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Leadership of European Union cities in environmental policies

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Abstract

This research addresses EU cities' leadership in environmental policies. Concretely, it aims to explore and understand the overarching strategic processes local governments establish to achieve their internal environmental ambitions regarding policy outputs: developing highly innovative environmental policies. The problem formulation of this research is "How do leading EU cities in environmental policy outputs achieve their internal environmental ambitions?".

Understanding and adapting the theoretical framework of causality factors for developing highly innovative environmental policies enabled the identification of two sequential factors: a collaborative creation and a well-established knowledge base of the actors involved. Furthermore, the research uses a theoretical framework delineating three co-creation strategies: internal whole of government, externally focused stakeholder and externally focused civil society. Based on the combination of both frameworks, the research outlines an analytical framework for developing highly innovative environmental policies, comprised of characterising elements.

The research uses the case of the city of Barcelona, largely known for its engagement in environmental policies, to further complete and test the analytical framework. Six crucial documents, each providing information on creation processes, policies' approaches, and knowledge development, have been analysed to understand and delineate Barcelona's City Council strategic mechanisms. Moreover, based on an abductive approach, the research outlines a third factor that follows the same sequential logic as the first two factors: a spread climate culture.

The research concludes that Barcelona's approach to achieving its IEA involves a collaborative creation that leverages a well-established knowledge base underpinned by a spread climate culture. Its approach is further comprised of the following five key aspects: i) A green advocacy coalition as the strategy cornerstone; ii) A whole-of-government strategy adopting an exemplary and disseminator role; iii) A combination of the three co-creation strategies to merge various forms of knowledge; iv) A particular emphasis on involving and addressing citizens; v) A social transformation towards climate culture.

This research's relevance lies in its capacity to showcase EU cities with high internal environmental policy ambitions and aspiring for leadership in environmental policy outputs, Barcelona's overarching strategic process and potentially mimic it. The research can also enhance overall climate action by contributing to developing further innovative policies that address environmental challenges.

Table of content

Table of Tables

Table of Figures

Abbreviation List

B+S Network	Barcelona + Sustainable Network
BCC	Barcelona's City Council
BCCC	Barcelona Climate City Contract
CBC	Barcelona's Commitment to the Climate
CCS	Citizen Commitment to Sustainability
CEAP	Climate Emergency Action Plan
CP	Barcelona's Climate Plan
EC strategy	Externally focused civil society strategy
EEA	External environmental ambitions
ES strategy	Externally focused stakeholder strategy
EU	European Union
IEA	Internal environmental ambitions
IG strategy	Internal whole of government strategy
LCCP	Let's Change for the Climate 2030 Plan
NGO	Non-Governmental Organisation
PF	Problem Formulation
SPAB	Strategy for promoting the 2030 Agenda in the city of Barcelona
UNFCCC	United Nations Framework Convention on Climate Change

1. Introduction

The World Health Organisation stated in 2018 that "*Climate change is the greatest challenge of the 21st century, threatening all aspects of the society in which we live*" (World Health Organization, 2018:8). The consequences, seen globally and daily, require a global effort, prompting the emergence of international initiatives such as the Paris Agreement and the UN Sustainable Development Goals. The European Union (EU) is particularly engaged in establishing tools and mechanisms, such as the European Green Deal, to promote further action to reduce greenhouse gas emissions among member states. Climatic governance encompasses the development of innovative policies and measures to mitigate climate change, fulfilling internal environmental ambitions (IEA) regarding policy outputs. Governments also often engage in gaining foreign replication of these domestic policies, advancing their external environmental ambitions (EEA) concerning policy outputs. The combination of these endeavours by governments resulting in leadership.

While this behaviour is commonly attributed to state governments, local governments within the EU are granted capacity and autonomy by national and EU institutions to engage in climatic governance, create and diffuse innovative policies, and thus own internal and external environmental ambitions related to policy outputs. Cities have been emerging as significant players in addressing the climate challenge. They have increased relevance in the international environmental framework stemming from their direct involvement in the issue, their proximity to the public and the increased decentralisation the world is experiencing (United Nations, 2019).

While the focus is usually on state governments and the implementation and enforcement of domestic policies, this research further investigates the first step for reaching leadership in policy output in the context of leading EU cities. Specifically, it explores the overarching strategic processes EU cities implement to create highly innovative environmental policies. Through an analysis of causal factors, the research highlights the necessity for collaborative creation processes that leverage a well-established knowledge base of the subjects involved. Along with adapting a theoretical co-creation framework based on three distinct strategies, an analytical framework is proposed for developing highly innovative environmental policies by cities. This analytical framework is empirically tested through a single case study centred on Barcelona. An extensive analysis of documents from Barcelona's City Council, enable to conclude on the city's approach for achieving internal environmental ambitions.

The research is structured into ten sections. Following this introduction, a comprehensive literature review aimed at elucidating the concept of leadership and its version within this research. The third section articulates the problem formulation and related objectives. Subsequently, the theoretical framework is delineated, discussed and adapted to the specific purpose of this research. Section five outlines the methods employed, and the analysis is presented in section six. The discussion of the analysis findings and the conclusion are further detailed in sections seven and eight, respectively. The research is finalised with an annex and bibliography. This research's relevance lies in presenting strategies followed by leading EU cities to develop highly innovative environmental policies, which can guide other cities to do the same, further contributing to tackling climate change.

2. Literature review

2.1 Leadership

"*Leadership is a social phenomenon that is found everywhere*" (Dinibutun, 2020:46). According to Young, it is "*a complex phenomenon*" (1991:281). As a subjective and multifaceted concept, "*understanding and delineating the investigator's purposes*" is crucial for grasping the conception of leadership that is taken (Karmel,1978:476). However, leadership is generally defined as the ability to guide others towards a goal (Robbins, 1990:302). In this definition, four main components are found: the subject leading, its action of leading, the subject(s) following its lead, and the goal toward which the action is directed. The subsequent section will explore the concept of leadership by examining these four components.

2.1.1 Components of Leadership

According to the definition provided, leadership implies that a subject, defined as the leader, guides in competition with other subjects (Nabers, 2010). While commonly associated with the conduct of individuals within organisational or political contexts, the principles of leadership can also be applied to the conduction of larger entities, such as corporations or states.

Three main research approaches have dominated the study of leadership generation (Goethals et al., 2004). The trait approach considers leadership capacity inherent to the subject embodying it and is dependent on specific traits (Grinnell, 2004; Goethals et al., 2004). Subsequent researchers saw leadership as a behavioural process that subjects engage in rather than based on qualities and abilities. The study of leadership from this behavioural approach implies that leadership can be learned and evolved and that subjects willingly guide others (Dinibutun, 2020). The last strategy for the study of leadership generation, situational, focuses on the influence of context and environment for leadership to emerge and be effective (Goethals et al., 2004:869).

The behavioural approach of leadership is often related to the concept of power. According to Colquitt et al., leadership is "*the use of power and influence to direct the activities of followers toward goal achievement*" (2015: 430). Power, as "*the ability to influence the behaviour of others to get the outcomes you want*" (Nye, 2004:2), is often differentiated between soft and hard power. The differentiation is critical because, as Burns states, "*all leaders are actual or potential powerholders, but not all powerholders are leaders*" (1978:18). The difference lies in the motives and considerations subjects have with the power they hold (Burns, 1978). Hard power means using force and coercion through military and economic tools to gain control and authority over others' actions (Nye, 1990). However, this does not quantify as leadership (Marvel, 2012: N/A), as hard power holders show little concern for others' interests, using their power to fulfil their own primarily (Goethals & Bradburn, 2016:2). Successful leadership thus implies the use of soft power (Nye, 2004) and influence towards a common goal "*having true concern for what matters to followers*" (Goethals & Bradburn, 2016:2), forging a relationship between both subjects (Goethals et al, 2004). The use of values and culture, for instance, is a means for influencing others and earning leadership (Maxwell, 1998:11). While influence is primarily attributed to leaders, the second subject also holds influence over leaders. Although often understudied, the follower plays a crucial role in leadership dynamics, as he can support or sabotage the leader's action (Grinnell, 2004:829). This implies that while it might not be symmetric, leaders and

followers hold mutual influence and leadership is a collective effort, not solely from the leader's side (Yukl, 2010). Leadership processes imply competition between different subjects, thus necessitating aspiring leaders to consider and adapt to the follower, for this one to understand and agree about what they are trying to make them do (Ibid).

The art of leadership depends on the level of legitimacy that the latter owns to lead (Goethals et al., 2004). Legitimacy is the consideration that the decisions and directions taken are valid and entitled to be obeyed and highly depends on followers' perception of leaders' justified capacity to lead (Marques et al., 2021). Apart from leaders' behaviour, influence and power, their capacity to lead is also based on the credibility and competence of leaders in the subject matter (Ibid). This implies that leaders must possess a certain skill or capacity in the area they are leading and demonstrate it. Without a solid foundation of capacity to sustain leadership, followers will likely recognise the lack of substance, leading to a loss of legitimacy for the leader and leadership becoming transitory. Overall, the dimension of time is essential in the case of leadership, as this can be achieved during a period but not maintained throughout the years.

2.1.2 Leadership approach

The previous section outlined the essential components of the concept of leadership; this section aims to delve deeper into the type of leadership this research addresses.

Leadership can be applied to various contexts (Ignatyeva & Isaev, 2018). In the governmental context, leadership is found on a political and geopolitical scale. As a subdiscipline of geopolitical leadership, political leadership refers to the leadership that individuals and political parties exercise within a state (Ibid). Geopolitical leadership, however, refers to leadership exercised by subjects on a global and international scale (Ibid). Within the latter, leading subjects can thus be states, cities, or even individuals within various spheres, including environmental, economic, and social.

2.1.2.1 Environmental Geopolitical Leadership

As seen in Section 1.1, leadership is a process that requires a collective effort to reach a common goal of the leader and follower(s). One such common contemporary goal is the fight against climate change within the environmental sphere. Given the global significance of this issue, it is natural that specific individuals or groups emerge as leaders in the quest for solutions. It is important to note that various scopes of environmental leadership can be under discussion, limiting the subjects engaged. Liefferink et al. (2009) differentiate environmental policy outcomes and policy outputs within the political scope. While policy outcome refers to the results, such as air quality or gas emissions, policy output refers to the formulated and enforced policies. Focusing specifically on governments' engagement in environmental action through policy output innovation, it is important to note that while national governments usually serve as the primary leaders in formulating environmental policies, local governments are also becoming increasingly important.

2.1.2.2 Cities' leadership in environmental policy output

Although EU cities operate within the framework of their respective national law as well as the EU and international ones, they do have the autonomy and capacity to enact their own

environmental policies and strategies. That can be further seen through the support provided by the international and EU climate framework.

The international one is first defined by the United Nations Framework Convention on Climate Change (UNFCCC) COP 21, also known as the 2015 Paris Agreement (UNFCCC, n.d.B). The agreement legally binds the 196 parties to hold "*the increase in the global average temperature to well below 2°C above pre-industrial levels*" and pursue efforts "*to limit the temperature increase to 1.5°C above pre-industrial levels*" (UNFCCC, n.d.A). This Agreement supposed a change in the traditional focus on national governments for climate action, recognising the crucial role of city councils as problem-solvers and setting the stage for them to undertake ambitious climate action, including pioneering innovative initiatives. During the Conference, more than 400 mayors signed the Compact of Mayors, pledging to reduce greenhouse gas emissions (Dasgupta, 2015). The international framework is completed with the United Nations' 2030 Agenda for Sustainable Development, a plan of action with 17 Sustainable Development Goals (SDG) targeting economic, social and environmental dimensions (United Nations, n.d.A). While the 12th through 15th SDGs are tightly related to climate, the 11th goal includes several targets linking the environment and cities, such as developing sustainable urban planning with civil society participation and reducing the environmental impact of cities (United Nations, n.d.B).

The EU climate framework is based on the European Green Deal, a package of policy initiatives established in 2019 to convert Europe into the first climate-neutral continent by 2050 (Council of the EU, n.d.). The European Green Deal recognises the critical role of local governments in developing ecologically transformative policies (Eurocities and Energy Cities, 2024). In 2021, the European Climate Law legally bound the whole EU to cut net greenhouse gas emissions by at least 55% by 2030, compared to 1990 levels, and to reach climate neutrality in 2050 (Regulation (EU) 2021/1119). Cities are highly involved in achieving this goal, notably through Horizon Europe's mission "*100 Climate-Neutral and Smart Cities by 2030*", which offers experimentation and innovation hubs to 100 selected cities to support them in the development and implementation of Climate City Contracts outlining the vision, action plan and investment strategy for local climate neutrality (European Commission, n.d.C).

Continually operating within the international, EU and national frameworks, numerous cities establish ambitious and novel policies and measures to accelerate actions further and achieve impactful results, resulting in leadership towards other cities, national governments, or even the EU. Cities issue climate change mitigation and adaptation plans, reflecting their local policies, measures, and goals (UN-Habitat, 2015; EURO-LCP Initiative). Serving as comprehensive frameworks, these climate action plans integrate a comprehensive vision and strategic direction for the city and all its stakeholders regarding climate action. Climate change mitigation and climate adaptation are the two main approaches to climate action (NASA; n.d.), each entailing different tools and policies. While the climate change mitigation approach aims to reduce the emission of greenhouse gases in the atmosphere, the climate adaptation one seeks to adapt to climate change.

2.2 Cities' ambitions in environmental policy

This section explores the behaviour approach to cities' leadership in environmental policy outputs, based on Liefferink and Wurzel (2017) understanding of internal and external

environmental ambitions. While it is applied to states, given cities' capacity to develop leadership in environmental policy outputs, it is argued that cities also possess these environmental ambitions.

2.2.1 Conceptualisation

As a global and pressing challenge, climate action is witnessing the emergence of diverse behaviours or positions and in the development of policy outputs. According to Liefferink & Wurzel (2017), these behaviours and positions are highly related to internal and external environmental ambitions. Here, environmental ambitions should not be confused with specific goals regarding environmental protection or climate change mitigation, such as reducing CO2 emissions. Instead, environmental ambitions refer to the commitment to create and develop policies that address environmental challenges. Thus, IEA, in the context of policy outputs' development, reflect the will to develop innovative domestic environmental policies and measures to address climate challenges internally. On the other hand, EEA indicate the commitment to disseminate domestic environmental policies and measures on a broader international scale (Ibid). It is important to note that references to environmental ambitions throughout the research will consistently take a policy output approach.

Table 1: Ambitions and positions of actors in environmental policies[1]

		Internal environmental ambitions	
		Low	High
External environmental ambitions	Low	Laggard	Pioneer
	High	Symbolic leader	Pusher

Table 1 shows that cities exhibit varying degrees of internal and external environmental ambitions, leading to four distinct behaviours regarding environmental policy outputs. Pioneers and pushers possess high IEA, meaning they actively seek to develop and implement innovative domestic policies. The reasons why governments have high IEA are various and cumulative. The multiplication and intensification of extreme weather events due to climate change affect all cities in some way or another. Genuinely concerned about the environment, local governments may advocate for policies that incentivise further actions and raise awareness about environmental issues. Stemming from this concern is the overarching impact of these events on all facets of societies, encompassing health, economy, and development. In anticipation of safeguarding society's future functionality and sustainability, governments are inclined to innovate and enact environmental policies. Moreover, climate consciousness does not solely reside within the government; the public, significantly impacted by the consequences of climate change, can exert pressure on governments to take measures. Finally, it is essential to consider the role of international agreements and treaties in driving the adoption of domestic policy outputs.

The distinction between pioneers and pushers lies in their EEA. Pushers, also known as leaders, actively diffuse and transfer their domestic policies internationally. Thus, they have the "*explicit aim of leading others, and, if necessary, to push others into a follower position*" (Liefferink &

[1] Replication of the table "Ambitions and positions of environmental leaders and pioneers" developed by Liefferink and Wurzel (2017:954).

Wurzel, 2017:953). Whether successful or not, they implement strategies to diffuse their policies and attract followers to replicate and adopt them through marketing and communication strategies. Therefore, leadership results from the interplay of internally establishing policies and actively implementing influential strategies to diffuse those policies and earn followership. This active engagement reflects the behavioural approach of leadership generation in Section 2.1.1. Pioneers, characterised by having low EEA, do not intentionally diffuse and transfer their domestic policies. The reasons behind cities' high EEA, similar to IEA's, lie in the contribution to society's future functionality and sustainability, but in this case, in its globality. Additionally, a forefront position will support the development of influence and power over others, resulting in improved reputation and soft power. Finally, by sharing, diffusing, and anchoring national policies at the European or international level and influencing global environmental frameworks and structures, cities can further enhance their competitiveness and subsequently minimise efforts to adapt (Jänicke, 2000).

Mirroring the importance of time in leadership, as seen in Section 2.1.1, it is crucial to recognise that cities' environmental ambitions can fluctuate over time (Liefferink & Wurzel, 2017). This entails that domestic preferences regarding the development of environmental policies or the level of diffusion of those can vary, particularly in the occurrence of triggering or, conversely, hindering events. Consequently, over time, cities shift their behaviour regarding environmental policy outputs, resulting in changes in their leadership.

2.2.2 Interplay of environmental ambitions

Leaders ' internal and external environmental ambitions are interrelated, and the impact of one on the other is to be considered (Liefferink & Wurzel, 2017). Leaders' second objective of transferring domestic policies implies that those need to be transferrable and feasible in other cities, avoiding overly local customisation during their design. Thus, their conception needs to comprise external consideration to ensure subsequent maximum diffusion and followership (Ibid). IEA also impact EEA because the latter can only be appropriately reached if "well-developed domestic capacities" exist (Ibid: 959). As seen in Section 2.1.1, such domestic capacities will provide legitimacy for the cities to seek the transfer of domestic policies and measures abroad (Jänicke, 2005).

