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Learning from 102 European Municipalities: Sectoral and Regional Patterns of Action Plans in Climate City Contracts

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Abstract

Cities are among the major consumers of environmental resources and contribute significantly to the degradation of many ecosystems. For this reason, the European Union is prioritising the transformation of the role of European cities to become key actors in enabling sustainable and efficient urban systems. Part of this effort is enacted through the Mission "Cities," that guides cities in developing Climate City Contracts (CCC), which are innovative governance instruments that outline municipalities' collaborative and systemic plans to reach climate neutrality. This article examines how 102 Mission Cities across Europe plan to reach climate neutrality by 2030, by analysing the selection of typologies of actions included in their CCCs. Results reveal distinct regional patterns in how municipalities design their portfolios of climate actions in key topics: an integrated and diversified combination of sectoral measures and governance innovations in Northern and Western Europe, a focus on upgrading core infrastructures in Central and Eastern Europe, and prioritisation of interventions in mobility and the Built Environment in Southern Europe. These findings provide insights for policy and planning strategies, and highlight countries that progress faster in specific topics and those that still face relevant barriers.

Keywords: systemic innovation; sustainable urban planning; climate transition; comparative analysis; GHG emissions

1. Introduction

Cities concentrate both opportunities and risks for climate transition as they are major drivers of emissions through Energy Systems, buildings, and mobility. As such, they are also the sites where climate policies and innovative solutions can be most effectively implemented [1,2]. Recent assessments confirm that urban areas face escalating risks from heatwaves, flooding, and deteriorating air quality, intensifying the urgency of developing robust mitigation and adaptation strategies [3]. Facing these conditions, the EU has increasingly positioned cities at the heart of its climate neutrality agenda. The European Green Deal sets the target of a climate-neutral continent by 2050 [4], and the Mission "100 Climate-Neutral and Smart Cities by 2030" (or "Cities Mission") supports municipalities to adopt systemic climate transformations [5]. These initiatives aim to align local action with global commitments such as the Paris Agreement. The Climate City Contracts (CCCs) represent the key operational tool of the Cities Mission: CCCs are strategic documents that are designed in collaboration with a wide set of urban stakeholders and articulate

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each city's vision in a systemic portfolio of actions for achieving climate neutrality before 2030 [6].

However, existing scholarship highlights a number of persistent challenges in urban climate governance: studies have shown that city climate plans across Europe vary considerably in scope, ambition, and integration of adaptation and mitigation [7–9]. While mitigation actions and adaptation measures are already quite diffused, their integration is not structural, and actual implementation does not always correspond to commitments, risking both maladaptation and missed opportunities for co-benefits [10]. Furthermore, governance silos, limited resources, and uneven regulatory frameworks across member states complicate the ability of cities to implement coherent cross-sectoral strategies [11]. In this context, comparative analyses that systematically examine planned actions across multiple sectors and countries remain scarce, particularly at the EU scale [12]. Comparison has so far been carried out concerning the indicators selected by cities, yet standardised comparisons across regions remain underdeveloped [13].

This study contributes to filling this gap by analysing Action Plans included in the CCCs approved by the European Commission (as of May 2025) of 102 cities. The aim of this paper is to identify the prevailing priorities in urban mitigation planning by examining sectoral emphases and regional differences across Europe, while also reflecting on the implications of these findings for integrated climate governance, highlighting both opportunities and gaps. In doing so, the paper contributes to the Special Issue on Climate Adaptation and Mitigation in the Urban Environment by offering empirical evidence of how ambitious municipalities implement the mandate of reducing emissions while enhancing resilience. By examining the distribution of typologies of actions across topics and countries, the paper provides a preliminary comparative picture of how European cities aiming to be climate neutral by 2030 are planning to operationalise their transition to climate neutrality, as well as planning patterns across European regions.

Contemporary scholarship emphasises understanding which sub-sectors and typologies of climate action are most effective in urban planning, and that it requires careful consideration of contextual factors [14]. Understanding regional differentiation is critical when examining how cities operationalise their climate commitments through collaborative planning mechanisms, as the success of any urban climate transition rests upon identifying which actions are most suited to each specific sub-sector [15]. The operationalisation of climate commitments faces persistent challenges, since multilevel governance involves not merely hierarchical relationships but complex networks of actors with differential capacities and interests [16,17]. A critical theme traversing the literature concerns the persistent challenge of integrating transition commitments [18,19] and silos between mitigation and adaptation planning [7]. The literature also documents the risk of maladaptation that stems from short-sighted, fragmented, and non-inclusive policy approaches, where adaptation measures intended to reduce harm instead increase vulnerabilities or shift them across space and time [20,21], as, for example, energy efficiency policies that inadvertently increase inequities without addressing energy poverty [22]. Scholarship points out the need to integrate the spatial dimension into urban climate vulnerability assessments [23] to shed light on how interdependencies between places, people, and movement patterns are affected by either transition policies or climate change. Collaborative and participatory planning of climate transition is thus increasingly recognised as vital to understanding and communicating progress on climate Action Plans [24]. The CCC represents an innovative governance tool to address these challenges, which was ideated and implemented in Europe in recent years, and which is attracting increasing scholarly attention [25,26]. Operating as both a strategic document and a governance mechanism, CCCs embody a co-creation process involving local stakeholders, citizens, regional and national author-

ities, and various non-state actors. The CCC comprises three interconnected parts: (i) a "Commitment" that establishes ambition and stakeholder endorsements; (ii) "2030 Climate Neutrality Action Plans" that identify existing strategies and coordinate interventions; and (iii) a "2030 Climate Neutrality Investment Plans" [26].

The analysis of 102 CCCs of respective European cities offers novel insights not only for academic debates on urban climate governance, but also for policymakers, practitioners, and stakeholders engaged in designing the next generation of European and global climate policies. The key novel contribution of this paper is that it provides evidence of specific regional differences in European cities regarding the planning of urban climate transition. Furthermore, this finding further corroborates the importance of collaborative planning with local stakeholders to secure the alignment of transition actions with local contexts and thus effective diffusion and adoption of innovation for systemic change.

2. Methodology

The methodology applied in the paper unfolds as follows. The data are sourced from 102 Action Plans, which are a core component of CCCs of European Mission Cities (that is, cities that have been selected by the European Commission to be part of the funded project NetZeroCities [6]), which are open access on the Cities Mission Portal. The complete list of cities included in this study is provided in Appendix A. Each CCC is typically over 100 pages. The coding of such data has been automated through a Python (version 3.10.9) code, which made it possible to extract actions included in the "Action Plan Module B-2: Climate Neutrality Portfolio Design" and in the "Key Priorities and Strategic Interventions" sections, in turn included in the commitments section of each CCC. The CCC Module B-2 section is focused on co-designing Climate Neutrality Portfolios with cities and relevant stakeholders, detailing single actions, synergies between actions, impacts, and implementation for measurable GHG emission reductions [6].

Through the methodology adopted in the paper, planned actions have been identified and categorised as belonging to 7 pre-defined topics and 30 sub-topics (outlined in detail in Appendix, Table A2). Such topics align with standard emission domains [27]; specifically, "Built Environment" and "Energy Systems" correspond to the emission domain of "stationary energy" and have been kept separate to accommodate municipalities' planning logics, as they are adopted in the CCCs template of the EU-funded Horizon project NetZeroCities. The analysis is based on the content of the CCC documents and focuses on planned actions. Other urban planning or sustainability-related documents were not directly analysed, as CCCs are intended to integrate and synthesise the main objectives and measures derived from broader urban strategies.

Each CCC contains a large number of actions, each named with unique wording and categorised only according to sectors or levers: analysing 102 CCCs required a methodology to categorise those actions into pre-defined topics. As a consequence, not all actions described in CCCs are included in this study: if an action did not belong to one of the pre-defined topics and/or did not match the coding schema, it was not included. Furthermore, it should be noted that the aggregation of actions does not entail other criteria of evaluation, such as the scale of investment budget, expected emissions reductions, and other implementation progress KPIs. Consequently, this study does not assess the actual physical condition of the urban environment or the existing level of implementation of specific measures, such as building renovation or energy efficiency. The identified patterns reflect similarities and differences in planning approaches rather than the current state or the needs in the analysed cities.

The methodology is structured in two main steps, synthesised in Figure 1 and described in detail in the following paragraphs.

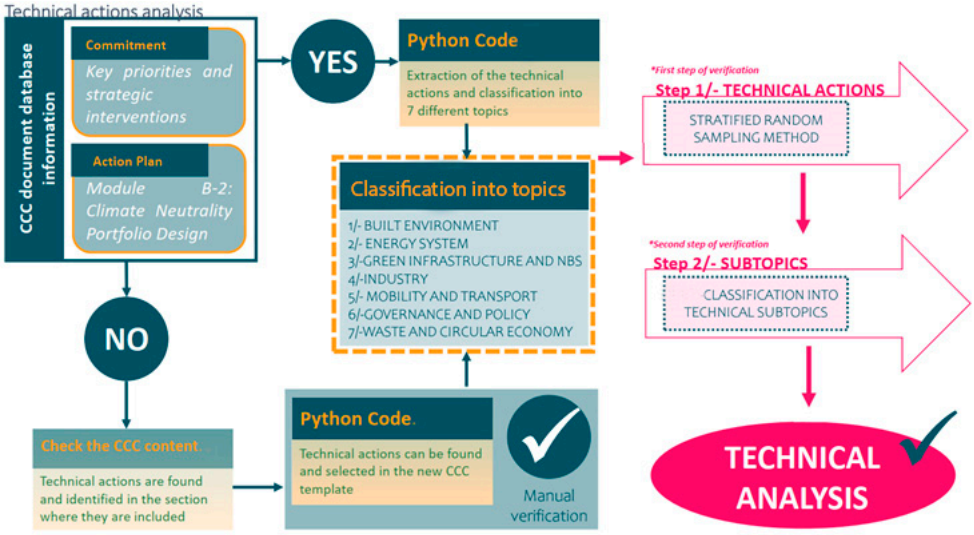

Figure 1. Process for the coding of actions of CCCs. Arrows indicate sequence of actions.

