

A CARTOGRAPHY OF FUTURE SUSTAINABILITY TRANSFORMATIONS

2026

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Authors

Turkan Firinci Orman & Jerneja Penca

With Contributions from

Sarah Milliken, Aleksandra Kekkonen, Anna Salomaa, Renee Wansdronk

and

Adina Popa, Amra Gadžo, Anthonette Quayee, Catarina Cadima, Dejan Vasovic, Ebru Kasnak, Elif Tugba Simsek, Florin Pruna, Gintarė Tamašauskaitė-Janickė, Goncalo Canto Moniz, Ilkhom Soliev, Jelena Brajković, Jelena Vapa, Kimete Canaj, Laura Boffi, Levent Bilgili, Mercedes del Río, Meryem Yeşim Çelik, Metin Mutlu Aydın, Mustafa Necati Çoban, Negulescu Mihaela Hermina, Panagiota Sergaki, Paulo Pinho, Paweł Przybylski, Pınar Gültekin, Rebekka Frick, Ribal Aman Eddine, Richard Völker, Tamara Radenović, Tatiana Kluvankova, Tatiana Ruchinskaya, Tugçem Yılmaz, Turgay Dindaroglu, Vered Holzmann, Vesela Kazashka, Victoria Lisnic, Viktoriya Voytsekhovska, Zeynep Eda Özcan, Ziya İnce, Žanina Žigo, Žarko Vranjanac

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Compendium of WG4- Future Sustainability Transformations, CA22156 - Transformations international Experience and Research network for Sustainable futures (TransformERS)

Transf^{rmers}
Experience · Research Network · Sustainability

Foreword

The COST Action CA22156 Transformations International Experience and Research Network for Sustainable Futures (TransformERS) was established to address a critical gap: while the need for deep societal transformations toward sustainability and justice is widely acknowledged, in the IPCC, IPBES, the European Green Deal, and beyond, our knowledge about how these transformations actually unfold, who shapes them, and how they can be steered equitably remains fragmented and unevenly distributed. Working Group 4, dedicated to Future Sustainability Transformations, has taken up the challenge of bringing these scattered pieces together, as a way of thinking how future transformations can unfold.

This Cartography of Future Sustainability Transformations is compiled from 51 contributions submitted by researchers, practitioners, and hybrid scholar-activists across Europe and beyond. By mapping concrete cases of transformation and emerging future sustainability transformation pathways this document makes visible the plurality of futures already being imagined, enacted, and contested in diverse contexts.

This cartography centers on aspects of justice, equity, participation, and inclusivity that are of central concern to TransformERS. The analysis foregrounds epistemic, geographic, disciplinary, and intersectional marginalisations while actively experimenting with tools and practices that would surface marginalised voices, local and experiential knowledges, more-than-human perspectives, and co-creative modes of future-making. In doing so, it directly advances several core objectives of the TransformERS Network: compiling transformation-relevant knowledge from diverse disciplines and geographies, identifying tools and leverage points for just transformations, highlighting gaps, and fostering meaningful transdisciplinary collaboration.

This cartography is designed foremost as an accessible, visually engaging atlas that can enable new causal and comparative insights and indicate new research or practice direction. It can be used across the sectors and roles, e.g. by decision-makers or planners looking for actionable governance models and inspirational cases, by researchers considering existing trends or new research directions, or practitioners looking for motivation. It embodies the spirit of TransformERS: moving beyond siloed knowledge but offering shared cartographies that can inform, rather than prescribe, a different understanding and action.

This cartography/paper is a collective achievement and, we hope, the beginning of an ongoing conversations. We acknowledge the contributions by various WG4 members in sharing their cases, ideas, and reflections. It is an open, living cartography inviting ongoing conversation about the ways in which societal change can be better understood, and more just, plural, and liveable.

Jerneja Penca (WG4 Co-Leader)

Turkan Firinci Orman (WG4 Member)

COST Action CA22156 TransformERS | 2026

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Authors contributions per CRediT Taxonomy.

Turkan Firinci Orman: Conceptualization, Methodology, Data Curation, Formal Analysis, Visualization, Writing – Original Draft, Writing – Review & Editing, Funding Acquisition (VM Grant)

Jerneja Penca: Conceptualization, Methodology, Writing – Review & Editing, Project Administration

Sarah Milliken: Conceptualisation, Investigation, Methodology (survey creation)

Aleksandra Kekkonen: Conceptualisation, Methodology (survey creation)

Anna Salomaa: Conceptualisation, Methodology (survey creation)

Renee Wansdronek: Conceptualisation, Methodology (survey creation)

Other Co-authors: Investigation (data collection)

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Executive Summary

Mapping the Future

This compendium maps concrete cases of ongoing and emerging sustainability transformations and analyses them from the point of view of the patterns they highlight and marginalise, thus impacting on the future transformations. Compiled from contributions from across the European continent and beyond, and from across a variety of thematic contexts, it presents the plurality of futures already being imagined, enacted, and contested, as the discourse on »transformations« is unfolding in the science and policy arenas.

Figure 1. Geographic Distribution of Future Transformation Cases by Country of Contributor

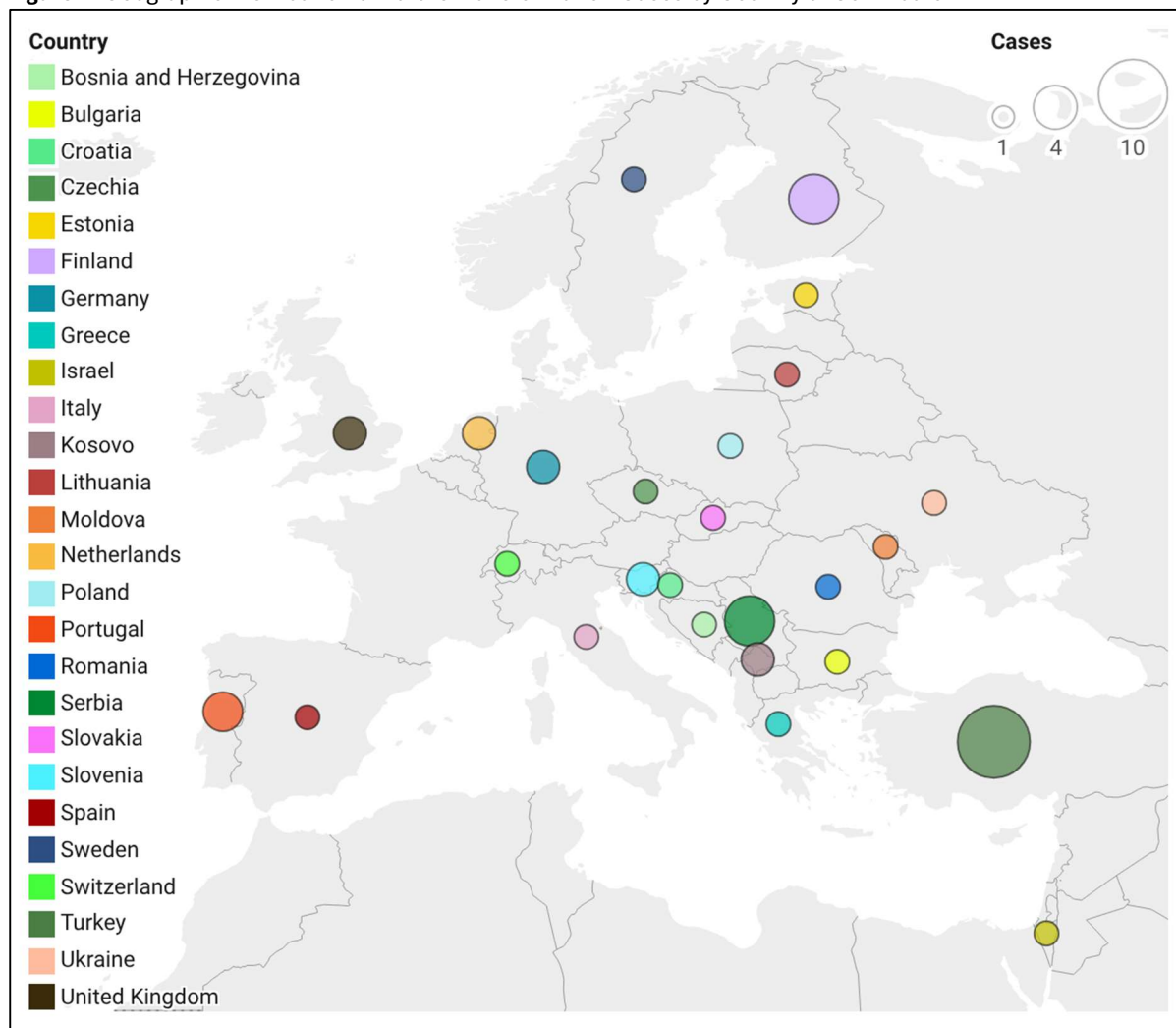
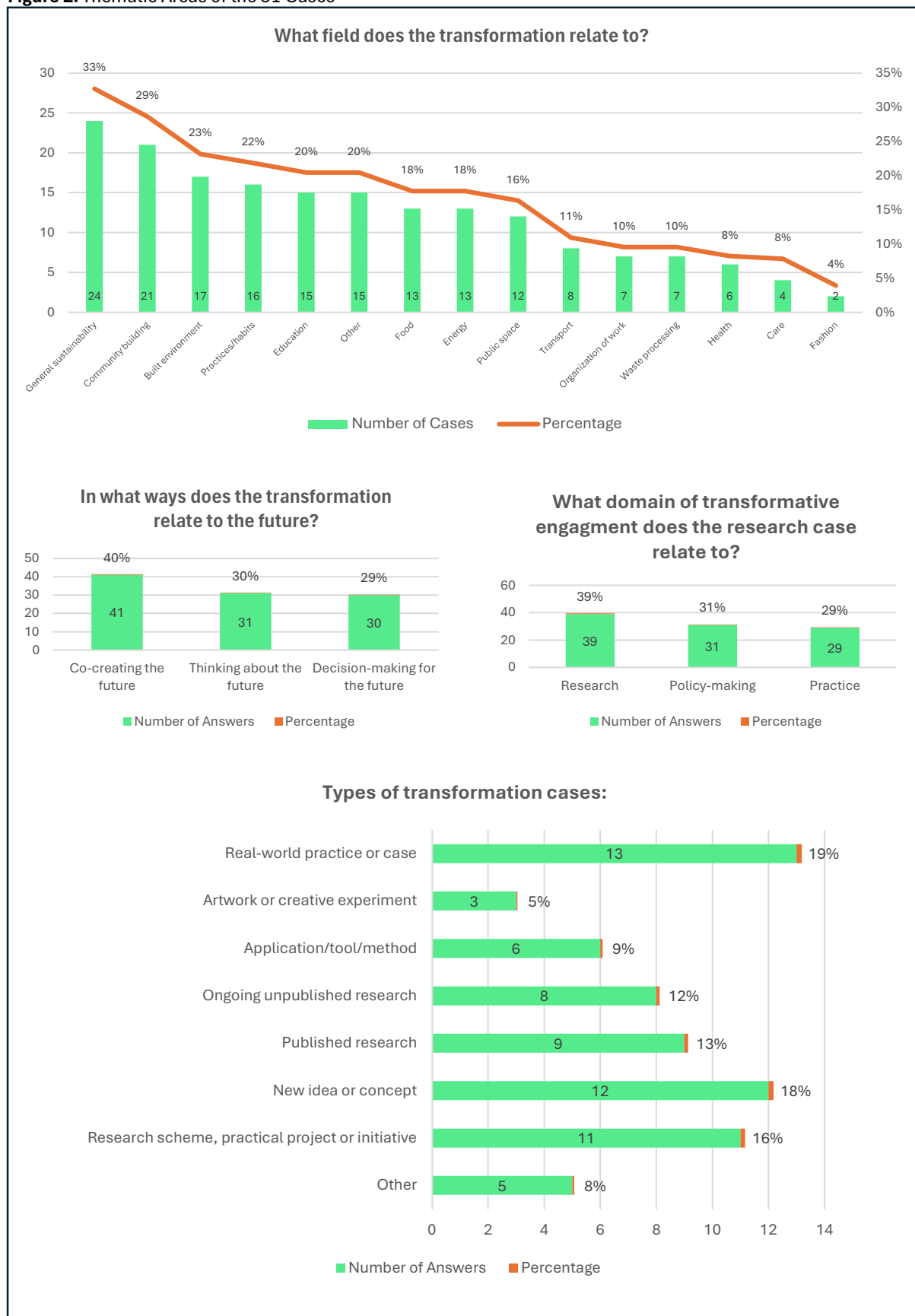


Figure 2. Thematic Areas of the 51 Cases



Various categories could be used to organise thematic clusters of cases. The compendium follows the organisation of four broad **Transformation Clusters, based on the main theme of the case**, while acknowledging that many cases could just as well fall into multiple categories:

- ⇒ **Socio-Technical, Mobility & Urban Infrastructures** reshaping the physical and digital foundations of society.
- ⇒ **Governance, Policy & Participatory Innovation** rethinking decision-making processes and participation.
- ⇒ **Regenerative & Bio-Economy Pathways** reconnecting economic activity with ecological regeneration.
- ⇒ **Social, Epistemic & Justice-Led Transformations** addressing values, knowledge systems, and power relations.

