NET ZERO CITIES
SGA-NZC

Governance Innovation and Implementation in the Cities Mission

Theme 3: Reflexive Monitoring, Evaluation, and Learning (MEL) in City Climate Governance

Authors: Duncan Edmondson (VC), Melina Aliaya (UPM), Paul Barton (ICLEI).

Extended Project Team: Nikhil Chaudhary (C-KIC), David Britto (DML), Beatriz Martínez Martín (UPM), Emma Puerari (Polimi).

April 2025

Funded by
the European Union

Disclaimer

Table of contents

1 Introduction 6

2 Key concepts for Reflexive Monitoring, Evaluation and Learning (MEL). 7

2.1 Governance and Partnerships: Processes, Collaboration, Co-Creation and Participation 7

2.2 Measurement and Monitoring: Metrics, Co-benefits Measurement and Challenges 8

2.3 Applications: Visualization, Engagement & Storytelling 8

2.4 Learning and Adaptation: Learning Processes & Revision Over Time 9

2.5 Outcomes and "Success Stories" 10

3 Research Design 10

3.1 Methods 10

3.2 Research Cases 11

4 Synthesis 13

4.1 Comparison across the four city cases 13

4.1.1 Governance and Key Partnerships 14

4.1.2 Measurement: Co-benefits, Experiences, and Challenges 14

4.1.3 MEL Applications: Communication, and Storytelling 15

4.1.4 Learning and Revision of MEL over Time 16

4.1.5 Outcomes of MEL (Including Success Stories) 16

4.2 Challenges, Opportunities, and Support Needs 17

5 Conclusion 18

Bibliography 20

6 Individual city cases 22

6.1 Barcelona 22

6.1.1 Background information 22

6.1.2 Barcelona's MEL processes and application. 28

6.1.3 Summary of key insights from the city's MEL practices. 38

6.2 Cluj-Napoca 40

6.2.1 City Profile 40

6.2.2 Cluj-Napoca's MEL Processes and Application 42

Funded by
the European Union

6.2.3 Summary 46

6.3 Košice 48

6.3.1 City Profile 48

6.3.2 Košice's MEL processes and application. 50

6.4 Porto 64

6.4.1 City Profile 64

6.4.2 Porto's City MEL Processes and Application 65

List of tables

Table 1 - Comparative geographic and socio-economic data. 12

Table 2 - Comparison of the four cities in terms of emission sectors, targets and key actions. 12

Table 3 - Comparison of key MEL features across 4 city cases. 13

Table 4 - Principles on the Barcelona CCC 24

Table 5 - Barcelona's main Actions by Sector. 24

Table 6 - Barcelona's MEL structure. 26

Table 7 - Košice's GHG inventory. 49

Table 8 - Košice's key actions by sector 50

Table 9 - Košice's KPIs 56

Table 10 - Summary of Estimated GHG Impacts in Porto. 65

Table 11 - Key Actors in Porto's MEL System and Their Roles, ... 66

Funded by the European Union

Abbreviations and acronyms

Acronym	Description
CAP	Climate Action Plan
CCC	Climate City Contract
CIP	Climate Investment Plan
EIB	European Investment Bank
WP	Work Package
AFOLU	Agriculture, forestry, and land use
CA	City Advisor
CSG	City Support Group
EC	European Commission
ECF	European Climate Foundation
NZC	NetZeroCities
JTF	Just Transition Fund
GHG	Greenhouse Gases
TM	Transition Management
SECAP	Sustainable Energy and Climate Action Plan
IPPU	Industrial processes and products use

Funded by
the European Union

Summary

This report focuses on Reflexive Monitoring, Evaluation, and Learning (MEL) as a critical component of city climate governance under the EU Cities Mission. It emphasizes adaptive, inclusive, and transformative governance practices that facilitate continuous learning and improvement in urban sustainability transitions. The report highlights how reflexive MEL, which involves ongoing stakeholder collaboration, iterative adaptation, and comprehensive evaluation, significantly enhances the effectiveness and resilience of urban climate governance strategies.

Utilizing a comparative case study methodology, the report examines four mission cities chosen for their innovative approaches and geographical diversity: Barcelona (Spain), Cluj-Napoca (Romania), Košice (Slovakia), and Porto (Portugal). It focuses on five central themes: governance and partnerships, measurement and monitoring (including co-benefits), MEL applications (visualization, engagement, and storytelling), learning and adaptation, and outcomes (including success stories).

Each city demonstrates distinctive practices tailored to their local contexts. Barcelona employs centralized MEL structures enhanced by partnerships with specialized technical agencies, emphasizing health and social equity co-benefits. Cluj-Napoca integrates extensive citizen participation through its Civic Innovation and Imagination Centre, prioritizing qualitative outcomes and active stakeholder engagement. Košice showcases a highly structured approach, with formal annual reviews, multi-level stakeholder collaboration, and a focus on measurable co-benefits. Porto strategically combines structured periodic reviews with robust public communication platforms, using storytelling and public events to engage citizens effectively.

Despite varied contexts, common challenges emerge across the cities, including methodological difficulties in quantifying qualitative co-benefits, maintaining consistent public engagement, resource constraints, and integrating MEL findings systematically into policymaking. Cities have responded with innovative measures such as citizen science initiatives, data integration platforms, and structured public engagement events.

The report highlights that reflexive MEL is an essential strategic tool for cities aiming for climate neutrality, facilitating informed decision-making, robust stakeholder collaboration, and adaptive governance practices. Possible next steps include strengthening human and financial resources dedicated to MEL, advancing methodological standardization, enhancing technical infrastructures for data management, and promoting structured peer-to-peer learning exchanges. These actions can significantly bolster cities' abilities to respond effectively to evolving urban climate challenges, driving sustained, meaningful climate action.

Keywords

Mission Governance, Reflexivity, Monitoring Learning and Evaluation (MEL), Multi-actor Collaboration.

Funded by the European Union

1 Introduction

Cities striving for climate neutrality by 2030 face complex and evolving challenges. As cities increasingly take centre stage in global climate change responses, there is a growing recognition of the need for innovative and adaptive governance approaches to address complex urban sustainability challenges (Frantzeskaki et al., 2023). To help navigate these challenges, city climate governance is increasingly adopting reflexive approaches to Monitoring, Evaluation, and Learning (MEL).

Reflexive MEL in climate governance involves continuously questioning assumptions, engaging diverse perspectives, and learning-by-doing so that policies can adapt over time (Voß and Bornemann, 2011). ***Monitoring***, in practice, entails broad collaboration among stakeholders, innovative metrics to track progress and co-benefits, and feedback loops that integrate learning into decision-making (Ansell and Torfing, 2021). ***Evaluation*** goes beyond traditional metrics of success to encompass a more holistic assessment of progress towards sustainability goals. It involves not only measuring quantitative outcomes but also qualitative changes in governance structures, social dynamics, and urban systems (Wolfram et al., 2019). Finally, collective ***Learning*** needs to involve diverse stakeholders, from policymakers to citizens, in co-creating and implementing sustainable urban futures (Frantzeskaki and Rok, 2018).

The integration of reflexive monitoring, learning, and evaluation in urban climate governance represents a shift from traditional project design, development, and management towards more adaptive, inclusive, and transformative approaches to addressing climate change at the city level. This paradigm shift recognizes the need for cities to become "living laboratories" for cross-sectoral and multi-stakeholder sustainability innovations, capable of experimenting with new governance models and rapidly scaling successful initiatives (Bulkeley et al., 2021). This represents a shift in how we view Monitoring, Evaluation and Learning (MEL), moving from its traditional role as merely a project-level reporting requirement focused on control, compliance, and accountability, toward a more open and participatory process that guides collective decision-making, cultivates trust among stakeholders, and enhances the efficacy of planning and implementation.

Well-established and robust MEL practices can help cities to adapt their strategies in real-time based on emerging knowledge and changing circumstances. Integrating reflexive learning can help cities to build capacity to govern the transition, share knowledge to accelerate change, and develop innovative, effective and resilient solutions to climate challenges. In addition, a more robust integration of reflexivity in MEL can support other governance processes, such as adaptive management, and can help cities respond to early warning signs or trigger points to increase resilience. This approach allows cities to adapt strategies as conditions change, is particularly relevant in the context of urban sustainability transitions, where complex socio-technical systems are in flux and traditional linear planning models may fall short (Loorbach et al., 2020). Accordingly, this allows policy mixes and action portfolios to co-evolve with the socio-technical system as the transition unfolds (Edmondson et al. 2019; 2024).

Mission cities represent some of the most ambitious examples of urban climate governance approaches. We focus of four cities Barcelona, Cluj-Napoca, Porto and Košice, which have all advanced their climate governance in innovative ways. This report details each city's approach through a dedicated case study while also providing comparative synthesis, common challenges and opportunities that emerged through the detailed work on each city. In the next section we introduce the core concepts of reflexive MEL, which is then used to analyse the city cases individually (See Sections "individual city cases": Barcleona, Cluj-Napoca, Košice and Porto) and comparatively in the cross-city synthesis section.

2 Key concepts for Reflexive Monitoring, Evaluation and Learning (MEL).

In this report, **we explore how city-driven reflexive MEL systems can be operationalised to support city climate governance**, focusing on five key themes:

- Governance and Partnerships: Processes, Collaboration, Co-Creation and Participation
- Measurement and Monitoring: Metrics, Co-benefits Measurement and Challenges
- MEL applications: Calibration, Visulisation, Engagement & Storytelling
- Learning and Adaptation: Learning Processes & Revision Over Time
- Outcomes and Success stories: outcomes, cross-boundary learning, replication and standardization

Considering these five core features, reflexive MEL is not simply an administrative exercise, but an integral part and a driver of systemic change processes. MEL helps translate climate ambitions into effective, enduring change. By anchoring governance processes in evidence, participation, and learning, cities stand better equipped to meet the complexity and urgency of climate neutrality targets.

2.1 Governance and Partnerships: Processes, Collaboration, Co-Creation and Participation

Effective city climate MEL systems are built on collaborative, participatory processes. Multiple actor groups, reflecting participations from both those implementing and those impacted by the transition, can and should participate in a governance network that co-creates both the climate solutions and the monitoring framework.

Collaboration can be structured through transition teams, urban living labs or climate assemblies, where stakeholders jointly define goals and indicators (Loorbach, 2010). Transition Management in an approach which emphasizes participation and reflexivity, where actors co-create transformative solutions rather than simply implementing top-down measures (Frantzeskaki et al., 2018). This governance network can involve city officials, civil society organizations, businesses, and researchers (Voß and Bornemann, 2011; Edelenbos et al., 2018). This inclusive approach reflects the principle that complex problems require multiple perspectives to foster innovation and produce robust solutions (Frantzeskaki et al., 2018).

As such, participation introduces a co-creation ethos: stakeholders not only implement but also shape what is monitored and how. In addition to co-defining goals, impact pathways and indicators to measure progress along the way, reflexive monitoring methods also use iterative feedback from citizens, NGOs, and experts to identify barriers and adapt interventions in real time (Van Mierlo et al., 2010). This contrasts with traditional, expert-driven monitoring regimes, where indicators are predetermined and leave little room for stakeholder engagement (Voß and Bornemann, 2011).

Participatory MEL can strengthen trust and commitment among stakeholders, key foundations for long-term climate action (Ansell and Torfing, 2021). Nonetheless, empirical studies suggest that maintaining stakeholder momentum beyond initial pilots can be challenging, making

Funded by the European Union

institutionalization of co-creation practices vital (Wals et al., 2009). Formally embedding participatory governance (e.g. in city charters or regular budget lines) and scheduling periodic “reflexive spaces” (workshops, forums) can help sustain collaborative processes (Edelenbos et al., 2018). Participation is not just a requisite for an effective transition management, it is also a desirable strategy. When residents actively contribute to data collection or strategic discussions, the governance process becomes more legitimate and locally grounded (Hajer et al., 2015), which can create a greater sense of ownership which build a strong local constituency of support and can make the transition more durable over time (Edmondson et al., 2025, 2019).

2.2 Measurement and Monitoring: Metrics, Co-benefits Measurement and Challenges

Designing appropriate indicators frameworks and metrics is central to MEL in city climate governance. Cities typically adopt Key Performance Indicators (KPIs) to track decarbonization progress (e.g. greenhouse gas emissions), while also capturing co-benefits such as public health improvements or job creation (European Commission, 2022).

Qualitative metrics are increasingly recognized for their value in revealing institutional and behavioural shifts, which are not sufficiently captured by quantitative metrics (Frantzeskaki et al., 2018). Techniques like Most Significant Change, storytelling, and interviews can unearth changes in mindsets, stakeholder relationships, or governance culture (Wals et al., 2009).

As presented above, reflexive MEL approach must remain flexible, because urban climate transitions often unfold under conditions of uncertainty. For monitoring, rather than fixing indicators at the outset, their definition, together with their targets and metrics, may need to evolve. As unforeseen impacts or emerging issues arise (e.g. equity, inclusion and distributive concerns) cities can revise what they measure and how data is collected (Van Mierlo et al., 2010).

2.3 Applications: Visualization, Engagement & Storytelling

Data collection, management, and visualisation processes also need to co-evolve as the transition progresses and new information sources emerge or are developed. For example, many cities now leverage digital platforms, sensors, and GIS for real-time monitoring. At the same time, they engage residents as citizen-scientists to gather localized data on climate impacts, such as mapping urban heat islands or flood risk areas (Hajer et al., 2015). In the conversation on data visualisation tools, it is important to note that ensuring data interoperability and quality remains a challenge, especially where resources or technical capacity are uneven across departments (European Commission, 2022).

Visualisation, engagement, and storytelling enable and enhance Communication and Transparency. MEL findings are shared through progress reports, dashboards, and open data portals, strengthening accountability and public trust (European Commission, 2022). This transparency can invite scrutiny, helping to guard against “greenwashing” and promoting broader stakeholder engagement.

Monitoring and evaluation are most valuable when they inform practical decision-making. Reflexive MEL systems feed insights back into policy, urban planning, and climate strategy updates, creating a dynamic feedback loop (Ansell and Torfing, 2021). This has several dimensions:

Together, these practices form an iterative policy cycle, where evidence shapes decisions, which then shape further monitoring. Over time, this fosters a culture of evidence-based governance in which learning and adaptation are the norm (Voß and Bornemann, 2011).

2.4 Learning and Adaptation: Learning Processes & Revision Over Time

Monitoring and evaluation are most valuable when they inform learning for practical decision-making. Reflexive MEL systems feed insights back into policy, urban planning, and climate strategy updates, creating a dynamic feedback loop (Ansell and Torfing, 2021). The Mission approach to climate action planning is that of a "living document," revisiting it in light of evaluation findings (NetZeroCities, 2022). MEL should guide policy "course-corrections", supporting iterative improvement and preventing stagnation under outdated assumptions. Reflexive MEL outputs can inform formal decision-making processes like budgeting, project approvals, and cross-departmental coordination (Frantzeskaki et al., 2018). Evidence of effectiveness from pilot projects is needed to justify scaling up or replicating successful interventions across a city. Crucially, reflexive MEL helps better identify and respond to emerging unexpected outcomes or regressive impacts of planned actions. If particular measures underperform or fail to reach vulnerable groups, a reflexive governance approach shall adjusts resource allocations and targets accordingly (Loorbach, 2010).

Together, these practices form an iterative policy cycle, where evidence shapes decisions, which then shape further monitoring. Over time, this fosters a culture of evidence-based governance in which learning and adaptation are the norm (Voß and Bornemann, 2011).

Learning is at the core of a reflexive governance approach. Beyond producing data, a MEL system should enable the city (as an organization and a community) to evolve in pursuit of its climate goals (Wals et al., 2009). Mechanisms for revising MEL frameworks, such as annual reviews or stakeholder workshops, provide opportunities to reflect and integrate lessons into governance processes and decision making (Ansell and Torfing, 2021).

Peer-to-peer exchange and collaborative "learning labs" can help institutionalize learning. In the EU context, for example, mission cities share experiences and data through dedicated platforms, collectively making sense of results and adapting their strategies (European Commission, 2022). Embedding reflexive monitoring roles within city administrations can further sustain organizational learning, prompting officials to question assumptions and adapt structures over time (Van Mierlo et al., 2010).

Effective learning may extend to deeper, "double-loop" changes, where fundamental goals or institutional routines are re-examined (Voß and Bornemann, 2011). This can be challenging but is vital for addressing the systemic nature of climate change. By normalizing reflexive practices, cities enhance their capacity to navigate uncertainty and maintain momentum toward ambitious targets (Loorbach, 2010). While first-order reflexivity involves learning within existing value systems, second-order reflexivity challenges underlying assumptions (Van de Poel and Zwart, 2010). For instance, policymakers may reflect on whether mission strategies exclude viable alternatives (Wesseling and Meijerhof, 2023).