The first step of the methodology focused on extracting all actions in target sections of CCCs through the Python code and aggregating the extracted actions according to the 7 topics (Table A2). Python was also used to structure the dataset of aggregated actions extracted from CCCs (topic, sub-topic, description, city, year, source). Python scripts were applied to standardise labels, check internal consistency, and ensure that identical classification rules were used across all cities. As a consequence, the coding identified 844 topic items. It is important to acknowledge that analysis was carried out on those 844 items coded with pre-defined topics, and not on single actions present in the CCCs. This normalisation procedure ensures that cities are compared on an equivalent basis regardless of the granularity with which they documented their actions. For example, a city reporting at least one action that falls under a sub-topic (e.g., renewable energy generation, under the topic Energy Systems) receives an item count of 1 for that sub-topic, regardless of whether the CCC documents include three or ten actions that fall within that specific sub- topic. This approach prevents systematic bias arising from variations in the granularity of actions described by each city in CCCs.

In some exceptional cases, when cities have submitted CCCs that did not follow the official EU template and thus the "B2" and "Key Priorities" were not included as sections, the mapping of actions could not be extracted automatically through Python code. In these cases, the extraction and aggregation of these actions were carried out manually. The final dataset was also manually double-checked by selecting a random set of actions to verify that the assignment of single actions to a specific topic was correct.

The second step of the methodology further aggregated the coded items as sub-topics of the seven main topics. In parallel, cities were aggregated by national membership to capture differences in national policy frameworks, regulatory environments, and implementation capacity, as well as to provide results in a more anonymised format by aggregating data of cities belonging to the same country. As it will be shown in Section 3, the grouping of countries changes depending on the topics analysed, because of the different national policies for each specific sector. It is relevant to note that the classification of countries in categories A, B, C, and D does not imply a descending maturity order but rather a different context (thus it is a categorical, not ordinal, variable).

The further analysis of data was carried out through Principal Component Analysis (PCA) [28], to identify patterns in how countries prioritise mitigation actions. The analysis was performed using Python's scientific libraries. Sectoral frequencies were transformed into principal components that group countries according to their baseline characteristics.

This method reduces dimensionality, highlights cross-country similarities, and identifies clusters of national mitigation strategies.

3. Results

Through the methodology outlined, a total of 844 items belonging to the pre-defined 7 topics and 30 sub-topics have been identified and categorised across 102 approved CCCs from cities participating in the European Cities Mission. Table 1 below shows the total number of items extracted from CCC documents, classified by topic.

Table 1. Number of items from CCC documents classified by topic.

Topics	Total Items: 844
Mobility and Transport	220
Energy Systems	187
Built Environment	145
Green Infrastructure and Nature-Based Solutions	91
Waste and Circular Economy	88
Governance and Policy	87
Industry	26

This finding is in line with the extant literature, as these three sectors above are typically cited as being the biggest sources of greenhouse gas (GHG) emissions in cities. In fact, transport, energy, and buildings are key priorities in the Cities Mission climate goals. They are essential to reaching climate neutrality and are aligned with international frameworks like the Paris Agreement and the European Green Deal [4]. In the following Sub-sections, each sector is analysed in detail.

3.1. Built Environment

Built Environment refers to the set of physical spaces [29] that are created, modified, or managed by humans for living, working, mobility, and social interaction. It includes both infrastructure and buildings, as well as their relationship with the urban environment [30,31].

The Built Environment topic includes the following sub-topics: Passive energy efficiency [32], Active Energy Systems, Smart building technologies [33], Sustainable construction practices, and Sustainable urban design [34]. The classification of the countries is based on data from EU energy and environmental agencies, international bodies working on energy efficiency and sustainable construction [35]. More details as follows:

- Passive energy efficiency: includes items where energy use is reduced by design, without the need for thermal Energy Systems for heating, cooling, and hot water production.
  Examples: improvement of building insulation, retrofitting of walls, buildings are oriented to receive more sunlight in winter, and indoor cooling through natural ventilation.
- Active Energy Systems: technologies that use mechanical components or renewable sources to generate, distribute, or manage energy within buildings or districts.
  Examples: heat is provided by heat pumps, electricity is generated by solar panels, and neighbourhoods are heated through shared systems such as district heating or the use of geothermal energy.

- Smart building technologies: Use of digital technologies to optimise energy consumption and improve indoor comfort. These systems build on automation, sensors, and smart controls to adapt the operation of buildings in real time.
  Examples: lighting and heating are automatically adjusted, energy use is monitored and managed through software, and presence sensors are installed to detect occupancy and regulate systems accordingly.
- Sustainable construction practices: Construction methods aimed at reducing environmental impact throughout the building process, while improving resource efficiency and general sustainability. It includes the range of materials, construction techniques, and technologies that minimise emissions and waste.
  Examples: recycled or low-impact materials are used, modular construction methods are applied, and cleaner, low-emission construction machinery is deployed.
- Sustainable urban design: planning and organisation of cities and neighbourhoods in ways that promote sustainability, well-being, and quality of life.
  Examples: urban areas are designed with housing and services in close proximity, streets are made walkable and accessible, space is used efficiently through compact development, and buildings are positioned to maximise natural sunlight and passive solar gains.

Table 2 below provides an overview of the number of items divided by subtopics.

Table 2. Built Environment sub-topics by number of items across Europe.

Built Environment	**Total: 145**
Passive energy efficiency	75
Active Energy Systems	40
Sustainable construction practices	12
Smart building technologies	9
Sustainable urban design	9

3.1.1. Built Environment Strategies by Country Group

Countries were grouped using policy proxies (not data in this study): presence and maturity of national renovation/renovation-planning instruments under the Energy Performance of Buildings Directory (EPBD) [35], stringency of national building-energy requirements (NZEB/zero-emission trajectory), the level of public investment in upgrades, and the condition of their residential building stock. For the purposes of country classification, renovation measures implemented before or during the 1990s often do not reach current EPBD-aligned performance levels; therefore, for comparability, they were excluded from the analysis as we focused on measures consistent with contemporary energy-performance trajectories. Table 3 provides a synthesis of the four different Built Environment policies identified.

Table 3. Built environment strategies by country group: classification based on renovation policies and building standards.

Group	**Description**	**Countries**
A. Deep renovation and high standards	Strong renovation policies, advanced energy codes (NZEB or better), and major investment in energy retrofitting and climate adaptation	Germany, Austria, the Netherlands, and Denmark

Table 3. *Cont.*

Group	Description	Countries
B. Progressive renovation with developing frameworks	National or local strategies are in place, but with limited coverage and funding	Spain, Italy, France, Portugal
C. Low renovation rate and inefficient building stock	Old buildings with little renovation, low thermal efficiency, and weak regulations	Poland, Romania, Bulgaria, Hungary
D. Focus on new buildings rather than renovation	High rate of new construction, fragmented regulations, and renovation progress across the existing stock	Ireland, Latvia, Lithuania, Croatia

3.1.2. Key Insights by Country Group

Data from the 102 analysed cities regarding the Built Environment topic are then aggregated with the country grouping defined in Table 3, with the aim of identifying patterns based on diverse regulatory environments. As shown in Figure 2, the analysis shows that most items focus on improving the building envelope to lower energy demand, especially through passive energy efficiency measures like insulation.

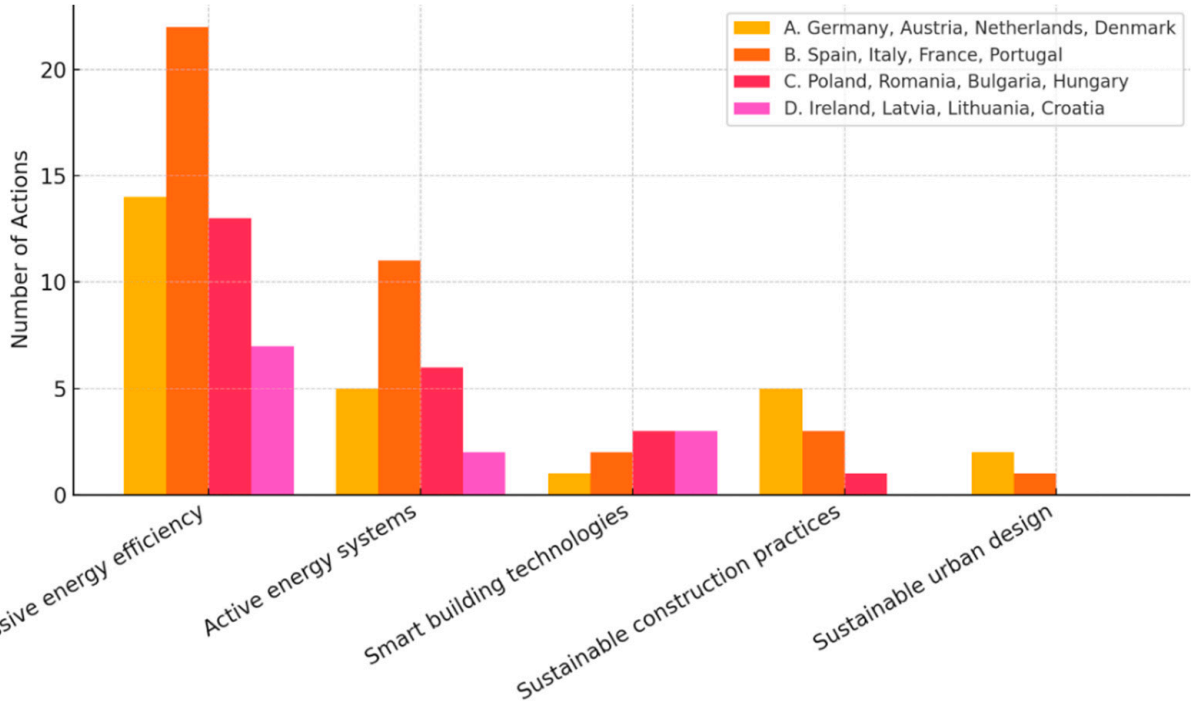

Figure 2. Distribution of items by Built Environment sub-topics across national strategy groups.

In Group A, several improvements have already been executed, and there are solid rules and public policies to keep advancing. These countries are starting to look at solutions that work not only for individual buildings but also at the scale of neighbourhoods and cities.

Group B follows a similar direction, although with fewer resources and less coverage. These countries are improving insulation and heating or cooling systems, but their support tools and funding are still under development.