Figure 3. Distribution of Transformation Clusters across the 51 Case Studies

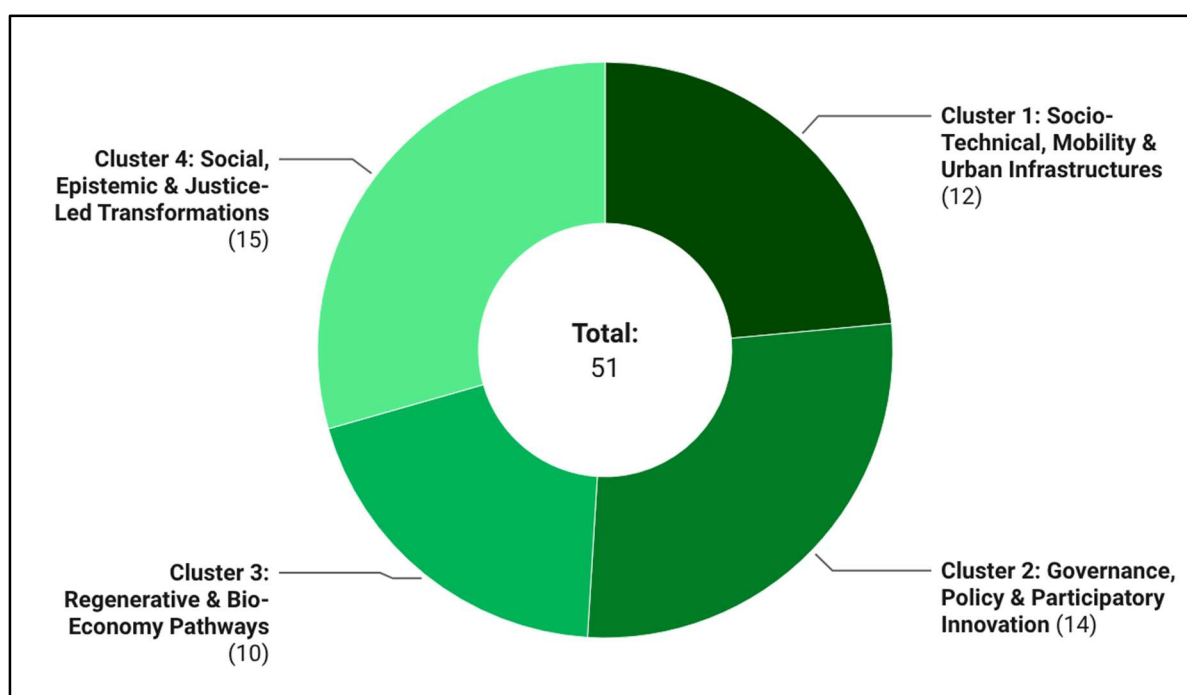


Figure 4. Transformation Fields across the Four Clusters Showing Number of Cases

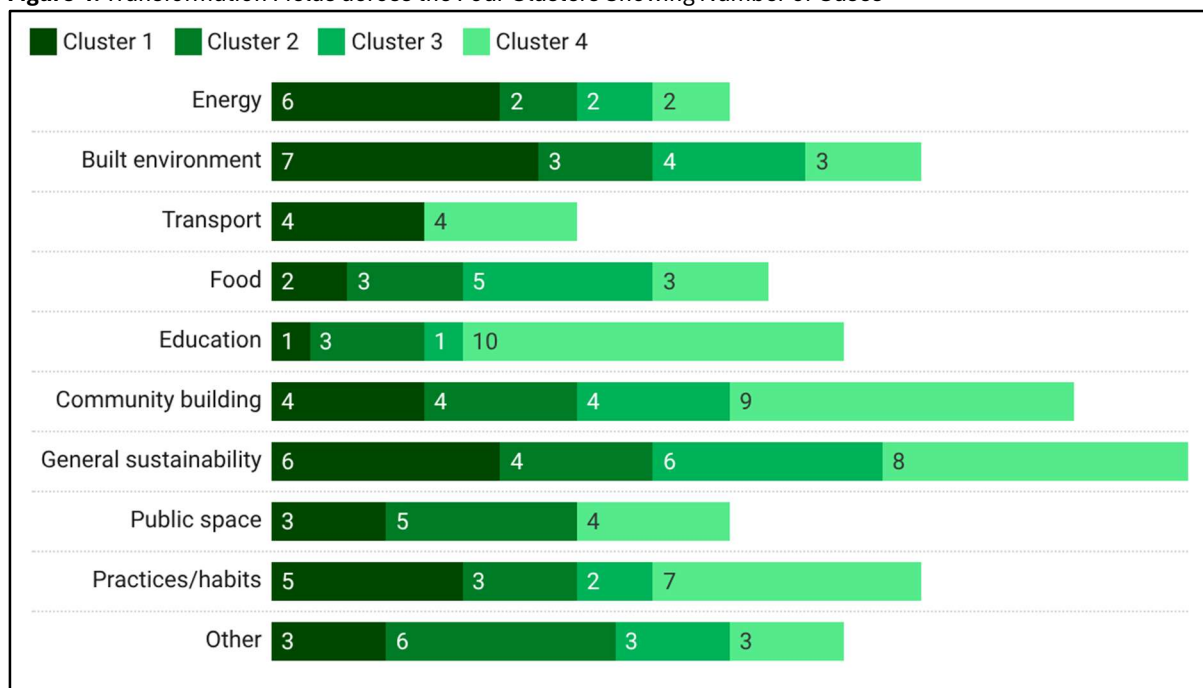
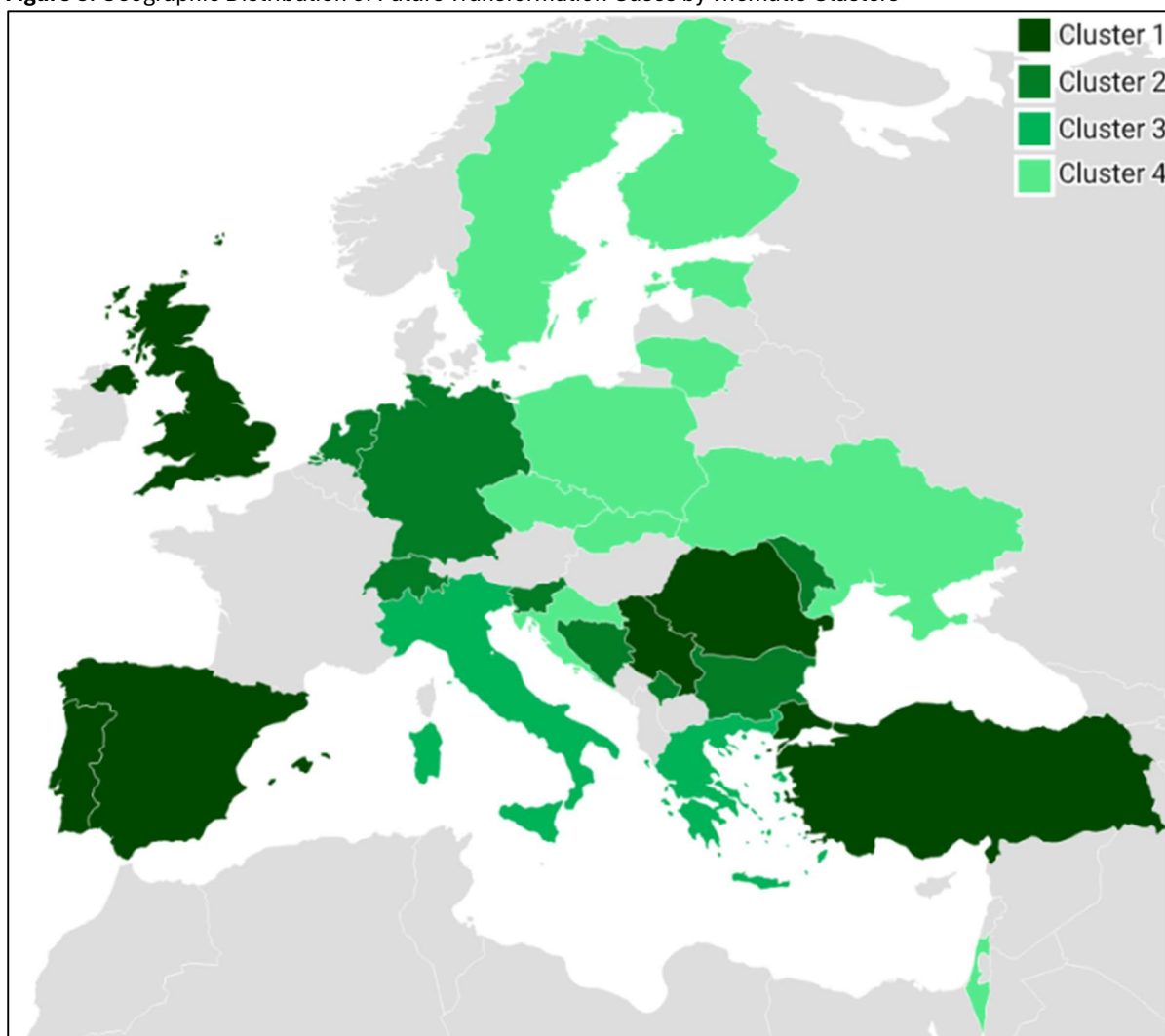


Figure 5. Geographic Distribution of Future Transformation Cases by Thematic Clusters



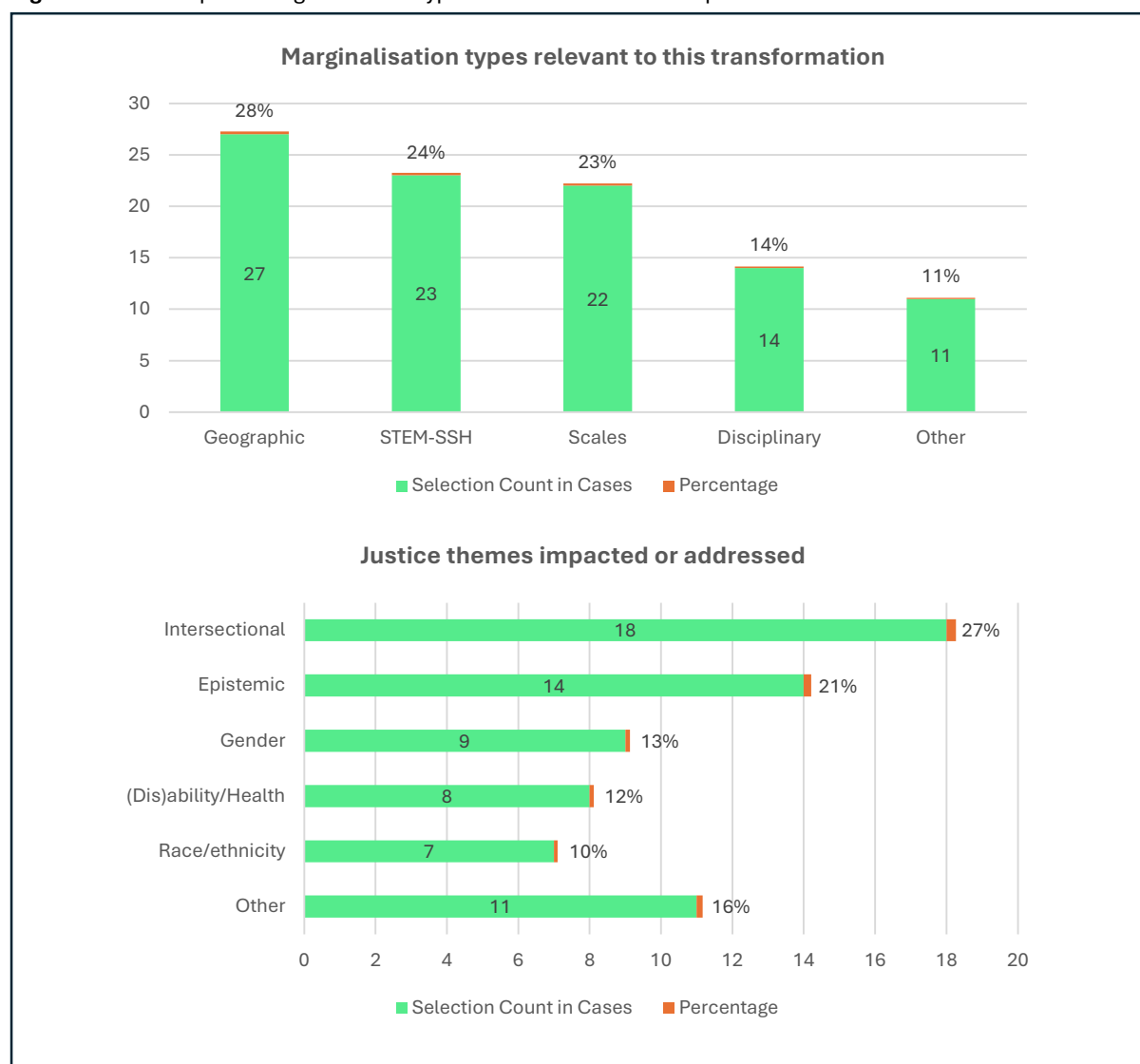
This map shows the geographic distribution of the **51 cases across 26 countries**, with each country coloured according to its dominant thematic cluster of future sustainability transformation.

- ⇒ **Cluster 1 - Socio-Technical, Mobility & Urban Infrastructures** is concentrated in Southern and Western Europe;
- ⇒ **Cluster 2 - Governance & Participatory Innovation** in Central and South-Eastern Europe;
- ⇒ **Cluster 3 - Regenerative & Bio-Economy** mainly in Southern Europe;
- ⇒ **Cluster 4 - Social, Epistemic & Justice-Led** has the broadest coverage, especially in Northern, Eastern, and South-Eastern Europe.

A Justice-First Approach

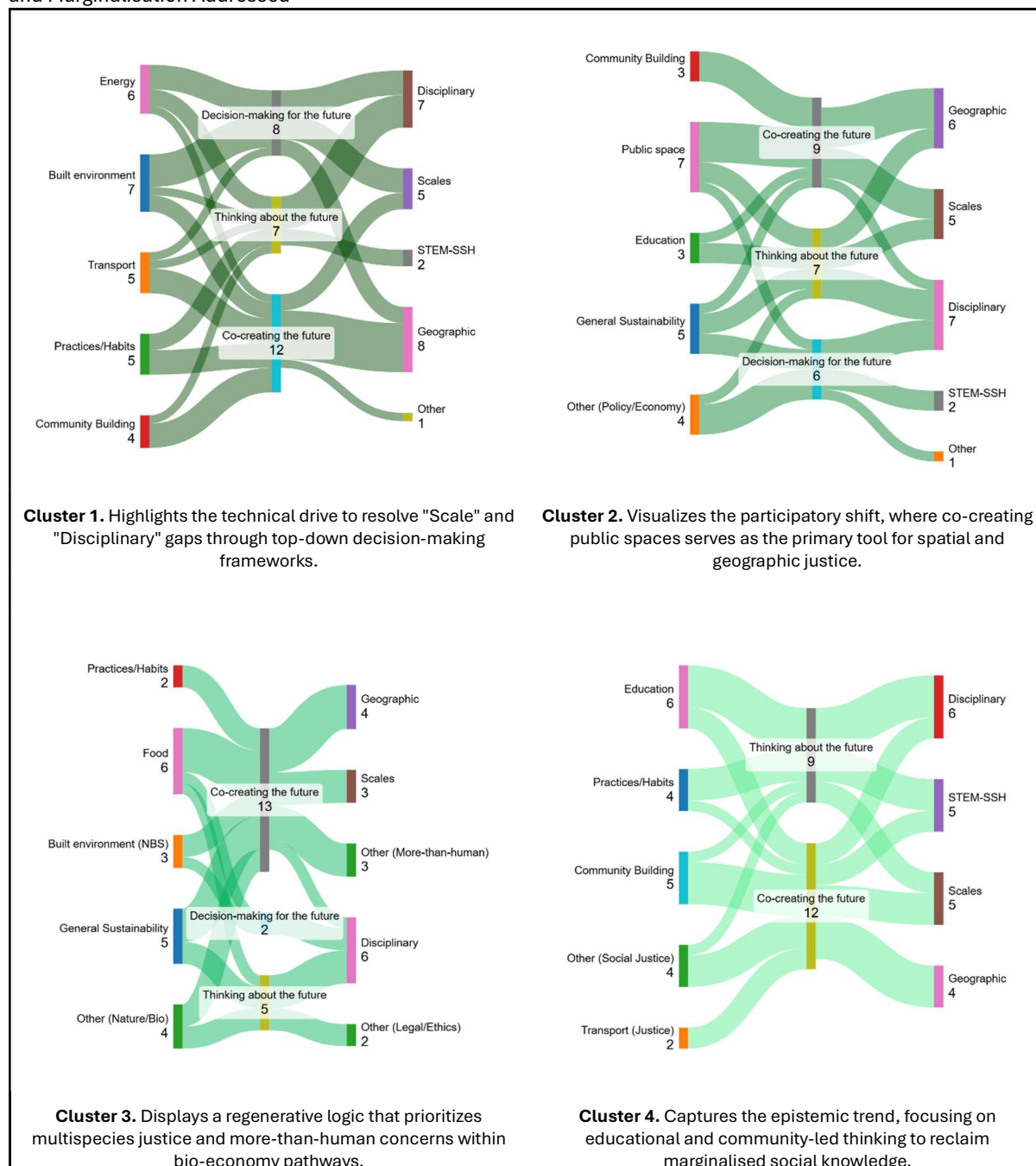
Justice and inclusion run throughout the cartography as a central analytical lens. Contributors highlight epistemic, geographic, disciplinary, STEM-SSH, and intersectional marginalisations as giving rise to the transformations. The initiatives experiment with approaches that amplify marginalised voices, local and experiential knowledge, more-than-human perspectives, and plural ways of knowing.

Figure 6. Most Frequent Marginalisation Types and Justice Themes Impacted/ Addressed Across all Cases



The following Sankey diagrams illustrate how the four thematic clusters relate to different forms of marginalisation. They show how sustainability transformation areas (such as energy, food, transport, and education) are connected to different ways of engaging with the future, and how these connections are associated with specific types of marginalisation, including geographic, disciplinary, scale-related, and STEM-SSH divides.

Figure 7. Flows of Marginalisation: Connections between Transformation Fields, Ways of Relating to the Future, and Marginalisation Addressed



- ⇒ **Cluster 1 (Socio-Technical, Mobility & Urban Infrastructures)** adopts a management and technology-led approach, using decision-making tools and infrastructure to bridge technical scale gaps and the STEM-SSH disciplinary divide.
- ⇒ **Cluster 2 (Governance, Policy & Participatory Innovation)** emphasises participatory co-creation, particularly in public space, to overcome geographic and institutional exclusion.
- ⇒ **Cluster 3 (Regenerative & Bio-Economy Pathways)** introduces a multispecies logic, employing co-creation and research to address the marginalisation of non-human ecological systems and more-than-human perspectives.
- ⇒ **Cluster 4 (Social, Epistemic & Justice-Led Transformations)** focuses on cognitive and relational empowerment, relying on education and community building to tackle epistemic injustices and the marginalisation of diverse social knowledge systems.

We identify a pattern where as transformation strategies shift from technical toward social and epistemic domains, the understanding of justice itself expands from systemic efficiency to inclusive knowledge production, power redistribution, and epistemic pluralism.

Key Insights from the 51 Cases

- ⇒ **Co-creation is central to nearly all of the transformations.** Most contributions combine “Thinking about the future,” “Decision-making for the future,” and especially “Co-creating the future,” reflecting a broader shift from expert-led planning toward participatory future-making.
- ⇒ **Place-based and community-driven initiatives stand out as most present.** Many cases challenge technocentric and top-down approaches by grounding transformation processes in local contexts and everyday practices.
- ⇒ **A wide range of tools and methods for transformation is emerging.** These include AI-supported co-design labs, nature-based solutions, low-footprint city labelling, serious games, multispecies justice frameworks, behavioural approaches, and participatory governance models.
- ⇒ **Important gaps in knowledge remain.** Rural and peripheral geographies, long-term stewardship, and deeper intersectional dimensions are still less visible across the cases.

This atlas maps an evolving landscape of transformations by **highlighting patterns, tensions, promising practices, and critical gaps**. Anchor cases illustrate each pathway more in depth, while visual syntheses including maps, Sankey diagrams, tool matrices, and justice lenses help make complex interconnections more visible and accessible.

Who Can Use This Compendium?

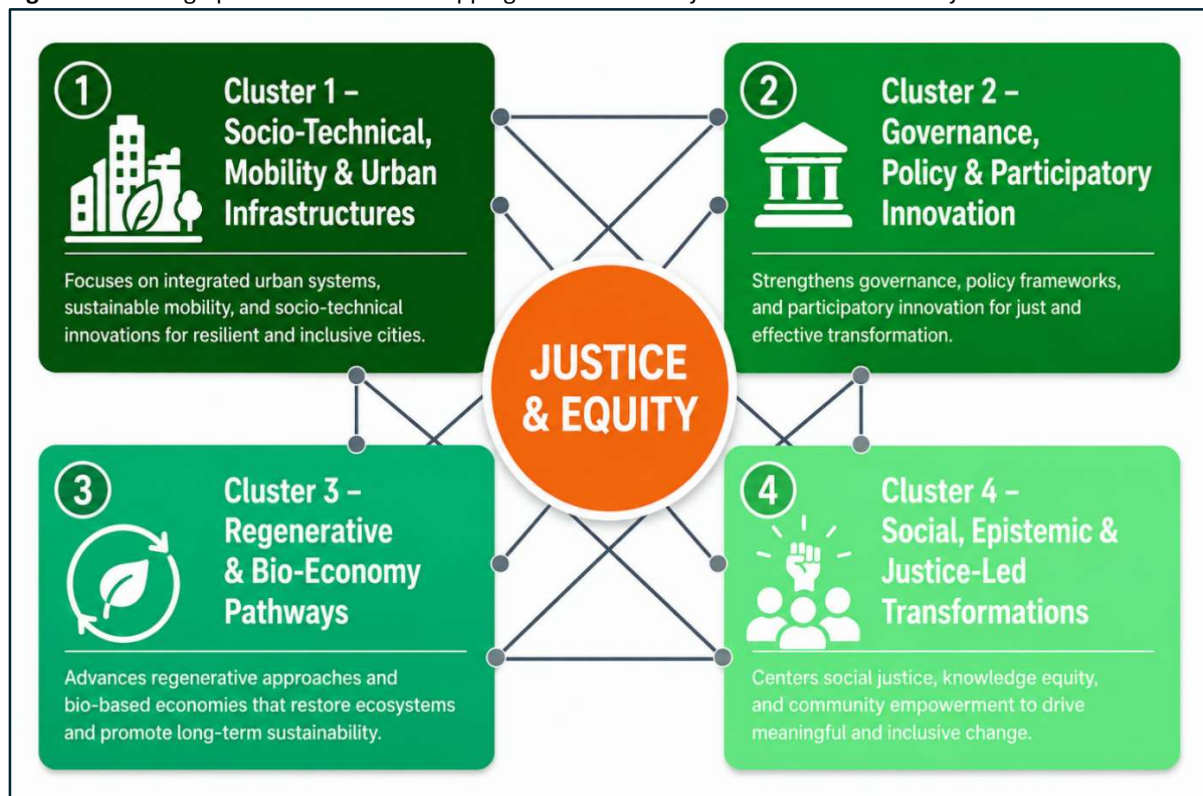
- ⇒ **Researchers** will find comparative material, conceptual inspiration, and clearly identified knowledge gaps for future studies.
- ⇒ **Policymakers** can engage with governance models, policy instruments, and leverage points for enabling just transformations.
- ⇒ **Practitioners** will find methods, tools, and adaptable cases grounded in real contexts.

Section 1. Framing the Terrain

1.1 What “Future Transformations” Mean in TransformERS

- ⇒ In the TransformERS COST Action CA22156, **future sustainability transformations are understood as deep, systemic, and inherently contested processes of societal change**. They seek not only to address climate breakdown and biodiversity loss, but to do so in ways that actively advance justice in a rapidly changing world (TransformERS MoU, 2023).
- ⇒ Rather than viewing transformations as linear pathways or technical optimisation exercises, **the Action emphasises their plural, emergent, and power-laden character**. Transformations involve the reconfiguration of socio-technical systems, governance arrangements, economic logics, and cultural-epistemic foundations. They require careful attention to roles, power dynamics, and the interplay between different forms of knowledge and experience.
- ⇒ Through an iterative qualitative analysis of the 51 contributed cases, **four broad Transformation Clusters emerged as a practical cartographic framework** for mapping the diversity of current and emerging pathways. These clusters are not rigid or pre-defined categories, but rather an empirically grounded synthesis that evolved through collective reflection on the cases and their underlying transformation dynamics.