3. Problem formulation

While investigating both environmental ambitions and their interplay is crucial to get a comprehensive overview of city leadership, due to page limitations and a desire for a focused and detailed analysis, this research concentrates solely on leaders' achievement of IEA. The exploration of EEA achievement is consequently deferred to a complementary study, which could serve as a second phase of a broader research endeavour. Building on the outlined literature review, the problem formulation (PF) of this research is:

"How do leading EU cities in environmental policy outputs achieve their internal environmental ambitions?"

The objective of this research is to understand how IEA of policy outputs are achieved by leading EU cities in environmental policy outputs. Specifically, it aims to outline and understand which

strategies and mechanisms governments of leading cities establish to develop innovative domestic environmental policies and measures. Thus, it does not focus on the implementation phase of policies but on the policy-making phase. This research addresses the leadership of EU cities in the environmental policy sphere, particularly regarding policy outputs aimed at mitigating climate change. It does not aim to compare successive policies but to discern the overarching strategic creation process embraced by leading EU cities in climate change mitigation policy-making.

This research is relevant because further developing cities capable of creating innovative environmental policies is crucial to addressing the climate crisis the world is currently experiencing and contributing to the mitigation of climate change. This research's discussion and conclusion aim to inform local governments about the strategies that leading cities establish and pursue, serving as a guide for them to become leaders as well in environmental policy outputs and further contribute to climate action. The research is also relevant for the various actors involved in developing environmental policy outputs, such as businesses, research institutions, NGOs and citizens, to showcase their cruciality in the process. Finally, this research provides the opportunity for further research on EEA, thus completing a broad research endeavour on city leadership and environmental ambitions of policy outputs.

4. Theoretical framework

The structure of the theoretical framework within this research is intricately linked to the PF. This one encompasses two key elements: the subjects under investigation, which are "*leading EU cities in environmental policy outputs*", and the action that those subjects undertake, set out as "*the achievement of their internal environmental ambitions*". Addressing the first aspect requires a thorough examination of the concept of leadership, specifically in environmental policy outputs, which has already been conducted in the literature review section (Section 2). The second aspect of the PF necessitates a theoretical explanation of the mechanisms and strategies employed to achieve those ambitions. Responding to the PF requires, thus, a combination of conceptual clarification (Section 2) and theoretical explanation, which will be addressed in the theoretical framework. This outline aims to provide a foundation for understanding leadership and environmental policy output development in the case of EU cities.

4.1 Cities' achievement of internal environmental ambitions

As seen, IEA encompass the development of highly innovative domestic environmental policies. This section builds upon a theoretical framework concerning developing and creating highly innovative environmental policies to present this research's unique interpretation and understanding.

4.1.1 Causality factors

The achievement of IEA and the possibility of subsequent legitimation of external transfer depends on various factors. Jänicke (2005) outlines a causality funnel encompassing four factors that lead to national pioneer capacity for developing environmental policies, therefore forging the accomplishment of states' IEA (Section 2.2.1). This section aims to review these factors and consider their application to cities.

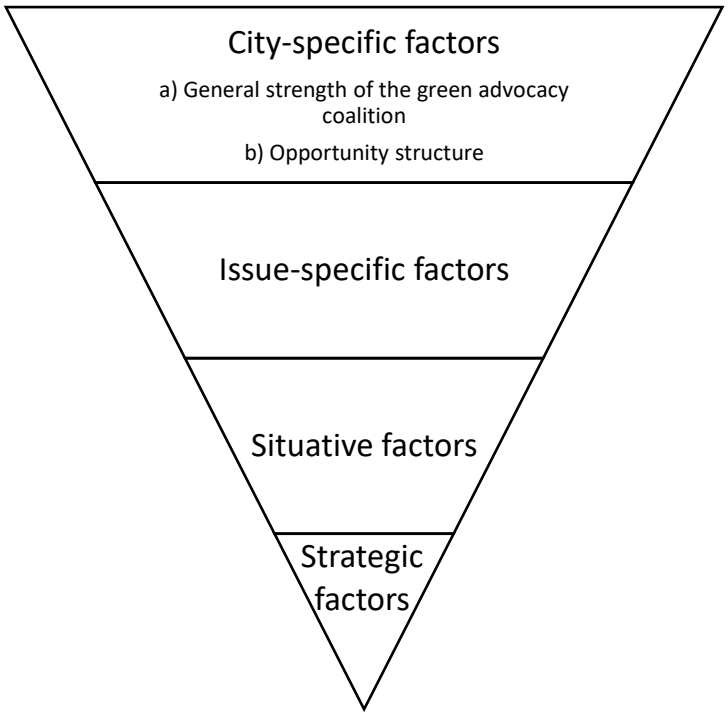


Figure 1: Causality funnel for achieving internal environmental ambitions[2]

As depicted in Figure 1, the four types of factors comprising the causality funnel are state or city-specific, issue-specific, situative, and strategic. Jänicke (2005) argues that policy innovation depends on a first instance of domestic factors that bring high capacity for environmental policy-making, which, according to the OECD, is the "*society's ability to identify and solve environmental problems*" (OECD, 1994:8). These factors are closely related to the personal qualities and abilities approach of leadership generation explained in Section 2.1.1. Under these factors, Jänicke (2005) distinguishes, on the one hand, an opportunity structure brought by political and institutional, economic, and cognitive and informational conditions, and on the other hand, a green advocacy coalition.

By political and institutional conditions, Jänicke (2005) refers to the structure of the political system, mainly the openness and capacity for policy integration and coordination that the state holds. Logically, for developing domestic environmental policies, states need a democratic and efficient political structure that promotes the creation of policies. Furthermore, Jänicke (2005) adds the policy style of states as a significant component of political and institutional conditions, meaning the culture of dialogues and consensus across the government. Jänicke (2005) further mentions EU membership as a critical component for favourable conditions, considering that the EU system actively fosters innovation in environmental policies. These conditions apply to both states and cities, as these also own political and institutional structures that can, to a greater or lower degree, affect their capacity to develop environmental policies. It is important to note that

[2] Replication and adaptation of the "National pioneer roles in environmental policy: Funnel of Causality" developed by Jänicke (2005:131).

the political government in place will further influence the direction of policies and initiatives, supporting or undermining pioneership in environmental policies. Governments with a progressive outlook will likely favour environmental policies and actions (Chan & Faria, 2022). Conversely, administrations with a traditional and conservative stance are less likely to prioritise these policies.

The state's economic condition also significantly shapes the opportunity structure for developing innovative environmental policies. A favourable economy allows states to allocate resources and funds to adapting and aligning the administrative and educational structure with the development of environmental policies. It additionally facilitates investment in scientific research and education development, fostering innovation. The economic condition also highly impacts cities' ability to develop environmental policies, as it directly influences the availability of funding for initiatives and structures that support environmental policy development.

The opportunity structure is lastly composed of cognitive and informational conditions. That is, establishing a knowledge base for environmental policy innovation, which entails three aspects. The first aspect is producing this knowledge base through high R&D expenditures and a strong national innovation system. The second aspect is the transfer of the knowledge base to the public and political elite, and the third and last aspect is the adoption of this knowledge base by an educated audience. Drawing from the multiplication of information flows in all aspects of societies and the successive processing, understanding and contextualisation of this information to transform it into knowledge, Western societies are often referred to as knowledge societies (Zelazny, 2015; Publications Office of the EU, n.d.). Knowledge production involves not only infrastructures promoting innovation and the development of knowledge but also facilitates knowledge management, distribution, dissemination, and communication (Zelazny, 2015). This results in knowledge-based economies that rely highly on intellectual capabilities (Powell & Snellman, 2004). In this type of economy, "*economic success depends on the effective utilisation of intangible assets such as knowledge, skills and innovative potential*" (Roberts, 2009: 11). Therefore, the combination of internal structures enabling the development, transfer and management of an environment knowledge base is critical for developing environmental policies. The cognitive and informational conditions of cities, while guided by the national conditions, are proper to them. These have their own knowledge base and innovation system, which can be seen by cities' budget for R&D expenditures aiming at funding research centres and knowledge development. Moreover, several EU initiatives are directed to local governments to develop their cognitive conditions, including URBACT (n.d.).

Jänicke (2005) also introduced green advocacy coalition as domestic factors that bring a high capacity for environmental policy-making. Two main groups of actors characterise this coalition. On one side, traditional proponents of environmental policy are composed of competent environmental government division administrations or a strong and professional ecology movement. The second side of the coalition is formed by modernisers within the industry, aiming to update and improve traditional practices with advanced systems and practices. Jänicke (2005) refers to this coalition as the coalition for ecological modernisation, a school of thought that advocates for a synergistic and positive-sum relationship between economic growth and environmental preservation (Howes et al., 2010).

According to Jänicke (2005), these state-specific factors are relatively stable, therefore not explaining changes in actors' ambitions and roles mentioned in Section 2.2.1. The author outlines three additional factors that explain the unstable aspect of IEA. The second type of factors that lead to pioneer roles is issue-specific. It entails that given the wide range of areas (contamination, biodiversity, deforestation, climate change…) and strategies that environmental policies can address, it is unlikely that states or cities can be pioneers in all of them. Given the greater uniformity of cities' internal characteristics and interests, they are likely to specialise in specific issues that better fit their situation or that they are most affected by or related to, based on their internal characteristics. For example, cities located near the sea will prioritise environmental policy innovations in mitigating maritime-related greenhouse gas emissions and adapting to sea-level rise.

As a third type of factor, Jänicke (2005) introduces situative factors, which recall the third approach for studying leadership generation, seen in Section 2.1.1. Also called policy windows, these events may restrict or support states' and cities' domestic capacity introduced previously, such as economic or political conditions. Those events can be internal or external, encompassing economic difficulties, elections, security issues, and competition. Moreover, climate-related events, such as droughts or hosting conferences on environmental issues, can further impact IEA.

4.1.2 Strategies to Achieve Internal Environmental Ambitions

The fourth and last type of factor Jänicke (2005) sets out is strategic. States' and cities' leadership in environmental policy does not solely rely on specific characteristics. As seen in Section 2.1.1, studies about leadership generation included a behavioural approach. This implies that pioneership emerges from a strategic leverage of the domestic capacity to innovate and develop environmental policies and from actively promoting a conducive environment. Similar to political and institutional conditions, the strategic aspect of environmental policies is largely influenced by the ideology of the governing political party or leader. It is noteworthy that governments with a progressive outlook will be more likely to establish strategies that promote a conducive environment for the development of environmental actions and policies (Chan & Faria, 2022).

4.1.3 Own understanding: Factors contributing to cities' achievement of internal environmental ambitions

Having set out Jänicke's causality funnel (2005) for achieving IEA, the researcher aims to further build its own understanding.

Given cities' limitations in leading across all environmental policy areas and strategies and limit issue-specific factors, the research focus will be specifically on policies and measures related to climate change mitigation. Furthermore, to simplify the research, situative factors, which are primarily external and beyond cities' control, are dismissed. As for strategic factors, they are considered constant, suggesting that cities maintain a consistent strategic inclination toward leading in environmental policy outputs. For that end, the standpoint of social and progressive-inclined governments will be taken to limit the influence of ideologies within the research. Thus, this research solely considers city-specific factors to explain cities' development of innovative policies.

The analysis of these city-specific factors revealed that they are intricately related to two aspects: collaborative creation and knowledge base. The explanation will first focus on collaborative creation, defined as the joint development of policies by subjects from diverse backgrounds and areas of expertise. The open and democratic political and institutional conditions of a city support the adoption of collaborative creation processes (Section 4.1.1). It was also seen that a city's good economic condition contributes to adapting its administrative structure and design to developing policies comprising collaborative processes. Lastly, these processes are also promoted by a strong advocacy coalition. It is thus argued that to develop highly innovative environmental policies, a collaborative creation process is essential. In the context of policy creation processes, knowledge base refers to the level of relevant information and knowledge possessed by those involved in the processes. The economic condition of a city significantly contributes to this aspect by facilitating investments in research and education development, thereby meeting the necessary cognitive and informational conditions (Section 4.1.1). Consequently, this research contends that well-established knowledge bases further enable the development of highly innovative environmental policies.

It is further argued that both aspects are interconnected and sequential, collaborative creation processes requiring a well-established knowledge base for the subjects involved. Without it, the subjects involved cannot effectively contribute to the policy-making process, failing to address the complexity of environmental issues efficiently. Thus, to develop highly innovative environmental policies, it can be concluded that City Councils need to engage in collaborative creation processes that leverage a well-established knowledge base of the subjects involved.

4.2 Collaborative creation leveraging a well-established knowledge base

This Section further presents the collaborative creation aspect and its connection with the well-established knowledge base aspect.

4.2.1 Collaborative creation of environmental policies

Nowadays, policy deadlocks and government failures in Western societies make the development of environmental policies complex, particularly in climate change policy (Sørensen & Torfing, 2019). Moreover, "*no single public or private actor possesses the knowledge, resources, and/or creativity to singlehandedly produce and implement the disrupt five solutions*" (Hofstad et al., 2021:1). With the increase of information flow and the establishment of knowledge-based economies, as mentioned in Section 4.1.1, "*cities planners need to develop cities that take advantage of local knowledge and intellectual capital of the population*" (Abdalla et al., 2020:47). Thus, collaborative policy innovations processes comprising public, private, civil society, scientific and other relevant stakeholders foster dialogue and knowledge transfer, enhancing the capacity to create "*innovative yet feasible climate solutions*" (Hofstad et al., 2021:1). Moreover, collective efforts further enhance the legitimacy and democracy of local policy-making (Sørensen & Torfing, 2019). Therefore, political leaders give up traditional hierarchical and managerial policy-making and prioritise "*disruptive and risk-prone policy processes based on collaboration with a broad range of societal actors*" (Ibid: 1443). This results in interactive public governance, characterised

by cross-boundary collaborations through networks and partnerships, where representative democracy is completed by participatory and deliberative democracy (Lafont, 2020).

International agreements and European institutions further promote the establishment of collaborative creation. The UNECE adopted in 1998 the Aarhus Convention recognising that "*citizens must have access to information, be entitled to participate in decision-making*" (UNECE, 1998:2). This international agreement regulates the citizen participation rights in environment-related matters, empowering their role in decision-making and preparation of policies relating to the environment. The EU and its member states are fully committed to complying with the Convention through the Regulation (EC) N° 1367/2006. The European Climate Law further reiterates the need to promote and facilitate public engagement at all levels (Regulation (EU) 2021/1119). To that end, the EU created the Competence Centre on Participatory and Deliberative Democracy, recognising that expert knowledge is insufficient and thus boosting citizens' engagement in creating laws and public policies at all levels (Joint Research Centre, 2021).

Collaborative governance is a method for decision-making and managing public policy, which involves the engagement of people "*across the boundaries of public agencies, levels of government, and/or the public, private and civic spheres*" (Emerson et al., 2012:2). Davies and White (2012) further explain that it implies co-production strategies and sharing responsibilities and resources. Ansell and Gash more specifically detailed collaborative governance, defining it as "*a governing arrangement where one or more public agencies directly engage non-state stakeholders in a collective decision-making process that is formal, consensus-oriented, and deliberative and that aims to make or implement public policy or manage public programs or assets*" (2008: 544).

As the definition suggests, it is a form of governance that comprises collective forums composed of public and private stakeholders that engage in decision-making. This mode of governance is an alternative to centralised and top-down management modes, allowing knowledgeable actors to bring capacity and collaborate (Ibid). Ansell and Gash's version of collaborative governance includes the following criteria: i) Participants engage directly in decision-making and are not merely "*consulted*" by public agencies; ii) The forum aims to make decisions by consensus (2008:544). Their definition of collaborative governance does not solely imply stakeholders' involvement in policy-making but also systematically in decision-making, with the same degree throughout the whole process. Critically analysing these three criteria, it is argued that they appear challenging to achieve. Both criteria necessitate a uniform distribution of decision-making power, which is difficult to attain because of the diverse array of stakeholders involved, each with disparate capacity and expertise. This inevitably leads to power imbalances, wherein the strongest and most influential stakeholders often dominate decisions. Moreover, disparate interests might also make a consensus decision difficult. That is particularly the case in the climate policy realm, which affects the whole population and encompasses various perspectives on potential solutions. As a result, public agencies initiating the forum must assume leadership to ensure a definitive decision, considering resource constraints and technical complexities, is reached in time. Hence, it is posited that collaborative governance's criteria of participants being directly involved in consensus-based decision-making is unlikely to be achieved.

Collaborative governance is an umbrella concept that encompasses several dynamics, including co-creation (Ansell & Torfing, 2021). Also called collaborative creation, co-creation is the co-design of "*visions, strategies, policies, regulatory frameworks or technological solutions*" (Hofstad et al., 2021:204). The process "*seeks to leverage distributed innovation and bring together public and social innovation for the proactive purpose of creating public value*" (Ansell & Torfing, 2021:219). The main difference with collaborative governance is that it does not include decision-making, it focuses on collaboration for the policy-making and design process, with policies being "*subsequently adopted by the City Council*" (Sørensen & Torfing, 2019:1460). Co-creation does not simply involve the participation of citizens; it is a dynamic and inclusive process that brings "*multiple types of actors' knowledge, resources and competencies together to address*" complex public problems (Hofstad et al., 2021:204). Co-creation brings "*continuous innovation and learning*" (Vedeld et al., 2021:350), thus, new ways of understanding and addressing climate change (Bulkeley, 2021).

Three features of co-creation help further differentiate collaborative governance and co-creation.

1. Co-creation particularly acknowledges that innovation is decentralised among various stakeholders and thus seeks to reach it by promoting overall engagement. Co-creation also comprises the "*importance of institutional intermediation for mobilising innovation*", encouraging exchange and overcoming difficulties (Ansell & Torfing, 2021:218).
2. Co-creation lessens collaborative governance's focus on decision-making (Hofstad et al., 2021) and further examines the process of sharing and mobilising "*otherwise untapped experience, knowledge, resources and perspectives*" (Ansell & Torfing, 2021:219) to find innovative solutions. Developing these solutions will inform decision-making in a second term (Bulkeley, 2021).
3. While co-creation proactively aims to mobilise experience and knowledge, collaborative governance is an alternative to centralised and top-down management methods, thus mediating conflict and achieving consent.