In Groups C and D, patterns are consistent with documented renovation underperformance and persistent efficiency gaps in parts of Central and Eastern Europe (EU Building Stock Observatory); however, the extent to which this is driven by regulation vs. funding varies by country, as well as cities' specific priorities.

Across the four national strategy groups, there is a clear trend: the number and diversity of items decrease from Group A to Group D. While Group A combines passive solutions, system upgrades, and smart technologies in a balanced way, Groups C and D rely mainly on items that embody passive building interventions, rather than technological systems. This may reflect either a lack of strong regulations, funding, or focus on other priorities as well. Table 4 below synthesises the items divided by country group.

Table 4. Overview of Built Environment items by country group.

Group	Type of Buildings	Level of Insulation	Main Items	Additional Information
A	Modern and energy-efficient	High	Items go beyond insulation: focus on urban space, tools, and policies	Advanced strategies can be applied
B	Mixed: some efficient, some not	High	Similarly to Group A: urban retrofitting and planning tools	Tools and funding support are still being developed
C	Old and inefficient	Low	Focus mainly on improving insulation and the building envelope	Reducing energy demand is the main priority
D	Outdated	Very low	Mostly focused on building the envelope	Problems with building quality limit other items

3.2. Energy Systems

The Energy Systems [36] topic includes strategies and technologies that cities adopt to decarbonise energy supply, improve energy reliability, and promote the integration of renewables [37]. It addresses both the generation and distribution of energy, as well as digital and structural interventions.

This topic is organised into five sub-topics, which structure the classification and analysis of items:

- Renewable energy generation: integration of clean and decentralised energy sources as a substitute for fossil fuels.
  Examples: items typically involve the deployment of photovoltaic (PV) panels, solar thermal collectors, wind turbines, and biomass-based power systems.
- District Energy Systems: centralised systems for heating, cooling, or power supply that serve multiple buildings or entire neighbourhoods.
  Examples: district heating and cooling networks powered by waste heat, geothermal energy, or combined heat and power (CHP) units.
- Energy storage solutions: technologies that enable the storage and later use of energy to balance demand, enhance flexibility, and support renewable integration.
  Examples: battery storage systems, thermal energy storage, and vehicle-to-grid (V2G) schemes.
- Smart grids: digital systems that improve the performance and capacity of electricity grids.
  Examples: real-time monitoring of consumption, demand-response platforms, grid automation, and integration of distributed renewable sources.
- Energy efficiency programmes: transversal items targeting the reduction in energy demand and the optimisation of system efficiency, supported by digital technologies

that improve the performance and resilience of electricity networks.

Examples: retrofitting public infrastructure, incentivising efficient appliances, energy audits, and awareness campaigns.

In all the cities analysed, the predominance of renewable-generation action is consistent with EU national decarbonization trajectories and renewable energy targets [38]. In particular, the efforts focus on increasing the number of photovoltaic and geothermal systems, often linked to national clean energy targets. Cities that already have urban energy infrastructures are planning on extending or modernising these networks. Other sub-topics, such as storage and smart grids, remain less developed but are emerging as important complements to improve energy flexibility and control (Table 5).

Table 5. Energy systems sub-topics by number of items across Europe.

Energy Systems	**187**
Renewable energy generation	112
Energy efficiency programmes	40
District Energy Systems	19
Smart grids	12
Energy storage solutions	4

3.2.1. Energy Systems Strategies by Country Grouping

Countries were grouped into four clusters (Table 6) according to their national energy context, based on indicators such as the share of renewables, degree of electrification of heat, reliance on fossil fuels, presence of smart grid infrastructure, and system vulnerability.

Table 6. Energy Systems strategies by country group: classification based on national energy context.

Group	**Description**	**Countries**
A. Renewable and Electrification Leaders	Already relatively advanced in decarbonization and integration of renewables.	Sweden, Austria, Denmark, Finland
B. Moving Fast, but Still Gas-Heavy	Solar and wind are growing quickly, but gas is still a big part of the energy mix.	Spain, Italy, Portugal, Ireland
C. Still Mainly Fossil-Fuel Based	Rely mostly on coal and gas, with older, less efficient systems and more modest shifts towards clean energy.	Poland, Czechia, Hungary, Bulgaria, Romania
D. With limited interconnection energy capacity Systems	Their energy supply is more fragile, which might be due to isolation or being less well-connected to wider grids.	Cyprus, Malta, Latvia

3.2.2. Key Insights by Country Group

When national strategies for urban Energy Systems are analysed, the differences between European countries emerge clearly. These gaps are shaped by the history of the country, geography, how modern or outdated its energy infrastructure is, and how strong public policy support has been. Figure 3 shows the results of the analysis in this regard.

Group A (Sweden, Austria, Denmark, and Finland) is already in a strong position, with modern and well-performing Energy Systems. Out of 32 items, almost half (44%) focus on renewable energy, and around a third (34%) are about improving energy efficiency. They also include digital tools, but there are fewer items on smart grids (6%) and district heating

(6%), which might be aligned with those action areas being already fairly developed. For example, Denmark and Sweden are frequently cited as leaders in district-heating governance and decarbonization policy frameworks.

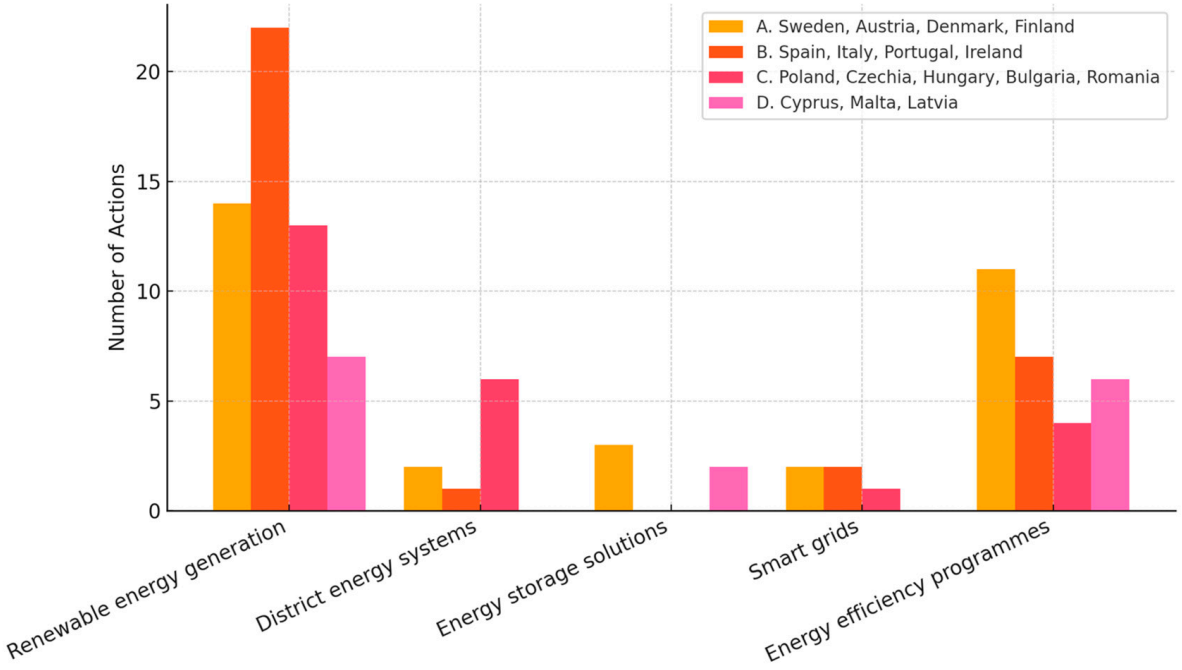

Figure 3. Distribution of items by Energy Systems sub-topics across national strategy groups.

Group B (Spain, Italy, Portugal and Ireland) is making big efforts in solar power, with 22 out of 32 items (69%) focused on renewables, but gas remains an important balancing fuel in several nations even when renewables expand rapidly. Only a small number of items go into smart grids (6%) or efficiency improvements (22%).

Group C (Poland, Czechia, Hungary, Bulgaria and Romania) still uses old heating systems, mostly running on coal and gas. Out of their 24 items, a quarter (25%) are aimed at improving these systems, and just over half (54%) are related to renewable energy. But very few items involve smart grids (4%) or energy storage (0%), and only 17% deal with efficiency. Many of these countries rely on gas, which makes fast changes harder.

Finally, Group D (Cyprus, Malta and Latvia) is composed of small or isolated countries with potentially weaker Energy Systems. Cities in these countries are trying to become more self-sufficient, focusing 47% of their 15 items on renewables and 40% on energy efficiency. Only 13% of items deal with storage, which might be due to infrastructure being more limited and/or harder to upgrade.

In summary, most urban energy strategies across the European analysed cities converge around three core objectives: increasing the share of renewable energy sources, reducing dependence on fossil fuels, and enhancing overall system efficiency. However, their implementation pathways vary significantly depending on geographical context, Energy System configuration, and energy infrastructure readiness. This difference is disclosed in Table 7.

Table 7. Overview of Energy Systems items by country group.

Group	Type of Energy System	System Maturity	Main Items	Additional Information
A	Modern, electrified with RES and DH	High	Focus on optimisation; efficiency, renewables	Advanced DH (4th/5th gen); digitalisation already in place

Table 7. *Cont.*

Group	Type of Energy System	System Maturity	Main Items	Additional Information
B	Solar-based, gas-dependent heating	Medium	Expand RES, improve efficiency, and early smart tech	High solar use; storage and DH are largely missing
C	Fossil-based DH with outdated infrastructure	Low	DH upgrades, introduce RES and basic efficiency	High reliance on coal/gas; slow and costly transition
D	Isolated grids, basic RES and efficiency	Very Low	Strengthen local RES and demand-side items	No DH or smart grids; limited grid capacity and scalability

3.3. Mobility and Transport

The Mobility and Transport [39] topic encompasses strategies and technologies that cities adopt to decarbonise urban transport [40], improve accessibility, and reduce reliance on private fossil-fuelled vehicles. This topic is organised into the following sub-topics:

- Public transportation enhancement: measures to improve the quality, scope and viability of public transport networks [41] in order to provide viable alternatives to the private car.
  Examples: expansion of bus and metro lines, fleet electrification and real-time information systems.
- Active mobility promotion: items that make it easier and safer for people to walk, cycle, or use other non-motorised ways of getting around. The idea is to support a healthier, greener daily life in the city.
  Examples: pedestrian zones, segregated bike lanes, cycling infrastructure and pedestrian-friendly urban design.
- Electric vehicle infrastructure: building the charging network and putting rules in place so more people and services can switch to electric cars and vans, cutting fossil-fuel use.
  Examples: public charging stations, EV parking incentives, integration with renewable energy sources, support for private and fleet electrification.
- Mobility-as-a-Service (MaaS): digital tools that pull different transport options into one simple system, so people can plan and pay for trips more easily and combine modes smoothly.
  Examples: multimodal travel apps, integrated digital ticketing, subscription-based mobility packages, and real-time data sharing.

