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Coping with decarbonisation: An inventory of strategies from resistance to transformation

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ABSTRACT

Decarbonisation is progressing rapidly and different actors respond to its impacts in different ways. Whether these responses seek to resist decarbonisation, adapt to new realities, or fundamentally transform the social and economic conditions that define decarbonisation contexts depends on the actor groups in question and the resources they are able to draw upon. This paper provides an overview of the kinds of "coping strategies" used by different actor groups in response to decarbonisation policy by inventorying these responses across eleven European carbon intensive regions in transitions. Using newspaper data, local level focus groups and elite interviews, a data set of 651 responses was created. Actions were grouped into 8 themes and 34 discrete strategies. These strategies reveal a wide range of responses. They demonstrate that resistance responses often reflect unaddressed injustices, that many governments are focused on decarbonisation strategies that substitute renewables for fossil fuels without changing wider socioeconomic conditions, and that there is broad appetite on the part of publics for more transformative strategies that allow deeper participation and representation, and reshape who benefits, and how, from the reorganisation of energy systems.

1. Introduction

For those living, working and governing in carbon-intensive regions, decarbonization is creating rapid and fundamental changes as industries related to coal, oil and gas are phased out. This is causing cascading impacts across social, economic, political and cultural spheres (Baran et al., 2020; Sovacool, 2021). In response to these changes, actors across scales cope in different ways. These "coping strategies" are highly consequential. They shape progress toward decarbonization, but also have implications for social and economic wellbeing, distribution of wealth and influence, and democratic quality. They are also increasingly enabled, or impeded, by the extent to which they are considered "just" by different populations (Axon and Morrissey, 2020; Arora and Schroeder, 2022).

The justice implications of transition have become an increasing focus of research (Swilling et al., 2016; e.g., Gürtler and Herberg, 2023), and a key feature of state decarbonization policies (Moesker and Pesch, 2022; McCauley et al., 2023). In practice, whether a transition is considered just depends on the perceptions of affected actors, and the ways that costs and benefits are distributed, decisions are made, and interests are recognised (McCauley et al., 2013; Sovacool and Dworkin, 2014).

This paper introduces an inventory of strategies used by different actors to cope with the impacts of decarbonization policies, with implications for justice in transitions, inductively developed from 636 individual coping "actions" identified as occurring in response to decarbonization policies across 11 carbon-intensive regions within the EU. Because decarbonization is a systemic issue that involves addressing all the ways that carbon intensity is embedded in economies and practices, decarbonization policies are defined broadly as any policy seeking to create, shape or support conditions that will lead to decarbonization. This covers a broad spectrum including, for example, divestment policies, support for renewable energy development, collaborations to support decarbonization, or energy efficiency measures. This open approach enables a systemic examination of trends in how different actors are responding to the different ways that decarbonization policy is manifesting.

Who copes is equally as important because differences in actor positioning, scale and resources shape the range of options available to them, and the potential impact of any strategy (Avelino and Wittmayer,

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2016; Gaventa, 2019). For example, multi-national corporations with elite access to politicians cope in very different ways to individual citizens, and have different mechanisms for recourse if they are unhappy with policy developments. This provides useful information regarding what to expect from different actor groups as decarbonization processes progress.

We develop a spectrum for evaluating coping strategies according to whether they resist, adapt to, or attempt to transform conditions, drawing upon research on climate change adaptation (Wolf, 2011; Peñalba et al., 2012; e.g., Neef et al., 2018), resistance to infrastructure projects (Temper et al., 2020; e.g., Sovacool et al., 2022), and social adaptation and transformation (e.g., O'Brien, 2012; Patterson et al., 2017; Scoones et al., 2020). This helps explore the implications of different types of strategies for both decarbonization potential, and their potential to contribute to more just outcomes.

This paper provides a high-level overview of who copes and in what ways, in response to decarbonization policy in carbon-intensive regions in the EU. We next establish background on justice in transitions, and develop the resist-adapt-transform spectrum. We present our research design and then describe the strategies, followed by a discussion of their implications for progress toward just decarbonization outcomes. Finally, we close with thoughts on how the inventory can help inform future research and decarbonization policy design.

2. Background

2.1. Justice in transitions

Justice is commonly viewed through distributional, procedural and recognitional perspectives, although many other perspectives exist (McCauley and Heffron, 2018). When considering decarbonization, issues of distribution concern where and to whom fall the costs and benefits of efforts to decarbonize. For example, those experiencing the impacts of utility-scale renewable energy development are often not those who receive financial benefits, with profits usually going to corporate shareholders (Dunlap and Arce, 2022).

Procedural justice focuses on the processes by which decarbonization happens, including how decisions are made and who is included. This can encompass the quality of democratic representation, and how that impacts political decision-making processes, and the presence or quality of consultation or public participation. Procedural justice also includes the ways that concerns about how transitions are progressing are handled (Jenkins et al., 2016).

Recognitional justice directs attention to the extent to which affected parties are accounted for in decarbonization processes. This can overlap with issues of inclusion addressed through procedural justice, but also directs attention to systemic or historical injustices that have shaped specific contexts (Hermwille et al., 2023). For example, many carbon-intensive regions score lower on key macro-economic indicators than other European regions (Vrontisi et al., 2024), and therefore may not have the same capacity to adapt to decarbonization impacts as regions with higher historical educational attainment and economic development (e.g., Hess et al., 2021).

When examining decarbonization from the perspective of different actors at different scales, as we do in this study, it is also important to note that perceptions of (in)justice are highly subjective (Sovacool et al., 2019). This has implications for how different actors respond to decarbonization policy, and how policy actors can respond. For example, fossil energy industry might claim "equitable treatment" in demanding government incentives to transition without suffering severe economic losses, even while this perpetuates or create injustices in the distribution of transition funds. Trade unions might find a transition unjust if any new jobs are not as well paid as those being lost (Stevis and Felli, 2015; Normann and Tellmann, 2021; Kalt, 2022). The development of new renewable industries can be unjust if they perpetuate or exacerbate issues of resource extraction in already disadvantaged communities (Cantoni, Skræp Svenningsen and Sanfo, 2021; Allan et al., 2022; Dunlap and Arce, 2022).

Important justice issues also arise when decarbonization is driven through top-down decisions, as is the case with the imposition of EU transition timelines on member states. Clashes between national and EU priorities can foreground justice issues. This is the case in Poland, grappling with a large legacy coal industry that is no longer profitable (Nowakowska, Rzeńca and Sobol, 2021), and in Greece, which was required to undertake an austerity program while transitioning (Nikas et al., 2020). Perceived injustices can also empower right-wing populism, as has happened in former coal-intensive regions such as the Nord-Pas de Calais Mining Basin in France (Alidières, 2004).

Perceptions of, and responses to, issues of justice have significant consequences for decarbonization progress. They can slow, or even halt, decarbonization actions. However, examining justice through different dimensions makes clear that decarbonization is not occurring in a vacuum and is instead layered on top of complex socioeconomic systems that are already characterized by injustices that can be exacerbated by decarbonization efforts (Hermwille et al., 2023). Examining how different actors cope with decarbonization through coping strategies, categorized below, can provide important information on the justice issues that need to be addressed to facilitate decarbonization.