Based on these features, it can be concluded that co-creation comprises collaborative processes for innovative problem-solving and drawing ideas and knowledge from a wide range of actors. Overall, this "*multi-actor collaboration*" replaces the public sector's monopolisation of public goods and public-private competition (Torfing et al., 2019:798).

It is essential to highlight that co-creation activities encompass two directions (Hofstad et al., 2022). First, there is the collaborative creation of projects and initiatives that lead to the development of innovative technological solutions. Second, as elaborated within this section and conforming to the direction of this research, co-creation is involved in designing policies, strategies, and measures within the scope of climate change mitigation. This enhances democracy and the legitimacy of the designed policies and measures (Sørensen & Torfing, 2019).

Hofstad et al. (2022) applied the concept of co-creation to local climate politics and created an analytical framework that delineates governments' capacity building and approach to urban climate solutions. The framework outlines three ideal co-creation strategies that can be employed to design policies, each fostering collaboration between the public sector and different subjects: internal whole of government (IG), externally focused stakeholder (ES), and externally focused civil society (EC). The article further uses the outlined analytical framework to conduct

a comparative case study of climate co-creation as an approach for urban climate governance in Copenhagen and Oslo. The three strategies and their characteristic elements are outlined in the following sections. In each section, a table summarises the characteristic elements, which have been further divided into three categories: those related to the collaboration process, those related to the outcomes of the collaboration, and a last category for additional relevant characteristics.

4.2.1.1 Internal whole of government strategy

This first strategy involves collaboration across the entire government, including the different sectoral departments and public agencies, to create environmental policies (Hofstad et al.,2022). Bringing together and aligning internal actors for co-creating climate measures and policies enables a comprehensive consideration of climate action (OECD; n.d.). Sectoral departments mainly affected by or impacting climate change, such as transport, energy, and economy, are the primary targets for joint efforts in addressing climate issues. Thus, climate policies resulting from this strategy will be cross-cutting, integrating these specific sectors (Hofstad et al.,2022). The integration of cross-cutting climate goals and policies leads to a broad spectrum of policies from other sectoral departments integrating climate considerations, ensuring a comprehensive and cohesive approach to the climate issue, and leading to the prioritisation of climate considerations over individual sectors' concerns (Vedeld, T., 2022). Thus, this strategy involves the development of formal cross-cutting planning instruments such as local climate plans and other sector-specific plans or strategies.

To facilitate this, reorganising and aligning internal government and public sector structures with collaborative processes is crucial, thereby reducing fragmentation among sectors (Hofsted et al., 2022). This involves establishing informal planning processes, including dialogue-based informal negotiations and discussions among sectors and government entities. Moreover, working groups across sectors can be set up for "*mobilising and aligning diverse staff and entities*" (Vedeld et al. 2021). This implies that coordination arenas with workers from different departments are established and that communication between them is promoted. Moreover, an in-house coordination agency or secretariat is often established to integrate multiple internal public sectors and entities, driving climate across sectors. This entity possesses the responsibility of administrating and coordinating internal co-creation processes.

Additionally, further showcasing the prioritisation of climate issues and operationalising the climate action, this strategy comprises setting a climate budget and account (Ibid). This helps coordinate climate governance across the sectors and entities because it demonstrates the expectations within the city administration regarding climate and establishes responsibilities towards climate action among the different sectors and entities.

This strategy implies that external stakeholders such as citizens and businesses provide inputs through focus groups to climate plans but have a limited role in co-creating and sharing ideas and knowledge (Hofstad et al., 2021). Consequently, co-creation remains mainly internal, and participation and collaboration with stakeholders and citizens are done afterwards.

Table 2 summarises the different elements characterising the internal whole of government co-creation, as outlined in this section. The elements have been distinguished between those related to the collaboration process and those related to the collaboration's result.

Table 2: Elements characterising the internal whole of government co-creation strategy

Category	Element
Co-creation processes	Dialogue-based informal negotiations and discussions among sectors and government
	Cross-sectoral working groups
	In-house coordination entity driving climate across sectors
Results of co-creation	Integration of key sectors (transport, energy, and economy) in climate policies
	Integration of climate change mitigation provisions in other sector-specific policies and strategies (transport, energy, and economic sectors)
Others	Setting of a climate budget
	Limited role in co-creation of stakeholders and citizens

4.2.1.2 Externally focused stakeholder strategy

Hofstad et al. (2022) state that the second co-creation strategy is externally focused on stakeholders. Contrary to the first strategy, this one focuses on external actors rather than on internal ones to the government. The strategy mainly consists of collaborating with private stakeholders and government partners that have a stake in climate-related issues, whether because they are large CO2 emitters or because they fight for its mitigation, and thus own knowledge and capacity to co-create climate policies and measures. The range of private stakeholders is vast, including private businesses from climate-related sectors such as green tech, transportation, and energy firms. Stakeholders can also include academic and research centres, such as universities, institutions, and think tanks with climate-related expertise. Professional associations and chambers of commerce representing professionals with a stake in climate issues, city developers and property owners are also typically solicited within this co-creation strategy (Ibid).

This strategy is characterised by promoting interaction, discussions, exchange of information, partnerships and collaboration of public and private actors in climate change. This strategy's combination of firms and research centres boosts innovation, technological advancement and green urban economy transformation (Ibid). The focus is on mobilising expert knowledge and ideas to transform key polluting sectors such as energy, construction and transportation.

This interaction and collaboration can be seen in different contexts, including "*experimentations, platforms, arenas, networks and public-private partnerships*" (Vedeld et al., 2021:350). Developing triple helix platforms involving government, academia, and industry is common within this co-creation strategy (Vedeld, 2022). Task forces, science parks, climate business networks or urban living laboratories (ULL) can also be set up. ULL group various stakeholders to experience and test innovations (Bulkeley et al., 2013). The experiments can go from "*novel governance arrangements to demonstration projects, transition management processes to grassroots innovations*" (Bulkeley et al., 2019: 318), all related to climate issues. The experiments are key to, upon success, scaling up to larger scales, regional, national, or even international (Ibid).

Ultimately, actors' constant collaboration and proximity to innovate and develop solutions can unfold in the co-creation processes of policies and measures (Vedeld et al., 2022). These structures "*help to sustain co-creation engagement*" and co-creation processes (Hofstad et al., 2021:360). The sequence can also be inverted, with policies and strategic co-creation initiatives leading to the construction of collaborative platforms for developing projects and innovation. Local governments play a pivotal role in fostering collaborative spaces that spur innovation and generate public value, but private stakeholders can also establish them outside the public sector (Hofstad et al., 2022).

Contrary to the first strategy, this strategy allows the alignment of actors with "*different political orientations, moving action away from fundamental debates around political positions*" (Bulkeley et al., 2013:1483), but also actors with vast heterogeneous experiences, values, and interests (Hofstad et al., 2021). However, as for the previous strategy, citizens do not have an essential role in this strategy; their input might be requested but on a second level (Ibid).

Table 3 showcases the elements outlined in this section that characterise externally focused stakeholder co-creation strategy.

Table 3: Elements characterising externally focused stakeholder co-creation strategy

Category	Element
Co-creation processes	Co-creation structures
Results of co-creation	Policies focus on technological innovations
	Policies focus on green urban economy
	Policies focus on key polluting sectors (energy, construction and transportation)
Others	Limited role in co-creation of citizens

4.2.1.3 Externally focused civil society strategy

The third and last strategy is externally focused on civil society (Hofstad et al., 2022). This strategy focuses on collaborations with local citizens and civil society organisations to gain "*local or lay actor competencies*" (Ibid:4).

As seen in Section 4.2.1, policy deadlocks require collaborative innovation processes to solve climate change. However, the proper society also demands that elected politicians participate in collaborative policy innovation and design innovative policy solutions. This strategy is led by combining the "*rise of interactive governance and the proliferation of assertive citizens*" (Sørensen & Torfing, 2019:1444).

While citizens most likely cannot provide expert knowledge (Hofstad et al., 2022), they can bring other valuable knowledge. They have first-hand knowledge about the local conditions, challenges and opportunities. They can thus help develop contextually relevant measures that are specific and adapted to the local context and needs. Moreover, based on their local knowledge, citizens can bring innovative ideas and experiments locally developed outside institutional and business structures (Bulkeley et al., 2013). This strategy will, therefore, lead to policies focusing on aspects such as social well-being, urban life quality and daily private consumption (Hofstad et al., 2022). This strategy does not solely centre on collaboration with individual citizens; it comprises the overall civil society, which includes non-government

organisations and advocacy groups related to the environment and climate change mitigation action.

Hofstad et al. (2022) mention different ways for the government to engage with citizens, including urban living labs, citizens' panels, workshops, and broader platforms. Increased "*mutual accessibility, openness and receptiveness*" between citizens and political leaders leads to growing proximity (Sørensen & Torfing, 2019:1447). Citizens today expect "*political leaders to listen and respond to their experiences, ideas, and demands and to justify their political decisions in the light of the input they receive*" (Ibid). Embracing citizen and civil society engagement in co-creation enriches the policy-making landscape and bolsters democracy and legitimacy in governance (Hofstad et al., 2022). That is because it cultivates a culture of transparency, responsiveness, and trust, ultimately strengthening democratic principles and governance effectiveness (Vedeld, 2022).

The listed elements illustrating externally focused civil society co-creation strategy are presented in Table 4.

Table 4: Elements characterising externally focused civil society co-creation strategy

Category	Element
Co-creation processes	Co-creation structures
Results of co-creation	Policies focus on social well-being, urban life quality and daily private consumption

4.2.1.4 Limits of Hofstad et al. (2022) article

Hofstad et al. (2022) analytical framework presents three ideal co-creation strategies involving different subjects that governments implement to build their capacity and develop innovative environmental policies. For each strategy, characterising elements are outlined, involving mainly the process of collaboration and the results of that collaboration. However, as it was concluded in Section 4.1.3, developing highly innovative environmental policies involves a collaborative creation and a well-established knowledge base of the subjects involved. It is thus argued that each co-creation strategy necessitates the establishment of a tailored knowledge base for the subjects involved. It is noted that Hofstad et al. (2022) analytical framework does not address this pre-condition, which is thus addressed in the following section.

4.2.2 Leverage of a Knowledge Base

4.2.2.1 Knowledge

As mentioned in Section 4.1.1, the importance of knowledge nowadays is reflected in the concept of knowledge societies, which is also applicable to cities. Knowledge production and management are "*key driver in urban development*", so cities engage in implementing structures to promote the generation of talent and innovation (Yigitcanlar et al., 2008:2). That can involve supporting structures that contribute to a strong local innovation system and knowledge development such as public education, research institutions, universities, international networks, and private companies research. As mentioned in Section 4.1.1, it can also involve facilitating knowledge management and dissemination, which can be seen, for example, in linkages

between political structure and universities or research institutions, key for cities' social, cultural and intellectual development (Beall, 2016). Universities and research institutions in European cities often dialogue with political structures, actively contributing to policy innovations (Penninx, 2015). Some cities mentioned as knowledge cities are Munich, Barcelona, Stockholm and Copenhagen (Yigitcanlar et al., 2008).

Knowledge development and management are further linked to the smart city concept, which has been widely discussed in the past decade. As an emerging and multifaceted concept, the term smart city lacks a singular, universally agreed-upon definition, and its components are not clearly delineated (Israilidis et al., 2019). According to the European Commission (n.d.), they are cities where "*traditional networks and services are made more efficient with the use of digital solutions for the benefit of its inhabitants and business*". They also note that digital technologies are not solely utilised for improved resource management and climate change mitigation but also contribute to enhanced urban transport networks, upgraded infrastructure, and refined city administration. Mohanty et al. (2016) add that smart cities use information and communication technologies (ICTs) to improve urban operations and services' efficiency, flexibility, and sustainability. Moreover, according to Lee et al. (2014), efficient information management helps resolve urban problems and revitalise some of the city's structural imbalances, particularly environmental and social aspects.

There are many variants to what factors or components smart cities hold. It can combine three core factors: technology, people and institutions (Nam & Pardo, 2011). Other authors have decomposed this combination to find six dimensions: smart economy, smart mobility, a smart environment, smart people, smart living, and smart governance (Giffinger & Gudrun, 2010). Overall, it can be concluded that smart cities are the interplay of several fields, including industry, education, governance, technology, transportation, and infrastructures (Abdalla et al., 2020; Mohanty et al., 2016), contributing to its improved competitiveness. The attribution of a smart city is often more closely related to the development of hard infrastructure, which encompasses the development of efficient and interconnected physical components such as transportation systems, buildings, and utilities. However, smart cities are also increasingly linked to the "*availability and quality of knowledge communication and social infrastructure*" (Israilidis et al., 2019:1231). Smart cities emerge as "*information hubs and knowledge repositories*", granting great competitivity (Ibid). Knowledge is increasingly recognised as an entire aspect of smart cities, and adequate management is critical to sustainable smartness (Abdalla et al., 2020).

4.2.2.2 Leverage a well-established knowledge base

A well-established knowledge base is crucial for developing highly innovative policies, specifically environmental ones (Ascher et al.,2010). Moreover, as seen in Section 4.1.3, it serves as a pre-condition for co-creation, legitimising their involvement. Individuals involved in co-creation are likely to have diverse backgrounds and expertise, leading to varying types of knowledge. While citizens possess local knowledge and insights, companies bring technological knowledge and scientific-technical expertise, and the whole BCC brings cross-cutting and administrative experience. Thus, the knowledge base required for each must be tailored to their strengths. A well-established knowledge base involves thus creating structures that promote the generation of knowledge tailored to the specific audience.

As seen in section 4.2.1, Hofstad et al. (2022) analytical framework delineates city councils' approach to urban climate solutions, but also for developing its own capacity building. This implies that the strategies also involve mechanisms to exploit the knowledge generated by each type of subject. The word linking both aspects, *leverage*, implies this need for City Councils to establish mechanisms and structures to develop the knowledge base of the subjects involved and actively exchange, and exploit, the generated knowledge for building their capacity and developing policies.

Lastly, a well-established knowledge base in co-creation processes also entails systematically providing essential and tailored technical, local or administrative information, according to the subjects involved. That is because while each has distinct knowledge, they also need a basic understanding of another form of expertise. For instance, governmental bodies need local knowledge to contribute to the development of context-specific policies, while citizens need a minimum level of technical understanding to contribute to the creation of viable policies.

In conclusion, leveraging a well-established knowledge base requires three steps: i) Establishment of structures to generate tailored knowledge; ii) Acquisition of valuable knowledge resulting from establishing a tailored knowledge base; and iii) Systematic provision of information in co-creation processes.

Given that the two factors – collaborative creation and establishment of a knowledge base – are sequential and that the latter enables the first, we can conclude that the three types of subjects that the co-creation strategies present are also applicable to the knowledge base factor. That is, each co-creation strategy requires a previous establishment of a knowledge base directed to the respective subjects involved. The establishment of a knowledge base factor and its three steps thus complete the analytical framework for developing highly innovative environmental policies. The analytical framework is outlined in Table 5 (see Annex)[3].

4.3 Theoretical framework overview

The theoretical framework starts with an overview of the factors leading to the development of highly innovative environmental policies and the achievement of IEA, which, as seen in the literature review, is the first step toward reaching leadership. After establishing limitations, it is concluded that these ambitions are achieved through city-specific factors, which include an opportunity structure and the general strength of the green coalition. It is further seen that these factors result in two sequential aspects: the establishment of collaborative creation processes and a knowledge base. Therefore, it is concluded that developing highly innovative environmental policies depends on collaborative creation processes that leverage a well-established knowledge base of the subjects involved. The theoretical framework further presents the concept of co-creation and, based on Hofstad et al. (2022) analytical framework, outlines the characteristic elements of three co-creation strategies that local governments can adopt to build their own capacity and develop climate policies and measures, each involving different subjects – whole of government, stakeholders, and civil society. The absence of any mention in the article about establishing a knowledge base of the subjects involved in each co-

[3] Please note that Table 5 presents the completed analytical framework featuring the three factors identified in this research. At this stage, only the first two factors need to be considered, which correspond to collaborative creation and leverage of a well-established knowledge base.

creation strategy leads to its overview in Section 4.2.2. Building on Hofstad et al.'s (2022) article and further elaboration, the theoretical framework thus outlines an analytical framework for developing highly innovative environmental policies. Based on three ideal co-creation strategies, this framework comprises the strategies' co-creation characteristic elements and the three essential steps for a well-established knowledge base for the subjects involved (see Table 5 in Annex).

5. Method

5.1 Research Design

The research design comprises the strategy that will be used to answer the problem formulation. When conducting research, the problem formulation implies the overall research design (Toshkov, 2016). Thus, this section will display and justify the research design based on the PF.

5.1.1 Research type

This research uses Toshkov's (2016) taxonomy of political science research, which is comprised of three interconnected levels: normative and positive research, empirical and theoretical research, and lastly descriptive/explorative, predictive and explanatory research. The PF aims to understand and explain the reality of city leadership, advocating for a positive research approach focused on "*describing, understanding, explaining or predicting reality as it is*" (Toshkov, 2016:24). This objective stance contrasts with the normative research approach, which emphasises on what is deemed appropriate and how reality should be (Ibid).

The PF further involves an empirical phenomenon—the achievement of IEA by leading EU cities in policy outputs—requiring the testing of the theoretical framework outlined against the observed empirical phenomenon. The focus on the analysis of "*real-life phenomena and empirical facts*" (Ibid:30) to relate it to the established theoretical concepts entails that the research is empirical and not theoretical.