In all the cities analysed, mobility [42] items primarily focus on accelerating the transition towards electric transport infrastructure, as disclosed in Table 8. However, a significant share of strategies also targets active travel modes (cycling and walking), which play a critical role in structural decarbonisation and public space redesign. Even though most items focus on electric vehicle infrastructure, active mobility and better public transport are still key for building a low-carbon transport system in the long run. MaaS items are less common for now, but they show that cities are starting to pay more attention to digital tools that help people mix different transport modes more easily.

Table 8. Mobility and Transport sub-topics by number of items across Europe.

Mobility and Transport	**Total: 220**
Electric vehicle infrastructure	96
Active mobility promotion	58

Table 8. *Cont.*

Mobility and Transport	**Total: 220**
Public transportation enhancement	43
Mobility-as-a-Service (MaaS)	23

3.3.1. Mobility and Transport Strategies by Country Group

The diversity of national urban mobility systems across Europe has been reflected through the establishment of a four-group classification, disclosed in Table 9. This classification includes levels of urban density, degrees of car dependency, the maturity of public transport systems, infrastructure quality, and the extent of digitalisation in mobility management. This makes it easier to compare countries and read their mobility strategies in context.

Table 9. Mobility and Transport strategies by country group: classification based on indicators such as urban density, car dependency, public transport maturity, infrastructure quality, and digitalisation level.

Group	Description	Countries
A. Multimodal and Electrified Urban Systems	Efficient public transport, strong cycling and walking culture	Netherlands, Denmark, Austria, Germany
B. Large Cities with Congestion and Active Transition	High car use but significant progress underway	France, Italy, Spain, Greece
C. Low-Quality Networks and Polluting Fleets	Underdeveloped public transport, high fossil fuel reliance	Poland, Bulgaria, Romania, Croatia
D. Small or Dispersed Urban Systems	Low-density cities with limited mobility options	Malta, Cyprus, Estonia, Slovakia

3.3.2. Key Insights by Country Group

Analysis of national mobility strategies across Europe, synthesised visually in Figure 4, indicates differences in trajectories in the transition towards sustainable transport systems. These trends are closely related not only to the maturity of infrastructure and urban form, but also to territorial scale, the historical role of the car sector in national economies, and the level of car dependency embedded in everyday life.

Group A (Netherlands, Denmark, Austria, and Germany) includes countries with multimodal urban systems and a policy framework that focuses on sustainable transport. With 30 items recorded, this group combines investment in electric vehicle (EV) infrastructure (43%) with strong support for active mobility (27%) and public transport (20%). This reflects a well-established model in which cycling and public transport are not only viable from an infrastructure point of view but are also socially integrated. The relatively moderate share of MaaS initiatives (10%) aligns with their early adoption of integrated mobility systems and advanced digital governance.

Group B (France, Italy, Spain, and Greece) includes countries with large metropolitan areas that grew fast in the mid-20th-century urbanisation processes. In these contexts, the car industry has been economically important and culturally strong, which helped shape cities around private cars. Among the 57 items analysed, EV infrastructure items are consistent with regulatory pressure from EU transport decarbonization and air quality

compliance frameworks. Still, the share going to active travel (23%) and public transport (16%) suggests that priorities are starting to change. MaaS (12%) is increasing in popularity, particularly in urban centres, where the integration of digital services is more feasible. However, the deep dependence on cars in peripheral areas continues to challenge efforts to achieve modal shift.

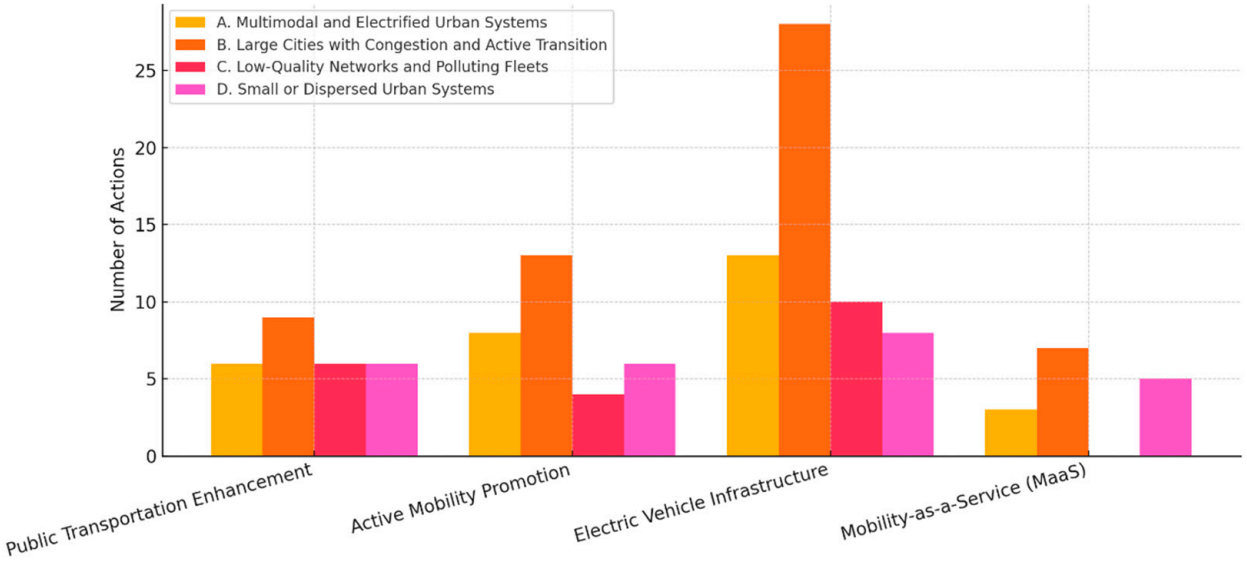

Figure 4. Distribution of items across Mobility and Transport sub-topics by the national strategy group.

Group C (Poland, Bulgaria, Romania, and Croatia) reflects industrial legacies strongly tied to fossil-fuel-based mobility and historically limited public investment in transport networks. With 20 items identified, 50% focus on EV infrastructure, enabled in several cases by the EU/European Investment Bank-backed financing instruments. The predominance of private car use, often out of necessity rather than choice, highlights structural barriers that hinder the adoption of integrated and low-carbon mobility systems.

Group D (Malta, Cyprus, Estonia, and Slovakia) includes countries with small or low-density urban systems, where traditional mass transit models are often difficult to implement efficiently. Of the 25 items registered, EV infrastructure accounts for 32%, complemented by context-adapted investments in public transport (24%) and active mobility (24%). Remarkably, MaaS represents 20% of items appearing more frequently in group D, potentially reflecting the role of pilots on digital mobility services in small markets. In these cases, digital tools have been used to compensate for scale limitations, enabling flexible, on-demand mobility services in both urban and semi-rural settings.

Overall, the distribution of items reflects the influence of national mobility cultures, spatial structure, and economic dependence on the car industry in sharing transport strategies. While electrification leads in all groups, whether complemented by active mobility, investment in public transport, or digital coordination. Recognising these territorial contexts is essential to designing effective mobility transitions across Europe. Table 10 synthesises the strategies of the four country groups.

Table 10. Overview of Mobility and Transport items by country group.

Group	Urban Mobility Profile	Transition Stage	Main Items (by %)	Additional Information
A	Dense, multimodal cities with mature infrastructure	Advanced	EV Infrastructure (43%), Active Mobility (27%), Public Transport (20%), MaaS (10%)	Integrated systems supported by infrastructure, policy, and social habits; strong modal balance

Table 10. *Cont.*

Group	Urban Mobility Profile	Transition Stage	Main Items (by %)	Additional Information
B	Large cities with high car use and active planning	Moderate	EV Infrastructure (49%), Active Mobility (23%), Public Transport (16%), MaaS (12%)	Strong dependence on private cars persists; transitions supported by SUMPs and urban policy reforms
C	Underserved networks with fossil-fuel reliance	Early	EV Infrastructure (50%), Public Transport (30%), Active Mobility (20%), MaaS (0%)	Limited investment capacity; reliance on EU funds; car dependency remains structurally embedded
D	Low-density or dispersed systems with limited options	Contextual	EV Infrastructure (32%), Public Transport (24%), Active Mobility (24%), MaaS (20%)	Micro-mobility and digital tools compensate for scale limitations; flexible models are gaining relevance

3.4. Waste and Circular Economy

The Waste and Circular Economy topic included strategies and systems that cities implement to reduce waste generation, improve resource efficiency, and recover energy or resources from what is disposed of. The goal is to treat waste as a resource, not a problem. Four sub-topics enable the classification and analysis of circularity items across cities:

- Waste reduction initiatives [43]: the goal is to use and consume less and choose smarter ways to consume. This means trying not to create waste.
  Examples: banning single-use plastics, implementing policies to reduce food waste, running zero-waste city plans, or increasing awareness about waste in schools.
- Recycling and composting: refers to systems that help process materials like plastics and organic waste, among others, so they can be reused.
  Examples: community composting units, and incentives for households or shops to sort waste properly.
- Product lifecycle management: Optimising the product lifecycle, from the moment it is designed to how it can be reused, repaired, or recycled at the end. It supports ideas like eco-design, shared use of products, repair centres, and take-back schemes for electronics and textiles.
- Resource recovery facilities: Resource recovery facilities are infrastructures that recover useful materials or energy from waste. These facilities help reduce the need to extract new raw materials.
  Examples: waste-to-energy plants or biogas systems using (food) waste.

