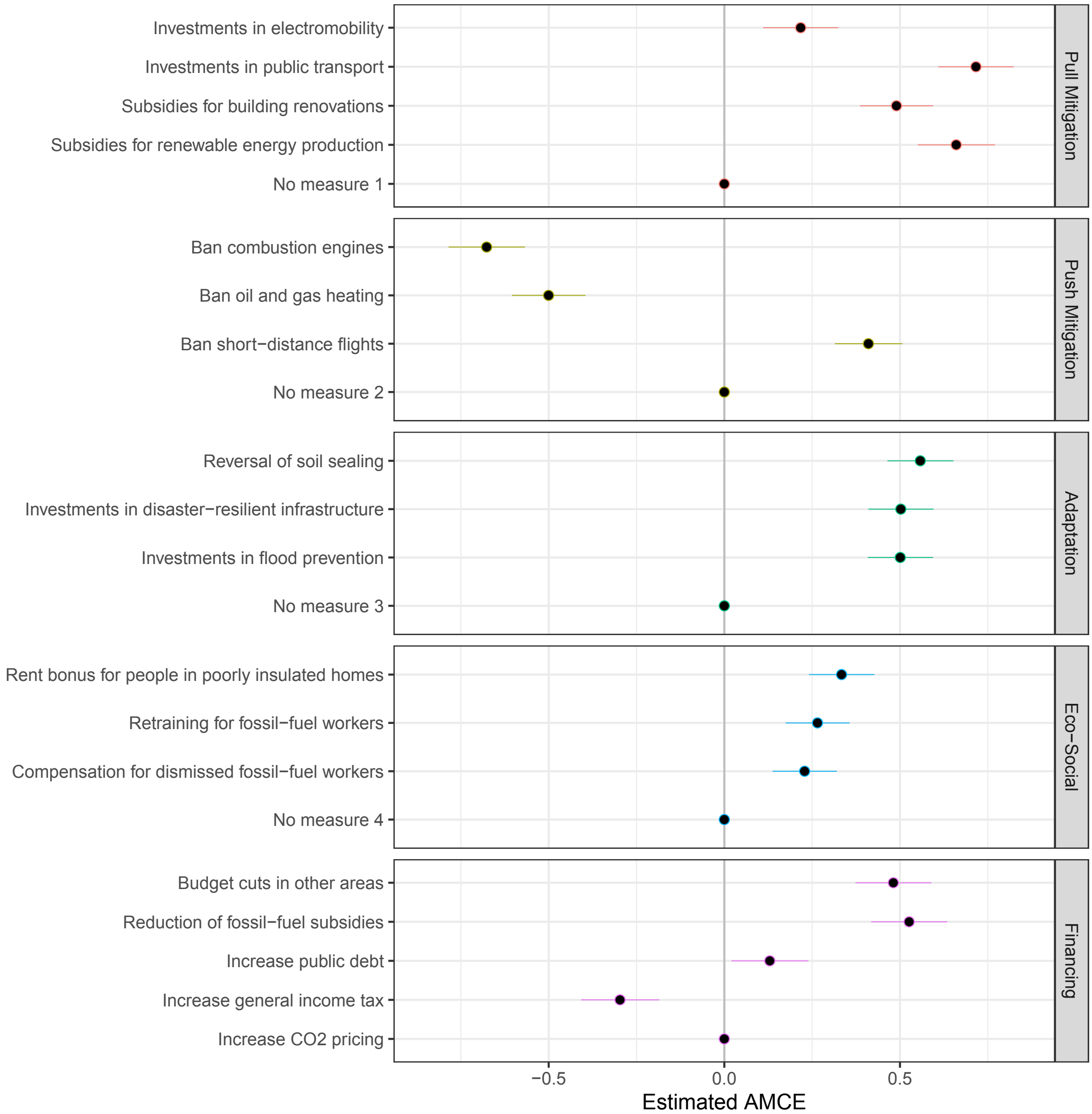

Figure A.14: ACME with rating variable, full population

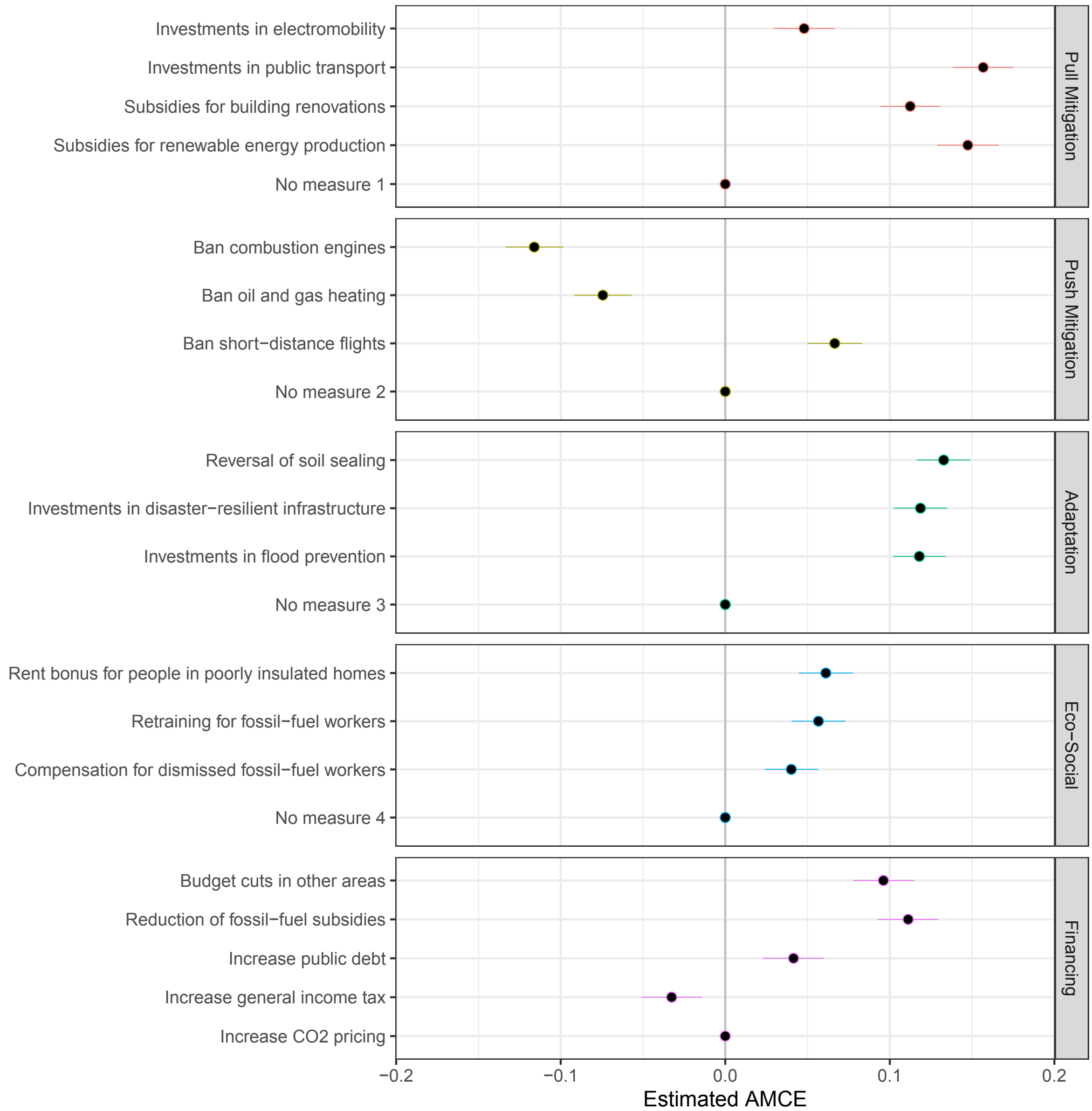

Figure A.15: AMCEs with choice variable, full population

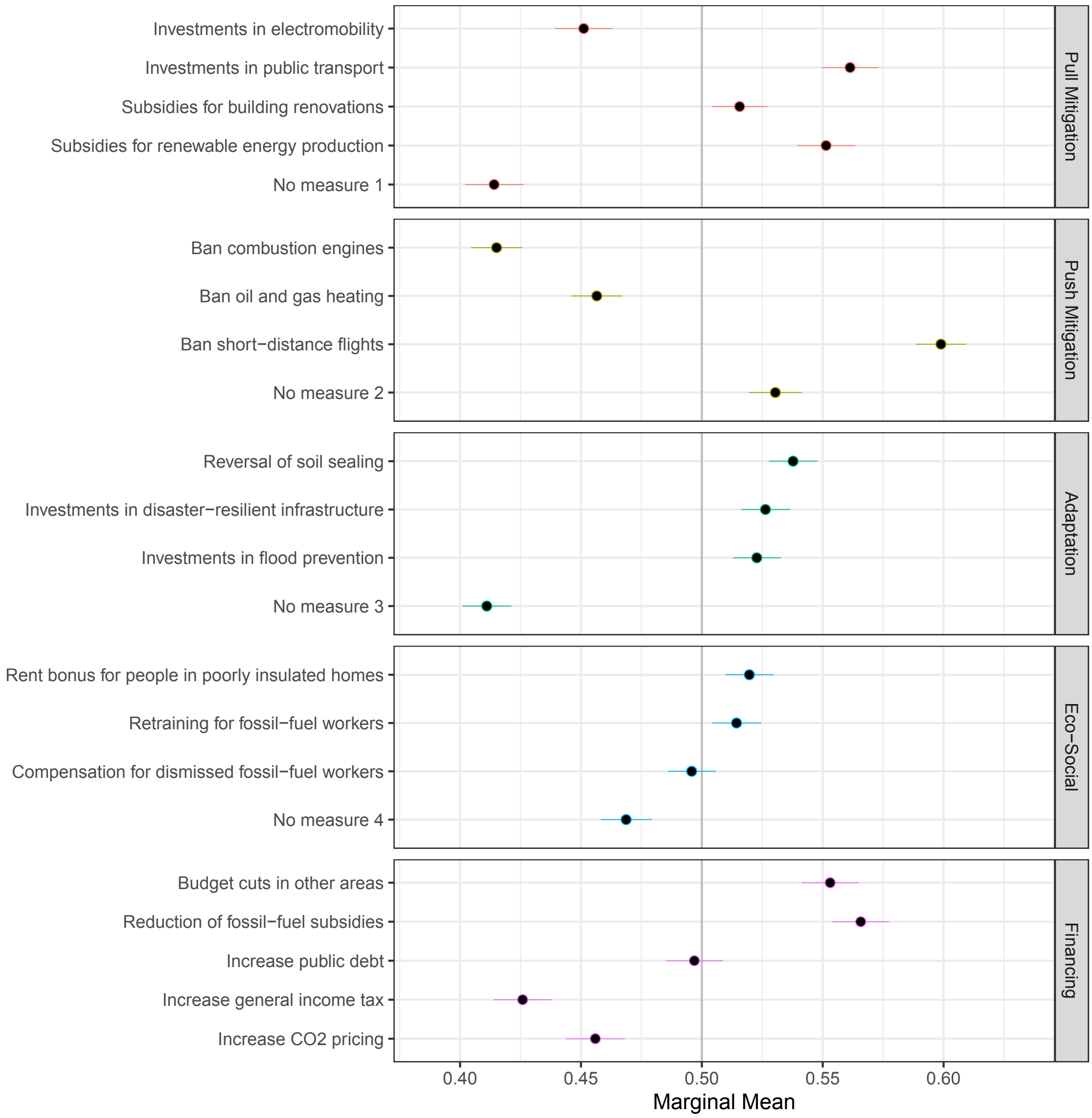

Figure A.16: Marginal means with choice variable, full population

B.4.2. Marginal means, by vulnerability

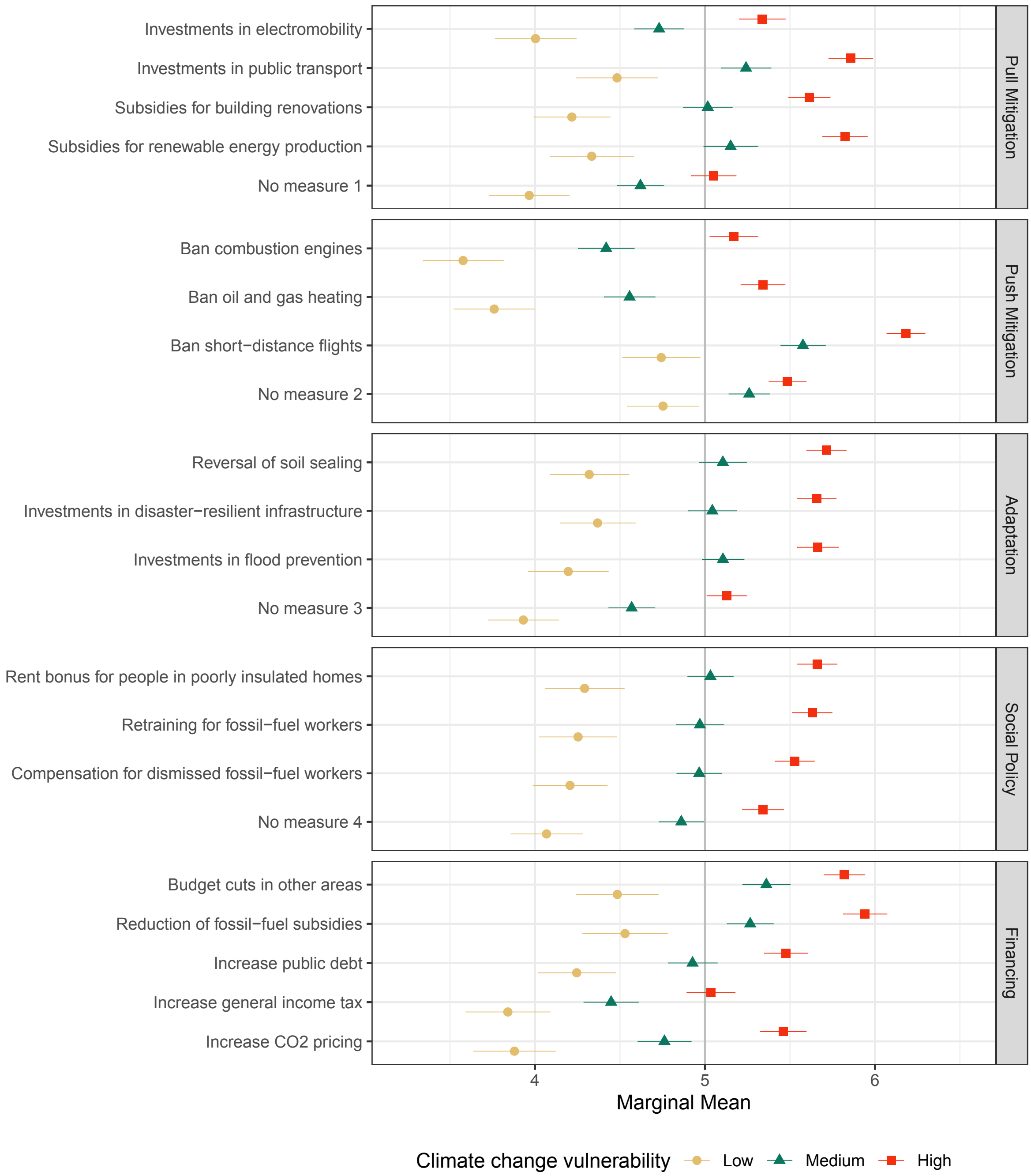

Figure A.17: Marginal means with rating variable, by natural vulnerability

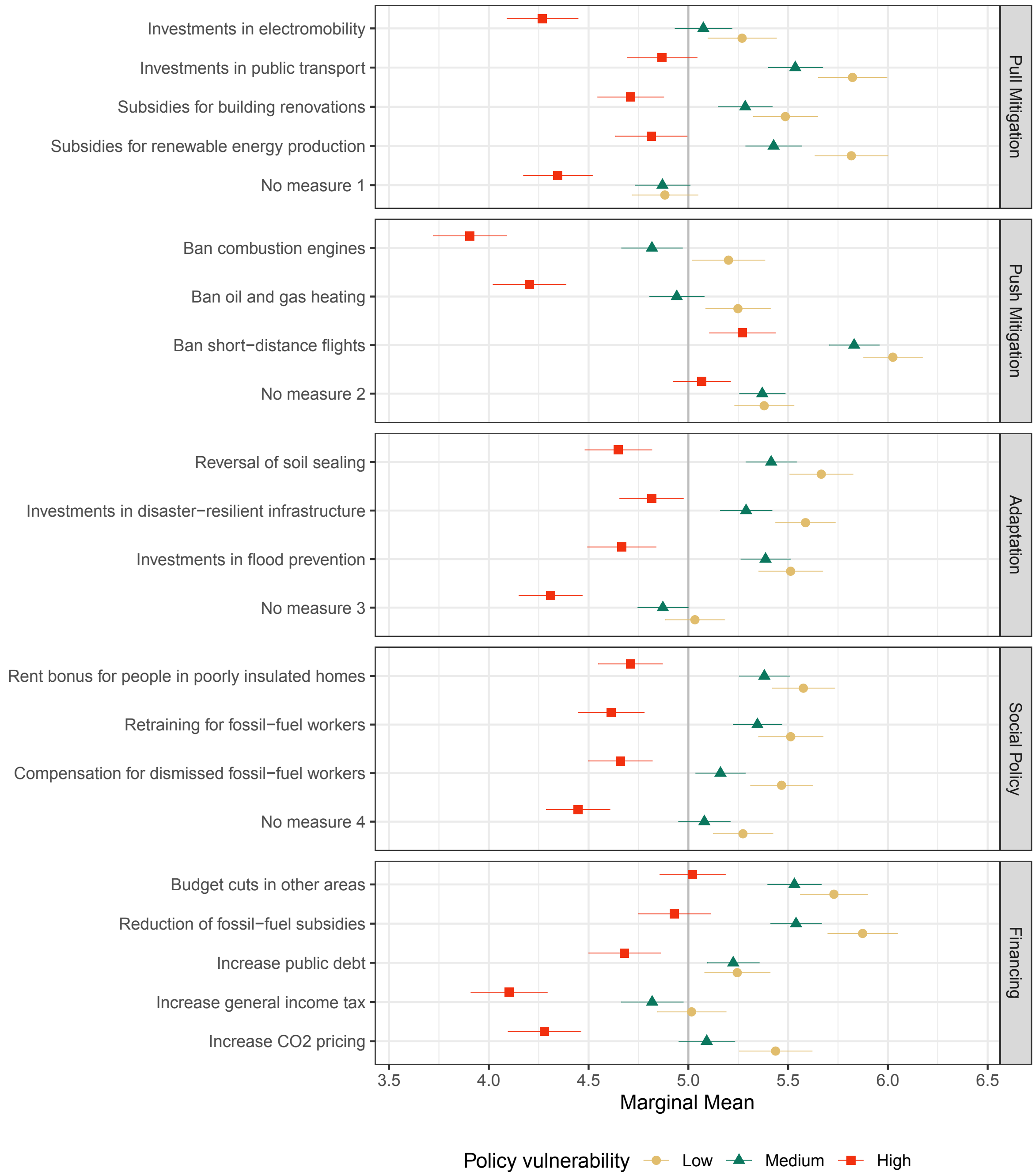

Figure A.18: Marginal means with rating variable, by policy vulnerability

C. Paper 3 Appendix

C.1. Empirical Approach

C.1.1. Operationalization

Table A. 19: Operationalization of main variables

Variable	Question Wording	Items (randomized)	Measurement
Beliefs about social norms	Now think about what people in Austria think their behavior should be like. Please indicate how many Austrians think they should act in the following way always or most of the time. If you are not sure, please guess.	- Save energy - Reduce consumption of meat and dairy products	10 point scale from 0 % - 10 % to 91 % - 100 %
Policy vulnerability	How likely do you think it is that climate policy in Austria will have negative consequences in the following areas?	- Economic development in Austria - Prices for everyday goods - Your general way of life	0 - not at all likely 10 - very likely
Personal prescriptive norm AUTNES W21	How often do you think you should behave like this in your daily life?	- Save energy - Reduce consumption of meat and dairy products	1 - always 2 - most of the time 3 - sometimes 4 - rarely 5 - almost never