Figure 8. A Cartographic Framework for Mapping: Diverse Pathways of Future Sustainability Transformation



- ⇒ The compendium seeks to illuminate existing gaps, exclusions, and uneven power relations, while foregrounding justice as a non-negotiable aspect of transformative change. It, therefore, approaches each case as a living fragment of an emerging transformative landscape; one that can contribute to both critical scholarly reflection and practical pathways towards more just and sustainable futures.

1.2 Cartography as Method

- ⇒ This White Paper adopts **cartography as both a metaphor and a methodological practice**: a deliberate act of mapping, connecting, and rendering visible diverse territories of transformation while acknowledging their partiality, situatedness, and ongoing evolution (Crampton & Krygier, 2005; Harley, 1989).
- ⇒ From a critical cartography perspective, **mapping is not a neutral or purely descriptive activity, but a selective and interpretative practice that produces particular forms of knowledge, visibility, and relational ordering** (Crampton & Krygier, 2005). In this sense, the cartographic approach employed here is understood as an epistemic device for assembling heterogeneous cases into an analytically meaningful but necessarily partial configuration of sustainability transformations.

Data Collection: The process began with an open call for contributions circulated within WG4 of the TransformERS COST Action (CA22156) in early 2025. A dedicated online survey (see Annex 2) was collaboratively designed by a core team of WG4 members. The survey collected structured information on each transformation case, covering: title and thematic field, “From → To” trajectory, ways of relating to the future, tools and mechanisms used, marginalisation patterns, justice themes addressed, and an optional image. Contributors were invited to self-identify as researcher, practitioner, or hybrid roles. A total of 51 valid cases were received from across Europe and beyond.

Analysis and Synthesis: Submitted cases were organised, cleaned, and subjected to iterative thematic analysis following Braun and Clarke’s (2021) reflexive approach. This involved: (1) Familiarisation with the full dataset. (2) Generating initial codes focused on transformation fields, approaches (research/practice/policy), ways of relating to the future, and justice/marginalisation dimensions. (3) Searching for and reviewing themes, which crystallised into the four broad Transformation Clusters presented in Table 1. Quantitative elements (e.g., geographic distribution, cluster frequencies, justice-inclusion scores) were derived from survey responses and visualised using maps, Sankey diagrams, and bar charts. Qualitative synthesis focused on cross-cutting patterns, trajectories (“From → To”), tools, and gaps. Anchor cases were selected by the first author as illustrative examples within each cluster. This mixed-methods cartographic approach was chosen to align with the TransformERS Action’s objectives: compiling fragmented transformation knowledge from diverse disciplines and geographies, identifying leverage points and gaps, and fostering transdisciplinary collaboration (TransformERS MoU, 2023). All steps emphasised justice and inclusion as the primary analytical lens.

Limitations and Reflexivity: As with any cartographic exercise, this mapping is necessarily partial and situated. It reflects the network of contributors who responded to the call (predominantly European, with strong representation from certain countries and sectors). Future iterations of this living atlas will seek to address identified geographic, thematic, and intersectional gaps.

Figure 9. Cartography as Method: From Case Contribution Call to Cluster Framework

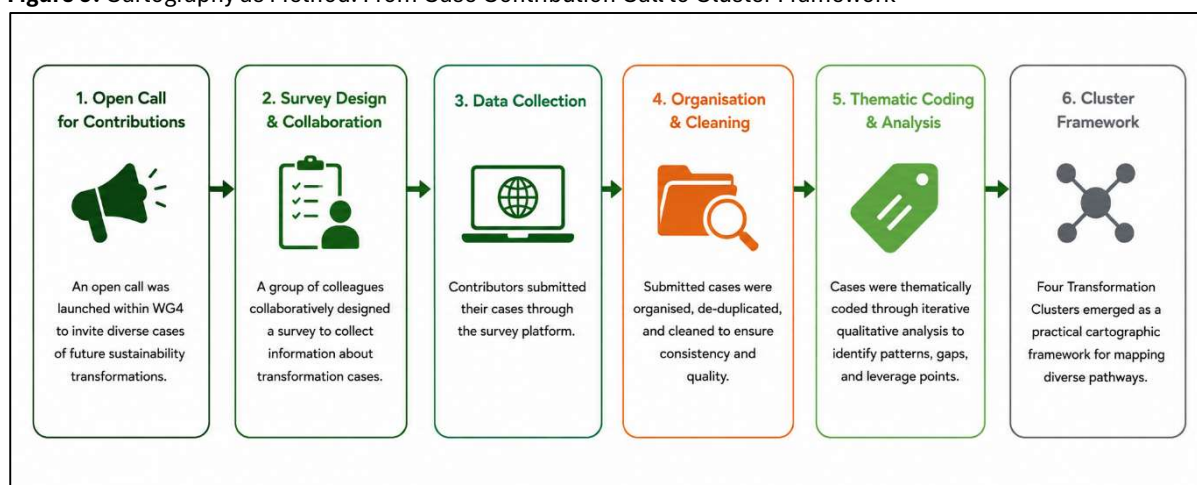


Table 1. The Four Future Sustainability Transformation Clusters Developed through Iterative Qualitative Analysis

Cluster	Definition	Key Characteristics	Representative Cases
 Cluster 1. Socio-Technical, Mobility & Urban Infrastructures	Transformations that centre on the reconfiguration of material, digital, and infrastructural systems, including energy, buildings, transport networks, and urban design, to enable low-carbon, efficient, and resilient urban futures (Geels, 2002; Smith & Stirling, 2010).	• Hardware & digital platforms • Urban planning tools • Energy systems • Mobility solutions • Technological innovation • System optimisation	→ Case 1: A Novel Approach to Urban Environmental Sustainability: Transitioning from Carbon-Intensive to Low-Footprint Cities → Case 5: Beyond Green Buildings → Case 20: From Flood Defence to Adaptive Resilience: The Thames Estuary as a Transformative Pathway → Case 31: Neighborhood multimodal (future) urban mobility schemes → Case 51: Virtual Positive Energy District Laboratories (VPED-Labs) as Enabling Infrastructures for Sustainability Transformations: A Conceptual Framework for Developing Virtual PED Labs
 Cluster 2. Governance, Policy & Participatory Innovation	Transformations focused on new institutional arrangements, decision-making processes, collaborative governance, and policy mechanisms that redistribute power and enable collective action (Patterson et al., 2017).	• Participatory methods • Policy adaptation • Co-creation • Institutional innovation • Bottom-up governance • Stakeholder engagement	→ Case 2: Adapting Swedish Good Practices: A Comparative Study of Sustainability Reporting in Listed Companies and Implications for Bosnia and Herzegovina → Case 3: AI-Powered Co-design Lab – Mondego (AI-COLAB) → Case 8: Community supported green public spaces → Case 9: Contributing to Mission Ocean bottom-up way → Case 47: Transformation through commoning
 Cluster 3. Regenerative & Bio-Economy Pathways	Transformations that work with living systems through circular economy principles, agroecology, biodiversity conservation, nature-based solutions, and multispecies relations (Scoones et al., 2020).	• Regenerative practices • Circular bio-economy • Ecosystem restoration • Place-based resource governance • More-than-human approaches	→ Case 7: Collective actions in rural areas → Case 18: From agri-food by-product to vegan leather → Case 19: From Evidence to Impact: A Context-Sensitive Framework for Double-Impact Mussel Aquaculture → Case 36: Postnatural landscapes → Case 39: Reimagining the Food System: A Multispecies Justice Approach to Future Transformation
 Cluster 4. Social, Epistemic & Justice-Led Transformations	Transformations that target worldviews, knowledge systems, education, cultural narratives, and justice; aiming to include marginalised voices, challenge dominant paradigms, and foster new ways of knowing and being (Leach et al., 2010; Fazey et al., 2020; IPBES, 2019).	• Education & pedagogy • Epistemic justice • Intergenerational & intercultural learning • Narrative change • Care & hope-based approaches	→ Case 6: Collapsology research → Case 26: Intergenerational Learning for Inclusive Sustainability → Case 28: Leveraging Critical Environmental Pedagogies for Sustainable Futures → Case 41: Reviewing Migrant Participation in Sustainability Transformations → Case 49: Transforming sustainability futures through inclusive and justice-oriented communication

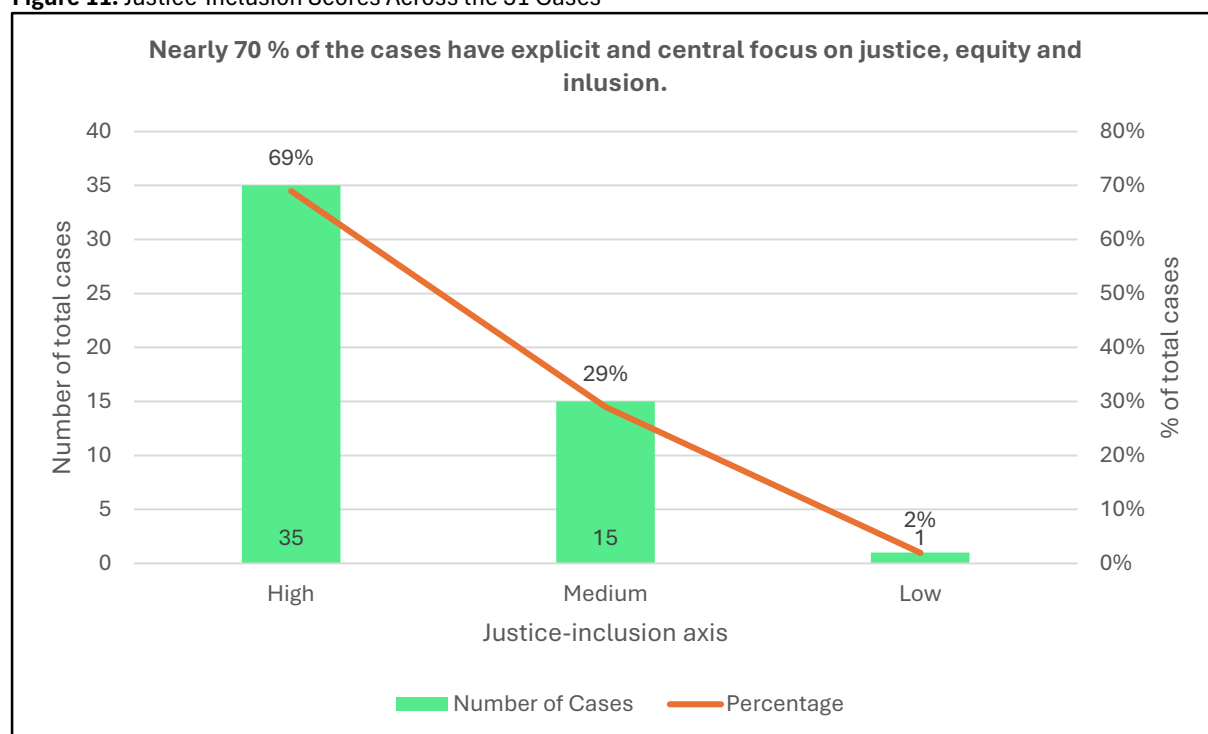
1.3 Justice & Equity as the Core Lens

- ⇒ Justice is not treated as a secondary evaluation criterion but as the primary analytical orientation of this cartography. It shapes both how cases are read and how patterns are interpreted.
- ⇒ Justice is understood as fairness in the distribution and recognition of benefits, burdens, and opportunities across social groups and knowledge systems, and equity as addressing unequal starting points through fair access to resources, participation, and decision-making processes.
- ⇒ Each case was evaluated using a three-point qualitative scale (High, Medium, Low) to assess the extent to which justice and equity are integrated into the proposed transformation. The scoring was based on a systematic qualitative reading of contributors' descriptions, with particular attention to explicit references to groups or forms of exclusion, unequal access to resources, knowledge, or decision-making processes, and the extent to which different actors are explicitly included in the design, governance, or implementation of the transformation.

Figure 10. Justice-Inclusion Scoring Rubric

 HIGH Explicit and central focus on justice, equity, and inclusion. Identifies specific marginalised knowledges, groups, or contexts; addresses multiple dimensions of justice; emphasises meaningful participation of excluded voices; and articulates clear justice-oriented goals or outcomes.	 MEDIUM Justice and inclusion are acknowledged but remain secondary or moderate concerns. Present in the transformation but not positioned as core drivers. Attention to equity or participation tends to be implicit rather than explicit.	 LOW Little or no explicit attention to justice or inclusion. Focus is predominately technical, economic, or ecological, with marginalised groups, knowledges, or equity concerns either barely mentioned or entirely absent.
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Figure 11. Justice-Inclusion Scores Across the 51 Cases



Section 2. Thematic Mapping – Four Pathways

2.1. Cluster 1: Socio-Technical, Mobility & Urban Infrastructures

What are Transformation Fields & Dominant Approaches?

This cluster focuses on hardware, digital platforms, transport networks, urban design, and energy systems, the physical and digital backbone of cities and regions.

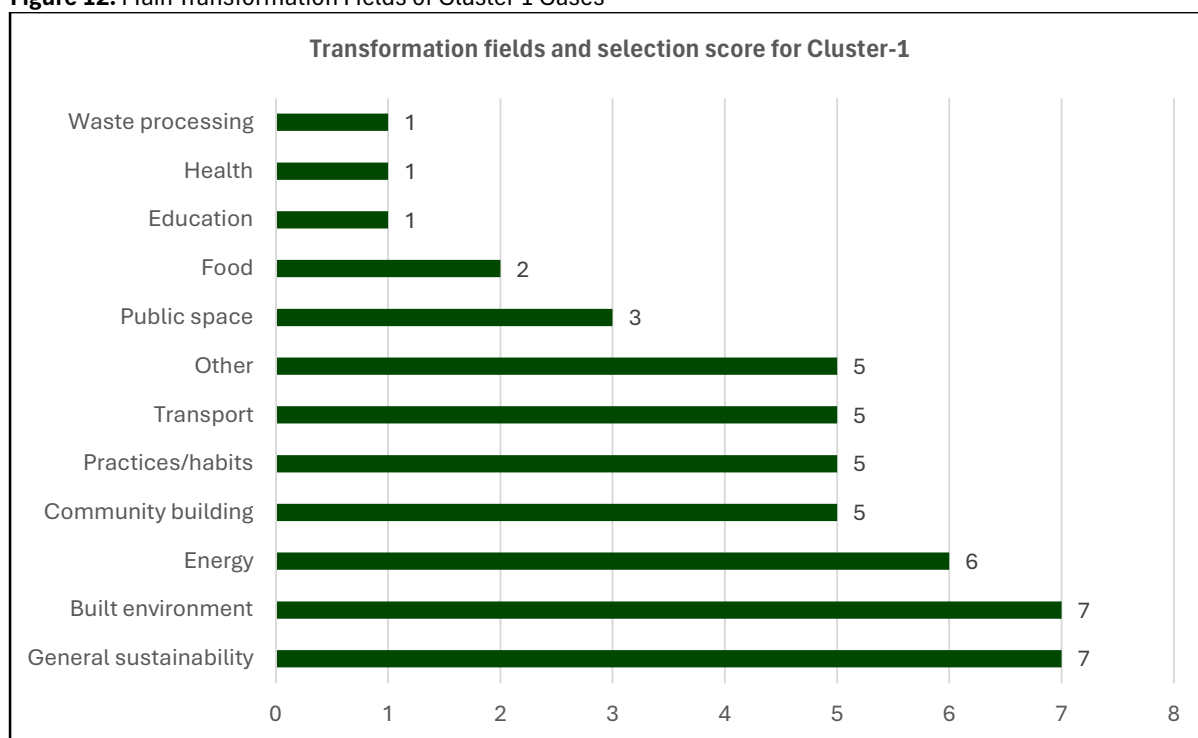
Dominant Approaches:

- ⇒ Strong emphasis on Practice and Policy-making, combined with Research.
- ⇒ Many cases operate at the intersection of real-world implementation (pilots, labelling systems, urban interventions) and policy integration.

Overall trend:

- ⇒ Main transformation fields include but are not limited to the built environment, general sustainability, energy, transport, practices/habits etc.

Figure 12. Main Transformation Fields of Cluster 1 Cases



What is Being Transformed?

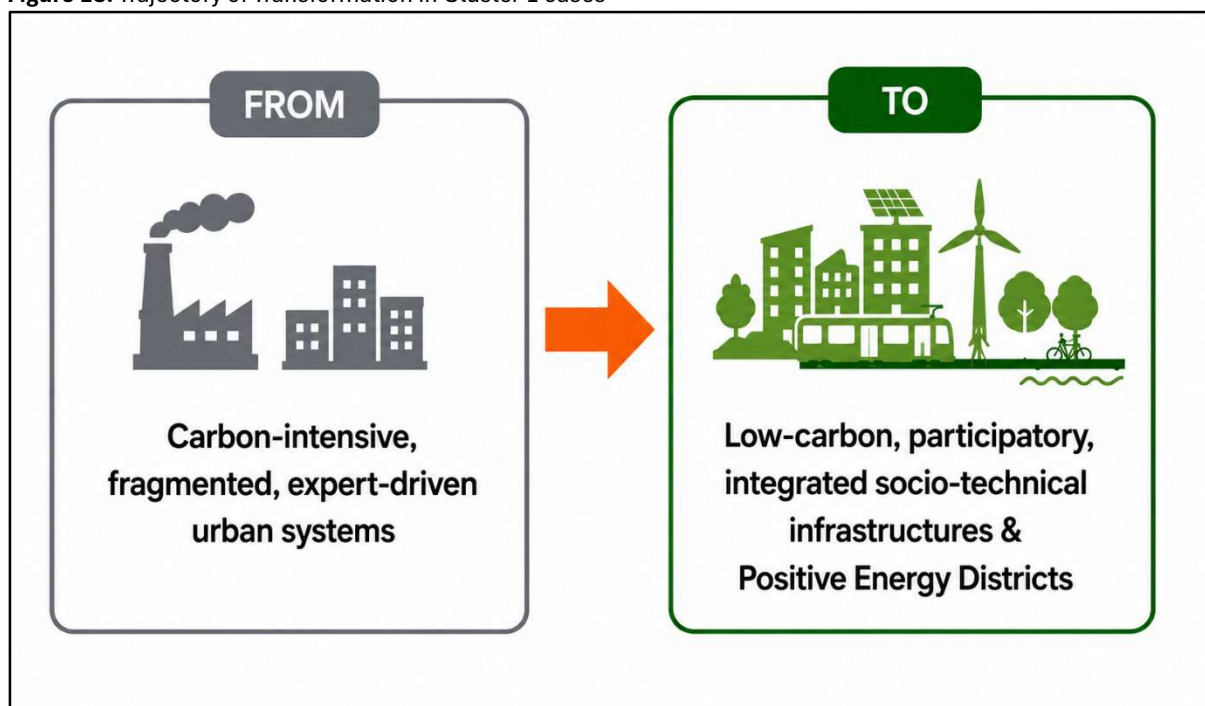
From: Carbon-intensive, expert-driven, fragmented, and high-impact urban systems (conventional buildings, fossil-dependent energy infrastructure, car-centric mobility, and top-down planning).