Funded by the European Union

2.5 Outcomes and "Success Stories"

Outcome harvesting is a stakeholder-centered methodology that identifies observable changes in behavior, relationships, activities, or practices of individuals, groups, organizations, or institutions involved in climate adaptation initiatives. Unlike traditional evaluation approaches that track progress against predetermined objectives, outcome harvesting works backward from observed changes to determine whether and how an intervention contributed to these outcomes. A key strength of Outcome Harvesting lies in its capacity to identify and document both anticipated and unexpected outcomes. By treating all outcomes equally rather than focusing primarily on planned changes, Outcome Harvesting proves effective at capturing the full spectrum of consequences, both intended and unintended. This approach is particularly valuable in complex environments where change is non-linear and influenced by multiple factors.

Replicable Success Stories can accelerate learning and standardisation of good practices. European frontrunner cities offer emerging examples and "success stories" of how reflexive MEL leads to tangible change, from reconfiguring mobility infrastructure to integrating nature-based solutions in urban design (European Commission, 2022; NetZeroCities, 2022). Highlighting and sharing these through city-to-city and peer-learning processes can help accelerate adoption and scalability of MEL practices:

- **Transformative Social Outcomes:** By tracking co-benefits and soliciting stakeholder feedback, MEL can spur broader cultural shifts; reducing silo thinking, fostering inter-departmental collaboration, and empowering communities (Hajer et al., 2015).
- **More Robust and Durable Policies:** Continuous learning-by-doing refines policies to be more ambitious and resilient. Co-created measures typically gain stronger buy-in from stakeholders, which can help maintain political and public support through changes in leadership or external crises (Edelenbos et al., 2018).
- **Adaptive and Accelerated Implementation:** Early detection of success or failure enables quicker scaling of effective interventions and reallocation of resources from underperforming ones (Loorbach, 2010). This adaptability is crucial given the pressing timeline for climate neutrality.

Identifying "stepping stones" and navigating emerging challenges also represent valuable learning outcomes in complex change processes. Not all progress manifests as major success stories, and direct attribution often proves difficult in complex, evolving environments where causal inference may lack robustness. This highlights the importance of identifying smaller stepping stones toward larger success, incremental advances that, when mutually reinforcing, may generate longer-term impacts greater than the sum of their parts. Similarly, continuous learning from responses to emerging challenges and systemic barriers yields valuable insights that can enhance individual cities' governance processes. These learning-by-doing examples can contribute to collective knowledge when shared with other cities through peer-exchange mechanisms, which can create a multiplier effect that benefits the other cities.

3 Research Design

3.1 Methods

This research follows a comparative case study design, focussing on selected Mission Cities' approaches to reflexive monitoring, evaluation and learning in their city climate governance.

We employed a mixed-methods and transdisciplinary design, drawing on interviews, workshops and a peer-to-peer workshop between city officials.

The first stage of the work involved a desk-based review of the selected cities' Climate City Contracts and supporting documents, which helped contextualise the cities in terms of city profile, main GHG sectors, and planned actions, along with the governance arrangements and the MEL systems which have been created to support the city's climate governance.

The primary research involved a multiple stage engagement process with city representatives, which followed two main steps:

City Official Interviews: Two discussions were convened between involved consortium members and city officials. Interviews followed a semi-structured format, with the number of participating city officials ranging from one to three per city. The sequencing of interviews allows time for the initial interview to be reflected on and allowed deeper investigation of key elements of the city MEL practices. Interview were (in general) 60 mins in length and were conducted November 2024 to February 2025.

City Peer-to-Peer Workshop: The final step involved an online peer-to-peer workshop in March 2025 where cities presented their respective approaches to anticipatory governance. Following these presentations, facilitated discussions were held, encouraging direct exchange and collaborative learning among city representatives.

This collaborative research design invited city officials to be part of the sensemaking process through a peer-to peer workshop, with a facilitated discussion moderated by the project team. The individual case studies were also shared with participating cities for their review and validation of the case contents, which helped ensure the reliability of the work. The final synthesis of shared insights, challenges and opportunities across the city cases built upon these interactions but was conducted by the project team. Therefore such opinions or insights reflect those of the project team and do not necessarily represent the views of the participating city officials.

3.2 Research Cases

The cities we include highlight both diversity and innovation. The mission cities were selection on the basis of highlighting innovative governance practices based on prior knowledge of the cities based on: (i) consultations with the NetZeroCities city support network, (ii) EC feedback of labelled cities CCCs, and (iii) consortium review of submitted CCCs, and (iv) knowledge of cities through the Pilot Cities Program (PCP). Cities were then narrowed down and balanced to represent a diversity of geographies across the EU mission cities. We explore these cities further in the cross cases-synthesis, while specifics and nuances of the MEL practices are included in the induvial city cases. In this section we give an overview to the cities (**Table 1**) and their priorities for climate action (**Table 2**).

Cluj-Napoca is the second-largest city in Romania, the largest city in the historical province of Transylvania (north-western Romania). It serves as an academic, cultural, and business hub, hosting Romania's largest university and its largest Romanian-owned commercial bank. With a population of approximately 286,598 (2021) and a metropolitan area of up to 420,000 people, Cluj is experiencing rapid growth, adding 5,000 new inhabitants in 2021 alone. Known for its dynamic economy driven by services, industry, and commerce, Cluj also faces challenges such as high greenhouse gas emissions from urban development and motorization.

Funded by the European Union

Table 1 - Comparative geographic and socio-economic data.

	Cluj-Napoca	Barcelona	Porto	Košice
Geographic Context	Northwestern Romania; largest city in Transylvania.	Northeastern Spain; capital of Catalonia Region, along the Mediterranean coast.	Northern Portugal; located along the Douro River estuary.	Eastern Slovakia; administrative center of Košice Region.
Population (City / Metro)	286,598 / ~420,000	1.69 million / 2.8 million	231,800 / 1.7 million	229,040 / ~300,000
Population Trends	Growing rapidly (+5,000 in 2021).	Stable growth linked to migration (21% foreign nationals).	Growth driven by immigration (+2.4% in 2023).	Declining due to suburbanization and limited job opportunities.
Economic Output	GDP per capita: $25,400 (2020).	GDP per capita: €46,000 (2021); Catalonia contributes 19.5% of Spain's GDP.	Regional GDP: €40 billion (~16% of Portugal's GDP).	GDP per capita: €17,000 (2021).
Main Industries	Services, Industry, Commerce	Services, High-knowledge sectors, SMEs	Technology, Tourism, Logistics	Manufacturing, IT, Green Tech
Employment Distribution	Services: 53.7%	Agriculture: 0.3%, Industry: 15.8%, Services: 78.2%	Mainly services; some manufacturing and logistics	Agriculture: 3%, Manufacturing: 30%, Services: 67%

Barcelona is Spain's second-largest city and the capital of Catalonia, located on the northeastern Mediterranean coast. With a population of 1.69 million in the city proper and nearly 5 million in its metropolitan area, Barcelona is a global hub for culture, tourism, and high-knowledge industries. Contributing nearly 19.5% to Spain's GDP with a per capita GDP of €46,000 (2021), the city has embraced green economy initiatives while addressing challenges such as air pollution, heatwaves, and limited green spaces due to high population density.

Porto is one of the Portugal's most vibrant cities, with a population of approximately 231,800 within the city and 1.7 million in its metropolitan area, and is situated in northern Portugal along the Douro River estuary. Porto is a dynamic urban centre known for its innovation in technology, tourism, and sustainable mobility projects. As a key contributor to Portugal's economy with a regional GDP of €40 billion (~16% of the national GDP), Porto balances urban density challenges with efforts to promote sustainability.

Table 2 - Comparison of the four cities in terms of emission sectors, targets and key actions.

	Cluj-Napoca	Barcelona	Porto	Košice
Baseline Year	2021	2021	2019	2018
Total GHG Emissions ($ktCO_2e$)	1,167	3,165	937	933
Main Emission Sectors	Buildings (55%), IPPU (26%), Transport (13%)	Buildings & Heating (855 kt), Transport (840 kt), Electricity (927 kt)	Buildings, Transport, Waste, IPPU	Buildings (65%), Electricity (17%), Transport (9%), Waste (6%)
Reduction Target	80% by 2030	Up to 71% (by sector)	85% by 2030	Buildings: -71%, Transport: -70%, Electricity: -66%, Waste: -11% by 2030
Key Actions	Urban regeneration, building renovations, EV infrastructure, green transport, circular city program	Public transport expansion, energy-efficient building standards, renewable energy, green infrastructure, waste reforms	Energy efficiency in buildings, sustainable mobility, green infra, circular economy, Porto Climate Pact	Energy efficiency in buildings, geothermal heating, renewable electricity, cycling infrastructure, public transport electrification, urban mobility policy, green urban development, waste reduction and circular economy
Monitoring Framework	Sectoral GHG tracking by scope (1–3)	Sector-specific plans and strategies	CIRIS system with mid-term evaluations in 2025 & 2027	Sectoral tracking with projected 2030 baseline and BAU comparisons

Košice is the second-largest city in Slovakia and the administrative centre of the Košice Region, located in the eastern part of the country. With a population of 229,040 (2021) and a metropolitan area of around 300,000 people, Košice is an important industrial and cultural centre. It is known for its heavy industry (e.g., U.S. Steel), IT sector, creative industries, and emerging green technologies. However, the city faces challenges such as population decline due to suburbanization and pollution from industrial activities.

4 Synthesis

4.1 Comparison across the four city cases

In this section we compare across the four city cases to highlight key elements of the cities' work as well as key similarities and differences across the cases. A summary of key insights across cities is found in **Table 3**.

Table 3 - Comparison of key MEL features across 4 city cases.

Category	Barcelona	Cluj-Napoca	Košice	Porto
Governance & Partnerships	Technical Programming Office coordinates MEL. Collaborative approach involving city departments and external expert agencies for data and health impacts.	Civic Innovation and Imagination Centre (CIIC) leads participatory MEL. Strong academic partnerships for indicator design.	Multi-level governance with clearly defined MEL roles, stakeholder board, universities, and city-owned companies actively engaged.	Coordinated by Transition Team and Energy Agency, supported by the Carbon Neutrality Directorate and multi-sector stakeholders.
Co-benefits Measurement & Challenges	Recognizes co-benefits (health, social equity), but measurement methods still evolving. Complex attribution challenges acknowledged.	Prioritizes co-benefit metrics like quality of life and health. Balances qualitative and planned quantitative measures.	Explicitly emphasizes multidimensional co-benefit indicators (economic, social, environmental). Faces challenges quantifying some (currently) more qualitatively measured impacts (e.g. air quality), since attribution and causality not straightforward at the policy level.	Initially GHG-focused but gradually incorporating indicators like energy poverty and quality of life.
Applications: Engagement & Storytelling	Limited new participation; leveraged prior citizen engagement platforms. Emphasizes transparent reporting.	Deep public participation via CIIC. Strong emphasis on communicating relatable stories of local co-benefits.	Participatory from inception, stakeholder group regularly engaged. Uses cultural and community events for MEL storytelling.	Structured public communication through annual events and Climate Pact Talks. Emphasizes visible local achievements. Gamification in schools. Open data platform.
Learning & Revision Over Time	Informal learning-by-doing approach. Currently refining indicators, lacking a formalized periodic review mechanism.	Actively iterative, responsive to data availability and citizen feedback. Frequent adjustments and CIIC-driven reviews.	Deliberate reflexivity with structured Annual Climate Reports and Mid-term Reviews. Strong internal MEL learning structures. Audits commissioned to review data quality.	Scheduled biennial reviews complemented by continuous iterative adjustments based on monitoring data and experiences. Regular (periodic) strategy and policy adjustments based on data
Outcomes & Success Stories	MEL informs strategic decisions (e.g., reframing retrofit incentives around health co-benefits). Emerging use in climate budgeting.	Directly linked to community-driven projects (e.g., pedestrian street). MEL supports policy justifications and investment attraction.	MEL accelerated successful building energy-efficiency pilot scaling. Directly influenced strategic priority towards building emissions reduction.	Data-driven prioritization of building retrofits. MEL outcomes publicly communicated (open data platform, public meetings) to motivate stakeholders and enhance transparency.

4.1.1 Governance and Key Partnerships

All of the analysed cities have established robust collaborative governance frameworks to effectively manage their MEL systems.

Barcelona and Porto are characterized by centralized structures that provide clarity, consistency, and well-defined roles. Barcelona has a dedicated Technical Programming Office coordinating the MEL approach, alongside a clearly structured Executive Committee of the Climate Plan involving representatives from each key city department. Additionally, external expert institutions such as the Barcelona Energy Agency and ISGlobal provide specialized technical support, enhancing MEL comprehensiveness and credibility. Porto operates a structured Transition Team composed of 11 entities, led by the longstanding municipal Energy Agency, facilitating clear coordination across multiple stakeholders. Porto's MEL processes benefit from a dedicated Carbon Neutrality Directorate, and the digital expertise provided by Porto Digital supports data integration. Their Climate Pact further engages an extensive network of private sector and institutional stakeholders, significantly enriching the MEL dataset.

Košice and Cluj-Napoca emphasize multi-level, networked governance approaches that integrate diverse partnerships spanning academia, NGOs, city-owned companies, and community organizations. Cluj-Napoca's Civic Innovation and Imagination Centre (CIIC) anchors a highly participatory governance model, bringing together stakeholders from local government, universities, private companies, and citizen groups. Key local universities such as Technical University of Cluj-Napoca and Babeș-Bolyai University play a central role in co-developing scientifically rigorous indicators, particularly in areas of environmental monitoring and social engagement. Košice's governance is characterized by deliberate multi-level partnership structures, including clearly defined MEL roles—such as dedicated internal coordinators and MEL officers—and extensive involvement of city-owned utilities and companies, especially for key sectors like energy, waste, and transport. The establishment of a formal stakeholder board of major public utilities and private investors further ensures high-level buy-in, aligning the city's major infrastructure projects closely with climate neutrality goals and enabling smoother data-sharing and alignment with MEL objectives.

In all cities is the central role of collaboration and partnerships both between internal municipal units and with external partners (universities, specialized agencies, private entities) to provide technical expertise, data management support, and credibility to the MEL frameworks. This multi-actor, integrative approach significantly strengthens the capacity, reliability, and effectiveness of city climate governance through MEL.

4.1.2 Measurement: Co-benefits, Experiences, and Challenges

Measurement is a broad topic, which is covered in more detail in each individual city case. Here, we focus explicitly on the measurement of co-benefits, which is clearly recognised across the four cities as of critical importance to strengthen support and legitimacy for climate actions, by demonstrating these benefits to different interest groups (stakeholders, citizens, politicians etc.).

Cluj-Napoca and Košice are notably proactive in explicitly emphasizing comprehensive co-benefit indicators, integrating metrics such as improved public health outcomes, citizen satisfaction, and enhanced quality of life directly into their MEL systems. Cluj-Napoca, for instance, explicitly prioritizes co-benefit metrics over direct emissions data, capturing qualitative aspects like improved air quality and public perceptions through surveys and feedback mechanisms, alongside an increaseing database of quantitative data inputs from sensor networks. Košice similarly foregrounds multidimensional co-benefits measurement in its MEL framework, consistently linking environmental interventions with socio-economic impacts. For example, when evaluating energy efficiency retrofits,

Košice measures not only energy savings but also household cost reductions and improved living conditions, employing university partnerships to enhance methodological rigor. Despite their leadership in this area, both Cluj-Napoca and Košice acknowledge the methodological challenges in accurately attributing these co-benefits directly to specific interventions, but have found use of proxy indicators, including increased use of a renovated sports facility usage example as a proxy for social benefit.

Porto and Barcelona have emphasised co-benefits and social indicators but highlight the challenegs in attributing outcomes to individual policies. Porto, initially more focused primarily on quantitative metrics, has progressively introduced broader co-benefit indicators into its MEL system, such as the Energy Poverty Index and other quality-of-life measures, acknowledging that their initial indicator set may not fully capture these complex outcomes. Barcelona, meanwhile, demonstrates caution regarding co-benefits measurement, recognizing significant methodological complexity in attributing observed improvements (like public health or social equity gains) definitively to particular policies, thus employing modeling alongside qualitative data measurement and evaluations.

Overall, the cities share a common challenge: accurately quantifying and attributing qualitative co-benefits, highlighting a critical area for further methodological innovation and consensus-building.

4.1.3 MEL Applications: Communication, and Storytelling

All four cities recognize public engagement, communication, and storytelling as integral components of their MEL systems, employing diverse approaches adapted to local contexts. Cluj-Napoca and Košice embedded participatory processes from the inception of their MEL frameworks, utilizing continuous citizen engagement platforms. Cluj-Napoca's CIIC facilitates ongoing co-creation processes, directly translating community feedback into tangible policy outcomes, such as pedestrianizing congested streets, thereby visibly linking MEL processes to real-world community benefits. Similarly, Košice uses structured, regular stakeholder meetings initiated during the URBACT participatory process to sustain citizen involvement and ensure that community perspectives consistently inform MEL revisions.

Barcelona's approach leverages previously established public engagement mechanisms, including online platforms like Decidim and the outcomes of a Climate Assembly, integrating earlier citizen input into MEL indicator design. Their emphasis on transparency involves making MEL data accessible to the public through clear reports and open data portals, enhancing accountability and public trust.