Most items in this topic focus on recycling and composting. These are the most common methods that cities use to manage waste, especially when solid waste is still sent to landfills. Some cities are also adopting items to capture gas from landfills and use it to produce energy for local needs. Other options, such as designing products that are easier to reuse or recycle, or recovering useful materials and energy from waste, are not very common yet.

However, some countries are beginning to explore these ideas. In total, 88 items were examined (Table 11), and 59 of them were related to recycling and composting, indicating these are the most frequent topics taken by cities.

Table 11. Waste and Circular Economy sub-topics by number of items across Europe.

Waste and Circular Economy	**Total: 88**
Recycling and composting	59
Product lifecycle management	13
Waste reduction initiatives	9
Resource recovery facilities	7

3.4.1. Waste and Circular Economy Strategies by Country Group

European countries are classified into four topics [44] according to the strength of their recycling systems, their progress in applying circular economy principles, and the quality of their infrastructure and public policies (Table 12). These topics range from countries with advanced national strategies to those where circular practices are still at a local and experimental stage.

Table 12. Country group classification for Waste and Circular Economy strategies based on recycling performance, circularity progress, and policy-Infrastructure Maturity.

Group	Description	Countries
A. Advanced Circular Economy	High recycling rates, mature business strategies, and well-developed infrastructure	Austria, Belgium, Germany, Netherlands
B. Active Transition with City Strategies	Local improvements supported by city-led items, emerging national policies	Spain, France, Italy, Portugal
C. Low Recovery and Landfill Dependency	Outdated systems, weak infrastructure, and strong reliance on landfilling	Romania, Bulgaria, Croatia, Hungary
D. Local Innovation and Pilot Projects	Small-scale/Small-country circular initiatives, often led by communities or municipalities, are strong initiatives	Slovenia, Estonia, Lithuania

3.4.2. Key Insights by Country Group

The analysis of Waste and Circular Economy items across Europe shows significant variation in strategy and system maturity, as disclosed in Figure 5 below.

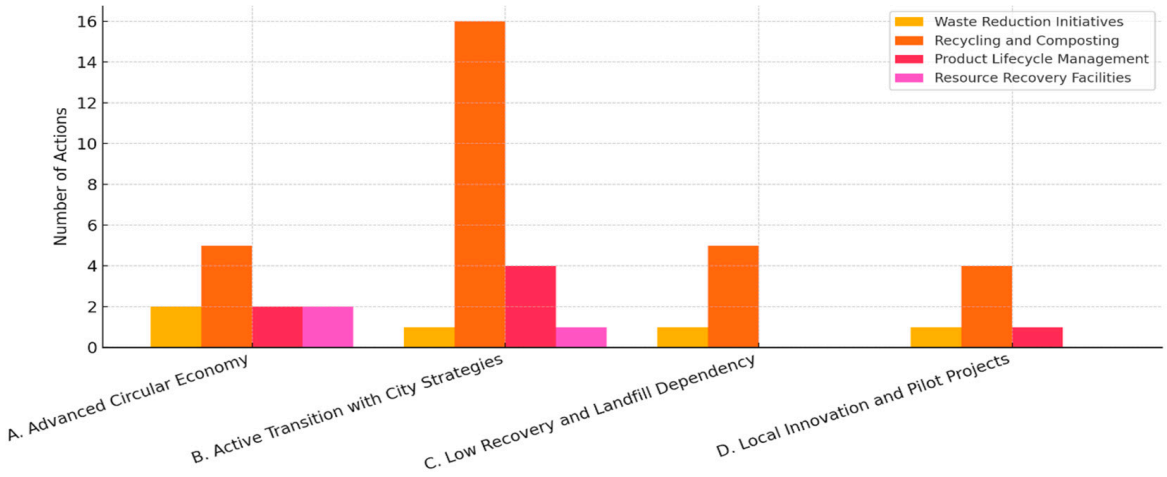

Figure 5. Distribution of items across Waste and Circular Economy sub-topics by national strategy group.

Group A (Austria, Belgium, Germany, Netherlands) includes countries with strong national frameworks, advanced infrastructure, and circular economy strategies. Almost half of their items (45%) focus on recycling and composting, but they also focus on waste prevention (18%), lifecycle thinking (18%), and resource recovery (18%).

Group B (Spain, France, Italy, Portugal) shows dynamic local leadership through city-led initiatives, despite gaps in national coherence. The majority of items (73%) focus on recycling and composting. This group reflects a transitional stage, where municipal ambition outpaces national alignment and investment.

Group C (Romania, Bulgaria, Croatia, Hungary) struggles with weak infrastructure and high landfill dependency. Most items (83%) are basic recycling efforts, and there are no examples of lifecycle or recovery strategies. These limitations stem from outdated systems, low public awareness, and insufficient incentives.

Group D (Slovenia, Estonia, Lithuania) demonstrates innovation at the local level through community-driven pilots like composting, repair cafés, or food-sharing. While small in scale, these efforts are relatively balanced, with items in recycling (67%), reuse (17%), and prevention (17%).

In summary, as shown in Table 13, while recycling is the entry point for most countries, only Groups A and D show efforts beyond basic waste management, either through integrated national systems or grassroots experimentation.

Table 13. Overview of Circular Economy items by country group.

Group	Circular Economy Profile	Implementation Stage	Main Items (by %)	Additional Information
A	National strategies with integrated systems	Advanced	Recycling (45%), Lifecycle (18%), Recovery (18%), Prevention (18%)	Strong performance across all areas; now exploring full-cycle circularity
B	Local innovation with partial national support	Moderate	Recycling (73%), Lifecycle (18%), Prevention (5%), Recovery (5%)	City-led efforts dominate; national frameworks are still underdeveloped
C	Basic systems with landfill dependency	Emerging	Recycling (83%), Prevention (17%), Lifecycle (0%), Recovery (0%)	Compliance-driven recycling; lacking investment and local ownership
D	Community-led pilots and experimentation	Contextual	Recycling (67%), Lifecycle (17%), Prevention (17%), Recovery (0%)	Creative local models; scaling and institutionalisation needed

3.5. Industry

The Industry topic (IPPU) focuses on making industrial activities cleaner and more efficient. It includes items to cut emissions, save energy, reduce waste, and improve how materials and products move through supply chains. The goal is to support a low-carbon, smart, and responsible industry in cities.

Four key sub-topics structure the classification and analysis of items about decarbonising and transforming industrial sectors:

- Industrial decarbonization: strategies and technologies that reduce or eliminate greenhouse gas emissions from industrial processes and energy use.
  Examples: using green hydrogen instead of fossil fuels, capturing and storing CO_2, using electricity instead of burning fuels for heat, making industrial processes more efficient [45], and choosing materials that cause less pollution.
- Circular economy practices in industries: approaches that improve resource efficiency, reduce waste, and promote the reuse of materials by closing production cycles.
  Examples: recycling and material recovery, industrial symbiosis, eco-design and product-as-a-service models.
- Energy management systems: digital tools that help industries track their energy use, understand where it goes, and reduce it.
  Examples: ISO 50001-based systems, real-time energy dashboards and energy audits.
- Sustainable supply chains: items that reduce emissions and resource use, and ensure equitable working conditions, from providers to customers.

Examples: buying from certified green suppliers, tracking CO_2 emissions, choosing recycled materials, and using local delivery options.

As disclosed in Table 14, half of the items focus on industrial decarbonisation, demonstrating a strong interest in reducing energy use and dependence on fossil fuels [46]. Energy management systems are also extensively used, while the circular economy and sustainable supply capacities remain poorly developed [47].

Table 14. Industry sub-topics by number of items across Europe.

Industry	**Total: 26**
Industrial decarbonization	13
Energy management systems	10
Circular economy practices in industries	2
Sustainable supply chains	1

3.5.1. Industry Strategies by Country Group

In order to ensure better alignment between the items proposed in CCCs and national industrial contexts, a four-group classification of countries (Table 15) is derived based on key structural characteristics, including the nature of the industrial base, levels of technological innovation, decarbonisation efforts, and energy intensity within production systems.

Table 15. Industrial strategies by country group: classification based on national energy context.

Group	**Description**	**Countries**
A. Low-Carbon, High-Innovation Industry	Countries characterised by clean, technologically advanced industrial sectors supported by green technologies and circular economy models, such as industrial symbiosis.	Sweden, Austria, Finland, Germany
B. Industrial Transition	Economies with energy-intensive sectors are currently undergoing transformation and adopting decarbonisation measures.	Italy, Spain, France, Czechia
C. Fossil-Dependent Traditional Industry	Countries with legacy industrial systems are marked by high emissions, low efficiency, and continued dependence on fossil fuels.	Poland, Romania, Hungary, Bulgaria
D. Service-Oriented Economies	Limited industrial activity and a predominance of service-based economic structures, often with a lower industrial carbon footprint.	Ireland, Cyprus, Malta, Slovenia

3.5.2. Key Insights by Country Group

The analysis reveals different levels of industrial transformation in Europe and the urgency to align with EU Green Deal targets, as disclosed in Figure 6.

Group A (Sweden, Austria, Finland, and Germany) represents highly technologically advanced economies, with industrial sectors already embedded in low-carbon innovation frameworks. Municipalities in these countries do not report dedicated items on circular economy models or sustainable supply chain management in their CCC, possibly due to their early focus on emissions reduction at the production level.

In contrast, Group B (Italy, Spain, France, and Czechia) municipalities in these countries have a long industrial history, and are trying to modernise and change their production. Of the eight items registered, nearly two-thirds relate to decarbonisation, supported by emerging efforts in circularity and energy optimisation. Figures reflect a transitional phase: although there is commitment, implementation is uneven and often determined by national policy signals and sectoral readiness.