To: Low-footprint, integrated, participatory, and adaptive **socio-technical infrastructures** — including Positive Energy Districts, low-footprint cities, nature-integrated urban corridors, adaptive resilience systems, and digitally enabled planning environments.

Overall trend:

⇒ This cluster represents transformations that aim to **reconfigure the material and technological foundations** of everyday urban life while making them more sustainable and responsive.

Figure 13. Trajectory of Transformation in Cluster-1 cases



How the Future is Conceived, Understood & Enacted?

The future is conceived as: Anticipatory and iterative rather than fixed; measurable and place-based; grounded in local contexts and planetary boundaries; and as a set of alternative system-level trajectories that can be tested and adjusted.

The future is enacted through:

- ⇒ Digital tools and virtual testing environments (simulations, digital twins, virtual labs).
- ⇒ Participatory co-design processes involving multiple stakeholders.
- ⇒ Institutional mechanisms such as labelling systems, standards, and new governance arrangements.
- ⇒ Hybrid approaches that combine technological innovation with community involvement.

Key insight:

- ⇒ The future in this cluster is not predicted but **actively prototyped and negotiated** in shared digital-physical spaces.

Justice-Inclusion Score is predominantly **High or Medium**.

Trend:

⇒ While these cases are strongly oriented toward participation and inclusion, they frequently highlight the risk of green gentrification, the exclusion of peripheral areas, and the difficulty of integrating non-technical knowledge into techno-centric planning processes. Justice is addressed mainly through participatory methods, but long-term stewardship and truly equitable access remain challenges.

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A Novel Approach to Urban Environmental Sustainability: Transitioning from Carbon-Intensive to Low-Footprint Cities

CASE 1

Location: Türkiye (Urban focus)

Contributor: Mustafa Necati Çoban,
Tokat Gaziosmanpaşa University

1

The Transformation Story



- Cities burdened by dense populations and carbon-intensive industrialization are the starting point for a macro-level shift toward environmental sustainability.
- The transformation moves from a growth-centered urban paradigm to a "low-footprint cities" labeling system (inspired by Citislow). This encourages cities to compete on environmental performance.
- The envisioned endpoint features cities where people drink from public fountains, pollution is minimized, repair economies are prioritized with neighbourhood repair units, natural elements have identities, recycling is embedded, and natural growth replaces economic growth, creating more livable places starting from cities.

2

The Justice Lens



- Dominant growth-oriented models marginalize local and experiential knowledge, care/maintenance capacities, place-based ecological identities, and long-term stewardship.
- This case addresses disciplinary, scale, STEM-SSH, temporal, epistemic, and intersectional marginalizations while promoting intergenerational equity and ecological responsibility.

3

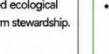
Future Prospect



- This transformation directly challenges today's paradigms to shape measurable, ecologically bounded urban futures built upward from cities.
- The future is conceived as place-based and ecologically responsible rather than abstract or growth-driven.
- It is enacted through a city-level low-footprint labeling system with clear indicators (carbon, material footprint, circularity), integrated into planning, repair economies, recycling infrastructure, and participatory governance.
- It is shaped and influenced by local governments, planners, citizens, researchers, and businesses through everyday practices, monitoring, benchmarking, and competition.

4

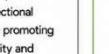
Toolkit for Transformation



- Core tool: city-level low-footprint labeling system with measurable indicators.
- Policy integration into urban planning.
- Incentives for repair and circular economies.
- Public infrastructure for recycling and low-carbon mobility.
- Participatory governance.
- Continuous monitoring and inter-city benchmarking.

5

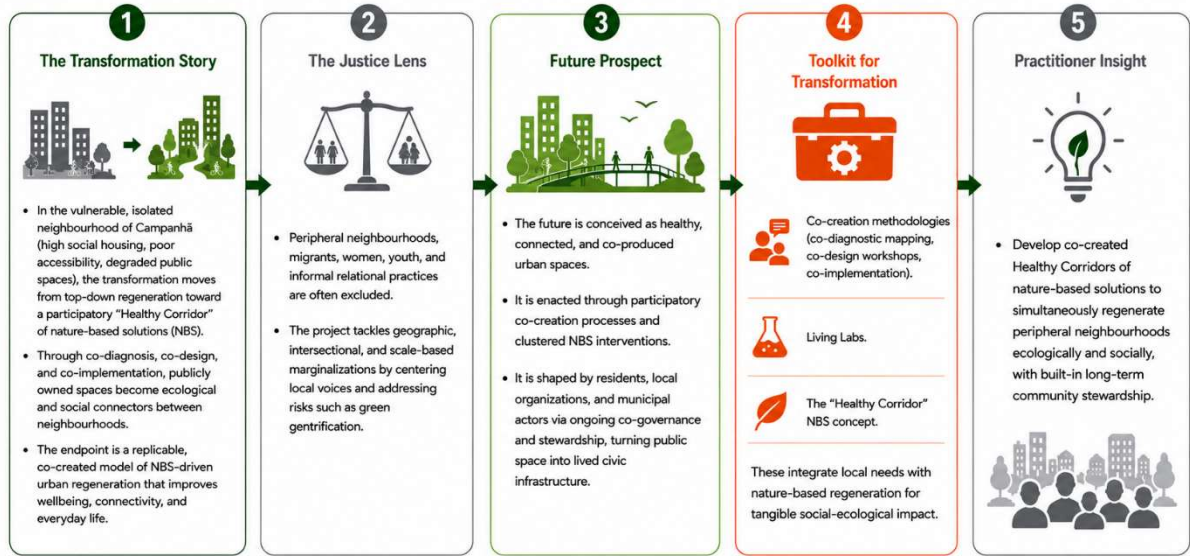
Practitioner Insight



- Implement city-level ecological labeling systems with competitive benchmarking to turn environmental sustainability into a core urban identity and driver of long-term behavioural and governance change.

CASE 50 URBINAT Healthy Corridor, Porto

Location: Campanhã, Porto, Portugal
Contributor: Goncalo Canto Moniz and Ribal Aman Eddine, University of Coimbra



2.2. Cluster 2: Governance, Policy & Participatory Innovation Transformations

What are Transformation Fields & Dominant Approaches?

This cluster centres on new forms of governance, collaborative decision-making, municipal policy, institutional innovation, and community-based models.

Dominant Approaches:

- ⇒ Very strong emphasis on decision-making, policy-making and practice, closely combined with research.
- ⇒ Many cases focus on Co-creating the future through participatory processes, regulatory adaptation, and bottom-up initiatives.

Overall trend:

- ⇒ Main transformation fields include but are not limited to community building, general sustainability, built environment, public space, education, food, energy and etc.

Figure 16. Main Transformation Fields of Cluster-2 cases



What is Being Transformed?

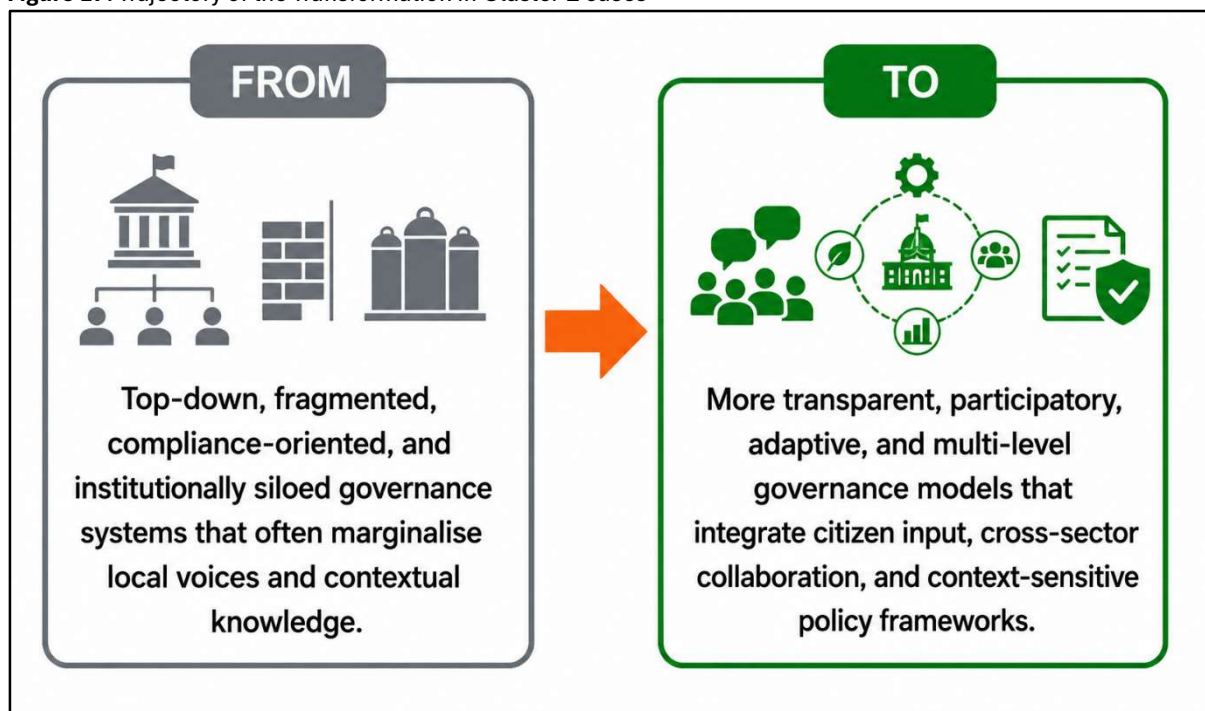
From: Top-down, fragmented, compliance-oriented, and institutionally siloed governance systems that often marginalise local voices and contextual knowledge.

To: More transparent, participatory, adaptive, and multi-level governance models that integrate citizen input, cross-sector collaboration, and context-sensitive policy frameworks.

Overall trend:

- ⇒ This cluster emphasises **who decides** and **how decisions are made** in sustainability transformations, moving from rigid structures toward more inclusive and responsive governance ecosystems.

Figure 17. Trajectory of the Transformation in Cluster-2 cases



How the Future is Conceived, Understood & Enacted?

The future is conceived as: A transition-oriented, plural process shaped by collective action rather than expert prediction, negotiated and continuously co-created within specific contexts, and focused on building the institutional and social capacities needed for long-term change.

The future is enacted through:

- ⇒ Regulatory harmonization and policy experimentation.
- ⇒ Participatory methods such as co-diagnosis, co-design, living labs, and informal engagement formats (“AI Over Coffee”, community dialogues).
- ⇒ Multi-actor collaboration involving municipalities, citizens, researchers, and civil society.
- ⇒ Adaptive governance tools that allow learning and iteration.

Key insight:

- ⇒ The future in this cluster is actively shaped through relationships, dialogue, and shared authority rather than imposed through top-down plans.

What Patterns of Marginalisation and Justice Emerge?

Justice-Inclusion Score is predominantly **High or Medium**.

Most frequent marginalisation types in this cluster include but are not limited to scales (mismatch between local realities and higher-level policies), geographic (peripheral, rural, and transition economies), epistemic (whose knowledge counts in policy processes), STEM-SSH, and intersectional, gender, race/ethnicity, and (dis)ability/health.

Trend:

- ⇒ While these cases are strongly oriented toward participation and inclusion, they frequently highlight the risk of green gentrification, the exclusion of peripheral areas, and the difficulty of integrating non-technical knowledge into techno-centric planning processes. Justice is addressed mainly through participatory methods, but long-term stewardship and truly equitable access remain challenges.

Figure 18. Marginalisation Types in Cluster-2 & Word Cloud Depicting Participant Responses (to the Question: “What Elements of this Transformation are Marginalised but Important?”)

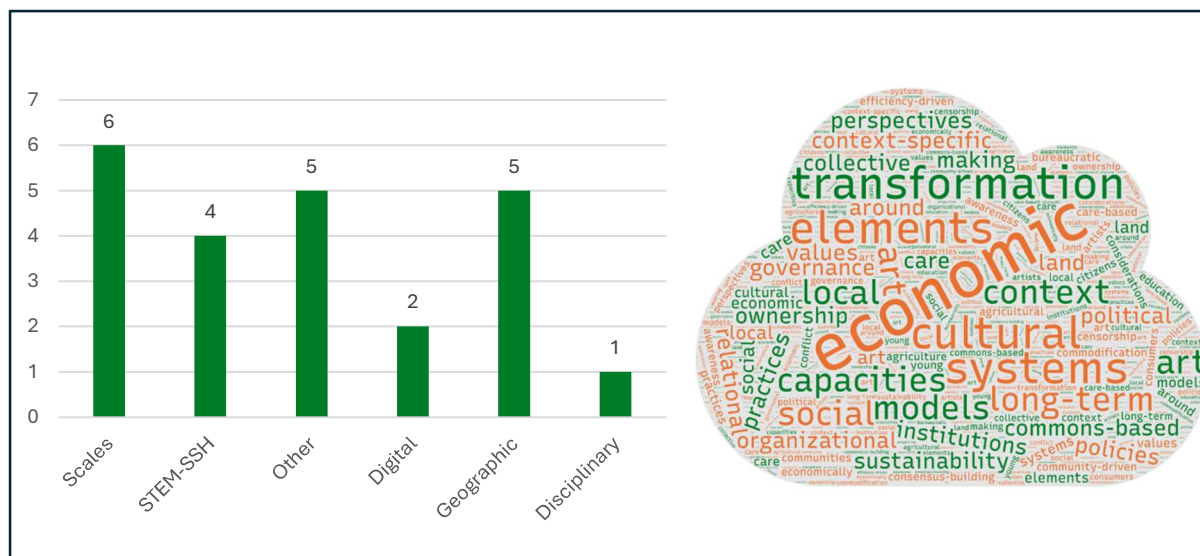
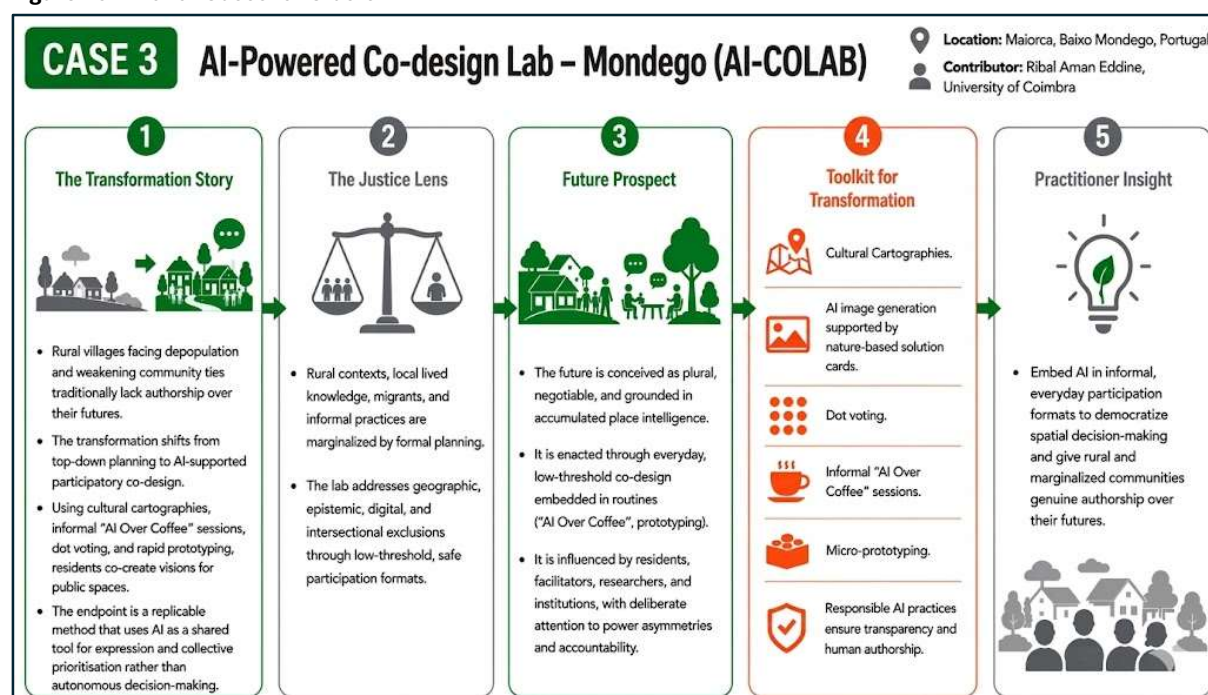


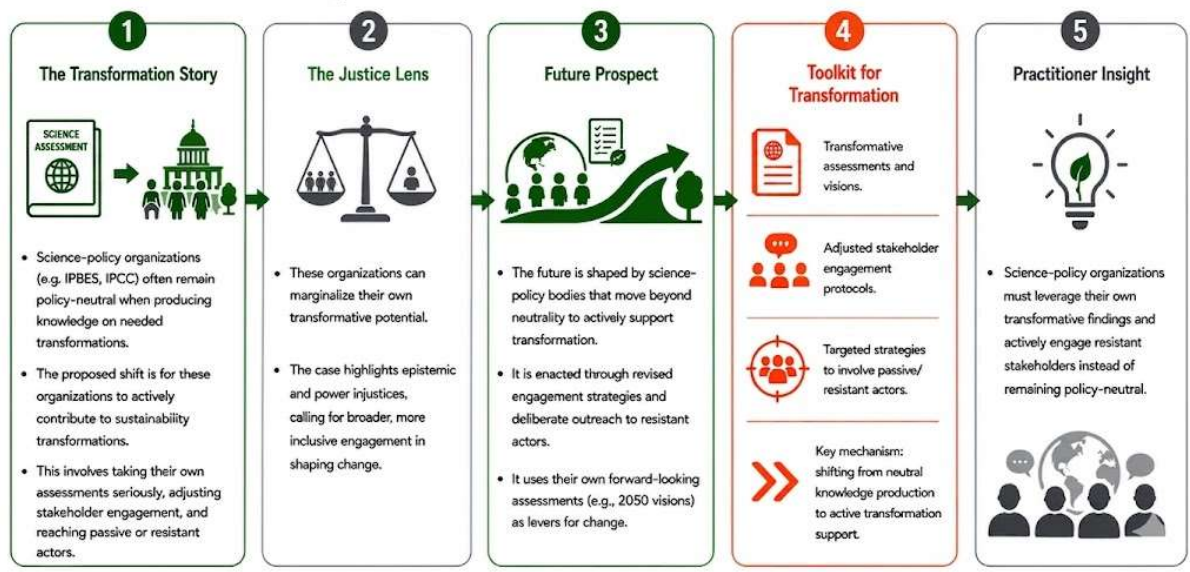
Figure 19. Anchor Cases for Cluster-2



CASE 42

Science-policy interface organizations contributing to transformations

Location: EU / Global
Contributor: Anna Salomaa, LUT University



2.3. Cluster 3: Regenerative & Bio-Economy Pathways Transformations

What are Transformation Fields & Dominant Approaches?

This cluster focuses on circular economy, agroecology, biodiversity conservation, nature-based solutions, and regenerative practices that restore the relationship between economy and biosphere.