Porto stands out through its proactive use of storytelling in structured public communications. Their annual public events and the Climate Pact Talks specifically showcase local climate success stories, celebrating tangible achievements such as solar installations or improvements in local mobility, which effectively translates technical MEL data into accessible narratives. This structured public celebration of successes has created relatable examples of climate action, building sustained civic interest and peer learning among stakeholders.

Collectively, the experiences of these cities underscore the necessity of translating MEL's technical outputs into compelling, meaningful stories that resonate broadly with citizens, thereby sustaining engagement, enhancing accountability, and strengthening overall support for climate policies.

4.1.4 Learning and Revision of MEL over Time

Iterative learning and flexibility strongly characterize MEL implementation across all four cities, though the formality and maturity of their processes vary. Košice stands out through its highly structured reflexive approach, anchored in formalized Annual Climate Reports and planned Mid-term Reviews (2025, 2027). This deliberate institutionalization of learning, supported by a dedicated MEL team, allows the city to rapidly adapt strategies based on robust, real-time data, exemplified by their quick expansion of a successful energy-efficiency building pilot following initial positive results.

Porto similarly adopts structured periodic reviews (conducting formal MEL assessments biennially) and also complements these with ongoing, iterative adjustments informed by immediate monitoring feedback. This dual approach ensures continuous MEL evolution, responsiveness, and practical policy relevance, as exemplified by proactive interventions like improving private-sector data collection practices through specific targeted initiatives.

Cluj-Napoca exhibits adaptive responsiveness driven by direct practical experience and active stakeholder engagement. Their MEL indicators and methodologies evolve frequently, informed by ongoing community dialogues facilitated through the CIIC, quickly addressing emerging practical challenges (such as shifts in waste data availability due to administrative restructuring).

Barcelona, by contrast, currently adopts a more informal and ad hoc learning process, progressively refining indicators as new practical challenges emerge. Despite a lack of structured review processes, Barcelona recognizes the necessity for formalizing and systematizing MEL revisions more explicitly, indicating an important next step toward institutionalizing MEL-based learning.

Together, these cases demonstrate MEL as inherently dynamic processes, underlining the critical importance of maintaining institutional flexibility, adaptability, and an ongoing commitment to reflective organizational learning.

4.1.5 Outcomes of MEL (Including Success Stories)

The practical utility of MEL in directly influencing policy implementation and decision-making emerges clearly across all cities. Košice provides a strong example, rapidly scaling its building energy efficiency pilot after MEL output (findings of the evaluation), demonstrated economic and energy-saving successes. These results informed a strategic shift toward prioritizing building retrofits, based on cost efficiencies and emissions reduction potential identified by initial MEL assessments.

Porto similarly demonstrates MEL's practical impact through its data-driven prioritization of municipal building retrofits, using detailed energy consumption data from their Energy Observatory to target specific interventions. Additionally, Porto's MEL results, communicated through structured annual events, inspire broader stakeholder engagement, directly motivating private sector and civic participants to enhance their own climate actions.

Cluj-Napoca's MEL processes directly resulted in tangible, community-driven outcomes, such as the pedestrianization project informed by citizen feedback via the CIIC. MEL data effectively supported policy advocacy by clearly illustrating the community benefits of specific climate actions, thereby justifying policy decisions and attracting further investment.

Barcelona employs MEL strategically in framing policy narratives, particularly around reframing investment rationales in building retrofits to emphasize comfort and health benefits. Such MEL-

informed policy framing enhances public acceptance and political support, further demonstrating MEL's instrumental role in practical governance.

Collectively, these city experiences validate MEL's effectiveness not merely as a reporting tool but as an active driver of informed, adaptive, and responsive climate governance.

4.2 Challenges, Opportunities, and Support Needs

Data availability and integration: Cities have experienced difficulties accessing reliable and consistent data, especially from private-sector partners, city-owned companies, and regional or national authorities. For instance, Porto encountered challenges in obtaining standardized emissions data from private-sector stakeholders, requiring additional initiatives such as the "A Plus Class" project to improve data reporting practices. Similarly, Cluj-Napoca faced limitations accessing commuter and regional waste management data due to legal and jurisdictional constraints, hindering comprehensive monitoring efforts. Košice had initial challenges harmonizing diverse data streams across its municipal companies, illustrating broader issues of interoperability and data standardization within cities.

Measuring qualitative outcomes and co-benefits: All cities highlight significant methodological complexities when quantifying qualitative co-benefits (e.g., health improvements, quality of life, equity). Barcelona explicitly acknowledged the difficulty in directly attributing co-benefits like improved air quality or reduced energy poverty to specific climate actions, due to external influences and multiple variables. Košice and Cluj-Napoca, while strongly emphasizing co-benefits measurement (such as public health and social engagement indicators), often resorted to proxy indicators due to the lack of standardized, accepted methodologies. Porto similarly recognized limitations in its initial indicators, expecting adjustments once initial data collection reveals gaps in effectively capturing co-benefits.

Resource constraints: Limited staffing, specialized technical expertise, and insufficient financial resources present ongoing challenges. Barcelona explicitly highlighted insufficient human resources dedicated to data management and analysis tasks. Smaller municipalities or departments within these cities frequently struggle to allocate dedicated MEL staff or afford advanced technology infrastructure (e.g., sensor networks, integrated digital platforms), limiting the granularity and comprehensiveness of their MEL frameworks.

Multi-stakeholder coordination: Managing coordination and maintaining momentum across diverse actors is challenging, particularly without dedicated resources. Barcelona experienced uncertainties around the formal process for updating indicators involving multiple departments. Cluj-Napoca recognized the extended timelines required for participatory co-creation processes due to frequent stakeholder negotiations. Effective alignment and maintaining active, consistent participation from stakeholders require clearly defined roles, regular communication, and well-structured governance frameworks, something that remains challenging to achieve consistently across all cities.

Integration into policymaking: A persistent challenge remains in embedding MEL findings systematically and routinely into actual policymaking, budgeting, and investment decisions. Barcelona is still working to fully integrate MEL indicators into its ongoing climate planning cycles. Cluj-Napoca noted that despite good MEL data, final policy approval often depends heavily on political, budgetary, or public opinion constraints. The cultural shift needed for MEL to become fully ingrained in evidence-based policymaking is still evolving in each of these cities.

Maintaining public engagement: Cities face ongoing difficulty in keeping the public consistently engaged with technical MEL information, which can often appear abstract or complex. Cluj-Napoca and Košice noted the substantial efforts required in translating MEL data into relatable stories that resonate with the public. Cluj-Napoca discovered residents engaged more effectively with benefits like improved green spaces or traffic reduction rather than abstract emissions data, indicating the ongoing need for skilled communication efforts.

Political continuity: Ensuring MEL systems remain stable and effective across political cycles and shifting leadership remains difficult. Košice proactively addressed this by embedding MEL within a non-partisan data department, which helped to insulate their climate efforts from political changes. However, not all cities have secured this degree of institutionalization, leaving their MEL frameworks potentially vulnerable to political disruptions.

5 Conclusion

As cities continue to grapple with the complexities of climate change mitigation, integrating principles of reflexive monitoring, learning, and evaluation offer promising opportunities for enhancing the effectiveness of urban climate governance. This report highlights learning and good practices from selected Mission cities and sets the stage for a deeper exploration of these concepts and their practical applications in fostering sustainable urban transitions.

The experiences of these four cities reveal valuable insights and learnings about the transformative potential of reflexive monitoring, evaluation, and learning (MEL) in practice. As cities navigate the complex challenges of climate action, their journeys highlight both significant opportunities and critical areas where targeted support could accelerate progress toward urban sustainability goals.

Cities that have embraced robust MEL systems are discovering their power as catalysts for evidence-based decision making. In Košice, what began as careful monitoring of a building energy efficiency pilot quickly evolved into a scaled initiative with widespread impact, demonstrating how data-driven approaches enable precise resource allocation. Similarly, Porto's ability to target building retrofits based on energy performance data illustrates how MEL practices help cities maximize climate impact while optimizing limited resources. These experiences point to a future where urban climate governance becomes increasingly precise and effective through systematic learning processes.

Evidence-based approaches can help strengthen public trust and meaningful stakeholder engagement. When cities transparently communicate their monitoring results and evaluation findings, they create foundations for authentic participation. Porto's structured annual events have become platforms where stakeholders not only receive information but actively contribute to collective learning. In Cluj-Napoca, participatory monitoring processes have directly empowered citizens, resulting in tangible outcomes like new pedestrian zones that enjoy broad community support. This demonstrates how MEL practices can transform the relationship between city governments and their residents, creating shared ownership of climate initiatives.

The strategic advantages extend to cost efficiencies and cities' financial sustainability. As external funders increasingly demand evidence of impact, cities with sophisticated MEL systems gain a competitive edge. Cluj-Napoca has explicitly leveraged its documented achievements to demonstrate capacity and reliability to potential funding bodies. This strategic approach positions cities advantageously for securing EU funding and private investment, creating a virtuous cycle where effective monitoring leads to increased resources for climate action.

Perhaps most promising is MEL's potential to break down traditional policy silos through cross-sectoral integration. Barcelona's approach of connecting climate actions with public health and equity outcomes has facilitated collaboration across previously isolated departments. By highlighting multi-dimensional benefits through careful monitoring, cities can build broader coalitions for climate action and attract support from diverse budgetary sources, including private investment. This integrated governance approach represents a fundamental shift from compartmentalized climate policy toward holistic urban sustainability.

Technological innovation further amplifies these opportunities. Cluj-Napoca's investments in sensor networks and digital twins exemplify how emerging technologies enable increasingly sophisticated monitoring capabilities. Porto's digital integration platform demonstrates the potential for scaling effective data management across city operations. As smart city technologies continue to evolve, they offer cities unprecedented abilities to track and monitor climate impacts in real-time, engage citizens through digital platforms, and make data-informed adjustments to their climate strategies.

Despite these promising developments, cities face significant challenges that require targeted support. The most pressing need involves human capacity development. Cities like Barcelona and Košice explicitly cite shortages of specialized personnel in MEL practices. Dedicated funding for MEL positions and professional development programs would significantly enhance cities' evaluation capabilities, allowing them to fully leverage the potential of their climate data.

The technical infrastructure supporting MEL activities represents another critical area for investment. Many cities struggle with fragmented data systems that create barriers to comprehensive monitoring. Support for integrated digital platforms, interoperable data standards, and advanced analytics would enable more timely and accurate evaluation of climate initiatives. This digital foundation is essential for reducing the lag between implementation and assessment, allowing for more streamlined and responsive climate governance.

Equally important is the development of standardized methodological frameworks. Cities consistently report challenges in measuring co-benefits and comparing outcomes across different contexts. Shared EU-wide guidance for data collection and impact assessment would facilitate more robust and comparable MEL practices, creating opportunities for meaningful benchmarking and collective learning across the European urban network.

These technical needs are underpinned by a need for dedicated financial resources specifically allocated for MEL activities. Experience shows that when MEL is funded as an afterthought or absorbed into broader project budgets, its implementation often becomes superficial. Dedicated funding streams would recognize MEL not as an administrative burden but as a strategic investment in governance effectiveness.

These cases highlight that MEL can be established not merely as a reporting requirement but as a transformative governance approach. The experiences of pioneering cities demonstrate that when properly implemented, reflexive monitoring becomes a powerful driver of continuous improvement in urban climate action. As cities continue to develop their MEL capabilities, they create not only more effective climate initiatives but more responsive, transparent, and adaptive governance systems capable of meeting the complex challenges of urban sustainability transitions and systemic change.

Finally, the value of structured knowledge exchange cannot be overstated. While each city faces unique circumstances, the challenges of implementing effective MEL systems are similar across contexts. This work has highlighted the value of city peer-to-peer learning, which can be further leveraged to accelerate governance innovation and scalability of approaches. Regular cross-city

workshops, mentoring programs, and collaborative platforms can accelerate the dissemination of successful practices throughout the NetZeroCities network and beyond, replicating successful approaches, and leading to accelerated widespread adoption of proven strategies.

Bibliography

Anguelovski, I., Connolly, J.J., Brand, A.L. and Chu, E. (2022) 'From Climate Change to Climate Justice: Critical Perspectives on the Intergovernmental Panel on Climate Change's Sixth Assessment Report', Urban Studies, 59(16), pp. 3369-3388.

Ansell, C. and Torfing, J. (2021) *Public Governance as Co-creation: A Strategy for Revitalizing the Public Sector and Rejuvenating Democracy*. Cambridge: Cambridge University Press.

Bulkeley, H., Marvin, S., Palgan, Y.V., McCormick, K., Breitfuss-Loidl, M., Mai, L., von Wirth, T. and Frantzeskaki, N. (2021) 'Urban living laboratories: Conducting the experimental city?', European Urban and Regional Studies, 28(4), pp. 419-437.

Edelenbos, J., Van Meerkerk, I. and Schenk, T. (2018) 'The Evolution of Community Self-Organization in Interaction With Government Institutions: Cross-Case Insights From Three Countries', *The American Review of Public Administration*, 48(1), pp. 52–66. doi: 10.1177/0275074016651142.

Edmondson, D., Flachsland, C., aus dem Moore, N., Koch, N., Koller, F., Gruhl, H., Brehm, J., 2025. Anticipatory climate policy mix pathways: a framework for ex-ante construction and assessment applied to the road transport sector. Climate Policy 25, 438–467. https://doi.org/10.1080/14693062.2024.2397440

Edmondson, D.L., Kern, F., Rogge, K.S., 2019. The co-evolution of policy mixes and socio-technical systems: Towards a conceptual framework of policy mix feedback in sustainability transitions. Res Policy 48. https://doi.org/10.1016/j.respol.2018.03.010

European Commission (2022) *NetZeroCities: Delivering the European Green Deal in Cities*. Brussels: European Commission. Available at: https://netzerocities.eu/ (Accessed: 15 March 2025).

Frantzeskaki, N. and Rok, A. (2018) 'Co-producing urban sustainability transitions knowledge with community, policy and science', Environmental Innovation and Societal Transitions, 29, pp. 47-51.

Frantzeskaki, N., Broto, V.C., Coenen, L. and Loorbach, D. (eds.) (2018) *Urban Sustainability Transitions*. London: Routledge.

Frantzeskaki, N., Hölscher, K., Holman, I.P., Pedde, S., Jaeger, J., Kok, K. and Harrison, P.A. (2023) 'Transition pathways to sustainability in greater than 2°C climate futures of Europe', Regional Environmental Change, 23(1), pp. 1-16.

Hajer, M., Nilsson, M., Raworth, K., Bakker, P., Berkhout, F., de Boer, Y., Rockström, J., Ludwig, D. and Kok, M. (2015) 'Beyond Cockpitism: Four Insights to Enhance the Transformative Potential of the Sustainable Development Goals', *Sustainability*, 7(2), pp. 1651–1660. doi: 10.3390/su7021651.

Loorbach, D. (2010) 'Transition Management for Sustainable Development: A Prescriptive, Complexity-Based Governance Framework', *Governance*, 23(1), pp. 161–183. doi: 10.1111/j.1468-0491.2009.01471.x.

Loorbach, D., Frantzeskaki, N. and Avelino, F. (2020) 'Sustainability Transitions Research: Transforming Science and Practice for Societal Change', Annual Review of Environment and Resources, 45, pp. 271-298.

Van de Poel, I. and Zwart, S.D. (2010) 'Reflective equilibrium in R&D networks', Science, Technology, & Human Values, 35(2), pp. 174–199. doi:10.1177/0162243909340272

Van Mierlo, B., Arkesteijn, M. and Leeuwis, C. (2010) 'Enhancing the Reflexivity of System Innovation Projects With System Analyses', *American Journal of Evaluation*, 31(2), pp. 143–161. doi: 10.1177/1098214010366046.

Voß, J.-P. and Bornemann, B. (2011) 'The Politics of Reflexive Governance: Challenges for Designing Adaptive Management and Transition Management', *Ecology and Society*, 16(2), p. 9. Available at: http://www.ecologyandsociety.org/vol16/iss2/art9/ (Accessed: 15 March 2025).

Wals, A.E.J., Van der Hoeven, N. and Blanken, H. (2009) *The Acoustics of Social Learning: Designing Learning Processes that Contribute to a More Sustainable World*. Wageningen: Wageningen Academic Publishers.

Wesseling, J.H. and Meijerhof, N. (2023) 'Towards a mission-oriented innovation systems (MIS) approach: Application for Dutch sustainable maritime shipping', PLOS Sustainability and Transformation, 2(4), p. e0000075. doi:10.1371/journal.pstr.0000075.

Wolfram, M., Frantzeskaki, N. and Maschmeyer, S. (2019) 'Cities, systems and sustainability: status and perspectives of research on urban transformations', Current Opinion in Environmental Sustainability, 22, pp. 18-25.

6 Individual city cases

6.1 Barcelona

6.1.1 Background information

Geographic and regional context

Location: Barcelona is in the northeastern Spain along the Mediterranean coast, and it is composed by 10 districts.