Climate policy preferences	Please indicate for each of the following policies if you don't support it at all or if you fully support it.	- Increase of the carbon-price - Subsidies for the change of heating systems - Decrease value added tax on renewable energy - Increase of the mineral oil tax - Increase taxes on meat and dairy products - Reduction of subsidies for meat and dairy production - Meat free meals in public canteens - Information on the ecological footprint on meat and dairy packaging	1 - Strongly in favor 2 - Rather in favor 3 - Neither in favor nor against 4 - Rather against 5 - Strongly against

C.2. Descriptive Statistics

C.2.1. Balance Tables

Table A. 20: Balance table of key covariates

		Control	Food treatment	Energy treatment	p	test	SMD
n		978	995	1005			
Ideology (0 = left)		5.31 (2.02)	5.14 (1.93)	5.21 (1.95)	0.208		0.055
Climate change concern (0 = low)		5.46 (2.87)	5.47 (2.90)	5.54 (2.93)	0.773		0.020
Policy vulnerability (0 = low)		0.61 (0.21)	0.61 (0.22)	0.62 (0.22)	0.300		0.046
Gender	male	476 (49.2)	490 (49.4)	495 (49.5)	0.994		0.003
	female	491 (50.8)	501 (50.6)	506 (50.5)			
Residence	rural	658 (67.3)	682 (68.5)	665 (66.2)	0.527		0.034
	urban	319 (32.7)	313 (31.5)	340 (33.8)			
Age	16-19	36 (3.7)	27 (2.7)	31 (3.1)	0.922		0.074
	20-29	139 (14.3)	161 (16.2)	140 (13.9)			
	30-39	186 (19.1)	181 (18.2)	195 (19.4)			
	40-49	167 (17.2)	169 (17.0)	183 (18.2)			
	50-59	192 (19.8)	211 (21.2)	202 (20.1)			
	60-69	165 (17.0)	167 (16.8)	170 (16.9)			
	>= 70	87 (9.0)	77 (7.8)	84 (8.4)			
Education	Lower Education	111 (11.4)	107 (10.9)	103 (10.4)	0.721		0.059
	Vocational Training	511 (52.5)	539 (54.7)	521 (52.6)			