Dominant Approaches:

- ⇒ Balanced mix of Research, Practice, and Policy-making.
- ⇒ Many cases are grounded in real-world applications and experiential learning.

Overall trend:

- ⇒ Main transformation fields include but are not limited to food, general sustainability, community building, built environment, energy, practices/habits etc.

Figure 20. Main Transformation Fields of Cluster-3 cases



What is Being Transformed?

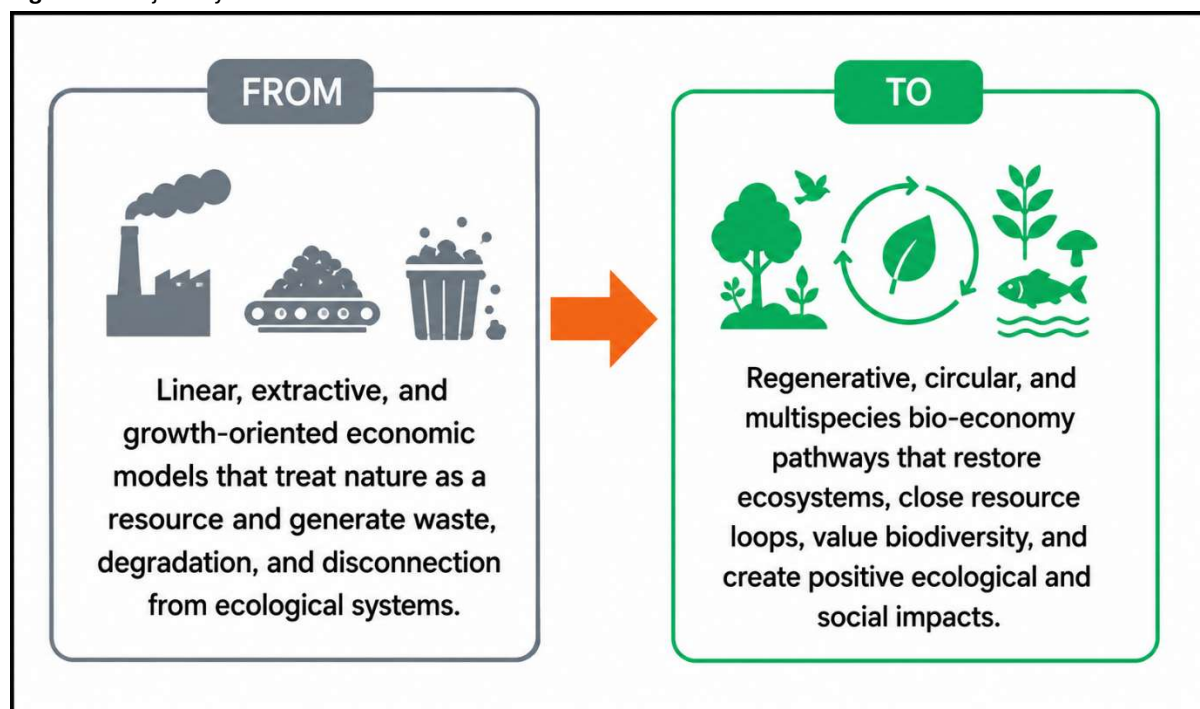
From: Linear, extractive, and growth-oriented economic models that treat nature as a resource and generate waste, degradation, and disconnection from ecological systems.

To: Regenerative, circular, and multispecies bio-economy pathways that restore ecosystems, close resource loops, value biodiversity, and create positive ecological and social impacts.

Overall trend:

- ⇒ This cluster emphasises **healing and regenerating** living systems rather than merely reducing harm.

Figure 21. Trajectory of Transformation in Cluster-3 cases



How the Future is Conceived, Understood & Enacted?

The future is conceived as: A regenerative, relational, plural, adaptive, and place-based process grounded in ecological limits and multispecies justice, prioritizing resilience, care, and long-term stewardship over endless growth while shifting from human domination of nature toward coexistence and mutual flourishing.

The future is enacted through:

- ⇒ Nature-based solutions and ecological restoration projects.
- ⇒ Circular and bio-based material practices (e.g., agri-food by-products to vegan leather).
- ⇒ Multispecies and community-led initiatives.
- ⇒ Participatory and transdisciplinary approaches that connect local knowledge with ecological science.

Key insight:

- ⇒ The future here is not engineered but co-evolved with living systems and communities.

What Patterns of Marginalisation and Justice Emerge?

Justice-Inclusion Score is mostly **High** or **Medium**.

Most frequent marginalisation types in this cluster include but are not limited to STEM-SSH divides, disciplinary and intersectional and multispecies perspectives, and epistemic (marginalised local, indigenous, and traditional ecological knowledge).

Trend:

- ⇒ Strong focus on justice, particularly multispecies justice and the inclusion of marginalised human and non-human voices. Cases often critique anthropocentric approaches and work to surface relational values of nature, care, and reciprocity. There is clear attention to bridging scientific and experiential knowledge.

Figure 22. Marginalisation Types in Cluster-3 & Word Cloud Depicting Participant Responses (to the Question: “What Elements of this Transformation are Marginalised but Important?”)

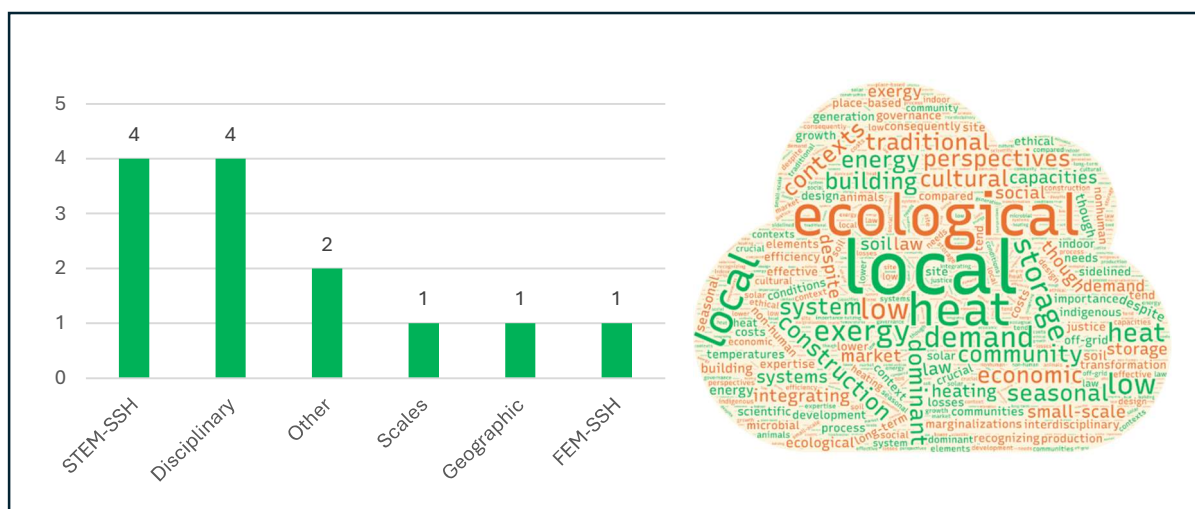
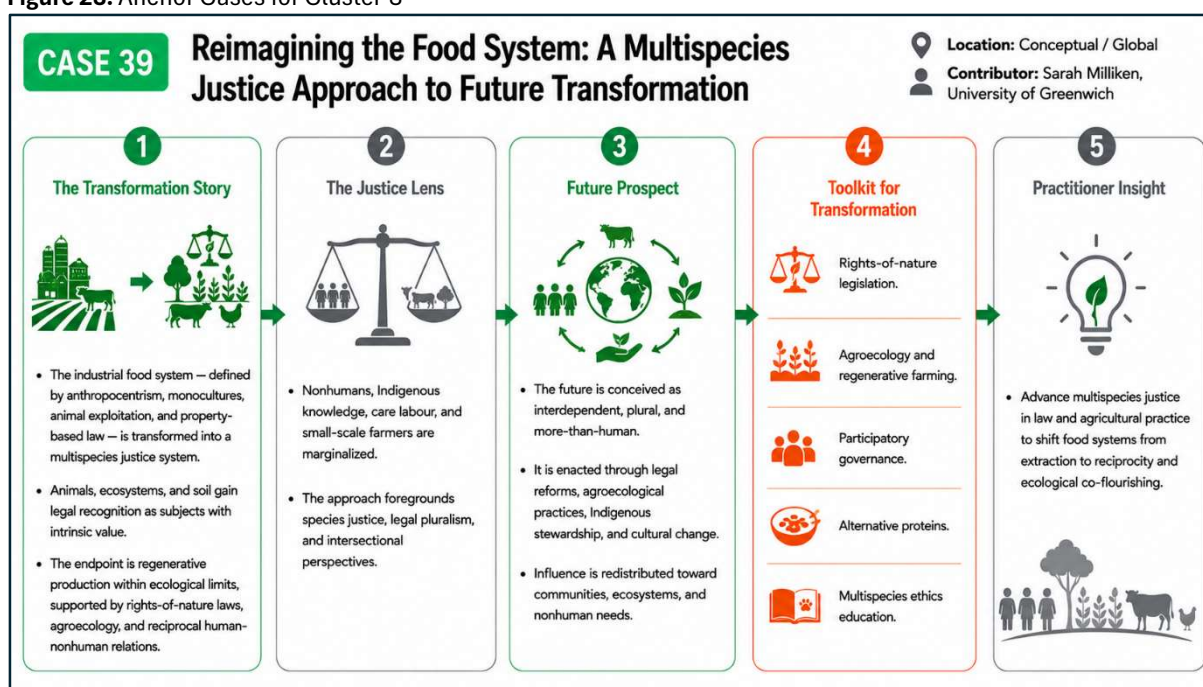


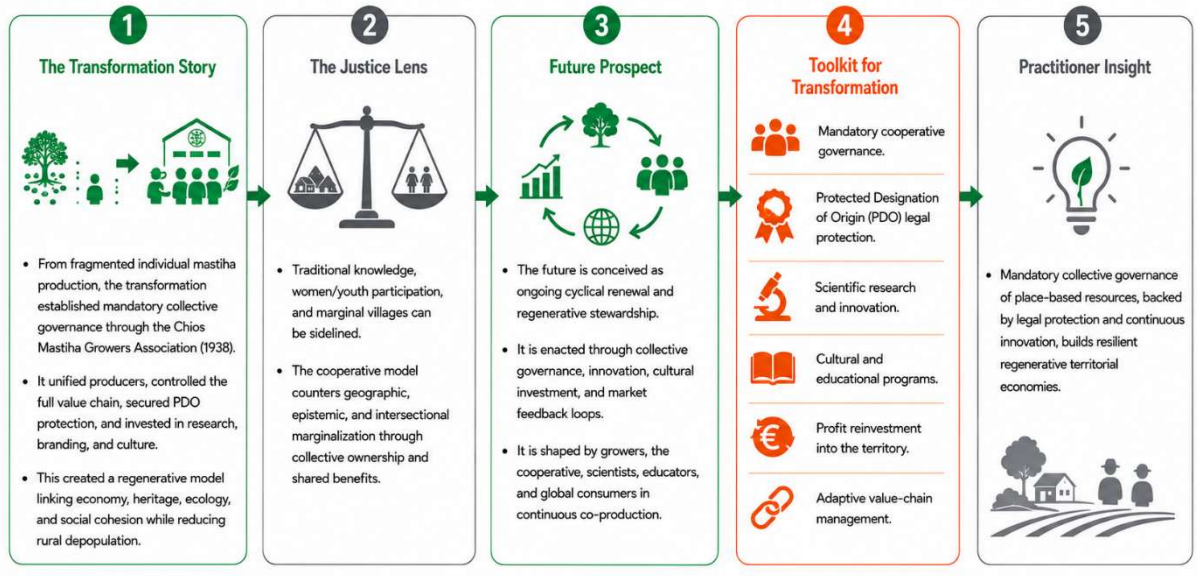
Figure 23. Anchor Cases for Cluster-3



CASE 7

Collective actions in rural areas (Chios Mastiha Growers Association)

Location: Chios Island, Greece
Contributor: Panagiota Sergaki,
Aristotle University of Thessaloniki



2.4. Cluster 4: Social, Epistemic & Justice-Led Transformations

What are Transformation Fields & Dominant Approaches?

This cluster emphasises education, arts/culture, social justice, changing narratives, and the inclusion of marginalised knowledges.

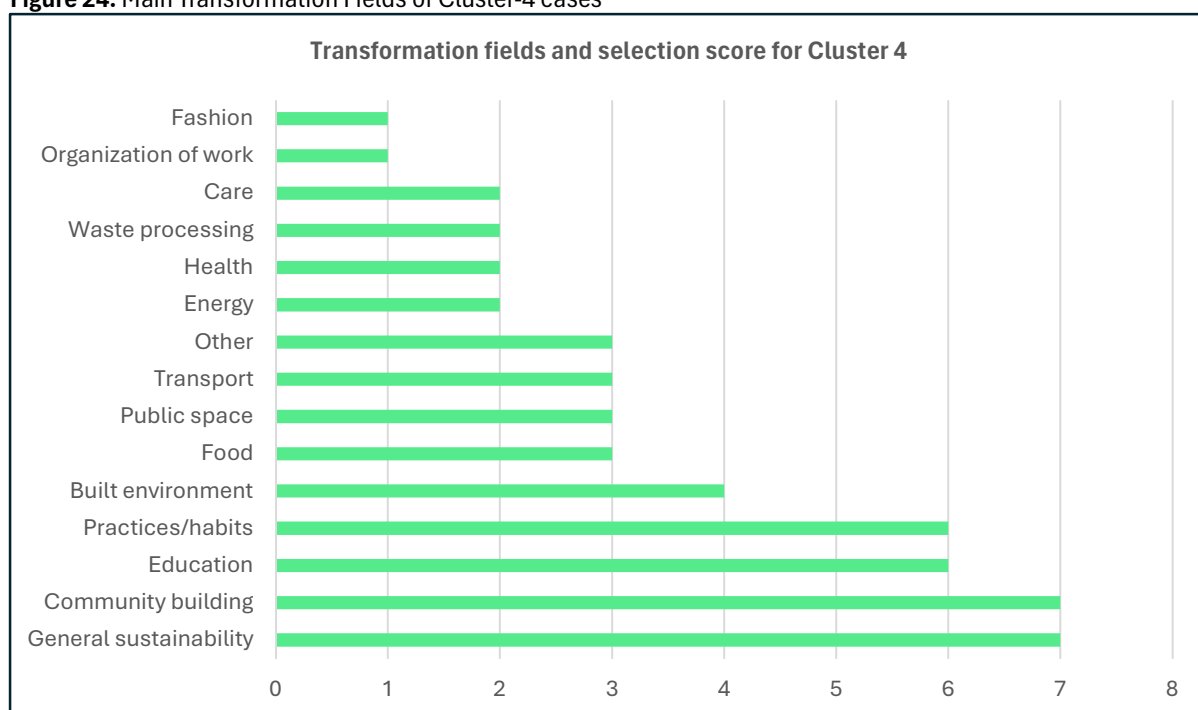
Dominant Approaches:

- ⇒ Strong focus on Research combined with Practice and Co-creating the future.
- ⇒ Many cases are experimental, pedagogical, and narrative-driven.

Overall trend:

- ⇒ Main transformation fields include but are not limited to general sustainability, education, built environment, public space, health, care, and fashion.

Figure 24. Main Transformation Fields of Cluster-4 cases



What is Being Transformed?

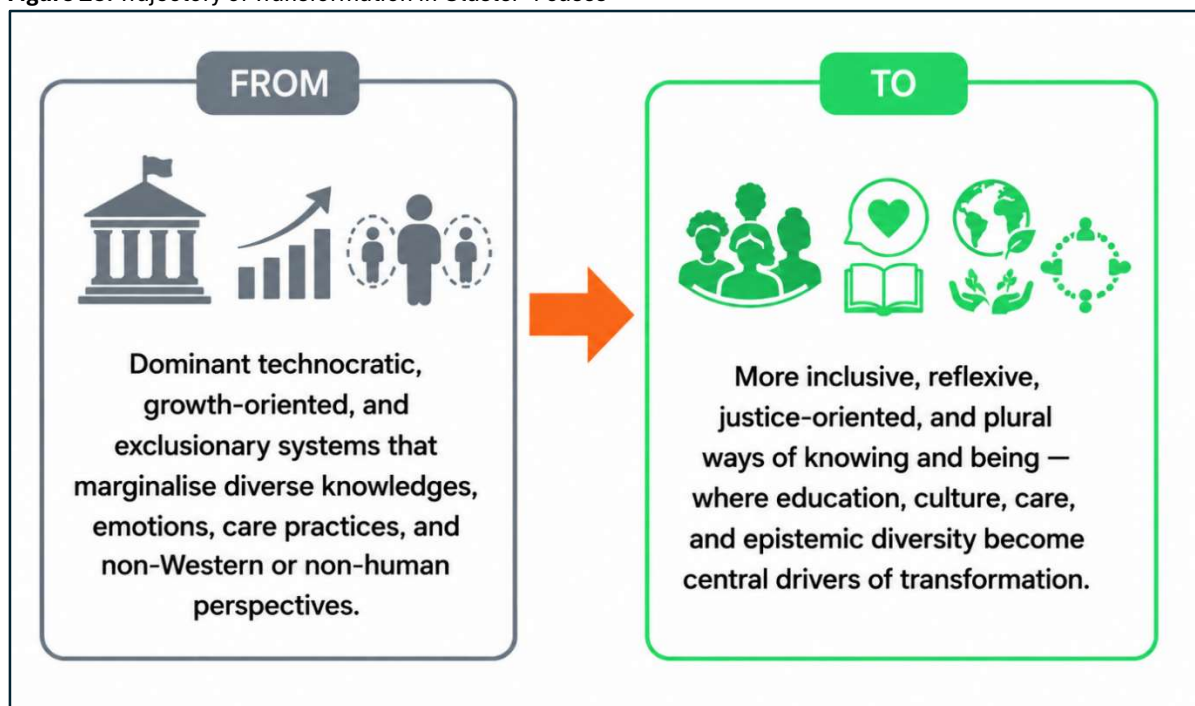
From: Dominant technocratic, growth-oriented, and exclusionary systems that marginalise diverse knowledges, emotions, care practices, and non-Western or non-human perspectives.

To: More inclusive, reflexive, justice-oriented, and plural ways of knowing and being — where education, culture, care, and epistemic diversity become central drivers of transformation.

Overall trend:

- ⇒ This is the most explicitly **value- and knowledge-driven** cluster, focusing on deep cultural and epistemic shifts.

Figure 25. Trajectory of Transformation in Cluster-4 cases



How the Future is Conceived, Understood & Enacted?

The future is conceived as: A plural, relational, and open-ended space rooted in hope, care, intergenerational learning, and radical imagination, where marginalised voices, emotions, and more-than-human perspectives actively shape what is possible.

The future is enacted through:

- ⇒ Critical pedagogies and transformative learning processes.
- ⇒ Arts, culture, and creative practices (storytelling, games, installations).
- ⇒ Intergenerational and community-based dialogue.
- ⇒ Reflexive and justice-led research methodologies.