Region: It serves as the capital of Catalonia Region.

Key administrations: Metropolitan Area of Barcelona, the Barcelona Provincial Council, and the Government of Catalonia. The City of Barcelona has a Municipal Charter with the status of a law[1], which regulates the Special Regime of the municipality of Barcelona, offering the municipal government a greater scope for action.

Autonomic government: The City of Barcelona enjoys a certain degree of autonomy for the government of its public interests, recognised and regulated by the Spanish Constitution and the Statute of Autonomy of Catalonia.

Population / demographics

Population size: the Barcelona population raise to **1.69 million inhabitants (inh.),** with a population density of **16,638 inh./square kilometre[2],** distributed in a surface area of 101.35 km^2.

Variation: increases in the population level are linked to migration movements. Total **migrant population arises to 1.44 million, by November 2024**[3] . By 2024, the registered immigrants equals to **120,349 people, according to the municipal registry (compared to 138,417, by 2023)[4].** This makes the city one of the most diverse of the country, apart from Spanish nationals, residents from around 180 different nationalities live in the city.

Rural population: The interdependence between Barcelona and its rural surroundings is evident in food supply chains, water management, and transportation networks. It is characterized by small towns, agricultural landscapes, and natural reserves, such as the Montseny Natural Park and the Penedès wine region, which play a crucial role in food production and environmental conservation. Several rural inhabitants commute to the city for work, education, and services, while others are engaged in agriculture, viticulture, and tourism-related activities.

Demographics:

The **average age of Barcelona's population remains stable at 44.4 years,** within the last two years period.[5]

- **Children Population** (<15): 11,34 in 2024
- **Youth Population** (15-24): 10,04%
- **Working- age Population** (25-59): 51,8 %
- **Population (60-64):** 5.86 %
- **Elderly Population (>65):** 20,91%

Age by gender distribution remained stable in the last two years, in **which women represent 52,3% of the total population**. This slightly higher women contribution to the binary ratio, is observable in most of the city's territories. In particular there is a predominance of woman above the 45 years old.[6]

Socio-economic figures

Barcelona's economy is based on services, which is one of the main sources of employment among the resident population. The industry has lost relevance in recent decades, largely because it has moved to other areas of the increasingly extensive metropolitan region of the city. Barcelona's economic structure is based on small and medium-sized companies (SMEs).

Barcelona has easy access to highly dynamic large markets such as the European Union common market, which provides access to 510 million people. It is also part of the Mediterranean corridor, a Trans-European network for transporting goods that has a direct impact on an area of 250 million residents (50% of the EU's population).

Summary of indicators:

- Barcelona's GDP per capita totalizes €46,000 by 2021. It grew by 2.8% in real terms, above Catalonia.[7]
- In 2023, Catalonia's GDP raised to €292.5 billion, representing 19.5% of Spain's total GDP.[8]
- There are 1.2 million jobs in the city and 2.8 million in the area of Barcelona. The city employment rate raises to 79.8%, which is higher than the Catalan, Spanish and European average.[9]
- High-knowledge sectors represents 55.4% of total jobs in Barcelona.
- GDP contributions by economic sector: Corporate services represents 15.3% of the Gross value added (GVA), among the main areas of activities in the city. followed by Retail and repairs: 13.2% ; Real State: 11.2%; Information and communications: 9.1%; Public administration: 7.4%; Education: 6.8%, Health and social services: 5.9%; Finance and insurance: 5.7% Manufacturing industry: 5.6%; Hospitality: 5.6%; Transport and storage: 4.3%; Energy, water, and waste: 3.6%; Arts and recreation: 2.7%.[10]
- Employment distribution by economic sector: in the province of Barcelona the distribution of workers by sectors are as follows: agriculture 30%, industry 15,8%, construction 5.6%, and services 78,2%. [11]
- Green jobs: Catalonia has over 190,000 jobs linked to the Green Economy, where the top Catalan companies leading green transformation initiatives comes from renewable energies field (20.2% of the total companies with more than nine employees in green sectors), followed by Resource recovery: use of recycled materials, 17,7%.[12] Barcelona accounts for 32.1% of green jobs in Catalonia, with around 60,000 people employed in 2022, this represents 5,1% of the city's jobs. [13]

Overview of the city's climate neutrality mission and objectives.

As stated in the Commitment document, the Barcelona City Council aims to achieve the city's neutrality in Scope 1 and 2 Greenhouse Gas (GHG) emissions by 2030. The intention is to achieve an 80% reduction in these emissions compared to what would be expected in a Business as Usual (BAU) scenario in 2030 (3.87 million tonnes of CO2 equivalent), which is close to the level recorded in 2019 (3.82 million).

Residual emissions expected for 2030 will be offset, on one hand, by increasing the city's green infrastructure (Nature Plan2030). On the other hand, through a significant reduction in level 3 emissions embedded in construction and consumer products. To achieve this, Municipal policies will be developed in the areas of food (Healthy and Sustainable Food Strategy 2030), waste prevention and reduction (Zero Waste Plan), and building construction and renovation.

We note that **the current regulatory framework and policies serve as a basis for the decarbonisation of Barcelona**, but with them the level of decarbonisation foreseen for 2030 reaches only 60% of the BAU scenario. Therefore, despite their very recent approval, rules, plans and policies **should be reformulated and complemented in some regards, in such a way that the level of ambition of the Mission and a credible and bankable set of instruments for decarbonisation, including both incentives and obligations for the various actors, are reflected.**

The implementation of the Action Plan and of the whole Climate City Contract (CCC) of the city of Barcelona is based on 12 principles, of which four are of a substantive, goal-oriented nature, while the remaining eight refer to methodological approaches and ways of working that will be used to achieve the objectives of the Agreement

Table 4 - Principles on the Barcelona CCC

Substantive principles	Operating principles
1. **Comprehensive approach to sustainable development:** environmental, social and economic 2. **Comprehensive approach to tackling climate change:** mitigation and adaptation; Scope 1, 2 and 3 emissions 3. **Local and global climate justice** 4. **Democratic planning:** transparency and participation	5. **Cross-cutting** design and management 6. **Proximity** 7. **Knowledge** and **innovation** 8. Communication and training for **cultural change** 9. Proactive and exemplary **municipal action** 10. Metropolitan approach and **multi-level cooperation** 11. **City-to-city cooperation** and municipal action 12. **Accountability and evaluation**

**Source Barcelona CCC. Pag 9.*

Main emission domains / key actions in sectors

The strategy will be structured around the five sectors we have identified as crucial for Barcelona's functioning and decarbonisation.

Table 5 - Barcelona's main Actions by Sector.

Sector	GHG (KT CO_2 eq/year)	Main actions
Transport Sector	840	- Expand public transportation infrastructure and services. - Transform the urban fabric with sustainable mobility criteria. - Change the rules of the mobility game through measures such as low-emission zones. - Upgrade public transportation vehicle fleets with low carbon technologies - Promote electric vehicles (cars, vans, trucks, motorcycles, bicycles, machinery, etc.). - Implement the 2030 Urban Freight Distribution Strategy (UFD). - Encourage the reduction of forced work-related mobility through sustainable mobility strategies and plans.
Buildings and Heating	855	- Advance in the knowledge of new construction systems and solutions to enhance heat protection and passive heating and cooling of buildings.

		- Promote changes in the sector's rules by introducing new technical specifications regarding thermal comfort standards in residential buildings. - Foster through communication, information and training, the necessary mindset changes among all stakeholders (developers, builders, technicians, users, etc.) in both the residential and tertiary sectors regarding design, construction, usage, maintenance, and renovation of buildings. - Increase incentives for building renovation by private entities. - Promote innovation through project competitions and challenges focused on finding efficient construction solutions specifically adapted to the Mediterranean climate. - Encourage the replacement of heating and hot water systems. - Encourage the replacement of household appliances and lighting elements with high energy efficiency models.
Energy Sector	927	- Increase public infrastructure for energy generation and efficient energy use - Enhance incentives for private entities to install renewable energy sources, - Encourage the establishment of energy communities that include not only residential buildings but also tertiary and industrial facilities and spaces.
Waste Sector	294	- Promote locally sourced products, second-hand trade, exchange markets, bulk distribution, and the consumption of products and supplies derived from waste valorisation. - Implement environmental measures at festivals, fairs, conferences, and other public events, - Deploy individualized collection systems for household and commercial waste - Enact regulatory changes to enable the implementation of new extended producer responsibility (EPR) systems and promote the establishment of deposit, return, and refund (DRR) systems - Reach voluntary agreements with the private sector to establish best practices in reducing packaging, single-use plastics, and more. - Optimize transportation routes to reduce travel and emissions generated in waste collection
Green infrastructure and water Sectors	250	- Significantly increase the city's green space, applying the criteria of the Green and Biodiversity Charter in green area and urban tree projects, - Expand green infrastructure in buildings encouraging the incorporation of plants on roofs, facades, and interior spaces of all types of buildings, - Promote tree and forest management with a climate change perspective. - Ensure that urban planning legislation and supra-municipal planning instruments, such as the Metropolitan Urban Planning Master Plan and the Collserola Natural Park Plan, regulate and manage the territory with a climate change perspective, - Generate knowledge and innovations applied to water management in a context of structural scarcity to improve efficiency and create alternative supply systems (reclaimed water, rainwater harvesting, use of greywater, desalination, etc.)

MEL framework and indicators

In the CCC of the city of Barcelona, the MEL framework, and its consequent indicators, are divided into those from the Action Plan and those from the Investment Plan.

The MEL Framework in the Action Plans involves 25 programmes with 82 indicators.[14] These 25 programmes are divided into the five principal sectors chosen to tackle onto:

- Greenhouse Gas Emissions (baseline programme)

- Mobility and transport (Programmes 1 to 6)
- Buildings and heating (Programmes 7 to 9)
- Electricity (Programmes 10 to 12)
- Waste and other (Programmes 13 to 16)
- Nature-based solutions (Programme 17)
- Urbanism (Programme 18)
- Social Protection and social inclusion (Programme 19)
- Economic promotion (Climate Neutral Economic Adaptations and Opportunities) (Programme 20)
- Education, culture and participation (Programme 21)
- Science and technology (Programme 22)
- Municipal organization and management (Programme 23)
- Metropolitan vision and multilevel government (Programme 24)
- City-to-city climate cooperation (Programme 25)

On the other hand, in the Investment Plan, the city of Barcelona gathers a series of economic and financial indicators following the Economic Model.[15] These indicators are utilised to estimate the target of their actions and the costs and returns of investment in the main emissions domains of the city:

- Transport
- Buildings and Heating
- Electricity
- Waste

The results of these estimations shows that investment in decarbonisation is profitable in the long term in most sectors and in global terms in the city. There are two major exceptions to this pattern: the electrification of mobility and the energy renovation of buildings. In these cases, the economic argument cannot be decisive, but the solid arguments provided by the expected co-benefits.[16]

Partnerships: To have a broad insight on the organizational city structure behind the definition of the CCC, below there is a table with the main systems and actors being involved in the city climate stakeholder's map.

Table 6 - Barcelona's MEL structure.

System	Actors involved	Network structure	Influence
Barcelona City Council and its Groups entities	**Barcelona City Council** plus its **autonomous bodies, public business entities and trading companies** wholly owned (IMHAB, IMU, CASA, BASA, BSM,	The basic municipal structure is not the network, but the cascading hierarchy (sectoral managements), in	Determinant for Mission leadership and implementation of key policies. Relevant in exemplary role and provision of resources.

	BIMSA...) or majority **municipal** (waste management and treatment companies).	coordination the territorial (district) managements and complemented by horizontal collaboration spaces to address issues that require the involvement of more than one sector.	
Multi-group public bodies whose budget is consolidated with that of Barcelona City Council (basically consortia).	With majority municipal participation: -Energy Agency, -Public Health Agency; or minority participation -Zona Franca Consortium, -ATM, -PN Collserola, -Institut Metròpoli	Sectoral networks with leadership, co-leadership or high influence of Barcelona City Council	High or very high in certain sectors
Private entities with municipal participation but excluded from budget consolidation	Basically foundations: - BIT Habitat, - IS Global, - BCN FP, - Eurecat, - I2cat, - Fòrum -Ambiental, - Mobilitat Sostenible i Segura	Sectoral networks with leadership, co-leadership or high influence of Barcelona City Council	Medium / high in certain sectors
Public interest entities associated with the City Council	With a minority but significant municipal participation - SABA, - Fira2000, - Sagrera Alta Velocitat Habitatge Metròpolis, - BCN	Sectoral networks with leadership, coleadership or high influence of Barcelona City Council	High or very high in certain sectors
European Net Zero Cities Mission	NetZeroCities Consortium EIT **Climate KIC Consortium Spanish Mission Platform**: - UPM, -7 Spanish mission cities, - other cities involved 112 EU mission cities and partner states	Complex network, made up of a multitude of highly motivated actors. Network spaces are often complementary, although there are also overlaps.	Highly relevant for the political impetus and operational management of the Mission, as well as for the promotion of innovation.
Supra-local regulators	**- European Commission** (especially DG Climate Action) - **Government of Spain** (especially the Ministry of Ecological Transition and Demographic Challenge) **- Generalitat (Autonomous Government) of Catalonia** (especially the Department of Climate Action, Food and Rural Agenda)	The formal relationship between administrations at different levels is, in principle, hierarchical in terms of enforcement and collaborative in terms of policy design and development.	Determinant in shaping the framework of what is possible in each policy area
Service operators	- Public transport operators - Operators in the construction sector (within this, in the rehabilitation subsector) - Operators in the energy sector (within this, in the renewable energy sub-sector)	Each sector and sub-sector have its own network, set up mainly to defend shared interests visà- vis public administrations.	Very relevant for decarbonisation, through corporate commitment (business model, investment), good management and innovation, of sectors that emit a large volume of emissions.

	- Operators in the waste management sector		
Municipal participatory system	- Sustainable Network Citizens' Council for Sustainability / - Climate Emergency Bureau - 2030 Agenda 2030 Promotion Roundtable (within the City Council) - Citizens' Climate Assembly - System of sectoral and territorial participatory councils	It is a set of spaces for citizen participation promoted by the City Council. Ideally, they are the meeting point between the "City Council" system and the "civil society" system. Some instruments that generate order and coherence in the network are the Citizen Participation Regulation, the City Council and the Decidim platform.	Relevant for developing, debating, validating and disseminating local policies leading to climate neutrality
Metropolitan governance	- Barcelona Metropolitan Area - Metropolitan municipalities - Barcelona Metropolitan Strategic Plan 2030	Network articulated around a few actors; highly conditioned by the influence of the city of Barcelona.	Quite relevant for coordinating territorial development strategies and some of the main policies involved in decarbonisation.
Innovative ecosystem	- BIT Habitat Foundation - Urban Innovation - Centres Working Group - EIT Urban Mobility - KIC - BIC Council - Universities and research centres - European Network of Universities with Barcelona's leadership (ECIU and other) - Public centres such as Institut Metròpoli i Barcelona Regional	There are various spaces, more or less stable/formal, for the meeting of the organisations of the innovative ecosystem. But it also functions through micro networks generated by specific projects.	Relevant for promoting the creation of new knowledge and its dissemination
National and international sectoral and generalist networks of cities, with municipal participation.	- C40 - Eurocities - ICLEI - UCLG - Metropolis - UCCI - Xarxa de Pobles i - Ciutats per la Sostenibilitat (Network of Towns and Cities for Sustainability) - FEMP Agenda 2030 - Network Cities for Cycling	The usual way of working is through projects involving one organisation and several cities.	Relevant for boosting both cityto- city collaboration and the role of cities in the global governance of the climate crisis.

6.1.2 Barcelona's MEL processes and application.

Processes/Collaboration in design and operationalisation of MEL

Considering the existent network implied in the city climate policy design and implementation initiatives, (See ***Table 6****. Main system contributors.*) the MEL system is built on the stakeholders able to provide metrics, participating in the design, calculation, and analysis of the indicators. The following sections better explain this process and their roles in the MEL system.

Analysis of co-creation and collaboration practices

Key partners and their contributions

The city of Barcelona is in an internal restructuring process, to support the implementation of various climate policies. At the end of 2024, the Barcelona City Council approved a government measure to launch the "Nuevo Plan Clima" (New Climate Plan), which integrates both climate change mitigation policies—including the Climate Agreement—and adaptation strategies. As explained by Sergi, “the CCC could be considered as a subsection of the Plan Clima”17, since it focuses on mitigation related initiatives.

The New Climate Plan is structured into six strategic programs, which organize the work stream and distribute responsibilities among the main contributing actors:

1. Heat Plan
2. Resilience Plan
3. Mobility Plan
4. Energy Transition Plan
5. Plan’ Neighbourhood Climate’
6. Plan ‘Let's Change for the Climate’

This structural approach provides a comprehensive framework for the Barcelona City Council’s climate policies and, in the context of the MEL process, also contributes to the definition of roles and responsibilities relative to the development and implementation of the indicators.