	Higher School Certificate	190 (19.5)	187 (19.0)	184 (18.6)			
	University	162 (16.6)	153 (15.5)	182 (18.4)			
Income	First Tercile	251 (25.7)	236 (23.7)	242 (24.1)	0.901		0.046
	Second Tercile	249 (25.5)	263 (26.4)	264 (26.3)			
	Third Tercile	293 (30.0)	301 (30.3)	291 (29.0)			
	NAs	185 (18.9)	195 (19.6)	208 (20.7)			

Table A. 21: Balance table of key covariates - passed manipulation check

		Control	Food treatment	Energy treatment	p	test	SMD
n		978	619	801			
Ideology (0 = left)		5.31 (2.02)	5.09 (1.89)	5.18 (1.93)	0.103		0.074
Climate change concern (0 = low)		5.46 (2.87)	5.80 (2.93)	5.72 (2.98)	0.046		0.077
Policy vulnerability (0 = low)		0.61 (0.21)	0.61 (0.22)	0.64 (0.22)	0.026		0.087
Gender	male	476 (49.2)	298 (48.3)	392 (49.1)	0.934		0.012
	female	491 (50.8)	319 (51.7)	407 (50.9)			
Residence	rural	658 (67.3)	426 (68.8)	522 (65.2)	0.333		0.052
	urban	319 (32.7)	193 (31.2)	279 (34.8)			
Age	16-19	36 (3.7)	12 (1.9)	18 (2.2)	0.244		0.137
	20-29	139 (14.3)	93 (15.0)	96 (12.0)			
	30-39	186 (19.1)	118 (19.1)	158 (19.7)			
	40-49	167 (17.2)	113 (18.3)	154 (19.2)			
	50-59	192 (19.8)	140 (22.7)	177 (22.1)			
	60-69	165 (17.0)	104 (16.8)	134 (16.7)			
	>= 70	87 (9.0)	38 (6.1)	64 (8.0)			
Education	Lower Education	111 (11.4)	58 (9.4)	72 (9.1)	0.484		0.079
	Vocational Training	511 (52.5)	321 (52.0)	418 (52.6)			
	Higher School Certificate	190 (19.5)	130 (21.1)	151 (19.0)			
	University	162 (16.6)	108 (17.5)	154 (19.4)			
Income	First Tercile	251 (31.6)	131 (26.1)	183 (28.2)	0.357		0.093
	Second Tercile	249 (31.4)	176 (35.1)	213 (32.9)			
	Third Tercile	293 (36.9)	194 (38.7)	252 (38.9)			