As for the third and final level of Toshkov's (2016) taxonomy, this research combines explanatory and exploratory aspects. First, this research aims to comprehend and explain causal processes that leading EU cities undertake to achieve their environmental ambitions, based on the outlined theoretical framework. This involves a deductive approach that "*employs theory as a broad explanation*" and tests it based on the empirical data (Creswell, 2009: 76). However, to avoid missing out on information and to be open to other explanations, the research also involves an inductive approach, aiming to generate theory based on the qualitative study made on the empirical data, thus employing exploratory research.

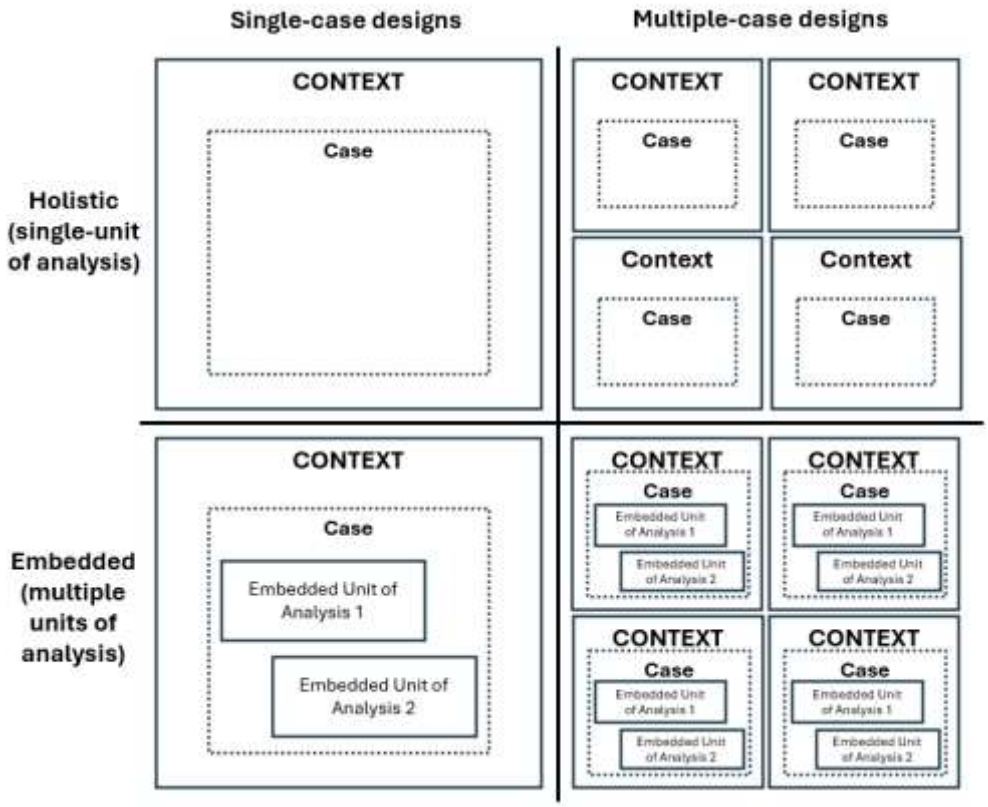
Therefore, it can be concluded that the research engages with a positive research question rooted in empirical phenomena, namely, leading EU cities in policy outputs' achievement of IEA. The research integrates both explanatory and explorative research, thereby offering a comprehensive analysis of the subject matter through the combination of deductive and inductive approaches.

5.1.2 Research design

The section explains the research design employed to address the PF. Based on the first word of PF, "*How*", this research employs a case study design. That is because it suggests the existence of operational links and the aim of aim to "*illuminate a decision or set of decisions: why they were taken, how they were implemented, and with what result*" (Yin, 2009:12), making case studies the preferred research strategy in such instances (Ibid). Moreover, case studies are often used to examine and understand complex contemporary phenomena within real-life contexts where control over the event is very limited (Ibid). Finally, case studies are particularly appropriate to address a wide range of evidence because they help "*retain the holistic and meaningful characteristics of real-life events*" (Ibid:2).

Yin (2009) introduces four case study designs based on a 2x2 matrix. As seen in Figure 2, the matrix categorises the designs based on two dimensions: the number of cases (single or multiple) and the number of units of analysis (single/holistic or multiple/embedded). The units of analysis correspond to the entity or entities that the research is analysing.

Figure 2: Basic types of designs for case studies[4]



Based on the PF, the context of this research is EU cities' leadership in environmental policies. This entails a single-case design, where the case studied is the achievement of IEA by leading EU cities in policy outputs. The following step is to determine whether a single or multiple units of analysis will be used. Within this research, the logical units of analysis are specific leading EU cities. According to Yin (2009), taking a holistic design approach can prevent the examination of specific phenomena because it focuses solely on one unit of analysis. Embedded designs,

[4] Replication of the "Basic types of designs for case studies" developed by Yin (2009:46).

however, by analysing diverse units of analysis, enable comparison and contrast of various developments of leadership by EU cities. However, embedded designs also entail fewer pages dedicated to each unit of analysis, resulting in a less detailed analysis of each unit. Considering the page limitations for this research and the aim for a detailed analysis, a single case design with one unit of analysis will be employed.

5.1.3 Choice of unit of analysis

As mentioned, the analysis unit for this research is a specific EU city that leads in environmental policy output. To choose the EU city, five factors are considered. The first three pertain directly to the city characteristics, while the last two are more technical in nature, aimed at facilitating the development of the research and the acquisition of relevant information: i) As the problem formulation implies, it has to be an EU city; ii) The city has to lead in environmental policy output; iii) As mentioned in Section 4.1.3, to mitigate the effect of political ideologies upon the achievement of environmental ambitions, the standpoint of social and progressive-inclined local governments is taken; iv) Information about the city and its creation of environmental policies and measures needs to be easily accessible; v) Consideration of the language barrier.

The city chosen for this research is Barcelona, hereafter is explained how the city complies with all the factors:

1) EU city

Barcelona, the second-largest city in Spain, is renowned for its rich history and vibrant culture. Located on the Mediterranean coast in the northeast part of the state, this European city has over 1,660 million residents (Oficina municipal de Dades, 2023). With over 12 million tourists in 2023 (Observatori del Turisme a Barcelona, 2024), Barcelona is one of the most visited European cities. It is also a dynamic business centre at the forefront of the technology and innovative industry (Orizi, 2023).

2) Leads in environmental policy output

The city of Barcelona encounters several environmental challenges that leads it to be active in climate action. Its geographical location, between the sea and the mountains, results in spatial constraints. Added to population and tourist pressure, Barcelona is one of Europe's densest and, therefore, most polluted cities (Misachi, 2017; Rae, 2020). Climate changes lead to extreme weather, ranging from droughts and heat waves to torrential rain and flooding (Le Monde & AFP, 2024; Catalan News, 2023).

As seen in Section 2.2.1, leadership in environmental policy outputs entails the combination of the development of innovative policies and their transfer and promotion of their adoption by other cities or states. Regarding the first aspect, various innovative measures, policies and initiatives have been adopted and implemented in Barcelona to mitigate climate change. Those include the development of superblocks, which "*prioritise access to public space for people rather than vehicles*" (EBRD, n.d.:N/A.), and the Tree Master Plan 2017-2037 (Interlace Hub, 2023). The city's climate plans are meeting the Climate Action Planning Framework requirements. Both include a letter from the Executive Director of the C40 Cities Climate Leadership Group, and have been qualified as "*robust, integrated and ambitious*", and mention that other cities can be inspired by this leadership (CP, 2020:4). Moreover, related to the European Mission "*100 Climate-*

Neutral and Smart Cities by 2030" mentioned in Section 2.1.2.2, Barcelona's government issued its 2023 Climate City Contract showcasing its vision and action plan for reaching climate neutrality (Management for the Area for Mobility, Infrastructures and Urban Services, 2023). In March 2024, 23 cities were awarded the EU Mission Label, including Barcelona (European Commission, 2024). This label ensures the quality and appropriateness of the city's climate neutrality plan.

Focusing now on the second aspect of leadership in environmental policy outputs, several events show the recognition by the international community of Barcelona's leadership. In 2018, Barcelona won the first-ever Cities in the Spotlight award, provided by the Covenant of Mayors for Climate and Energy, in the large-size signatories category (POLIS, 2018). This Award recognises the quality and efficiency of climate plans (ICLEI Europe). The not-for-profit international organisation CDP has issued since 2018 an annual report on cities' climate leadership and action. Based on scoring criteria, which include ambition and transparency, the organisation classifies cities into five bands. The last band, called A-list, corresponds to leader cities that demonstrate "*best practice standards across adaptation and mitigation*", ambitious and realistic goals (CDP, n.d. B). Barcelona, jointly with Athens and Paris, is the only European city that has been included in the A-list every year since its conception (CDP, n.d. A). Finally, Barcelona is also engaged in serving as an example of policy transfer. That is seen in the interest of the cities of Vienna and Berlin to adapt the superblock measure locally (Polonyi, 2023).

3) Social and progressive-inclined local government

Barcelona has a long-standing tradition of governance from a coalition of left-wing parties characterised by socialism and progressivism (Blanco, 2020). The city is currently led by Mayor Jaume Collboni, representing the *Partit dels Socialistes de Catalunya*, Catalan for *Socialists' Party of Catalonia*. Before Collboni's tenure, Ada Colau, affiliated with *Barcelona en Comú*, Catalan for *Barcelona in Common*, held office for eight years (Le Monde & AFP, 2023). This party is founded from a citizen movement, leading to the advocacy for social justice and participatory democracy.

4) Easiness to find information

Many reports and documents of Barcelona about environmental action and policies are publicly available. Another city that was under consideration for the research was Copenhagen; however, the relative scarcity of available information led to the decision to focus on Barcelona instead.

5) Language barrier

The author of this research can read Spanish, French, Catalan, and English. Selecting Barcelona as the focus of the research offers language advantages. First, much information is available in English. Additionally, the author's proficiency in Spanish and Catalan ensures an effective use of available information in these languages if necessary.

5.2 Choice of data

This Section aims to justify the data collection and analysis employed within this research, conferring the approach and procedure used by researchers to conduct the investigation. Data is usually divided into qualitative and quantitative. Qualitative methods imply non-numerical data that can be interpreted to understand the "*meaning underlying an intention, action, object*

or phenomenon" (Keman & Woldendorp, 2016:309). On the other hand, quantitative methods require the use of numerical data to establish "*causal relationships between social phenomena*" (Keman & Woldendorp, 2016:309) through positivism and objectivity. The PF and research goal of explaining and exploring the overarching strategic trajectory embraced by the city of Barcelona in environmental policy-making implies that qualitative research methods are more appropriate than quantitative ones.

5.2.1 Qualitative data

Qualitative data about the overarching strategic trajectory embraced by the city in environmental policy-making can mainly be obtained through interviews with the principal actors or through the analysis of documents that report on the measures and related processes. For this research, the qualitative data employed are documents. Documents are discursive messages and statements issued in a physical and written form "*that provide evidence for a state of affairs*" (Scott, 2006). Public documents include government publications such as policy statements, departmental annual reports, and Acts of Parliament. As the research focuses on the strategy followed by local governments, the documents employed pertain to the public sphere. More particularly, documents issued by Barcelona's City Council (BCC) that include the strategies followed to create environmental policies and measures. All this information is usually compiled in climate plans, which, as seen in Section 2.1.2.2, City Councils develop to compile information and contextualised explanations about the policy frameworks and strategies undertaken for addressing climate change.

Document analysis, fitting studies that aim to produce "*rich descriptions of a single phenomenon*" (Bowen, 2009:29), involves a "*systematic procedure for reviewing or evaluating documents*", encompassing the examination and interpretation of the data in the documents (Bowen, 2009:27). However, aware that relying solely on one research method, and particularly documents, is often criticised because it can result in limited information and risk of bias, hereafter this decision is justified. Using documents is less time-consuming and costly than conducting interviews (Bowen, 2009). That is particularly the case within this research because a significant number of interviews would be required to gather all the necessary information. Climate plans and strategic documents are public, comprehensive, and detailed, as well as unobtrusive and non-reactive (Bowen, 2009). Moreover, their official status ensures their validity and authenticity. On the contrary, the researcher's presence can affect and influence interviews. To address the limitations of using documents, it has been ensured that the selected documents comprised the necessary information and detail required for the research. Furthermore, using official documents whose production and content adhere to high rigour, quality, and accuracy standards minimises potential bias.

The empirical data used in this research will be composed of primary and secondary source. While primary source data are first-hand, original data that has not been interpreted or modified, secondary source data is used to help understand and interpret primary source data.

5.2.2 Primary Source

Primary source data used of in this research comprises the set of documents published by BCC. These are considered primary sources because, despite not being produced by the researcher, they remain unchanged since their initial publication, ensuring their non-interpretation and

originality. While they "*are not deliberately produced for the purpose of research*", meaning how highly innovative environmental policies are created, they can be re-analysed from the research perspective, with many details and information provided in them being key to understanding BCC's overarching strategic process (Mogalakwe, 2006:222).

The research uses a wide range of documents published by BCC, however, the analysis will be primarily focused on six (6) of them. In this Section, these main documents are detailed, briefly summarising "*the meaning of the document and its contribution to the issues being explored"* (Bowen, 2009:33). As social facts, documents' production and use are "*shaped by social processes and interactions*". That is why their broader social context is also outlined (Atkinson and Coffey, 1997: 47). Details about the author and nature of the document, original purpose, and nature of the document are crucial. Additionally, an explanation of their relevance for the research to justify that the "*content of the documents fits the conceptual framework of the study*" is given (Bowen, 2009:33).

- Barcelona's Climate Plan 2018-2030 (CP)

Barcelona's Climate Plan, published in 2017, collects BCC's objectives, policies, measures, and actions to promote climate change mitigation, adaptation and resilience, climate justice and citizen action. The plan contains 5 action areas, 18 lines, and 242 actions. The CP is relevant in the analysis because it provides an overview of BCC's approach to developing environmental policies, details the creation process followed, and lists the policies and measures to reach climate neutrality by 2050.

- Barcelona's Climate Emergency Action Plan (CEAP)

Barcelona's Climate Emergency Action Plan, published in November 2021, confers an update on the CP. Produced after the city's Declaration of Climate Emergency in 2020, it further strengthens and accelerates the previous Climate Plan, merging its objectives, policies and actions with the measures defined in the Declaration of Climate Emergency. Some measures have been retained, while others have been modified, combined, or eliminated. This document's relevance lies in acquiring further information about the creation approach followed, to further understand the overarching strategic process. While the analysis will be mostly based on the CEAP, details in CP and lacking in the CEAP will nevertheless be provided. Similarly to the CP, the CEAP aims to promote advanced mitigation, adaptation and resilience, climate justice and citizen action and provides an overview of BCC's approach for developing the outlined policies and measures.

- Barcelona Climate City Contract (BCCC)

Barcelona's Climate City Contract, issued in 2023, is a tool to collaboratively guide the city to reach climate neutrality by 2030. Produced in the context of the European Mission "*100 Climate-Neutral and Smart Cities by 2030*", it comprises three parts. The Commitments consist of a contract with key actors to achieve the goals defined collaboratively. The Action Plan delineates a portfolio of agreed measures, and the investment plan mobilises and details public resources for reaching climate neutrality. Based on the CEAP, it is enriched with more recent strategies and plans. While the CP, CEAP and BCCC present similarities, this research focuses on the overall trajectory of the local government. Thus, elements from the three documents will be used in the analysis.

- Strategy for promoting the 2030 Agenda in the city of Barcelona. Government measure. (SPAB)

Published in January 2020, the Strategy for promoting the 2030 Agenda in the city of Barcelona outlines the strategy, adopted by BCC to reach the objectives outlined in Barcelona's Agenda 2030. It is relevant for the analysis because it outlines the government approach into three strategic lines: 2030 Agenda at the City Council, 2030 Agenda in the city, and Barcelona 2030 international.

- Let's Change for the Climate 2030 Plan. Sustainable Culture Strategy for Barcelona. (LCCP)

The Let's Change for the Climate 2030 Plan, adopted in 2022, is a strategy developed by BCC to build and spread a culture of sustainability across the city. Divided into 6 areas of intervention related to the plan's social scope, 88 actions aim to drive a social transformation that shifts mindsets and behaviour regarding sustainability. This document is relevant because it introduces a new factor in developing highly innovative environmental policies.

5.2.2.1 Quality control of documents

As for any other data, opting for document analysis requires a "*rigorous adherence to research protocol*" (Mogalakwe, 2016:222). Scott (1990) proposed a document quality control process designed to ensure documents are suitable for research purposes. This process consists of four criteria: authenticity, credibility, representativeness and meaning. The research proceeds to describe each criterion while simultaneously analysing the selected documents with respect to each criterion.

The authenticity criterion requires the documents to be genuine, not falsified, and from a reliable origin; thus, special attention was given to the source of documents, ensuring they come from BCC's official website. The second criterion, credibility, involves the absence of errors and the accuracy and reliability of the presented information. It also addresses the potential for document distortion, ensuring the authors' sincerity and integrity during their creation. While these aspects cannot be completely ensured, it is trusted that the official status of the documents, along with their intended dissemination to international institutions and key stakeholders, resulted in thorough reviews, thereby minimising errors and biases to the greatest extent possible. The third criterion, representativeness, involves evaluating how well the documents reflect their respective categories. Climate Plans are widely adopted by European cities, and they typically share certain characteristics. As seen in Section 5.1.3, both the CP and the CEAP meet the requirements of the CAPF. Additionally, since these documents are issued under BCC's name, they are expected to represent the Council's views accurately. Given the significance of these documents in shaping future actions, it is presumed that BCC has ensured their alignment with its view. Assessment of the clarity and comprehensiveness of the documents is ensured by meaning, the fourth and last criterion. Climate plans, because they are complex documents that display the strategies of governments, include both literal and interpretative meanings. A critical theoretical perspective is adopted to discern the underlying meaning when analysing the documents.