The **Executive Committee of the Climate Plan** gathers all the main governmental offices involved in the process: representatives of each thematic area, city council representatives, as well as communication personnel.

The Climate Change and Sustainability Office, has a key role in the Executive Committee regarding the Climate Plan and in the CCC implementation, likewise.

The **Technical Programming Office coordinates the development and design of the MEL System** within the framework of the **Barcelona Climate City Contract (CCC)**. They are ultimately responsible for coordinating, synthesizing, and drafting the MEL-related sections in the final CCC document. As a relatively small department within the Barcelona City Council, it worked in close collaboration with other key municipal areas to ensure a comprehensive MEL system.

The **Barcelona Energy Agency** plays a fundamental role in the definition of the mitigation metrics, in which the CCC economic model is built. Additionally, they contribute with social and adaptation indicators in the **‘Plan Clima y Sustentabilidad’**[18] context.

The **Barcelona Data Office**, part of the City Council, is a key actor in providing statistical information. They implement public opinion surveys to account for the population actual involvement and awareness about the climate related topics. For instance, the use of electric vehicles, heating pumps, as well as other heating systems, and further relevant information. This is very useful to account for civil engagement regarding these topics. [19]

Even though the Technical Programming Office have the operational leadership coordinating the MEL process, ensuring overall coherence[20], **the development of the MEL system is a broad, collective process that involves a complex network** of various departments and areas within the Barcelona City Council. In some cases, it also includes the participation of external stakeholders, contributing to the system’s implementation[21].

External Contributors

The monitoring and interpretation of data related to the city's MEL system is carried out through various strategic partnerships. The key contributors are mentioned as follows.

One of the most significant partners in this process is Barcelona Regional (BR), a metropolitan consultancy and research agency. BR, as a highly stable and reliable partner, is **entrusted with key emission assessments,** particularly those related to the mobility sector. They contribute with the Barcelona Energy Agency, providing the calculation of emissions within this sector. This collaboration has greatly improved efficiency within the City Council., since mobility-related emissions data created a significant bottleneck, delaying essential reporting and decision-making. The partnership with BR has effectively addressed this challenge, ensuring timely and accurate data delivery. By February 2025 indicators for 2024 were already accessible, representing a major improvement in the data management process, compared to previous years. Beyond emissions calculations**, BR also provides valuable expertise in urban resilience and risk assessment**, further supporting the city's strategic planning.

Public consortia and Barcelona City Council related offices are also engaged in the city MEL system. As research institutions they provide valuable insights across several fields.

The Barcelona Public Health Agency, which regularly reports on climate impacts on health and evaluates the health effects of key urban policies, such as the *Barcelona Superblocks (Supermanzanas) model* and the *Low Emission Zone (ZBE).*

The independent research institute ISGlobal, has a similar profile. It specializes in studying the health impacts of climate change, analysing both the co-benefits and risks associated with urban environmental policies.

As previously mentioned, **the MEL system was mostly built upon the New Clima Plan of the city**, therefore is worth to mention that civil society also had an indirect participation in the process, since they could provide their feedback in the elaboration of the Clima Plan. This public consultation process was introduced through the *Decidim Platform*, enabling civil society participation by raising their concerns and point of views through this collaborative process. [22]

Role of participatory processes

The development of the **Climate City Contract of Barcelona** coincided with a city electoral process. Since the governance structure was evolving, it was challenging to integrate specific participatory processes such as citizen engagement initiatives and stakeholder workshops for the MEL system design.

Given this context, the MEL system heavily relied on previous work, particularly on the inventory of indicators that had already been developed as part of the **2030 Agenda in Barcelona**, developed by 2020. However, as previously mentioned, the **'Plan Clima'** or the **'Social Inclusion Strategy',** had already incorporated participatory processes that were also integrated to the MEL definition process. Throughout these prior initiatives, relevant indicators and targets were already identified, the city built the existing structures addressing the gaps.

To further complement the MEL system, additional key metrics were identified to these pre-existing indicators, to ensure a comprehensive monitoring approach for all aspects of the CCC.

Purpose of the city's MEL system

The Barcelona MEL system, as highlighted during the interviews had with cities representatives, has the following intended objectives:

- **Assessing the initial situation of the climate policies** being implemented by the city, to establish a baseline.
- **Evaluating the city's progress** in relation to climate policy objectives.
- Providing internal insights to support **data-driven decision-making.**
- Facilitating external **communication**

The indicators are essentially results-oriented, designed to measure the impact of implemented climate-related policies. The MEL system will "*allows us (Technical Programming Office) to evaluate the city's progress relative to that policy, identify impacts, and enable policymakers and managers to make informed decisions*".[23]

Additionally, the intention for the MEL System is to contribute to inform civil society, since most of this work is open to public consultation, and the outcomes and indicators of the systems will be used to develop reports potentially used by the press, organized citizens, and public in general.

Moreover, an underlying goal is to serve to make informed investments decisions, considering that MEL indicators, as mentioned in the interviews, are able to "provide an order of magnitude, a preliminary measure of how many emissions is reduced by doing this in mobility, this in buildings, and so on. Essentially, creating a complete climate budget."[24]

Measurement and Monitoring

Organizational structure used for data collection and monitoring.

Barcelona has a long trajectory regarding climate policy implementation, and the data management organizational structure has been evolved to meet the reporting requirements embedded in those agreements (See Section 2.1 on key partners contributions).

The data collection and monitoring embedded in the MEL system, is leveraged in the existent network of public and private organizations that were involved in collecting and analysing the most relevant climate and socio-economic related data. This is relying on the Plan Clima working groups.

These groups work independently, and they are responsible for providing the data, indicators, and analysis within each of their expertise area. Ultimately, the information will be gathered and integrated by the Technical Programming Office, who will compile it.

Indicators of the MEL system could be categorized into quantitative and qualitative types. This could help to better understand the complexity of the data process, derived not only by the different organizations contributing to the process, but also by the 82 indicators being defined[25].

The Barcelona Energy Agency is one of the public offices centralizing most of the quantitative data, e.g., those related to greenhouse gas emission inventory, and mitigation-related variables. As indicated by its responsible Sergi Delgado: "The emissions inventory (…) we test and process this data, but it is beyond strictly the energy transition plan, but there is a part of the data that comes out of us, (…)".[26]

The Technical Programming Office oversees the qualitative-oriented metrics**.** Whereas they also centralize all the data that comes from other sources in order to account for the main indicators of the system.

One of the strongly used data sources is the **Barcelona data portal**[27], a public source available for consultation, gathering relevant information for the MEL indicators calculations.

As previously exposed in the external contributors to the MEL system, the following actors are the main partners contributing with data generation and analysis:

- **Barcelona Regional**, which is "middle ground" also has connections with the municipality; their participation is in response to the requirements of the specific areas that request them specific task on data management and provision.
- **Institut Metròpoli,** public consortium located on the Bellaterra campus of the UAB and attached to the Metropolitan Area of Barcelona, which develops urban research, training and knowledge transfer activities, mainly in the area and metropolitan region of Barcelona[28]
- **The Barcelona Institute for Health Data, IS Global**[29], an alliance between the "la Caixa" Foundation, academic institutions and government bodies to contribute to the efforts to address the challenges related to global health.

These institutions shape the complex and multi-actor ecosystem of data providers. With some of them, they work on-demand basis, inquiring specific calculations, e.g., simulations on consumption in buildings required to Barcelona Regional entity, usually on a yearly basis.

> "*There's a continuum (…) between what is directly part of the organization and entities that are municipal, partially owned, or consortia, which drift a bit from the city council group but maintain a strong relationship*".[30]

There are also other specific data providers like **DataDis**[31] sourcing electricity data from the distribution companies,

Involvement of internal and external stakeholders in monitoring efforts.

The operational monitoring activities are also within the domain of the six (aforementioned) thematic groups linked to the Climate Plan organizational structure. These actors will consider whether external actors are also being involved in monitoring efforts.

As Ramón C. explained, this is a process "*on a one-off basis to promote the different projects. (…) from the **Programming technical office**, which is a really very small real unit, is more of giving overall momentum*". Their role mainly consists of controlling and ensuring the six working groups are implementing the initiatives being proposed.

For monitoring purposes, the program used is called Project Monitor. This program has been previously used having only three levels of breakdown plus the project level, mainly processes linked to municipal planning, e.g., the percentage of progress or finalization of a project. For this stage, they are requiring more indicators to be integrated, to measure the resources used, the output obtained, and the impacts, relative to at least some of the projects that are engaged with the MEL system.

In practice, they have periodical meetings, organized by the groups depending on their needs and structure.

Data governance practices (e.g., ownership, privacy, interoperability)

Regarding the data governance practices, in general the procedures are on behalf the six thematic offices defined in the context of Plan Clima. Even though there is a coordination role embody by the Technical Programming Office, the information management lay within their scope.

In general, all the information used in the MEL process are released in reports publicly available. See section **Communication and dissemination of the MEL results.**

Development and use of indicators to track progress

Indicators definition is a continuous process of learning to make sure that they are capturing the intended impact variables and their progress aligned to the CCC City initiatives.

Alignment of indicators with city objectives and outcomes.

Built upon the main emission reduction target of 80%, the impact pathways established through the economic gathered in the CCC, indicators were considered to be aligned with objectives, according to the interviewed perspective. There was an adjustment process, made through adapting the existing metrics, including Barcelona metropolitan area and regional autonomous government of Catalonia, to better align goals. This matches for instance the transport related measures, to the targets of the CCC.

There are some factors that are beyond the scope of the city action. Beyond the definition of metrics of the CCC, investments and further decarbonization outcomes will depend not only on the city commitment to promote them, but also on macroeconomic factors that they consider beyond the authority's control.[33] This is also part of the mission challenge.

Balance of quantitative and qualitative indicators.

Most indicators included are quantitative. It was indicated that these are more reliable and straightforward in terms of interpretation and legitimacy. This point consider that the participants of the process tend to be more related to hard sciences, like engineering, architecture, planners, who find more reliability in these types of metrics.

Qualitative indicators are also important, although data collection is more challenging to be accounted in robust metrics and is consequently less frequently integrated. Barcelona usually obtain most of this information every four years from "**T clima**" data providers. Additionally, they indicated that other useful resources come from the Climate Assembly, a broadly represented group that held discussions on climate related topics and come with important contributions.[34]

Methods to measure co-benefits (e.g., environmental, economic, social).

Barcelona's CCC dedicates a specific chapter to co-benefits generated by implementing the mission related initiatives, with particular attention to social aspects, air quality and health. Evidence is clear in sectors like transportation by reducing air pollution; in the building sector by increasing comfort for the occupants on renovated and more energy efficient buildings; in the energy sector by reducing dependence on fossil fuels and increasing energy sovereignty; and in the waste management sector, by savings and material recovery through the extension of product lifecycles and recycling processes.[35]

The Climate Plan monitors the connection between social aspects and access to services. It could be translated into some co-benefits type of assessment. This approach, introduced by Sergi, indicated that some measures like people access to green spaces, embeds health related improvements that could be considered one of the main co-benefits arise from the process. Additionally, related to energy poverty, ensuring people access to temperature adaptation systems, especially during summer which tends to be the season in which vulnerable people are most affected, is also part of the co-benefits that are considered to be reached by the system implementation. However, the measurement is complex and there is not yet a full consensus on it.[36]

Theoretical models account for co-benefits measurement upon accounting for the causal effects of policy implementation. However, there is not yet a clear consensus regarding its implementation in the MEL system framework. For instance, the air quality improves (regarding some components) there are some air particles that are partly affected by vehicle contamination, which are not directly affected by human action. [37] Therefore, these aspects are not easily accounted due to the several numbers of factors interacting in the effect observed. This makes it overly complex to set the causality

between the policy implementation due to initiative in the CCC and the co-benefits obtained. It is an evolving science that deserves to be carefully considered and adapted.

Application of MEL Processes

Integration of MEL data into decision-making

Considering that the main purpose of the MEL system was defined to support the decision-making process, representatives of Barcelona indicated that there is a dissemination of the outcomes from these indicators, mainly among key decision-makers, in order to inform decisions and track the city's progress in terms of environmental goals – also gathered in the CCC. The structure of the information and its dissemination is subject to each area of the climate plan, abovementioned.

Accessibility and use of data sources (including addressing gaps).

There is a sectoral approach adopted for the use and integration of the MEL data into the decision-making process. Each management area, aligned to the Clima Plan operational structure, has its department and studies that investigate and analyse according to their own areas of expertise.

Data usage and calculations for mitigation indicators have been adapted to better fit the economic model of the Barcelona CCC. Managed by the Energy Agency Office, the city had an already defined set of metrics, however, the interviewed explained that some were adapted to better fit the economic model. For instance, minor changes in the conversion from vehicle/km to passenger/km, which were not difficult to re-estimate. [38]

For some resilience and adaptation metrics, systematization processes were found to be relevant to perform inter-related indicators analysis. For instance, studies on energy poverty related metrics, found that it has become more severe during the summer period (estimates of 15% during winter and around 30% in summer months were mentioned during the interview) [39]. Even though this is subject to further alignment with other metrics for a more integrated analysis, it is important to acknowledge that the more comprehensive the indicators are, the better measures can be taken in terms of adaptation and resilience in the city.

The availability of data and its access is considered a strength of the climate accountability system in the city. The interviewers mentioned that they have several data sources, integrating efforts of different organizations from public and private sector. Barcelona possesses a significant volume of data, including surveys and statistical records. This enables to account for many of the MEL indicators, which rely on this vast volume of sources.

However, this also posit a **challenge for the data managers**, since certain data sources have not yet been fully explored. The MEL system coordinators recognize this point and plan to delve deeper into these untapped resources, not only to develop new indicators but also to take advantage of existent information to better diagnose and recommend policy makers on this realm.

A **challenge lies in to defining the boundary between essential and complementary indicators.** Ensuring a balanced and strategic approach to data selection and analysis is challenging, especially given budgetary constraints that restrict the availability of resources that might be applied to develop a broader analysis.

Another challenge posit by the interviewers was regarding the scope to measure the evolution of green economy and social economy related progress. In this sense Ramón indicated that there are not yet indicators clearly capturing to what extent, e.g., green jobs are being created and of which kind. "Also, regarding the economy's evolution, how the green economy is progressing—whether it's creating jobs,

and what kinds of jobs—we need to develop this further. It's a lot of work, but we have the basics. To measure impacts, crossed impacts, or relationships more precisely, more work is needed."[40]

Considering **the time availability of the data, there are some gaps that make it difficult to make timely decisions.** For instance, regarding emissions inventory, there are some delays in the data confirmation process. The validated information of what is published by the energy distribution company through DataDIS, takes too long to be checked. This poses a challenge to for the KPI purpose, since it might not be delayed and subject to related biases. This is under re-considerations, as Sergi mentioned.[41]

Real-time monitoring and digital tools

Most information being utilised is released monthly or annually , with limited incorporation of real time metrics in the MEL system.[42]However, as posed by Sergi during the interview, they have access to **some mobility-related data,** to complement some of the indicators which are published with higher periodicity.

The *Barcelona Data Portal* contains frequently updated data which is helpful to assess indicator measurements. In this platform there are some indicators published very frequently, which are about **air quality, energy generation,** which could be released in a more frequent basis.

A key contributor providing real-time data in key climate policies is *TERSA*, a metropolitan public company , chaired by the Barcelona City Council, which is in charge of the incineration of waste, which in turn generates electricity and residual heat that feed municipal buildings and a district heating network, along with other clients. TERSA also manages most of the PV energy surpluses generated in municipal premises and public spaces.

Regarding digital tools, ***the Net Zero Planner*** could be considered as one of the tools integrated into the MEL system contributing to calculations. Also, the use of other platforms like Webex or Excel Spreadsheets are mentioned to be helpful in data processing.

Communication and dissemination of the MEL results

Each of the abovementioned sectors, aligned to the Plan Clima structure, works with a specific communication criterion, following an open and transparent process to report the indicators outputs.

Each department prepares sectoral reports, mainly targeting decision-making actors, from the government offices and other private sector representatives. The reports are usually prepared on an annual basis and presented to both targeting stakeholders and general public in open press conferences.

Data and outputs from this analysis are used by several actors, and the communication **criteria usually is homogeneous** regardless of the user.

As per general criteria, they try to process the most data as possible, to be able to provide a digest set of indicators, useful to the users. However, the prevailing criteria is to balance the number of resources available for the data processing and interpretation with the availability of information being generated by the several actors interacting with the several actors in place. "In *this whole issue of information you always have to consider cost-effectiveness, as in everything. If I have to obtain an indicator, then it has a cost and it has to have a specific valuable output. In general, there is usually a custom of presenting it, at least making it known and always publishing it*."[43]

Learning and Adaptation

Mechanisms for continuous improvement

It was highlighted in the interviews that there is a continuous improvement process under the indicator's definition and analysis, to better align the metrics to the CCC goals. As per mentioned by Ramon, "*There's learning involved, even in the indicators themselves. It's a complex and vast task. Plus, as a climate plan, it also places a lot of emphasis on adaptation, resilience, and climate justice, so these aspects will carry more weight as well."* [44]

Processes for revising indicators and MEL frameworks based on feedback.