C.2.2. Perceived Policy Vulnerability

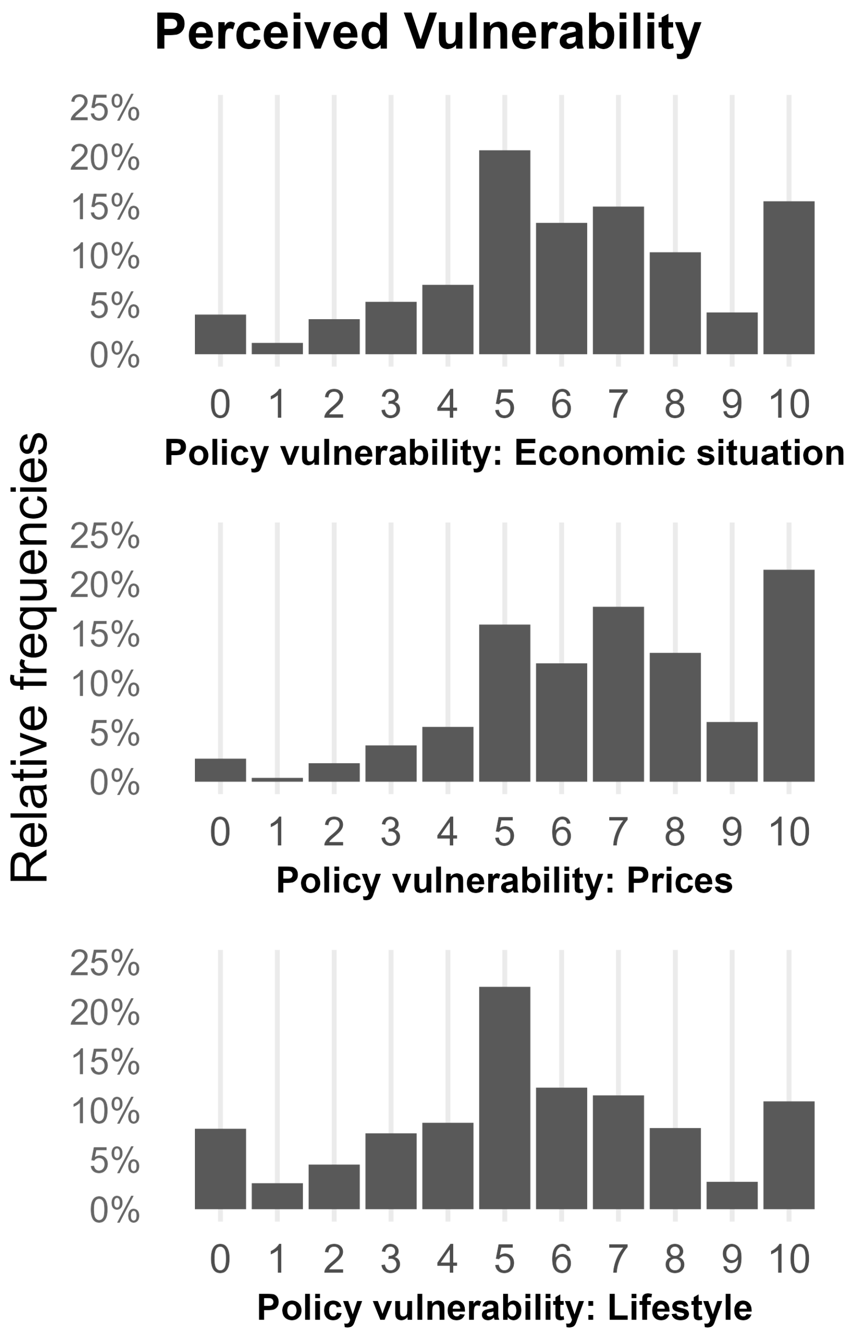

Figure A.19: Perceived policy vulnerability regarding the general economic situation, rising prices, and the way of life, measured on a 0 to 10 scale (0 = low vulnerability).

C.2.3. Policy Support

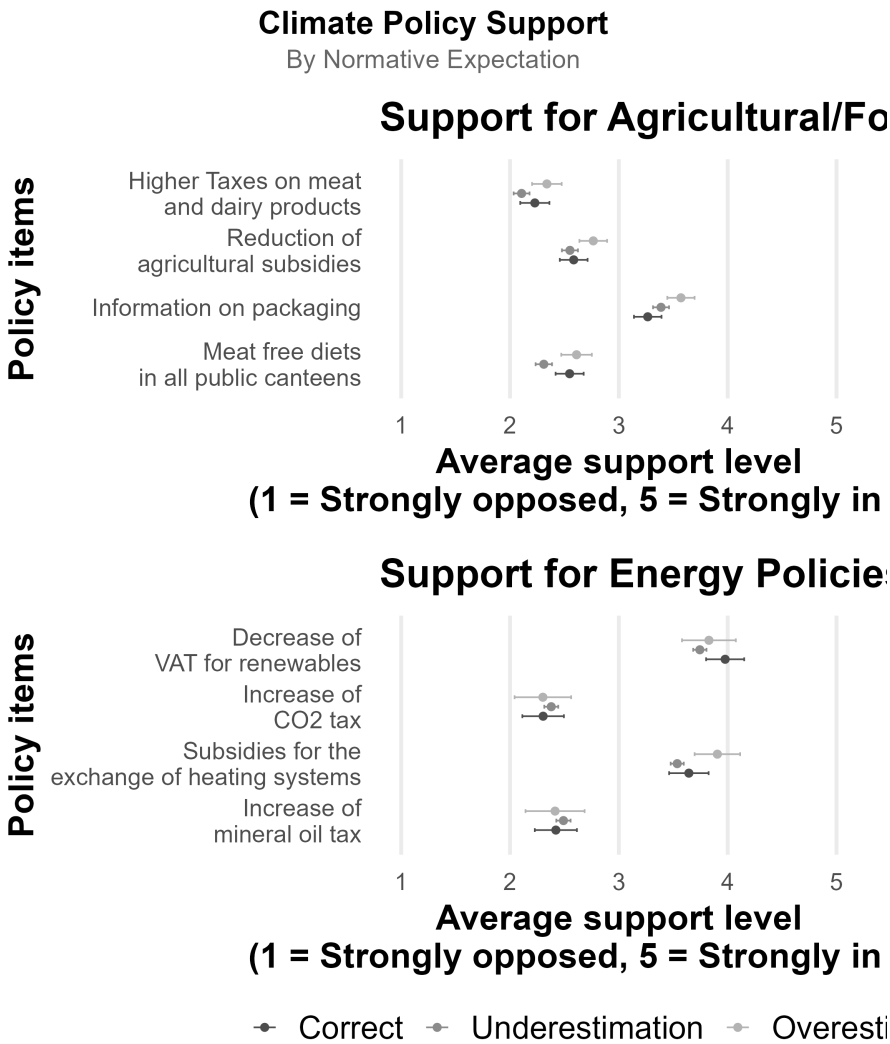

Figure A.20: Support for climate policies in the field of energy by normative expectation of a reduction of meat and dairy consumption.

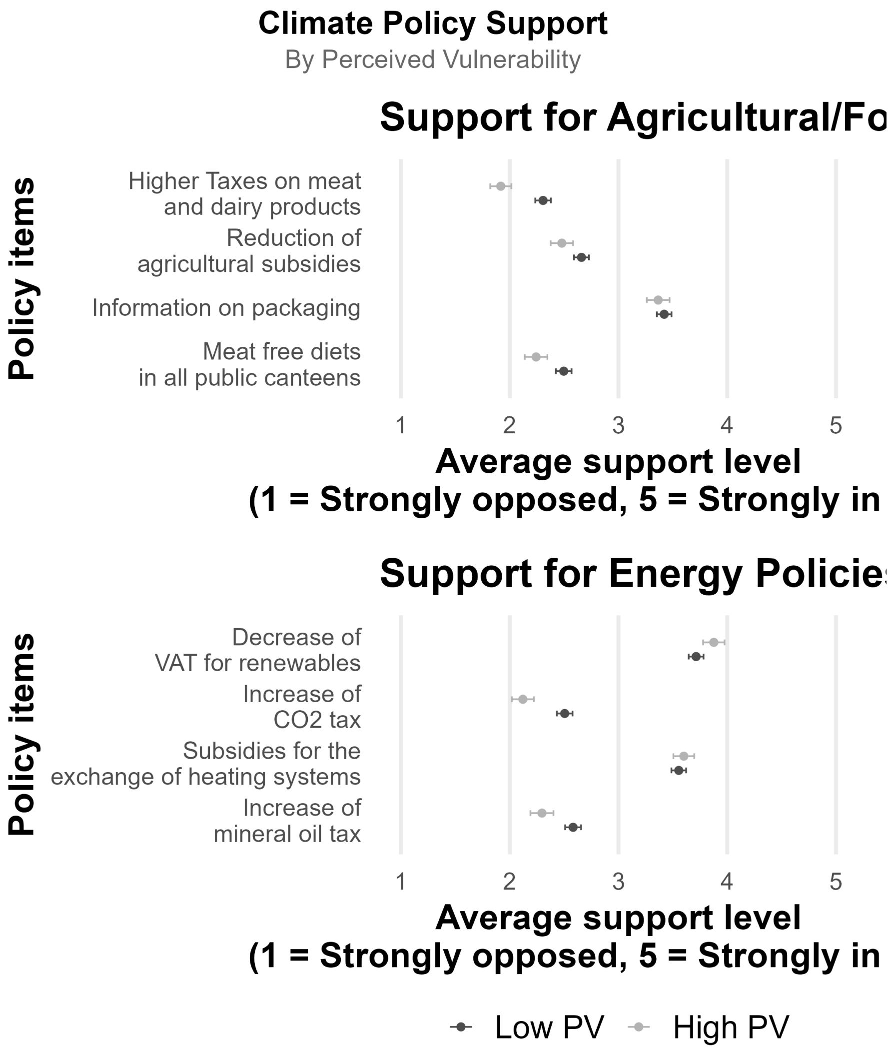

Figure A.21: Support for climate policies in the field of energy by policy vulnerability index. Cut-off for high vulnerability group is at 0.7.

C.3. Results

C.3.1. Results for Overall Policy Support

Table A. 22: OLS regression with heteroskedasticity robust standard errors of mitigation policy support on experimental treatment. Control variables include ideology, climate change concern, age, gender, residence and education.