2.2. Actors and responses

An actor is "a social entity, … a person or organisation, or a collective of persons and organizations, which is able to act" (Avelino and Wittmayer, 2016:7). Different actors have different resources available for coping, and can exercise influence at different scales. For example, the options available to an individual worker facing redundancy are very different from those available to a multi-national corporation facing a carbon tax. Gaventa (2019) outlines three vectors describing how the possible responses available to an actor can be made visible. First, the decision-making levels to which they have access at, for example, the local, regional, national, translocal or international level define the extent to which they can influence. Second, the capacities, resources and forms of power an actor has at their disposal through, for example, money, ability to influence policy decisions, or ability to shape the public imaginary, define the strategies they are able to use (see also Lukes, 2005). Finally, the venues where an actor is able to take action shapes whether coping happens, for example, in direct conversation with policy makers, in invited spaces like public consultations, or through collective action or civic mobilisation. While full analysis of why actors respond the way they do is beyond the scope of this study, these vectors help to understand why some actors are able to undertake specific strategies, and why these strategies are not available to all actors.

2.3. Resistance, adaptation and transformation

Research into climate change impact responses is often grounded in perspectives on socio-ecological systems and resilience, including Walker et al. (2004) and Folke et al.'s (2010) frameworks of resilience, adaptation and transformation. There, resilience is the capacity of a system to change within set boundaries and "retain essentially the same function, structure and feedbacks, and therefore identity" (Folke et al., 2010). Adaptation is perceived as a critical component of resilience and is the ability to respond to changing conditions to "allow development along the current trajectory" (Folke et al., 2010). Pelling (2010) refers to this stage as "transition" and differentiates between continuing along existing trajectories and broader transformation processes that require a realignment and redefinition of existing trajectories. From this perspective, transformation is enabled by resilience and adaptation and reflects "the capacity to create a fundamentally new system when ecological, economic, or social structures make the existing system untenable" (Walker et al., 2004:5). The distinction between adaptation (or

transition) and transformation is fuzzy because transformation is often an extension or progression of adaptation actions. These actions can become transformative when pressure to change is high, or when scaled up or out (Göpel, 2016; Barnes et al., 2017).

These frameworks provide helpful conceptual building blocks for understanding human responses to internal and external pressures, and reveal that different types of responses are interlinked and feed into each other. However, they focus on responding to the physical and unchangeable – at least in the short term – impacts of climate change, rather than on responses to human-devised, and therefore contestable, decarbonization policies. For example, when examining responses to decarbonization policy, it makes less sense to speak of resilience in the face of immutable pressures, than to focus on different ways that actors might resist policies or seek to change them. The intention of resistance is similar to that of resilience i.e., retaining similar functions, structures, feedbacks and identity, but this is expressed politically through resistance strategies that seek, if possible, to reverse or change policy decisions. This is developed further below, together with conceptualizations of adaptation and transformation that are directly relevant for responding to decarbonization policy.

2.3.1. Resistance

Resistance is a common feature of decarbonization policy responses. We define resistance strategies as those that seek to preserve current conditions and resist drivers of change. Such strategies include resistance to three types of activities: to phase-out of, for example, coal mines, processing facilities, or factories (Abraham, 2017; Brauers and Oei, 2020; Temper et al., 2020; Sovacool et al., 2022); to the creation of new, decarbonized infrastructures like wind turbines or solar farms (Avila et al., 2022; Sovacool et al., 2022); and, to financial and regulatory mechanisms that aim to support low-carbon transitions (e.g. carbon taxes) (Mehleb et al., 2021).

Resistance differs depending on who is resisting. Research on social movements identifies strategies such as protest or mobilisation that arise at the interface between top-down efforts to decarbonize, and bottom-up efforts to address issues of justice and distribution (Del Bene et al., 2018). For these actors, resistance to decarbonization can be driven by, for example, concern over personal socioeconomic impacts (Sovacool, 2021), political and economic ideologies (Stanley, Wilson and Milfont, 2021; Sovacool and Dunlap, 2022), attachment to place (Devine-Wright and Batel, 2017), climate denialism (Ekberg et al., 2022), and concern over health or safety impacts (Kirchherr et al., 2016).

The motivations for resistance of firms often differ from those of social movements. These types of actors tend to push back against decarbonization efforts that threaten existing political and economic orders in an attempt to maintain conditions that allow profit generation (Newell, 2008). Governments from the local to the national have more diverse mandates than companies, yet will often prioritise solutions that support companies in their pursuit of profit as this tends to support economic growth (Fuchs, 2007).

For all actors, the reasons for, and types of, resistance are nuanced and shaped by the extent to which context-specific governing systems and institutional settings provide potential arenas for action (Sovacool et al., 2022). For example, in countries where meaningful participation and inclusion are normal parts of wind planning processes, there is usually less resistance because many concerns are integrated and addressed during the institutionalized process (Armeni, 2016). Thus, resistance strategies can indicate failures to adequately account for different views, perspectives and positions in decarbonization plans and projects.

2.3.2. Adaptation

Adaptation to decarbonization policy, in contrast to resistance, reflects an acceptance of the premise that decarbonization policies are inevitable and changes must be made. These strategies represent behavioural and institutional responses to adjust to changing conditions while protecting, intentionally or not, the functioning and direction of existing socioeconomic, political and cultural systems from substantial change (Barnes et al., 2017). These are strategies focused on reducing vulnerability to change without contesting larger systems (O'Brien, 2012). This is analogous with forms of sociotechnical transition that "fit and conform" into incumbent regimes without, at least initially, challenging existing structures and functioning, or political power relationships (Smith and Raven, 2012). However, adaptations can induce changes in institutions, rules, values and norms that have wider implications (Adger et al., 2005).

Adaptation strategies are inherently political because the range of possible adaptive responses is a function of how the decarbonization problem has been framed, usually by elite actors, and of the very different vulnerabilities and capabilities of coping actors (Eriksen et al., 2015). Decarbonization efforts have differential impacts depending on, for example, the level of dependence of an actor on carbon resources. However, actors are not beginning their responses as equals (Hermwille et al., 2023). Instead, choices for adaptative actions need to be understood as constituted by existing structures and capacities, and these vary with actors, and existing distributions of wealth, resources and power (e.g., Barnes et al., 2017; Hölscher et al., 2018).

Adaptation actions can also represent resistance in disguise. Actors may respond to decarbonization policies by embracing solutions that provide some progress toward decarbonization, but also act to further entrench fossil fuel interests. This is a form of "greenwashing" (de Freitas Netto et al., 2020). For example, hydrogen projects are often proposed with either an implicit or explicit assumption that hydrogen will be made from renewables, but seek to operate mainly using hydrogen made from natural gas (Gordon et al., 2024). It can therefore be helpful to note "adapt-resist" actions in cases where the appearance of adaptation is sought, but without a clear commitment to decarbonization.

2.3.3. Transformation

Transformative coping strategies are those that move beyond adaptation and challenge the stability of the existing system by introducing "fundamental changes in structural, functional, relational, and cognitive aspects of socio-technical-ecological systems that lead to new patterns of interactions and outcomes" (Patterson et al., 2017). These types of strategies seek or imply significant shifts in the structure and orientation of systems (O'Brien, 2012; Linnér and Wibeck, 2020), or what Smith and Raven (2012) refer to as socio-technical transitions that "stretch and transform".

Navigating 'transition' and 'transformation' terminology is confused by disciplinary differences. For example, socio-technical transitions research tends to understand transformations as a subset of transitions, with transitions representing the broader systemic change that we describe above (Geels, 2007; e.g., Avelino et al., 2024). Smith and Raven (2012), referenced above, note that some forms of transitions create deeper, more systemic change than others.

