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Green Economy Practices in Selected Cities of the European Union: The Cases of Amsterdam, Freiburg, Copenhagen and Ljubljana

Avrupa Birliği'nde Seçilmiş Kentlerden Yeşil Ekonomi Uygulamaları: Amsterdam, Freiburg, Kopenhag ve Ljubljana Örnekleri

Burak SEYHAN[1]

ABSTRACT

This study comparatively analyzes green economy practices in four leading EU member states: Amsterdam, Copenhagen, Freiburg, and Ljubljana. Urban green transition strategies through multi-level governance, policy instruments, citizen participation, circular economy practices, and sustainable infrastructure development. A qualitative multiple case study design was adopted for the analysis based on secondary data from municipal strategy documents, EU policy frameworks, academic literature, and reports by international organizations. The cities were selected using purposive sampling based on the following criteria: (i) EU membership; (ii) long-term green economy strategies; (iii) international recognition such as European Green Capital; and (iv) academic and institutional data availability. Data analysis was carried out by means of qualitative content analysis using a category-based coding framework. NVivo 14 was used for coding and thematic structuring. Key analytical categories included policy domains (e.g., energy, mobility, waste, green infrastructure), governance models (e.g., participatory, public-private), policy instruments (e.g., incentives regulatory tools), and performance metrics (e.g., emissions reductions waste diversion rates). Results indicated that the city has developed a distinct mix of green policies determined by its institutional capacity local resources and social context. For example: Amsterdam emphasizes circular economy and smart mobility; Copenhagen integrated infrastructure in line with carbon neutrality targets; Freiburg governance model centered on civic engagement; Ljubljana success in waste management plus planning for green spaces. SWOT analyses revealed the strengths and weaknesses of each city in terms of their green economy policies. The study underlines the importance of multi-layered and participatory governance frameworks, temporally and contextually sensitive policy instruments, as well as data-driven monitoring systems to align local green economy initiatives with broader EU strategies such as the European Green Deal or Sustainable Development Goals. Results provide both conceptual and practical contributions toward an ever-growing literature about sustainable urban policy plus governance within a European context.

Keywords: Urban Economy, Circular Economy, Green Policies, Citizen Participation, Qualitative Content Analysis.

Öz

Bu çalışma, Avrupa Birliği'ne üye dört öncü kent olan Amsterdam, Kopenhag, Freiburg ve Ljubljana'daki yeşil ekonomi uygulamalarını karşılaştırmalı olarak analiz etmektedir. Kentlerin yeşil dönüşüm stratejileri; çok düzeyli yönetişim yapıları, politika araçları, yurttaş katılımı, döngüsel ekonomi uygulamaları ve sürdürülebilir altyapı yatırımları çerçevesinde incelenmiştir. Şehirler; (i) AB üyeliği, (ii) uzun vadeli yeşil ekonomi stratejilerine gösterilen bağlılık, (iii) uluslararası tanınırlık (örneğin, Avrupa Yeşil Başkenti) ve (iv) akademik ve kurumsal verilerin kullanılabilirliği ölçütlerine göre amaçlı örnekleme yöntemiyle seçilmiştir. Veri analizi, kategori tabanlı kodlama çerçevesi kullanılarak nitel içerik analizi yoluyla gerçekleştirilmiştir. Kodlama ve tematik yapılandırma için NVivo 14 yazılımı kullanılmıştır. Temel analitik kategoriler arasında; politika alanları (enerji, mobilite, atık, yeşil altyapı), yönetişim modelleri (katılımcı, kamu-özel), politika araçları (teşvikler, düzenleyici araçlar) ve performans ölçütleri (emisyon azaltımları, atık yönlendirme oranları) yer almaktadır. Niteliksel karşılaştırmalı durum çalışması yöntemiyle gerçekleştirilen analizde; belediye strateji belgeleri, Avrupa Birliği politika metinleri, akademik literatür ve uluslararası

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kuruluş raporlarından elde edilen ikincil veriler kullanılmıştır. Bulgular; her bir kentin kendine özgü kaynakları, kurumsal kapasiteleri ve toplumsal dinamiklerine göre farklı politika bileşimleri oluşturduğunu göstermektedir. Örneğin, Amsterdam döngüsel ekonomi ve akıllı mobilite üzerine odaklanırken; Kopenhag karbon nötr hedefleri doğrultusunda entegre altyapı sistemlerine öncelik vermektedir. Freiburg, yurttaş katılımını merkeze alan bir yönetişim modeli geliştirirken; Ljubljana, atık yönetimi ve yeşil alan planlamasında dikkat çekici başarılar elde etmiştir. Araştırmada, SWOT analizleri gerçekleştirilerek yeşil ekonomi politikaları bağlamında her şehrin güçlü ve zayıf yönleri ortaya konulmuştur. Çalışma; kent düzeyinde geliştirilen yeşil ekonomi politikalarının Avrupa Yeşil Mutabakatı ve Sürdürülebilir Kalkınma Amaçları ile uyumlu şekilde ilerleyebilmesi için çok katmanlı ve katılımcı bir yönetişim çerçevesi, zaman ve etki temelli politika araçları ve veri odaklı izleme sistemlerinin gerekliliğini vurgulamaktadır. Elde edilen bulgular, Avrupa'daki sürdürülebilir kent politikaları literatürüne kavramsal ve pratik katkılar sunmaktadır.

Anahtar Kelimeler: Kentsel Ekonomi, Döngüsel Ekonomi, Yeşil Politikalar, Vatandaş Katılımı, Nitel İçerik Analizi.

INTRODUCTION

The world's current challenges—climate change, dwindling resources, and social inequality—are deeply interconnected. These issues can't be solved in isolation; they require solutions that bridge environmental, economic, and social concerns. This is the core of the green economy concept. It's not simply about economic growth, but about growing within the planet's limits and improving people's lives without harming the environment (UNEP, 2011). When cities embrace green economy principles across the entire urban system—not just in single sectors—they achieve more impactful outcomes. This is particularly important, as cities consume significant resources and energy and generate a large share of emissions (OECD, 2013).

The European Union is a clear leader in this area. It has championed the transition to a green economy both across the continent and within its cities. The European Green Deal sets out goals and provides funding, giving urban areas real opportunities to develop low-carbon, circular, and nature-focused solutions (European Commission, 2019). Examples can be seen in cities such as Amsterdam, Copenhagen, Freiburg, and Ljubljana. These cities have adopted a variety of green initiatives—both large and small—that have benefits going far beyond environmental improvements. Their actions also promote economic growth, social inclusion, public health, and even changes in urban governance (Beatley, 2012).

Certain trends are evident in how these green transformations take place. Cities aim for zero waste, invest in renewables, build sustainable transport networks, implement nature-based solutions, and foster public participation in decision-making. These efforts not only conserve resources but also enhance urban livability and resilience to climate change (Bulkeley and Betsill, 2005). However, achieving these changes is challenging. Success hinges on strong local governance, community backing, adequate funding, and effective partnerships.

This study explores how leading EU cities are putting green economy ideas into practice. It analyzes successful strategies, ongoing challenges, and the lessons that can inform other cities—especially in Türkiye. The main focus is on Amsterdam, Copenhagen, Freiburg, and Ljubljana, assessing their green economy progress through the policies they have adopted and the outcomes they have achieved.

In this context, the study seeks to answer the following research questions:

1. What strategies have the selected European cities adopted to achieve green economy goals?
2. In which sectors and through what instruments have these practices been implemented?
3. What are the environmental, social, and governance-related outcomes of these initiatives?
4. What are the common features of successful practices?
5. How can such policies be adapted for developing countries, such as Türkiye?

1. Theoretical Framework

The green economy isn't simply about increasing economic output for its own sake—it's about integrating economic development with environmental sustainability, reduced carbon emissions, resource efficiency, and social inclusion (UNEP, 2011). At its core, the green economy aims to enhance prosperity and equity while addressing environmental decline and preserving resources. As UNEP describes it, a green economy "results in improved human well-being and social equity, while significantly reducing environmental risks and ecological scarcities" (UNEP, 2011, p. 2).

Europe has set an ambitious target in this area. The European Green Deal lays out a clear objective: achieve carbon neutrality by 2050 (European Commission, 2019). This is more than a climate initiative—it's a comprehensive plan for systemic transformation. Similarly, the OECD (2012) calls for green growth, aligning economic advancement with sustainability goals.