	Agricultural/Food Policy	Energy Policy
(Intercept)	0.492***	0.520***
	(0.038)	(0.031)
Food treatment (ref.: Control)	0.017+	
	(0.009)	
Energy treatment		0.024**
		(0.007)
High perceived policy vulnerability (ref.: 0 = low)	−0.027**	−0.028***
	(0.009)	(0.008)
Normative expectation dietary habits Underestimation (ref.: Correct)	−0.006	
	(0.012)	
Overestimation	0.025+	
	(0.014)	
Normative expectation energy saving Underestimation (ref.: Correct)		−0.003
		(0.011)
Overestimation		−0.003
		(0.019)
Ideology (0 = left)	−0.009**	−0.011***
	(0.003)	(0.002)
Climate change concern (0 = low)	0.022***	0.024***
	(0.002)	(0.001)
N	1451	1617
R2	0.213	0.268
R2 Adj.	0.203	0.260

+ $p < 0.1$, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table A. 23: OLS regression with heteroskedasticity robust standard errors of mitigation policy support on experimental treatment interacted with normative beliefs. Control variables include policy vulnerability, ideology, climate change concern, age, gender, residence and education.

	Agricultural/Food Policy	Energy Policy
(Intercept)	0.489***	0.521***
	(0.039)	(0.033)
Food treatment (ref.: Control)	0.024	
	(0.022)	
Energy treatment		0.024
		(0.020)
High perceived policy vulnerability (ref.: 0 = low)	−0.027**	−0.028***
	(0.009)	(0.008)
Normative expectation dietary habits Underestimation (ref.: Correct)	−0.003	
	(0.015)	
Overestimation	0.029	
	(0.018)	
Normative expectation energy saving Underestimation (ref.: Correct)		−0.002
		(0.016)
Overestimation		−0.014
		(0.025)
Food treatment × Underestimation	−0.007	
	(0.024)	
Food treatment × Overestimation	−0.010	
	(0.029)	
Energy treatment × Underestimation		−0.002
		(0.022)
Energy treatment × Overestimation		0.032
		(0.037)
Ideology (0 = left)	−0.009**	−0.011***
	(0.003)	(0.002)
Climate change concern (0 = low)	0.022***	0.024***
	(0.002)	(0.001)
N	1451	1617
R2	0.213	0.269
R2 Adj.	0.202	0.260

+ $p < 0.1$, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table A. 24: OLS regression with heteroskedasticity robust standard errors of mitigation policy support on experimental treatment interacted with perceived policy vulnerability. Control variables include normative beliefs, ideology, climate change concern, age, gender, residence and education.

	Agricultural/Food Policy	Energy Policy
(Intercept)	0.490***	0.519***
	(0.038)	(0.031)
Food treatment (ref.: Control)	0.023*	
	(0.011)	
High perceived policy vulnerability (ref.: 0 = low)	−0.021+	−0.027*
	(0.012)	(0.011)
Food treatment × High perceived policy vulnerability	−0.016	
	(0.019)	
Energy treatment		0.024**
		(0.009)
Energy treatment × High perceived policy vulnerability		−0.002
		(0.015)
Normative expectation dietary habits Underestimation (ref.: Correct)	−0.006	
	(0.012)	
Overestimation	0.025+	
	(0.014)	
Normative expectation energy saving Underestimation (ref.: Correct)		−0.003
		(0.011)
Overestimation		−0.003
		(0.019)
Ideology (0 = left)	−0.009**	−0.011***
	(0.003)	(0.002)
Climate change concern (0 = low)	0.021***	0.024***
	(0.002)	(0.001)
Num.Obs.	1451	1617
R2	0.213	0.268
R2 Adj.	0.203	0.260

+ $p < 0.1$, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

C.3.2. Results for Support by Policy Type

Table A. 25: OLS regression with heteroskedasticity robust standard errors of push and pull mitigation policy support on experimental treatment. Control variables include policy vulnerability, normative expectations, ideology, climate change concern, age, gender, residence and education.

	Agricultural/ Food Policy - Push	Agricultural/ Food Policy - Pull	Energy Policy - Push	Energy Policy - Pull
(Intercept)	0.454***	0.532***	0.424***	0.605***
	(0.045)	(0.042)	(0.043)	(0.039)
Food treatment (ref.: Control)	0.007	0.030**		
	(0.011)	(0.010)		
Energy treatment			0.011	0.038***
			(0.010)	(0.009)
High perceived policy vulnerability (ref.: 0 = low)	−0.037***	−0.017	−0.058***	0.010
	(0.011)	(0.011)	(0.011)	(0.010)
Normative expectation dietary habits Underestimation (ref.: Correct)	−0.003	−0.006		
	(0.014)	(0.013)		
Overestimation	0.019	0.025		
	(0.017)	(0.016)		
Normative expectation energy saving Underestimation (ref.: Correct)			0.008	−0.019
			(0.015)	(0.016)
Overestimation			−0.021	0.016
			(0.026)	(0.023)
Ideology (0 = left)	−0.008*	−0.012***	−0.015***	−0.008**
	(0.003)	(0.003)	(0.003)	(0.003)
Climate change concern (0 = low)	0.019***	0.025***	0.034***	0.016***
	(0.002)	(0.002)	(0.002)	(0.002)
N	1451	1451	1617	1617
R2	0.144	0.226	0.324	0.108
R2 Adj.	0.134	0.217	0.317	0.099

+ $p < 0.1$, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table A. 26: OLS regression with heteroskedasticity robust standard errors of push and pull mitigation policy support on experimental treatment interacted with normative beliefs. Control variables include policy vulnerability ideology, climate change concern, age, gender, residence and education.

	Agricultural/ Food Policy - Push	Agricultural/ Food Policy - Pull	Energy Policy - Push	Energy Policy - Pull
(Intercept)	0.461***	0.520***	0.427***	0.607***
	(0.047)	(0.043)	(0.044)	(0.042)
Food treatment (ref.: Control)	−0.011	0.065**		
	(0.026)	(0.024)		
Energy treatment			0.006	0.035
			(0.028)	(0.029)
Normative expectation dietary habits Underestimation (ref.: Correct)	−0.010	0.010		
	(0.018)	(0.017)		
Overestimation	0.007	0.040+		
	(0.022)	(0.020)		
Normative expectation energy saving Underestimation (ref.: Correct)			0.006	−0.019
			(0.020)	(0.023)
Overestimation			−0.033	−0.001
			(0.034)	(0.032)
Food treatment × Underestimation	0.018	−0.041		
	(0.029)	(0.027)		
Food treatment × Overestimation	0.031	−0.041		
	(0.035)	(0.032)		
Energy treatment × Underestimation			0.004	0.000
			(0.030)	(0.031)
Energy treatment × Overestimation			0.031	0.045
			(0.054)	(0.046)
High perceived policy vulnerability (ref.: 0 = low)	−0.036**	−0.017	−0.058***	0.010
	(0.011)	(0.011)	(0.011)	(0.010)
Ideology (0 = left)	−0.008*	−0.012***	−0.015***	−0.008***
	(0.003)	(0.003)	(0.003)	(0.003)
Climate change concern (0 = low)	0.019***	0.025***	0.034***	0.016***
N	1451	1451	1617	1617
R2	0.145	0.227	0.324	0.109
R2 Adj.	0.133	0.217	0.316	0.098

+ $p < 0.1$, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table A. 27: OLS regression with heteroskedasticity robust standard errors of mitigation policy support on experimental treatment interacted with perceived policy vulnerability. Control variables include normative beliefs, ideology, climate change concern, age, gender, residence and education.

	Agricultural/ Food Policy - Push	Agricultural/ Food Policy - Pull	Energy Policy - Push	Energy Policy - Pull
(Intercept)	0.450***	0.532***	0.423***	0.605***
	(0.045)	(0.043)	(0.043)	(0.039)
Food treatment (ref.: Control)	0.024+	0.029*		
	(0.013)	(0.012)		
Energy treatment			0.012	0.037**
			(0.013)	(0.011)
High perceived policy vulnerability (ref.: 0 = low)	−0.018	−0.018	−0.056***	0.008
	(0.014)	(0.014)	(0.014)	(0.014)
Food treatment × High perceived policy vulnerability	−0.046*	0.004		
	(0.022)	(0.021)		
Energy treatment × High perceived policy vulnerability			−0.005	0.004
			(0.021)	(0.020)
Normative expectation dietary habits Underestimation (ref.: Correct)	−0.003	−0.006		
	(0.014)	(0.013)		
Overestimation	0.018	0.025		
	(0.017)	(0.016)		
Normative expectation energy saving Underestimation (ref.: Correct)			0.008	−0.019
			(0.015)	(0.016)
Overestimation			−0.021	0.016
			(0.026)	(0.023)
Ideology (0 = left)	−0.008**	−0.012***	−0.015***	−0.008**
	(0.003)	(0.003)	(0.003)	(0.003)
Climate change concern (0 = low)	0.019***	0.025***	0.034***	0.016***
N	1451	1451	1617	1617
R2	0.147	0.226	0.324	0.108
R2 Adj.	0.136	0.216	0.316	0.098

+ $p < 0.1$, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

C.3.3. Results for Support by Vulnerability Type and Policy Item

Table A. 28: Ordered logit estimation of food and agricultural policy support on experimental treatment interacted with types of perceived policy vulnerability. Control variables include normative beliefs, ideology, climate change concern, age, gender, residence and education.