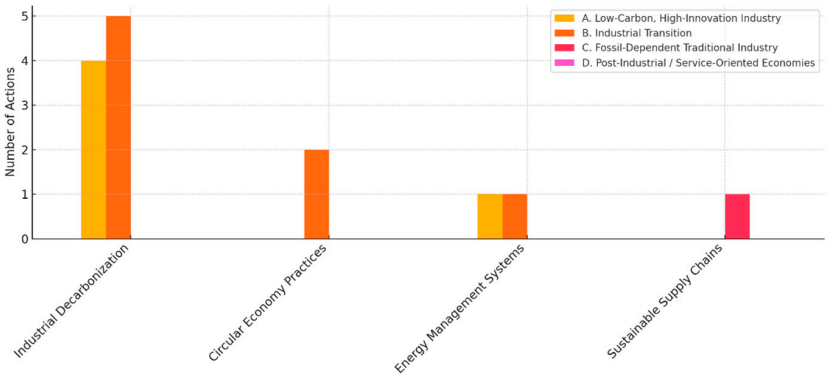

Figure 6. Distribution of items across Industry sub-topics by national strategy group.

Group C (Poland, Romania, Hungary, and Bulgaria), the absence of reported industrial items in CCCs may be consistent with structural constraints and the policy/finance challenge of decarbonising industrial systems. Only one action has been reported, focused on supply chain sustainability, and none on decarbonisation, circular practices, or energy management. This seems to indicate that Mission Cities in these countries have not focused on those aspects.

Lastly, Group D (Ireland, Cyprus, Malta, and Slovenia) represents post-industrial or service-based economies, where the industrial sector is either small or marginal. No actions were reported, which aligns with the lower relevance of the industry in their economic structures. However, this does not exclude the potential role of green innovation in light manufacturing or digital services, especially in the context of cross-sectoral climate adaptation.

Table 16 below synthesises the differentiation of items in this topic, divided by country group.

Table 16. Overview of industry items by country group.

Group	Industrial Profile	Transition Stage	Main Items	Additional Information
A	Advanced, low-carbon industry with strong R&D	High	Decarbonisation (80%), Energy Mgmt. (20%)	Prioritisation of tech-led decarbonisation; circularity yet to emerge as a priority
B	Traditional industry under transformation	Moderate	Decarbonisation (63%), Circularity (25%), Energy Mgmt. (13%)	Gradual shift; driven by regulation, innovation capacity is still uneven
C	Fossil-intensive legacy industry	Early	Supply Chains (100%)	Industrial inertia; innovation hindered by structural and economic limitations
D	Service-based or post-industrial economies	Not applicable	No reported actions	Low industrial weight; potential exists in green digital/tech sectors

3.6. Green Infrastructure and Nature-Based Solutions

The sub-topics of Green Infrastructure and Nature-Based Solutions (NBS) [48] include urban planning strategies and ecological interventions that cities adopt to increase climate resilience, improve environmental quality, and support biodiversity [49]. This topic is structured in sub-topics following the classification of urban ecosystem services, which enables Green Infrastructure and nature-based measures to be organised in a coherent way [50]:

- Urban green spaces: interventions that improve or maintain natural areas within cities to promote environmental quality and human well-being.
  Examples: public parks, green roofs, tree-lined streets, and community gardens,

- Blue infrastructure: water interventions that integrate natural water flows into urban development, while managing flood risk and improving ecosystem services.
  Examples: urban wetlands, rainwater harvesting, permeable pavements, restored waterways, and bioswales.
- Biodiversity enhancement [51]: initiatives designed to protect, restore, or increase biodiversity in urban areas, and ecological planning that helps create and protect habitats.
  Examples: native species planting, creation of green corridors, bird and insect habitats, and reduction in light and noise pollution.
- Adaptation and climate resilience projects: initiatives designed to strengthen the capacity of cities to adapt to and recover from climate-related stresses and shocks.
  Examples: heatwave mitigation through green shading, flood control infrastructure, drought-tolerant landscaping, and city-wide resilience strategies.

A significant number of items related to Green Infrastructure and Nature-Based Solutions involve the creation of areas dedicated to organic agriculture and the increased allocation of urban land for farming activities. Other interventions focus on the wider implementation of green roofs across urban areas, with the objective of reducing energy consumption and strengthening passive design strategies in residential buildings. Additional measures are designed to improve the role of green zones as carbon sinks [52] and to mitigate the urban heat island effect by increasing the presence of shaded areas throughout the city. Adaptation measures are beyond the scope of the CCCs; however, they are included when they are aligned with Mitigation-related items.

The classification of these items is presented in Table 17, indicating the specific type of intervention addressed in each topic.

Table 17. Green Infrastructure and NBS sub-topics by number of items across Europe.

Green Infrastructure and Nature-Based Solutions	**Total: 91**
Urban green spaces	43
Climate resilience projects	32
Blue infrastructure	8
Biodiversity enhancement	8

3.6.1. Green Infrastructure and Nature-Based Solutions Strategies by Country Group

To understand how NBS are planned in cities across Europe, countries were grouped into four types based on how they plan and organise their green and blue spaces (Table 18). The focus is on how these natural elements are included in city design, and how they connect with nearby streets, buildings, parks, and open spaces. It also considers whether cities have clear policies and strategies in place to support this. Specific attention was paid to urban ecosystems such as gardens and parks, because of their specific need to be well connected for their endurance, not only to each other, but also to the public spaces and green areas surrounding the city.

Table 18. Green Infrastructure and Nature-Based Solutions strategies by country group: classification based on structural, strategic, and spatial planning aspects.

Group	**Description**	**Countries**
A. Structured Green Cities	Green urban planning, NBS strategies, ecological corridors	Netherlands, Germany, Austria, Sweden

Table 18. *Cont.*

Group	Description	Countries
B. High Potential, variable Implementation	Green space deficits, but emerging local initiatives	Spain, Italy, Portugal, Greece
C. Low Integration of NBS in Urban Planning	Green areas are treated as isolated or decorative elements	Bulgaria, Slovakia, Romania, Poland
D. Ecosystem-Based National Approach	Territorial-rural integration of green solutions	Finland, Estonia, and Slovenia

3.6.2. Key Insights by Country Group

The implementation of Green Infrastructure and Nature-Based Solutions (NBS) across Europe is shaped by complex interplays of national planning traditions, institutional frameworks, and environmental priorities, which reveal strong contrasts in approaches to planning, systemic coherence, and the degree of ecological integration. Figure 7 shows the distribution of items in this topic.

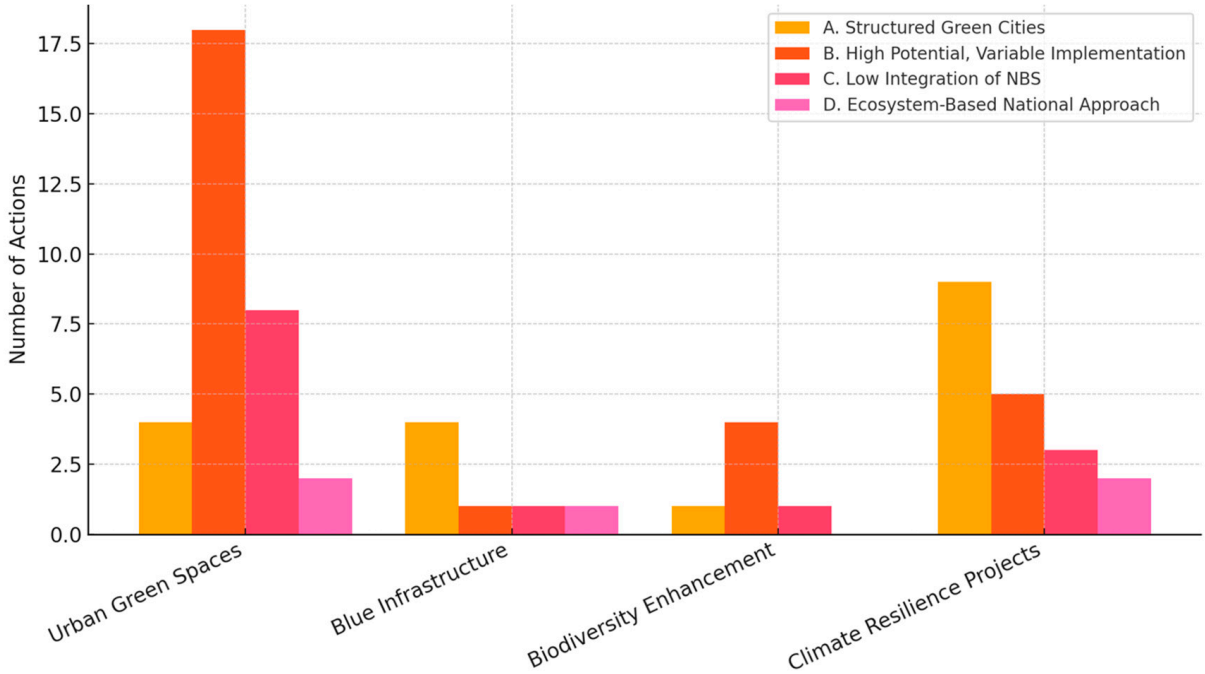

Figure 7. Distribution of topic items across Green Infrastructure and Nature-Based Solutions (NBS) sub-topics by national strategy.

Group A countries (Netherlands, Germany, Austria, and Sweden) show a systemic approach, with half of their identified items focused on climate resilience and additional efforts evenly distributed between urban green spaces and blue infrastructure (22% each), while biodiversity items are still quite few (6%) and usually come as part of bigger, wider strategies rather than standing on their own.

In contrast, Group B (Spain, Italy, Portugal, and Greece) exhibits high potential but yet fragmented implementation: 64% of municipalities' items target green urban areas, mostly parks and tree planting, while only 18% address climate resilience, 14% biodiversity, and a 4% involve blue infrastructure, reflecting weak integration in CCCs of water-sensitive planning and a dependence on local leadership.

A more limited application is observed in Group C (Bulgaria, Slovakia, Romania, and Poland), where 62% of items are green interventions, while measures for biodiversity and

blue infrastructure reach only 8% each. Climate resilience items account for 23%, though often in reactive rather than strategic terms.

Group D (Finland, Estonia, and Slovenia) follows a more "ecosystem-based" territorial approach. The few urban items planned are equally shared across the sub-topics of green spaces, climate resilience and blue infrastructure. This seems to suggest a planning model where urban and rural nature are seen as part of the same system, and where many decisions come from national or regional policies rather than from individual cities.

Table 19 below provides a synthesis of Nature-Based Solutions (NBS) items across country groups.

Table 19. Overview of Green Infrastructure and Nature-Based Solutions (NBS) items by country group.

