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EDITED BY
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Cairo University, Egypt
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Federal University of Santa Catarina, Brazil

*CORRESPONDENCE
Oksana Udovyk
✉ oudovyk@upvnet.upv.es

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From "build back the same" to transformative recovery: enablers and barriers for climate-focused pathways in post-disaster case studies across Europe

Oksana Udovyk[1]*, Vitaliy Soloviy[2], Jordi Peris Blanes[1], Kh Md Nahiduzzaman[3], Fatma Özdoğan[4], Andrés David Maglione[5] and Stella Pennino[5]

[1]Institute for the Management and Innovation of Knowledge, INGENIO (CSIC-UPV), Polytechnic University of Valencia, Valencia, Spain, [2]Austrian Institute of Technology, Vienna, Austria, [3]Universite Mohammed VI Polytechnique, Ben Guerir, Morocco, [4]Universite de Montreal, Montreal, QC, Canada, [5]Università degli Studi di Napoli Federico II, Naples, Italy

Disasters are frequently framed as opportunities for transformative change. Yet in practice, recovery processes often restore unsustainable systems under the guise of resilience or return to normal. This article examines whether, how, and under what conditions post-disaster recovery can catalyze transformative recovery pathways with a focus on climate mitigation and adaptation. Our study presents an interdisciplinary analytical framework that integrates insights from transformative research, sustainability transitions, and resilience thinking, providing a pragmatic heuristic to navigate post-disaster recovery efforts. We apply the framework to four case studies that represent different systems triggered by different disruptions: agriculture in Italy (drought), housing in Türkiye (earthquake), mobility in Spain (flood), and energy in Ukraine (war). Our findings across the cases show that most recovery efforts fall short of reconfiguring the systems in focus, primarily reproducing pre-disaster patterns, with recovery processes commonly characterized by siloed governance, technocratic fixes, and fragmented activities. Still, disasters can also open opportunities for new climate solutions, collaborations, and narratives that can challenge existing regimes and path dependencies. This is possible through addressing the enablers and barriers that cut across different spheres of transformations. Based on the findings, we argue that transformative recovery cannot be enabled purely through risk management, technical adaptation, or return to normal, but must engage with questions of power, meaning, and governance. The study offers researchers a lens to analyze transformation potential across various types of systems and disruptions and provides policymakers and practitioners with insight into the conditions that are important for transformative recovery.

KEYWORDS

transformative recovery, urban, regional, climate, governance, post-disaster, resilience

Introduction

With the increase of climate-related extreme weather events and growing global instability, disasters and other shocks have become more frequent and harder to manage. Post-disaster recovery is often framed as a "window of opportunity" for sustainable transformations, with crises acting as catalysts toward systemic change (Pelling, 2011).

However, in practice, the urgent need to rebuild what was destroyed or lost tends to overshadow deeper reflections about what could, or should, be reimagined. Current evidence on climate change adaptation and post-disaster recovery endeavors suggests that meaningful changes in sustainability and climate governance are infrequent and difficult to achieve (Davidson et al., 2025).

To deepen understanding of how disasters may open or foreclose windows of opportunity for systemic transformation, recent studies highlight the potential and limitations of post-crisis experimentation. Davidson et al. (2025) introduce the concept of *Natural Disaster–Induced Sustainability Experimentation* based on the 2022 Queensland floods, showing how such events can catalyze innovative practices and leadership. Yet, they caution that without institutional support, these experiments often remain fragile and short-lived. Similarly, Rutherford et al. (2024), examining the 2022 Northern Rivers floods in New South Wales, show that while crises can enable new cross-scalar governance arrangements, entrenched institutional routines and fragmented responsibilities frequently undermine sustained change. Among others, factors in play include pre-existing conditions, degrees and frequency of disruptions, and features of political regimes (Povitkina et al., 2025). Shocks create ruptures between the old and the new, with outcomes being both open-ended and subject to manipulation, given the possibility to invoke emergency frames (Patterson et al., 2021). This double-edged nature of disruptions requires navigating transformative and non-transformative possibilities.

This challenge raises a few critical questions. Are disasters destined to reinforce the status quo? And under which conditions could recovery efforts enable alternative futures? While it's challenging to trace all the activities that follow disasters, climate adaptation and mitigation present a specific area that is particularly linked to post-disaster recovery. The urgency of climate action is closely linked to the increasing frequency of disasters, while mitigating the impacts of future disasters depends on how recovery efforts incorporate the lessons learned and address the root causes of unsustainability. Within this study, we therefore focus on the changes in climate mitigation and adaptation efforts within different systems, in the follow-up to major disruptions that trigger critical systems. To explore this, our analysis is structured around two interrelated questions:

- How do post-disaster recovery processes **engage climate transformation elements**?
- What are the **barriers and enablers** that shape these engagements?

We investigate these questions through an analysis of four critical provisioning systems: agriculture in Sicily (Italy), housing in Southeastern Anatolia (Türkiye), mobility in València (Spain), and energy in Rivne (Ukraine). Each of these systems is significant for climate action and have experienced a distinct form of disruption: drought, earthquake, flood, and war, respectively (Figure 1). The cases provide a diverse set of empirical contexts to interrogate the dynamics of recovery and the potential for transformation. While they are not directly comparable, the cases resemble common features that allow for learning across diverse geographies, systems, and types of disruptions.

The study uses an interdisciplinary analytical framework that combines the Multi-level Perspective from the field of sustainability transitions (Geels, 2002; Geels and Schot, 2007), the Three Spheres of Transformation (O'Brien and Sygna, 2013) and the typology of system patterns with regard to resilience and sustainability by the European Environment Agency (2024) (EEA). The framework was designed to be able to grasp aspects that are commonly overseen by siloed approaches that rely on disciplinary perspectives and is presented further in detail and allowing for within-case depth and cross-case insights. Throughout the development of the cases, we held iterative team discussions that supported interpretive alignment, supporting the identification of recurring governance patterns, enabling conditions, and limitations across the cases.

This paper contributes to the emerging interdisciplinary studies of **transformative resilience and recovery** by tracing how climate mitigation and adaptation goals are engaged or neglected in recovery processes, and by identifying patterns that shape the potential for long-term system change. By attending to both enablers and barriers, and drawing insights from diverse contexts, the study seeks to inform more coherent, inclusive, and future-oriented approaches to post-disaster governance.

The study is further structured as follows. In the Materials and methods section, we introduce the framework and the main ideas guiding our thinking on recovery and transformations. We also introduce our approach to the case study selection and how we approached the collection and analysis of evidence. In the Results, we present a narrative for each case study based on a common structure, highlighting main developments and insights. Further, in the Analysis section, we provide a cross-cutting analysis of cases along the three spheres of transformations and regarding sustainability and resilience patterns. In the Discussion section, we connect our insights to broader evidence and debates around transformative recovery along with the main themes emerging from our analysis. In Conclusion, we reflect on the potential for further research for advancing transformative recovery pathways.

Materials and methods

Theoretical background and analytical framework

Disaster recovery has traditionally been situated within the Disaster Risk Reduction (DRR) paradigm, codified in frameworks such as the *Hyogo Framework for Action* (United Nations International Strategy for Disaster Reduction Secretariat, 2015). This framework emphasizes preparedness, early warning, and recovery as central strategies for reducing vulnerability and managing hazards. However, DRR has often operated through restoration-oriented logic, seeking to return systems to pre-crisis conditions. While such strategies may mitigate immediate risks, they risk reinforcing social and ecological vulnerabilities—particularly when structural inequalities, fragmented governance, or extractive economic practices are left unchallenged (Gaillard, 2010; Tierney, 2020; Wisner et al., 2004). Moreover, the uptake of emergency frames in the aftermath of disasters can be used to reinforce previous agendas, incumbent power, and unsustainable trajectories (Patterson et al., 2021).

Considering these critiques, Build Back Better (BBB) was introduced as a corrective approach within the DRR agenda. Formalized in the Sendai Framework, BBB was intended to reframe recovery as an opportunity for improvement—not simply "build back the same." It emphasized the integration of disaster preparedness, infrastructure resilience, and institutional strengthening into recovery processes (UNDRR, 2015). Importantly, BBB also introduced sustainability elements, including measures for climate resilience and equity. However, its implementation has remained uneven and largely technocratic, commonly defaulting to infrastructure-centric and efficiency-driven projects without considering broader changes (González-Muzzio et al., 2021; Gould and Lewis, 2018).

Acknowledging the limitations of existing approaches, this study aims to advance a more systemic and transformative approach to post-disaster recovery, drawing on insights from interdisciplinary fields of sustainability transitions, transformative research, and resilience studies. Our analysis is also informed by complementary insights from several other research areas and conceptual developments that have explored implications of and responses to major shocks, disruptions and disasters, such as disaster studies, emergency frames (Patterson et al., 2021), transformative adaptation (Davidson et al., 2025; Nightingale et al., 2022; Novalia and Malekpour, 2020), and political science (Povitkina et al., 2025).

In what follows, we structure our analytical framework around three interconnected dimensions of recovery. **First, disruption**: how crises destabilize existing regimes and open windows of opportunity. **Second, response and immediate recovery**: how actors engage within these openings across the three spheres of transformation. **Third, stabilization and long-term recovery**: how recovery pathways consolidate into new configurations with respect to resilience and sustainability.

Disruption and destabilization

Transition theory, and particularly the multi-level perspective (MLP), frames systemic change as the outcome of interactions between niche innovations, dominant socio-technical regimes, and broader landscape pressures (Geels, 2002; Geels and Schot, 2007; Smith et al., 2005) Socio-technical regimes—such as energy, mobility, housing, or food—are stabilized by the interplay of technologies, policies, norms, and institutions (see Figure 2). These regimes tend to resist change due to strong path dependencies and "institutional lock-in."

Crises, including natural disasters, pandemics, and wars, can act as landscape shocks: they disrupt routines, weaken the legitimacy of existing systems, and create political and institutional fluidity. Such disruptions may open "windows of opportunity" for systemic experimentation and transformative alternatives (Avelino, 2017; Geels, 2014; Loorbach et al., 2017). To analyze these dynamics, we build on the MLP heuristic but extend it through the concept of provisioning, which highlights human needs and biophysical processes often overlooked in socio-technical perspectives (Schaffartzik et al., 2021).

In addition, we draw on the growing field of transformative research, which emphasizes that systemic change occurs across three interrelated spheres in the system (see Figure 2) (O'Brien et al., 2023; O'Brien and Sygna, 2013):

- **The practical sphere (what):** technologies, infrastructures, and formal policies or actions.
- **The political sphere (how):** governance arrangements, institutional dynamics, and power relations.
- **The personal sphere (why):** values, beliefs, worldviews, and identities.

Transformation becomes possible when these spheres reinforce one another—when practical interventions are underpinned by institutional reforms and grounded in shared imaginaries. This framework has gained influence in climate governance, where it challenges technocratic adaptation and emphasizes more holistic and culturally embedded approaches (Head, 2022; Leach et al., 2015; O'Brien, 2018). It also highlights the symbolic and emotional dimensions of recovery: whether crises are interpreted as opportunities, ruptures, or threats depends on shared narratives of loss, justice, hope, and renewal (Eriksen et al., 2021; Kaika, 2017). Figure 2 illustrates this stage of destabilization, integrating the MLP, the three spheres of transformation, and conceptualizations of socio-political shocks (Geels and Schot, 2007; Herrfahrdt-Pähle et al., 2020; O'Brien and Sygna, 2013).

Response and immediate recovery

While disasters may disrupt regimes and open temporary space for alternative pathways, transformative recovery outcomes are far from guaranteed (Davidson et al., 2025; Povitkina et al., 2025). To seize such openings, transition scholars emphasize the role of **transition arenas**—dedicated, experimental governance platforms that bring together diverse actors across sectors to co-develop shared visions, strategies, and innovations (Avelino, 2017; Geels, 2014). These arenas create protected spaces for deliberation, learning, and coordination across system levels, which is especially critical in post-disaster contexts marked by fragmentation and inertia. Within the window of opportunity, change can unfold across the practical, political, and personal spheres (O'Brien and Sygna, 2013). Responses to disruption may trigger processes such as the upscaling of niche innovations, which can subsequently stabilize into emerging recovery pathways.

Figure 3 situates this stage, highlighting the possibilities of reconfiguration during the window of opportunity. Together, Figures 2, 3 illustrate a dynamic sequence: disruption destabilizes systems, and arenas of response shape whether recovery reinforces the status quo or advances systemic transformation.