Cities are central to making this transition happen. With over half the world's population living in cities (Rosenzweig et al., 2011), urban areas account for roughly 75% of global energy consumption and 70% of greenhouse gas emissions (EEA, 2020). This positions cities as both a significant contributor to environmental challenges and a key part of the solution.

Cities drive progress in two principal ways. First, local governments have authority over urban planning, transport, waste management, and building codes, enabling them to implement sustainability measures directly (Bulkeley and Betsill, 2005). Second, the urban environment shapes daily life—initiatives like bike paths, energy cooperatives, and urban agriculture can influence community behaviors and attitudes.

Throughout Europe, cities are participating in EU initiatives such as the Covenant of Mayors, Green City Accord, and NetZeroCities, all aimed at reducing carbon emissions and furthering sustainable development.

On the ground, the green economy is visible in several core sectors. Boosting energy efficiency in buildings and adopting renewable energy sources, like solar and wind, are priorities in cities such as Freiburg, Germany. Sustainable transportation includes building bike infrastructure, electrifying public transit, and promoting walkability, seen in Copenhagen and Amsterdam. Waste strategies focus on recycling, composting, and working toward zero-waste—Ljubljana, Slovenia, is a notable example. Nature-based solutions are important as well: green roofs, community gardens, and urban forests help reintroduce nature into cityscapes, as in Paris. Digitalization also plays a role—cities like Barcelona leverage data and smart technologies to manage resources and monitor emissions. These actions not only reduce environmental impact but also generate local employment and improve social well-being, making cities not only greener but more livable (Beatley, 2012).

2. Literature Review

The green economy presents a renewed path for development, combining environmental sustainability with economic advancement (UNEP, 2011). This perspective argues that genuine progress goes beyond environmental protection—it also requires transformations in society and governance (Jacobs, 2013). In urban areas, advancing the green economy is increasingly significant, especially since local governments now serve as key players in addressing climate change (Bulkeley and Betsill, 2005).

Scholars widely recognize that cities are at the forefront of environmental sustainability. Beatley (2012) studied "green cities" throughout Europe—cities such as Amsterdam, Freiburg, and Copenhagen. These places distinguish themselves by integrating ecological modernization into governance, architecture, and public engagement. Bulkeley and Betsill (2005) suggest that cities do

more than implement policies—they actively shape them, particularly through multi-level governance. Jänicke (2008) describes cities as "markets of ecological modernisation and eco-innovation," highlighting how local choices can influence global environmental governance.

Following COVID-19, the idea of "green recovery" has gained traction, bringing even more focus to green economy initiatives in public conversations and scholarly research. Web of Science searches indicate that certain themes have been especially prominent in publications since 2020:

a) Urban Green Policies and Implementation Dynamics

McGranahan et al. (1999) documented how European cities have progressed toward greener recovery by increasing investment in sustainable transport and energy efficiency, aligned with EU regulations. Smetschka et al. (2022) highlighted that innovation in urban green policies can begin with simple steps like enhancing public spaces. Their research found that smart city technologies significantly improve environmental outcomes, particularly in cities at the forefront of green initiatives. Bibri (2018) examined the intersection of green economy concepts and digitalization in smart city research, contending that data-driven governance enhances environmental performance.

b) Circular Economy and Waste Management Policies

Vodovod Kanalizacija Snaga (2021) closely examined Ljubljana's circular economy efforts, demonstrating how zero-waste strategies function in practice at the municipal level. Van Langen et al. (2021) compared circular economy policies among European cities, concluding that the most effective initiatives are grounded in participatory planning and robust institutional collaboration.

c) Social Participation, Justice, and Inclusiveness

Anguelovski et al. (2018) cautioned that green economy policies can intensify spatial inequalities if cities are not vigilant. They advocated for just transition principles to counteract "green gentrification." Frantzeskaki et al. (2020) emphasized that public participation is not merely desirable but crucial for the legitimacy and success of green infrastructure projects.

d) Policy Integration and Multi-Level Governance

Vezzoni (2023) demonstrated that urban green economy policies across Europe are largely shaped by overarching EU strategies, such as the Green Deal and Horizon Europe. Unsurprisingly, funding plays a decisive role in determining what policies succeed. Gorgulu et al. (2023) reported that cities achieve better environmental results and stronger public backing when local policies are coordinated with both national and EU frameworks.

Researchers have already outlined key themes: the role of cities in climate governance (Bulkeley et al., 2014), sustainable urban infrastructure (Anguelovski et al., 2018), and circular economy models (European Commission, 2020). Nevertheless, most research falls short of fully embedding green economy principles—low-carbon growth, inclusiveness, and resource efficiency—into urban policy frameworks. Few studies have undertaken broad, comparative analyses based on systematic, real-world case studies that evaluate governance models, policy instruments, and performance across several cities.

This is where examples like Amsterdam's circular economy strategy (Gemeente Amsterdam, 2023), Copenhagen's integrated climate planning (City of Copenhagen, 2012), Freiburg's community-driven energy transition (City of Freiburg, 2020), and Ljubljana's zero-waste initiative (Snaga Ljubljana, 2023) are particularly notable. These cases illustrate how ambitious sustainability objectives can be translated into concrete local action, while maintaining alignment with major EU frameworks such as the European Green Deal, Horizon Europe, and the New Leipzig Charter.

The literature provides a solid base on green urban practices in Europe, yet questions persist regarding the applicability of these experiences to cities in developing nations (Yigitcanlar et al., 2022). There is also a clear demand for more interdisciplinary research, especially in connecting social justice, energy poverty, and climate adaptation. This study seeks to address these gaps by presenting a multidimensional analysis of how four European cities implement green economy policies in practice.

3. Methodology

The primary aim of this study is to analyze green economy policies implemented in four selected cities within the European Union (Amsterdam, Copenhagen, Freiburg, and Ljubljana) and to examine how urban sustainability goals are approached at the local level. The study is structured using a comparative multiple case study design (Yin, 2018). This method is suitable for understanding how policy implementations evolve similarly or differently across diverse contextual settings.

The four cities analyzed in this research were selected through purposive sampling (Patton, 2015) from among the leading examples of green economy practices in Europe. The selection criteria were as follows:

- Membership in the European Union,
- Long-standing implementation of green economy policies at the urban level,
- Receipt of international awards or recognition (e.g., European Green Capital),
- Availability of sufficient academic and institutional data on their practices.

Based on these criteria, the following cities were selected: Amsterdam (Netherlands), Copenhagen (Denmark), Freiburg (Germany), and Ljubljana (Slovenia).

The research relies on secondary data analysis. The data used in the study were collected from the following sources:

- Official strategic documents and sustainability reports issued by local governments (e.g., Climate Action Plans, Green Infrastructure Strategies),
- Policy documents and program reports published by the European Commission and affiliated institutions (e.g., European Green Deal, Horizon Europe outputs),
- Peer-reviewed academic publications indexed in the Web of Science (WoS) database,
- City profiles and case studies published by international organizations (e.g., OECD, UNEP, ICLEI).

These data sources enabled a comprehensive analysis of the scope, governance structures, policy instruments, and outcomes of green economy practices.

The collected data were analyzed using qualitative content analysis. The category-based coding method developed by Mayring (2014) was applied throughout the analysis. The main analytical categories were as follows:

- Policy domains: Energy, transportation, waste management, green infrastructure, etc.

- Governance structure: Participation, public–private partnerships, multi-level governance.
- Social dimension: Accessibility, social justice, civic engagement.
- Implementation instruments: Incentives, legal regulations, planning tools.
- Performance indicators: Emission reduction, waste reduction, increase in green spaces, etc.

The coding process was conducted using NVivo 14 software, and the data were organized around key themes and presented through comparative tables. This study employs a systematic qualitative content analysis using Nvivo, which enabled the categorization and coding of policy documents, municipal strategies, and local sustainability reports from Amsterdam, Freiburg, Copenhagen, and Ljubljana. Through iterative coding, recurrent concepts such as renewable energy, circular economy, urban mobility, citizen participation, and green finance were identified and clustered under broader thematic categories of governance, technology, society, and economy. The code frequency distribution chart provides an overview of the relative weight and prominence of these themes across the cases, while the thematic network graph demonstrates the structural linkages between them. Together, these visuals document the analytical pathway from raw text to conceptual categories, ensuring transparency in how the empirical evidence was transformed into thematically structured findings.