Key insight:

- ⇒ The future in this cluster is nurtured through relationships, reflection, and cultural change rather than primarily through technology or policy.

What Patterns of Marginalisation and Justice Emerge?

Justice-Inclusion Score is Predominantly **High**.

Most frequent marginalisation types in this cluster are epistemic (strongest), STEM-SSH, scales and geographic, intersectional, gender, race/ethnicity, and emotional/affective knowledge, and more than human perspectives.

Trend:

- ⇒ This cluster shows the deepest engagement with justice themes. It actively works to surface and value marginalised knowledges (local, indigenous, experiential, emotional, and ecological). There is strong attention to power asymmetries, care, hope, and avoiding the reproduction of dominant narratives. Justice is not an add-on but a core organising principle.

Figure 26. Marginalisation Types in Cluster-4 & Word Cloud Depicting Participant Responses (to the Question: “What Elements of this Transformation are Marginalised but Important?”)

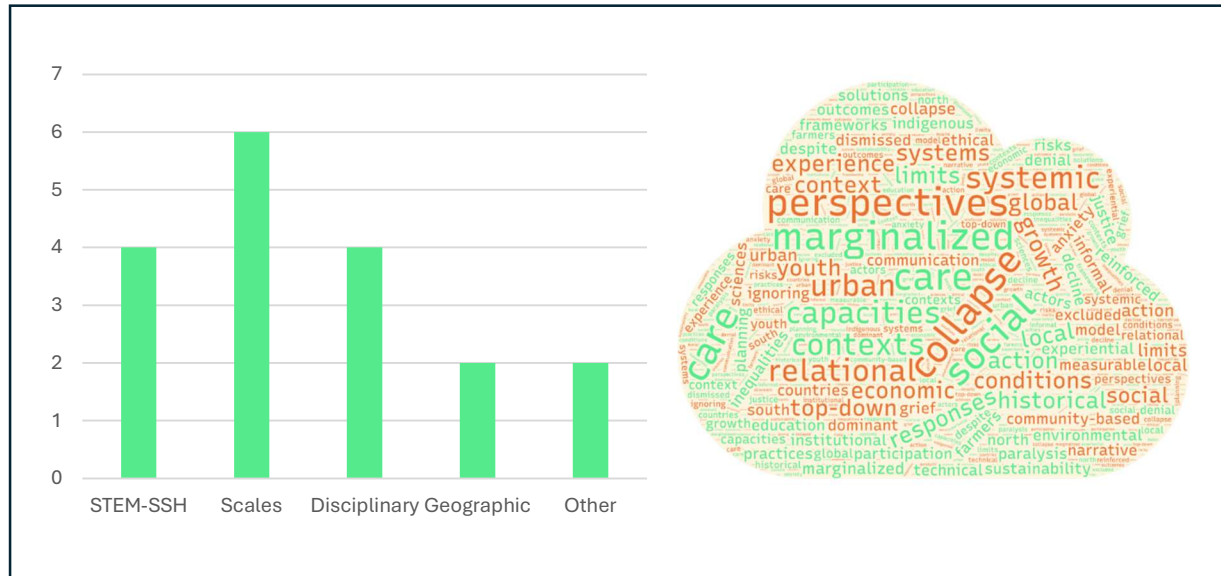
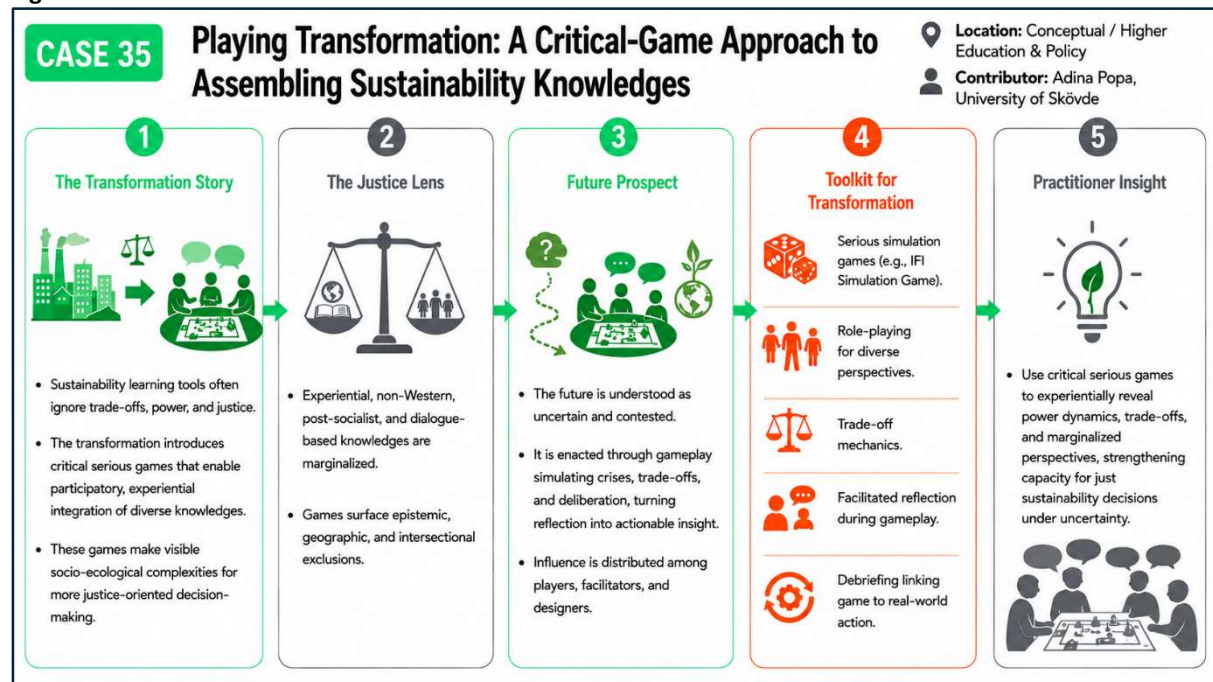
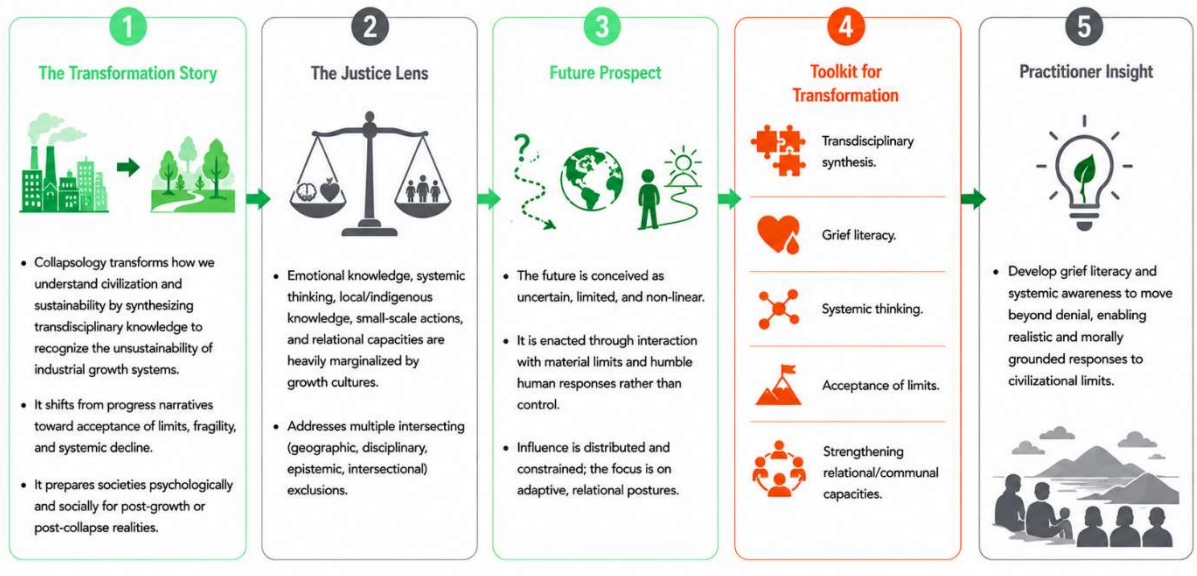


Figure 27. Anchor Cases for Cluster-4



CASE 6 Collapsology research

Location: Conceptual / Europe
Contributor: Aleksandra Kekkonen,
 Estonian Business School



Section 3: Synthesis & Cartography of Gaps

3.1. Overall Patterns Across the 51 Cases

Building on the quantitative overview presented in the Executive Summary (Figures 1–5), a closer synthesis of the 51 cases, conducted through iterative thematic analysis of the full survey responses, reveals several deeper cross-cutting patterns that define the emerging landscape of future sustainability transformations.

Co-creation stands out as the dominant way of relating to the future.

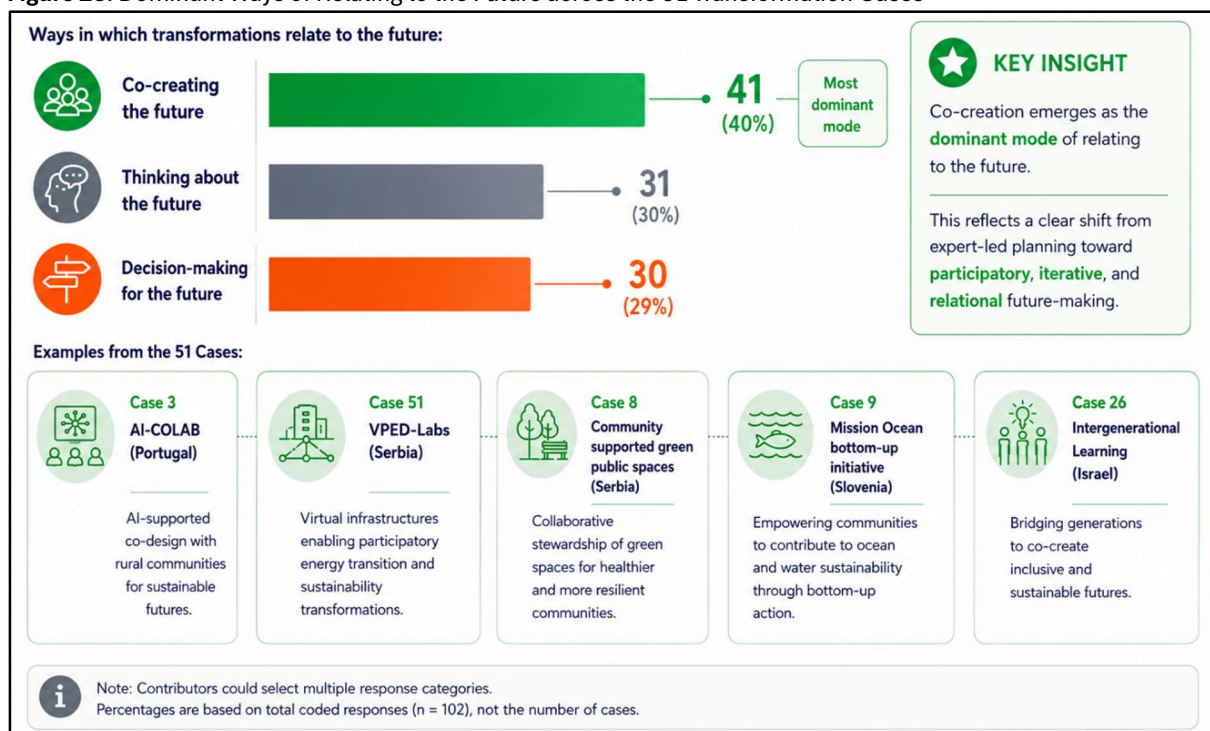
The survey question “What does the transformation relate to?” was introduced because in our earlier conversations in the Working Group this frame emerged as a convenient way for a diverse group to organise and exchange knowledge. In the survey, we wanted to test which of these dimensions resonated most with the cases. The vast majority of the 51 cases explicitly combine “thinking about the future” and “decision-making for the future” with a strong emphasis on “co-creating the future.” Rarely was a case classified into only one of these categories.

Out of 102 total selections of these categories, co-creating the future was selected 41 times (40%), followed by “thinking about the future” (31 responses, 30%) and “decision-making for the future” (30 responses, 29%). This distribution demonstrates a clear shift from expert-led planning toward participatory, iterative, and relational future-making. Collective authorship is no longer peripheral but has become central to transformative practice.

Concrete examples include:

- ⇒ Case 3: AI-Powered Co-design Lab – Mondego (AI-COLAB) in rural Portugal
- ⇒ Case 51: Virtual Positive Energy District Laboratories (VPED-Labs) as Enabling Infrastructures for Sustainability Transformations (Serbia)
- ⇒ Case 8: Community supported green public spaces (Serbia)
- ⇒ Case 9: Contributing to Mission Ocean and waters in a bottom-up way (Slovenia)

Figure 28. Dominant Ways of Relating to the Future across the 51 Transformation Cases



A second prominent pattern is the strong grounding of transformations in place-based and community-driven approaches.

Thematic analysis of the survey responses (particularly the fields “What is being transformed?”, “How is the future enacted?”, and open descriptions) reveals that a substantial proportion of the 51 cases deliberately move away from universal techno-centric or top-down models. Instead, they anchor transformation processes in local contexts, everyday practices, cultural heritage, and lived experience.

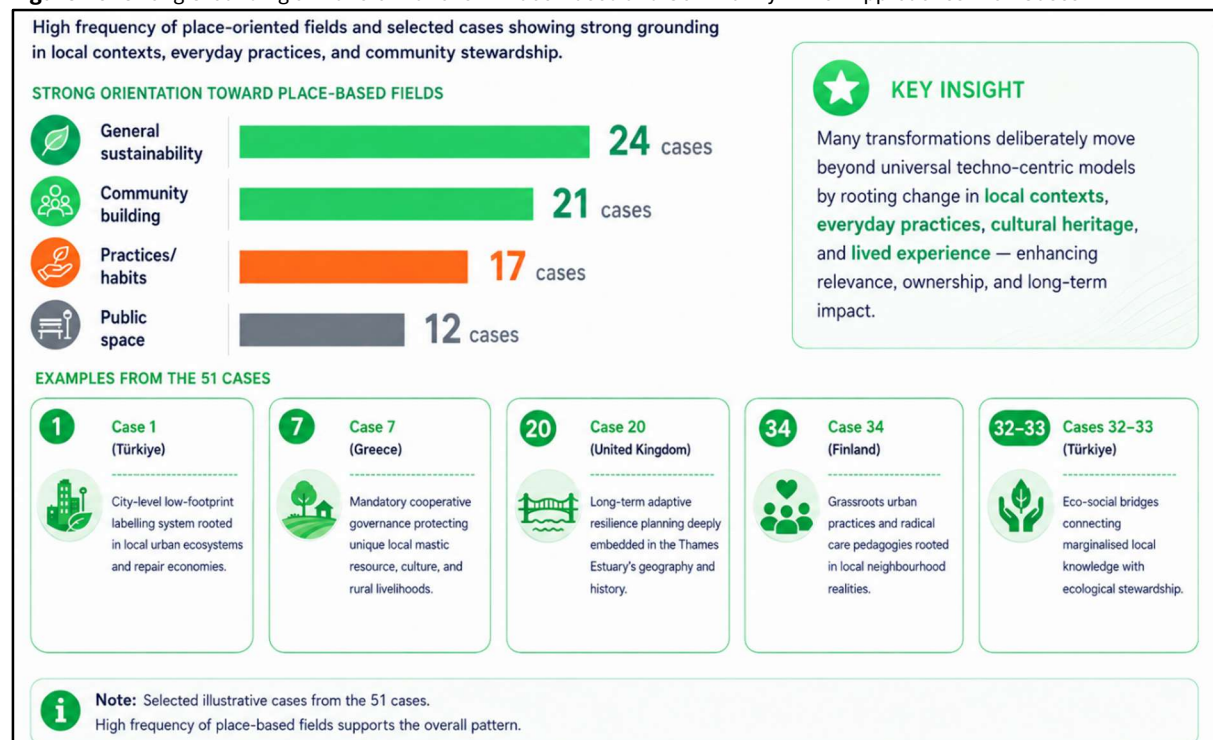
This pattern was identified through quantitative analysis of the transformation fields, with particularly high frequencies recorded for:

- ⇒ **Community building** (21 cases)
- ⇒ **General sustainability** (24 cases)
- ⇒ **Practices/habits** (17 cases)
- ⇒ **Public space** (12 cases)

The pattern is also qualitatively evident in multiple strong cases, including:

- ⇒ **Case 1: A Novel Approach to Urban Environmental Sustainability: Transitioning from Carbon-Intensive to Low-Footprint Cities** (Türkiye) – a city-level labelling system rooted in local urban ecosystems, repair economies, and place-based environmental identity.
- ⇒ **Case 7: Collective actions in rural areas** (Chios Mastiha Growers Cooperative, Greece) – a mandatory cooperative model protecting a unique local natural resource, cultural heritage, and rural livelihoods.
- ⇒ **Case 20: From Flood Defence to Adaptive Resilience: The Thames Estuary as a Transformative Pathway** (United Kingdom) – long-term adaptive planning deeply embedded in the specific geography, history, and ecological dynamics of the estuary.
- ⇒ **Case 34: Pedagogies of sustainability and radical care: grassroots urban practices in Tampere, Finland** – community-led practices and care-based pedagogies rooted in local neighbourhood realities and everyday experiences.
- ⇒ **Cases 32–33: Paraecological Transformation: Eco-social Bridges from Marginal Knowledge to a Just Future** (Türkiye) – bridging marginalised local and traditional knowledge with ecological stewardship and justice-oriented practices.

Figure 29. Strong Grounding of Transformations in Place-Based and Community-Driven Approaches in 51 Cases



The 51 cases also demonstrate significant hybridity and interconnection across different transformation approaches.

Through cross-referencing of transformation fields, tools, and “From → To” descriptions in the survey responses, it becomes evident that socio-technical innovations are frequently combined with participatory governance methods, regenerative practices often integrate epistemic and justice dimensions, and community initiatives draw on both technological tools and ecological insights.