Group	Type of NBS Integration	System Maturity	Main Items	Additional Information
A	Structurally integrated green–blue networks	High	Climate resilience (50%), green and blue infrastructure	Strong ecological corridors; multifunctional and connected urban ecosystems
B	Patchy green interventions with local leadership	Medium	Green spaces (64%), low blue infrastructure	High potential but low coherence; implementation depends on city initiatives
C	Isolated and decorative green elements	Low	Green spots (62%), minimal biodiversity and blue	NBS not linked to planning; weak strategic and ecological integration
D	Ecosystem-based, territorial planning	Moderate	Balanced items across sub-topics	Few urban items, but embedded in national/regional ecological strategies

3.7. Levers of Change Transversal to the Solution Themes

CCCs include specific forms dedicated to social innovation, stakeholders' involvement and financing mechanisms (investment plans), these aspects are not the focus of this analysis; the topic of "levers of change transversal to the solution themes" here analysed is based on the items planned by cities in relation to technological and infrastructural solutions and not in terms of transversal levers of change. The analysis, synthesised in Table 20, reveals a clear prioritisation of Climate policy development, representing 61 of 87 identified items. This finding seems to indicate a high focus on strategic planning for emissions reduction.

Table 20. Levers of change sub-topics related to technological and infrastructural items.

Levers of Change	Total: 87
Climate policy development	61
Stakeholder engagement	9
Capacity building	9
Monitoring and evaluation	8

Stakeholder engagement and Capacity building (9 items each) indicate growing attention to inclusive processes and the reinforcement of municipal capabilities related to technical and infrastructural solutions. Monitoring and evaluation, with only 8 items, remains the least prioritised component.

3.7.1. Levers of Change Strategies by Country Group

Differences in institutional maturity, decentralisation, and policy coherence have been reflected by grouping countries into four groups (Table 21) based on the structure of their multilevel governance frameworks and the degree of national-local alignment.

Table 21. Levers of change governance and policy strategies by country group: classification based on institutional maturity, decentralisation, and policy coherence framework.

Group	Description	Countries
A. Robust and Mature Multilevel Governance	Strong local autonomy and aligned national frameworks	Germany, Sweden, the Netherlands, and Austria
B. Strong Local Leadership with Uneven Support	Ambitious local policies in fragmented governance contexts	Spain, Italy, France, Portugal
C. Centralised Governance with Weak Local-national alignment	Low local capacity or limited multilevel governance alignment	Bulgaria, Romania, Slovakia, Latvia
D. Innovative Local Governments in Small-Scale Contexts	Promising local initiatives in smaller urban systems	Slovenia, Estonia, Ireland

3.7.2. Key Insights by Country Group

The analysis of climate governance across European cities indicates contrasts in institutional capacity, decentralisation models, and the coherence of national-local frameworks. As shown in Figure 8, while the development of local climate policies dominates across all groups, critical gaps remain in implementation, capacity, and accountability structures.

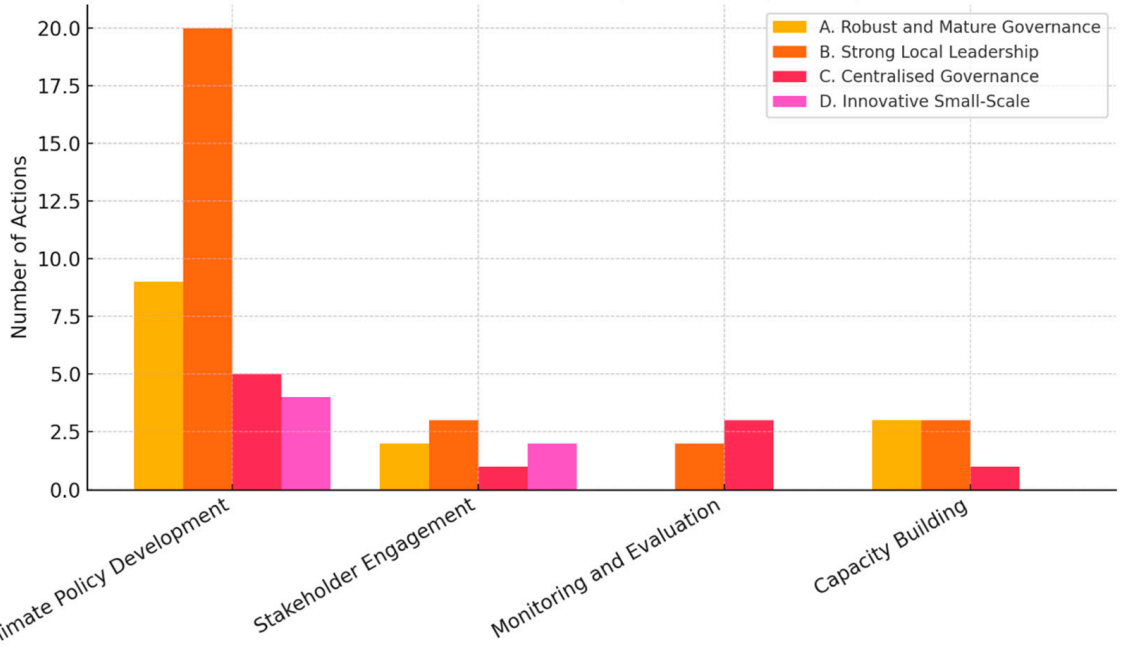

Figure 8. Distribution of items across the levers of change sub-topics by the national strategy group.

Group A (Germany, Sweden, the Netherlands, and Austria) includes municipalities of countries where national and local governments work well together and have long

experience managing climate policies. Most of their work in this topic (64%) focuses on planning strategies, and some efforts (21%) help local governments do their job better.

Group B (Spain, Italy, France, Portugal) includes countries where cities are very active in fighting climate change, but support from national governments is not always consistent. Most of their efforts (71%) are found in writing plans and setting goals.

Group C (Bulgaria, Romania, Slovakia, Latvia) includes countries where decisions are mostly made at the national level. Half of the items focus on writing climate policies, and almost a third (30%) are about reporting.

Group D (Slovenia, Estonia, Ireland) includes smaller countries or those with more flexible ways of working, where cities test innovative ways for involving stakeholders. Two-thirds of their work is about setting policies, and one-third is about including local actors.

Table 22 provides a synthesis of results by country group.

Table 22. Overview of levers of change by country group.

Group	Governance Profile	Institutional Stage	Main Items (by %)	Additional Information
A	Mature multilevel systems with strong coordination	Advanced	Climate Policy (64%), Capacity Building (21%), Stakeholder (14%), Monitoring (0%)	Strong alignment across levels of government; performance evaluation mechanisms are underdeveloped
B	Local leadership in fragmented national contexts	Moderate	Climate Policy (71%), Stakeholder (11%), Capacity Building (11%), Monitoring (7%)	Dynamic municipal action: gaps in institutional consolidation and feedback mechanisms
C	Centralised frameworks with limited local autonomy	Emerging	Climate Policy (50%), Monitoring (30%), Stakeholder (10%), Capacity Building (10%)	(EU) Compliance drives monitoring; local ownership and engagement remain weak
D	Small-scale innovation in decentralised settings	Contextual	Climate Policy (67%), Stakeholder (33%), Capacity Building (0%), Monitoring (0%)	Promising participatory practices; limited capacity and systems for scaling and institutionalisation

4. Discussion

The analysis of typologies of actions planned by 102 European ambitious Mission cities to reach climate neutrality by 2030 offers a valuable opportunity to reflect on the practical and policy implications of urban climate governance in the EU. The results are aligned with the sustainability science literature by showing that mobility, Energy Systems, and Built Environment remain the dominant areas of the intervention in the climate planning of selected European cities [53]. The country-level analysis presented in this paper reveals structural patterns that go beyond simple sectoral prioritisation.

The uneven distribution of typologies of actions across European regions' goals can be connected to climatic zones as well as persistent differences in national governance approaches, regulatory framework and infrastructural governance [54]. Southern European emphasis on mobility and renewable energy deployment seem to reflects both climate advantages (solar irradiance) and cultural specificities (i.e., automobile-dependence); Central and Eastern European focus on building retrofits and district heating can be correlated with both ageing stock and inherited heat infrastructure; Northern and Western European integration of smart technologies and governance innovation reflects prior investment in advanced systems and civic participation traditions. The article thus corroborates the need

to contextualise climate planning for identifying differentiated governance frameworks that leverage regional strengths while addressing their structural constraints.

The recurrent association of the same countries across the Built Environment, Energy Systems, Mobility and Transport, and Waste and Circular Economy sub-topics also corroborates the assumption that climate transition planning is strongly shaped by long-standing historical trajectories, climatic conditions, and institutional traditions. These results support the argument in the literature that social and institutional dimensions of local governance are central to understanding the direction of climate transitions in the EU [55] while also reflecting the EU policy environment in which CCCs operate as a governance and implementation tool to operationalise the European Green Deal and the Cities Mission [4–6,27].

Overall, the study indicates that while European cities share common priorities, their implementation trajectories diverge significantly; this can be due to multiple factors, including national governance structures, infrastructural conditions, and socio-cultural factors. Recognising these differences is crucial for developing more effective, context-sensitive climate governance frameworks capable of supporting a just and coherent transition across the EU. The distribution of typology of actions within sub-sectors differ markedly across country groups, suggesting that the form and maturity of "climate neutrality planning" is not uniform but depends on context; this is consistent with place-based arguments that effective climate action requires contextual differentiation in governance capacity, socio-technical systems, and policy baselines [14–17]. Several topics display a pattern of incremental rather than fully systemic transition portfolios—echoing scholarship warning that cities often prioritise politically feasible items rather than the most effective or transformative measures [15,19].

5. Conclusions

This study aimed to identify the priorities in urban mitigation planning across European Mission Cities and to examine how these priorities vary across regional and national contexts. To address these objectives, 844 action items from 102 CCCs, belonging to 7 topics and 30 sub-topics, were systematically coded and classified. The analysis shows that CCC portfolios concentrate most strongly on Mobility and Transport (220 items; 26.1%), Energy Systems (187 items; 22.2%), and the Built Environment (145 items; 17.2%), followed by Green Infrastructure and Nature-Based Solutions (NBS) (91 items; 10.8%), Waste and Circular Economy (88 items; 10.4%), and Levers of Change related to technological/infrastructural topic items (87 items; 10.3%). Industry is comparatively marginal in the CCC portfolios (26 items; 3.1%). By examining sectoral and geographic variation in approaches of EU cities to climate planning, this study aims to clarify what priorities dominate cities' agendas and to assess both the potential and shortcomings for addressing climate challenges.