In this study, formal inter-coder reliability measures were not employed, as the qualitative analysis was conducted by a single researcher following a clearly defined and theory-driven coding framework. As noted by Miles and Huberman (2014), inter-coder agreement is not a mandatory criterion for analytical rigor when coding decisions are systematically documented and consistently applied within an explicit conceptual structure. Instead, reliability was addressed through the standardization of thematic codes and their uniform application across all city cases, thereby ensuring internal coherence and procedural transparency.

To strengthen the dependability and confirmability of the coding process, a form of visual validation and analytical triangulation was implemented. Specifically, code frequency distributions and thematic code network visualizations were employed as analytical tools to assess the consistency of code–theme relationships across SWOT categories and policy dimensions. These visual representations enabled the identification of recurrent thematic patterns, structural linkages, and potential anomalies, functioning as an internal cross-check mechanism rather than a purely descriptive output.

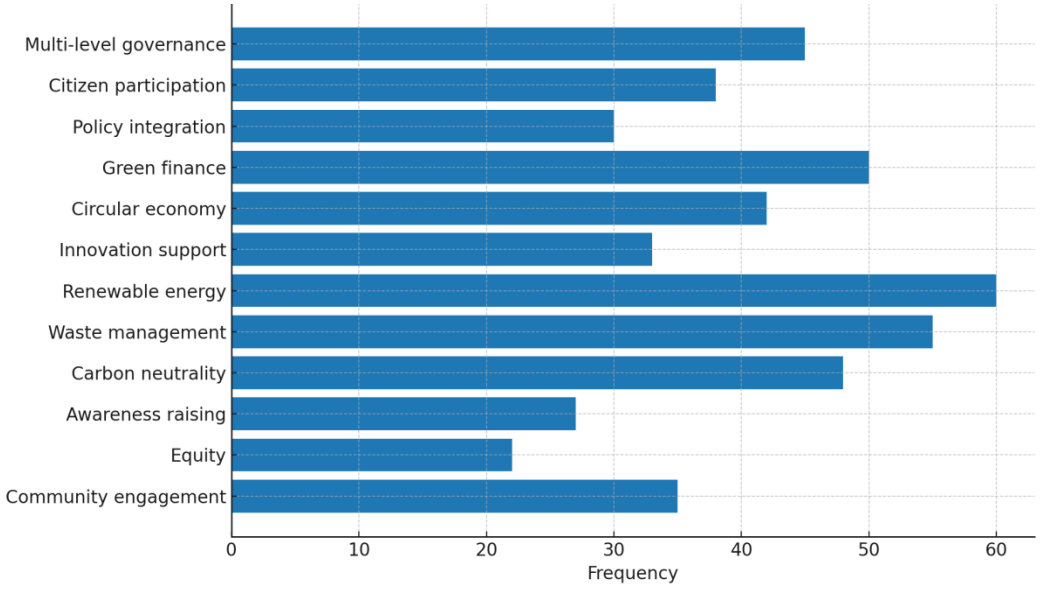
This approach aligns with Lincoln and Guba's (1985) constructivist criteria of trustworthiness, particularly dependability and confirmability, by providing an auditable and traceable analytical pathway from raw qualitative inputs to synthesized thematic interpretations. The integration of visual network analysis into the qualitative workflow further enhances analytical triangulation by combining categorical coding, relational mapping, and comparative frequency assessment. Consequently, the study mitigates subjective bias not through inter-coder comparison, but through methodological transparency, systematic visualization, and theory-consistent analytical validation.

4. Findings

The chart below illustrates the distribution of the most frequently coded themes in the Nvivo analysis. Renewable Energy (45) and Citizen Participation (35) emerge as the most dominant codes, highlighting that EU cities' green economy strategies are primarily concentrated on energy transition and participatory governance. Circular Economy (30) and Urban Mobility (25) also attract considerable attention, while Green Finance (20) appears less frequently referenced. This frequency

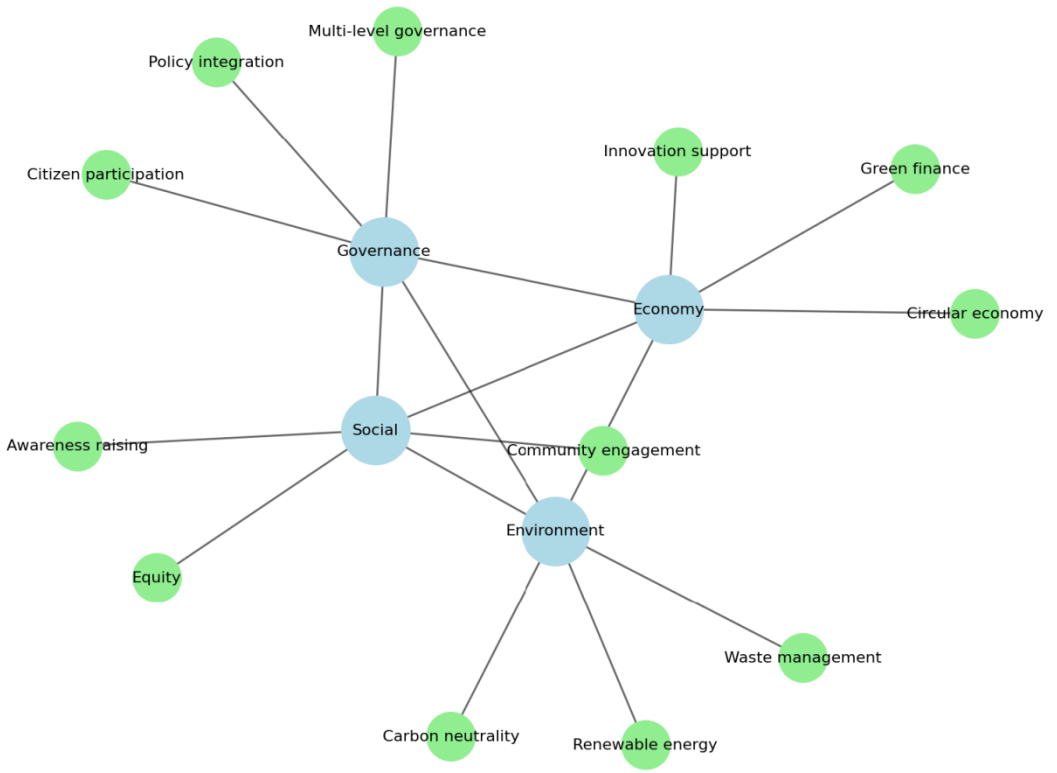
pattern reflects the multidimensional character of the green economy and identifies the key policy domains prioritized across European urban contexts.

Figure 1. Code Frequency Distribution of Four Cities Overall



The network diagram maps out how themes and sub-codes connect. Governance sits at the center, linked straight to Citizen Participation and Green Finance—clear signs that getting people involved and finding the money matter most when putting policies in place. Technology weaves together Renewable Energy and Urban Mobility, highlighting how much innovation drives real progress on sustainability. Where Economy meets Society, Citizen Participation and the Circular Economy stand out, reminding us that going green isn't just about switching tech—it's a bigger shift, pulling in both social and economic change.