	Taxes on meat and dairy production	Reduction of Subsidies	Meat free diets in public canteens	Labeling
Support:				
Strongly opposed|Somewhat opposed	−0.533	−1.027*	−1.579***	−0.883*
	(0.410)	(0.407)	(0.401)	(0.419)
Somewhat opposed|Partly in favor/opposed	0.728+	0.221	−0.493	0.182
	(0.410)	(0.406)	(0.399)	(0.415)
Partly in favor/opposed|Somewhat in favor	1.812***	1.602***	0.861*	1.622***
	(0.412)	(0.409)	(0.399)	(0.418)
Somewhat in favor|Strongly in favor	3.061***	2.784***	1.959***	3.153***
	(0.421)	(0.415)	(0.404)	(0.423)
Food treatment (ref.: Control)	−0.086	0.107	0.099	0.481**
	(0.158)	(0.158)	(0.158)	(0.159)
Policy Vulnerability: Economy (0 = low)	−0.194	−0.003	−0.006	−0.091
	(0.162)	(0.155)	(0.158)	(0.157)
Policy Vulnerability: Prices (0 = low)	−0.676***	−0.302*	−0.408**	0.314*
	(0.158)	(0.152)	(0.153)	(0.155)
Policy Vulnerability: Lifestyle (0 = low)	0.000	0.269+	0.033	−0.100
	(0.159)	(0.155)	(0.157)	(0.154)
Food treatment × High Policy Vulnerability: Economy	0.004	−0.197	−0.255	0.162
	(0.259)	(0.252)	(0.254)	(0.256)
Food treatment × High Policy Vulnerability: Prices	0.306	0.137	0.192	−0.326
	(0.252)	(0.242)	(0.244)	(0.247)
Food treatment × High Policy Vulnerability: Lifestyle	0.036	−0.387	0.138	0.183
	(0.256)	(0.249)	(0.251)	(0.251)
Normative expectation dietary habits Underestimation (ref.: Correct)	−0.082	−0.071	−0.363**	0.227+
	(0.139)	(0.135)	(0.135)	(0.136)
Overestimation	0.114	0.132	−0.033	0.326*
	(0.165)	(0.162)	(0.164)	(0.164)
Ideology (0 = left)	−0.122***	−0.044	−0.137***	−0.083**
	(0.028)	(0.028)	(0.028)	(0.028)
Climate change concern (0 = low)	0.230***	0.143***	0.204***	0.256***
	(0.021)	(0.019)	(0.020)	(0.020)
Num.Obs.	1421	1358	1411	1385
AIC	3775.9	4090.9	3977.9	3960.3
BIC	3912.7	4226.5	4114.4	4096.3

+ $p < 0.1$, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

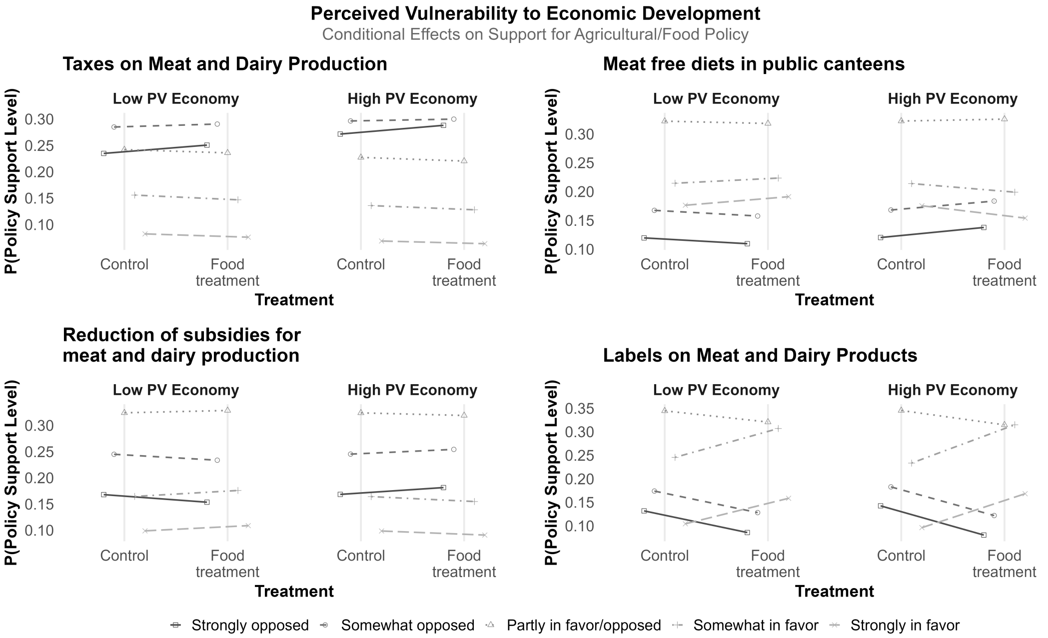

Figure A.22: Ordered logit estimation of food and agricultural policy support on experimental treatment interacted with perceived policy vulnerability regarding the economic development. Control variables include normative beliefs, ideology, climate change concern, age, gender, residence and education.

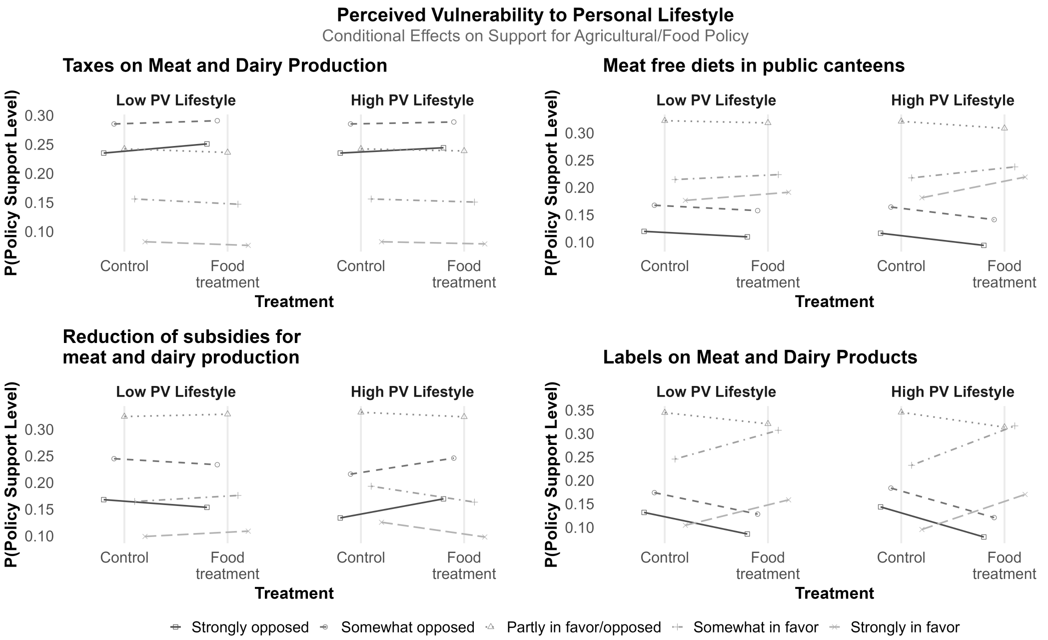

Figure A.23: Ordered logit estimation of food and agricultural policy support on experimental treatment interacted with perceived policy vulnerability regarding the general way of life. Control variables include normative beliefs, ideology, climate change concern, age, gender, residence and education.

Table A. 29: Ordered logit estimation of energy policy support on experimental treatment interacted with types of perceived policy vulnerability. Control variables include normative beliefs, ideology, climate change concern, age, gender, residence and education.