Research grounded in socio-ecological systems tends to identify sustainability transitions frameworks and thinking as a contributing perspective to transformation that specifically helps to describe stepwise change processes (e.g., Bennett et al., 2019; Herrfahrdt-Pähle et al., 2020). The IPCC also takes this broader perspective on transformation as "the altering of fundamental attributes of a system (including value systems; regulatory, legislative, or bureaucratic regimes; financial institutions; and technological or biological systems)" (IPCC, 2012:5). There is also a subset of literature examining material differences between the two terms. These generally determine that the concepts of transition and transformation are very closely related and often have similar target goals (e.g., Child and Breyer, 2017; Patterson et al., 2017; Hölscher et al., 2018).

Finally, other traditions and movements address the same transformative dynamics discussed here, but are explicitly derived from lived experiences of oppression and emancipatory efforts for deep systems

change. For example, there is a vast literature exploring structurally transformative concepts such as *buen vivir/vivir bien* ('good living') in Ecuador and Bolivia (Thomson, 2011; Ranta, 2020), or Ubuntu in southern Africa (Chipango and To, 2024). Applied to energy transitions, these perspectives typically call for transformative dynamics such as convivial and participatory use of energy, emphasizing fair distribution of ownership and benefits, and environmentally respectful systems.

We acknowledge these terminological differences and proceed by specifying three sub-forms of transformation after Scoones et al (2020). The forms are useful in understanding what is being transformed and what future states may result. *Systemic transformations* refer to intentional changes that shift interdependencies between the actors, institutions and technologies that comprise sociotechnical and socioecological systems, but without significantly shifting deeper values or relationships of production and consumption (e.g., renewable energy transitions that do not significantly shift lifestyles or ownership models). This category is analogous to the "adaptation" strategies discussed above. S*tructural transformations* are fundamental changes to existing systems of production and consumption (e.g., permanent reductions in energy demand, post growth strategies that seek to reorient systems around priorities beyond economic growth). *Enabling transformations* build the social, political and cultural capacities required to move toward desired futures (e.g., participatory decision making). These forms are complementary, but structural transformations are unlikely to proceed in a just or effective manner without enabling transformations that build broad capacity and social support for change (Scoones et al., 2020).

In application, the division between transformation and adaptation is fuzzy. Despite work delineating conditions that differentiate adaptation and transformation, it is often only possible to clearly identify transformations when taking a historical perspective (Geels, 2006; Patterson et al., 2017). This is especially true for transformations which slowly evolve from adaptation strategies. Single adaptation actions, viewed independently and from a contemporary perspective, may not be disruptive to incumbent regimes. However, when enough adaptations accumulate, they can trigger emergent structural transformations (Scoones et al., 2020)(e.g., the accumulation of renewable energy infrastructure). It is thus helpful to differentiate actions as adaptive, or structural or enabling transformations, based on the extent to which they engage with deeper change, regardless of whether they have yet led to widespread social change. The spectrum is pictured in Fig. 1.

2.4. Accounting for scale

Classifying any action depends upon the scale at which it is viewed. Using a global perspective, retraining coal workers for the renewable energy industry is an adaptive action, usually initiated by governments or companies, that attempts to cope with job losses due to decarbonization. However, at an individual level, retraining can mean a transformative reorganisation of household dynamics and social opportunities. We use the global as our default level of analysis but note possible differences in classification at different scales. This helps reconcile empirical observations with our theoretical approach, and also helps track local or individual actions that may, in aggregate, lead to more profound global transformations.

2.5. Rhetorical versus action-focused strategies

Coping strategies take many forms. These can be broadly separated into rhetorical strategies focused on "saying something" and action-focused strategies that "do something". Action strategies (e.g., building a battery factory, laying off mine workers) enact a material change while rhetorical strategies represent a public airing of thoughts, plans or ideas. Conceptual and empirical work on the relationship between rhetorical and action-focused strategies, and particularly how they feed each other, is underdeveloped. There is acknowledgement of gaps between, for example, government rhetoric and actual progress (Han et al., 2012; van der Leeuw et al., 2012).

Drawing from literature on discourses, narratives, and political strategies, we can assume that, in the context of decarbonization strategies, rhetoric will be important in creating, re-enforcing or contesting possible futures (Han et al., 2012; Hermwille et al., 2023);

intentionally or unintentionally deferring action by using "chat" or "cheap talk" as a delay tactic (van der Leeuw et al., 2012); building discourse coalitions in support of different transition pathways (Rosenbloom et al., 2016); or, in creating a discussion space that allows a diverse societal debate around relevant issues and options (Habermas, 1991). The literature on discourse analysis has shown the importance of rhetorical actions in providing narrative frames for energy transition-related measures that help shape the perception of audiences (Isoaho and Karhunmaa, 2019). However, it is unclear how rhetoric, for example, feeds into more concrete action strategies in the context of decarbonization.

3. Methods

A mixed methods approach was used to collect and triangulate data. Data was gathered in eleven European carbon intensive regions in transition selected for maximum variation (see Flyvbjerg, 2006), and from the most vulnerable NUTS2 regions at risk from decarbonization (Vrontisi et al., 2024). For these cases, the risk identified arises as a result of transitions away from high carbon energy generation (as opposed to, e.g., a concentrated automotive sector). Risk was assessed using a composite index of hazard, exposure and vulnerability that accounted for socioeconomic, demographic, energy, and socio-political challenges. The European Union was selected as the broader research focus because it is attempting to implement an ambitious just decarbonization plan across member states through the European Green Deal and associated instruments like the Just Transition Mechanism. This multi-level approach imposes top-down targets but allows member states flexibility to choose how to meet these targets. The list of regions is presented in Table 1 along with the newspapers searched, and the search strings used.

Data collection focused on coping activities over 7 years (January 2015 – December 2021). The time frame reflects developments since Paris Agreement adoption in 2015 until the end of the study period. Note that the period does not cover responses following the Russian invasion of Ukraine, which had major repercussions for the energy transition in European coal regions. Newspaper data were collected using searches for word strings related to energy transitions (reported in Table 1). Search strings were modified to search for comparable concepts in local languages. In each region, one national newspaper and one local newspaper were analysed. Newspapers were chosen based on

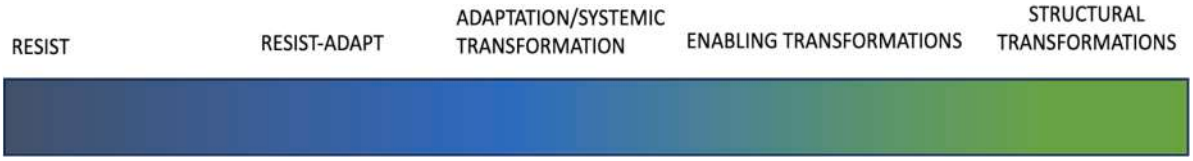

Fig. 1. The resist-adapt-transform spectrum.

Table 1
Newspaper searches carried out in the focus regions.