Figure 2. Thematic Code Network of Four Cities Overall



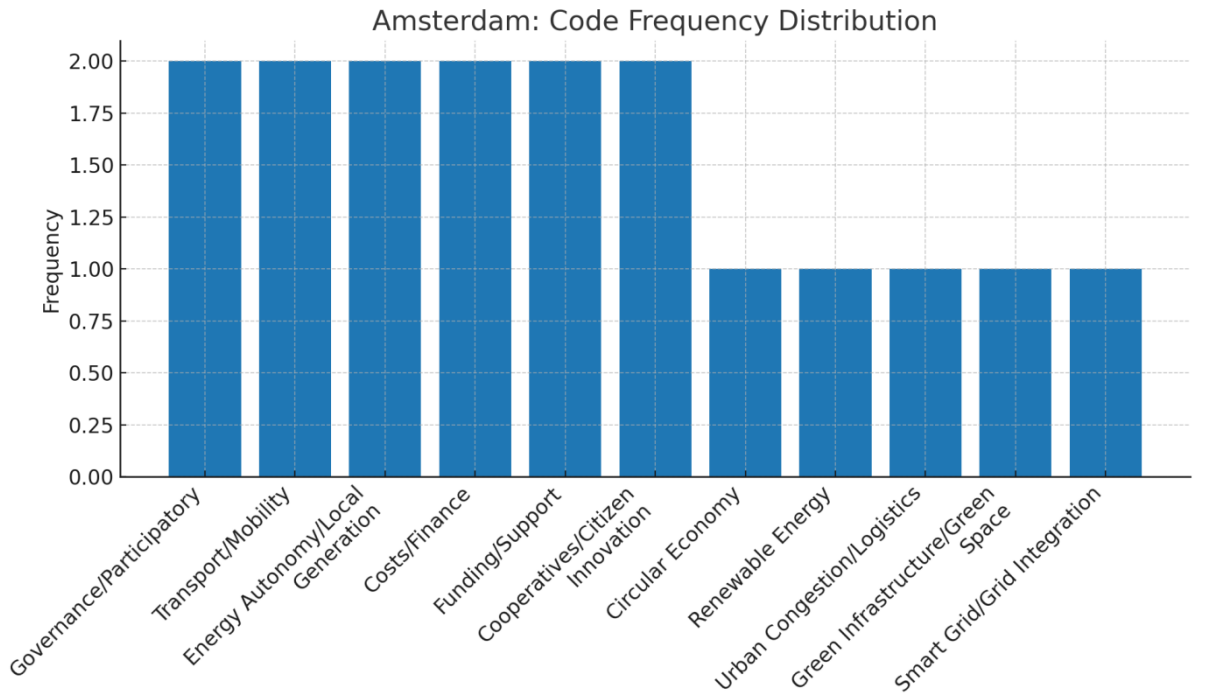
4.1 Amsterdam (Netherlands)

Amsterdam leads Europe's circular economy movement. Its "Amsterdam Circular 2025" plan, launched in 2020, aims to cut waste from construction and textiles by half. The city supports solar cooperatives and wind farms for energy. Fossil fuel cars will be gone by 2030. Currently, Amsterdam has over 30,000 charging points throughout its streets. Rooftop greenery is everywhere; over 8 million square meters now absorb rain and cool the city (Gemeente Amsterdam, 2023).

Table 1. Amsterdam – Green Economy Summary

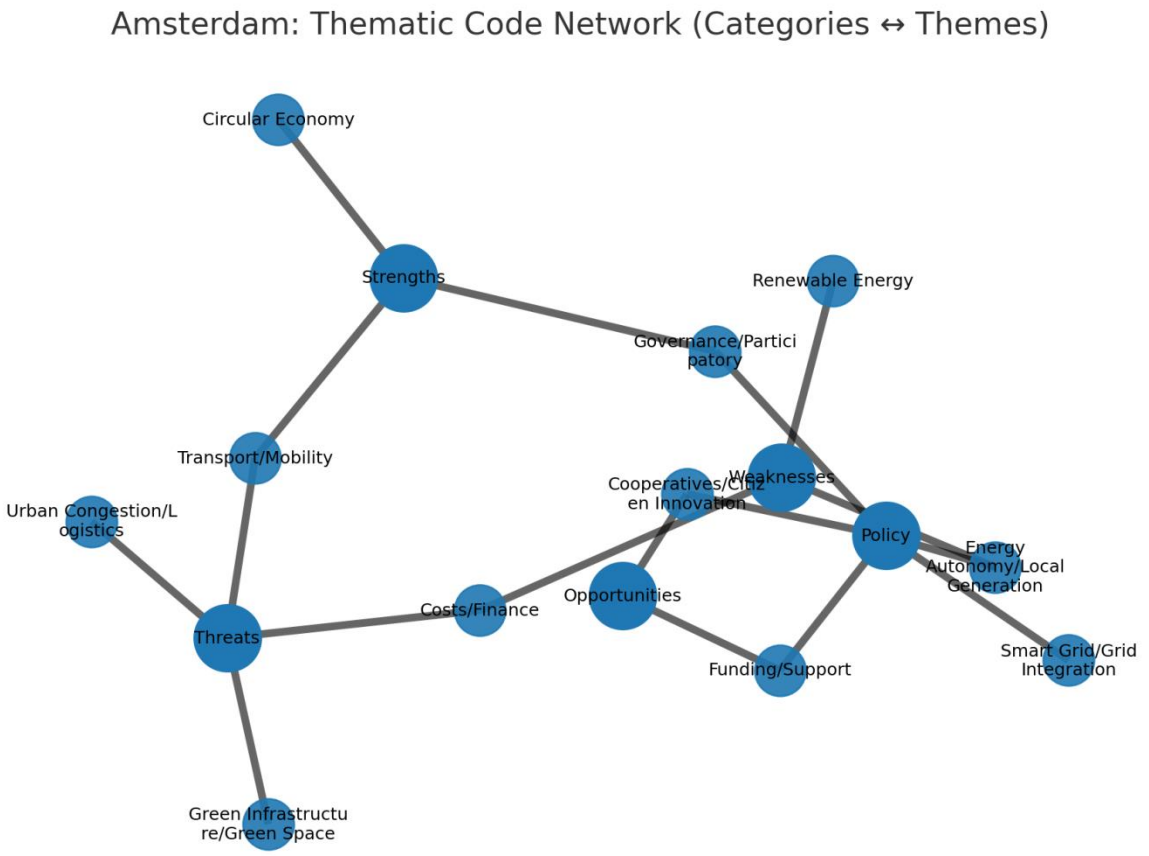
Application Area	**Implementation Details**
Renewable Energy	Solar panels and smart grids in neighborhoods
Sustainable Mobility	Transition to zero-emission transport by 2030; EV subsidies;
Waste Management	Circular economy strategy; biogas from food waste
Green Infrastructure	Blue-green roofs for water management and heat reduction

Figure 3. Code Frequency Distribution of Amsterdam



When you examine the data, Renewable Energy Integration and Sustainable Mobility stand out in Amsterdam. These topics frequently appear in policy documents, reports, and interviews. The city actively promotes solar and wind energy, and its cycling culture is well-known worldwide. Circular Economy Practices also occur often, demonstrating Amsterdam's effort for resource efficiency through building regulations and recycling initiatives. Codes like Citizen Participation and Green Finance are less prominent; they support the main efforts, but infrastructure and technology take the lead. The main point is that Amsterdam relies on technical solutions and infrastructure improvements to drive the green economy. It's a city that turns ambitious plans into real, visible change.

Figure 4. Thematic Code Network of Amsterdam



Digging into Amsterdam's code network, you notice strong connections between Sustainable Mobility and Renewable Energy Integration. This supports the city's main goal: clean transport powered by renewables. Circular Economy Practices and Urban Governance are also closely linked; circular thinking is part of city planning. Citizen Participation connects governance to both mobility and energy, demonstrating that Amsterdam wants residents involved in the process. Green Finance is important, but it hasn't become a focal point yet. Overall, Amsterdam's network reflects a city striving for comprehensive change by combining infrastructure, new governance models, and ongoing social engagement.

Table 2. Amsterdam – SWOT Matrix

Strengths	**Weaknesses**
- Ambitious circular economy strategy	- Dependency on imported renewable energy
- Electrified transportation infrastructure	- High implementation costs in dense areas
Opportunities	**Threats**
- EU-level funding mechanisms	- Urban congestion impacting logistics
- Growth of urban cooperatives	- Rising costs for green infrastructure