	Increase of CO2 Tax	Increase of Mineral Oil Tax	Increase of Subsidies	Lower VAT for Renewables
Support:				
Strongly opposed|Somewhat opposed	−0.626	−0.677	−1.386***	−1.509***
	(0.422)	(0.412)	(0.395)	(0.386)
Somewhat opposed|Partly in favor/opposed	0.462	0.382	−0.386	−0.644+
	(0.422)	(0.412)	(0.391)	(0.381)
Partly in favor/opposed|Somewhat in favor	1.864***	1.755***	0.992*	0.418
	(0.424)	(0.414)	(0.391)	(0.380)
Somewhat in favor|Strongly in favor	3.492***	3.213***	2.470***	1.872***
	(0.433)	(0.422)	(0.394)	(0.383)
Energy treatment (ref.: Control)	0.035	0.004	0.566***	0.250+
	(0.152)	(0.153)	(0.153)	(0.150)
Policy Vulnerability: Economy (0 = low)	−0.298+	−0.105	0.021	−0.138
	(0.164)	(0.159)	(0.155)	(0.156)
Policy Vulnerability: Prices (0 = low)	−0.494**	−0.609***	0.285+	0.610***
	(0.157)	(0.155)	(0.151)	(0.152)
Policy Vulnerability: Lifestyle (0 = low)	−0.202	−0.082	0.091	−0.082
	(0.164)	(0.158)	(0.152)	(0.154)
Energy treatment × High Policy Vulnerability: Economy	0.077	−0.158	0.038	0.299
	(0.240)	(0.233)	(0.229)	(0.232)
Energy treatment × High Policy Vulnerability: Prices	−0.052	0.054	−0.317	−0.116
	(0.233)	(0.230)	(0.227)	(0.229)
Energy treatment × High Policy Vulnerability: Lifestyle	0.137	0.196	−0.126	−0.010
	(0.242)	(0.236)	(0.228)	(0.230)
Normative expectation energy saving Underestimation (ref.: Correct)	0.105	0.014	−0.129	−0.169
	(0.157)	(0.151)	(0.151)	(0.151)
Overestimation	−0.198	−0.121	0.458*	−0.061
	(0.249)	(0.241)	(0.229)	(0.233)
Ideology (0 = left)	−0.153***	−0.135***	−0.093***	−0.051*
	(0.027)	(0.027)	(0.025)	(0.026)
Climate change concern (0 = low)	0.357***	0.320***	0.174***	0.092***
	(0.021)	(0.020)	(0.018)	(0.018)
N	1563	1554	1571	1575
AIC	4053.2	4216.8	4480.8	4371.8
BIC	4192.4	4355.8	4620.2	4511.2

+ $p < 0.1$, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

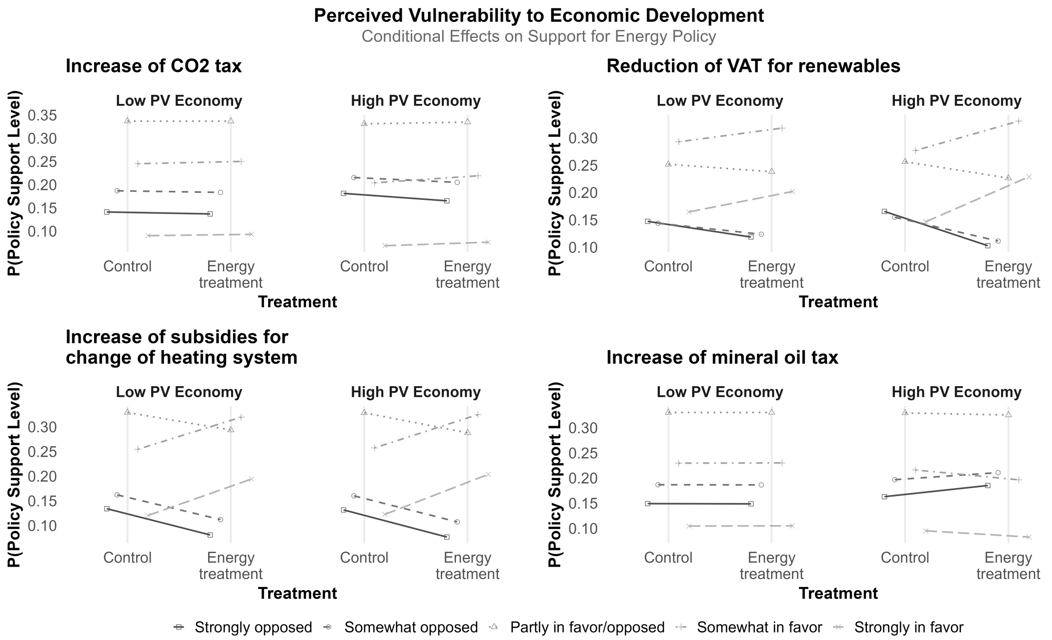

Figure A.24: Ordered logit estimation of energy policy support on experimental treatment interacted with perceived policy vulnerability regarding the economic development. Control variables include normative beliefs, ideology, climate change concern, age, gender, residence and education.

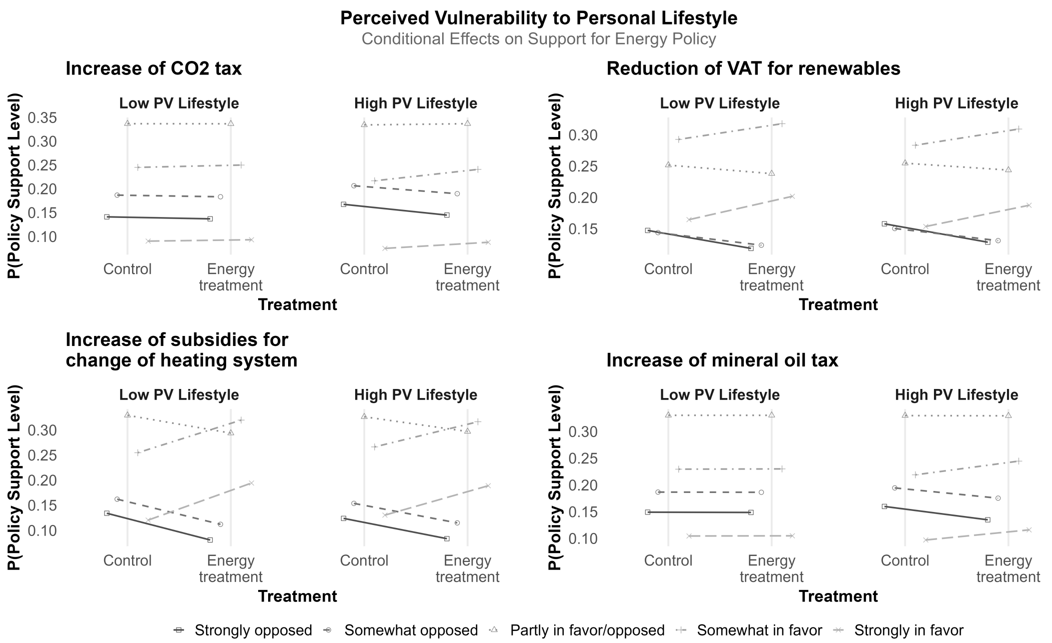

Figure A.25: Ordered logit estimation of energy policy support on experimental treatment interacted with perceived policy vulnerability regarding the general way of life. Control variables include normative beliefs, ideology, climate change concern, age, gender, residence and education.

C.3.4. Full Sample Results

Table A. 30: OLS regression with heteroskedasticity robust standard errors of push and pull mitigation policy support on experimental treatment (full sample). Control variables include policy vulnerability, normative expectations, ideology, climate change concern, age, gender, residence and education.

	Agricultural/ Food Policy - Push	Agricultural/ Food Policy - Pull	Energy Policy - Push	Energy Policy - Pull
(Intercept)	0.465***	0.536***	0.420***	0.575***
	(0.039)	(0.036)	(0.039)	(0.036)
Food treatment				
(ref.: Control)	0.001	0.014		
	(0.009)	(0.009)		
Energy treatment				
(ref.: Control)			0.013	0.018*
			(0.010)	(0.009)
High perceived policy vulnerability				
(ref.: 0 = low)	−0.041***	−0.014	−0.057***	0.011
	(0.010)	(0.009)	(0.010)	(0.010)
Normative expectation dietary habits				
Underestimation (ref.: Correct)	0.000	−0.001		
	(0.012)	(0.012)		
Overestimation	0.019	0.023		
	(0.015)	(0.014)		
Normative expectation energy saving				
Underestimation (ref.: Correct)			0.010	−0.026+
			(0.015)	(0.016)
Overestimation			−0.020	0.011
			(0.026)	(0.023)
Ideology (0 = left)	−0.007*	−0.012***	−0.015***	−0.008**
	(0.003)	(0.003)	(0.003)	(0.002)
Climate change concern (0 = low)	0.019***	0.024***	0.034***	0.016***
	(0.002)	(0.002)	(0.002)	(0.002)
N	1774	1774	1781	1781
R2	0.142	0.208	0.317	0.107
R2 Adj.	0.134	0.200	0.311	0.099
AIC	−765.6	−1004.5	−661.6	−897.9
BIC	−661.5	−900.4	−557.4	−793.7

+ $p < 0.1$, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table A. 31: OLS regression with heteroskedasticity robust standard errors of push and pull mitigation policy support on experimental treatment interacted with normative beliefs (full sample). Control variables include policy vulnerability ideology, climate change concern, age, gender, residence and education.