Region	National Newspaper	National daily search strings	Regional Newspaper	Regional daily search strings
Asturias (ES)	*El País*	energy transition/ fair AND Asturias OR Oviedo OR Caudal OR Nalón energy AND Asturias transition AND coal or central	*La Nueva España*	energy transition/ fair; transition AND coal OR central transition AND coal OR central
Ida-Virumaa (EE)	*Postimees*	Ida-Viru and oil shale	*Postimees Ida-Virumaa*	Ida-Viru and oil shale
Moravia-Silesia (CZ)	*Právo*	energy transition OR energy transformation OR just transition OR fair transformation	*Deník.cz (6 provinces)*	energy transition OR energy transformation OR just transition OR fair transformation
Northern Hungary (HU)	*Portfolio.hu*	energy transition OR energy conversion OR just transition OR Matr OR just transition funding	*Boon.hu (Észak-Magyarország)*	energy transition OR energy conversion OR just transition OR Matr OR energy OR just transition funding
N. Rhine-Westphalia (DE)	*Süddeutsche Zeitung*	energy transition AND North Rhine-Westphalia	*Süddeutsche Zeitung Regionalausgabe*	energy transition AND North Rhine-Westphalia
Northwest (CZ)	*Právo*	energy transition OR energy transformation OR fair transition OR fair transformation	*Deník.cz (10 provinces)*	energy transition OR energy transformation OR fair transition OR fair transformation
Silesia (PL)	*Gazeta Wyborcza*	energy transformation AND Silesia OR Katowice just transformation AND Silesia OR Katowice	*Gazeta Wyborcza – Katowice edition*	energy transformation OR just transformation
Southeast (BG)	*Capital Daily*	energy transition AND Stara Zagora	*No regional paper found*	N/A
South-West Oltenia (RO)	*Adevărul*	power transition OR just transition OR Olten AND energy	*Gazeta de Sud*	transition OR power
Upper Nitra (SK)	*Pravda.sk*	energy transition OR energy transformation OR just transition OR just transformation	*SME.sk*	energy transition OR energy transformation OR just transition OR just transformation
Western Macedonia (GR)	*Ta Nea*	energy transition/just transition AND West Macedonia OR Kozan	*Kozani*	energy transition OR fair transition

circulation, and the availability of online archives. Articles were translated from local languages using automated translation software. In instances where articles described a coping action but provided insufficient information, further web searches were conducted to better understand the action.

14 key informant interviewees were snowball-sampled from a population of government, third sector and research actors. Transcripts were approved by interviewees. Local level focus group participants (n = 41) from four regions that represent maximum variation across cases (i.e., Ida-Virumaa in Estonia, Silesia in Poland, Western Macedonia in Greece, and North Rhine-Westphalia in Germany) were sourced using a marketing recruitment firm using criteria that selected for gender balance, broad distribution of ages and incomes, and representation from employment sectors focused on local government, local business, and the third sector. Two focus groups were held in each of these four regions, with five participants each. One group, in Estonia, had six participants

Focus groups were used to understand prevalent coping strategies in the region, and collect data on coping strategies that had not attracted media attention. Sessions were conducted in the local language. All materials were translated from English to the local language, and transcripts were translated back to English.

The newspaper sample created a bias toward higher profile coping actions undertaken by elite actors. Interview and focus group data often validated and expanded these strategies, but also addressed data imbalances by revealing additional strategies undertaken by less high-profile actors, or addressing long term trends (e.g., outmigration). While this triangulation was not available for all the regions identified, the additional data for the four focus regions provide an important indication of the kinds of dynamics that are hidden by the media analysis.

Data was thematically analysed in NVivo to record the nature of the action, type of coping actor (see Table 2), and according to the resist, adapt, transform spectrum (Fig. 1). References to the same action were consolidated to ensure actions were not double-counted. While we provide strategy frequencies in the results, these are indicative rather than absolute as our methods were not intended to provide an exhaustive account of strategies, but rather to identify the range of strategies being used by different actors. Relative frequencies are also shaped by our methods, with a bias toward higher profile actions.

Table 2
List of coping actors.

Type	Description
Individual actors	Individual citizens
	Non-governing party politicians
Organisational actors	EU government
	National government
	Local or regional government
	Fossil fuel industry
	Renewable energy industry
	Utilities
	Non-energy industry
	Unions
	NGOs
	Universities, schools and research institutes
	Media

The initial coding framework for strategies was modified and refined through the analytical process (Vila-Henninger et al., 2022). Axial coding was used to group individual actions into more general strategies, which were then grouped into thematic categories of strategies.

4. Results

The database contains 651 coping actions. These were classified into 8 themes containing 34 discrete strategies (Table 3). This section describes themes and strategies, and which actors use them (summarised in Fig. 2), with indicative examples. The full inventory is available as an open access database and is searchable for more strategy examples (Brisbois, Cantoni and Kanger, 2023). Strategies are also categorised according to the resist-adapt-transform spectrum (see Fig. 1), and according to whether they represent rhetorical or action strategies. Many strategies were used in pursuit of all forms across the spectrum.

Table 3
Thematically grouped coping strategies.

Theme	Strategies
Attempts to lobby	Publishing newspaper opinion pieces or editorials
	Sending letters to decision-makers
	Meetings with politicians
	Making public declarations
Creating new economies	Developing wind, solar or biomass
	Developing nuclear
	Developing hydrogen
	Developing EVs and batteries
	Developing district heating
	Developing energy efficiency
	Developing renewable energy communities
	Developing non-energy economies (e.g. tourism, creative industries, general manufacturing)
	General investment and job funds, plans and programs
Modifying fossil fuel economies	Maintaining, supporting or expanding fossil fuel operations
	Creating anti-renewables policies
	Developing lower carbon fossil fuel infrastructures
	Divestment from fossil fuels
Investing in education and research	Creating new R&D centres
	Developing new education programs
	Publishing transition studies or pathways
Changing worker conditions	Making payments or providing severance to redundant workers
	Imposing layoffs, austerity or forced holidays
	Creating or subsidising replacement jobs
Participatory processes	Collaborative processes
	New partnerships or working groups
	Conferences, meetings or summits
	Public consultations
Collective action strategies	Petitions
	Protests and rallies
	Workers strikes and sit-ins
Individual strategies	Litigation
	Outmigration
	Personal retraining

4.1. Theme 1. Attempts to lobby

Lobbying strategies included both direct attempts to lobby decision makers (i.e., internal lobbying), and attempts to influence public opinion (i.e., external lobbying). *Publishing newspaper opinion pieces or editorials* (n = 109) is a rhetorical strategy aimed at influencing public opinion and, often, putting pressure on political decision-makers. Due to our sampling strategy, this was the most common strategy observed. Newspaper pieces were used to pursue all types of outcomes, by all different actors. This is one of the few strategies aimed at political influence directly available to non-elite actors. For example, citizens in Germany used newspapers to register their resistance to local development of wind turbines.

Sending letters to decision-makers (n = 16) individually or with co-signatories, is a strategy largely used by institutionalised actors to influence decisions (e.g., local governments, unions, NGOs, industry). Co-signed letters demonstrate consensus and add weight to arguments. Formal letters are often released to the media to maximise public attention and impact. This strategy was used mainly to resist and adapt, but also for structural transformation: in 2021, five Spanish NGOs pushed for structural transformation by co-signing a letter to their government asking for the development of clear socio-environmental criteria for the development of renewables to protect biodiversity and local communities, and publicized this in the media.

Meetings with politicians (n = 14) is a strategy usually only available to elite actors such as business or union heads, or between government levels. Meetings have the potential to be highly influential because those involved can usually make consequential decisions. Many elite meetings are not reported in newspapers. However, of the ones publicized, meetings were exclusively used to resist and adapt as when the Romanian Minister of Energy met with the unions from the Oltenia Energy Complex in Bucharest following a workers strike that was mobilised to stop the complex from being closed.

Making public declarations (n = 50) is an influence strategy largely used by elite actors (e.g., national and local governments, opposition politicians). This strategy is used for all aims except enabling transformations. For example, the City of Kozani in Greece put forward a Declaration of Climate Neutrality to 2030.

4.2. Theme 2. Creating new economies

Efforts to create new economies primarily focused on creating new energy-related economies including *wind, solar, and biomass* (n = 53); *nuclear* (n = 1); *hydrogen* (=13); *electric vehicles (EVs) and batteries* (n = 3); *district heating* (n = 6), *energy efficiency* (n = 28); and, *renewable energy communities* (n = 6). Renewables generation was the most common economic development strategy, present in every region examined. This ranged from small-scale, municipally owned rooftop solar in the city of Burgas, Bulgaria, to repurposing old mine sites at the Mátra Power Plant for biomass production in Hungary, to Iberdrola-owned windfarms in Asturias, Spain.