Stabilization and new system configurations

The final component of our framework concerns the qualities of the new system that emerge after disruption. Moving beyond

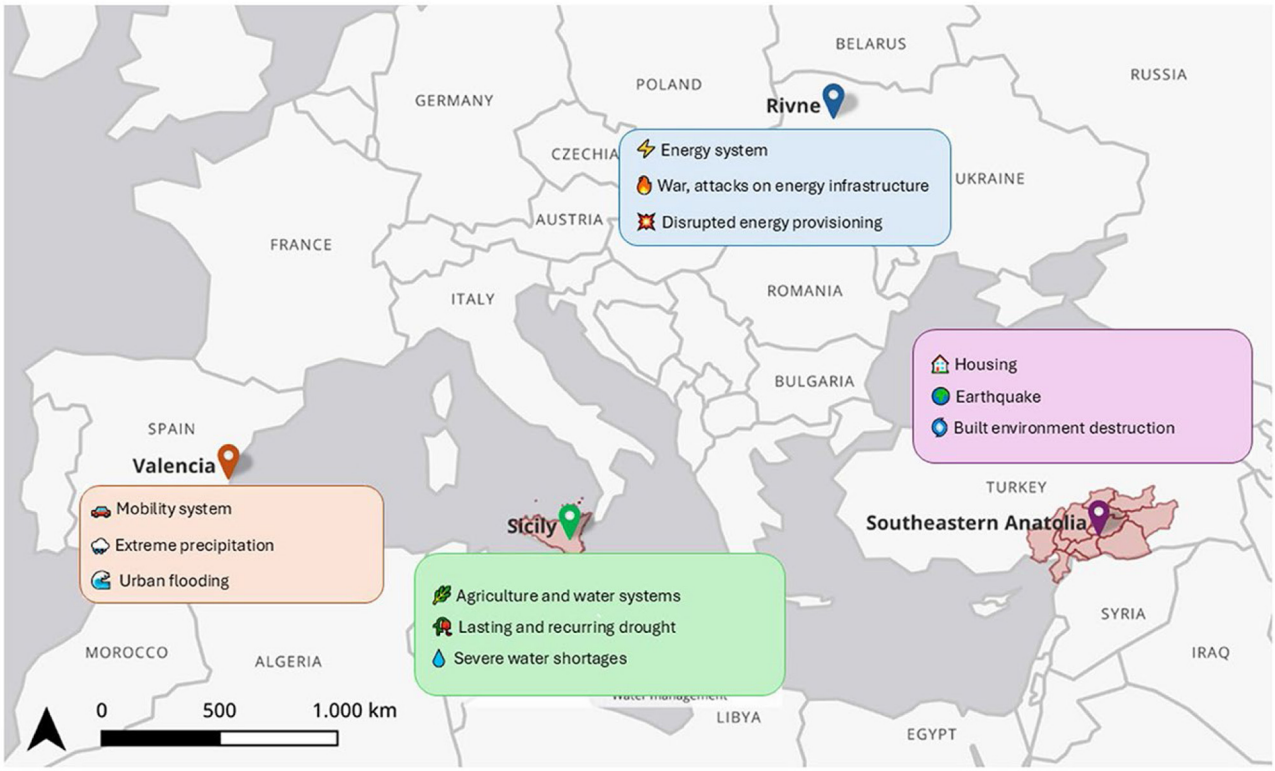

FIGURE 1
Locations of the selected case studies.

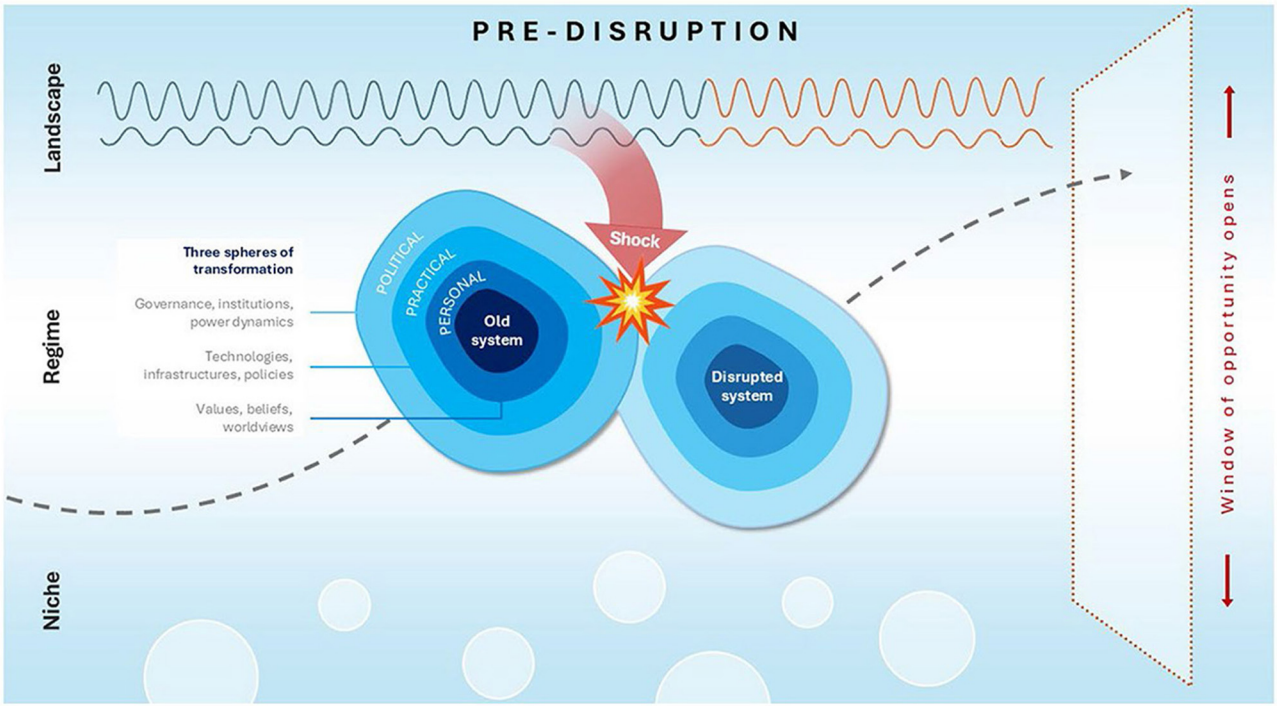

FIGURE 2
System destabilization through disruption.

TABLE 1 Three patterns of resilience and sustainability, based on European Environment Agency (2024).

Pattern	Description	Example (garden example)
Pattern 1: resilient but not sustainable	• This trajectory represents systems that can recover from disruption in the short term but remain locked into unsustainable practices. The system survives, but only at the cost of its ecological and social foundations	• In the garden example, this is like using pesticides to quickly deal with pests—producing visible results but degrading the soil, biodiversity, and long-term resilience
Pattern 2: sustainable but not resilient	• This represents systems that are aligned with long-term sustainability goals (e.g., organic farming or low-impact technologies) but lack resilience to shocks. These systems fail when confronted by unanticipated stressors	• In garden terms, it's like a permaculture garden that lacks protective structures during a storm—valuable, but vulnerable
Pattern 3: transformative sustainability and resilience	• This is the desired trajectory, where systems adaptively reorganize after disruption and improve both their resilience and sustainability over time. This pattern emphasizes polycentric governance, innovation, local knowledge, and long-term vision	• The garden example here includes strategic diversity (different crops, pollinators, layered trees), learning from past shocks, and proactive care—representing systems that flourish through disruption, not despite it

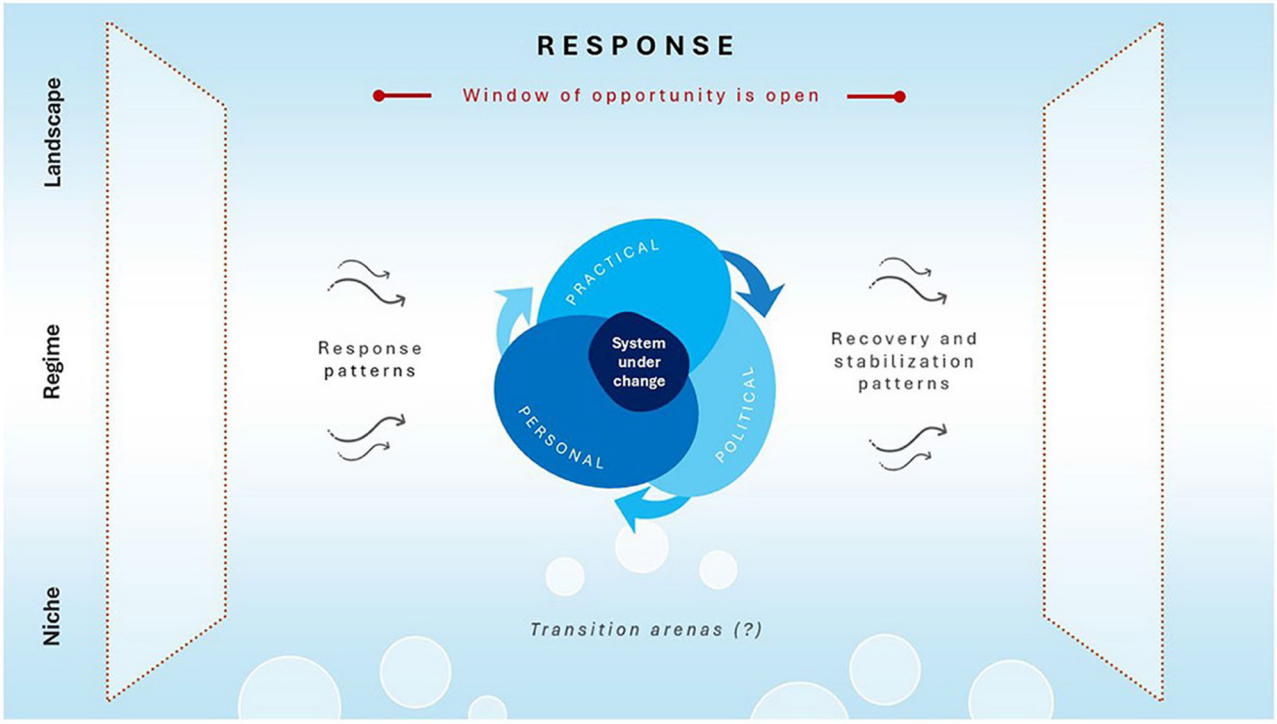

FIGURE 3
System reconfiguration possibilities emerge within the window of opportunity.

the logic of simply "building back the same," the European Environment Agency (European Environment Agency, 2024) offers a compelling typology of trajectories: (i) Pattern 1: resilient but not sustainable, (ii) Pattern 2: sustainable but not resilient, and (iii) Pattern 3: sustainable and resilient (**transformative resilience**). The EEA's Garden example offers an intuitive and symbolic way of distinguishing between three system patterns (Table 1).

As the window of opportunity closes, the reconfigured system stabilizes and may follow one of the possible pathways. Figure 4 situates the described patterns within the broader sequence introduced earlier: following disruption (Figure 2) and the opening of a window of opportunity for responses (Figure 3), recovery pathways eventually stabilize into new systemic configurations. These may align with any of the three EEA patterns (European Environment Agency, 2024) —or revert to business-as-usual "building back the same"—depending on how responses unfold across the practical, political, and personal spheres (O'Brien et al., 2023). The concept of different recovery pathways also resonates with previous research on regime reconfiguration following socio-political shocks, which have informed our interpretation of the EEA typology (Herrfahrdt-Pähle et al., 2020).

We use this typology to interrogate whether post-disaster interventions restore, incrementally adjust, or reorganize systems toward resilience and sustainability. By juxtaposing empirical evidence with this framework, we articulate a concept of **transformative recovery**, a process in which crises are leveraged not only to rebuild but also to reimagine and reconfigure systems toward both resilience and sustainability.