The indicators initially established in the Climate City Contract are currently undergoing review and redefinition to enhance their effectiveness. As mentioned, the Technical Programming Office is the ultimate responsible for ensuring a coherent and integrated system, the measurement and monitoring process relies on collaborative efforts involving various municipal departments and external stakeholders.

The organizational structure follows the six designated working groups, with each sector's members required to approve the indicators defined by the Technical Programming Office. This approval process is essential, as these departments must commit to providing the necessary data for monitoring and evaluation.

Even though the structure of responsibilities is defined, the process of reviewing indicators and MEL frameworks seems not clearly defined yet.

It is important to highlight that the city is using the Net Zero Planner as one of the tools to revise some of the indicators initially incorporated to the MEL system. The city is currently analysing results from the implementation of this tool, this is within the iteration of the CCC that the city is currently developing.

Incorporation of new evidence into existing systems.

There is not yet a systematic procedure defined to include new indicators into the MEL system.

However, as mentioned by Sergi, "*(…) areas have incorporated new measures that prompted us to measure new things. For example, beaches or other specific topics. You end up adding a new indicator when a previously unaddressed issue emerges. For instance, sometimes it's as simple as park accessibility and ensuring they're not unbearable in summer. Questions like, "Why doesn't this neighbourhood have this when others do?" prompt you to investigate*"[45].

Outcomes and Impact

Developing indicators and evaluation tools that help translate economic investments into emissions reductions remains a major challenge for the utility of the current MEL system outputs. Further development in this area will help support robust climate budgeting processes. [46]

There is still an ongoing process of incorporating the MEL indicators in the decision-making process. There seems to be a good history of measuring and defining policy and initiatives based on the outputs of Plan Clima, already in place.

Evaluation of the impact of MEL processes on the city's climate transition

To approach the MEL process on the city's climate transition, the main emitting sectors were considered since one of the major goals is the emission abatement through the policies and initiatives being promoted within the CCC context. One of the major sectors responsible for the emissions in Barcelona, exposed by the respondents were buildings and heating related (align to the metrics exposed in Section 1.2.1), in particular the private buildings infrastructure because most of them are not well adapted in terms of energy efficiency. Additionally, the transport sector, integrating mobility and traffic related policies. To a lesser extent, but still relevant, the respondents also noted the waste sector. Although there are not strictly linked to decisions made within the city domain, since they are more at a national level, there also have an important impact in the overall city level of emissions.

The MEL process is therefore considered as an accounting mechanism of measuring progress of several indicators relative to the city's goals. Likewise, it helps to identify some important barriers to ensure emissions reduction.

Sergi posited some of them: "*There are **matters of available capital,** which is very noticeable in building renovations. And because it's not only about having the available capital but also about the return, which often involves talking about comfort and co-benefits rather than economic returns from a renovation—unless the building is already in very bad shape. A building that is in decent condition but not very efficient won't have a high economic return given Barcelona's climate. And sometimes there's a rebound effect where people consume more afterward because they install appliances, no matter how efficient they are. But, well, that's okay; in the end, there has to be thermal comfort.*

*Then there are **also social issues**, right? Mobility, in the end, is something that is clear in terms of what needs to be done. Ensuring its acceptance and figuring out the "how" is more complex. The timelines are longer than what you'd like from a purely climate perspective, but there are other variables, especially those the politicians take into account. (…)*

*Furthermore, **social or cultural aspects could affect waste management issues**, although to a lesser extent. Sometimes there are barriers you don't perceive beforehand when implementing a measure. For example, the door-to-door service in the Sarrià neighbourhood works very well, but in Sant Andreu (a Barcelona neighbourhood), there was a neighbour complaint within two weeks. I think the situation in Sant Andreu has improved a lot, but at the beginning. It was purely a matter of social convenience— what's beneficial or detrimental in people's day-to-day lives*."[47]

Examples of how MEL data has influenced policy or resource allocation.

Examples of indicators that are accounting for concrete initiatives are as follows:

- **Metrics on green spaces**, one indicator might measure the absolute increase in green areas; while another one tracks it accessibility, to ensuring people are e.g., within 5–10 minutes of a green space.
- **In the waste sector**, there is an indicator tracking each type of waste.
- **Health related metrics,** facilitated by **ISGlobal**, which have analysed the effects of low-emission zones and superblocks.
- **In transport sector** related to trucks, there are distinctions between heavy and light vehicles. This is a relevant categorization to better address policy within the sector.
- **Electric vehicles:** there is a revision to include in urban services surveys about electric vehicles, availability to purchase them, who buys them
- **Heating systems penetration** like heat pumps—this kind of information.

It was highlighted by the interviewed that this type of data can provide very rich insights and help to move forward the decision-making process in the related areas.

Success stories and challenges.

This was not specifically addressed as part of a systematic evaluation process the city has in place. However, in the previous section, 7.1.1, there are highlighted examples. Additionally, in section 5.1.1., there are challenges regarding data collection and analysis which are the ones that could be covered during the interviewing process.

6.1.3 Summary of key insights from the city's MEL practices.

The availability of resources, the access to information sources, data, and systems that enable to work with the data and publish quality reports, in suitable formats for public dissemination, was one of the most valuable aspects highlighted about the Barcelona case. As per mentioned by Ramon: "*The city tradition, in statistically terms, dating back to the early 20th century, and opinion surveys and studies since the 1990s, is a very strong aspect that reinforces and provide a solid background in which the MEL system is built upon*".

The collaboration between the different offices, facilitates the access to data, aspect reinforced by Sergi: "having a municipal data office that has "tentacles" in different areas makes life much easier. Either you have an information portal that is constantly evolving or a department you can directly call and say, "*Hey, for example, what is the cost-benefit analysis of things we don't know much about?" You have a referent to knock on their door and see what information is available. This ends up being very, very useful*."

Having a Municipal Data Office, focused on processing the data to facilitate its interpretation to different actors, makes the process more open and accessible to different users. This enables a better understanding of the results and recommendations arising from the system implementation.

Next steps and support needs: future plans and areas where external support is required.

Regarding to human and economic resources, it was highlighted that there are still further improvements in terms of data processing, identifying who is responsible for developing the analysis and to what extent there is a need to incorporate more resources to better work the outputs of the data sources. As well as introducing new platforms to process the data.

Additionally, more dialogue raising awareness and debating around the climate issues is remarked to be important. Ramon mentioned that "*To make people aware of what we have and question to be discussed (…) Now, we're talking with the **Climate Change Office** about organizing some scientific seminars, but it's still just an initial idea, perhaps for the end of next year or so. (…) Targeting mainly actors involved in knowledge creation and the academic world, to see where we stand, right? Where the frontier of those indicators is, where the frontier of that knowledge lies. Sorry, I'm running late, but I have another meeting waiting for me."*

References to additional data sources used in the case study.

a) **Public City statistics and Reports:**

- National State Official Bulletin. Law 1/2006, 13 March, Special Regime of Barcelona Municipality.
- Barcelona Data Portal. Population in Barcelona. *Portaldades. Total population, per year.*

- Barcelona Data Portal. Population Density in Barcelona. *Portaldades. Population density, per year.*
- Catalonian Statistics Institute. 2024. *Idescat*
- Barcelona Data Portal. *Total Immigrant population, per year.*,
- Barcelona City Council. *Barcelona in Figures 2023*.
- Barcelona City Council. *Barcelona in figures 2024. Main economic indicators for the Barcelona Area*
- *Ayuntamiento de Barcelona. Plan Clima*

6.2 Cluj-Napoca

6.2.1 City Profile

Background information

Cluj-Napoca is the second-largest city in Romania, situated in the northwestern part of the country. As the largest city in the historical province of Transylvania, it serves as a major academic, cultural, and business hub. Cluj is home to Romania's largest university and the country's largest Romanian-owned commercial bank. It has also emerged as the most attractive destination for internal migration, according to a World Bank survey.

In 2021, Cluj-Napoca had a population of 286,598 inhabitants, while the broader metropolitan region was estimated to have up to 420,000 people, encompassing the surrounding peri-urban areas. The city is Romania's most dynamic in terms of population growth, adding approximately 5,000 new residents in 2021 alone. Demographically, Cluj's population consists of about 15% under 15 years old, 67% within the working-age bracket of 15–64, and around 19% aged 65 and above. However, rapid growth in the housing sector and increasing motorization rates have contributed to rising greenhouse gas emissions, posing environmental challenges.

Socio-economically, Cluj-Napoca had an estimated GDP per capita of $25,400 in 2020. The city hosts approximately 48 registered businesses per 1,000 inhabitants, indicating a strong entrepreneurial environment. The local economy is primarily service-driven, with additional contributions from industry, construction, and commerce. Of the 203,900 employees in Cluj-Napoca, around 53.7% work in the service sector, underscoring its dominant role in the city's economic structure.

Climate Neutrality Objectives

Cluj-Napoca's greenhouse gas inventory identifies 2021 as the baseline year, with total emissions primarily driven by the built environment and industrial processes. **The city's main sources of emissions are buildings and heating (55%), industrial processes and product use (26%), transport (13%), waste management (5%), and agriculture, forestry, and land use (1%).** While rapid urban growth presents challenges, Cluj is actively investing in strategies to reduce emissions and enhance sustainability.

Sector	Scope 1 (tCO_2e/yr)	Scope 2 (tCO_2e/yr)	Scope 3 (tCO_2e/yr)	Total Emissions (tCO_2e/yr)	% of Total
Transport	140,725	11,237	-	151,962	13%
Buildings	479,160	162,590	-	641,750	55%
IPPU	91,043	212,435	-	303,478	26%
Waste	1,442	-	56,919	58,361	5%
AFOLU	8,170	3,502	-	11,674	1%
Total	720,540	389,764	56,919	1,167,223	100%

Cluj has committed to an ambitious climate target of an 80% reduction in GHG emissions compared to 2021 levels. This goal is supported by a comprehensive strategy focused on urban regeneration, energy efficiency, sustainable mobility, and circular economy practices. Key initiatives include deep renovation of public and commercial buildings, redevelopment of brownfields, and improving district-level energy efficiency. Additionally, the city aims to enhance public spaces to mitigate urban heat islands and encourage outdoor activities.

Sustainable mobility is central to Cluj's strategy, with a focus on expanding electric vehicle infrastructure, offering benefits for electric car users, and extending key initiatives such as the Walkable City investment program, the Cluj Bike program, and an updated parking policy. Large-scale transport infrastructure projects aim to reduce congestion and support green mobility. Meanwhile, the Cluj Circular City program promotes resource efficiency and waste reduction.

Green infrastructure is another priority, with the Green Cluj investment program driving the expansion of green spaces across the city. This aligns with broader efforts to enhance urban resilience and improve the overall quality of life for residents.

MEL Framework & Indicators

This set of climate action indicators and co-benefits aims to assess and track the progress of urban sustainability efforts, with a focus on reducing environmental impacts and improving quality of life. Key indicators include reductions in CO2 emissions, the percentage of daily trips made using public transport or non-motorised means, and the expansion of green spaces within the city. Additionally, the general air quality index, citizen satisfaction, and financial savings for households are considered important metrics. The co-benefits provide a broader view of the impact, highlighting improvements such as enhanced air quality, increased safety, lower energy costs, reduced congestion, and stronger community cohesion. These measures not only reflect the success of climate action policies but also emphasize their contribution to building a healthier, more resilient urban environment.

Main indicators

- Reduction of CO2 emissions
- Percentage of daily trips done by public transport/ non-motorised means
- Hectare of green space
- General air quality index
- Percent of people fully satisfied to be living in the city
- Euro per household per year saved over 2022 baseline
- Euro spent by municipality for energy and fuel

Co-benefits

- Improved air quality: General Air Quality Index 20 (AQI)
- Improved quality of life: 75% of the population
- Lower energy costs for households: 75 euro per household per year saved, over 2022 baseline
- Increased safety of public spaces: 22% decrease in the crime rate
- Reduced local budget energy costs: 48 mil. euro
- Reduced congestion: 50 h time reduction in rush hour per year (TomTom)
- Reduced monthly transportation costs for households: 50 euro per household

- Reduced flight to suburbs: 18% per year
- Strengthen community cohesion and collaboration: 50 members in the Net Zero City Coalition
- Better informed citizens: 40% of the population aware of climate neutrality

6.2.2 Cluj-Napoca's MEL Processes and Application

Processes/Collaboration in Design and Operationalisation of MEL

Cluj-Napoca's MEL process is built on a foundation of co-creation, ensuring that diverse stakeholders contribute to defining and refining key indicators. A crucial tool in this process is the Civic Innovation and Imagination Centre (CIIC), which serves as a collaborative platform uniting partners from academia, the private sector, NGOs, and citizens. Through the CIIC, affected neighbourhoods can provide input on major projects, ensuring that MEL processes reflect the concerns and priorities of local communities.

The CIIC operates as a flexible, community-driven entity rather than a fixed institution. Established in 2017, it was designed to facilitate public participation in shaping the city's development. Its inaugural event focused on urban regeneration, bringing together local government representatives, residents, and experts to co-create solutions. When Cluj joined the Cities Mission, the CIIC was well-suited for co-creation of actions and indicators for the MEL framework. The CIIC continues to function as a vital tool in Cluj's participatory governance, integrating citizen feedback into decision-making processes and involving relevant external experts to refine and implement MEL strategies.

As one official put it, the CIIC **"is a very good tool because we see that people from certain neighbourhoods have certain needs that we are not aware of."** A notable example of its impact is the transformation of a street near student dormitories. Initially, residents voiced concerns about excessive car parking by students, leading to a call for change during a public debate organized by CIIC. Following this input, the city developed a project to modernize the area, ultimately converting the street into a pedestrian space. While students were initially disappointed by the reduced parking availability, the space has since evolved into a vibrant community hub where both students and residents coexist harmoniously. The CIIC framework is now an integral part of Cluj's infrastructure planning, systematically incorporating public feedback into major projects. Although the participatory process extends implementation timelines by six to twelve months, it results in better-designed, community-driven urban improvements that address local needs more effectively.

The success of Cluj's MEL framework depends on strong partnerships across multiple sectors. Universities play a particularly critical role, leveraging their expertise to develop precise and effective indicators. The Technical University of Cluj-Napoca contributes by designing indicators related to environmental concerns, such as air quality and noise pollution. Meanwhile, Babeș-Bolyai University focuses on social indicators, such as participatory budgeting and citizen satisfaction.

In addition to academic institutions, international organizations such as the World Bank have played a key role, particularly as consultants in the development of Cluj's Climate Action Plan and broader infrastructure projects. Within the municipal government, various departments take on responsibilities aligned with their expertise. For instance, the Waste Management Department contributes to indicators related to clean water, while centralized institutions like the Institute for Meteorology and the Water and Sewage Company provide essential data for local implementation.

To ensure an effective MEL process, responsibilities are clearly distributed among key stakeholders. **Data collection is a shared responsibility, with various partners contributing based on their expertise.** Some data sets are gathered directly by the City Hall, ensuring official oversight and continuity in reporting.

Measurement and Monitoring

Cluj-Napoca employs a mix of real-time monitoring, structured data collection, and open-access platforms to track progress on its climate action goals. A key component of this effort is their open data portal, which serves as a repository for various datasets used in monitoring and evaluation. While the portal is already operational, ongoing efforts are focused on expanding and improving its functionality to ensure more comprehensive data availability.

One of the most advanced areas of real-time monitoring is traffic data collection, which enables dynamic tracking of congestion patterns and mobility trends. This system is continuously being upgraded, with plans underway to integrate additional sensor-based monitoring in other areas, such as air quality and energy consumption. The city aims to have a fully functional and integrated data platform by 2027, streamlining data collection across multiple environmental and social indicators.

Academic institutions play a crucial role in Cluj's monitoring framework, contributing both quantitative and qualitative data. Universities are responsible for collecting and analysing weather data, air quality metrics, and heating system performance. This scientific expertise helps establish reliable environmental indicators that guide policy adjustments.

In addition to technical measurements, universities also conduct interviews and surveys to capture qualitative indicators such as citizen perceptions and social impacts. This dual approach—combining empirical data with community insights—ensures a more holistic evaluation of the city's climate action initiatives.

Despite Cluj's progress in data collection and monitoring, certain governance challenges persist. One of the primary obstacles is that some critical datasets are owned and controlled by national ministries, requiring formal requests for access. This represents an administrative, rather than technical, barrier, which can slow down decision-making processes. Addressing these bureaucratic hurdles will be key to improving data-driven policymaking in the city.

Indicators and Priorities for Tracking Progress

In Cluj-Napoca's climate monitoring framework, co-benefit indicators—those that capture the broader social, economic, and environmental advantages of climate actions—are considered more important than direct greenhouse gas emission indicators. While emissions tracking remains relevant, the city places a stronger emphasis on measuring how climate initiatives improve quality of life, public health, and economic efficiency. This reflects a shift toward an integrated approach that recognizes success in climate action is not just about reducing emissions but also about creating a more liveable and resilient city.