This category also includes creation of *non-energy economies* (n = 41) including tourism, creative industries, and general manufacturing and production, like vinyl manufacturing in Estonia, and funding for 15

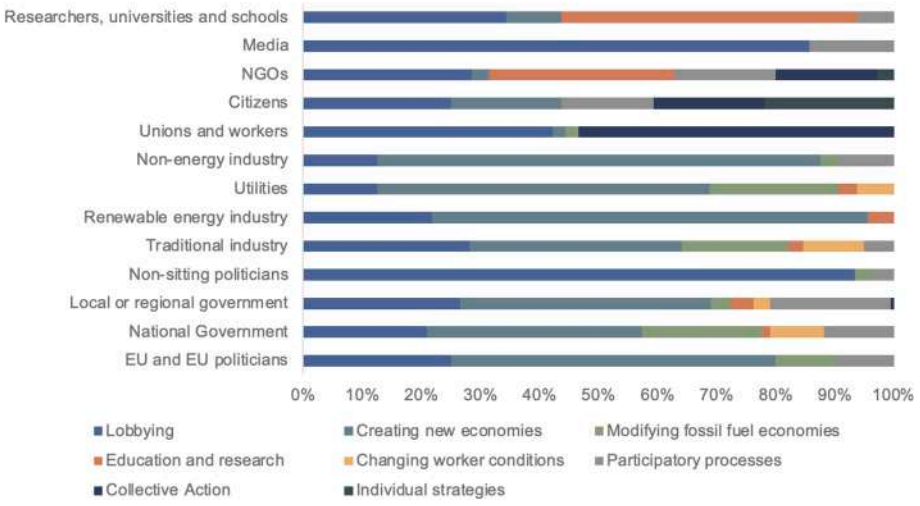

Fig. 2. Strategy categories by different actor groups.

creative centres in Czechia. Most actions coded for *general investment and job funds, plans and programs* (n = 59) record national and regional proposals and plans for the use of Just Transition Funds, often focusing on entrepreneurial activity, new industries, and job creation.

With the exception of citizen involvement in small-scale renewables (n = 9 of the 53 renewable generation initiatives), renewable energy communities, and non-energy developments, these strategies were undertaken by research, government and business actors. There were more actions focused on adaptation (n = 97) than transformation (n = 62). Energy efficiency and renewable energy community developments were all classified as structural transformations because they shift patterns of energy ownership and consumption with potential implications for broader economies.

4.3. Theme 3. Modifying fossil fuel economies

Modifications to fossil fuel economies are mainly undertaken by the state, industry and unions. They were strongly action-focused (i.e., not used rhetorically). Outright resistance strategies included *maintaining, supporting or expanding fossil fuel operations* (n = 17) as when the Bulgarian government, ultimately unsuccessfully, committed to supporting the Maritsa 2 coal plant. There were also examples of *creating anti-renewables policies* (n = 2) like the Estonian government's de facto ban on wind through the restriction of wind parks that conflict with national defence interests.

This theme also included strategies that bordered resistance and adaptation and focused on *developing lower carbon fossil fuel infrastructures* (n = 14). This mainly included developing natural gas infrastructure to be used as a "bridge" fuel to lower carbon sources as occurred in Greece, Hungary and Slovakia.

Other strategies were adaptation-focused and included *divestment from fossil fuels* (n = 21). This included splitting companies into renewable and fossil components to isolate loss-making coal assets. This was the case in Germany where energy companies RWE and E.ON both split their operations. There were also examples of mine closures and potentially transformative policies to divest from fossil fuels. These are undertaken by different levels of government and by industries and include mine closures in, for example, Asturias, Spain, and Western Macedonia, Greece.

4.4. Theme 4. Investing in education and research

Investments in education and research were often action-focused and included *creating new R&D centres* (n = 5), *developing new education programs* (n = 14), and *publishing transition studies or pathways* (n = 21). These strategies were mainly adaptive but also included some structural transformations. Mainly institutionalised actors engaged in these strategies including national and local governments, universities, NGOs, and occasionally renewable energy industries. As examples, the University of Western Macedonia set up an "Innovation Zone", and the Silesian University established an MSc in Energy Transformation. NGOs were very active in publishing transition studies including a report by Bankwatch on the territorial just transition plan for South-West Oltenia, Romania, and a study by the Polish Academy of Science on economic diversification following coal phase-out.

4.5. Theme 5. Changing worker conditions

Strategies focused on conditions for workers were action-focused and included *making payments or providing severance to redundant workers* (n = 14) by national or regional governments; *imposing layoffs, austerity or forced holidays* (n = 5) by traditional industry and utilities; and national, regional and local government efforts at *creating or subsidising replacement jobs* (n = 5). All countries and regions, with the exception of Bulgaria, which was at a very early transition stage during data collection, acted to create different forms of support packages for workers, usually using Just Transition Funds.

4.6. Theme 6. Participatory processes

Strategies invoking participatory processes included *collaborative processes* (n = 10); *new partnerships or working groups* (n = 18)*; conferences, meetings or summits* (n = 39); and *public consultations* (n = 12). These were used almost entirely to adapt, enable transformations, or structurally transform.

Collaborative processes are usually initiated by governments as was the case with the German and Czech Coal Commissions which both supported intensive deliberation between actor groups to develop a process for meeting coal phase-out targets (see Hauenstein et al., 2023). Partnerships and working groups are less structured arrangements initiated by a wide range of institutional actors. For example, the Estonian government set up a Green Policy Steering Committee and firms in the Moravia-Silesia of the Czech Republic developed a working group to support the energy transition.

Various meetings, summits and conferences were held by different kinds of actors. In Asturias, Spain, the Association of Mining Counties and the EU's Economic and Social Council organised a conference on Just Transition. In Western Macedonia, Greece, citizens and local government ran a Non-Profit Energy Communities Workshop. Public consultations were more structured inputs, generally run by governments. These included in person consultations and also online mechanisms such as a Czech website set up to allow citizens to provide input into decarbonization. Other actors also consulted, including in Upper Nitra, Slovakia, where the NGO Greenpeace ran a public consultation to better understand public perceptions of coal.

4.7. Theme 7. Collective action strategies

Collective action strategies were largely undertaken by citizens, NGOs and unions and included *petitions* (n = 3), which were always used to resist or resist-adapt, *protests and rallies* (n = 17) used largely by citizens, unions and NGOs to resist, adapt and transform, and *workers strikes and sit-ins* (n = 14), used exclusively by unions and workers to resist and resist-adapt. These strategies were a mix of action-focused and rhetorical strategies. Protests and rallies differ from workers strikes in that the latter encompasses only industrial action by unions, while protests were much broader forms of social movement. For example, there were several miners strikes in Silesia, Poland, in response to planned coal closures over several years. In Western Macedonia, Greece, there were large public protests against plans for the Vermio wind farm.

4.8. Theme 8. Individual strategies

Individual strategies are undertaken largely by individual or small groups of citizens and represent different points on the resist-adapt-transform spectrum. These were poorly represented in the dataset, likely because they are often undertaken quietly by individuals and are thus unlikely to be reported upon in the media (with the exception of *litigation,* n = 4). Indeed, reports of *outmigration* (n = 3) and *personal retraining* (n = 1) came exclusively from focus groups and interviews. Litigation was used by citizens and NGOs to both resist and adapt, with resistance to wind through litigation in Spain and Germany, and litigation contesting that decarbonization policy is not strong enough in Germany. Outmigration was reported in Estonia, Greece and Poland as a citizen adaptation strategy. Personal retraining, although it is presumably occurring widely across carbon-intensive regions, was only discussed once as an adaptive citizen response in Poland, Germany, and Greece.