5.2.3 Secondary source data

This research also uses secondary source data for multiple purposes. First, they aid in interpreting and analysing primary sources, illustrate the statements, provide insights, and offer additional contextualisation and understanding. Their use also stems from the fact that primary source data are all issued by BCC, raising concerns about author diversity and objectivity. Data issued from other authors can help validate the information provided and bring alternative perspectives.

5.3 Methods of Analysis

With the research design and data collection now outlined, it is essential to define the methods of analysis. This section aims to elucidate how the analysis of the empirical data will be performed, and outline its structure.

First, it is important to define the timeframe considered in this research. As seen in section 2.2.1, cities' environmental ambitions can fluctuate over time, affecting cities' leadership positions. In section 4.1.1, three causality factors for developing highly innovative environment policies are defined as unstable: situative, issue-specific and strategic factors. In section 4.1.3, it was decided to dismiss situative factors, and to limit the research to climate change mitigation policies, to address the issue-specific factor. Moreover, strategic factors were considered as constant based on the will of the city of Barcelona to continuously address climate change through innovative policies. This results in the research focusing on stable city-specific factors, which enable the look at Barcelona's work in its globality without focusing on a specific point in time. Another factor supporting this global focus is that policies, particularly within climate change mitigation, are continuously created, reviewed, and adapted. Thus, confining the analysis to a specific time point might result in data limitations and oversight of the continuous production of environmental policies. While a specific timeframe must be defined to delimit the research, it is also crucial to acknowledge the dynamic nature of environmental policy-making. Hence, this research will look at the continual creation of policy measures within a timeframe to discern the overarching strategic process embraced by the city in environmental policy-making. The timeframe will span from 2017, when the creation of the CP began, to 2023.

The analysis begins with a section on Barcelona's climate framework, to ensure a comprehensive understanding of the context. To ensure a logical and coherent approach, the rest of the analysis structure mirrors the process followed for the empirical data analysis. As seen in section 5.2.1, the analysis adheres to document analysis methods. According to Bowen, document analysis involves three steps: skimming, reading and interpretation (2009:32). The first step consisting of superficially examining the document. The second step, *reading*, involves thoroughly examining the document to identify, select and synthesise meaningful and relevant data passages. Lastly, *interpretation* is about understanding, contextualising, and organising data "*into categories related to the central questions of the research*" (Ibid). With this approach, document analysis will be performed through content analysis rather than discourse or frame analysis. That is because the problem formulation implies that what the research aims to analyse is the policies and their conception rather than the language or frame underlying the documents (Ercan & Marsh, 2016).

As mentioned in Section 5.1.1, the research combines a deductive and abductive approach. Using the deductive approach requires ensuring the operationalisation of the theoretical concepts set out in the theoretical framework section by transforming them into measurable observations. In first instance, the presence in the documents of the two aspects needed for highly innovative policies - co-creation processes and a well-established knowledge base - as found in Section 4.1.3, is analysed. Evidence for co-creation can be found in BCC's process followed for creating the policies and in the general collaborative approach, evidenced through its goals and values. Evidence for establishing a knowledge base will be provided following the three steps outlined in Section 4.2.2.2, but without the notion of customisation: i) Establishment of structures to generate tailored knowledge; ii) Acquisition of valuable knowledge resulting from establishing a tailored knowledge base; and iii) Systematic provision of information in co-creation processes. As it can be seen, both structures differ slightly from the one set out in the analytical framework. That is because this section aims to look for general evidence without outlining the specific elements for each co-creation strategy.

The use of inductive research within this research enables the empirical data to unveil other factors contributing to the development of highly innovative environmental policies that might not have been set out in the theoretical framework, thus enriching and expanding the one set out. The analysis of various primary documents revealed a third essential factor employed by BCC for developing highly innovative policies: building and spreading climate culture. As it will be explained, this factor follows the sequential logic that the first two factors had: a spread climate culture among subjects enables the establishment of a knowledge base for these individuals, facilitating their involvement in co-creation processes aimed at developing highly innovative environmental policies. After analysing BCC's co-creation processes and leverage of a well-established knowledge base, this new factor will be presented, particularly emphasising its contribution to developing highly innovative environmental policies.

Based on the analytical framework outlined in Table 5 (see Annex) featuring the three factors, the development of highly innovative environmental policies will be assessed for each strategy outlined in section 4.2.1. The comprehensive analysis will further facilitate a discussion on i) the key factors for creating innovative environmental policies, ii) the implementation of co-creation strategies by BCC, and iii) the impact of these key factors and co-creation strategies on EEA.

6. Analysis

6.1 Climate Framework

The contextualisation of BCC's capacity to innovate in climate change mitigation is essential for conducting this research's analysis. The BCC framework comprises several levels—international, European, national, and regional—each level helping define as well as impacting its climate action. The international and European framework has already been detailed in Section 2.1.2.2 to showcase cities' leadership in environmental policy outputs. Keeping in mind that information, this section focuses on the national and regional framework, and finalises with an overview of Barcelona's climate action history.

6.1.1 Spain's Climate Framework

All EU member states are required to adopt an Integrated Nacional Energy and Climate Plan (INECPs). Spain adopted its own in 2020 (Boletín Oficial del Estado, 2021A), setting out the targets and policies for the period 2021-2030, including the aim to reduce emissions by 2030 by 23% respective to 1990, which later rose to 32%, due to EU requirements. In the same year, a long-term decarbonisation strategy was adopted to reduce by 90% the emission of gas in 2050, with respect to 1990 (Ministerio para la Transición Ecológica y el Reto Demográfico, 2020). The legal framework and specific measures were further enforced by adopting Law 7/2021 of Climate Change and Energy Transition, which binds climate neutrality by 2050 (Boletín Oficial del Estado, 2021B).

6.1.2 Catalonia's Climate Framework

Spain comprises 17 autonomous communities, each with a certain degree of legislative and administrative autonomy. Article 148 of the Spanish constitution's Title VIII outlines that autonomous communities are responsible for environmental protection and are empowered to enact additional measures, provided they adhere to national legislation and overarching strategies as the minimum standard (Boletín Oficial del Estado, 1978). In 2017, the Catalan Parliament ratified Law 16/2017 on Climate Change (Portal Jurídic de Catalunya, 2017). This legislation supports the transition to an emission-neutral economy, stipulating a 40% reduction in greenhouse gas emissions by 2030 compared to the 1990 baseline. Moreover, it sets ambitious long-term targets of 65% reduction by 2040 and complete decarbonisation by 2050. Article 33 states that local administrations must participate in climate policy planning and integrate mitigation measures into their local planning. Article 84 of Catalonia's Statute of Autonomy further states that local governments have competencies in developing mitigation policies for climate change (Portal Jurídic de Catalunya, 2006).

6.1.3 Barcelona

Barcelona's international, European, national, and regional framework enables and drives its actions for climate change mitigation. Several elements within this section will be further described and analysed in subsequent sections of the analysis, but this summary aims to provide an initial overview of Barcelona's climate change mitigation scheme. Barcelona's action began at the end of the 90s with the adoption of the United Nations' Agenda 21 by 178 governments in 1992, addressing global, national, and local challenges to sustainable development (United Nations, 1992). Chapter 28, called *Local authorities' initiatives in support of Agenda 21*, foresaw the responsibility and capacity of transformation that cities hold, therefore highlighting the cruciality of local authorities' participation and cooperation, particularly in establishing local environmental policies and plans. That drove many cities' elaboration of Local Agendas 21 to define objectives and actions, and contribute locally to global sustainable development. As one of those cities, Barcelona published the Citizen Commitment to Sustainability: Barcelona Agenda 21 for the period 2002-2012 (Consell Municipal de Medi Ambient i Sostenibilitat, 2002). Throughout the years, the commitment has started numerous initiatives and actions, such as the Barcelona + Sustainable Network (B+S Network), which today comprises over 1900 organisations, including educative centres, businesses and public entities. All the members are committed to promoting the city's sustainability dimension by signing the Citizen Commitment to Sustainability

(CCS) (Barcelona + Sostenible, N/A). The CCS was further reviewed and adapted for 2012-2022, jointly by BCC and the B+S Network, and again recently renewed for 2024-2034 (Ajuntament de Barcelona, 2024). A Citizen Council for Sustainability was created in 2014 as an advisory and sectoral participation body representing the different collectives and sectors comprised in the Commitment and B+S Network. It aimed to promote further action and strategies, as well as citizen participation in sustainability-related subjects, including the CCSs (Area for Urban Planning, Ecological Transition, Urban Services and Housing, n.d.A). The B+S Network and BCC also jointly issued Barcelona's Commitment to Climate (CBC) to showcase their commitment to the 2015 Paris Agreement at COP 21. Apart from reaffirming their commitment to climate objectives, the document presented a short-term roadmap comprising 5 strategic measures, 7 projects led by BCC, and 9 projects led by the Network (CBC).

In 2020, the city of Barcelona issued Barcelona's Agenda 2030: SDG goals and key indicators (Oficina del Comisionado de Agenda 2030, 2020). The document aims to interpret, localise and monitor the 17 SDGs and 169 targets of the Agenda 2030, already introduced in Section 2.1.2.2, according to Barcelona's vision for 2030 regarding sustainable development. Jointly with the Agenda, the Strategy to impulse the localisation of Agenda 2030 in Barcelona was issued (SPAB). The achievement of the defined vision has been given primary importance because a third mayoral office has been created to, among other functions, bolster the agenda.

The climate commitment was then further extended and enhanced with the approval of the 2018-2030 CP, which shows the municipal commitment to fighting against climate change. The CP addresses four main aspects of climate change - mitigation, adaptation, and resilience, promoting citizen action and climate justice – and encompasses 5 areas of action (people first, starting at home, transforming communal spaces, climate economy, and building together), further developed through 18 lines of action and 242 measures. The main goal for mitigation is reducing greenhouse gas emissions by 45% by 2030, compared to 2005, and carbon neutrality by 2050.

In 2019, the Citizen Council for Sustainability created a Climate Emergency Board to elaborate on a Declaration of Climate Emergency (CEAP), declared in 2020 (Ajuntament de Barcelona, 2020C). This declaration served to strengthen and speed up "*the implementation of some of the initiatives already noted in the CP, as well as adding new ones, besides taking a further step and extending the city's goals relating to the fight against climate change*" (Area of Urban Ecology, 2021:3). The action plan "*makes the Climate Plan more ambitious, accelerates it and enables other authorities to be called on*" (Ibid:4). It proposes seven major model changes (urban, mobility and infrastructure, economic, consumption and waste, food, and cultural and education model) and two adaptations (taking care of health, well-being, and environmental quality, and taking care of water). The Climate Emergency Board was renamed in 2022 into the Citizens' Climate Assembly-Workgroup of the Citizen Council for Sustainability, enabling its openness to more organisations and citizens and thus strengthening actions aimed at addressing climate emergencies. The merge of the CP and Declaration of Climate Emergency resulted in the CEAP, the actual climate plan.

6.2 Collaborative creation

In this section, the research analyses BCC's collaborative policy creation approach. It does so by first examining the collaborative approach reflected in BCC's strategic documents, focusing on goals, values, and related elements. Then, it delves into the actual co-creation processes employed in developing policies and measures.

6.2.1 Collaborative approach

As seen in Section 4.1.3, the collaborative approaches are firstly conditioned by cities' political and economic context. Barcelona has a long-standing tradition of socialist and progressist governments, fostering open and democratic approaches, conducive for collaborations (Section 5.1.3). These processes further require the adaptation of administrative structures, which is facilitated by Barcelona's wealthy economy.

The city of Barcelona has long incorporated collaborative approaches into its climate action efforts. The fourth goal of the 2012-2022 CCS, "*Efficient city, productive and with zero emissions: From the technologic Barcelona to the smart Barcelona"* (CBC:16), involves facilitating citizen participation and decision-making, using the city as a laboratory for new solutions. Moreover, the CBC has also been led by citizens through a bottom-up approach, with over 800 public organisations participating in the creation of the nine citizen-centric projects (C40, 2016).

The CEAP outlines its scope across three dimensions: time, territorial, and competence. The latter adopts a multi-level and holistic approach, implying a need for collaboration across various levels in the process, including organisations, companies, and citizens (CEAP). It also suggests an intradisciplinary vision, where the interconnectedness and collaboration of sectors is crucial (CEAP). Moreover, the last pillar for achieving a more sustainable Barcelona is *Committed Barcelonians*, indicating the participation and action of various subjects, including citizens, to change the situation (Ibid:51). It is important to note that the fifth area of action of the CEAP, *Climate culture*, addresses the need for cooperation in climate action. The 18th line of action, *Let's Get Organised*, states that climate change "*cannot be tackled in isolation by a specific local authority department*" (Ibid:161). That implies the need to involve all the local authorities through a cross-departmental approach and key city actors. It is noteworthy that the CEAP seems to place a strong emphasis on people. The first inspiration principles are closely related to people, stating that the plans are centred on them, their health and quality of life (Ibid). That is also reflected in the values that the CEAP follows, which the first three are deeply related to citizens and their well-being: *Healthy Barcelona, Socially fair Barcelona, Habitable, safe Barcelona* (Ibid: 50). Moreover, the plan confirms that all measures have a core theme in common, "*people and their well-being*" (Ibid:52).

An important element of BCC's strategy for collaboration is the B+S Network, already introduced in Section 6.1.3. The Network comprised 1917 members in 2022, including social organisations, educational establishments, companies, and political and public bodies. Figure 3 illustrates the distribution of member categories within the Network. Member categories are distinguished by colours: the business world is shown in purple, research, and education centres in green, citizens and related organisations in orange, and public entities in blue. This Network is a good example of a green advocacy coalition, mentioned in Section 4.1.3 as a significant factor for promoting

co-creation approaches. The Network facilitates the sharing of best practices and collaboration among committed members to build a socially and environmentally responsible city, each within their own capacity and area of expertise (BCCC). Over the years, it has become a crucial element in the city's sought for sustainability, constantly promoting action and initiatives. Overall, the Network "*drives transformations, generates learning, allows what works to be scaled up, inspires the rest of the citizenry and has an impact on the improvement of public policies*" (Ibid:61). The B+S Network is governed by the values of equitable participation, co-responsibility, and shared decision-making of the members (Ibid).

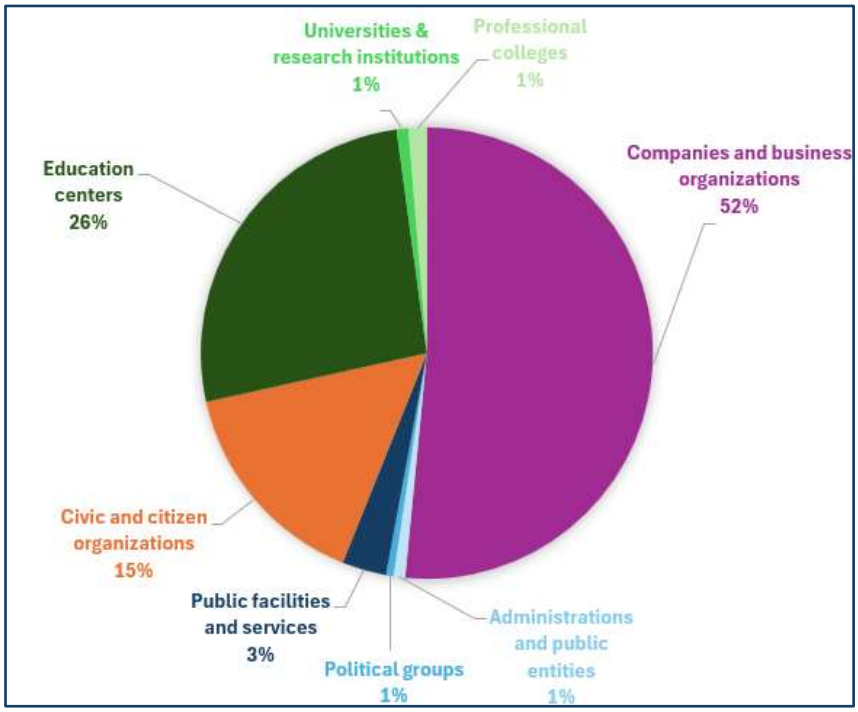


Figure 3: Members of the B+S Network (Xarxa Barcelona + Sostenible, 2022: 4)

So far, this Section has elucidated the collaborative framework underpinning BCC's climate-related strategies. However, the context in which collaboration occurs is often not specifically delineated in the documents and, as seen in Section 3, collaboration is typically more prevalent in the implementation phase of policies. Thus, hereafter, the aim is to demonstrate that the framework also refers to collaboration in co-creation. In the case of the CEAP, its fourth strategic line is "*Promoting action by the general public, promoting co-creation projects*" (CEAP:11). Moreover, the fourth principle underlying the CEAP is to undertake "*a process of citizen co-production"* (Ibid:48). The Citizen Council for Sustainability, as a consultative and sectoral participation body formed through an elective process, represents the B+S Network for the creation of policies. A consultative body of Experts for the Climate Emergency has been created to advise the local government. Comprised of 16 experts from various scientific disciplines, this peer-to-peer group works together to formulate policy proposals and actions, as well as transfer knowledge and promote collaboration and synergies between BCC and the education world (Àrea d'Urbanisme, Transició Ecològica, Serveis Urbans i Habitatge, n.d.; BCCC).

This Section has shown that the "*traditional prescriptive attitude of public administrations is not valid anymore*" (Donaldson & Lacasa, 2020: N/A) and that the BCC undertakes and promotes

collaborative approaches, including policy creation, throughout its main strategic climate-related plans.

6.2.2 Co-creation processes

This Section aims to further analyse the actual creation processes of environmental policies and , to conclude whether they follow co-creation characteristics.