Figure 5 presents the overall analytical framework, integrating the MLP that frames the system configuration (Geels and Schot, 2007), the three spheres of transformation that unpack the dimensions of change (O'Brien and Sygna, 2013), and possible

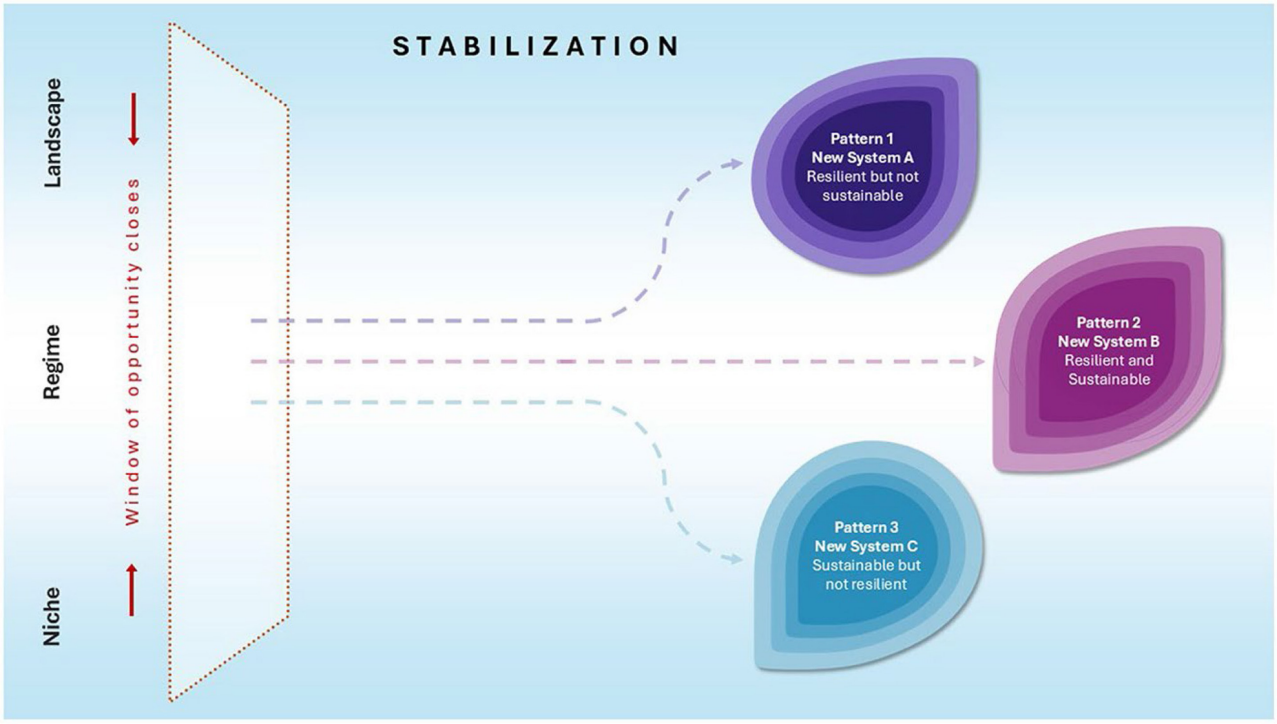

FIGURE 4
Three generic recovery pathway patterns.

system reconfiguration options represented by the EEA resilience and sustainability pathways (European Environment Agency, 2024).

The framework aims to assess both the logic of recovery and the mechanisms that enable or constrain transformation. This structured approach helps trace not only what is rebuilt, but also how and to what ends, and whether the resulting configuration is resilient and/or sustainable.

Methodological approach and case study selection

This study employs an exploratory, multi-case study design to investigate how post-disaster recovery processes engage—or fail to engage—with elements of transformative recovery regarding climate adaptation and mitigation. Rather than comparing cases systematically, we aim to investigate how recovery trajectories unfold in different contexts, each shaped by distinct types of disruption, and what can be learned across those contexts. This approach is grounded in interpretive research traditions that value contextual depth and situated knowledge (Flyvbjerg, 2006; Yanow, 2000).

The selection of our cases follows a purposive logic, reflecting the inclusion of diverse forms of disruption (i.e. war, drought, earthquake, flood), governance scales (municipal, metropolitan, regional), and timescales of recovery (from acute to protracted). Such diversity enables the identification of patterns, blockages, and openings for transformative climate-centered recovery across different contexts, without assuming equivalence or generalizability. This strategy is consistent with approaches taken in recent climate governance research that uses heterogeneity to map typologies or identify enabling conditions (Boyd and Juhola, 2015; Castán Broto and Bulkeley, 2013). We treat the diversity of cases analyzed as sources of unique and distinct insights and as an opportunity for learning, while making it explicit that the cases are not directly comparable.

Data collection and analysis

Each case study was conducted by researchers with prior engagement in the specific context and sector, drawing on a combination of primary and secondary data. Data collection was designed to capture recovery processes using the following methods:

1. Policy and document analysis: a comprehensive review of policy documents, such as national disaster management plans, climate action plans, building codes, recovery strategies, and related reporting. This analysis allowed us to identify relevant policy objectives, implementation strategies, and intended outcomes related to climate adaptation, mitigation, and systemic change. It also included analyzing media reports and gray literature to provide context and connect climate issues to the broader recovery processes. For each case study, we identified the relevant scope of documents and the

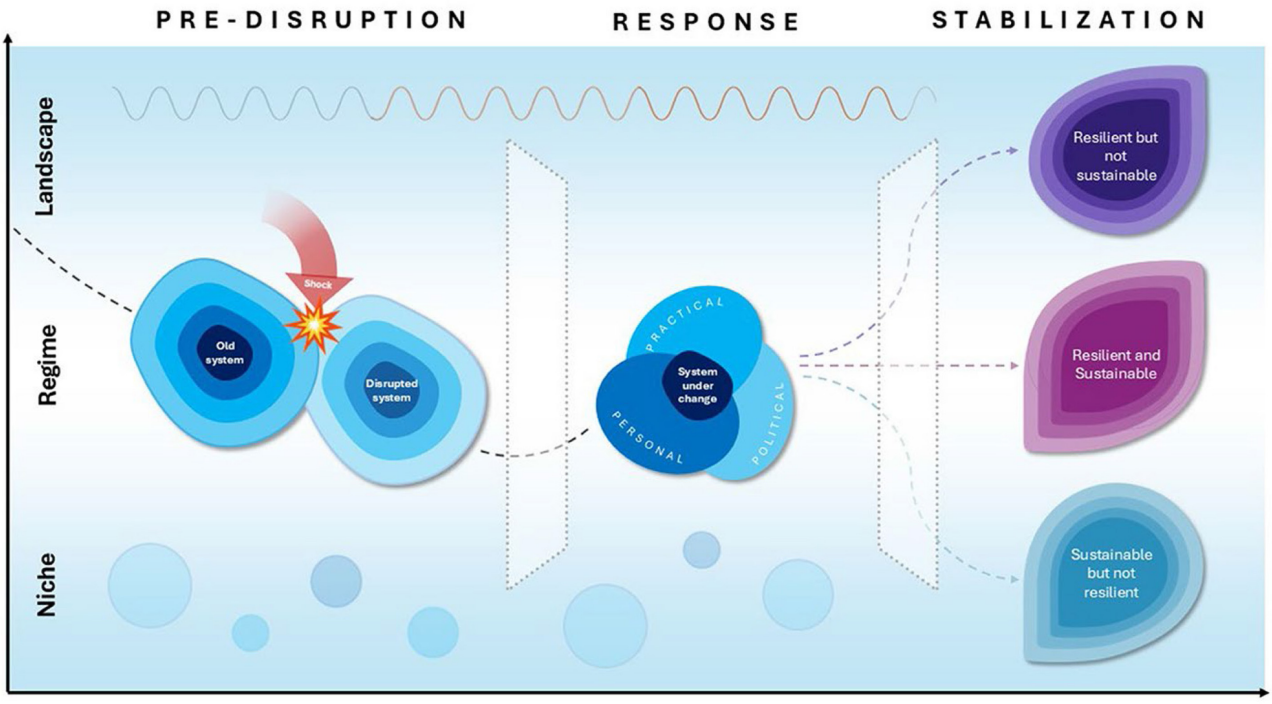

FIGURE 5
Transformative recovery analytical framework.

temporal scope of analysis, given the history, dynamics, and most recent developments around every case.

2. Semi-structured interviews were conducted with stakeholders involved in the recovery process, including practitioners (e.g., engineers, planners, etc.), policymakers and public workers (e.g., government officials, international aid representatives, etc.), and community leaders (e.g., local representatives, NGO staff, etc.) were used to deepen and validate the analysis based on the documents. Overall, nine interviews were conducted across the case studies: three in Rivne (with one policymaker, one practitioner and one community leader), two in Sicily (one public worker and practitioner), three in Türkiye (two practitioners, along with a direct correspondence with government officials), and two in València (one with a policymaker and one group interview with two community leaders). Our approach to anonymization ensures that interviewees can be associated with the context and ensures that they are referred to in terms of the broader stakeholder groups they represent.

The collected data was analyzed using an abductive approach that involves moving between theory and empirical evidence to systematically and iteratively organize and interpret the data (Timmermans and Tavory, 2022). Inductively, recurring themes, patterns, and contradictions were identified within each case study, revealing insights into how recovery processes are framed and executed. Deductively, the data was analyzed along each of the three spheres of transformation, the stages of the recovery processes, relevance to the dimensions of mitigation and adaptation, as well as resilience and sustainability patterns. Following individual analyses of the cases, cross-cutting insights were extracted through iterative team discussions, providing a basis for extracting broader patterns and the basis for recommendations.

Results: cases of post-disaster recovery

Case 1. Rivne, Ukraine: energy system and full-scale Russian invasion

This case study examines how Rivne navigates energy system disruptions under wartime conditions. Since Russia's full-scale invasion of Ukraine in 2022, cities across the country have grappled with unprecedented attacks on energy infrastructure. Severely impacted by targeted attacks on energy infrastructure, Rivne's centralized energy model, reliant on the nearby Rivne Nuclear Power Plant and Russian-imported gas, has witnessed recurring attacks on substations, transmission infrastructure, and energy distribution nodes, undermining essential services, industrial production, and the life of the city in broader through frequent electricity outages lasting for hours. Amid this turmoil, the city reaffirmed its climate commitments, joining the EU's NetZeroCities Project[1] and intensifying its efforts toward carbon neutrality and

1 NetZeroCities is part of the Horizon 2020 Research and Innovation Programme in support of European Union's Green Deal. NetZeroCities has been designed to help cities overcome the current structural, institutional and cultural barriers they face in order to achieve climate neutrality by 2030. https://netzerocities.eu/the-netzerocities-project/.

energy resilience by 2030. We further outline the changes induced by the war, with a focus on implications for energy systems and in relation to climate mitigation and adaptation.

Political sphere (how): shifting governance logics

Prior to the start of the full-scale invasion in February 2022, Rivne's energy governance reflected a predominantly centralized and technocratic model shaped by national regulatory frameworks and vertically integrated, state-owned utilities (UNDP, 2023). Climate considerations were often subordinated to sectoral planning priorities (Guziy, 2025). Still, for more than a decade prior to 2022, the city already had a history of both dedicated climate action and grassroots organization. For example, in 2016, Rivne joined the Covenant of Mayors for Climate and Energy, developing its first Sustainable Energy and Climate Action Plan (SECAP), later updated in 2018. Although this process was only semi-participatory, it opened the door to cooperation among municipal authorities, local environmental organizations, small businesses, and universities. These developments paralleled Ukraine's EU integration trajectory, which gradually embedded climate objectives into national planning (Government of Ukraine, 2021).

A more profound reorientation emerged after 2022, when Rivne was selected as one of the EU's 112 NetZeroCities Pilot Cities, a milestone that coincided with the onset of full-scale war (EIT, 2023). The escalation of Russian attacks on Ukraine's centralized energy infrastructure exposed the acute vulnerabilities of the existing system and underscored the strategic urgency of decentralized, renewable energy. As a result, the city's current formal commitment to carbon neutrality by 2030 represents both a normative and strategic pivot, aligning Rivne with European green transition ambitions while asserting energy sovereignty as a form of resistance. Current governance efforts include updating the city's development strategy for 2027, revising the SECAP, and drafting a dedicated NetZero Implementation Plan, according to the interviews. These processes feature collaborations between local government, civil society, universities, and international advisors.

While new collaborative models have emerged with the onset of war, the overall governance approach remains fragmented. There is no dedicated coordinating entity in charge of leading and overseeing the decarbonization trajectory that would connect actors and processes on a long-term basis. Leadership is diffused, and responsibilities are spread thinly across various municipal departments and external actors. This results in siloed decision-making, limited institutional learning, and a high dependence on the initiative of individual civil servants or external consultants.