4.9. Resist-adapt-transform frequencies

Actions aimed at adapting were by far most common (56 %). Actions

aimed at realising structural transformations represented 20 % of actions, resistance actions were 16 %, and both resist-adapt actions and actions aimed at enabling transformations represented 4 % of strategies. These proportions are relatively consistent when examining strategies that "do" something. However, proportions change when examining only rhetorical actions that "say" something (Fig. 3). Rhetorical resistance actions are much more common (30 % as opposed to 12 % for actions that do something and 16 % for all actions). In general, 162 entries were rhetorical or aimed at influencing actions (i.e., shaping public debate through newspaper editorials, public declarations), while 489 entries "did" something (e.g. developed renewable energy, worker strikes).

4.10. Actor strategy preferences

As expected, different strategies were used by different actors. Fig. 4 shows the distribution of different types of strategies for all actions. Fig. 5 shows normalised distributions to show which actors tend to use which types of strategies. The greatest number of recorded actions were undertaken by government entities.

In examining who undertakes which kinds of strategies, there is a great deal of variation. Unions most often resist, followed by non-sitting and opposition politicians, citizens, the media and industry. Many actors were largely focused on adaptation, including renewable energy industries, the EU, non-energy industries, traditional energy industries and utilities, and researchers, universities and schools. Structural or enabling transformations were not the most significant form of action for any actors, but were a higher proportion of the strategies for citizens, NGOs, local and regional governments, and non-sitting and opposition politicians. Enabling transformations were the most infrequent overall, but were mostly undertaken by citizens, NGOs, national and local governments, and non-sitting and opposition politicians.

5. Discussion

This paper develops and tests an approach for understanding responses to decarbonization policy in order to better understand how responses are manifesting across actor groups, what this tells us about decarbonization policy to date, and how policies can be designed and implemented to ensure faster decarbonization that supports a more just society. The results demonstrate that there is an enormous diversity of strategies being undertaken in response to decarbonization policy in the EU. In general, the types of strategies used by different actors depends largely upon the amount of control they have over consequential decarbonization-related decisions, the resources at their disposal, and the forums to which they have access (after Gaventa, 2019).

Most actor groups engage at multiple points along the resistance, adaptation and transformation spectrum, depending on the issue area and situation. For example, energy companies simultaneously engaged in resistance and adaptation strategies in ways that were consistent with maintaining their overall competitiveness. Likewise, citizens resisted, adapted or engaged in transformative structural change, depending on how they perceived decarbonization would impact their lives, and the opportunities available for action.

Beyond actor response patterns, developing the inventory demonstrated that the relationship between resistance, adaptation and transformation is indeed a spectrum that defies simplistic categorisation. In particular, the division between resistance and transformation was often blurry. This is counter-intuitive as they are on opposite ends of the spectrum but, as we explain below, can be closely related. The following discussion identifies patterns in strategies and identifies significant dynamics.

5.1. Resistance often reveals injustices

Resistance was persistent across actors and time. It was the dominant strategy for unions but general citizens, the media, traditional industry, and opposition and sitting politicians also regularly resisted decarbonization policies. This is unsurprising. Decarbonization represents a fundamental shift in global energy policy and has far reaching impacts on lives and economies (Stirling, 2014). Resistance from the fossil fuel industry, for example, is well documented as it represents an existential threat to their profitability, and existing political and economic organisation (Smink et al., 2015; Brisbois, 2020; Ford and Newell, 2021). Resistance from these kinds of actors is part of the process of phasing out an industry that will have a substantially reduced, and potentially non-existent, role in a decarbonized world.

Resistance strategies from unions, citizens and NGOs usually highlighted claims of injustice related to job losses (e.g., opinion pieces in Spanish newspapers), impacts on local communities (e.g., protests in Western Macedonia about use of former mining lands), and a lack of voice and impact in decision-making processes (e.g., workers' strikes in Romania). Returning to Gaventa's (2019) understanding of how actors can advocate for themselves, these actors are claiming space at higher jurisdictional levels by using the legitimacy and moral authority they possess as impacted local interests. When resistance is undertaken by actors with less influence, it can be because it is the best, and sometimes only, available option to try to change transition plans they feel will negatively impact their lives.

The dynamics of resistance enacted by non-fossil fuel actors in the inventory are signposts to two different sets of justice issues: the need to address underlying distributional inequalities, and the failure of decision processes to adequately include and recognise voices. This pattern is significant because it indicates that resistance strategies have the potential to provide information about the issues that need to be resolved to design more just and socially acceptable decarbonization

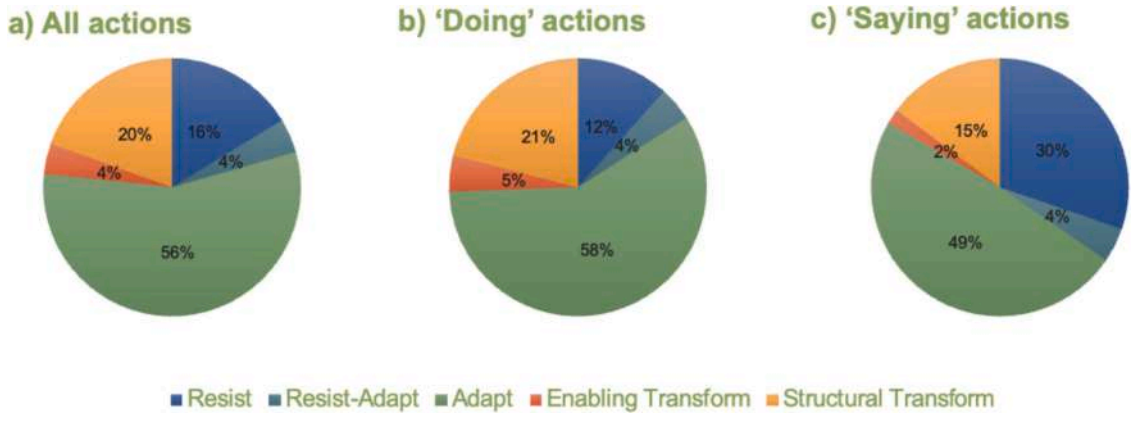

Fig. 3. Frequency of different strategy types for a) all actions, b) 'doing' actions, and c) 'saying' actions.

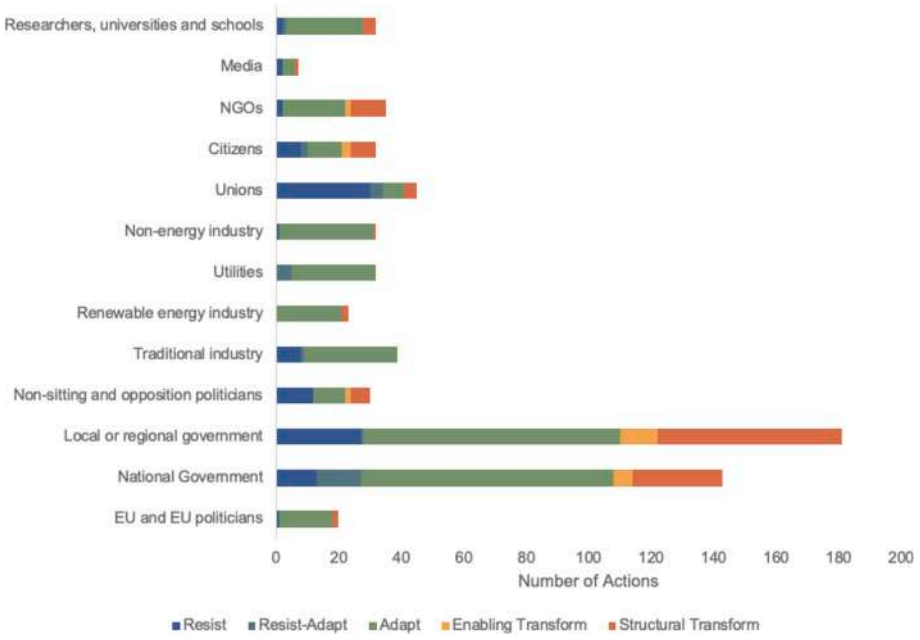

Fig. 4. Actor use of different types of strategies.