The letter at the beginning of both the CP and CEAP, from the then Mayor of the City, Ada Colau, mentions that they were "*co-produced […] by hundreds of the city's organisations*" (CEAP, 2018: 3). Moreover, as seen in Section 5.1.3, both meet the requirements of the Climate Action Planning Framework (CAPF) issued by C40. The CAPF sets out essential components, divided into three pillars of a climate action plan to deliver low-carbon resilient development consistent with the objectives of the Paris Agreement (C40, 2020). The first pillar, *Commitment & Collaboration*, provides details on the plan's governance and coordination and highlights "*the need for community and business engagement, and communications, throughout the plan's development and implementation*" (Ibid:9). Its second component, *Vision, commitment and engagement,* states that reaching long-term commitment from across government, business and civil society is key to achieve the objectives. *Targeted engagement and consultation with stakeholders* is one of the assigned measures, crucial because, among other reasons, it secures inclusivity, gathering "*the most appropriate and comprehensive data and information to develop actions*", as well as ensures future support for the plan (CAPF, 2020: 12). Thus, the CAPF outlines the creation of the CP and CEAP in "*consultation with key government, business and civil society stakeholders*" as essential (Ibid).

6.2.2.1 Climate Plan

In both the CP and CEAP, a section is aimed at explaining how it is a "*co-produced climate plan, from conception to implementation*" (CEAP, 2018: 54). The drafting of the CP started in 2017 after the CBC's signatories requested to "*Barcelona City Council to come up with a roadmap for tackling the climate crisis*" (Ibid). The CP states that due to the complexity of the climate change, its creation cannot rely on one sole department, revealing an expressed need of transversal input from the administration for creating cross-cutting measures (CP:52). For this matter, a team representing all municipal areas and pertaining to the Public Space Co-responsibility Board, has been set up to manage climate change within the administration, co-create and assess policies and projects, as well as to ensure the availability of information for municipal workers (Ibid). Moreover, the CP mentions that three working groups were set up to address cross-cutting aspects (Ibid). Meetings, informative session, and internal participatory sessions involving municipal technical staff were also established to define and agree on the measures (Ibid).

The Citizen Sustainability Council, in representation of the B+S Network, was the driving force of "*the smooth running of the participatory process and compliance with the planning provided for*" (CEAP, 2018:56). A monitoring committee was appointed to monitor the involvement of citizens and B+S Network members in the production (CP:50). An initial informative session was organised on July 13th to present the motives and the co-production process to 58 organisations from the B+S Network (Decidim.Barcelona, n.d.B). The session aimed to primarily encourage the involvement of the network in the co-production process and for them to promote the engagement of other actors further. The phase open for proposals lasted from July 13th till

October 9th and combined face-to-face and online mechanisms. The CEAP explains that the three documents, the CBC, CP and CEAP, have been "*promoted through citizen initiatives and implemented through citizen participation and co-production*" (CEAP, 2018: 54). Indeed, the dual format of proposals reception enabled the participation of both individuals and entities. The online process was made available through the participative platform Decidim.Barcelona, enabling citizens to contribute, through proposals and comments, to building a more democratic, transparent and collaborative city (Decidim.Barcelona, n.d.A).

During the same period, two presential sessions were organised with citizens and B+S Network members to bring and debate proposals. A total of 42 organisations and individuals assisted, bringing 66 proposals (CP:51). The process also promoted the organisation of autonomous sessions by entities to internally debate about possible proposals. The platform provided a resource kit for the organisation of those sessions, including instructions and support material (Ajuntament de Barcelona, 2017C). On October 17th, a participative session was organised to present all the proposals to the B+S Network and for them to debate and prioritise the proposals, which congregated over 35 assistants (Decidim.Barcelona, n.d.B). The last session, attended by close to 250 people in April 2018, served to present the CP and conclude the participative production. Overall, a total of 112 proposals were received from 119 organizations and individuals, leading to 85% of the proposals being incorporated into the CP (Ibid).

6.2.2.2 Declaration of Climate Emergency and Climate Emergency Action Plan

As mentioned in Section 5.2.2, the CEAP is derived from the merger of the CP and the Declaration of Climate Emergency. The latter, elaborated as seen in Section 6.1.3 by the Climate Emergency Board, maintains a co-creation approach as it represents all the groups, including business, scientific, governmental and citizen actors (CEAP:58). Moreover, the opening meeting was open to the B+S Network, as well as the scientific community, social movements, and all requesting entities. Four work sessions with fifteen thematic roundtables were set up from October to December to elaborate the Declaration of Climate Emergency, jointly with 200 organisations from the B+S Network (Area for Urban Planning, Ecological Transition, Urban Services and Housing, n.d.B). Similarly to the CP, the Decidim.Barcelona platform was also set up for citizens to comment and adhere to proposals (CEAP:58). The draft of the CEAP involved a structure representing all municipal areas to manage climate change issues, and co-create policies called the Technical Policy Board (Ibid:60). Additionally, cross-cutting work groups have been created within the Council to address specific issues, always ensuring the representation of the entire B+S Network (BCCC). Moreover, informational and internal participatory sessions involving municipal managers were also organised for its creation (CEAP:60).

It is worth adding that the measures and policies in the CP and CEAP were chosen, among other criteria, due to their co-creation approach, involving the active participation of all stakeholders (CP:46). On another note, collaborative creation processes with actors from key sectors, whether governmental or business, are likely to result in policies and measures being cross-cutting across sectors. Three of the areas of action of the CEAP are specifically directed to the energy, transport, and economic sectors, respectively (CEAP:72). Additionally, the CEAP shows that 21 active sectoral plans and programmes contain climate change mitigation provisions (Ibid:16). Figure 4 illustrates the sectors to which each of those government measure and strategic plan belongs,

with the most prominent ones being energy, urbanisation and infrastructures, consumption and economy, and mobility.

Government measures and strategic plans relating to climate change mitigation

Sector	Measure and strategic plans
Energy	Programme to Promote Solar Power Generation in Barcelona (2017-2019) Transition towards energy sovereignty (2016) Creation of energy advice and basic supply guarantee centres (2016) Energy, Climate Change and Air Quality Plan (2011-2020) Plan for Energy Saving and Improvements in Municipal Buildings (2017-2020)
Urbanisation and infrastructures	Urban resilience (2016) "Filling the streets with life" by creating Superblocks in Barcelona (2016) Barcelona Neighbourhood Plan (2021-2024) Right to Housing Plan (2016-2025)
Consumption and economy	Responsible Consumption Promotion Strategy (2016-2019) Social and Solidarity Economy Promotion Plan (2016-2019) Food Policy Promotion Strategy (2016-2019)
Mobility	Developing the electric vehicle in Barcelona (2018) Bicycle Strategy (2018) Urban Mobility Plan (2019-2024)
Pollution	Barcelona Air Quality Improvement Plan (2015-2018) Programme of anti-air pollution measures (2016)
Waste	Barcelona Zero Waste Strategy (2016-2020) Barcelona Municipal Waste Prevention Plan (2019-2024)
Environment	Promoting living terraces and green roofs in Barcelona (2014)
Science	Barcelona Science Plan (2020-2030)

Figure 4: Government measures and strategic plans relating to climate change mitigation

6.2.2.3 Citizens' Climate Assembly Initiative

Further co-creation processes can be seen with BCC's initiative, Citizens' Climate Assembly (translation from *Assamblea Ciutadana pel Clima*). This initiative aims to find necessary municipal politics to address the climate emergency through citizen participation. End of 2022, 100 citizens of the city of Barcelona were randomly chosen, ensuring social representativity (Oficina de Canvi Climàtic i Sostenibilitat, 2024). Their task was to debate measures and ideas and draft recommendations, solutions, and actions to the question appropriate to the question: *What can we do to address the climate emergency?* The process was divided into three phases, encompassing ten sessions between September and December 2022 (Ibid). The first phase, *information and capacitation*, had climate change experts presenting the main challenges and key information for the citizens. The second phase, *deliberation and concretion*, consisted of citizens' thinking, preparing, and debating in groups proposals and recommendations in three

areas: energy, mobility, and consumption and waste. Throughout the whole process, experts were available to solve doubts and fill in the required knowledge. The third and last phase, *consensus and voting*, served for the proposals to be presented and voted by the overall participants, leading to 34 final proposals. These were presented to the Mayor, Ada Colau, and several political groups in a closing session. The proposals were then reviewed and approved or not for follow-up and implementation by the technical staff of the Climate Change and Sustainability Office of BCC. Globally, out of the 34 proposals, 7 were considered viable, 22 with considerations, and 5 were not considered viable (Ibid:6). A Commission, composed of representants of the Citizen Council for Sustainability, entities engaged in climate actions, political parties, and local agencies and sectors, monitored the Assembly. As the assessment report of the proposals states, "*Citizen participation in the design of public policies and working towards consensus are powerful tools to address the climate emergency*" (Ibid:4).

6.2.2.4 Strategy for promoting the 2030 Agenda

While the co-creation process is not as detailed as with the CP and CEAP, Barcelona's Agenda 2030 can also showcase BCC's co-creation processes approach. Its promotion strategy is divided into three strategic lines (SPAB:12): *Agenda 2030 in the City Council*, *Agenda 2030 in the City*, and *Barcelona 2030 International*. The first strategic line recognises the crucial need to innovate, implement, and promote policies and measures to achieve the Agenda. For that matter, BCC created the Foundation Barcelona Institute of Technology for Habitat (BIT Habitat) to collaboratively create and coordinate innovative policies and measures and align them with the Agenda 2030 (Ibid). The Foundation's board of trustees is formed by representatives of political parties, and the executive committee by representatives of different sectoral departments, including mobility, urbanism, and digital and social innovation. Moreover, a scientific and a business council bring external input (BitHabitat, n.d). To further advise the government on the definition of innovative public policies, prestigious academics from the three domains of sustainability formed an Academic Advisory Council (SPAB). In the context of the strategic line, *The Agenda 2030 in the city*, includes measures aimed at "*Promoting participative processes for the presentation of proposals from citizens*" (Ibid:16).

6.3 Leverage of a well-established knowledge base

In Section 4.1.3, it was observed that leveraging a well-established knowledge base by the city is key to developing highly innovative policies, as well as for legitimising co-creation. Moreover, as highlighted in section 4.1.1, establishing a knowledge base for environmental policy innovation entails a strong local innovation system that develops knowledge base and tailors it to the audience. In this Section, it will be seen how BCC has been establishing a knowledge base related to climate change mitigation for the subjects involved in co-creation, and how it leverages it for co-creation processes.

6.3.1 Establishment of structures to generate a knowledge base

Although sometimes coinciding, the knowledge base should be tailored to the specific nature of each type of subject involved in co-creation. This section highlights structures established by BCC promoting a strong local knowledge base and innovation system in climate action.

As mentioned in section 4.1.3, the economic condition of a city significantly contributes to Research and Development investments, thus to the establishment of a knowledge base. Barcelona has a wealthy economy, with its 2023 budget allocating 1.6 million of euros to the policy covering investigation, development, and innovation, as well as 63,7 million to the environmental policy, representing 0,1% and 2,23% of the total expenditure, respectively (Ajuntament de Barcelona, 2023B).

Within the BCC, the Project Agora offers a space for municipal workers to exchange experiences and enrich collective knowledge. Presentations and debates about innovative projects are hosted (Ajuntament + Sostenible, 2022). Moreover, Section 6.2.2.4 introduced the Foundation BIT Habitat, established by the BCC for creating, coordinating and managing innovative policies and measures. The Foundation developed in 2018 Barcelona's Centre of Urban Innovation, called Ca l'Alier. This Centre is key in allowing knowledge development and innovation of new products, services and processes that address citizens' needs and improve their quality of life (Donaldson & Lacasa, 2020). The Foundation also developed Barcelona Innova, BCC's strategy to impulse urban innovation, defined as incorporating innovation in city management. The strategy comprises several initiatives and programmes that promote innovation and knowledge exchange with different subjects (BitHabitat, n.d).

The Barcelona Innova Lab was designed to stimulate innovation, providing the opportunity to experiment and test, in real city spaces, innovative products, services and methodologies that can solve problems, such as urban decarbonisation and climatic neutrality, to be then up-scaled (BCCC:183). Support is also provided to companies, organisations, investigation centres and universities that request the Lab (BitHabitat, n.d.). The Foundation further stimulates stakeholders' innovation through "*The proactive City*", an annual call for grant proposals for solutions. In 2020, the theme was "*Barcelona… And now*", and urban decarbonisation was one of the themes for which solutions could be proposed. Over 200 proposals were received (Ibid).

As mentioned, establishing a knowledge base also involves creating spaces for subjects to exchange knowledge. The Foundation's Urban Innovation Platform is a space for reflection, dialogue, knowledge exchange, and innovation of local policies. It comprises approximately 100 people from different backgrounds, including citizens, business representatives, and investigators (BCCC:181). Knowledge among startups and companies is further enhanced through the 22@ Innovation District. This BCC strategic initiative aims to transform an industrial area into a hub for innovation, facilitate cooperation between companies, and a "*strategic concentration of intensive knowledge-based activities*" for urban, economic and social innovations (USE, n.d.: N/A).

The aforementioned B+S Network provides a platforms for members to discuss and sharing experiences and knowledge (CBC). The Network also provides consultation services and training tailored to each type of member, through its following five programmes (Ajuntament de Barcelona, n.d.):

- Schools + Sustainable
- Entities and Companies + Sustainable
- Commerce + Sustainable
- Neighbourhoods + Sustainable

- City Council + Sustainable

The fourth goal of the 2012-2022 CCS, mentioned in Section 6.2.1, includes a line of action transforming the city through social and technological innovation, creativity, and talent. That reinforces the idea of creating a knowledge base and implies building a smart city, which, Section 4.2.2.1 shows, is closely related to the development and management of knowledge. Barcelona was first recognised as a smart city in 2014 when the city won the first-ever European Capital of Innovation Award, delivered by the European Commission. Barcelona was particularly recognised for using "*new technologies to bring the city closer to citizens*" (European Commission, 2014: N/A) and focusing on delivering benefits to them. Moreover, the Smart City Expo World Congress (SCEWC) has been organised in Barcelona every year since 2011. As the biggest congress on urban innovation, it aims to be a meeting point for entrepreneurs, public officials, academia and experts to share knowledge and connect to address challenges and reach green, efficient and thriving cities (SCEWC, n.d.). BCC also participates in the Congress, with a stand to present innovative actions and projects. In the 2023 edition of the Congress, the city presented 30 initiatives related to building a city "*climatically neutral, competitive and equitative*" (Info Barcelona, n.d.: N/A).

Barcelona is widely recognised today as a smart city, particularly due to its "*enduring strength as a centre of research, knowledge and innovation*" (Smart Cities World, 2019:17). The city comprises world-class universities and about 46,000 professionals dedicated to research and development, including smart city innovation. Moreover, Barcelona reached the 26th place in the Innovation Cities Index in 2023. It is important to note that Barcelona's Smart City strategy has reportedly shifted from a techno-centric innovation to a social and environmental approach to innovation. The city is seeking today a more holistic model that prioritises sustainability and community well-being, as well as inclusive growth and the generation of public value (BCCC). This approach puts citizens' needs at the centre of technological innovation (ITU/UN tech agency, 2021). It also adopts a citizen-driven approach that considers citizens as a "*rich source of co-creating urban innovation*" (Smart Cities World, 2019:19), to better acquire knowledge about serving them. It is thus refocusing "*towards less top-down style, and more citizen-centric approach*" (Smith, 2018:N/A). As seen in Section 6.2.2.2, this participation is mainly done through the already-mentioned Decidim.Barcelona platform, but also face-to-face, through diverse initiatives aimed at bringing citizens closer to innovation. Barcelona's Fab Labs offer educational sessions for citizens to enhance their innovative skills, thereby fostering their capacity for engagement (Ibid). Barcelona's strategy aims for "*promoting collective intelligence and involving all the key players in the city's innovation ecosystem*" (Smart Cities World, 2019:6).

6.3.2 Acquisition of valuable knowledge by BCC

In Section 4.2.2.2, it was seen that the second step to leverage a knowledge base is for the BCC to acquire valuable knowledge. Barcelona Innova, through its various initiatives and programmes, contributes to this. The Barcelona Innova Week, for example, annually organised, comprises debates, workshops, visits, expositions and activities related to innovation, to reflect on how citizens would like to live in the city. The activities are addressed to different people; some are even open to families. Experts and entities are also welcome to participate or to present and organise an activity (BitHabitat, n.d.). Moreover, the educational programme HaBITants is directed to teachers with students aged 10 to 13 years old, aiming to provide them with tools

for experiential learning (Ibid). By considering students able to identify issues and needs within communities and to develop concrete proposals to address them, the programme fosters their critical and autonomous skills so that they become active in fostering an inclusive, safe, resilient, and sustainable environment. Finally, the programme Urban Challenges, an open consultation about unresolved challenges, is launched, inviting the innovative ecosystem to creatively propose solutions, such as a product or methodologies (Ibid).

6.3.3 Systematic provision of information in co-creation processes

As highlighted in section 4.2.2.2, it is important to consider that collaborative creation processes necessitate providing information and knowledge to the involved parties to legitimise their involvement. This is particularly true for citizens, who most likely lack significant technical and administrative knowledge. Thus, necessary information and expert guidance must be given throughout the different stages of co-creation processes to ensure that all subjects possess a foundation understanding of technical, interdisciplinary, and local knowledge.