GHG emission data shows that the majority of emissions in Cluj come from households and commuters. **This finding has reinforced the city's focus on behavioural change as a key pillar of its climate strategy**. If indicators can demonstrate that adopting greener behaviours leads to tangible benefits, such as lower costs for citizens and improved urban living conditions, the city will be closer to achieving its objectives.

Another important aspect of Cluj's approach is using data to show that climate-friendly behaviours and policies contribute to more efficient decision-making, ultimately leading to financial savings both for individuals and for the municipal budget. By making these benefits clear, the city hopes to drive wider public engagement and support for sustainability measures.

Different universities act as technical partners in developing both quantitative and qualitative indicators. Currently, there is a stronger emphasis on qualitative indicators, particularly those assessing social and behavioural aspects of climate action. However, as more sensors are installed across the city, the amount of quantitative data collected will increase. Achieving a better balance between the two types of indicators is a key goal for Cluj, ensuring that monitoring efforts capture both measurable environmental changes and shifts in public perception and behaviour.

Cluj's most important indicators focus on strengthening public administration capacity, promoting social inclusion, and increasing citizen participation in Climate City Contract (CCC) activities. These priorities reflect the city's commitment to making climate governance more transparent, participatory, and effective.

A major technical priority is the installation and activation of new sensors to improve real-time monitoring capabilities. Other high-priority actions include improving traffic management, planting 100,000 trees by 2030, and creating 200 hectares of new green spaces. These initiatives were selected not only for their environmental impact but also for their visibility, allowing citizens to directly experience the benefits of climate action in their daily lives.

Application of MEL

Integration of MEL Data into Decision-Making

Cluj-Napoca is transitioning toward a more data-driven approach to decision-making, gradually incorporating MEL processes into City Hall projects. While this shift is ongoing, the city sees monitoring and evaluation as a tool to improve public policies by ensuring they are informed by reliable data.

One of the ways MEL data is integrated into decision-making is through a system for gathering public opinion at the neighbourhood level, using citizen input to shape policies. The implementation team presents the collected data to policymakers, but securing approval often depends on factors such as budget constraints and public sentiment. This reflects the city's broader approach to climate action, which prioritizes clear, relatable benefits. As one official put it, **"We focus on our communication in the core benefits because people do not especially relate to the fact that we say to them, look, greenhouse gas emissions went down."** Instead of focusing solely on emissions reductions, the city highlights tangible improvements in daily life to foster public support.

Accessibility and Use of Data Sources

A key goal for Cluj is to **make MEL data publicly accessible through a centralized platform that consolidates all relevant indicators in one place**. This platform will create a standardized framework for data collection while also serving as an open resource for citizens. The city expects it to be fully operational by 2027.

However, there are still challenges in data collection and governance. One major gap is the lack of data on traffic and pollution generated by people commuting into the city from surrounding areas. The municipality currently does not have the legal authority or technical capacity to collect data beyond its

borders. Additionally, existing regulations sometimes prevent the use of real-time data for certain applications, creating administrative hurdles for a fully responsive MEL system.

Use of Real-Time Monitoring and Digital Tools

Expanding real-time monitoring capabilities is a priority for Cluj. The city is working toward installing a network of sensors connected to an integrated dashboard, allowing for real-time environmental and mobility data tracking. Currently, real-time capabilities are limited, with the most advanced data systems focused on traffic monitoring and public transportation, which already provide digitized, openly available data.

As the city expands its sensor network, it aims to improve monitoring in areas such as air quality and noise pollution, providing decision-makers and citizens with up-to-date, actionable information.

Communication and Storytelling

Recognizing that data alone is not enough to drive engagement, Cluj's MEL team is working with a communications expert to ensure that MEL findings are presented in an accessible and compelling way. This applies both to the public and to internal discussions within City Hall. A key priority is ensuring that people understand project objectives and have a clear view of key indicators such as air quality and traffic conditions.

The city's communication strategy emphasizes visible and relatable climate actions. As one official explained, **"Everything else comes after these big narratives because these are things that are easy to comprehend by everyone. So basically we plant trees, we create green spaces, we create green public transport. It's easy for them to understand and to adhere to our position."** By focusing on tangible benefits, the city fosters public support and makes climate policies more engaging for residents.

Cluj's approach to climate neutrality is built around three key objectives: awareness, experimentation, and economic incentives. First, the city aims to keep residents informed about key urban indicators, such as air quality and traffic congestion, ensuring transparency on environmental conditions. Second, Cluj is developing a digital twin model as part of the Blueprint project, allowing citizens to simulate and experiment with behavioural changes—such as adjusting indoor temperatures—to understand their impact. Finally, the city emphasizes the financial benefits of climate-friendly actions, showing residents that sustainable behaviours not only contribute to emissions reduction but also lead to cost savings. Given Cluj's service-based economy, where most emissions come from households and commuting rather than heavy industry, citizen engagement is essential. By leveraging digital tools and education, Cluj seeks to align personal benefits with broader sustainability goals.

Learning and Adaptation

Processes for Revising the MEL System

While the core indicators and targets in Cluj's MEL framework generally remain consistent, **budget allocations and specific implementation strategies often evolve over time**. Preliminary estimates frequently change during execution, requiring an iterative approach where projections are reassessed and adapted as new challenges arise.

As one city official explained, **"We started thinking on how we can better emphasize the indicators that are easily obtainable and how to better frame the others for which data is harder to obtain and harder to implement. So for sure, some of the indicators can be improved, and I think at some point we will have to change a little bit the indicators in order to enhance**

our CCC implementation. Some of the indicators that we thought in the first place were highly relevant proved in practice that they are not so relevant, and they can be moved to other indicators." This reflects an adaptive approach, where indicators are refined based on practical experience to ensure they remain useful for monitoring progress and guiding policy.

Incorporation of New Evidence

Despite the city's commitment to flexibility in MEL processes, certain legal and administrative constraints can make adapting the system challenging. In some cases, external policy changes have affected data collection responsibilities. For example, in 2022, waste collection was centralized under a regional authority, meaning the city no longer had direct access to this data. Such shifts create data barriers that require adjustments in how indicators are tracked and interpreted.

Public Engagement

Public engagement remains central to the evolution of Cluj's MEL system. The Civic Imagination and Innovation Centre is a key platform where amendments to the CCC, including MEL components, are presented and discussed with the community.

Additionally, **city hall and academic partners conduct surveys** to assess how citizens perceive and react to changes within the city. These insights help refine policies to align with public expectations and needs. A digital portal also allows residents to submit feedback and report concerns about city management. These citizen inputs carry significant weight in decision-making, ensuring that MEL processes not only track technical progress but also reflect the lived experiences of the people of Cluj.

Outcomes and Success Stories

Investment Persuasion

Cluj-Napoca views MEL as more than just a tool for tracking climate progress—it is also a way to position the city as an attractive destination for investment. By demonstrating clear progress through indicators, the city can showcase its infrastructure improvements and sustainability efforts, making it more appealing for potential investors and funding opportunities. Data-driven decision-making helps secure financing for projects that align with the city's climate and development goals.

6.2.3 Summary

- **High-Priority Indicators:** The city places particular emphasis on **tree planting, expansion of green spaces, congestion levels, and citizen participation**—all of which are seen as tangible, visible outcomes that directly impact residents' daily lives.
- **Processes:** Cluj employs multiple collaborative processes to integrate citizen input into policy and project design. Platforms such as the My Cluj portal and the Civic Innovation and Imagination Centre enable residents to contribute ideas and feedback before projects are finalized and approved.
- **Partnerships:** A strong network of partners supports Cluj's MEL processes, including academic institutions, the private sector, NGOs, and citizens. Additionally, the World Bank has played a key role in shaping the city's climate action and monitoring strategies.

As Cluj advances toward its climate neutrality goals, the integration of real-time monitoring, citizen engagement, and evidence-based policymaking will be essential in ensuring that climate actions remain effective, adaptable, and aligned with the city's broader objectives.

Looking ahead, Cluj-Napoca is focused on expanding its monitoring infrastructure to improve data collection and decision-making. A key priority is ensuring that all major projects incorporate sensors

and monitoring systems, allowing for real-time tracking of key indicators such as air quality, congestion, and public space usage.

By 2030, the city aims to have a fully operational Cluj 2030 platform, which will serve as a centralized hub for all MEL data. This platform will provide open access to key indicators, fostering transparency and enabling both policymakers and residents to track the city's progress toward its climate and urban development goals.

6.3 Košice

6.3.1 City Profile

Background information

Košice is the second-largest city in Slovakia, strategically located in the eastern part of the country. It functions as the administrative center of the Košice Region, playing a pivotal role in regional governance and economic development. Historically recognized as an industrial center, Košice has undergone significant economic transformation, diversifying from traditional heavy industries to emerging sectors such as information technology (IT), creative industries, and green technologies.

In 2021, Košice had a population of 229,040 inhabitants, with the broader metropolitan region home to approximately 380,000 people. This larger figure includes daily commuters (300,000) and from surrounding rural areas, which consist predominantly of forests and agricultural lands, shaping distinctive urban-rural interactions. Demographically, Košice's population is approximately 24% under 15 years old, 63% within the working-age bracket of 15–64, and about 13% aged 65 and above, making Košice the highest average age in country. The city faces challenges related to population decline driven by suburban migration and constraints in local employment opportunities which makes it the fastest ageing nationwide. Consequently, there is dramatic demographic shift ahead of the city of Košice if this trend continues.

Socio-economically, the GDP per capita for the Košice region was approximately €17,000 in 2021. The city hosts around 30 registered businesses per 1,000 inhabitants, reflecting a moderately developed local business environment. Dominant industries include manufacturing and heavy industry, particularly U.S. Steel Košice, a major employer with significant environmental impact. The rapidly growing IT sector and creative industries collectively employ around 17,000 people, highlighting the city's evolving economic profile. Additionally, green technologies and sustainability initiatives are emerging as critical components of the local economy. Educationally and intellectually, Košice is bolstered by three universities, strengthening its research capabilities and skilled workforce. Regarding employment distribution, agriculture accounts for approximately 3%, manufacturing and heavy industry constitute roughly 30%, and the service sector, including IT, comprises about 67% of employment. A new automotive plant from Volvo Cars is under construction, with full production plans set for 2026. Approximate numbers of direct employees is 5.000, with 10.000 additional subcontractors anticipated by the end of decade.

Climate Neutrality Objectives

Košice's greenhouse gas (GHG) inventory identifies buildings and heating as the largest contributor, accounting for approximately 65% of total emissions in 2018. Other significant sectors include electricity at 17%, transport at 9%, and waste management contributing around 6%. In absolute terms, emissions for 2018 stood at 602,682 tonnes CO_2 from buildings and heating, 157,305 tonnes CO_2 from electricity consumption, 83,725 tonnes CO_2 from transport, and 53,410 tonnes CO_2 from waste management activities. Additional sectors, including Industrial Processes and Product Use (IPPU) and Agriculture, Forestry, and Other Land Use (AFOLU), collectively added 36,184 tonnes CO_2, equivalent to about 4% of total emissions. Overall, the city's emissions totaled 933,306 tonnes CO_2 in 2018.

Through targeted climate action initiatives, Košice aims for substantial emission reductions by 2030 compared to the 2018 baseline. Specifically, emissions from buildings and heating are planned to decrease by 71%, transport emissions by 70%, electricity-related emissions by 66%, and

waste management emissions by approximately 11%. These ambitious targets underscore the city's commitment to significant climate mitigation and transition to a low-carbon economy.

GHG Emissions by Source Sector (2018 Baseline)

Table 7 - Košice's GHG inventory.

Sector	Scope 1 (t CO_2/year)	Scope 2 (t CO_2/year)	Scope 3 (t CO_2/year)	Total Emissions (t CO_2/year)	% of Total
Transport	83,725	-	-	83,725	9%
Buildings & Heating	602,682	-	-	602,682	65%
Electricity	-	157,305	-	157,305	17%
Waste	-	-	53,410	53,410	6%
Other (incl. IPPU & AFOLU)	36,184	-	-	36,184	4%
Total	722,591	157,305	53,410	933,306	100%

Climate Action Framework

Košice's climate action framework focuses primarily on the sectors of buildings, transport, energy, waste management, and urban development. It strategically excludes Industrial Processes and Product Use (IPPU) as well as air transport, which are already regulated under the EU Emissions Trading System (EU ETS).

The city's strategic priorities include advancing energy efficiency and transitioning to renewable energy sources, promoting sustainable mobility, enhancing urban greenery and waste management practices, and fostering stakeholder and citizen engagement.

In the buildings sector, responsible for approximately 63% of Košice's total greenhouse gas emissions, planned actions emphasize improving energy efficiency across residential and commercial structures. A key initiative involves integrating geothermal energy sourced from the Ďurkov area into the city's district heating **systems**, significantly reducing reliance on fossil fuels.

Electricity consumption accounts for about 23% of total emissions, prompting the city to prioritize expanding renewable energy capacity. Košice intends to develop additional renewable energy facilities, including solar photovoltaic installations, hydropower, and geothermal energy projects, to substantially reduce carbon emissions from electricity generation.

Sustainable mobility and transport currently contribute around 9% to the city's overall greenhouse gas emissions. To address this, Košice has allocated €3.2 million in 2023 towards expanding cycling infrastructure. Additional measures include modernizing and electrifying public transportation networks, particularly tram and bus services, and implementing urban mobility policies designed to decrease car dependency and promote more sustainable modes of travel.

The sector comprising green infrastructure and waste management, while not explicitly quantified in terms of emissions, has been identified as a significant area requiring

improvement, notably due to insufficient green spaces and low recycling rates. This stems from a nation-wide policy approach to waste-management, typically are landfills. The incineration plant in Košice is one of only two in the country and plays a significant role in the heating plant's energy mix — the heat generated through incineration contributes more than 20% to the overall energy supply. Planned interventions include a €12 million investment in urban greening initiatives in 2023, expansion of waste sorting facilities, the promotion of circular economy practices, and strategic efforts to substantially reduce dependency on landfills.

Table 8 - Košice's key actions by sector

Sector	GHG Emissions Contribution	Planned Actions
Buildings	63% of total emissions	- Increase energy efficiency in residential & commercial buildings. - Integrate geothermal energy from the Ďurkov area for district heating.
Electricity	23% of total emissions	- Expand renewable energy sources (solar PV, hydro, geothermal).
Sustainable Mobility (Transport)	9% of total emissions	- Expand cycling infrastructure (€3.2M in 2023). - Electrify public transport (tram and bus modernization). - Reduce car dependency through urban mobility policies.
Green Infrastructure & Waste Management	Not specified, but highlighted insufficient green spaces and recycling	- Increase urban greenery (€12M investment in 2023). - Expand waste sorting & circular economy projects. - Reduce landfill dependency.

6.3.2 Košice's MEL processes and application.

The Strategic Development Department leads the coordination of Košice's climate actions and oversees the implementation of the city's climate neutrality strategy. It works in close collaboration with specialized units to ensure an integrated and effective approach across planning, funding, and monitoring processes.

The EU Project Implementation Unit plays a vital role in managing applications for external funding, particularly from European Union sources. This unit supports the financial sustainability of climate projects by securing grants and facilitating project implementation aligned with EU priorities.

The Mobility Strategy Unit is responsible for coordinating sustainable transportation initiatives across the city. It ensures that mobility planning aligns with Košice's climate goals, including the electrification of public transport and the expansion of active mobility infrastructure.

The Policy and Data Analysis Unit leads the Monitoring, Evaluation, and Learning (MEL) reporting processes. This includes collecting, analyzing, and reporting climate-related data to track progress, assess policy impacts, and ensure accountability.

The core team overseeing Košice's climate action strategy is tasked with several key responsibilities. These include monitoring emissions trends to evaluate progress toward climate

targets, securing necessary funding for implementation, engaging stakeholders from across society in climate initiatives, and ensuring the city's full compliance with EU climate policies and objectives.

The Monitoring, Evaluation, and Learning (MEL) framework for Košice is structured around three core components designed to guide and strengthen its journey toward climate neutrality.

- **Indicators & Measurement Tools: defining clear and measurable performance metrics.** These indicators enable Košice to systematically track and evaluate its progress across targeted climate actions, ensuring transparency and accountability in the city's climate transition process.
- **Evaluation & Learning Processes: establishing structured mechanisms for reviewing performance data and adapting strategies.** Through regular evaluations, Košice will identify successes, recognize areas requiring improvement, and apply lessons learned to enhance policy effectiveness and optimize resource allocation.
- **Partnerships & Governance: actively engaging stakeholders from local, national, and international levels.** By leveraging collaborative governance structures, Košice ensures inclusive decision-making and robust support for its climate neutrality mission, facilitating shared responsibility and collective action across various sectors and communities.