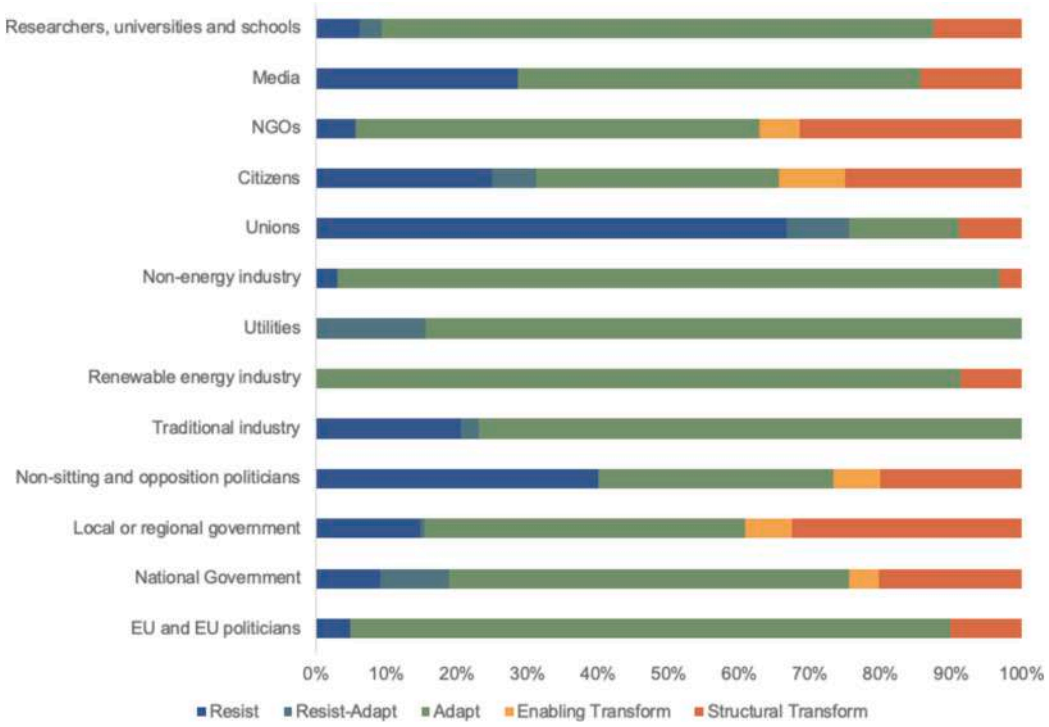

Fig. 5. Percentage actor use of different types of strategies.

pathways. This has been discussed in the context of resistance to climate adaptation but is also relevant for decarbonisation policy (Brink et al., 2023).

In many cases, resistance to decarbonization plans and developments indicated that key concerns about the implications of change had not yet been addressed. This shifts the focus on resistance from something to overcome, to a signal to look more deeply at why actors are resisting. Indeed, instances of resistance to decarbonization policy by, for example, unions in Germany, the Netherlands, Poland, and Spain, have been resolved following negotiations resulting in improved compensation and retraining packages (but also sometimes with delays to mine closures) (Broughton and Wehnert, 2020). Resistance thus can indicate that more attention should be paid to where costs and benefits are falling, and how imbalances in these can be addressed.

It is also important to note that the resistance forms observed in these EU cases reflect a specific Western context. In particular, there are no forms of physically violent resistance recorded in the inventory. This represents a clear difference from other parts of the world where violence is a relatively common feature of, for example, resistance to policies that support renewable energy expansion, but may do so through land dispossession (Yenneti, Day and Golubchikov, 2016; Kramarz, Park and Johnson, 2021).

This highlights the existential threats to survival that can result from threats to lands and livelihoods in regions with colonial legacies (Del Bene et al., 2018). In many of these regions, the typically strong institutions, social support systems, and legal systems that characterise most European countries have been undermined or impeded by colonial dynamics. This is true even while there are variations across the EU. Indeed, there is emerging evidence that strategies of last resort like outmigration are much more likely in peripheral and economically underperforming EU regions (Vrontisi et al., 2024). Evidence from global studies confirms that such 'strategies of last resort' in other locations likewise reflect both the perceived severity of the threat from decarbonisation activity, and the resources available to affected populations (Del Bene et al., 2018; Temper et al., 2020; Sovacool et al., 2022).

Treating resistance as an annoying or illegitimate obstacle can exacerbate issues of inequality, and fuel popular or populist unrest. For example, populist parties in Poland have used the closure of coal mines to mobilise support, drawing upon themes that reject decarbonization agendas and highlight protection of coal workers, jobs and communities (Allen, 2021; Yazar and Haarstad, 2023). In the same way, failing to properly consider the distributional impact of policies can lead to widespread social disempowerment and frustration. This can manifest as populist backlash, as evidenced by the *gilets jaunes* protests in France where large protests followed attempts to implement a carbon tax that would have significant impacts on the working class (Mehleb et al., 2021). Similar situations are arising with farmer protests in the Netherlands and France against environmental policies (van der Ploeg, 2020).

Tellingly, many citizen resistance strategies in the inventory push back against low carbon infrastructure or arrangements which help to decarbonize, but do so while reproducing unequal social and economic structures. For example, inventory entries recording citizen protests in Greece against wind farm developments foregrounded that profits from wind do not benefit communities. According to these citizens, the proposed development plan reproduced the status quo where big companies generate income with benefits that fail to "trickle down" to communities. This pattern of extractive natural resource development is well documented around the world, as are forms of resistance against it (e.g., Del Bene et al., 2018). Its adoption in transition contexts is increasingly problematised by scholars highlighting that such adaptive "replacement" activities perpetuate status quo inequalities (e.g., Newell, 2019). A further implication of adopting this approach to renewable energy development is that these attempts to simply transition – instead of transform – are likely to trigger resistance instead of social acceptance if they mainly serve to reproduce existing inequalities.

Finally, as most of our database is press-based, rhetorical strategies (e.g., interviews, opinion pieces) are significant for our analysis. Patterns in the use of rhetorical strategies for resistance by actors can offer insight into the motivations and capacities of actors. For citizens, rhetoric can represent one of few options available to address procedural inequalities and make their voices heard. More well-resourced actors may have diverse motivations including building support for particular policy positions, verbally 'greenwashing' by making statements without any intention of follow through (Kwon et al., 2024), or signalling resistance to their shareholders or constituents even while they take adaptive actions. In the inventory, rhetoric was used to formalize political promises and commitments to affected regions, independent of whether they would actually be pursued. For example, the former government in Poland claimed it would keep coal mines open if elected but later proposed a program of job cuts – which were in turn resisted by workers (Cantoni and Brisbois, 2024).