As one civil servant noted:

> *"…There are many projects happening, but no one is holding the big picture. We work in silos, and when one person leaves, everything pauses."*

The situation is further complicated by unstable financing mechanisms. Although Rivne has been able to implement critical measures through NetZeroCities and other donor-funded programmes, most activities rely on short-term and externally driven project cycles. There is no long-term municipal financing strategy in place to sustain the transition of work beyond the current funding horizon. Another civil servant noted:

> *"…This process is working now because there is money. But if the money goes away, will anyone still be working on this?"*

National-level policy also adds friction. While Rivne's civil society actors advocate for distributed renewables and municipal energy autonomy (Ecoclub Rivne, 2023, 2024), national strategy continues to prioritize centralized energy solutions, including nuclear expansion (Cretti et al., 2024). This creates a disconnect between local climate ambitions and the broader energy policy environment.

Practical sphere (what): adaptive infrastructure

Before the full-scale invasion, local climate initiatives focused largely on upgrading existing systems. For example, in 2021, the city implemented 58 infrastructure projects valued at 50.4 million UAH—mostly targeting maintenance of electricity systems, engineering networks, roofing, and elevators. Although 65% of the funding came from municipal budgets, the remainder was co-financed by residents, reflecting limited but growing community engagement.

The onset of war in 2022 radically altered this context. Repeated attacks on national grid infrastructure led to widespread disruptions, catalyzing emergency energy stabilization measures and a pivot toward decentralization. Under the NetZeroCities pilot, Rivne prioritized investments in solar energy for critical infrastructure—including hospitals and water utilities (Rivne Vodokanal, 2024), and began retrofitting existing infrastructure to meet enhanced energy efficiency standards (State Agency on Energy Efficiency Energy Saving of Ukraine, 2024).

The development of a digital "Municipal Energy Passport" platform, as a part of the NetZeroCities pilot, marked another important step, enabling data-driven planning, real-time monitoring, and better integration of renewable energy systems. Simultaneously, the city launched a series of capacity-building initiatives, training municipal employees, schoolchildren, building managers, and technical professionals in renewable energy technologies and energy management.

One civil servant explains:

> *"…We are not just creating concepts. We are actually insulating buildings, installing solar collectors and heat pumps… it is not only about saving budgets, but also reducing emissions."*

Despite these advances, the second and third winters of the war were especially cold and challenging. Rolling blackouts and power rationing significantly disrupted daily life. Emergency measures that do not go well with the decarbonization direction, including the acquisition of diesel generators, temporary localized energy storage, and installation of cogeneration units, provided critical short-term relief.

Moreover, several other actions taken by the municipality also might not follow the declared NetZero targets. A civil society

actor shared the following observation: *"…Some actions go against climate targets—like cutting down trees for parking or buying diesel buses. These contradict what is written in the plans."* Thus, while alternative measures manifested and were supported by diverse actors, including the policy actors, the dominant mode of response and recovery focused on obvious and immediate solutions.

Personal sphere (why): evolving narratives of resilience and sovereignty

Prior to the war, climate discourse in Rivne, where it existed, was primarily couched in terms of cost savings, energy efficiency, and reliability. Public engagement remained modest, while environmental NGOs and youth-led initiatives advocated for broader change.

The invasion catalyzed a significant shift in local narratives. Energy independence became reframed not just as a technical goal but as a symbol of national sovereignty and survival. An interviewee from the municipality puts it: *"People may not talk about climate per se, but they understand the value of energy sovereignty."* Citizens' interest in installing solar panels, reducing household consumption, and upgrading insulation has increased. Civil society organizations have amplified this through public education campaigns and participatory tools. Ecoclub, for example, facilitated a city-wide vulnerability assessment and supported citizen engagement with mapping tools and feedback loops.

Local leaders, civil society, and everyday citizens increasingly view renewable energy as a form of resistance—detaching Ukraine's future from fossil-fuel dependency on Russia and enabling greater self-determination. As one city official stated during Rivne EUROFORUM: *"Solar panels are our new shields."* This narrative shift is visible in local public events such as Rivne EUROFORUM, which provides spaces for dialogue, education, and vision-building around energy futures and climate neutrality (Rivne City Council, 2025). In broader terms, the narrative shift has focused on the role of energy in resilience and sovereignty, while its implications for climate mitigation and adaptation are yet to be seen over the longer term, as multiple actors representing coupled framing of solutions and rationales continue to compete for funding while the national narrative remains focused around centralization and control over the energy system (Table 2).

Case 2. Food production systems throughout the drought in Sicily, Italy

This case examines how Sicily navigated intersecting crises in its agricultural and water systems during the 2024 drought emergency. Historically reliant on rain-fed crops and centralized water infrastructure, the region experienced one of the most extreme climate-induced water shortages in Europe (Zachariah et al., 2024). The drought, preceded by decades of declining rainfall and rising temperatures (Aschale et al., 2024; Granata et al., 2024), exposed long-standing vulnerabilities in water governance and agricultural systems. Failures to implement preventive maintenance and structural measures led to reservoir depletion, crop failures exceeding 60%, and rationing for civil use (Catalano, 2025; Duello, 2024). The national government declared a state of emergency in May 2024 (Presidenza del Consiglio dei Ministri - Dipartimento della Protezione Civile, 2024), appointing extraordinary commissioners for both drought management and the livestock sector (Regione Sicilia, 2024b,c). The crisis was not only climatic but also a governance failure, compounded by demographic decline, youth emigration, and economic fragility (ISTAT, 2024; ANSA, 2024; Arena, 2023).

Political sphere (how): shifting governance under pressure

Sicilian water governance has long been marked by fragmentation and centralization. Before reforms, management relied on regional basins and *Ambiti Territoriali Ottimali* (ATOs) at the provincial scale (Regione Sicilia, 2024a). The EU Water Framework Directive (2000), transposed through Italian Legislative Decree 152/2006 (Decreto Legislativo 3 Aprile 2006, 2006), created seven national river basin districts, including Sicily, though initially without a single authority. Law 221/2015 later concentrated responsibilities within unified basin authorities (Governo Italiano, 2015), leading to the establishment of the Sicily River Basin Authority (Regione Sicilia, 2020). Wholesale infrastructure was placed under Siciliacque, while local operators managed distribution. Centralized governance was under the authority of the River Basin Authority and the concessionaire.

Planning instruments such as the River Basin District Management Plan, the Water Conservation Plan, and the 2020 Regional Plan to Combat Droughts set out water conservation, infrastructure maintenance, wastewater reuse, and emergency measures. Yet, implementation lagged due to outdated infrastructure, insufficient resources, weak regional–local coordination and limited public engagement. Interviewees emphasized this gap: "*Approved plans get put away in a drawer*," one practitioner noted, while another stressed "*a persisting problem of political will*." Both observed that "*environmental concerns are often an excuse, used to cover the lack of funding*," pointing to incremental cuts in infrastructure budgets for southern regions in favor of "tax reduction" policies (Avvenire, 2012; TPI, 2021).

The 2024 drought prompted extraordinary centralization. Three regional commissioners were appointed, and a multidisciplinary working group of technicians and politicians managed emergency funds (Regione Sicilia, 2024c). As one public worker explained, the emergency was the "*winning method to bring everyone around the same table*." Simplified procedures and €20 million in extraordinary funds (later expanded) were released (Regione Sicilia, 2024d). Yet, decisions focused narrowly on maintaining water supply and supporting agriculture. "*The aim was to ensure water supply and avoid service interruptions*," a practitioner recalled. This strengthened operational capacity but did not alter governance structures.

After the crisis peak, no permanent inter-institutional mechanisms were created. A public worker urged a "*structural return to the ordinary*," stressing the need for long-term investments. Drought governance remained framed as exceptional rather than systemic, closing the window of opportunity for institutional learning. As a result, responses amounted to incremental adaptation, not transformative governance. Academic initiatives hinted at alternatives. In western Sicily, participatory

TABLE 2 Ukraine case study.

Sphere	Observed actions and dynamics	Critical gaps and challenges	Observations
Practical	• Solar for critical infrastructure (hospitals, water systems) • Municipal Energy Passport (data-based planning) • Capacity-building for energy professionals Participation in NetZeroCities	• Continued dependence on diesel generators and nuclear power • No stable financing for green infrastructure • Project-driven initiatives not scaled city-wide	• Patchy and fragile progress; experimentation not yet institutionalized
Political	• Emerging patched hybrid governance (city, civil society, university) • Local decarbonization center Coordination with EU platforms	• Siloed municipal departments, no formal transition office or team • Local-national misalignment (national focus on nuclear).	• Governance is adaptive but fragmented; lacks consolidation and durable mandate
Personal	• Strong symbolic and survival link between energy autonomy from Russian oil and gas and sovereignty • Civil society (e.g., Ecoclub) is deeply engaged • Rise in public interest in renewables	• No institutionalized participatory planning for recovery	• Transformative potential exists, but a broader deliberative culture is underdeveloped to lift a collective narrative

action research brought together farmers and researchers to co-develop agroecological strategies (Conte et al., 2024). Yet these experiments remained disconnected from mainstream policy processes.

Overall, Sicily's political response remained reactive, and emergency driven. Centralized authority and persistent underfunding constrained preventive action, while bottom-up initiatives lacked institutional uptake. The resulting governance landscape reflected complex multi-level interactions and competing national–regional interests, ultimately sidelining local experimentation that could have supported more transformative pathways.

Practical sphere (what): coping, adapting, and incremental innovations

Sicily retains a deep repertoire of traditional agroecological knowledge. Dryland farming systems based on rain-fed cereals, almonds, and olives are central to local identities and practices of place-making (Ferrara et al., 2025). Ancient irrigation techniques, such as stone cisterns and *saje*, testify to centuries of adaptation to semi-arid conditions (Lofrano et al., 2013). These systems, however, have been increasingly displaced by industrial agriculture, with ecological and cultural costs (Cammarata et al., 2021). More recent innovations—drip irrigation, drought-resistant crops, wastewater reuse—have been promoted as alternatives (Aiello et al., 2013) and were tested through the EU LIFE ADAPT2CLIMA project, while rainwater harvesting remained a key practice, already integrated into building codes in cities like Catania.

At the farm level, adaptive responses emerged, though often guided by markets rather than climate considerations. Some producers have shifted to tropical crops: mango, avocado, banana, papaya, once unthinkable in Mediterranean conditions (Nunn, 2024). While interpreted as innovation, these crops demand high water inputs (Cárceles Rodríguez et al., 2023), potentially worsening scarcity and reinforcing extractive models without regulation. At the community scale, initiatives like *Sicilia Integra* trained unemployed youth and migrants in agroecology, merging traditional knowledge with regenerative practices (UNDESA, 2019), while the Palma Nana Cooperative offered experiential education in sustainability and rural living (Palma Nana, 2025)

Among the most innovative proposals stand pilot projects or recommendations by universities and the third sector (Cirelli and Sciuto, 2024). A notable example is the research project by Conte et al. (2024) in Western Sicily, where researchers and farmers co-developed agroecological alternatives to industrial agriculture through action research. The advocacy of rainwater harvesting promoted by the interviewer also extends to wastewater reuse, highlighted as a key measure to expand water supply, with proven viability for irrigation, also discussed in existing publications (e.g. Aiello et al., 2013). Yet, as the interviewee emphasized, prior to the drought emergency, such technical proposals were disregarded by institutional actors, underscoring the persistent disconnect between knowledge production and policy implementation.

Governmental crisis measures prioritized continuity over transformation. The national government allocated €20 million, later expanded to €2 billion in infrastructure spending (Regione Sicilia, 2024d). Civil Protection relied on short-term measures: emergency water trucking, reactivated wells, subsidies for farmers, and mobile desalination units deployed only in June 2025 (Regione Sicilia, 2020). As one engineer explained, "*The aim was to ensure water supply and avoid service interruptions.*" Another acknowledged that while a medium-term investment plan existed, "*it was never integrated into institutional mechanisms.*" Infrastructural investments thus focused on maintaining existing systems, not redesigning them.

Interviewees confirmed both the sector's slow shift and its constraints. Civil servants stressed the lack of gray infrastructure—dams, reservoirs, maintenance—as the main bottleneck. They also pointed to the political use of climate narratives: "*Climate change is turning into an alibi for everyone*" and "*Environmental concern is often a pretext. The real issue is a lack of funding.*" These testimonies reveal how climate discourse can obscure systemic deficits, sustaining reactive rather than structural responses.