The ninth goal of the 2012-2022 CCS is related to education and citizen action and includes a line of action of educating and capacitating the citizens to the participation culture (CBC:27). In the case of the online participation of citizens for the CP, the platform provided information to participants about on-going measures and actions (Ajuntament de Barcelona, 2017A), as well as about the actual situation through most notable data (Ajuntament de Barcelona, 2017B). The link between co-creation and establishing a knowledge base can also be seen through the Citizens' Climate Assembly in Section 6.2.2.3. Previously starting discussions and elaborating on proposals, citizens were given crucial climate technical information which would allow them to participate legitimately. Moreover, experts were available throughout the process to provide citizens with information to understand the context better and develop viable proposals. Javier Martín Vide, climatologist, stated that "*It is essential for science, for researchers, to disseminate scientific knowledge that can be assimilated by the citizens so that they make proposals*" (Àrea d'Urbanisme, Transició Ecològica, Serveis Urbans i Habitatge, 2023, 1:00-1:12) (Javier Martín Vide, climatologist). A participant confirmed that the concepts and information were very interesting and new for her, things that she had never thought about before (Ibid). The knowledge base is towards citizens but also vice-versa, as those citizens hold a "*knowledge base on how the city operates*" (Ibid, 3:45-4:02, Frederic Ximeno), which is very valuable for other actors, including scientific and Council actors. Exchanging knowledge is thus crucial: "*It is our job as researchers, public administration, to take those recommendations very seriously and work hand in hand with citizens to make them a reality, to exchange knowledge*" (Ibid, 4:00-4:16) (Gara Villalba).

6.4 Climate Culture

This Section aims to analyse BCC's building and spreading of a climate culture and demonstrate its contribution as a third factor for achieving highly innovative environmental policies.

6.4.1 Barcelona's strategy to spread climate culture

Climate culture is defined as the collective beliefs, values, knowledge and behaviours that individuals and communities develop regarding climate (LCCP:8). The nature of climate culture encompasses the mindset and attitudes taken by subjects in response to climate change and

environmental challenges. While a positive climate culture characterises values and behaviours that prioritise climate action and sustainability, a negative one, on the contrary, bids for its degradation through unsustainable practices.

The recognition of the need to forge and cultivate a positive climate culture is not new in Barcelona. The 9th goal of the 2012-2022 CBC comprises spreading sustainable culture to the whole citizenship, particularly through the education system. Furthermore, the CEAP introduces culture as a "*key element for tackling the climate crisis*" (CEAP:63). The Plan mentions the necessity of changing the cultural model and style of life to be more appropriate to sustainability and reducing carbonisation.

Climate culture, the CEAP's fifth area, involves using education and communication to raise global awareness so that "*everyone can assume their own responsibility*" (Ibid:154). The first line of action, "*Cultural action for the climate*," appeals to culture as a "*key element for overcoming any crisis, as the cultural context is the reference framework which shapes the way people live and act*" (Ibid).

To further act towards that direction, BCC released in 2022 the Let's Change for the Climate 2030 Plan (LCCP), aiming to build and develop a culture of sustainability, thereby fostering climate culture. The plan aims to forge a social transformation towards sustainability through two crucial dimensions (Ibid). The first dimension is *thought*, which involves developing the ecological mindset of individual and collective identity by conducting a "*critical review of established ideas, habits and ways of living*" (Ibid:12). Values such as capitalism, consumption and competition are aimed to be replaced by human development, recycle and cooperation. That is, raise awareness and consciousness about the limits of the environment world and to value it accordingly. The second dimension is *action*, involving the habits of sharing and cooperating to improve sustainability, for example, by developing platforms and means for people to participate in creating and designing measures.

The LCCP is built around six areas of action based on the Plan's social scope, meaning the collectives and people that the Plan aims to address and/or work with (Ibid:50). The first area of action concerns the City Council. Through its 13000 workers and the internal coordination and cooperation of its departments, BCC is a good means to forge a culture of sustainability and disseminate it across the rest of the society (Ibid:53). BCC can serve as an example through its internal actions, but also by implementing projects that forge the culture. The Programme City Council + Sustainable, mentioned in Section 6.3.1, aims to further establish the culture of sustainability within BCC (Ibid:54). Furthermore, showcasing the active aim to raise awareness within the BCC, an annual report monitors the internal environmentalisation. The report lists a number of initiatives directed to municipal workers (Ajuntament + Sostenible, 2022). These include posting relevant information and news about internal environmental best practices on the intranet platform and guided visits to climate-related sites. Moreover, a communication campaign called *Marató* (Marathon) aims to raise awareness among municipal workers about the need to reduce energy and water consumption, which is key lowering gas emissions.

The LCCP is also directed to the B+S Network. The extensive reach of the Network's organisations, entities and associations results in "*key allies for spreading a culture of sustainability within their sphere of influence*" (LCCP:56). The third line of action concerns individuals and collectives who

are aware of the need for change and are already taking action on their own scale (Ibid:60). The aim is to empower and stimulate them "*to feel involved in transformative action and experiences*" (Ibid:61). Additionally, the LCCP, in their regards, aims to provide opportunities and support to enhance the multiplying effect of their commitment and involvement. That is partly done through the programme Neighbourhoods + Sustainable (Section 6.3.1). This programme also targets individuals and collectives who are not yet aware of the climate emergency and their capacity or responsibility to take action. Thus, the fourth LCCP's line of action, through the implementation of programmes and initiatives, aims to "*raise awareness among these unmotivated or minimally motivated audiences, helping them connect with the magnitude, urgency, and impact this global crisis has on daily life*" (LCCP:65).

Tailored initiatives, information, and communications are planned within the LCCP for each target group to raise awareness about climate change and its essential role in addressing it. Additionally, they serve to inform them about various avenues for participation, including contributing to the co-creation of policies by sharing their expertise.

The LCCP mentions a survey conducted every four years in Barcelona about citizens' environmental habits and values. The last edition, published in 2020, found that while over 94% of the respondents consider climate change a very or quite serious problem, only 55% of them consider that the information received related to it is enough (Departament d'Estudis d'Opinió, 2020). Moreover, 31% of the respondents consider that information given about ways to participate in the improvement of the city's environment is enough. Regarding the extent to which different aspects personally motivate them to improve their environmental habits, 78% found information motivating, and 54% found feeling like a key player in the improvement motivation. There is a clear deficit of knowledge of different networks of spaces that promote citizen action, with all of them being known by less than 20% of the respondents.

6.4.2 Climate culture, key for highly innovative environmental policies

The LCCP outlines a conceptual scope of action composed of a three steps process (LCCP:36). The first step involves the internal improvement of the BCC and the second focuses on the consolidation of new ideas and the empowerment of action, achieved with the LCCP. Finally, the last step is achieving planned results set out in the CEAP and other plans related to sustainability. Given that this research does not focus on policy outcomes but on outputs, this scope of action is not applicable. However, it does demonstrate that the LCCP aligns with a strategic framework for environmental policy. The logical scope that the LCCP integrates within this research is further detailed within this section.

As discussed, climate culture involves a social transformation based two dimensions. The second dimension, related to action, recognises that the "*empowerment of individuals and their active involvement is essential to addressing the challenges arising from the climate emergency and the ecological crisis*" (LCCP:34) is crucial. However, previous to action, the first dimension involves mindset. As mentioned, through the LCCP, BCC aims to shift the beliefs and values related to climate. That is, "*evolve mindsets, working with ideas and people*" (Ibid). The aim is to "*generate interest and raise awareness*" (Ibid: 5), which will help build the climate culture by offering platforms, resources, and providing support. The second dimension has already been seen through the co-creation factor, and while the first dimension can partly involve the establishment

of a knowledge base, it goes further than that. This first dimension implies change in subjects to be open, aware and sensible to the climate matter, before even acquiring the necessary knowledge to co-create policies. This implies that for the establishment of this knowledge base to be effective and accepted by the subjects, as a pre-condition, they must possess a minimum level of openness and awareness regarding climate issues, as well as an understanding of their capacity and essential role in taking action (Ibid).

Climate culture, thus, is part of the sequential development of highly innovative environmental policies seen in Section 4.1.3. It supports the idea that such policies are enabled through co-creation processes that leverage a well-established knowledge base for the subjects involved. Additionally, it adds the necessity for them to have an appropriate climate culture characterised by openness, awareness, and curiosity about climate action.

A knowledge base of subjects is an essential and enabling aspect for effective collaboration. Climate culture is also an essential and enabling aspect for the establishment of a knowledge base and, thus, for effective collaboration.

6.5 Co-creation strategies

The combination of a deductive and inductive approach has led to the delineation of three factors that sequentially contribute to the development of highly innovative environmental policies. A widespread climate culture within the society is found to be essential for establishing a climate knowledge base, which, in turn, is crucial for enabling co-creation processes, ultimately resulting in highly innovative environmental policies. These three factors are people-based, meaning that they are all directed to people. In section 4.2.2.2 the conclusion was drawn that the three types of subjects that the co-creation strategies present also apply to the knowledge base factor. Similarly, and given that the spread of climate culture factor is also sequential with the other two factors, it can be concluded that the three types of subjects also apply to the climate culture spread factor. The completed analytical framework, with the three strategies linked to the three factors contributing to developing highly innovative environmental policies is delineated in Table 5 (see Annex).

Based on the information collected in section 6.2, 6.3 and 6.4, the Table 5 has been applied to the case of the city of Barcelona, detailing the elements characterising each co-creation strategy for each factor (see Tables 6, 7 and 8 respectively, in Annex). The column *Results* indicates whether each element was identified throughout the analysis, and the column *Comments* provides evidence and observations related to each element. The following sections aim to provide an overview of the Tables 6, 7 and 8 and conclude on BCC's strategy for co-creation.

6.5.1 Internally whole of government strategy

Table 6 (see Annex) outlines, for each factor for developing innovative environmental policies, the elements implemented in Barcelona characterising the internally whole of government strategy. It is noteworthy that the internal aspect of this strategy has posed challenges to verify certain elements.

The Table highlights that BCC established several elements for promoting internal whole-of-government co-creation, including cross-sectoral working groups and the Technical Policy Board,

an in-house coordination entity. This strategy is further supported by the fact that climate policies significantly feature provisions typical of the energy, transport, and economic sectors. In return, these sectors' policies also highly address climate change mitigation. On the other hand, some elements have not been identified or fully completed. That is the case with the cross-cutting climate budget, while the BCCC includes an investment plan, the annual budget does not incorporate a detailed climate budget covering all sectors. The last element characterising IG strategy, corresponding to the limited role of stakeholders and citizens in co-creation, as it can be seen in Table 6, has been rejected. Their role extends beyond mere consultation after decisions have been made, they are actively involved throughout the process through various structures and initiatives (Section 6.2.2).

Focusing on the second factor, the City Council + Sustainable programme actively promotes employee support and diffusion of information and knowledge. The first social scope directed by the LCCP is the City Council, with initiatives directed to internal environmentalisation. The focus on the City Council lies in its exemplary role and, thus, capacity to multiply and further disseminate climate culture among other subjects.

Overall, despite the lack of information on some elements, it can be concluded that the BCC engages, for the three factors, on the whole of government strategy. This strategy serves as a preliminary step for the implementation of the other two strategies, adopting an exemplary role. Moreover, the use of the whole government strategy provides a cross-cutting approach that facilitates the engagement of multiple sectors.

6.5.2 Externally focused stakeholder strategy

The elements contributing to the ES strategy established by BCC across the three factors are shown in Table 7 (see Annex). Several structures enable co-creation with stakeholders, including the B+S Network and the Decidim.Barcelona platform, as well as a couple of consultative bodies reuniting experts. The B+S Network is a key component of this strategy, as 52% of its members are companies, and 28% are education-related entities. While the policies defined in the CP and CEAP integrate a green urban economy and address key polluting sectors such as energy, construction, and transportation, they superficially address technological innovations. Moreover, the ES strategy stipulates limited citizen involvement throughout the co-creation process, which has been demonstrated to be not the case. The BCC implements several structures that promote active citizen involvement.

Various programmes under Barcelona Innova, the BCC's strategy to drive urban innovation, further establish a knowledge base for stakeholders, and favour information exchange. Additionally, the B+S Network's programmes targeting schools, businesses, and commerce are particularly valuable for supporting and spreading knowledge among stakeholders. Focusing on the third factor, similarly to the City Council, the LCCP considers stakeholders key for spreading climate culture among climate-unaware subjects.

In conclusion, the BCC engages with the stakeholder strategy across the three factors contributing to the development of highly innovative environmental policies. The B+S Network forms the backbone of this strategy, enabling co-creation processes, the production and exchange of knowledge and information among stakeholders, as well as the spread of climate culture.

6.5.3 Externally Focused Civil Society Strategy

The elements implemented in Barcelona characterising the externally focused stakeholder strategy and each factor are outlined in Table 8 (see Annex).

The co-creation of policies with civil society is facilitated through platforms such as Decidim.Barcelona, as well as the Citizen Assembly for the Climate initiative. It is noteworthy that these initiatives systematically provide crucial technical information to citizens and that experts remain available to resolve doubts. The analysis also reveals that policies and measures, as well as goals and values are particularly directed at citizens and their life quality. This focus aligns with the survey mentioned in Section 6.4.1 on citizens' environmental values. When asked which values environmental policies should more importantly have, nearly 52% of the respondents answered health and well-being, while 26,6% mentioned facing climate change and 11,9% resource savings (Departament d'Estudis d'Opinió, 2020). The social and environmental approach adopted by Barcelona's smart city model further underscores the emphasis on citizens, both in terms of their inclusion in participatory processes, as well as in addressing their well-being.

Barcelona's establishment of knowledge-based civil society involves a wide range of programmes and initiatives, such as Barcelona's Fab Lab, which enhances citizens' innovative skills, the Neighbourgoods + Sustainable programme, as well as Barcelona Innova's programmes involving citizens. Finally, the spread of climate culture towards civil society is approached in two ways: targeting individuals and collectives who are already conscious of climate emergency to disseminate the culture further, and also, reaching out to those who are not yet conscious.

The analysis demonstrates that the BCC considerably addresses and involves civil society. Several mechanisms are established to ensure civil society's involvement in policy co-creation processes, access to information, establishment of knowledge base, and shift towards a climate-conscious culture.

7. Discussion

The discussion of this research is divided into two subsections. The first sub-section aims to discuss the analysis findings. Comments on key factors for creating innovative environmental policies in Barcelona's City Council, as well as insights on how the city implements the co-creation strategies, allow to draw a conclusion on Barcelona's approach to achieving its IEA. The provision of examples from other cities will allow to assess further the replicability of the conclusions made.

On a second stance, it was seen in Section 2.2 that leadership involves achieving both IEA and EEA. While the examination of EEA is left for future research, the inherent interconnection between both ambitions was recognised. Thus, the discussion will further explore the implications Barcelona's approach to IEA has on achieving EEA.

7.1 Barcelona's approach to achieving its IEA

The analysis explores the approach taken by BCC to achieve its IEA. It is first conducted through the study of the implementation of the three sequential factors to achieve highly innovative environmental policies: a collaborative creation, a well-established knowledge base, and a

spread climate culture. On a second stance, the implementation of Hofstad et al.'s (2022) three co-creation strategies were assessed for each factor. This section aims thus to discuss the approach Barcelona takes to achieve its IEA, based on the factors for developing highly innovative environmental policies, and on the co-creation strategies.

The B+S Network, one of the cornerstones of BCC strategy, serves as a green advocacy coalition by allying various actors and transversally bidding for co-creation processes, knowledge base establishment and exchanges, and the spread of climate culture. Jointly with other initiatives such as the Foundation Bit Habitat, it promotes the inclusion of stakeholders and citizens in the creation of policies. Leading EU cities are also actively engaged in developing green coalitions. The Oslo Centre for Interdisciplinary Environmental and Social Research, a strategic collaboration structure composed of research institutes and universities, was set up to develop the knowledge base in climate policy (CIENS, n.d.). In Copenhagen, the Nordic hub for sustainable urbanisation, named BLOXHUB, enables dialogue and collaboration of companies, organisations, research institutions, as well as public bodies (Bloxhub, n.d.). The integration of stakeholders and citizens adds a layer of consistency to the process, thereby mitigating its political nature. As the recently adopted 2024-2034 CCS states, "*the strength of the Barcelona + Sustainable Network has made it possible to uphold our commitments beyond political change*" (Consell Ciutadà per la Sostenibilitat, 2024:9).

Despite the crucial reduction of centralised and top-bottom creation processes, the weight of BCC is still crucial in the promotion of innovation. Most initiatives and structures related to knowledge are linked to BCC, making them vulnerable to future political divergence. Moreover, it has been seen that BCC actively engages in developing cross-sectoral policies and measures. Similarly, in Milan, the creation of the Air and Climate Plan implied an "*internal sharing laboratory*", where the directors of the different departments and areas jointly shared and created measures for the plan (Direzione Transizione Ambientale, 2022:12). It is argued that a coherent and integrated public sector conforms a crucial first step for establishing the following two strategies. This stems from BCC's ability to adopt an exemplary role and amplify messages to citizens and stakeholders and from the City Council's sectoral departments influence on their respective industries.

The analysis found that Barcelona implements the three co-creation strategies, incorporating structures that facilitate whole government, stakeholder and citizens' co-creation. The combination of the three strategies is argued to be key for developing comprehensive, cross-cutting, and scientific policies and measures, as each type of subject brings different knowledge and input. Citizens bring local knowledge, companies bring technological knowledge and scientific-technical expertise, and the whole government brings cross-cutting and administrative expertise. This open process brings participatory and deliberative democracy and legitimacy, as seen in Section 4.2.1.