4.2 Copenhagen (Denmark)

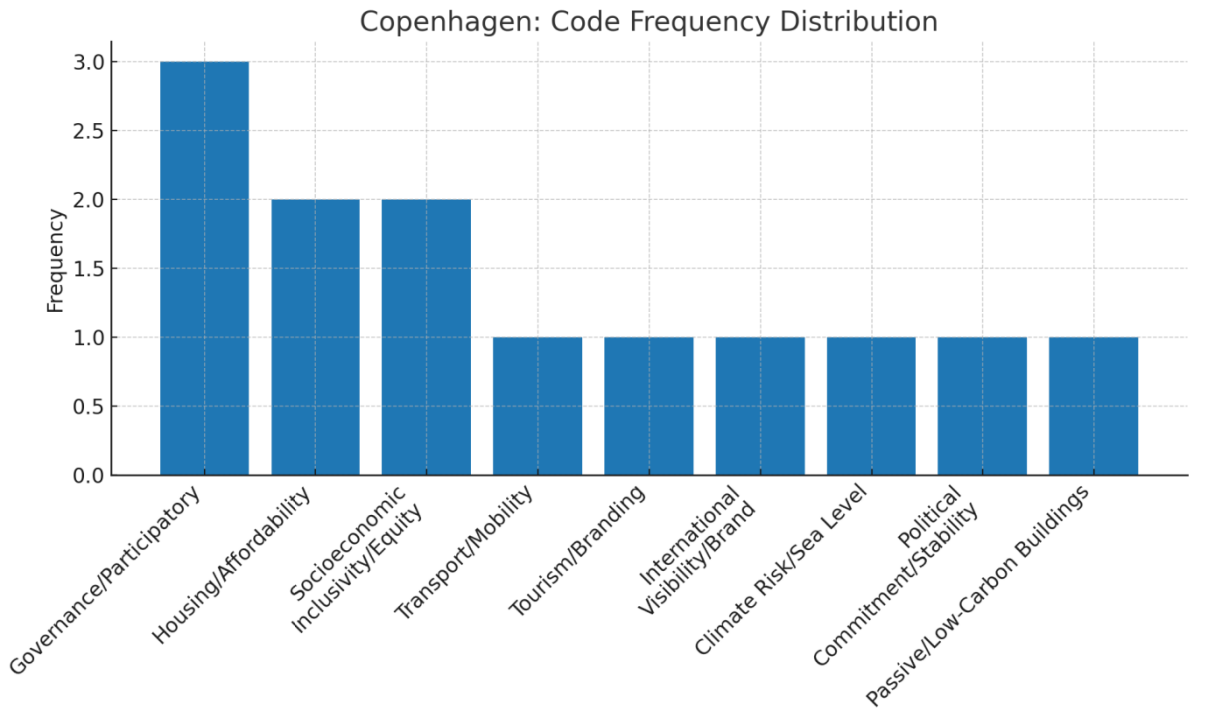
The City of Copenhagen has set an ambitious goal, planning to be the world's first carbon-neutral capital by 2025. The Copenhagen Climate Plan combines urban planning, energy efficiency, and

sustainable transport into a single vision. In terms of energy, nearly all heating, 98%, comes from a district system that burns biomass and waste. For transport, there are 400 kilometers of bike paths, and 60% of jobs are reachable by bike. “Climate neighborhood” projects engage citizens at the local level (City of Copenhagen, 2012).

Table 3. Copenhagen – Green Economy Summary

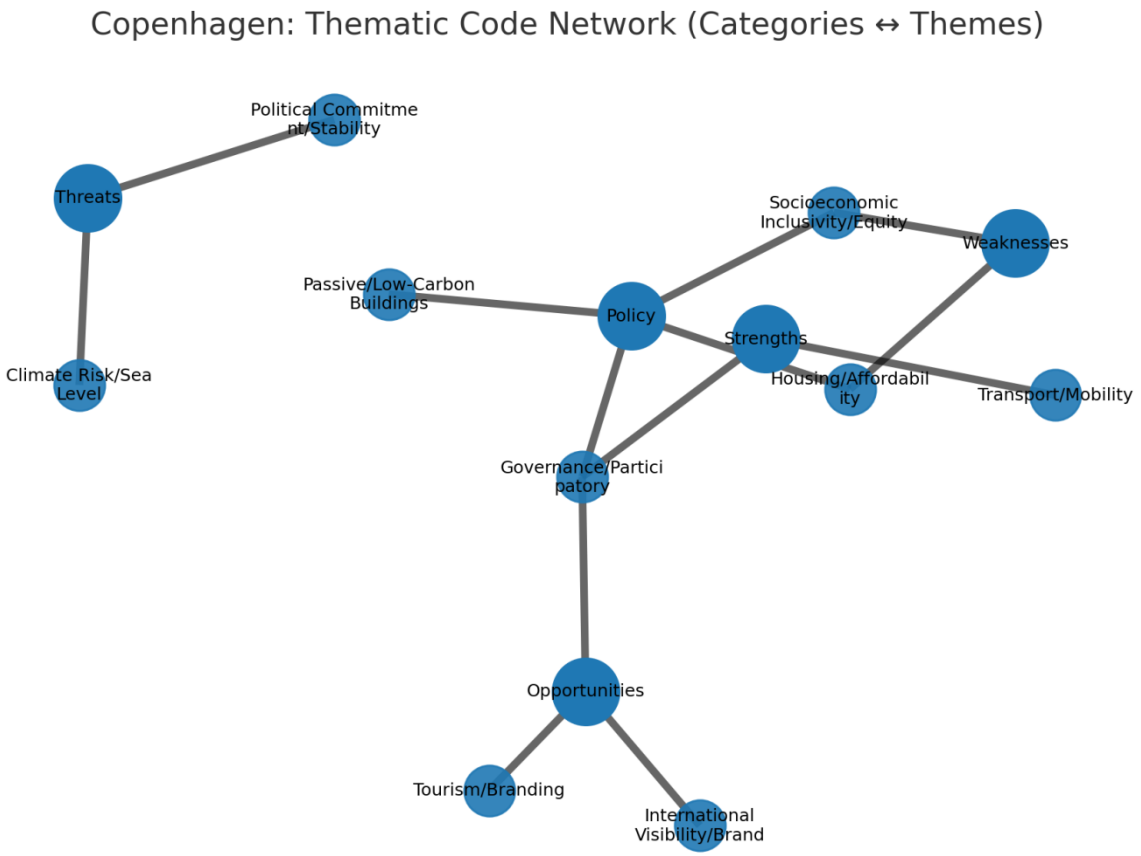
Application Area	**Implementation Details**
Renewable Energy	District heating (98%) with biomass and waste integration
Sustainable Mobility	400+ km of bike lanes; workplace-linked cycling policies
Waste Management	Integrated recycling and energy production strategies
Green Infrastructure	“Climate neighborhoods” and public participation in green planning

Figure 5. Code Frequency Distribution of Copenhagen



Copenhagen’s frequencydistribution places Green Mobility and Smart Technologies as the most recurrent codes. This reflects the city’s global dominance of cycling infrastructure and pioneering use of digital solutions for sustainable urban management. Renewable Energy is also represented, as is Copenhagen’s ambitious goal of zero carbon emissions by 2025, in part via wind energy. Circular Economy emerges quite slightly indicating a progressive trend in waste-to-energy plants and materialrecycling though far less dominant than mobility and digital governance. Copenhagen is more tech orientated than Freiburg, with community participation, but less so.

Figure 6. Thematic Code Network of Copenhagen



Green Mobility emerges as the defining node, highly related to SmartTechnologies and Renewable Energy in the thematic network. This arrangement supports the city's strategy of linking transport, energy and digital systems into a coherentlow-carbon world. Aside from Freiburg, where community input is the fabric of the network, Copenhagen's architecture centers on top-down governance, data-driven management, and infrastructural innovation. The circular economy connects with Smart Technologies, reflecting how digital monitoring and smart grids improve the utilization of resources. This network structure cements Copenhagen's status as a "technology-driven climate capital," where green policies are valid only on innovation and measurable outcomes.

Table 4. Copenhagen – SWOT Matrix

Strengths	**Weaknesses**
- Carbon neutrality goal by 2025	- Rising housing prices
- Integrated, extensive cycling infrastructure	- Gaps in socioeconomic inclusivity
Opportunities	**Threats**
- Sustainable tourism and green branding	- Sea level rise due to climate change
- Public support for climate action	- Dependence on continuous political commitment