Nevertheless, some openings emerged. Universities demonstrated that treated wastewater reuse could meet up to 15% of agricultural demand. As the interviewed practitioner observed, "*The agricultural sector became more accepting of treated wastewater reuse after the drought.*" Yet uptake remains contingent on investment, public acceptance, and political commitment. Overall, practical responses to the drought reinforced absorptive capacity—the ability to buffer shocks without learning or changing—rather than triggering systemic innovation.

Academia and civil society have advanced viable pathways, but without institutional integration, their transformative potential remains marginal.

Personal sphere (why): changing perceptions and frustrated agency

In Sicily, where "*water scarcity is a historical issue,*" as noted by the practitioner interviewed, communities have long adapted to prolonged drought through inherited practices, such as underground rainwater cisterns in ancient dwellings (Lofrano et al., 2013). These forms of Indigenous Knowledge highlight the enduring role of agricultural heritage—deeply tied to identity—in shaping adaptive practices (Conte et al., 2024).

The 2024 drought, however, was both a material and symbolic rupture. Despite farmers' embedded knowledge, governmental responses were technocratic and top-down, marginalizing local actors. Farmers were forced to abandon harvests and cull livestock (Duello, 2024), turning the crisis into one that undermined livelihoods and dignity as much as material production. "*Citizens became more aware,*" the practitioner stated, noting that the drought drew "*greater media attention.*" Yet no genuine community-level dialogue emerged, and trust eroded as funds targeted only short-term relief. These reinforced perceptions of a detached government, while opportunities to mobilize community agency were left untapped.

Some cultural shifts nevertheless appeared. Farmers began "*asking for support to implement water-harvesting solutions*," as was mentioned by the interviewed practitioner, suggesting a willingness to engage in adaptive change. Citizens increasingly recognized drought as systemic rather than exceptional. The crisis thus exposed the fragility of existing governance, while simultaneously sowing seeds of transformation through revived Indigenous Knowledge and local resilience practices.

Public institutions continued to frame the drought in narrow technical terms, emphasizing immediate water logistics and emergency management over long-term social and ecological transformation. In some cases, climate change discourse was used to obscure structural neglect. As one civil servant remarked, "*Climate change is turning into an alibi for everyone.*" This instrumentalization of climate narratives served to justify top-down decisions and deflect attention from governance failures, further undermining trust and civic engagement.

Yet, the drought also acted as a catalyst for rethinking. Among certain segments of the population—particularly younger generations and community-rooted actors—a shift in consciousness began to take shape. Local initiatives emerged that enacted small-scale but meaningful transitions: agroecological cooperatives, permaculture gardens, and informal water-sharing networks (Conte et al., 2024). For example, in places like the Belice Valley, grassroots assemblies brought together farmers, hydrologists, artists, and students to reframe water not as a commodity, but as a common good (Centro di Ricerche Economiche e Sociali del Meridione, 2025) Though informal and lacking institutional backing, these gatherings embodied a nascent cultural transformation, one in which drought is reimagined not solely as a technical problem, but as a political and ethical challenge that demands collective reorientation.

Grassroots initiatives such as *Coltivare il Futuro* increasingly invoked the language of territorial sovereignty, environmental stewardship, and regenerative futures (Palmeri and Bissanti, 2025). These emerging narratives argue that climate responses must be rooted in historical memory, local knowledge systems, and the agency of those directly affected (Nanni et al., 2021). In contexts like Sicily—where rural abandonment and demographic decline converge with ecological precarity—such actors insist that recovery cannot be reduced to material infrastructure alone.

Together, these shifts signal the early stages of a cultural metamorphosis. While not yet dominant in the collective narrative, they open space for alternative imaginaries of recovery—ones that foreground relational, place-based, and intergenerational forms of resilience (Table 3).

Case 3. Post-earthquake reconstruction in Türkiye: barriers and pathways for sustainable building practices

This case study traces how Southeastern Türkiye has approached systemic recovery of its construction sector following the 2023 earthquakes, amid compounding social and political pressures. In February 2023, devastating earthquakes in southern Türkiye resulted in over 55,000 fatalities and severe damage or destruction to approximately 280,000 buildings across 11 provinces, displacing around 1.5 million people (Presidency of Strategy Budget, 2023). Cities like Hatay and Kahramanmaraş experienced extensive damage, with entire neighborhoods reduced to rubble under harsh winter conditions (Çetin et al., 2023). The Turkish government responded swiftly with a massive reconstruction program, pledging to build approximately 650,000 new homes. By early 2024, around 319,000 units were committed, with over 200,000 completed and approximately 120,000 under construction. However, this rapid rebuilding effort, managed by the Ministry of Environment, Urbanization, and Climate Change (MoEUCC) and the Housing Development Administration of the Republic of Türkiye (TOKI), prioritized speed and earthquake safety, largely neglecting the integration of sustainability practices crucial for Türkiye's long-term climate change adaptation and mitigation goals. Despite Türkiye's stated commitments to climate-responsive policies—including a 2053 net-zero carbon target, sustainable energy transitions, and green building practices—the reconstruction process remained largely disconnected from these sustainability objectives.

Political sphere: centralized governance, fragmented climate integration

Türkiye historically responds to large-scale disasters through centralized governance structures. These structures are defined by regulations such as Law No. 7269 (Law on Measures and Assistance Regarding Disasters Affecting Public Life) and Law No. 6306 (Law on Transformation of Areas Under Disaster Risk). These laws grant substantial authority to national institutions such as MoEUCC, TOKI, and the Disaster and Emergency Management Presidency (AFAD), significantly limiting local stakeholders and community participation (Özdogan et al., 2024).

TABLE 3 Italy case study.

Sphere	Observed actions and dynamics	Critical gaps and challenges	Observations
Practical	• Emergency measures: subsidies, water trucks, reactivation of desalination plants • Limited experimentation with agroecology and irrigation upgrades	• Fragmented implementation • No scale-up of sustainable innovations • No systemic water governance reform	• Short-term relief prioritized over structural change
Political	• Crisis governance is centralized in regional authorities • Some EU funding mechanisms triggered • Disconnected rural planning and agricultural policy	• Absence of coordination across water, agriculture, and climate sectors • No cross-level or participatory governance structure	• Governance remains reactive and siloed
Personal	• Rising awareness among farmers about climate risks • Local cooperatives and activist networks engaged in resilience and climate mitigation discourses	• Farmers' experiential knowledge marginalized • Lack of inclusive planning processes • No mechanisms for value-driven dialogue	• Potential exists, but not institutionally activated

During the 2023 earthquake recovery, this top-down institutional legacy was reinforced rather than reformed. Regional and municipal actors were sidelined, and the decision-making process remained centralized in the hands of governmental bodies and political appointees (Resmî Gazete, 2023). In this governance context, climate considerations and participatory planning processes were left largely at the discretion of central authorities. The urgency of recovery was framed primarily through the lens of rapid housing production, leaving little room for deliberation or local input (Oguz and Hansu, 2025). In line with that, the Turkish government expanded expropriation powers to facilitate swift reconstruction, often favoring peripheral land development and urban sprawl over sustainable *in-situ* rebuilding strategies (Çakir, 2023). Although new buildings now meet improved seismic standards, they generally lack integration of climate-responsive principles.

However, a more sustainable direction is not absent. Türkiye's national green building certification system, *Yeşil Bina Sertifikasi* (YeS-TR), offers a potential avenue to align reconstruction with climate mitigation and resilience goals. Developed by MoEUCC, YeS-TR is a comprehensive framework that incorporates multiple modules—such as integrated design, building materials, energy and water efficiency, indoor environmental quality, and innovation—drawing on both international standards and local environmental conditions (ÇSB, 2020; Umumi Hayata Müessir Afetler Dolayisiyle Alinacak Tedbirlerle Yapilacak Yardimlara Dair Kanun, 1959).

Although YeS-TR certification remains voluntary today, it will become mandatory for new public buildings exceeding 10,000 square meters starting in January 2026 (ÇSB, 2024). According to our interviews, one of the certification's lead developers emphasized its value in the post-disaster context:

> "*YeS-TR provides feasible and grounded recommendations suitable for Türkiye's unique environmental and socio-economic conditions.*"

Our correspondence with MoEUCC confirmed this growing institutional interest. A ministry representative noted:

> "*the certification's initial implementation in public building processes would substantially elevate awareness, technical expertise, and practical experience within the construction industry, eventually supporting voluntary uptake in private construction due to proven economic and environmental benefits*"

Of particular relevance is YeS-TR's *Adaptation, Conservation, and Ecology (AKE)* module, which uniquely includes a dedicated disaster resilience component—something rarely found in other green building systems. This module encourages comprehensive disaster risk assessments, sustainable site selection, and climate-adaptive land use planning. As the ministry noted:

> "*The 'Disaster Resilience' theme within the AKE module constitutes a critical component of sustainable site selection and land-use planning in Türkiye, given the country's frequent exposure to various disasters. It has no equivalent in international certification systems, making it a unique and strong feature of our national green certification. . . . This module significantly contributes to national disaster mitigation efforts. It aims to advance disaster awareness and to demonstrate that disaster impacts can effectively be minimized through proactive measures.*"

Despite these promising developments, YeS-TR has not yet been systematically incorporated into post-earthquake reconstruction across affected provinces. Institutional uptake remains slow, and without a clear regulatory push, its impact may remain marginal. Moreover, the centralized governance structure continues to limit the scope of local innovation and civic agency in shaping a transformative recovery.

In sum, Türkiye's post-disaster governance reflects a deep institutional inertia shaped by decades of centralization. Yet, embedded within this landscape are tools—like YeS-TR—that hold potential for more inclusive, climate-aligned reconstruction.

Practical sphere: potentials for climate-responsive innovations

Despite the existence of science-based frameworks such as the YeS-TR green building certification and the availability of climate-resilient design principles, practical uptake remained minimal. While YeS-TR has been promoted for public buildings and includes a module on disaster resilience, most new constructions

conformed to traditional, cost and speed driven models with limited attention to energy efficiency, sustainable materials, or land-use adaptation. A pilot energy efficient design initiative in Hatay, for instance, demonstrated that incorporating renewable energy and passive design strategies could significantly reduce energy demand (Saleh et al., 2024), yet such examples have not been scaled or mainstreamed.

Instead, reconstruction was dominated by a highly centralized and opaque governance structure. Tenders were often awarded to large, politically affiliated companies through non-transparent processes (Toker, 2023). In the initial weeks following the earthquake, President Erdogan's promises to complete all disaster housing within 1 year as part of his local election campaign (Erem 2024) received widespread media attention, raising public expectations. Built environment professionals frequently emphasized that this timeline was unrealistic and would likely lead to long-term environmental, economic, and social problems.

Contractor-driven practices also shaped the urban form of recovery. Reconstruction sites were frequently located on the periphery of affected cities, as guided by the current laws and regulations, requiring the expropriation of agricultural lands, forests, and even olive groves (Bianet, 2023). The demolition of undamaged buildings within designated reserve areas—including the building of the Chamber of Architects Kahramanmaraş Branch, despite its structurally intact condition— alongside the adoption of rapid and simplified construction practices concentrated on urban peripheries instead of *in-situ* reconstruction, has been significantly criticized by built environment specialists (Batuman, 2024). Concerns have been raised that such practices could lead to adverse environmental impacts, increased infrastructure costs, and enduring social issues in the long term. In many cases, retrofitting damaged but salvageable buildings—a more cost-effective and environmentally responsible solution, were dismissed in favor of demolition and new construction. Yet engineers estimated that retrofitting could have secured thousands of structures at a fraction of the cost and environmental footprint of rebuilding (Aktas et al., 2024).

Furthermore, while seismic codes have improved since 2018, weak enforcement remains a persistent challenge. Even before the 2023 disaster, construction amnesties had allowed thousands of non-compliant buildings to be legalized, undermining the credibility of regulatory systems (TMMOB, 2018). Against this backdrop, civil society and academic initiatives advocating for ecologically sensitive reconstruction faced significant challenges in gaining traction. Particularly in Hatay, the expropriation of agricultural lands and olive groves for reconstruction purposes was met with strong opposition from local communities. Robust civic initiatives and collective solidarity emerged, explicitly demanding a more ecological reconstruction approach, as exemplified by grassroots mobilizations such as the Dikmece resistance (Arti Gerçek, 2023).