5.1. Pragmatic Implications

From a practical perspective, the analysis informs municipalities and institutions worldwide on the ongoing trends in European urban decarbonization with regional analysis [54]. It provides data-driven insights to cities' transition teams, urban planners and municipalities' consultants on the most diffused climate planning priorities undertaken by the most climate-ambitious European cities. The results inform practitioners that across Europe, municipalities prioritise renewable energy generation, building retrofits, and electric mobility infrastructure, aligning with EU-level targets and funding streams.

The findings of this article shed light on the importance of comparative approaches for understanding how national contexts shape local governance capacities. The EU Missions,

by generating a large-scale, coordinated field experiment across more than one hundred cities, provide a unique empirical setting to compare strategies, identify structural barriers, and observe how different governance systems enable or constrain climate action [56]. This comparative lens is essential for designing targeted policy instruments, facilitating knowledge transfer and supporting cities that face systemic limitations in their transition pathways [57].

Furthermore, with relevance for ongoing activities in the EU Mission Cities, the results also suggest that cities in different regional clusters require tailored support; for example, Central and Eastern European cities seem to have needs mostly focused on financial resources and overcoming regulatory barriers, while Northern and Western European cities are moving toward integrated, cross-sectoral solutions. Such consideration further highlights the importance of collaborative planning for leveraging the resources mobilised in the Cities Mission [58–60].

5.2. Policy Implications

The Cities Mission provides an unprecedented set of cross-national data about systemic urban transformation in the EU. The analysis of Mission Cities data, as the one carried out in this paper, provides policymakers with an EU-wide and granular perspective, which would have been impossible to achieve without the Mission. In this context, our analysis highlights the need to strengthen coherence between local collaborative planning and EU-level top-down setting of priorities [61,62]. While CCCs represent a novel and promising governance instrument, their effectiveness depends on an effective portfolio of items, adequate financing, monitoring, and structured knowledge exchange across cities, and between cities and the national government. The analysis presented in this paper can be utilised by municipalities, national governments and the European Commission to develop a specific set of guidelines tailored to each group of countries, for example, through Policy labs and policy dialogues organised at the national level within the project and the Mission. Such data-supported co-design of policies can be fruitfully aimed at developing roadmaps for specific actions that tackle specific barriers of groups of countries to align progress in EU Member States, which is also relevant to prevent social inequalities and related consequences. Beyond Europe, the analysis provides a baseline for comparison for nations worldwide.

Differences in progress levels across EU countries should not be viewed as competitive advantages, but rather as opportunities to accelerate advancement in specific topics in a set of countries through targeted support, capacity building, and shared learning mechanisms. These differences can guide cohesion-oriented policies that promote more balanced development across the Union.

The results suggest that future policy design and research should focus not just on whether cities "cover" the right sectors but more on portfolio quality, balance between deployment and enabling infrastructure; coherence between mitigation and adaptation; and integration across topics (e.g., coupling EV charging with grid management, linking district energy upgrades with building retrofits, combining NBS with heat-risk management and social equity). This echoes the literature on co-benefits and synergies between mitigation and adaptation [10], and the warnings about fragmented planning and maladaptation risk when integration is weak [21,22]. The finding that many portfolios emphasise entry-point measures also reinforces the argument that transitions require not only more action, but smarter sequencing—from basic measures to systemic transformation—supported by multilevel governance alignment and sustained investment [16,19].

At the same time, social, economic, and territorial contexts play a decisive role in guiding national progress patterns. In this regard, Mediterranean countries hold significant

potential to become key drivers of renewable energy deployment at the European scale. By contrast, in several Western European countries, the main challenge lies not in developing new infrastructure but in modernising and optimising existing systems. With the 2030 target for climate neutrality approaching, regional, national and European policies and funding instruments should focus on the targeted support in specific sectors and subsectors depending on regions. This differentiated approach can help ensure a more balanced and cohesive transition and reduce the risk of increasing internal disparities within the European Union.

5.3. Limitations and Future Research

This study is not free of limitations. First, the analysis builds on planned actions, while their implementation and results cannot be guaranteed; future research should track whether and how commitments translate into measurable emission reductions for a causal and normative evaluation [61].

Second, the classification approach over-simplifies complex and systemic actions that cut across multiple topics, so future research should analyse specifically cross-sectoral mitigation and adaptation actions, and interconnections between actions in cities' portfolios. Furthermore, the financial, emissions reductions, and implementation progress are not considered in the present analysis of Action Plans in CCCs.

Third, the focus on European Mission Cities limits the generalizability of findings to other cities not part of the Mission, as well as to other continents with different governance structures and resource levels. To overcome those limitations, future studies could focus on systemic evaluations of urban climate actions and tracking the interdependencies between actions in single cities and in regions [61].

Fourth, this study presents a quantitative analysis that future studies could complement with an in-depth analysis of past and present policies and cultural specificities per country or clusters of countries.

Promising venues of research also include the investigation of adaptation and mitigation synergies, stakeholders' role [57] and financing opportunities that can enable cities to enact their ambitious climate actions, analysing business models per specific topics and sub-topics: in turn, this would allow collaborative planning to focus innovation on developing new financial instruments suited for adaptation and mitigation challenges [62]. The limited inclusion of actions related to industry and agriculture calls for investigation of this relevant gap, which can be crucial for the actual implementation of actions through private-public partnerships and other forms of collaborations.

The recurrent association of some countries in the grouping of cities suggests that regional differences in climate transition planning are related to historical reasons, corroborating the need for inclusion also of cultural historical analysis in the application of systemic approaches to Cities Mission and more in general climate transition in the EU [55] to address policies as well as the cultural roots [63] of the different perceptions also through tailored communication [64–66] and policy dialogues [67].

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Abbreviations

The following abbreviations are used in this manuscript:

CCC	Climate City Contract
EU	European Union
GHG	Greenhouse gases
NBS	Nature-Based Solutions
IPPU	Industrial Processes and Product Use

Appendix A

Table A1 below provides the complete list of the analysed cities and the respective countries.

Table A1. List of analysed cities and countries.

City	Country	City	Country
Klagenfurt	Austria	Liepaja	Latvia
Antwerp	Belgium	Riga	Latvia
La Louvière	Belgium	Vilnius	Lithuania
Leuven	Belgium	Tauragė	Lithuania
Gabrovo	Bulgaria	Differdange	Luxembourg
Sofia	Bulgaria	Amsterdam	The Netherlands
Zagreb	Croatia	Eindhoven	The Netherlands
Limassol	Cyprus	Helmond	The Netherlands
Liberec	Czech Republic	Groningen	The Netherlands
Aarhus	Denmark	Rotterdam	The Netherlands
Sønderborg	Denmark	The Hague	The Netherlands
Espoo	Finland	Trondheim	Norway
Helsinki	Finland	Oslo	Norway
Lahti	Finland	Stavanger	Norway
Lappeenranta	Finland	Warsaw	Poland
Tampere	Finland	Wrocław	Poland
Turku	Finland	Krakow	Poland
Angers Loire Metropole	France	Rzeszów	Poland
Bordeaux Metropole	France	Guimarães	Portugal
Dijon Metropole	France	Lisbon	Portugal
Dunkirk	France	Porto	Portugal

Table A1. *Cont.*

City	Country	City	Country
Grenoble-Alpes Metropole	France	2nd District of Bucharest	Romania
Lyon	France	Cluj-Napoca	Romania
Marseille	France	Suceava	Romania
Nantes Metropole	France	Bratislava	Slovakia
Paris	France	Košice	Slovakia
Aachen	Germany	Velenje	Slovenia
Dortmund	Germany	Kranj	Slovenia
Dresden	Germany	Ljubljana	Slovenia
Heidelberg	Germany	Valencia	Spain
Leipzig	Germany	Valladolid	Spain
Mannheim	Germany	Vitoria-Gasteiz	Spain
Munich	Germany	Zaragoza	Spain
Münster	Germany	Barcelona	Spain
Athens	Greece	Madrid	Spain
Ioannina	Greece	Seville	Spain
Kalamata	Greece	Umeå	Sweden
Kozani	Greece	Gävle	Sweden
Thessaloniki	Greece	Gothenburg	Sweden
Trikala	Greece	Lund	Sweden
Budapest	Hungary	Malmö	Sweden
Miskolc	Hungary	Stockholm	Sweden
Pécs	Hungary	Istanbul	Turkey
Reykjavik	Iceland	Izmir	Turkey
Cork	Ireland	Bristol	UK
Dublin	Ireland	Glasgow	UK
Eilat	Israel		
Turin	Italy		
Bergamo	Italy		
Bologna	Italy		
Florence	Italy		
Milan	Italy		
Padua	Italy		
Parma	Italy		
Prato	Italy		
Rome	Italy		

List of Topics and Sub-Topics

Table A2. List of the topics and sub-topics used to code actions from CCCs into items.

List of Topics and Sub-Topics	
Built Environment	
	Passive energy efficiency
	Active Energy Systems
	Sustainable construction practices
	Smart building technologies
	Sustainable urban design
Energy Systems	
	Renewable energy generation
	Energy efficiency programmes
	District Energy Systems
	Smart grids
	Energy storage solutions
Mobility and Transport	
	Electric vehicle infrastructure
	Active mobility promotion
	Public transportation enhancement
	Mobility-as-a-Service (MaaS)
Waste and Circular Economy	
	Recycling and composting
	Product lifecycle management
	Waste reduction initiatives
	Resource recovery facilities
Industry	
	Industrial decarbonization
	Energy management systems
	Circular economy practices in industries
	Sustainable supply chains
Green Infrastructure and Nature-Based Solutions	
	Urban green spaces
	Climate resilience projects
	Blue infrastructure
	Biodiversity enhancement
Levers of change	
	Climate policy development
	Stakeholder engagement
	Capacity building
	Monitoring and evaluation

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