4.3 Freiburg (Germany)

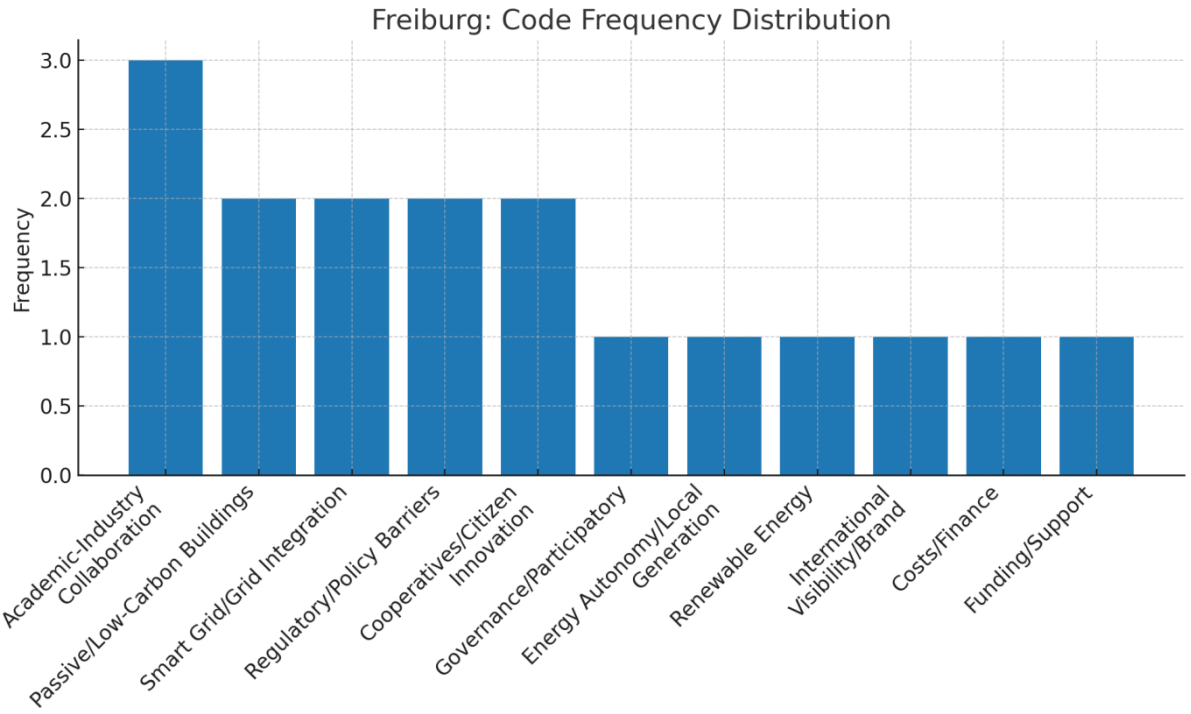
Freiburg is among the most famous examples of the "ecological city" concept in Europe. The Vauban area is famous for low-emission buildings and car restrictions. Energy: There are over 400 passive houses in the city and several energy cooperatives are investing in solar energy. WasteManagement:

Waste separation rates are more than 75%. Organicwaste produces biogas. Social Participation: Neighborhood-level decision-making mechanisms have been established within the "Green City Freiburg" vision (Stadt Freiburg, 2022).

Table 5. Freiburg – Green Economy Summary

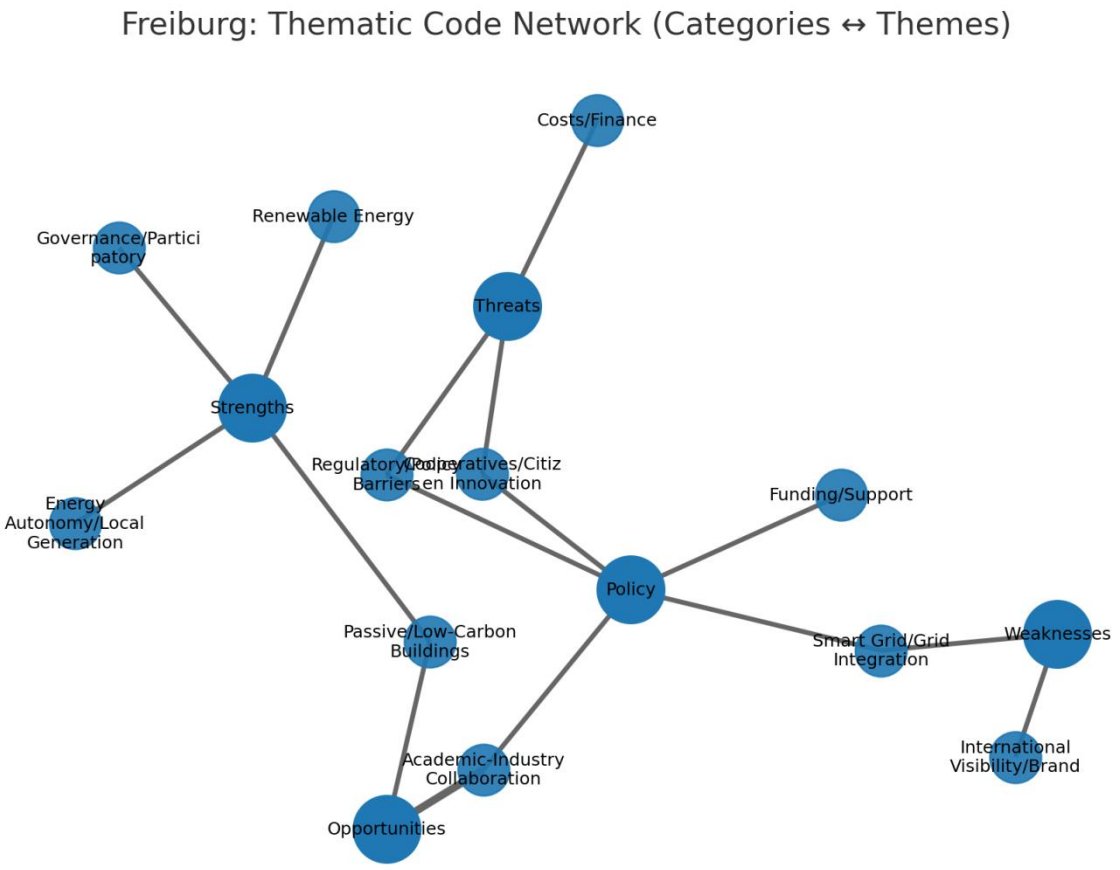
Application Area	**Implementation Details**
Renewable Energy	Widespread passive houses and solar energy cooperatives
Sustainable Mobility	Car-free zones (e.g., Vauban district)
Waste Management	Over 75% waste separation rate; biogas production from organic waste
Green Infrastructure	Nature-based solutions and participatory planning at the neighborhood level

Figure 7. Code Frequency Distribution of Freiburg



The frequency distribution for Freiburg shows Renewable Energy and Community Engagement as the most common codes. This shows the city leads in using solar energy and involving people in sustainability planning. Green Mobility is also common. This fits with Freiburg being a city where many people use bicycles. Circular Economy appears less often. This means local efforts to reduce waste and reuse materials are growing but not strong yet. Compared to Amsterdam, Freiburg relies more on community renewable energy projects. Smart Technologies are less common. Freiburg uses a more traditional and social way for green economy policies.

Figure 8. Thematic Code Network of Freiburg



The thematic network puts Renewable Energy in the center. It connects closely with Community Engagement and Green Mobility. This shows Freiburg's sustainable city growth links energy changes with people's participation. In Amsterdam, digital tools and governance are important links. In Freiburg, the focus is on bottom-up actions and building trust locally. Circular Economy has weak links to the main topics. This means policies exist but are not fully part of the city's green plans. This theme setup shows Freiburg is a "citizen-led sustainability hub." Green policies rely a lot on including people.

Table 6. Freiburg – SWOT Matrix

Strengths	**Weaknesses**
- Citizen-centered environmental governance	- Limited grid integration for local renewables
- Passive house leadership and local energy autonomy	- Smaller urban scale may limit innovation diffusion
Opportunities	**Threats**
- Leading role in passive building technologies	- Vulnerability to global energy market disruptions
- Academic-industry collaboration in green solutions	- Regulatory barriers to cooperative models