Personal sphere: dominant narratives, urgent needs, and shifting perspectives

Understanding public perceptions and attitudes toward climate change adaptation and mitigation in post-disaster reconstruction is critical for achieving effective recovery outcomes. In disaster contexts, prevailing narratives and prior exposure to climate-responsive solutions significantly shape community priorities, often creating tension between immediate relief and long-term sustainability goals.

Following the 2023 earthquakes, communities experiencing severe hardships in temporary housing, such as tents and container settlements, understandably prioritized immediate access to permanent housing solutions. This priority was heightened by the government's pledge to deliver disaster housing within 1 year, which elevated societal expectations for rapid reconstruction. Consequently, proposals emphasizing sustainability, such as green building standards, climate-adaptive designs, or participatory planning processes, were often perceived as potential delays rather than beneficial enhancements.

The government's framing of the recovery process as an emergency, while undoubtedly justified by the urgent conditions, further restricted opportunities for meaningful public deliberation and democratic engagement, which might take longer than standardized housing projects. By predominantly emphasizing speed, this approach overlooked equally critical factors such as sustainability, inclusivity, and local participation—elements that inherently require more extended timelines but are vital to ensuring durable, resilient outcomes beyond immediate relief.

Additionally, the unprecedented scale of destruction strengthened the perception among local stakeholders that only centralized governmental intervention could adequately manage recovery efforts. Field interviews with municipal authorities in affected cities explicitly illustrate this perspective. A representative from one district in Hatay noted: "*The current reconstruction approach excludes local ideas and priorities; however, relying solely on local governments and communities would also be insufficient for managing recovery efforts following a disaster of this magnitude. Central government involvement remains essential, but it must be based on genuine cooperation.*" This observation highlights a recurring practical tension: effective recovery requires balancing central oversight, necessary due to resource and capacity limitations, with locally driven initiatives.

Nevertheless, evidence indicates a gradual shift in public perspectives toward sustainability, driven by strategic interventions and practical demonstrations. Current public projects employing the YeS-TR certification illustrate the tangible practicality and long-term advantages of systematically integrating sustainable construction methodologies, provided they receive consistent political backing (ÇSB, 2023). Studies clearly demonstrate benefits, including improved environmental performance, lasting economic savings, and greater resilience in the built environment (Kartal et al., 2020) Simultaneously, civil society organizations, NGOs, and built environment professionals increasingly advocate for environmentally responsible approaches. Their advocacy reflects growing public awareness about environmental degradation and concerns regarding the expropriation of agricultural lands, forests, and olive groves for new settlements.

Addressing the existing tensions requires clearly demonstrating the tangible practicality and long-term advantages of sustainable reconstruction. Yet, achieving broad societal acceptance for sustainable reconstruction necessitates continuous educational initiatives, transparent governance practices, and meaningful

reforms within the construction industry. By strategically leveraging existing scientific knowledge and technical expertise, it is possible to enhance both public support and practical adoption of sustainability measures. Ultimately, such efforts hold the potential to transform Türkiye's post-earthquake reconstruction into an internationally exemplary model of climate-responsive recovery, embedding resilience within governance frameworks, construction practices, and broader societal attitudes (Table 4).

Case 4. València: DANA flooding and the struggle for climate-conscious mobility transformation

On October 29, 2024, the València metropolitan area was struck by a catastrophic DANA (isolated high-altitude depression), unleashing 771 l/m² in 24 h, of which 185 were accumulated in just one hour, a record for Spain in that period (AEMET, 2024). The floods claimed more than 232 lives representing 70% of all deaths linked to torrential rains in Europe throughout 2024, submerged entire neighborhoods, and destroyed over 120,000 vehicles (La Moncloa, 2024). Many fatalities occurred in underground garages and during evening commutes, with people trapped in cars or swept away by torrents. The event underscored how València's car-dependent infrastructure not only failed under extreme conditions but actively amplified vulnerability. This case study therefore investigates whether the disaster would reinforce the status quo or catalyze systemic transformation in urban mobility and climate resilience.

Political sphere: fragmented governance meets public pressure

Prior to the disaster, València's mobility governance reflected chronic fragmentation and a reliance on reactive, sectoral planning. The dismantling of the city's integrated emergency coordination unit in 2023 delayed critical alerts and exposed institutional unpreparedness. Despite policy frameworks promoting climate action—such as EU directives, Low Emission Zone (LEZ) plans, and a Metropolitan Mobility Plan focused on public transport expansion, deterrent parking, and Mobility-as-a-Service (MaaS) platforms—car-centric development remained dominant. At the time of the flood, approximately 60% of daily commutes in the region were made by private vehicles (GVA, 2022).

These dynamics unfolded within a broader governance landscape marked by transition. In recent years, València has embraced a progressive, mission-oriented approach through its participation in the EU Cities Mission and the formation of multi-actor partnerships to advance climate neutrality, experimentation, and participatory governance (Blanes et al., 2024; Udovyk et al., 2025a,b). However, following the 2023 municipal elections, this trajectory began to shift. The new political leadership has reoriented priorities toward a more technocratic governance model, emphasizing digital and technological innovation over deliberative, systemic transition—highlighting how political change can redefine the contours of urban climate governance (Blanes et al., 2024; Udovyk et al., 2025a,b).

The flood spurred rapid, though uneven, policy responses. The Spanish government allocated over €1 billion for transport recovery, including €465 million through the Plan Reinicia Auto for vehicle replacement (Real Decreto-Ley 8/2024, de 28 de Noviembre, Por El Que Se Adoptan Medidas Urgentes Relativas al Plan REINICIA AUTO+, Pub. L. No. 8/2024, 2024) Simultaneously, the regional government passed the Climate-Resilient Mobility Act, banning construction in floodplains and mandating flood risk assessments for new infrastructure.

Citizen science and advocacy played a significant role. Post-flood maps developed by the Universitat de València, combining satellite and crowdsourced data, were cited in parliamentary debates. There was a demand for elevated bike lanes and resilient transit hubs, calling attention to the systemic risks of car-centered planning. As one activist noted: "*This wasn't just weather—it was policy failure on wheels.*"

Yet, the reforms coexisted with contradictions. National subsidies promoted vehicle renewal over public transit, while conservative coalitions (PP–Vox) framed green reforms as "economic sabotage." Governance thus oscillated between transformative ambition and regime-preserving investments, limiting the coherence of post-disaster strategy. Crucially, what remained absent was a shared governance space where diverse stakeholders (including citizens, local governments, businesses, and civil society) could co-create long-term recovery pathways to address mobility recovery. Although various expert groups and intergovernmental committees convened to address aspects of recovery, these efforts operated in silos and lacked mechanisms for inclusive deliberation, vision-building, or systemic learning. This absence limited the capacity for reflexive, anticipatory governance and hindered the emergence of a cohesive transformation strategy.

Practical sphere: cars as catalysts of crisis, mobility niches under pressure

The flood transformed the city's dominant mode of transport—cars—into sources of chaos and death. Residents drowned attempting to reach or retrieve vehicles; streets clogged with floating cars impeded emergency response. "*We found seven bodies in a garage where they were trying to save their cars*," said a firefighter. *"The water just came too fast."* In contrast, cycling and walking became vital mobility alternatives. The Turia River footbridge emerged as a lifeline—renamed the *"Solidarity Bridge"* by residents—when all other routes were impassable. Informal walking routes and pre-existing bike lanes played unexpected roles in maintaining connectivity.

Prior to the flood, València piloted several niche innovations: bike-sharing schemes, electric scooters, and smart mobility zones in selected districts. Reports from Las Naves, the city's innovation agency, documented modest shifts toward non-motorized trips. However, these innovations remained siloed, underfunded, and insufficiently scaled. Post-flood investment prioritized road and drainage repairs, while alternative mobility received rhetorical support but limited resources.

> *"When there was pure mud on the streets, cycling, public transport, and citizen collaboration gained weight. I once took the train, which was a shuttle bus, and for example, I know*

TABLE 4 Türkiye case study.

Sphere	Observed actions and dynamics	Critical gaps and challenges	Observations
Political	• Centralized recovery led by MoEUCC, TOKI, AFAD—Local and civil actors sidelined—Contracts favor political allies	• Exclusion of democratic input • Weak accountability and transparency • Climate goals subordinated to urgency	• Governance is shaped by top-down control and opacity
Practical	• Rapid housing delivery prioritized • Emphasis on earthquake safety • Public projects with YeS-TR certification system -new builds on rural land	• Sustainability marginal or symbolic • No mandatory green standards • Urban sprawl, missed retrofitting options	• Speed-driven reconstruction hinders climate integration
Personal	• Public demand for fast shelter • Low climate awareness and demand for sustainable solutions	• Green building seen as a potential delay • Social and cultural needs ignored—Emerging awareness among youth and NGOs	• Dominant narratives limit change, but cracks emerged

> *other people who organized themselves with the few people who had vehicles. It was the time of the post, when we still hadn't recovered… but now it's the time of the avalanche of vehicles. Everyone has restocked their vehicle, and people I know who had two and three vehicles have completely restocked their vehicles."*

The continued dominance of car-based solutions—particularly through subsidies—suggests a missed opportunity to realign infrastructure with climate-resilient principles. *"We're rebuilding the old system with newer cars,"* commented one mobility planner. *"It's reconstruction without transformation." In fact, one cyclist activist who played a key role delivering bikes to the population in the first months of the crisis, pledged that "the first thing that the Regional Government did when they re-opened the metro service, we to forbid the entrance of bikes in the trains,"* which meant a significant step back from previous multi-mode sustainable mobility policies. In fact, the only innovative solution that seems to prevail is the building of high-rise parking spaces on the edges of towns to empty the streets of cars through pedestrianization and green spaces. This is expected to contribute to increased security in case of flooding and to urban space quality.

Personal sphere: from complacency to cognitive dissonance

Before the disaster, car ownership in València was deeply normalized—viewed as a necessity for commuting, comfort, and status. Confidence in flood defenses, combined with the convenience of driving, created a sense of safety that proved fatally misleading. Climate risks were seen as distant, and mobility choices were rarely linked to environmental consequences.

The DANA disaster triggered a deep emotional rupture. Cars, once symbols of security, became associated with death, helplessness, and debris. *"They floated like toys and killed people,"* said one survivor. *"We'll never look at parking garages the same again."*

Public discourse momentarily shifted. Solidarity narratives circulated widely, centered on shared trauma and the use of bicycles or footpaths to navigate the submerged city. Yet, this collective awareness did not translate into widespread behavioral or cultural change. A survey by the Polytechnic University of València found that the most frequently cited recovery priority was car replacement—not public transport or climate-safe infrastructure.

> *"It was surreal," recalled one resident. "We were driving shiny new subsidized electric cars through streets full of mud, collapsed houses, and dead gardens. Everything was broken—but we still needed to drive."*

This illustrates a fundamental disjuncture between emotional awareness and structural alternatives. Without reliable public transit or participatory platforms for reimagining mobility futures, even a rupture of this scale failed to anchor a transformation narrative (Table 5).

Analysis

Analysis across cases along the three spheres of transformation

Political sphere: governance without anticipation

As for the cases, in response to disruptions, the governance mode was primarily reactive and siloed. Türkiye exemplified centralized recovery, with national agencies excluding municipalities from planning processes and bypassing public accountability. Italy's drought response was fragmented across agriculture, water, and climate departments, without a cross-sector transition mandate. Even in relatively decentralized Spain, strategic contradictions impeded structural transition in mobility.

Where new institutional forms emerged, however, recovery showed signs of transformative potential. Rivne developed a civic–academic–municipal alliance, supported by EU climate frameworks, enabling the city to adopt a long-term energy transition pathway. This case highlights how multi-scalar coalitions and hybrid governance configurations provide the scaffolding for experimentation and adaptation (Bulkeley and Betsill, 2013; Hölscher et al., 2019). In more constrained settings, like Türkiye and Italy, civil society coalitions and rural networks also pursued alternative recovery logics, albeit without formal mandates or sustained funding.

These examples highlight a key insight from transition theory: transformative change requires not only better policy, but new arenas for policy formation, where participatory visioning and institutional learning can co-evolve (Frantzeskaki et al., 2012).

TABLE 5 Spain case study.