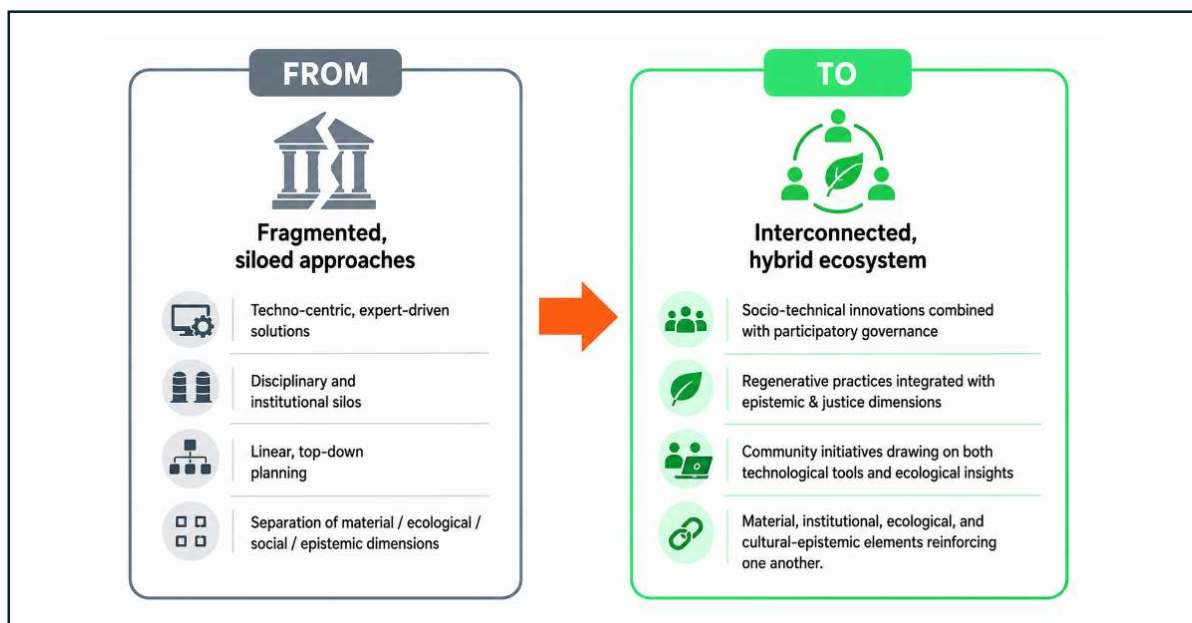
This hybrid character is clearly visible in several strong cases, including:

- ⇒ **Case 3:** AI-Powered Co-design Lab – Mondego (AI-COLAB) (Portugal) – blending digital visualisation and AI tools with participatory co-design and community placemaking in a rural setting.
- ⇒ **Case 50:** URBINAT Healthy Corridor, Porto (Portugal) – merging nature-based solutions and urban infrastructure with intensive community co-creation and co-governance processes.
- ⇒ **Case 51:** Virtual Positive Energy District Laboratories (VPED-Labs) (Serbia) – integrating digital simulation, virtual testing environments, and technical energy modelling with stakeholder co-creation and decision-support platforms.
- ⇒ **Cases 32–33:** Paraecological Transformation: Eco-social Bridges from Marginal Knowledge to a Just Future (Türkiye) – connecting marginalised local and traditional knowledge with regenerative ecological and bio-economy practices.
- ⇒ **Case 21:** From Passive Forests to Active Infrastructures: Wood-Based Piezoelectric Systems (Türkiye) – fusing nature-based materials and ecological systems with socio-technical energy generation and sensing technologies.

Quantitative mapping of transformation fields further reinforces this pattern: “General sustainability,” “Built environment,” “Community building,” and “Practices/habits” emerge as major overlapping domains across the full set of cases.

Rather than operating in isolation, many of the 51 cases actively blend material, institutional, ecological, and cultural-epistemic elements to create synergistic pathways. This blending suggests that various transformation logics do not just coexist, but actually reinforce one another within an evolving, interconnected ecosystem of sustainability transformations.

Figure 30. Hybridity and Interconnections Across Transformation Approaches.



Despite these advances, notable tensions remain visible across the dataset.

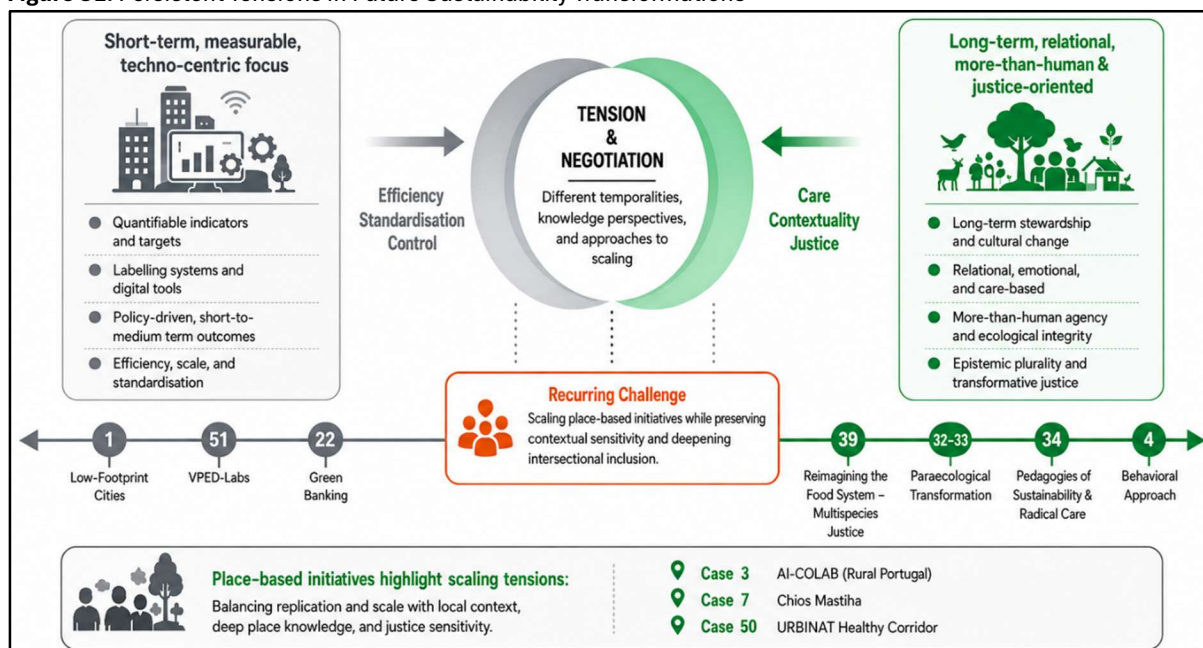
An iterative thematic analysis of the survey responses, including the “From → To” trajectories, marginalisation descriptions, and transformation tools, shows that many initiatives still struggle to bridge the short-term, measurable outcomes favoured in technical and governance-oriented cases with the slower temporalities, relational care, and more-than-human perspectives emphasised in regenerative and justice-led cases. Scaling place-based experiments while preserving contextual sensitivity and deepening intersectional inclusion also continues to be a recurring challenge.

This tension manifests in several ways:

- ⇒ Technical and governance cases (e.g. Case 1 Low-Footprint Cities, Case 51 VPED-Labs, Case 22 Green Banking) frequently prioritise quantifiable indicators, labelling systems, digital tools, and short-to-medium-term policy targets.
- ⇒ In contrast, regenerative and justice-led cases (e.g. Case 39 Reimagining the Food System – Multispecies Justice, Cases 32–33 Paraecological Transformation, Case 34 Pedagogies of sustainability and radical care, Case 4 Behavioral approach) foreground long-term stewardship, emotional and relational dimensions, more-than-human agency, and slower processes of cultural and epistemic change.
- ⇒ Place-based initiatives often explicitly highlight the difficulty of scaling without losing contextual depth and justice sensitivity (e.g. Case 3 AI-COLAB in rural Portugal, Case 7 Chios Mastiha, Case 50 URBINAT Healthy Corridor).

The 51 cases reveal ongoing challenges in reconciling differing temporalities, knowledge perspectives, and approaches to scaling.

Figure 31. Persistent Tensions in Future Sustainability Transformations



Taken together, the 51 cases portray a maturing, plural, and increasingly reflexive field of future sustainability transformations. They demonstrate growing convergence around co-creation, place-based action, and justice as guiding principles, while also exposing the persistent work needed to connect local experiments with systemic change and to broaden inclusivity across scales, worldviews, and time horizons.

3.2. The Cartography of Marginalisation

Building on the quantitative overview presented in the Executive Summary (Figures 1–5) and the overall patterns identified in Section 3.1, a closer synthesis of the 51 cases reveals differentiated patterns of exclusion across geographies and clusters. This synthesis combines quantitative frequency analysis of the marginalisation fields with qualitative coding of responses to the open-ended question, “What elements (knowledge/capacities/contexts) are marginalized, but important?”.

The following tables summarise marginalisation patterns across the dataset. Tables 2 and 3 report selection frequencies across geographical contexts and transformation clusters, while Table 4 presents co-occurrence patterns between marginalisation types and justice themes.

Table 2. Heatmap of Marginalisation Types by Geographical Context

Heatmap of Marginalisation Types by Geographical Context						
Marginalisation Type	Türkiye & Balkans	Northern Europe	Southern Europe	Other Europe / UK	Other / Global	Total
Geographic	9	3	4	3	8	27
STEM-SSH	6	5	4	3	5	23
Scales	6	4	3	4	5	22
Disciplinary	3	2	2	3	4	14
Other	3	3	2	2	1	11

Created with Datawrapper

Table 3. Heatmap of Marginalisation Types by Transformation Cluster

Heatmap of Marginalisation Types by Cluster					
Marginalisation Type	Cluster 1 (Socio-Technical)	Cluster 2 (Governance)	Cluster 3 (Regenerative Bio-Economy)	Cluster 4 (Social/Epistemic/Justice)	Total
Geographic	4	8	3	12	27
STEM-SSH	7	5	4	7	23
Scales	5	6	2	9	22
Disciplinary	4	2	4	4	14
Other	3	4	2	2	11

Table 4. Heatmap of Marginalisation Types and Associated Justice Themes

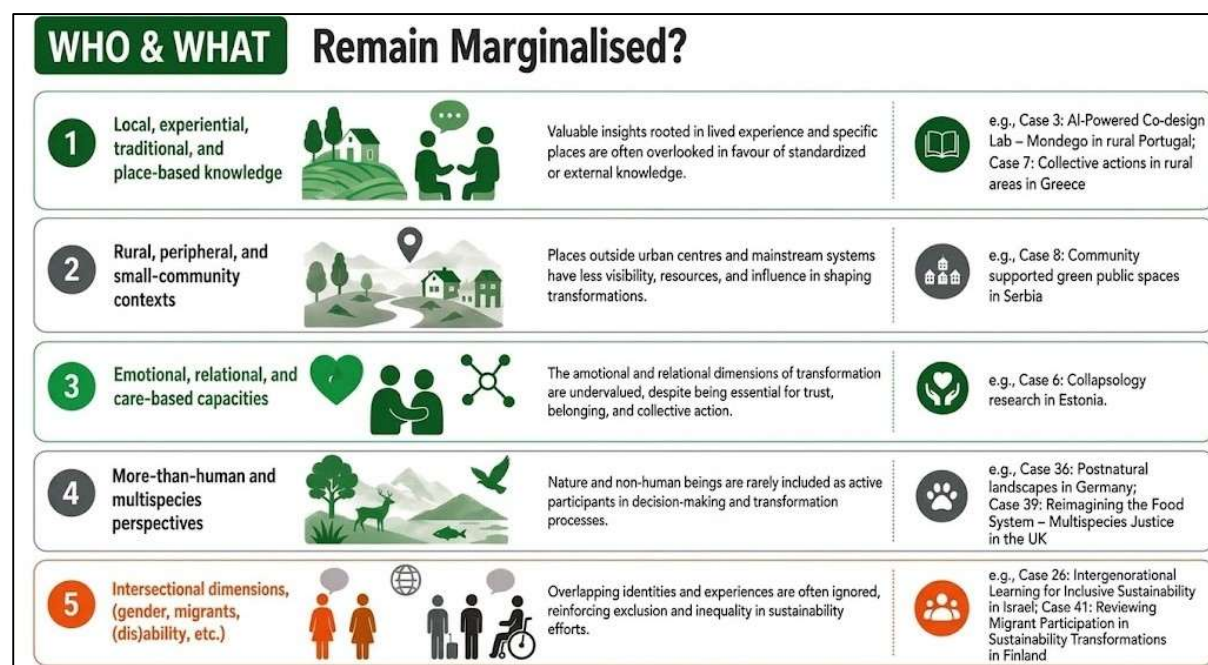
Heatmap of Marginalisation Types and Associated Justice Themes						
Marginalisation Type	Epistemic	Intersectional	Gender	(Dis)ability/Health	Race/ethnicity	Other Justice
Geographic	8	9	4	3	2	1
STEM-SSH	7	6	5	4	3	2
Scales	6	7	3	4	2	0
Disciplinary	5	4	3	3	2	2
Other	9	8	5	6	4	6

Created with Datawrapper

These heatmaps reveal notable differences across the cases. Geographic marginalisation is particularly prominent in several regions and clusters, while concerns related to STEM–SSH integration and scale are evident throughout the dataset. Disciplinary and “other” categories including epistemic, intersectional, more-than-human, and care/stewardship dimensions are especially visible in specific clusters.

Insights of patterns derived from the qualitative analysis are presented in the following figure, highlighting several elements that remain insufficiently addressed but are crucial for achieving meaningful future sustainability transformations

Figure 32. Crucial Elements for Achieving Meaningful Future Sustainability Transformations



Who and What Remain Marginalised?

These forms of exclusion do not appear to be uniform. Rather, the findings suggest that they may manifest differently across geographical contexts and types of transformation. The co-occurrence analysis further indicates that geographic marginalisation frequently coincides with epistemic and intersectional concerns, while scale mismatches may constrain the translation of local initiatives into broader systemic change. Taken together, these patterns suggest that sustainability transformations often continue to emphasise technical and efficiency-oriented solutions, potentially overlooking relational, contextual, and plural ways of knowing and being.

This cartography of marginalisation provides insights into persistent gaps within the current landscape of sustainability transformations. While the findings should be interpreted with caution, they point toward the value of more reflexive and inclusive approaches that better recognise and centre marginalised knowledges, capacities, and contexts. As such, the cartography highlights areas that may warrant greater attention in future sustainability transformations.

3.3. Future Directions

Building on the cluster analysis in Section 2 and the cartography of marginalisation in Section 3.2, this subsection identifies key forward-looking directions for advancing more inclusive future sustainability transformations. The analysis synthesises quantitative frequencies of marginalisation types, qualitative insights from open responses, and cluster-specific patterns observed across the 51 cases. These insights are offered as generative rather than exhaustive, given the exploratory nature of the dataset.

The following mind map synthesises priority leverage points derived from marginalisation patterns and cluster insights. The pathway diagram illustrates movement from identified gaps through these leverage points toward desired outcomes.

Figure 33. Key Leverage Points for Just Sustainability Transformations (Mind Map)

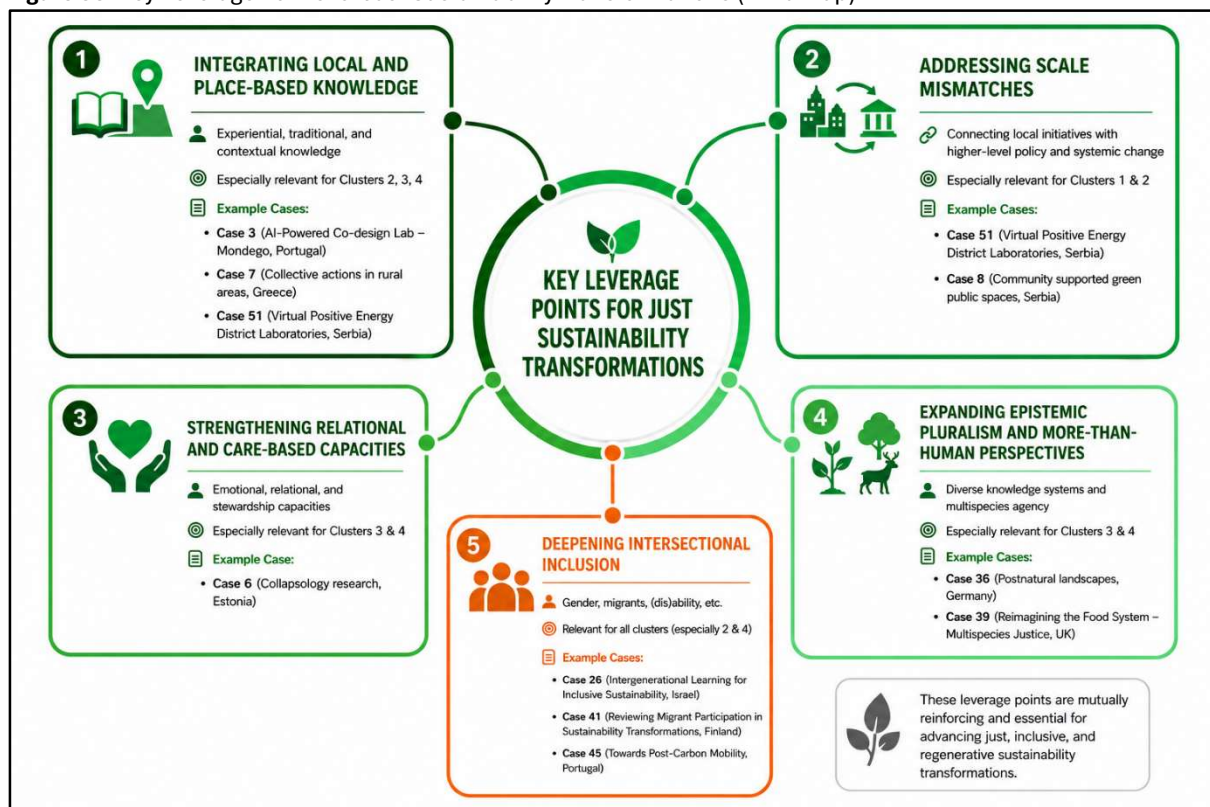
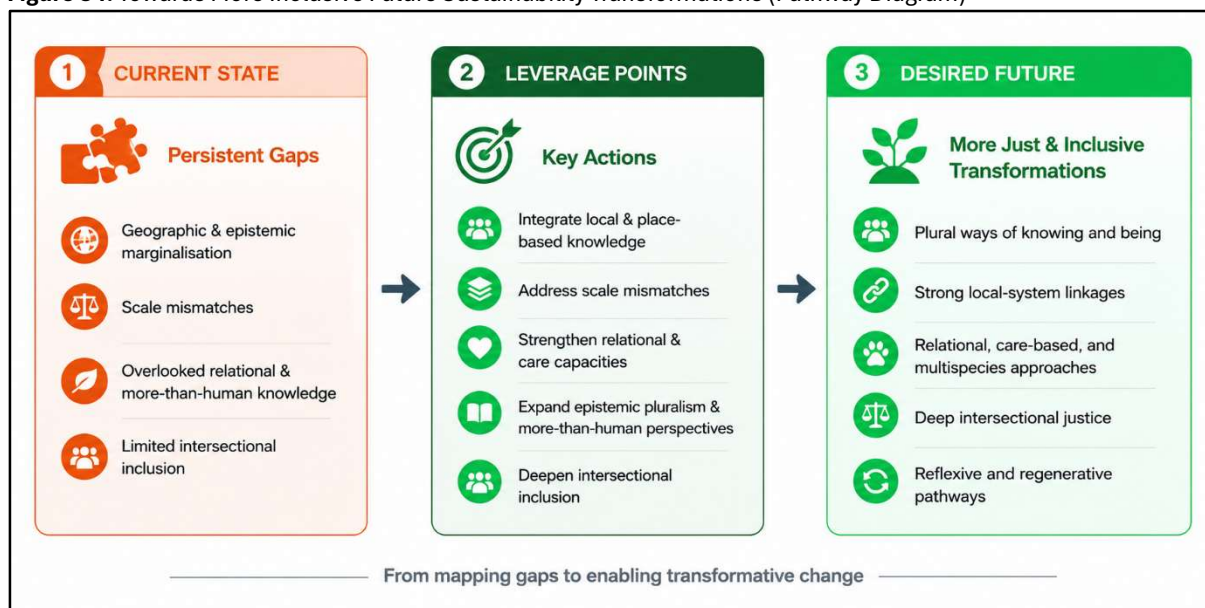


Figure 34. Towards More Inclusive Future Sustainability Transformations (Pathway Diagram)



Cluster-Specific Opportunities

The four clusters reveal distinct opportunities for addressing marginalisation:

- ⇒ **Cluster 1 (Socio-Technical, Mobility & Urban Infrastructures):** Leverage technical capacity to better integrate local and experiential knowledge and to address scale mismatches between urban innovations and peripheral contexts.
- ⇒ **Cluster 2 (Governance, Policy & Participatory Innovation):** Build on participatory methods to strengthen intersectional inclusion and create more effective linkages between local action and higher-level policy.
- ⇒ **Cluster 3 (Regenerative & Bio-Economy Pathways):** Deepen the integration of more-than-human and multispecies perspectives while expanding relational and care-based approaches.
- ⇒ **Cluster 4 (Social, Epistemic & Justice-Led Transformations):** Capitalise on epistemic and justice strengths by developing practical tools that bridge emotional, relational, and place-based knowledge with broader systemic change.