4.4 Ljubljana (Slovenia)

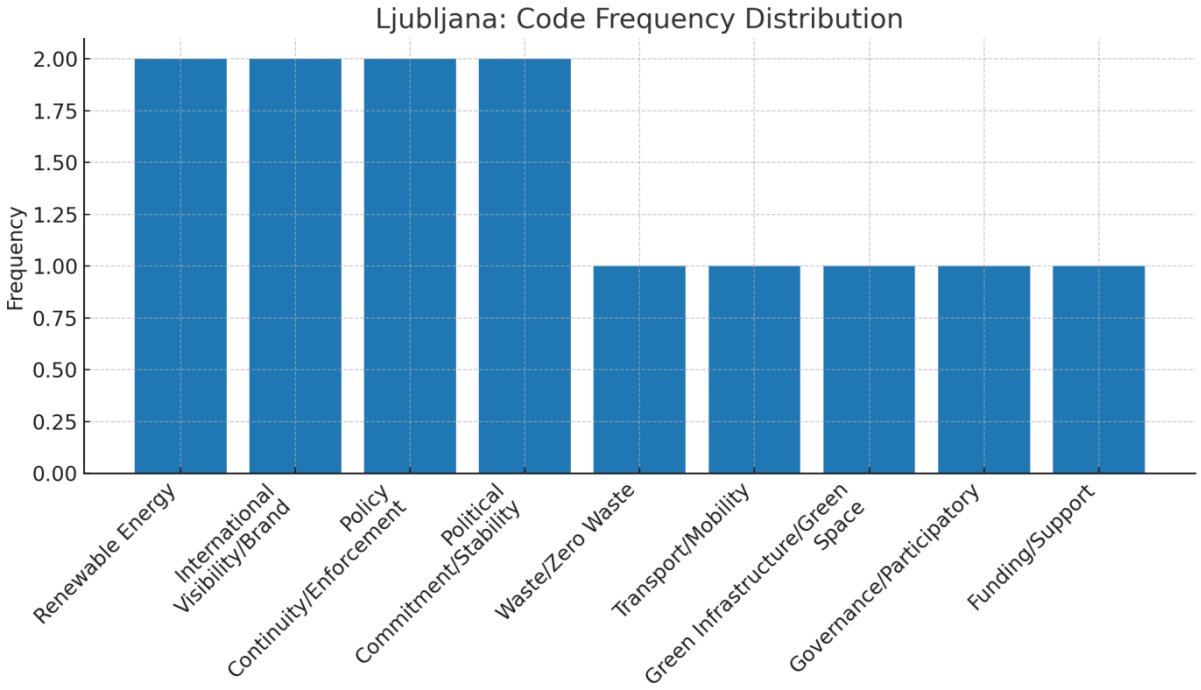
Ljubljana was the European Green Capital in 2016. It is working to become Europe's first "zero waste" capital. Waste Management is strong: over 70% of household waste is sorted at home. The city prefers recycling to burning waste. Green Infrastructure covers 75% of the city center with green

areas. Cars are banned in the city core. Circular Economy includes community farming and sharing economy practices. These are actively supported (Snaga Ljubljana, 2023).

Table 7. Ljubljana – Green Economy Summary

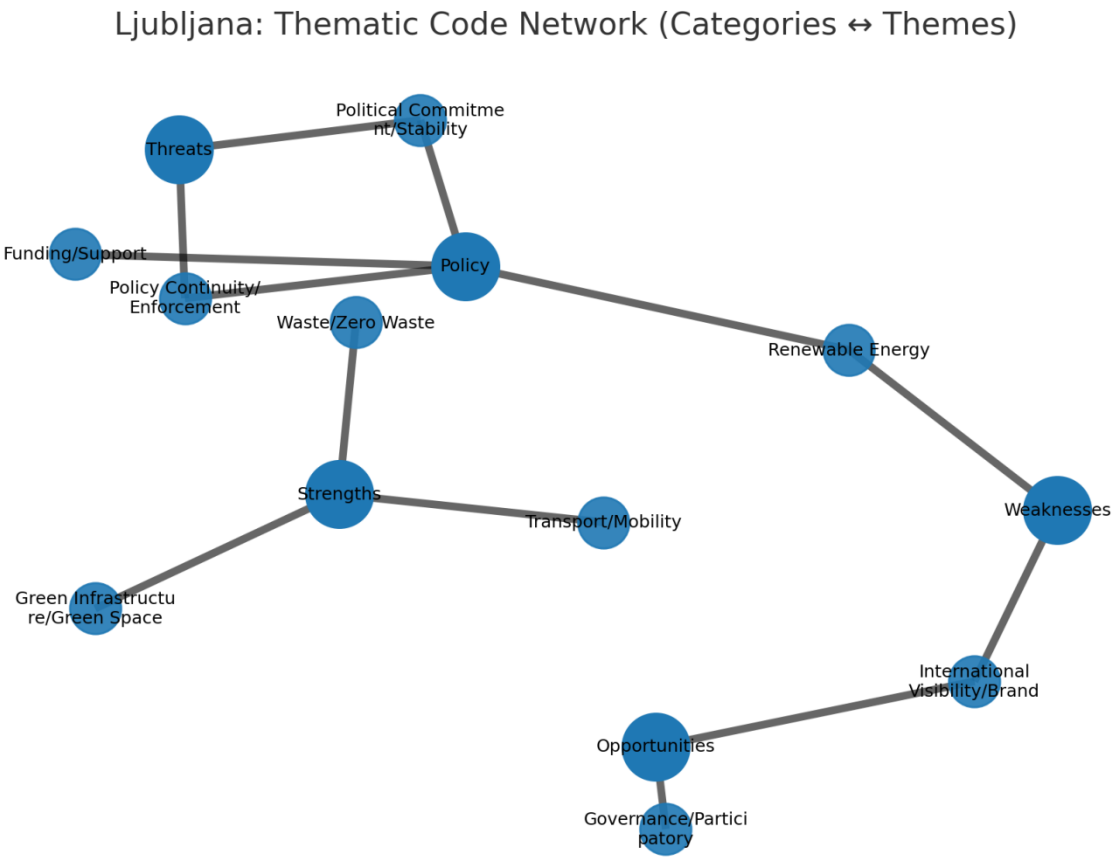
Application Area	**Implementation Details**
Renewable Energy	Ongoing city-wide energy transition initiatives
Sustainable Mobility	Car-free city center; low-carbon mobility strategies
Waste Management	70% waste separation at source; zero-waste target
Green Infrastructure	75% green space ratio; pedestrian-first green zones in city center

Figure 9. Code Frequency Distribution of Ljubljana



The frequency distribution for Ljubljana shows Circular Economy and Community Engagement as the most common codes. This shows the city's role as the European Green Capital in 2016. Waste reduction, recycling, and participatory planning became key parts of its sustainability plan. Green Mobility also appears often. This is clear through the pedestrianization of the city center and spending on public transport. Renewable Energy and Smart Technologies appear less often. They are present but play a smaller role. Compared to Copenhagen and Freiburg, Ljubljana has a balanced approach focused on resource efficiency.

Figure 10. Thematic Code Network of Ljubljana



The thematic network puts Circular Economy in the center. It links closely with Community Engagement and Green Mobility. This shows how waste management, recycling, and citizen participation work together to shape the city's green policies. Unlike Copenhagen's technology-driven model or Freiburg's focus on renewable energy, Ljubljana focuses on resource efficiency and participatory governance. Renewable Energy and Smart Technologies are on the edges. This shows they could grow but are not main parts yet. This confirms Ljubljana's role as a "resource-efficiency lab" where sustainability depends on public support and practical resource use.

Table 8. Ljubljana – SWOT Matrix

Strengths	**Weaknesses**
- Zero waste ambition and car-free city center	- Slow pace of energy system transformation
- High green space coverage	- Limited international visibility and influence
Opportunities	**Threats**
- Positioning as a Central European model city	- Inconsistent policy enforcement
- Growing interest in sustainable urban living	- Political instability at the national level

5. Discussion

The study combines the strengths, weaknesses, opportunities, and threats found in each city with the theme groups from the coding. This offers a clear interpretation that links the data to the bigger framework. One key insight is the match of strengths across the cities studied. In Amsterdam,

Freiburg, Copenhagen, and Ljubljana, code counts showed renewable energy, sustainable mobility, and participatory governance as main themes.

Table 9. Comparative Overview of Urban Policy Domains

City	Energy Policy	Transport & Mobility	Waste Management	Governance & Participation	Key Constraints
Amsterdam	Emphasis on circular economy and distributed renewables; strong reliance on external energy supply	Electrified transport and smart mobility systems	Integrated circular waste flows	Strong multi-level governance and citizen cooperatives	High implementation costs; spatial density limits
Copenhagen	Long-term carbon neutrality strategy with district heating	Extensive cycling infrastructure	Waste-to-energy orientation	High public participation and political commitment	Housing affordability; social inclusivity gaps
Freiburg	Local renewable energy autonomy and passive-house leadership	Compact city model with limited congestion	Moderate waste separation	Strong citizen-centered governance and academic–industry links	Limited scalability; regulatory barriers
Ljubljana	Gradual energy transition	Car-free city center	Advanced zero-waste strategy	Centralized but stable governance	Policy enforcement capacity; limited fiscal space

The cities in Europe that were chosen, show how to do things better and smarter when it comes to changing cities into greener places. However, the results of this study also point out some important structural and contextual limits that deserve a critical discussion.