Sphere	Observed actions and dynamics	Critical gaps and challenges	Observations
Practical	• Mobility reforms launched (Climate-Resilient Mobility Act, LEZs, active mobility plans) • Some EU conditionalities used • Grassroots initiatives mobilization	• Car replacement subsidies (Plan Reinicia Auto) contradicted climate goals • Infrastructure still prioritizes private car use	• Climate-smart measures are emerging but inconsistently applied and undermined by legacy systems
Political	• Climate-mobility integration initiated through new legislation • Some cross-sector governance experimentation at the municipal level • Strong technical leadership	• Political fragmentation: tensions between progressive agendas and car-centric coalitions • No functioning transition arena	• Politically contested; institutional innovation exists but lacks coherence and enforcement
Personal	• Rising public support for bike infrastructure, resilience awareness	• Car dependency is still dominant and is the main cultural narrative	• High awareness and will to change in some groups; broader value shift still shallow and contested

Practical sphere: infrastructure without imagination

Across all cases, recovery actions were dominated by a technical, infrastructure-focused rationality centered on short-term continuity rather than long-term system change. In Türkiye, centralized recovery efforts in post-earthquake housing reconstruction adhered to earthquake design standards but neglected environmental sustainability and participatory design, thus disregarding potential long-term impacts. Similarly, Sicily's drought response relied on desalination infrastructure, neglecting regenerative land use and water management practices. Ukraine's response to energy infrastructure damage involved mass procurement of diesel generators to ensure winter survival—reinforcing fossil fuel dependence rather than accelerating a renewable transition. In València, the paradox of promoting bike lanes while simultaneously subsidizing car replacement (via Plan Reinicia Auto) reflects a lack of internal policy coherence and reveals the limitations of technocratic adaptation under conflicting agendas.

Yet even in cases with advanced pilots, such as agroecological initiatives in Sicily or climate-friendly solutions in Türkiye, transformative potential remained under-realized due to the absence of institutional mechanisms to consolidate learning, scale innovation, or formalize change, factors considered crucial for advancing transition agendas (Loorbach et al., 2017; Stirling, 2014). Without political support or budgetary anchoring, these initiatives functioned more as symbolic signals than structural shifts.

Personal sphere: recovery without narrative change

Across all four cases, the personal sphere—the realm of values, identity, emotion, and meaning—emerged as the most underdeveloped yet foundational dimension of recovery. While infrastructure was rebuilt and policies reformed, the deeper symbolic and cultural ruptures caused by disaster were almost unacknowledged. Recovery governance dominated by technocratic scripts marginalized experiential knowledge, erased trauma, and foreclosed opportunities for collective sense-making.

This tendency manifested in diverse ways across the cases. In Türkiye, the recovery process was framed around urgency, positioning centralized reconstruction as the quickest solution and influencing perceptions of alternative approaches as unnecessary obstacles causing delays. In Sicily, technical water management solutions sidelined long-standing local ecological knowledge, and climate change was framed to be the "one to be blamed". In València, mobility planning remained embedded in a depoliticized, expert-driven discourse, detached from lived experience. Across these contexts, there were few, if any, institutional mechanisms for narrative renegotiation, public mourning, or imaginative reorientation—practices essential for rebuilding not just infrastructure but meaning.

As transformation scholars argue, structural and technological shifts remain fragile and performative unless they are accompanied by shifts in culture, identity, and affect (Fazey et al., 2018; Head, 2022). As Brown and Westaway (2011) emphasize, affect, and memory are not peripheral to climate governance—they are constitutive of it. Such shifts, however, are hard to predict and steer. Narrative changes across cases could be observed if linked to the necessity and poignant inexpedience of dominant storylines. In Rivne, for instance, the growth in decentralized energy was catalyzed not only by damaged infrastructure, but by a broader reframing of energy as a question of sovereignty and survival from the Russian attacks—a narrative that galvanized civic participation and legitimized alternative energy system configurations.

As recovery regimes continue to neglect the symbolic and emotional work required for transformation, such openings remain rare and fragile. Without space for grief, imagination, and deliberation, the rupture of disaster risks being quickly sutured by familiar logic, undermining the possibility of deeper, systemic reconfiguration.

Analysis of transformation patterns across the cases

Looking at the recovery pathways across the four systems underscores the persistent gravitational pull of functionalist, path-dependent responses to crises. Despite heterogeneous threats and institutional contexts, the dominant trajectory across cases aligns with what is termed the "resilience of the status quo" that restores system performance without reconfiguring its structure, purpose, or politics (Pelling and Dill, 2009).

This orientation toward **Pattern 1**—resilience without sustainability—is evident in all cases, albeit in different configurations. In Türkiye, the post-earthquake reconstruction program led by the central government exemplifies a technocratic approach prioritizing speed and scale of physical recovery while actively circumventing participatory planning, environmental safeguards, and design innovation despite existing solutions. The result is infrastructural resilience decoupled from any broader concerns, resembling "authoritarian resilience" in urban planning (Oguz and Hansu, 2025).

Similarly, in Sicily's drought-stricken agricultural system, the revival of desalination plants and emergency water subsidies reflected a short-term logic aimed at stabilizing outputs, not redesigning water-agriculture-climate links. While pockets of agroecological innovation existed, they remained peripheral, lacking governance anchoring and finance. This reproduced the common pattern of institutional lock-in, where deeply embedded systems resist change even in the face of manifest failure (Groen et al., 2023; Stirling, 2014).

In València, the post-flood recovery process prioritized immediate risk mitigation and restoration of mobility infrastructure yet largely failed to challenge the entrenched dominance of car-based planning. The substantial funding under *Plan Reinicia Auto* reflected a strategy aimed at restoring disrupted flows rather than transforming them. As a result, the recovery effort reinforced a path-dependent model of urban mobility, where resilience is pursued through protective infrastructure and sectoral fixes. In Rivne, the response to wartime energy disruption similarly focused on short-term technological fixes—backup generators, emergency grid stabilization, and fuel imports.

All those cases reveal governance incoherence and conflicting regime logics (Geels, 2011). These misalignments showcase how strategic visions fail to materialize institutionally due to competing mandates, fragmented competencies, and limited political commitment (Loorbach et al., 2017). Even where sustainability discourse permeates official plans, such as with Türkiye's 2053 net-zero target, discursive commitment does not equate to transformative ambition. As Avelino et al. (2019) argue, transformative change requires not only radical goals but also the capacity to challenge incumbent power structures, create new institutional logics, and build cross-sector alliances. In the absence of such mechanisms, change remains aspirational, as post-disaster interventions stabilize existing regimes rather than open space for transformation (Bevir, 2016; MacKinnon and Derickson, 2013).

Across all cases, **Pattern 2** surfaces through promising pilots, such as smart mobility, agroecology, and solar microgrids. These efforts, however, remain fragmented, lacking capacities, institutional anchoring, or political momentum to drive system-wide change. In Sicily, agroecological practices and efficient irrigation technologies remain peripheral and disconnected from mainstream drought governance and top-down funding schemes. Similarly, existing climate-responsive solutions, such as 2053 net-zero emission targets and the YeS-TR certification, hold significant potential for Türkiye's reconstruction; however, dominant discourse excludes these options, framing them as obstacles to rapid and effective recovery. In València, bike lanes and grassroots pressure reflect an emerging sustainability vision, but are undermined by car-replacement subsidies. And in Rivne, solar deployment and local energy planning signal movement toward net-zero futures, but remain fragile and dependent on wartime urgency, donor support, and fragmented governance.

In this context, **Pattern 3** is rare. The most promising signals appear in Rivne, Ukraine, where wartime energy disruption catalyzed decentralized solar and new alliances. The co-development of a Municipal Energy Passport, combined with public training programs and participation in EU NetZeroCities, suggests an emergent form of hybrid governance, a relational configuration of actors and institutions capable of learning, adapting, and imagining alternative energy futures (Castán Broto and Bulkeley, 2013). Yet even here, centralization remains high and institutional sustainability is uncertain.

Finally, a common thread across all cases is the absence of formal transition arenas—dedicated, cross-sectoral governance platforms that allow for coordinated experimentation, deliberation, and system redesign. As Hölscher et al. (2019) argue, such arenas are essential for fostering co-evolution between policy, innovation, and public meaning. Without such or similar purposeful arrangements and associated systemic experimentation and learning, even promising pilots remain isolated.

In sum, the analysis reveals that transformative resilience is not a natural consequence of disruption—it is a political, institutional, and narrative project. It requires a convergence of new solutions, participatory governance, and cultural sense-making processes that can challenge existing regimes. The cases offer both cautionary tales and hopeful signals: they show that while transformation is rarely achieved, it remains possible when the cities use crises not only to rebuild what was lost, but also to discover what could be (Table 6).

Barriers and enablers of transformative recovery

Rather than mapping each case neatly onto a single trajectory, our analysis reveals that Patterns 1 (resilience without sustainability), 2 (sustainability without resilience), and 3 (transformative resilience) often coexist within the same system. Post-disaster recovery is rarely linear; it is a contested and uneven terrain where multiple logics compete and overlap. The critical question, then, is not which pattern a case "represents," but which logic is gaining institutional ground, and under what conditions.

Understanding why recovery does or does not lead to transformation requires attention to how recovery is governed, imagined, and experienced. Drawing on O'Brien and Sygna (2013) Three *Spheres of Transformation* framework, we assess how actions in the practical, political, and personal spheres interact to either reinforce existing systems (Patterns 1 and 2) or open pathways toward systemic change (Pattern 3). These spheres are not siloed; transformation emerges only when interventions across all three dynamically interact and reinforce each other.

This relational analysis shows that Pattern 3 is not a default outcome of disruption, but a fragile, emergent possibility. It materializes only when technical innovations are aligned with

TABLE 6 Patterns identified in the cases.

System/case	Pattern 1: resilient but not sustainable	Pattern 2: sustainable but not resilient	Pattern 3: transformative resilience (climate-focused)
Agriculture/sicily (drought)	• Emergency water subsidies- Reactivation of desalination plants • Top-down funding schemes	• Agroecological research pilots • Drip irrigation and reuse tech not scaled	*Blocked* • No system-wide reform • No integration of farmer agency or nature-based governance • No formal transition governance arena
Housing/Türkiye (earthquake)	• Rapid rebuild via TOKI • Centralized control, minimal transparency • Limited environmental impact consideration	• Some improvements in the construction techniques, such as sustainable material use or reduced energy consumption • Recognition of need for energy-efficient housing (discursive and political level)	*Blocked* • Potential lies in involving the 2053 net-zero target and existing climate change adaptation and mitigation strategies in the construction efforts • Promotion of the green transition agenda among stakeholders, including national and local governments, built environment professionals, and citizens
Mobility/Spain-València (flood)	• Car-replacement subsidies (Plan Reinicia Auto) • Post-disaster highway repair	• Smart mobility pilots (bike lanes, shared services) • LEZ plans and new mobility law • Activist pressure (e.g. "València Sense Inundacions")	*Emerging potential* • Climate-resilient mobility legislation passed • But structural transformation is slow and politically contested
Energy/Ukraine-Rivne (War)	• Diesel generators, schedule-based blackouts • Focus on nuclear energy	• Decentralized solar for critical infra • Energy Passport system; local capacity building	*In Progress, but very fragile* • Hybrid governance • Shift to net-zero by 2030 + EU integration logics enable transformation • Collective narrative of resilience

institutional flexibility and cultural reimagining. Most cases remain stuck in Patterns 1 and 2, not due to lack of ideas, but due to fragmented governance and resistance from within the existing regimes. In summary, transformation is a political, institutional, and narrative project that can become transformative when disruption is treated not just as a crisis to be managed, but as a generative opening to change (Table 7).

Discussion

Beyond the myth of crisis as a "window of opportunity"

The framing of disasters as a "window of opportunity" (Boin and 't Hart, 2003; Nohrstedt and Parker, 2024) has come under growing scrutiny. Our analysis across the cases suggests that such windows are not merely opened by disruption; they are constructed (or not) by politics, governance, and culture. Mechanisms for collective envisioning, social learning, and institutional embedding are necessary to mitigate reinforcing existing power relations, technocratic planning cultures, and unsustainable trajectories (O'Brien and Sygna, 2013; Scoones et al., 2015). Addressing these limitations requires not just better recovery plans, but also new capacities, alliances, and imaginations.