Further opportunities from the cartography

Building on the insights emerging from this mapping exercise, the following directions may help inform future activities within WG4 and the TransformERS network:

- ⇒ Continue expanding the collection and comparative analysis of cases from underrepresented geographies, contexts, and knowledge systems to strengthen the diversity of perspectives represented.
- ⇒ Further explore hybrid methodological approaches that bring together technical innovation with relational, emotional, and care-based capacities, recognising their complementary contributions to transformative change.
- ⇒ Foster opportunities for dialogue and knowledge exchange across clusters and scales to help address identified gaps and strengthen connections between local and broader transformation processes.
- ⇒ Integrate more systematic attention to marginalisation, equity, and justice considerations within future mapping and analytical activities.
- ⇒ Encourage transdisciplinary pilot initiatives that can test and refine the identified leverage points in real-world settings, while paying particular attention to intersectional inclusion, collective learning, and long-term stewardship.

Section 4: Practitioner & Policy Toolkit

4.1. Catalogue of Tools & Techniques for Future Sustainability Transformations

Strategic Selection & Mapping Tools/Techniques

The below catalogue provides a mapping of the tools, techniques, mechanisms, and interventions identified across the 51 cases included in this document. The catalogue was developed through an analysis of the survey responses. The tools, techniques, mechanisms, and interventions were organised using three analytical filters:

- ⇒ Operational Domain – based on the survey question “What field does the transformation relate to?”
- ⇒ Action Environment & Typology – based on the survey question “The research relates to:”, distinguishing between research, practice, and policy-making contexts.
- ⇒ Systemic Scaling Vector – based on the assigned transformation cluster and responses to “How is the future enacted/created/shaped?”

Key insight:

- ⇒ These dimensions reveal not only what tools are being used, but also how they operate across different transformation contexts and scales.

Figure 35. Integrated Tool Mapping Across Four Clusters and Case Studies.

CLUSTER 1 Socio-Technical, Mobility & Urban Infrastructures					
 Toolkit Instrument	 Brief Description	Action Environment	 Primary Operational Domain	 Context & Empirical Mapping Basis	
Low-Footprint Urban Benchmarking & Labeling	 City-level labelling system with measurable indicators for carbon, material footprint, repair and place identity	Policy-making & Practice	 Built Environment, Energy	 Case 1	
BIM Collaborative Exchange Environments	 Collaborative digital modelling and exchange for building projects	Research & Practice	 Built Environment	 Case 5	
Virtual Positive Energy District Laboratories (VPED-Labs)	 Virtual laboratories for testing Positive Energy District scenarios	Research & Policy-making	 Built Environment, Energy	 Case 51	
Nature-Based Solutions (NBS) Spatial Interventions	 Green corridors and nature-based solutions developed with community input	Practice & Policy	 Urban Regeneration	 Case 50	
Adaptive Flood Plain Infrastructure Structuring	 Long-term adaptive planning shifting from traditional flood defence	Policy-making & Practice	 Climate Adaptation	 Case 20	
Just Transit Accessibility Mapping	 Frameworks for inclusive and just urban transportation	Practice & Research	 Urban Mobility	 Case 25	

CLUSTER 2 Governance, Policy & Participatory Innovation

 Toolkit Instrument	 Brief Description	Action Environment	 Primary Operational Domain	 Context & Empirical Mapping Basis
Harmonized Corporate Sustainability Transposition	 Comparative adaptation of sustainability reporting standards	Research, Policy & Practice	 Economy, Reporting	 Case 2
AI Over Coffee (Low-Threshold Co-Design)	 Informal AI-supported participatory design and visualisation	Research & Practice	 Community Building	 Case 3
Community-Led Tactical Neighborhood Interventions	 Resident-led contribution to green public spaces	Practice	 Public Space	 Case 8
Bottom-Up Transnational Policy Stimulation	 Bottom-up input into EU missions	Policy-making & Research	 Marine Protection	 Case 9
Participatory Causal Loop Diagramming	 Participatory development of theories of change	Research & Policy-making	 Theories of Change	 Case 10
Reflexivity-Situatedness Matrices for Commoning	 Frameworks for commons-based governance	Research, Policy & Practice	 Common Resource Governance	 Case 47

CLUSTER 3 Regenerative & Bio-Economy Pathways

 Toolkit Instrument	 Brief Description	Action Environment	 Primary Operational Domain	 Context & Empirical Mapping Basis
Mandatory Cooperative Governance Frameworks	 Mandatory cooperative models for local resource management	Policy-making & Practice	 Agri-Food Systems	 Case 7
Bio-Based Agricultural Waste Upcycling	 Conversion of agri-food by-products into new materials	Practice	 Material Innovation	 Case 18
Double-Impact Aquaculture Licensing	 Context-sensitive frameworks for sustainable aquaculture	Research & Policy-making	 Bio-Economy	 Case 19
Multispecies Justice Food Sovereignty Audits	 Frameworks recognising non-human agency in food systems	Research & Practice	 Food Systems	 Case 39

CLUSTER 4 Social, Epistemic & Justice-Led Transformations					
 Toolkit Instrument	 Brief Description	Action Environment	 Primary Operational Domain	 Context & Empirical Mapping Basis	
Behavioral Multi-Species Governance Arenas	 Behavioural approaches integrating multispecies perspectives	Research & Policy-making	 Biodiversity Protection	 Case 4	
Critical Environmental Pedagogies Modules	 Critical pedagogies and radical care practices	Research & Practice	 Educational Equity	 Cases 28, 34	
Critical-Gaming Knowledge Assemblage Platforms	 Serious games for assembling sustainability knowledges	Research & Practice	 Gamification	 Case 35	
Migrant-Inclusionary Participation Toolkits	 Frameworks for migrant inclusion in sustainability processes	Research & Policy-making	 Intersectional Governance	 Case 41	

4.2. Cross-Cutting Patterns Regarding Tools & Techniques

Distribution

- ⇒ **Cluster 1** cases contain the highest concentration of technical and infrastructural tools, including digital platforms, simulation environments, monitoring systems, and urban planning instruments.
- ⇒ **Cluster 2** cases are strongest in participatory and governance mechanisms, particularly co-design processes, living labs, stakeholder dialogues, and collaborative decision-making approaches.
- ⇒ **Cluster 3** cases contain a smaller but distinctive set of regenerative and relational tools focused on ecological restoration, circular practices, stewardship, and community-led environmental action.
- ⇒ **Cluster 4** cases are dominated by epistemic, pedagogical, and justice-oriented tools, including transformative learning, storytelling, critical pedagogies, arts-based methods, and knowledge co-production approaches.

Hybridity

- ⇒ **Many tools operate across multiple transformation clusters** rather than within a single pathway.
- ⇒ Frequently occurring combinations include Nature-Based Solutions and Co-Governance approaches (Clusters 1 and 3), Multispecies Justice Frameworks (Clusters 3 and 4), Participatory Foresight and Serious Games (Clusters 2 and 4), and Commoning Models (Clusters 2 and 3).
- ⇒ This pattern suggests that future sustainability transformations **increasingly combine technical, ecological, social, and governance dimensions** within integrated approaches.

Key Insight

- ⇒ Most tools **combine technical and participatory elements** rather than relying on a single intervention.
- ⇒ There is a **strong emphasis on low-threshold, place-based, and relational approaches** that can be adapted to local contexts.
- ⇒ **Justice is frequently embedded within the design of tools and transformation processes** rather than added as a separate consideration or outcome.

Annexes

Annex 1. Complete List of 51 Future Sustainability Transformation Cases

ID No	Contributor	Role	Country	Title of transformation case	Cluster
1	Mustafa Necati Çoban	Researcher	Türkiye	A Novel Approach to Urban Environmental Sustainability: Transitioning from Carbon-Intensive to Low-Footprint Cities	1
2	Amra Gadžo	Researcher, Researcher-practitioner, Researcher-policy maker	Bosnia and Herzegovina	Adapting Swedish Good Practices: A Comparative Study of Sustainability Reporting in Listed Companies and Implications for Bosnia and Herzegovina	2
3	Ribal Aman Eddine	Researcher-practitioner	Portugal	AI-Powered Co-design Lab – Mondego (AI-COLAB)	2
4	Tatiana Kluvankova	Researcher	Slovakia	Behavioral approach in transformative research	4
5	Mercedes del Río	Researcher	Spain	Beyond Green Buildings	1
6	Aleksandra Kekkonen	Researcher	Estonia	Collapsology research	4
7	Panagiota Sergaki	Researcher-practitioner	Greece	Collective actions in rural areas	3
8	Tamara Radenović	Researcher	Serbia	Community supported green public spaces	2
9	Jerneja Penca	Researcher	Slovenia	Contributing to Mission Ocean and waters in a bottom-up way	2
10	Rebekka Frick	Researcher	Switzerland	Developing theories of change in participatory processes in different case studies of a Horizon Europe project	2
11	Vesela Kazashka	Researcher	Bulgaria	Digital Art Managent	2
12	Anthonette Quayee	Researcher-practitioner	Netherlands	Education Connected to Place	2
13	Kimete Canaj	Researcher, Policy maker	Kosovo	EduTransform: Shaping Tomorrow's Research	2
14	Renee Wansdronek	Researcher, Practitioner, Researcher-practitioner	Netherlands	Emporium	3
15	Victoria Lisnic	Researcher	Moldova	Empowering Research, Expanding Horizons	2
16	Pınar Gültekin	Researcher	Türkiye	Environmental transformation	4
17	Viktoriya Voytsekhovska	Researcher	Ukraine	Food security and Russian military aggression in Ukraine	4
18	Tugçem Yılmaz	Researcher	Türkiye	From agri-food by-product to vegan leather	3
19	Meryem Yeşim Çelik	Researcher	Türkiye	From Evidence to Impact: A Context-Sensitive Framework for Double-Impact Mussel Aquaculture	3
20	Tatiana Ruchinskaya	Practitioner, Researcher-practitioner	United Kingdom	From Flood Defence to Adaptive Resilience: The Thames Estuary as a Transformative Pathway	1
21	Zeynep Eda Özcan	Researcher	Türkiye	From Passive Forests to Active Infrastructures: Wood-Based Piezoelectric Systems for Sustainability Transformations	1
22	Jelena Vapa	Researcher	Serbia	Green Banking	1
23	Ebru Kasnak	Researcher	Türkiye	Green transformation as a corporate strategy	2

24	Jerneja Penca	Researcher, Researcher-practitioner	Slovenia	Including young generations into thinking about adaptation to sea level rise	2
25	Metin Mutlu Aydın	Researcher	Türkiye	Inclusive and Just Sustainability Transformations in Urban Transportation Systems	1
26	Vered Holzmänn	Researcher	Israel	Intergenerational Learning for Inclusive Sustainability	4
27	Gintarė Tamašauskaitė-Janickė	Researcher; Researcher-practitioner	Lithuania	Justice based on hope	4
28	Turkan Firinci Orman	Researcher	Finland	Leveraging Critical Environmental Pedagogies for Sustainable Futures	4
29	Elif Tugba Simsek, Jerneja Penca, Tatiana Kluvankova	Researcher	Czechia/Slovenia/Slovakia	Literature review: Sustainability Transformations and the Concept of Future: A Review of the State of the Field	4
30	Levent Bilgili	Researcher	Türkiye	Maritime	1
31	Negulescu Mihaela Hermina	Researcher	Romania	Neighborhood multimodal (future) urban mobility schemes	1
32	Turgay Dindaroglu	Researcher	Türkiye	Paraecological Transformation: Eco-social Bridges from Marginal Knowledge to a Just Future	3
33	Turgay Dindaroglu	Researcher-practitioner	Türkiye	Paraecological Transformation: Eco-social Bridges from Marginal Knowledge to a Just Future	3
34	Turkan Firinci Orman	Researcher	Finland	Pedagogies of sustainability and radical care: grassroots urban practices in Tampere, Finland	4
35	Adina Popa	Researcher, Researcher-practitioner	Sweden	Playing Transformation: A Critical-Game Approach to Assembling Sustainability Knowledges	4
36	Florin Pruna	Researcher, Practitioner, Researcher-practitioner	Germany	Postnatural landscapes	3
37	Dejan Vasovic	Researcher	Serbia	Public utilities	1
38	Žarko Vranjanac	Researcher	Serbia	PUT (Public Utility Transformation)	2
39	Sarah Milliken	Researcher	United Kingdom	Reimagining the Food System: A Multispecies Justice Approach to Future Transformation	3
40	Kimete Canaj	Researcher; Researcher-policy maker	Kosovo	Research and Innovation on Education and Health-Transformation of Society	4
41	Anna Salomaa	Researcher	Finland	Reviewing Migrant Participation in Sustainability Transformations	4
42	Anna Salomaa	Researcher	Finland	Science-policy interface organizations contributing to transformations	2
43	Laura Boffi	Researcher-practitioner	Italy	The Embassy of Reindeers	3
44	Ziya İnce	Researcher	Türkiye	The transformation of education in the future.	4
45	Catarina Cadima and Paulo Pinho	Researcher	Portugal	Towards Post-Carbon Mobility: Empowering Communities through Social Innovation for Climate-Resilient Futures	1
46	Paweł Przybylski	Researcher	Poland	Transformation as a European civilizational challenge	4
47	Ilkhom Soliev, Richard Völker	Researcher	Germany	Transformation through commoning	2
48	Anna Salomaa	Researcher	Finland	Transformative potential of conservation actions	3

49	Žanina Žigo	Researcher	Croatia	Transforming sustainability futures through inclusive and justice-oriented communication	4
50	Goncalo Canto Moniz and Ribal Aman Eddine	Researcher-practitioner	Portugal	URBINAT Healthy Corridor, Porto	1
51	Jelena Brajković (framework developed together with Giovanni Semprini, Matthias Haase, Maria Beatrice Andreucci, Marco Delli Paoli, Touraj Ashrafian, Silvia Soutullo Castro, Emanuela Giancola, Oscar Seco Calvo)- (Serbia, Italy, Switzerland, UK, Spain)	Researcher-practitioner	Serbia	Virtual Positive Energy District Laboratories (VPED-Labs) as Enabling Infrastructures for Sustainability Transformations: A Conceptual Framework for Developing Virtual PED Labs	1

Annex 2. Full Survey Template

Collection of Future Sustainability Transformations

TransformERS WG 4 compendium

This is an internal survey of WG4 members to produce a compendium of future transformations. All contributors are invited to be co-authors. In the survey, we collect your name and email address solely to attribute authorship and to follow up with you if clarification of your survey response is needed. This information is used only for these purposes and will not be shared outside the project team. Your data will be stored securely and kept only as long as necessary for the stated purposes. You may request access, correction, or deletion of your personal data at any time in accordance with the GDPR.

About the compendium

How can we ensure that future sustainability transformations are truly inclusive and fair? We invite diverse perspectives on how justice can be embedded in *emerging transformation processes*— especially those that challenge mainstream approaches and open new pathways for change. Contributions may explore innovative practices, frameworks, or experiments that reimagine sustainability through equity, participation, and fairness.

Future transformation case

Title of the transformation *

What field does the transformation relate to? *

- ☐ Food
- ☐ Transport
- ☐ Education
- ☐ Health
- ☐ Care
- ☐ Energy
- ☐ Community building
- ☐ Built environment
- ☐ Public space
- ☐ Fashion
- ☐ Waste processing
- ☐ Organization of work
- ☐ General sustainability
- ☐ Practices/habits
- ☐ Other: _____

What does the transformation relate to? *

- ☐ Thinking about the future
- ☐ Decision-making for the future
- ☐ Co-creating the future

The research relates to: *

- ☐ Research
- ☐ Practice

- ☐ Policy-making

Type of transformation *

- ☐ New idea or concept
- ☐ Ongoing unpublished research
- ☐ Published research
- ☐ Research scheme, practical project or initiative
- ☐ Application/tool/method
- ☐ Real-world practice or case
- ☐ Artwork or creative experiment
- ☐ (Mega)trend
- ☐ Other: _____

Relevant reference, source, link

What is being transformed? What is the point of departure for this transformation? *

What is it being transformed into in the future? What is the end point of this transformation? *

Future

How does this instance of transformation relate to the future? *

How is the future conceived, understood? *

Who influences it? *

How is the future enacted/created/shaped? *

Who influences this? *

Tools for transformation

What tools/technique/mechanism/intervention/action does this process use? *

What would be needed to facilitate action in this instance of transformation? *

Marginalisation

What elements (knowledge/capacities/contexts) are marginalized, but important? Please describe briefly, by reference to the dominant context that created these marginalisations.

Marginalisation types relevant to this transformation: *

- ☐ Geographic (e.g., dominance of Western/EU cases, exclusion of Global South or post-socialist contexts)
- ☐ Disciplinary
- ☐ Scales (e.g., focus on individual vs. systemic levels)
- ☐ STEM-SSH (e.g., social sciences/humanities undervalued compared to physical sciences)
- ☐ Other: _____

Justice themes impacted or addressed *

- ☐ Gender
- ☐ Race/ethnicity
- ☐ (Dis)ability/Health
- ☐ Epistemic
- ☐ Intersectional

☐ Other: _____

Do you have an image to append? Please consider copyright (include only the image you are an author of or have the right to use)

Contributor

Name *

Institution *

Role *

- ☐ Researcher
- ☐ Practitioner
- ☐ Researcher-practitioner
- ☐ Policy maker
- ☐ Researcher-policy maker
- ☐ Practitioner-policy maker

Thoughts, resources

What thoughts/questions relevant to TRANSFORMATIONS and the FUTURE do you suggest to include in the compendium?

Do you have relevant resources to share (conferences, materials, resources etc.)?

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