5.2. From resistance to transformation

Instead of a decarbonized status quo, resisting actors appear more interested in pathways that move beyond adaptive strategies to address the systemic inequalities that characterise current systems. The structural transformations in the inventory offer some insight into how more just systems are being pursued. They include efforts to create energy communities, economies based on small- and medium-sized enterprises, and measures to reduce energy consumption (e.g., home energy efficiency, improved public transit). However, these transformative actions remain limited, and comprise 19 % of all strategies, while combined resistance, resist-adapt, and adaptation actions represent 16 %, 4 %, and 57 % of strategies, respectively. This indicates that more attention needs to be paid to systemic distributional inequalities if decarbonization policies are to proceed to successful implementation.

The observed patterns of resistance also point to the need for attention to the processes by which decarbonization is pursued, and who is included in these. This is also reflected in Scoones et al.'s (2020) definition of "enabling transformations", with these types of strategies often undertaken by NGOs, citizens, and local and national governments (4 % of inventory actions).

Enabling transformations are actions that provide the skills and spaces necessary to drive deep structural transformations. Consistent with observations by Hermwille et al. (2023), protests and resistance movements, as well as some individual adaptation strategies, often focus on a lack of inclusion in decision-making processes. This represents a lack of both procedural and recognitional justice. For example, outmigration strategies in oil shale regions in Estonia highlighted community disempowerment and a lack of voice in creating a post-shale future. Beyond the inventory, Mehleb et al. (2021), found that some of the motivation for the French *gilets jaunes* protestors was a lack of involvement in the decision process.

This need for attention to process is also observable in strategies demonstrating enabling or structural transformations by actors with more resources, and access to higher-level decision fora. For example, then-mayor of the city of Kozani, Greece, formed the Forum of Mayors to better advocate for fairer procedural and distributional outcomes in EU-driven decarbonisation processes. The German government used its resources to create the German Coal Commission in 2018. This process was largely successful, at least in the short term, in addressing deep societal divisions over trade-offs in coal phaseout pathways through a facilitated collaborative governance process involving broad inclusion, deliberation and debate (Hauenstein et al., 2023).

Best practice from fields such as natural resource governance highlights the importance of meaningful participation and inclusion in decision-making processes (Wesselink et al., 2011; Reed et al., 2018). This moves beyond securing consent, to providing meaningful opportunities for affected parties to shape the decisions that will affect their lives, and create a fairer distribution of benefits. It also creates space to integrate local knowledge and create better development plans (Armitage, Berkes and Doubleday, 2010). There is considerable room to explore how to improve decision-making processes for decarbonization to make them more open and inclusive. Work on, for example, citizens assemblies and more direct forms of democracy, addresses this (Willis, 2020; Peterson et al., 2023). However, efforts at enabling transformations need to remain attuned to emerging evidence from citizens assemblies (Minsart and Jacquet, 2023), and experiences from other sectors where more collaborative practices are common, about the importance of follow through. When broader input is sought but either not used in a meaningful manner, or used inauthentically, this can disempower citizens and damage public trust, potentially leading to further resistance (Brisbois and de Loë, 2016).

5.3. The dominance of adaptation

The bulk of discussion thus far has focused on the productive dynamics between resistance and transformation. However, 57 % of strategies in the inventory represent adaptions that seek decarbonization without broader shifts in social or political economies. The majority of these are undertaken by government or private sector actors who do

potentially have the resources and decision-making power to support more transformative strategies. This thus represents an area of significant potential, but also brings issues of institutional lock-in, socio-economic drivers, and power to the fore.

Research on institutional theory, transitions and political economy all highlight that powerful dominant actors, networks, institutions and logics create path dependencies that shape future pathways with pressures to conform to existing norms (Smith and Raven, 2012; Smink et al., 2015). This path dependence is co-constituted by pervasive underlying economic drivers for large-scale investment that yield returns and economic growth. This motivates the focus on adaptation evident in the inventory, even when widespread resistance, in addition to outcomes that remain too slow and too narrow, makes clear that adopting different approaches would be helpful. This is not to say that all adaptation actions are inadequate – indeed they are a necessary part of transition processes – but rather that they could be approached in ways that proactively address issues of process and distribution with likely stronger outcomes. This type of approach would be particularly transformative for the private sector, where incentives for profit maximisation can make strategies like economic benefit sharing, or time spent on community-led or informed planning, difficult to justify to shareholders.

6. Conclusions

The Carbon Intensive Regions in Transition (CINTRAN) Coping Strategies Inventory represents a cataloguing of responses to decarbonization policy, and proposes the resist-adapt-transform spectrum to help make sense of these. Because these responses are largely to policies enacted post-Paris Agreement adoption in 2015, it is still too early to provide definitive evidence about which strategies are most effective in advancing decarbonization. There is emerging evidence –not tested in this paper – that policies that advance decarbonization while working, sometimes in unfamiliar or uncomfortable ways, to address systemic distributional, procedural and recognitional inequalities are likely to be more socially accepted (Minsart and Jacquet, 2023). However, such solutions often challenge, or at least do not directly support, the economic goals of many elites of profit maximisation and exponential growth. This indicates that the "win–win" outcomes being pursued by many national transition plans are unlikely to manifest at the scale and speed required. Instead, there is a need to continue deeper explorations in, for example, work on co-benefits of climate action (Finn and Brockway, 2023), and post growth perspectives (Hickel et al., 2021), of how to shift existing structures and systems to support just and sustainable livelihoods.

Work on the inventory also revealed an empirical distinction between rhetorical and action-focused strategies. Exploring this distinction fully was beyond our scope, but raised interesting questions about the relationship between the two, and whether certain strategies are more or less likely to emerge at different times in the transition process. There are also questions about the extent to which rhetoric is used to support different strategy types. Wider conceptual and empirical development of the link between rhetoric and action is needed, and the inventory can be used to help begin to understand how rhetoric is shaping action-focused coping strategies.

Investigating resistance strategies made clear that there is a strong link between resistance and transformation that deserves further analytical attention. This is encouraging as it offers possibilities for pathways to decarbonization that, with careful design and processes, can also help address persistent societal inequalities. It also makes clear that resistance is not inherently negative, and not something to be uncritically minimised or muted. Instead, engaging with and meaningfully considering the sources of resistance is essential to the design of decarbonization policies given imperatives for rapid decarbonization, and increasingly widespread backlash against decarbonization policies (e.g., Patterson, 2023). There is also interesting possible conceptual exploration around the threshold between adaptive and transformative strategies and the factors that catalyse shifts to larger systems transformations. This links to existing work on societal tipping points (Milkoreit et al., 2018; Tàbara et al., 2024), but also invokes interesting questions about how power relations, and particularly the power of elites can, and must, change to enable transformation.

We hope the open-access Coping Strategies Inventory provides a useful resource for examining the turbulent yet productive space created by rapid decarbonization efforts. The above analysis provides a useful starting point for thinking about what strategies are most productive, by whom, where, and for what purpose. The inventory can also be further used to identify patterns and trends in decarbonisation responses, and to go deeper into specific issues, or specific geographies. For example, process tracing or timeline construction could be applied to try to understand how decarbonization processes are evolving in different regions to learn lessons for regions at earlier transition stages (e.g., Cantoni and Brisbois 2024). The inventory can also be used to identify fruitful areas for primary data collection to, for example, better understand why some regions move more rapidly to transformative strategies. Decarbonization processes are rapidly evolving and there is much still to be explored to help support rapid and just transformations.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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Data availability

The Coping Strategies Inventory is open access and available at 10.5281/zenodo.8120855

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