Türkiye's post-earthquake reconstruction, for example, illustrates how centralized and non-transparent processes (Anguelovski et al., 2014) can consolidate elite control under the guise of emergency response, bypassing regulations and participation. Urgency rhetoric not only depoliticized the disaster but actively foreclosed imaginaries of sustainable rebuilding, echoing critiques that fatalist framings can suppress public agency and reduce crises to technical management (Head, 2022; Kaika, 2017; Patterson et al., 2021).

By contrast, Rivne's wartime energy transformation demonstrates that crisis can indeed become a crucible for institutional experimentation when pre-existing civic capacity, hybrid governance, and external legitimacy converge. However, even in this relatively hopeful case, transformation remains fragile and contested, susceptible to re-centralization and manipulation. This supports Nohrstedt and Parker (2024) claim that disasters do not automatically recalibrate climate policy trajectories unless deliberate mechanisms for foresight, deliberation, and redistribution are in place.

Alignment across spheres as precondition for transformation

The interdisciplinary framework presented in this study enabled a multi-dimensional diagnosis of why transformation often stalls and highlighted the importance of alignment across the three spheres of transformation. València's case exemplifies how grassroots mobilization and legislative reforms signaled new possibilities, constrained by regime lock-in and institutional inertia. Sicily's drought response further illustrates this dynamic. While agroecological practices piloted by cooperatives offered glimpses of a regenerative paradigm, their exclusion from mainstream governance processes rendered epiphenomenal change. Without mechanisms to scale, connect, and institutionalize such initiatives, they remain vulnerable to co-optation or decay Avelino et al. (2019).

In contrast, transformation may take root when infrastructural interventions are embedded in institutional learning and coupled

TABLE 7 Barriers and enablers of transformative recovery.

Sphere	Why transformation stalls (pattern 1 or 2)	Examples from cases	What enables pattern 3 (transformative resilience)	Examples from cases (expanded)
Practical	Recovery as short-term technical fix—housing rebuilt, water trucked, roads repaired. Little effort to integrate sustainability (e.g., climate), equity, or flexibility	Türkiye: Seismic design codes were followed, but green building practices were ignored. Sicily: emergency water relief without transforming irrigation systems. València: car subsidies (Plan Reinicia Auto) contradicted low-emission goals	Technologies are used not just to restore, but to prototype future systems. Pilots become platforms for scaling and institutional learning	Rivne: solar + training + energy passports. Sicily: agroecological demonstration projects, although underfunded, offer alternative knowledge systems. València: post-flood response included smart mobility planning, biking. Türkiye: earthquake safety is achieved, but long-term environmental impacts are worsened through land management and construction practices
Political	Centralized, reactive governance; fragmented coordination; absence of participatory arenas, anticipation and futuring	Türkiye: central authorities sidelined municipalities and other local actors. València: urban climate agenda competed with political-economic interests in car industry. Sicily: sectoral silos prevailed	New institutional forms emerge—hybrid governance, multi-scalar coalitions, and use of external legitimacy mechanisms (e.g. EU missions)	Rivne: civic–academic–government alliance + NetZeroCities. Sicily: some EU climate adaptation funds channeled via rural innovation networks. València: passed Climate-Resilient Mobility Law and initiated deliberative consultations on zoning. Türkiye: Rethinging the legal framework for recovery by developing context-specific strategies and inclusive planning processes that integrate diverse expertise
Personal	Survivors are treated as passive beneficiaries, with no reimagining of the future. Dominant message is "restore what was lost." Collective envisioning, values, trauma, and agency are ignored	Türkiye: broadening the dialogue on housing strategies by incorporating climate-sensitive perspectives. Sicily: Farmers' knowledge sidelined. València: Public confused by mixed messaging; car-based recovery narrative dominates	Disruption becomes a transformative story. Agency is recovered through participation, narrative work, and community vision	Rivne: energy-as-sovereignty narrative activated civic agency. València: civil society mobilized around climate justice discourse. Türkiye: fostering alternative, community-led practices emphasizing climate awareness within the built environment Sicily: cooperatives working with youth reframe drought as a cultural and ecological challenge, not just economic loss

with shared public imaginaries. In Rivne, the deployment of solar was not merely a technical fix, but part of a broader reconfiguration involving municipal planning toward net-zero, civil society engagement, and cultural reframing of energy sovereignty. This reflects Castán Broto and Bulkeley (2013) insight into the importance of linking governance across material, discursive, and institutional dimensions.

The personal sphere: a missing catalyst in disaster governance

Perhaps the most underdeveloped dimension in recovery is the personal sphere. Our analysis reveals that the legitimacy, durability, and creativity of systemic change often hinge on whether public values, memories, and emotional geographies are integrated into recovery. In most cases, the failure to formally engage with grief, identity, and collective narrative-making weakened public ownership of recovery agendas. This echoes Fazey et al. (2018) and Brown and Westaway (2011), who argue that affect and meaning making are not peripheral but central to adaptive capacity.

In València, the spontaneous renaming of footbridges and grassroots mobilizations illustrated emergent symbolic ruptures. However, the absence of formal participatory processes meant that emotional energy dissipated rather than being harnessed for transition. Similarly, in Türkiye, the cultural framing of the post-disaster housing process requiring urgent and centralized responses tended to marginalize alternative solutions that could enhance long-term sustainability but inherently require more time.

In Sicily, responses to drought framed the crisis in technical terms such as desalination and pipelines, neglecting the lived experiences of small farmers who viewed water loss as a rupture in cultural identity. Their grief and attachment to land were left unacknowledged, limiting mobilization toward transformative alternatives. In Ukraine, the pressure of war has given rise to new narratives of energy sovereignty, with possibilities to at least partially reclaim agency during destruction. Yet these emotionally charged acts of resilience remained largely disconnected from formal planning processes, staying exceptional rather than

foundational. These patterns reveal a key gap in both disaster governance and sustainability transitions: the failure to treat the personal sphere as a site of generative capacity, legitimacy, and innovation.

Public policy recommendations: operationalizing transformative recovery

To translate the concept of transformative recovery into policy, cities and regions could move beyond the conventional disaster response paradigm and reimagine recovery as both a systemic and contested process. This shift entails action across all three spheres of transformative change.

In the **personal sphere**, governments could consider embedding collective meaning-making and psychosocial engagement into official recovery protocols. Participatory visioning, community storytelling forums, and cultural healing events facilitated by artists, educators, and local organizations can offer crucial emotional scaffolding for communities navigating post-disaster uncertainty and may support the co-creation of shared long-term aspirations. Rather than treating such initiatives as auxiliary, authorities might formalize their inclusion within early recovery planning and fund the local infrastructures (e.g., cultural mediators, NGOs) needed to support them. This would help address the often-overlooked dimension of the personal sphere, where communities are not just recipients of aid but agents of renewal.

In the **political sphere**, transition arenas could be used to enable anticipatory governance. These multi-actor platforms commonly involve local authorities, civil society groups, universities, private sector actors, and media representatives, working together to co-develop recovery and transition agendas. Rather than being convened only in moments of crisis, such bodies might be institutionalized to maintain institutional memory and foster alignment between climate, social, and territorial goals. National or regional governments could encourage such arrangements through enabling legislation or performance-based incentives. To enhance legitimacy and inclusiveness, participation quotas may be introduced to ensure the representation of women, displaced people, youth, and other often-marginalized groups. These arenas can offer a more deliberative and transparent alternative to centralized, top-down recovery models, while enhancing social trust and democratic accountability.

In the **practical sphere**, public infrastructure could be reconceived not merely as a means of restoring function, but as a vehicle for systemic innovation. Governments may wish to revise procurement rules to give preference to projects that support transformation. Municipalities could, for instance, allocate a fixed proportion of post-disaster investment to initiatives that align with recognized standards. Authorities might establish "transition zones" or experimental districts where infrastructure projects, such as renewable microgrids, ecological corridors, or cooperative housing, serve both practical needs and as learning sites for transformative innovation. Crucially, such shifts would benefit from durable financing. Policymakers could explore long-term funding mechanisms to sustain transition efforts beyond immediate crisis response. This may help overcome the common problem of short-termism and enable cities to invest in recovery pathways aligned with broader climate goals.

To support these shifts, cities and regions could not only implement transformative recovery processes but also invest in the capacities that make such practices viable—something that European Environment Agency (2024) calls capacities for transformative resilience, and we reframe as **capacities for transformative recovery**. These include capacities specific to each of the three spheres: facilitation of the collective futuring, foresight, and healing (personal), deliberative governance and coalition-building (political), and experimental portfolio design and transition financing (practical). These capacities would act as strategic assets developed through targeted public investment, training, and institutional reform.

In summary, transformative recovery could become a strategic opportunity rather than a reactive necessity. By enabling collective imagination, supporting plural governance arrangements, and leveraging infrastructure as a platform for experimentation, public policy can help reframe recovery not as a return to normal, but as a chance for sustainable, inclusive, and regenerative futures.

Conclusion

This article has critically examined the conditions under which post-disaster recovery succeeds or fails to foster climate-aligned transformation. Through a cross-case analysis of four diverse contexts, we interrogated how recovery processes are governed, imagined, and enacted across the practical, political, and personal spheres of transformation. Our findings underscore that while disasters often reveal the unsustainability of existing systems, they rarely lead to genuine transformations. Instead, we find that most recovery efforts fall back to "usual" patterns that stabilize infrastructures and institutions without altering the regime.

Across the cases, we identified a persistent tendency to frame disaster recovery as a technical challenge best solved through centralized, sectoral, and short-term approaches. This often-foreclosed inclusive deliberation reinforced incumbent systems and undermined climate action. Infrastructural resilience was frequently prioritized at the expense of long-term sustainability, with recovery processes reverting to established routines. Even where climate-responsive pilots or progressive policies were present, their impact was often limited, lacking institutional anchoring and arenas to coordinate vision, learning, and action.

Nonetheless, the study also highlights enabling dynamics. In Rivne, for instance, the convergence of civic engagement, municipal leadership, and international frameworks allowed energy recovery to be reframed as a pathway toward decarbonization and sovereignty. Similarly, local agroecological networks in Sicily, sustainability experiments in Türkiye, and grassroots ideas in Valencia demonstrate the potential of alternative recovery logics, even if they remain marginal.

Future research could build on this work by investigating how cities and regions can institutionalize mechanisms that sustain systemic experimentation and embed long-term climate goals within post-crisis governance. Particular attention should be given to the symbolic and emotional dimensions of recovery,

which remain largely unaddressed in climate policy but play a critical role in shaping legitimacy, public engagement, and narrative coherence.

Furthermore, while this article focuses on the climate dimension, truly transformative recovery must also attend to issues such as justice, equity, and political economy, recognizing the complexity and interlinked nature of sustainability transitions. The challenge is not simply to repair the broken, but to redefine what cities and regions recover for, how, and to what ends.

Data availability statement

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

Ethics statement

Ethical approval was not required for this study as it did not involve direct experiments on human or animal subjects. The research consisted of qualitative interviews with professionals and stakeholders in non-sensitive roles, conducted in accordance with institutional guidelines for informed consent and data protection. All participants were informed about the purpose of the study and participated voluntarily. Data were fully anonymized to ensure confidentiality and protect participant identities. The studies were conducted in accordance with the local legislation and institutional requirements. The participants provided their written informed consent to participate in this study.

Author contributions

OU: Writing – review & editing, Methodology, Supervision, Writing – original draft, Investigation, Conceptualization, Formal analysis, Data curation, Project administration, Validation. VS: Data curation, Conceptualization, Visualization, Methodology, Writing – review & editing, Writing – original draft, Investigation, Formal analysis. JB: Data curation, Investigation, Conceptualization, Writing – review & editing. KN: Conceptualization, Writing – review & editing. FÖ: Investigation, Writing – review & editing, Conceptualization, Writing – original draft, Data curation. AM: Investigation, Writing – original draft, Writing – review & editing, Conceptualization. SP: Writing – original draft, Visualization, Investigation, Data curation, Methodology, Conceptualization, Writing – review & editing.

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Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

Correction note

A correction has been made to this article. Details can be found at: 10.3389/frsc.2025.1731573.

Generative AI statement

The author(s) declare that Gen AI was used in the creation of this manuscript. The author(s) verify and take full responsibility for the use of generative AI in the preparation of this manuscript. Generative AI was used to support language refinement, structure optimization, and editing of manuscript text. All intellectual content, analysis, interpretation, and original ideas were developed by the author(s). The author(s) reviewed and approved all AI-assisted outputs to ensure accuracy and academic integrity.

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