	Agricultural/ Food Policy - Push	Agricultural/ Food Policy - Pull	Energy Policy - Push	Energy Policy - Pull
(Intercept)	0.473***	0.526***	0.425***	0.569***
	(0.041)	(0.038)	(0.041)	(0.040)
Food treatment (ref.: Control)	−0.016	0.033		
	(0.022)	(0.020)		
Energy treatment (ref.: Control)			0.004	0.033
			(0.027)	(0.029)
Normative expectation dietary habits Underestimation (ref.: Correct)	−0.010	0.009		
	(0.019)	(0.017)		
Overestimation	0.006	0.040+		
	(0.022)	(0.020)		
Normative expectation energy saving Underestimation (ref.: Correct)			0.006	−0.016
			(0.020)	(0.023)
Overestimation			−0.033	0.000
			(0.034)	(0.032)
Food treatment × Underestimation	0.019	−0.020		
	(0.025)	(0.023)		
Food treatment × Overestimation	0.025	−0.035		
	(0.030)	(0.028)		
Energy treatment × Underestimation			0.009	−0.021
			(0.029)	(0.031)
Energy treatment × Overestimation			0.030	0.029
			(0.053)	(0.045)
High perceived policy vulnerability (ref.: 0 = low)	−0.041***	−0.015	−0.057***	0.011
	(0.010)	(0.009)	(0.010)	(0.010)
Ideology (0 = left)	−0.007*	−0.012***	−0.015***	−0.008**
	(0.003)	(0.003)	(0.003)	(0.002)
Climate change concern (0 = low)	0.019***	0.024***	0.034***	0.016***
	(0.002)	(0.002)	(0.002)	(0.002)
N	1774	1774	1781	1781
R2	0.143	0.208	0.317	0.108
R2 Adj.	0.133	0.200	0.310	0.099
AIC	−762.4	−1002.0	−658.0	−896.1
BIC	−647.3	−886.9	−542.8	−780.9

+ $p < 0.1$, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table A. 32: OLS regression with heteroskedasticity robust standard errors of mitigation policy support on experimental treatment interacted with perceived policy vulnerability (full sample). Control variables include normative beliefs, ideology, climate change concern, age, gender, residence and education.

	Agricultural/ Food Policy - Push	Agricultural/ Food Policy - Pull	Energy Policy - Push	Energy Policy - Pull
(Intercept)	0.457***	0.537***	0.420***	0.576***
	(0.039)	(0.037)	(0.040)	(0.036)
Food treatment				
(ref.: Control)	0.017	0.011		
	(0.011)	(0.011)		
Energy treatment				
(ref.: Control)			0.014	0.015
			(0.012)	(0.011)
High perceived				
policy vulnerability				
(ref.: 0 = low)	−0.018	−0.018	−0.056***	0.007
	(0.014)	(0.014)	(0.014)	(0.014)
Food				
treatment ×				
High perceived				
policy vulnerability	−0.046*	0.007		
	(0.019)	(0.018)		
Energy				
treatment ×				
High perceived				
policy vulnerability			0.000	0.008
			(0.020)	(0.019)
Normative expectation				
dietary habits				
Underestimation (ref.: Correct)	0.000	−0.001		
	(0.012)	(0.012)		
Overestimation	0.018	0.023		
Normative expectation				
energy saving				
Underestimation (ref.: Correct)			0.010	−0.026+
			(0.015)	(0.016)
Overestimation			−0.020	0.011
			(0.026)	(0.023)
	(0.015)	(0.014)		
Ideology (0 = left)	−0.007*	−0.012***	−0.015***	−0.008**
	(0.003)	(0.003)	(0.003)	(0.002)
Climate change concern (0 = low)	0.019***	0.024***	0.034***	0.016***
	(0.002)	(0.002)	(0.002)	(0.002)
N	1774	1774	1781	1781
R2	0.145	0.208	0.317	0.107
R2 Adj.	0.136	0.200	0.310	0.098
AIC	−769.3	−1002.7	−659.6	−896.1
BIC	−659.7	−893.0	−549.9	−786.4

+ $p < 0.1$, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

D. Abstract

D.1. English Abstract

Climate change confronts welfare states with a dual eco-social risk: mounting natural hazards and disruptive economic transition pressures. Meeting the Paris Agreement's 1.5 °C target requires costly mitigation policies with uncertain future benefits, while immediate natural consequences demand public spending on adaptation policies. These material pressures intersect with contested social norms about climate-appropriate behavior, creating a political dilemma: governments must impose costly policies to manage eco-social risks, yet democratic feasibility depends on public support. This dissertation examines how welfare state responses can reconcile citizens' material vulnerabilities with normative appeals for climate-friendly behavior, highlighting a potential trade-off between economic needs and social approval. The first paper analyzes labor-market risks of decarbonization. By analyzing skill and task descriptions across green and brown sectors, it introduces a novel indicator of green skill transferability. The findings show that workers in high-polluting industries are most exposed to transition risks but also possess the highest transferable green skills, demonstrating both the necessity and cost-efficiency of targeted retraining. The second paper examines perceived vulnerability to climate change and climate policy through an original conjoint experiment. It shows that subjective vulnerability strongly predicts support for both mitigation and adaptation. Tailored compensation effectively increases support among those vulnerable to climate impacts, but fails to persuade citizens who anticipate losses from climate policy itself – revealing limits of compensation. The third paper directly tests the trade-off between material needs and social approval using a belief-updating experiment. It finds that citizens vulnerable to climate policy resist climate-friendly normative information, especially for intrusive or expensive measures, indicating that vulnerability dampens responsiveness to pro-environmental norms. Together, the three papers demonstrate that effective welfare state responses to eco-social risks require detailed vulnerability profiling that integrates objective exposure and subjective perceptions. Compensation and retraining can address material risks only to a limited extent and normative appeals alone cannot overcome policy-related insecurity, underscoring a fundamental trade-off shaping public support for climate action.

D.2. German Abstract

Der Klimawandel konfrontiert Wohlfahrtsstaaten mit einem doppelten öko-sozialen Risiko: zunehmende Naturgefahren und tiefgreifender ökonomischer Transformationsdruck. Die Einhaltung des 1,5-°C-Ziels des Pariser Abkommens erfordert kostspielige Klimapolitik mit nur vagem zukünftigen Nutzen. Bereits eintretende Klimawandeleffekte verlangen hingegen sofortige öffentliche Ausgaben für Anpassungspolitiken. Diese materiellen Belastungen überschneiden sich mit kontestierten sozialen Normen über klimanfreundliches Verhalten und erzeugen ein politisches Dilemma: Regierungen müssen kostspielige Politiken zur Bewältigung öko-sozialer Risiken durchsetzen, doch ihre demokratische Umsetzbarkeit hängt von öffentlicher Unterstützung ab. Diese Dissertation untersucht, wie wohlfahrtsstaatliche Antworten die materiellen Vulnerabilitäten von Bürger:innen mit normativen Appellen zu klimafreundlichem Verhalten in Einklang bringen können. Dabei untersucht sie einen möglichen Zielkonflikt zwischen ökonomischen Bedürfnissen und sozialer Anerkennung. Der erste Beitrag analysiert Arbeitsmarktrisiken der Dekarbonisierung. Durch die Auswertung von Kompetenz- und Tätigkeitsbeschreibungen in grünen und braunen Sektoren führt er einen neuen Indikator für die Übertragbarkeit grüner Kompetenzen ein. Die Ergebnisse zeigen, dass Beschäftigte in stark emittierenden Branchen Transformationsrisiken am stärksten ausgesetzt sind. Zugleich verfügen sie aber über die höchsten übertragbaren grünen Kompetenzen, was sowohl die Notwendigkeit als auch die Kosteneffizienz zielgerichteter Weiterqualifizierung nahelegt. Der zweite Beitrag untersucht wahrgenommene Vulnerabilität gegenüber dem Klimawandel und der Klimapolitik mittels eines Conjoint-Experiments. Er zeigt, dass subjektive Vulnerabilität die Unterstützung für Minderungs- und Anpassungspolitiken stark vorhersagt. Maßgeschneiderte Kompensation erhöht die Zustimmung unter klimavulnerablen Personen wirksam, scheitert jedoch bei Bürger:innen, die Verluste durch Klimapolitik selbst erwarten – und offenbart damit Grenzen materieller Kompensation. Der dritte Beitrag testet den Zielkonflikt zwischen materiellen Bedürfnissen und sozialer Anerkennung direkt in einem Belief-Updating-Experiment. Er zeigt, dass gegenüber Klimapolitik vulnerable Bürger:innen klimafreundliche normative Informationen weniger stark rezipieren. Dies ist insbesondere bei kostspieligen (Zwangs-)Maßnahmen der Fall, was darauf hindeutet, dass Vulnerabilität die Responsivität gegenüber pro-ökologischen Normen dämpft. Zusammen zeigen die drei Beiträge, dass wirksame wohlfahrtsstaatliche Antworten auf öko-soziale Risiken detailierte Einblicke in individuell Vulnerabilitäten erfordern, die objektive Risiken und subjektive Wahrnehmungen integrieren. Kompensation und Weiterqualifizierung können materielle Risiken nur bedingt adressieren und normative Appelle allein sind nicht ausreichend, um Klimapolitikbedingte Risikowahrnehmungen zu überwinden. Dies unterstreicht einen grundlegen Trade-off in der Klimapolitik.