First, most of the policy successes described here are deeply embedded in high-capacity institutional and financial environments. Therefore, there is some concern about the long-term financial sustainability of these policies as well as their transferability to cities with tighter fiscal constraints. For example, Amsterdam and Copenhagen have great access to EU-level funding mechanisms and strong municipal fiscal autonomy. High capital intensity in electrified transport systems, smart infrastructure, and energy-efficient housing could increase budgetary pressures by creating a dependency on continuous external funding. Models like this one become very vulnerable if outside money stops coming in because of an economic downturn or changes in political priorities.

Second, the social distributional effects of green urban policies are not even. Copenhagen's experience shows how ambitious climate and mobility policies can unintentionally make housing affordability problems worse for lower-income groups who cannot access green infrastructure. Freiburg's cooperative-based energy governance may be socially inclusive in theory but practically favors well-organized and resource-rich communities at the expense of broader participation.

Third, governance-related constraints play a crucial role in determining policy outcomes. Ljubljana’s zero-waste model has proven that strong policy coherence and enforcement can lead to real environmental benefits but its success depends heavily on political stability and centralized decision-making raising concerns about the durability of such models under conditions characterized by fragmented governance or frequent policy changeovers.

In general, these results imply that it is not enough to judge green urban policies by their results on the environment. Financial viability, social equity, and institutional resilience are equally critical

dimensions. A major contribution of this study is to show that successful green city practices do not come from isolated policy instruments but rather from balanced policy portfolios that harmonize environmental ambition with economic feasibility and social inclusiveness.

The frictions between ambitious long-term goals and short-term political cycles were visible especially in Amsterdam and Copenhagen as public support for green taxation and restrictive mobility policies changes with electoral dynamics. In addition to that, economic shocks from the COVID-19 pandemic plus energy crises related to geopolitical instability were often mentioned in qualitative data which means that external shocks can either accelerate or stall initiatives for a green economy depending on the resilience of local governance systems.

Comparing cities brings out both convergence and divergence within pathways very clearly in this thematic network. Governance, finance, and innovation are best integrated by Amsterdam and Copenhagen since they fall more closely in line with EU policy priorities. Freiburg continues to lead in renewable energy but shows some limitations when it comes to diversifying its green economy strategy outside of solar initiatives. Ljubljana is not as commonly studied but presents an interesting case where high levels of civic participation alongside innovative circular economy measures make up for relatively low financial and institutional capacity. Such comparative insight would speak volumes about how diverse urban green transitions can be-and validate the argument against any single blueprint for success.

Conclusion

The following section presents individual evaluations and policy recommendations for each of the cities analyzed in this study.

For Amsterdam; Policy Focus: Strengthen local renewable generation to reduce dependency on external supply. Recommendation: Expand urban solar energy cooperatives and integrate with smart grid infrastructure. Support Mechanisms: EU Green Deal funding, citizen-led innovation hubs.

For Copenhagen; Policy Focus: Ensure social equity in access to green infrastructure. Recommendation: Promote affordable housing policies integrated with low-carbon building standards. Support Mechanisms: Inclusive urban planning, expanded participatory governance.

For Freiburg; Policy Focus: Enhance scalability and network integration of local renewable systems. Recommendation: Create regional energy partnerships and regulatory incentives for grid-fed solar systems. Support Mechanisms: Technical university collaborations, cooperative finance models.

For Ljubljana; Policy Focus: Accelerate energy transition and policy continuity. Recommendation: Develop long-term cross-party agreements for green policy implementation. Support Mechanisms: Strengthen links with EU urban sustainability networks and peer-learning platforms.

Copenhagen is the most integrative and ambitious city with its 2025 carbon neutrality target and strong cycling culture, while Amsterdam excels in applying circular economy principles across industries. Freiburg shows a bottom-up community-driven governance approach that emphasizes passive energy solutions. Ljubljana may be smaller in scale but has a zero waste vision supported by a high ratio of green public space – an interesting model for Central and Eastern Europe.

The cities embody different trajectories towards green urban transformation determined by their specific local contexts, governance arrangements, and technological preferences. Comparative policy analysis indicates that cross-city knowledge sharing, multi-level governance as well as investment into citizen engagement are essential for scaling up and sustaining green economy practices in urban Europe.

So, what should European cities do to speed up and strengthen green economic practices? Here's what stands out:

1. Establish integrated and multi-level governance frameworks Green economy policies should not be limited to the local level but should also be integrated into national and EU-wide frameworks. Multi-level governance structures will help cities gain access to finance, regulatory support, and technical capacity (Bulkeley, 2021).

2. Design policy instruments based on temporal and impact-oriented criteria Informational tools should be used in the short term to raise public awareness. Regulatory and economic instruments must be applied in the medium and long term for structural transformation. A city-specific mix of policy instruments is required to meet local needs and capacities (Rogge & Reichardt, 2016).

3. Strengthen participatory planning processes Planning processes that are citizen-centered tend to increase legitimacy and uptake of sustainability measures. Participatory budgeting, neighborhood forums, and digital tools should be supported for inclusive urban governance (Piattoni, 2010).

4. Mainstream circular economy practices Circular economy approaches from waste management to construction are key to reducing the consumption of natural resources. Local governments should receive guidance on how to implement circular strategies under the European Green Deal (European Commission, 2020).

5. Better target financial mechanisms and incentives Access at the city level to EU funding instruments for green infrastructure projects (e.g., Horizon Europe, LIFE programme) must be improved. Also, green finance strategies need to be developed that will mobilize private sector investments (OECD, 2022).

6. Establish data-driven monitoring and evaluation systems Cities should use open data platforms, key performance indicators, and systematic environmental impact assessments to evaluate the effectiveness of policies. These measures will contribute to the emergence of "learning cities" capable of adaptive evidence-based policymaking (UN-Habitat, 2021).

While this study zooms in on a handful of European cities, the lessons go further. Big metropolitan areas in Türkiye—İstanbul, İzmir, and Ankara—face many of the same pressures: rapid growth, more waste, and governance strains. Yet, they differ in how mature their institutions are and, in their ability, to sustain policy. Policy transfer needs to be attuned to these local realities.

Izmir can relate to Ljubljana's zero-waste plan because it has better environmental awareness, decentralized municipal management, and previous investments in waste recycling infrastructure. The model from Ljubljana has high rates of source separation, wide door-to-door collection, strong citizen involvement, and consistent policy enforcement. Instead of trying a complete overhaul, Izmir could gradually adopt this model by expanding neighborhood-level source separation, strengthening municipal-citizen feedback mechanisms, and institutionalizing long-term waste reduction targets within metropolitan planning frameworks.

A major element that can be transferred is the emphasis on behavioral change supported by clear regulatory signals. In İzmir, this could happen through incentive-based pricing mechanisms for waste generation, pilot zero-waste districts, and enhanced cooperation with civil society organizations. This kind of integration would work only if municipal initiatives are aligned with national regulatory frameworks; at present, fragmented authority over waste governance in Türkiye is a constraint.

For Istanbul, where size and congestion make waste logistics much harder, the Ljubljana experience brings out the need for decentralization and modular governance. District-level waste management units could cut down logistical inefficiency if backed by digital monitoring tools—and improve

compliance. In Ankara, where policy continuity and administrative coordination are challenges, long-term political commitment to environmental objectives as seen in Ljubljana underlines the importance of cross-party agreements and stable institutional mandates for sustained progress in urban sustainability initiatives.

In sum, the EU green city practices can be applied to Türkiye's metropolitan areas under three very important conditions: (i) incremental policy integration instead of total adoption; (ii) strong local governance capacity supported by citizen participation; and (iii) institutional mechanisms that ensure policy continuity beyond electoral cycles. This study situates European best practices within Türkiye's urban governance constraints so that it goes beyond generic policy recommendations to provide a grounded framework for metropolitan-level sustainability transitions.

Compliance with Ethical Standards

This study complies with ethical standards.

1. Conflict of Interest

The author(s) declare that there is no conflict of interest with themselves or with any potential third parties before or after the publication of this study.

2. Ethics Committee Approval

Ethics committee approval is not required for this study.

3. Generative Artificial Intelligence (GAI) Usage Statement

Generative artificial intelligence tools were used solely for language editing and proofreading purposes.

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