The analysis has further shown that BCC very much involves and addresses citizens. The new Citizen Assembly for the Climate Initiative and the Decidim.Barcelona platform brings citizens' local knowledge to the centre of the process. The shift in the city's Smart City model from a techno-centric innovation to an approach increasingly social and environmental, and driven by citizens supports this idea. Climate plans' principles, objectives and values, as seen in Section 6.2.1, as well as policies and measures, also systematically put citizens and their well-being at

their core (Valbuena, 2023). A review of other key climate plans has shown that this is not necessarily the case in other EU-leading cities. Copenhagen and Oslo's climate plans are sectoral-oriented, with little mention of citizens' quality of life (Technical and Environmental Administration, 2012; Oslo City Council, 2020). Barcelona's climate plans also seem to involve citizens way more than other cities, where citizens' input is limited to a second stage. In the case of Milan's Air and Climate Plan, a consultation phase is organised between the adoption and approval of the plan for citizens to make comments on the already outlined measures through the platform *Milano Partecipa* (Direzione Transizione Ambientale, 2022). Moreover, Barcelona's Climate Plans stand out for their detail regarding the involvement of citizens in co-creation processes, demonstrating significant transparency. It is noteworthy to mention Paris' Climate Plan, which, to ensure citizens' participation, called for a vote on its adoption. While this approach helped raise awareness, offering only two options, "*yes*" or "*no*", for the entire Climate Plan, limited the participation scope (M. & C.H., 2018). Based on the overview of other cities' strategies and considering the technical difficulties, it is argued that civil society involvement is generally lower than the whole government or other stakeholders. In the case of Barcelona, while the combination of the three strategies has been shown, it is argued that the city places great importance on involving citizens more than other cities. Greater involvement of citizens democratises governance decisions (Hofstad et al., 2022). The city of Barcelona has indeed been recognised as a highly democratic city by being awarded the first-ever European Capital of Democracy award in 2023 (European Capital of Democracy, n.d.). Based on measures that promote participatory processes, the deciding factors for offering Barcelona the award included the platform Decidim.Barcelona and Superblock are initiatives that aim to re-assign streets to citizens rather than cars.

The focus on citizens is further supported by the active aim to build and spread of climate culture, identified as the initial step in the sequential logic for developing highly innovative environmental policies, which appears to be a unique measure undertaken by the city of Barcelona. The LCCP showcases a will by the BCC to produce a social transformation towards climate consciousness, both in terms of mindset and action. While other cities may have projects and initiatives aimed at this goal, none seem to have adopted such a comprehensive, advanced, and explicit plan. It is argued that fostering a shift in subjects' mindsets is a logical first step for developing and implementing highly innovative environmental policies. That is because individuals or companies lacking a climate-conscious culture will most likely not implement those measures or constructively participate in co-creation processes.

In conclusion, Barcelona's approach for achieving its IEA involves a collaborative creation that leverages a well-established knowledge base underpinned by a spread climate culture. Moreover, the BCC approach comprises the following five key aspects:

1. A green advocacy coalition as the strategy cornerstone;
2. A whole-of-government strategy adopting an exemplary and disseminator role;
3. A combination of the three co-creation strategies to merge various forms of knowledge;
4. A particular emphasis on involving and addressing citizens;
5. A social transformation towards climate culture.

7.2 Implications of Barcelona's approach for achieving IEA on EEA

The second part of the discussion addresses the implications that Barcelona's approach for achieving IEA has on EEA. EEA was defined in Section 2.2 as the diffusion of policies and followers' attraction to replicate and adopt them. As seen in Section 2.1.1, legitimacy is an important factor for potential followers to support or reject the diffusion of policies. Legitimacy was seen as the consideration that the decisions and directions taken are valid and entitled to be followed, highly depending on followers' perception of leaders' justified capacity to lead. We saw that domestic capacities can provide the legitimacy that cities need to transfer their domestic policies and measures abroad. All five aspects except the second one can have an implication on EEA. The second aspect, a whole-of-government strategy adopting an exemplary and disseminator role, contributes to the implementation of initiatives and measures within the city. However, it does not necessarily bring a valuable aspect for other cities seeking to replicate similar strategies.

Focusing on the first and third key aspects of Barcelona's approach for achieving IEA, they both involve the collaboration of different subjects. This pooling approach evidences representative and transparent processes, which can be highly valued by other cities. Moreover, the merging of different knowledge by the different subjects can result in increased domestic capacities to create policies that are highly technical and viable but also locally contextualised. Overall, contributing to the cities' legitimacy to transfer policies.

The fourth and fifth key aspects showcase the focus of Barcelona's approach on citizens, further bringing local knowledge, which enhances democracy and internal legitimacy. As seen in Section 4.2.1, both the Aarhus Convention and European Climate Law particularly value citizens' input. Moreover, Haverland and Liefferink (2012:182) further explained that for developing policy proposals, the Commission highly values i) scientific expertise, ii) experiential expertise, and iii) legitimacy, "*particularly in the form of (claimed) target group support*" (Haverland and Liefferink, 2012:182). That means that policies and measures to be considered by the Commission require a strong scientific back-up, a proven application that demonstrates its effectiveness, and the endorsement of the subjects impacted by them. The involvement and focus on citizens can significantly contribute to this last aspect. Thus, it is argued that Barcelona's focus on people, both in co-creation processes and policy direction, brings legitimacy to its policies from a democratic and endorsement perspective, facilitating the interest of EU institutions and other cities in replicating them. Furthermore, an increasingly climate-conscious society can potentially result in greater public acceptance and commitment and in more positive outcomes, further legitimising the transfer of policies.

8. Conclusion

Given the increasing importance of confronting one of the most pressing challenges of this century, the study of climate governance and its methodologies is paramount, particularly locally. This research aimed to explore the overarching strategic process that leading EU cities in policy outputs establish to create highly innovative environmental policies, as a means for them to achieve their IEA. Given the complexity, global scope and urgency of climate challenges,

addressing them has proved to require a central element in policy-making: collaboration. Throughout this research, collaboration is found to be essential, not only in implementing policies and measures, but in their creation. Such co-creation can potentially involve three strategies involving three types of subjects, each with a different background and expertise: whole of government, stakeholder and civil society. Given the extensive and highly technical nature of climate change, legitimacy for the involvement of subjects is required. This research has further shown that this legitimacy can be acquired by establishing knowledge bases tailored to each type of subject involved in the process, as well as to the type of knowledge they own. The analysis of Barcelona's City Council documents has found that a previous third factor, the building and spread of a climate culture, is involved in developing highly innovative policies. Conscious and willing subjects is essential for establishing knowledge base and further seek their collaboration in the creation of policies.

BCC's strategy to develop highly innovative environmental policies thus relies on a collaborative creation that leverages a well-established knowledge base underpinned by a spread climate culture, further outlined through the following three sequential factors:

i) Build and spread a climate culture by promoting a mindset shift and encouraging action, particularly within the government, B+S Network, and citizens.
ii) Establishment of structures to inform, generate a knowledge base and acquire valuable knowledge generated within the government, companies, scientifics and citizens
iii) Co-creation processes that involve the whole government, companies, scientifics and citizens

The analysis of the three co-creation strategies allows to conclude that Barcelona's City Council approach to achieve its IEA relies on five key aspects. The use of a green advocacy coalition - B+S Network - as a cornerstone of the strategy adds a layer of consistency, mitigating its political nature. The use of a whole-of-government strategy introduces an exemplary and disseminator role that significantly accelerates processes. The combination of the three co-creation strategies enable the use, exchange and integration of various forms of knowledge, key for the development of comprehensive policies. The emphasis on involving and addressing citizens, which democratises governance decisions and enhances internal legitimacy. And, the social transformation towards climate culture, ensuring widespread commitment and action.

It is crucial to consider the scope delineated for this research, as it inherently imposes limitations on the study and its findings. Regarding causality factors for the development of environmental policies, it is to be noted that situative factors have been dismissed, considering internal and external events not impactful. Issue-specific factors have been narrowed by focusing solely on climate change mitigation policies. Moreover, the research has delimited the economic and political scope by concentrating on wealthy and progressist cities. The time frame of the research is limited to the period from 2017 to 2023.

It is noteworthy that the focus on documents as primary data, all of which are issued by BCC, has proven to limit the objectivity of the delineated mechanisms and strategies and restrict the acquisition of additional information beyond the content of the documents. This research has further resulted to be limited in its capacity for generalisation. Focusing on a single case study

prevented comparing and contrasting findings with other cities. While the last two factors - generation of a knowledge base and co-creation processes – can be generalised to other EU-leading cities, the first factor – spreading a climate culture – cannot be generalised due to its definition through an abductive approach. Moreover, as seen in the discussion section, no other city particularly addresses this strategy. It has also been highlighted that the focus on citizens' participation and well-being is particular to the city of Barcelona.

This conclusion will be finalised by highlighting different possible studies based on this research. First, research can be conducted on how other leading EU cities achieve their internal environmental ambitions, enabling a comparative study with this research. Additionally, future research can focus on Barcelona's achievement of external environmental ambitions, as well as further analyse the interplay between internal and external environmental ambitions.

9. Annex

Table 5: Analytical framework with linking the three factors to the three strategies

Factor	Category	Internal whole of government strategy	Externally focused stakeholder strategy	Externally focused civil society strategy
Collaborative creation	**Co-creation processes**	Dialogue-based informal negotiations and discussions among sectors and government	Co-creation structures	Co-creation structures
		Cross-sectoral working groups		
		In-house coordination entity driving climate across sectors		
	Results of co-creation	Integration of key sectors (transport, energy, and economy) in climate policies	Policies focus on technological innovations	Policies focus on social well-being, urban life quality and daily private consumption
		Integration of climate change mitigation provisions in other sector-specific policies and strategies (transport, energy, and economic sectors)	Policies focus on green urban economy	
			Policies focus on key polluting sectors (energy, construction, and transportation)	
	Others	Setting of a climate budget	Limited role in co-creation of citizens	
		Limited role in co-creation of stakeholders and citizens		
		Establishment of structures to generate tailored knowledge	Establishment of structures to generate tailored knowledge	Establishment of structures to generate tailored knowledge

Leverage a well-established knowledge base		Acquisition of valuable knowledge resulting from the establishment of a tailored knowledge base	Acquisition of valuable knowledge resulting from the establishment of a tailored knowledge base	Acquisition of valuable knowledge resulting from the establishment of a tailored knowledge base
		Systematic provision of tailored information in co-creation processes	Systematic provision of tailored information	Systematic provision of tailored information
Spread climate culture		The spread of climate culture is addressed to the City Council	The spread of climate culture is addressed to Stakeholders	The spread of climate culture is addressed to Civil Society

Table 6: Elements on Internal whole of government strategy

Factor	Category	Element	Result	Comments
Collaborative creation	**Co-creation processes**	Dialogue-based informal negotiations and discussions among sectors and government	-	• Difficult to know based on documents' analysis.
		Cross-sectoral working groups	Yes	• Three working groups were set up to address particular cross-cutting aspects for the creation of the CP and CEAP (Section 6.2.2).
		In-house coordination entity driving climate across sectors	Yes	• A Technical Policy Board representing all municipal areas was set up to manage climate change within the administration and to co-create and assess policies and projects (Section 6.2.2).
	Results of co-creation	Integration of key sectors (transport, energy, and economy) in climate policies	Yes	• The CEAP is divided into five areas of action, three of which correspond to these key sectors: Energy saving and generation, Urban and mobility model, and economy and consumption (Section 6.2.2).

		Integration of climate change mitigation provisions in other sector-specific policies and strategies (transport, energy, and economic sectors)	Yes	• Plans and programmes from Energy, Urbanisation and infrastructures, Consumption and economy, and Mobility sectors contribute to mitigation (Figure 4).
	Others	Setting of a climate budget	Not completed	• The 2023 budget does not detail a climate budget, but an assessment of the budget in terms of climate change has been issued. It analyses the overall economic contribution to climate policies and thus to the fight against climate emergency (Ajuntament de Barcelona, 2023A). • The BCCC includes an investment plan outlining the costs attributable to the different policy areas and to the transformative actions involving other sectors.
		Limited role in co-creation of stakeholders and citizens	No	• The description of co-creation processes shows that stakeholders' and citizens' roles extend beyond mere consultation after decisions have been made. They are actively involved throughout the process (Section 6.2.2).
Leverage a well-established knowledge base		Establishment of structures to generate knowledge	Yes	• Provision of support and information through the B+S Network's programme City Council + Sustainable (Section 6.3.1). • Project Agora offers a space for municipal workers to exchange experiences and enrich collective knowledge (Section 6.3.1)
		Acquisition of valuable knowledge resulting from the establishment of a knowledge base	-	• Difficult to know based on documents' analysis.
		Systematic provision of information in co-creation processes	Yes	• Informative sessions about climate-related issues, including climate change mitigation (Section 6.3.3). • The Technical Policy Board ensures the availability of information for municipal workers (Section 6.2.2).
Climate culture		The spread of climate culture is addressed to the City Council		• The LCCP includes measures directed to the City Council and its workers (Section 6.4.1).

				• The LCCP culture strategy aims to position the City Council as a key disseminator of climate culture (Section 6.4.1). • Report monitoring the internal environmentalisation and related initiatives to raise awareness: intranet, communication campaign Marató and site visits (Section 6.4.1)

Table 7: Elements on Externally focused stakeholder strategy

Factor	Category	Element	Result	Comments
Collaborative creation	**Co-creation processes**	Co-creation structures	Yes	• The Citizen Council for Sustainability, representing the B+S Network, co-created the CP. Proposals were received through the Decidim.Barcelona platform and presential sessions (Section 6.2.2). • The Climate Emergency Board, composed by all groups including business and scientific actors, created the CEAP. Work sessions with 200 organisations from the B+S Network were set up to discuss and elaborate policies and measures. Moreover, the Decidim.Barcelona platform was available for proposals (Section 6.2.2). • A consultative body of experts for the climate emergency was created to advise the local government in the formulation of policy proposals for the CEAP (Section 6.2.1). • The Academic Advisory Council, formed by prestigious academics, advises the government in the definition of innovative public policies to achieve Barcelona's Agenda 2030 (Section 6.2.1).
	Results of co-creation	Policies focus on technological innovations	No	• While technological development and innovation is implied in the most technical areas of action of the CEAP, such as Energy

				saving and generation, and Urban and mobility model, the policies do not specifically focus on it (CEAP: 72).
		Policies focus on green urban economy	Yes	• The fourth area of action of the CEAP is addressed to the economy and consumption, aiming to adopt a green and circular economy to entails responsible consumption and reduces emissions (CEAP: 72).
		Policies focus on key polluting sectors (energy, construction and transportation)	Yes	• The second and third area of action in the CEAP address energy and transportation, respectively. Moreover, each area of action encompasses aspects of construction and urban transformation (CEAP: 72).
	Others	Limited role in co-creation of citizens	No	• The description of co-creation processes shows that citizens' role extends beyond mere consultation after decisions have been made. They are actively involved throughout the process (Section 6.2.2).
Leverage a well-established knowledge base		Establishment of structures to generate knowledge		• The B+S Network largely comprises companies and business organisations, as well as research and education centres (Section 6.2.1). It provides support, information and enables exchange of knowledge through the B+S Network's programme Schools + Sustainable, Entities and Companies + Sustainable and Commerce + Sustainable (Section 6.3.1). • The following Barcelona Innova programmes and initiatives generate knowledge for stakeholders: Barcelona Innova Lab, the call for grant "The proactive City" and the Urban Innovation Platform (Section 6.3.1). • The 22@ Innovation District contributes to knowledge development among startups and companies (Section 6.3.1).
		Acquisition of valuable knowledge resulting from the establishment of a knowledge base		• The following Barcelona Innova programmes and initiatives enable acquisition of knowledge from stakeholders: Programme Urban Challenges and Barcelona Innova Week (Section 6.3.2).

		Systematic provision of information in co-creation processes	Yes	• Each co-creation procedure systematically involves informative sessions (Section 6.3.3).
Climate culture		The spread of climate culture is addressed to stakeholders	Yes	• The LCCP includes measures directed to the B+S Network members (Section 6.4.1). • The LCCP aims to position the B+S Network as a key disseminator of climate culture (Section 6.4.1).

Table 8: Elements on Externally focused civil society strategy

Factor	Category	Element	Result	Comments
Co-creation approach	**Co-creation processes**	Co-creation structures	Yes	• The Citizen Council for Sustainability, representing the B+S Network, co-created the CP. Additionally, proposals were received through the Decidim.Barcelona platform and presential sessions (Section 6.2.2). • The Climate Emergency Board, composed by all groups including civil society, created the CEAP. Work sessions with 200 organisations from the B+S Network were set up to discuss and elaborate policies and measures. Moreover, the Decidim.Barcelona platform was available for proposals (Section 6.2.2). • The Citizens' Climate Assembly Initiative, involving 100 citizens, was aimed to uncover necessary municipal politics to address climate emergency (Section 6.2.2).

	Results of co-creation	Policies focus on social well-being, urban life quality and daily private consumption	Yes	• The CP and CEAP's inspiration principles are closely centred on people, their health and quality of life (Section 6.2.1). • Four of the seven CEAP values (*Healthy Barcelona, Socially fair Barcelona, Habitable, safe Barcelona, and Committed Barcelonians)* are deeply related to citizens and their life quality (Section 6.2.1). • The CEAP confirms that all measures have "people and their well-being" as a core theme (Section 6.2.1).
Leverage a well-established knowledge base		Establishment of structures to generate knowledge	Yes	• B+S Network: 15% of the members of the B+S Network are civic and citizen organisations (Section 6.2.1). It provides support, information and enables exchange of knowledge through the B+S Network's programme Neighbourhoods + Sustainable (Section 6.3.1). • The shift in Barcelona's smart city model towards a social and environmental approach driven by citizens evidences a focus on local knowledge (Section 6.3.1). • Education sessions offered by Barcelona's Fab Labs to enhance citizens' innovative skills (Section 6.3.1)
		Acquisition of valuable knowledge resulting from the establishment of a knowledge base	Yes	• The following Barcelona Innova programmes and initiatives: Barcelona Innova Week and Educational programme HaBITants (Section 6.3.2)
		Systematic provision of information in co-creation processes	Yes	• Each co-creation procedure systematically offers information to citizens and makes experts available to answer questions (Section 6.3.3).
Climate culture		The spread of climate culture is addressed to the civil society	Yes	• The LCCP includes measures directed to the individuals and collectives who are aware and conscious about the climate emergency, but also to those who are not (Section 6.4.1).

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