Processes/Collaboration in Design and Operationalization of MEL

Košice's approach to designing and operationalizing its Monitoring, Evaluation, and Learning (MEL) system has been collaborative and rooted in co-creation. The city leveraged an experimental European Urban Initiative project (2020–2023) to kick-start broad stakeholder engagement in climate planning. *"We introduced participatory planning co-creation with all the stakeholders in a really, really big way,"*, resulting in *"a lot of strategic documents and manuals"* that laid the groundwork for Košice's climate strategy. This early co-creative work meant that when Košice developed its Climate City Contract (CCC) much of the content was already in place.

A core element of Košice's collaborative MEL design was the use of the URBACT participatory methodology to form a local stakeholder group dedicated to climate policy. This group functioned as a stakeholder arena involving representatives from various sectors, and they became the main signatories of the CCC. The city provided guidance to this group from the beginning of the CCC drafting, aligning meetings and workshops with the URBACT framework. These stakeholders met regularly (on a routine meeting schedule) to co-design the climate actions. Even after the CCC was submitted (in September 2023), Košice continued this engagement: the stakeholder group (now formalized through the CCC) will convene twice or three times per year to monitor implementation and maintain collaboration. This ongoing participatory forum acts as a feedback mechanism and keeps stakeholders involved in operationalizing and updating the MEL system over time.

Key partners and their contributions in Košice's MEL process spanned the public, private, academic, and civil sectors:

- **City-Owned Companies**: Implementers of city services (energy, transport, waste, etc.) that needed to align with climate goals. Košice used the CCC preparation to harmonize approaches across 14 city-owned companies, ensuring they work with climate targets rather than inadvertently against them. These companies provide on-the-ground data and carry out projects, so aligning them created a more unified effort.
- **NGOs and Civic Associations**: Translators of change to the public and drivers of community engagement. While local NGOs may not implement large infrastructure projects, they play a crucial role in outreach and education. Košice views them as bridges to citizens – for example, leveraging cultural programs (a legacy of Košice's time as European Capital of Culture) to drive climate awareness and behavioural change. NGOs help communicate MEL findings (e.g. progress, challenges) in citizen-friendly ways and rally community support.

- **Universities**: Knowledge partners providing research, data analysis, and technical expertise. Košice forged detailed agreements with specific university faculties (rather than generic MOUs) to tap into relevant expertise – for instance, the economics university that had evaluated the city's European Capital of Culture impacts. These academic partners bring capacity for evaluation, modelling, and innovation. They act as technical advisors, helping design indicators, analyse data, and verify findings, lending credibility and rigor to the MEL process.
- **Stakeholder Board (Major Investors/Utilities)**: Public–private platform for large-scale climate investments. Košice established a stakeholder board through a memorandum of understanding, which includes major energy investors (such as the district heating company). This was crucial for a flagship initiative to switch the city's heating source to geothermal water (replacing coal/gas). By involving this stakeholder board in the design phase, Košice secured high-level buy-in and coordinated planning for transformational projects. These partners contribute data (e.g. energy usage, emissions) and commit to action within the MEL framework.

Košice also engaged external expert organizations to support MEL design. During the European Urban Initiative project, the city collaborated with an external company specializing in strategy and process innovation. This external partner is typically Creative Industry Košice—a city-owned enterprise that operates as an autonomous agency. This partner acted as an expert bringing new processes and training to the city administration. They helped design new methods, trained city staff, and disseminated innovative practices to city-owned companies. City officials noted this company was the *"main force"* in introducing new governance processes and bringing *"expertise from outside into the municipal body"* and then spread that knowledge internally. Košice continues to use such external expertise for capacity-building; currently, the same partner is advising on greening the city's procurement processes.

Defined intentions and purposes of the MEL system:

At the start of Košice's climate neutrality journey, city stakeholders had a discussion to clearly define why they needed a MEL system and how they intended to use it. The consensus was that MEL in Košice would serve multiple purposes: learning, steering, accountability, and communication.

1. **Learning and improvement** (internal purpose): The MEL system is fundamentally a tool for *organizational learning*. Košice's climate team wanted to continuously learn "what works and what doesn't" and to adapt accordingly. The MEL system was intended to capture those patterns and successes so that future projects can replicate or build on them.
2. **Steering and decision support** (strategic purpose): The MEL framework was designed to inform strategic decisions and resource allocation. By monitoring key indicators and evaluating outcomes, Košice's MEL provides evidence on whether policies are effective or need adjustment.
3. **Accountability and reporting** (external purpose): Košice also intended the MEL system to serve as an accountability tool, both to its citizens and to external funders/partners. With robust MEL, the city can transparently report progress to the public, showing how far it has come in emissions reduction, what money has been spent and achieved, etc. It helps build trust when the city can say, "We committed to retrofit 10 buildings this year, and we did 12 – here are the energy savings data." For external audiences like the European Commission or national government, a solid MEL system helps Košice demonstrate it is fulfilling any grants or obligations, and it positions the city as a serious candidate for future support (because it can prove outcomes).
4. **Communication and engagement** (public purpose): Another purpose of Košice's MEL is to provide content for storytelling and engagement. The idea is that MEL doesn't only have to be dry numbers for experts; it can yield stories and facts that inspire the community and stakeholders. Košice intended for MEL to supply such narratives to sustain public support, helping demonstrate value to people's lives in order to keep them engaged.

Roles and responsibilities were clearly defined in the MEL governance structure, ensuring effective coordination. Through experience in the EU Pilot Cities program, Košice realized the importance of a structured team. They identified a core team and delineated roles to cover all aspects of communication and MEL management. One official described that it's now *"really clear…who is responsible for everything"*. In this setup, leadership is distributed: the city climate coordinator serves as the primary communicator to external partners. Another team member handles internal coordination, ensuring all city departments are informed and aligned. A dedicated MEL officer focuses on overseeing the monitoring and evaluation process itself. *"It's standardized,"* an official noted, meaning each person knows their domain, and together they *"can really work vertically and horizontally."* This structure enables smooth vertical coordination (across different levels of government and departments) and horizontal coordination (across sectors and companies).

Measurement and Monitoring

Košice has put significant effort into developing the methods and frameworks for data collection and monitoring. The city recognizes that a robust evidence base is the backbone of MEL. A major step was the creation of a Data Analysis and Interpretation Department around 2020. This new department was a turning point for the city's data culture. As one official described, *"it was a really big step towards having any kind of decision based on data."* Before 2020, Košice did not have a formal data-driven policy, but through the European Urban Initiative project, they established this department to institutionalize data practices. This team (often called the data policy department) is responsible for gathering, managing, and analysing data relevant to the city's climate and sustainability efforts. Coordination of the MEL system is housed in this department, which has helped standardize data governance and ensure that MEL activities are integrated with the city's broader data infrastructure.

Košice employs both traditional and innovative methods to collect and monitor data. The city compiles data from its own operations and from mandatory reporting. There are legal requirements for certain stakeholders (e.g. utilities or large emitters) to report data to the city or to publish data publicly. For example, the municipal waste company and public transport authority provide annual or periodic reports, and these become part of the monitoring dataset. Even so, Košice often needs more granular or frequent data than what is legally required, which is where they have to actively engage stakeholders and deploy new tools.

Košice has strategically leveraged partnerships with private companies to enhance data collection and management, particularly within the energy and buildings sector. The city has procured a private energy management system to monitor consumption across municipal properties. Initially implemented in a pilot phase, this system connected four municipal buildings and approximately 1,000 streetlights to a centralized monitoring platform. Operated by a private provider under municipal oversight, the system collects detailed real-time data on electricity and heating usage. The pilot phase yielded significant insights and financial savings, with officials affirming that the system "worked and it saved us a lot of money." Following these successful outcomes, Košice now intends to scale this energy management system to encompass all municipal buildings. The enhanced data granularity provided by continuous monitoring has allowed the city to shift from relying on broad annual reports to accessing detailed, near-real-time energy consumption data. Officials emphasized the value of this continuous oversight, noting that they now have *"24 hours oversight over all the connection points where we are using electricity."*

City-wide data collection involves stakeholders outside direct municipal control, requiring proactive engagement with external entities. Košice has prioritized collaboration with external stakeholders, especially energy providers and utilities, to obtain precise data on electricity and heating fuel consumption. Recognizing that accurate data requires strong partnerships, city officials have cultivated productive relationships with these companies, noting: *"If we want to have actual data, we*

have to have a nice relationship with the energy providers." In practice, Košice has implemented formal data-sharing agreements or leveraged its stakeholder board to facilitate regular data exchange. While certain data is accessible through open data policies or legal obligations, allowing the city straightforward access, more detailed or frequent data often requires explicit requests and careful negotiation. Officials acknowledged challenges arising from companies protective of their proprietary data or business practices. In response, the city emphasizes mutual benefits, such as enhanced service efficiency for both parties, and robust data governance practices that address privacy and competitive concerns.

The collaborative nature of Košice's Monitoring, Evaluation, and Learning (MEL) framework extends beyond energy utilities, encompassing multiple actors across sectors such as transportation, waste, and water management. Within transportation, comprehensive data gathering requires collaboration with multiple entities including the municipal transport authority for buses and trams, the national railway company, and potentially private transit providers. Košice recognized the necessity of integrating data from these diverse sources to construct a holistic view of transport emissions and mobility patterns. Similarly, in waste and water management, the city collects data from both municipal operations and external contractors or neighboring jurisdictions when relevant. As a result, Košice's MEL system operates through an extensive collaborative network, demonstrating that effective city-level monitoring and evaluation relies significantly on contributions from stakeholders across and beyond the municipality.

Data governance practices

Establishing the Data Analysis Department was the cornerstone of Košice's data governance improvements. This department created a formal structure for data ownership and stewardship within the municipality. Data that was previously scattered across departments (and sometimes not maintained) now has a home and responsible personnel.

One key governance challenge Košice faced was interoperability; integrating data from various sources and systems. The city historically had myriad databases, each serving different purposes (energy billing, transport stats, environmental monitoring, etc.). Many of these systems were not originally designed to talk to each other. The digital tools strategy (digital twin and the AI data platform) is one solution to this (see section 2.3).

The Data Department has been manually extracting and combining data. They have been migrating data from paper records to digital formats, standardizing data entries, and trying to centralize databases where possible. This is tedious work and explains why officials say *"we are not there yet"* in terms of a fully integrated system. *"The department is quite new, and they're still in delay just to bring data from the papers and from the non-digital to digital,"* one person admitted. *"It's not automated… not on a regular basis. It's just project by project."* While Košice has a data governance structure, a lot of data handling is still done through specific projects or one-off efforts, rather than through a seamless automated flow. Each new project (like a survey or an EU initiative) often comes with its own data requirements, and the city addresses those, gradually improving the overall pool of data. The visionis to have a more continuous data pipeline feeding the MEL system, and they are making progress toward that.

On the privacy and data ownership front, Košice is cautious to respect boundaries. Data on energy usage in public buildings or city operations is straightforward (the city owns it). But for data coming from private companies or citizens, the city ensures it either has consent or a legal basis. When dealing with smart energy meters provided by a private company, data agreements spell out that the city can use the data for internal planning, but perhaps not publish proprietary details publicly without permission.

Anonymization is applied where needed. If Košice ever uses mobility data from cell towers or apps, they would aggregate it to avoid personal data issues. So far, privacy hasn't been highlighted as a

major hurdle because the data is mostly aggregate city-level information. The city's partnership approach also helps, by collaborating rather than mandating, they build trust that data will be used responsibly.

Data accuracy and quality control is a crucial part of Košice's monitoring practice. The city learned that not all data it had was reliable. In some cases, data gaps or errors led to what was termed *"wild guesses."* Transportation data was identified as particularly weak, methodologies were outdated, leading to large error margins *"sometimes we have so bad data… it's the same as having no data."*

Košice took steps to either improve those data streams or to be transparent about the uncertainty. One strategy was commissioning an external audit of data sources. They brought in an outside expert team to review all existing climate-related data and documentation. The result was an in-depth audit report (around 30 pages) that essentially graded their data: telling them *"you can use these sources and please don't use those"*. This helped the Data Department filter out unreliable data and focus on strengthening the remaining sources. Going forward, Košice is likely to repeat such audits periodically and continuously calibrate their data collection methods (for instance, upgrading traffic counting technologies or conducting new baseline studies) to ensure the monitoring data is accurate, up-to-date, and reliable.

Indicators and Metrics

Košice's MEL framework involves a mix of indicators and metrics designed to track progress toward climate and sustainability goals. The development of these indicators has been informed by both local context and lessons from past projects, aiming for alignment with the city's objectives as well as a balance between quantitative and qualitative measures.

Košice has established clear key performance indicators (KPIs) to measure and track its progress toward climate neutrality. By 2030, the city aims to achieve a 68% reduction in greenhouse gas (GHG) emissions compared to baseline levels. Specific indicators include a 50% reduction in per capita energy consumption, increasing renewable energy sources to constitute at least 50% of the city's total energy use, and electrifying at least 30% of its public transportation fleet. In addition, Košice targets expanding cycling infrastructure by 100 kilometers, achieving a 30% increase in urban green areas, attaining a waste recycling rate above 50%, and significantly improving air quality through a 50% reduction in PM2.5 pollution levels. Current efforts toward these targets are ongoing, with cycling infrastructure expansion notably already in progress.

The set of indicators was built upon prior experiences. A notable influence was Košice's stint as European Capital of Culture in 2013, which required the city to monitor a broad range of outcomes (cultural event attendance, tourism numbers, economic impact, etc.). City officials recall that *"there were so many KPIs, amazingly big and structured"* during that time, and they *"learned and used that"* experience. In other words, the exercise of tracking diverse indicators for a large initiative taught Košice how to handle complex monitoring frameworks – skills they could transfer to climate action. They became comfortable with tracking everything from infrastructure usage (e.g., how many people use a facility) to economic indicators (like tourist spending or jobs created).

Košice has also integrated indicators that reflect co-benefits and broader city outcomes. For instance, when implementing a climate measure like greening a public space, they won't only track hectares of green area added (an environmental metric); they might also track the increase in visitors to that park, or survey data on how citizens' satisfaction with their urban environment changes (a social metric). This approach ensures the MEL system captures the multi-dimensional impact of climate actions.

Table 9 - Košice's KPIs

Indicator	Metric	Target by 2030	Current Status
GHG Emissions Reduction	CO_2 emissions reduction (%)	68% reduction	Ongoing
Energy Efficiency	Energy consumption per capita (kWh/person)	50% reduction	-
Renewable Energy Usage	Share of renewables in city's energy (%)	50% share	-
Public Transport Electrification	% of public transport electrified	>30% electric fleet	-
Cycling Infrastructure Expansion	New cycle lanes (km)	100 km added	In progress
Green Space Expansion	% increase in urban green areas	+30% urban greenery	-
Waste Recycling Rate	% of waste recycled	>50%	-
Air Quality Improvement	Reduction in PM2.5 pollution levels	50% reduction	-

Alignment of MEL with city objectives and outcomes. Košice used data from its Sustainable Energy and Climate Action Plan (SECAP) to focus its indicators. The SECAP analysis revealed that buildings contributed roughly two-thirds of the city's emissions, whereas transportation was less than 10%. The city understood it *"needed to focus on [buildings] much more"* and shifted the emphasis of its climate program accordingly. Indicators were then set to reflect this focus: e.g., tracking megawatt-hours of energy saved in buildings or progress in deploying renewable heating.

Balance of quantitative and qualitative indicators

Košice strives to include a balance between quantitative data and qualitative insights in its MEL system. Košice's monitoring was dominated by quantitative indicators: energy consumption figures, emission inventories, financial costs, etc. Over time, especially through learning from networks and projects, Košice began to incorporate qualitative indicators and narratives.

One highlighted qualitative aspect is public sentiment and acceptance of climate actions. While difficult to quantify, Košice found ways to gauge this through surveys, public consultations, and feedback at town hall meetings. The city acknowledged that winning public support is a key metric of success: if people perceive that climate actions are making their lives better or at least not imposing undue burdens, the overall transition will be smoother. Conversely, negative sentiment is a warning sign. One official candidly noted the importance of keeping costs manageable for residents, saying people are *"keen to support anything if we are not putting new taxes [or] new prices… in the end it's like the pocket of individual citizens – if the transformation will be super expensive there will be civil war."*

A good illustration of Košice's balance of indicators is how they handled a project to refurbish a public sports complex. Quantitatively, they measured the increase in energy efficiency of the facility and maybe the reduction in operational costs. This was complemented by a survey with local citizens and sports clubs about their anticipated use of the improved facility to gauge demand and social impact. The survey city found that *"capacity of usage for the public will grow by twice, and capacity for sporting clubs will grow about 50%"* after the refurbishment. It helped justify the project by

showing a social benefit. The city effectively treated *"meeting community needs"* as an indicator of success alongside energy savings.

Another example of combining qualitative insight into metrics is Košice's use of storytelling and narratives as part of MEL. The city collects success stories or case studies (e.g., a school that was renovated and now has better air quality and happier students) and uses those as qualitative indicators of improvement. These are sometimes presented alongside graphs and figures in reports. While not a "metric" in the strict sense, they function as indicators in that they are tracked and reported to illustrate progress in areas that numbers alone can't capture.

Methods to measure co-benefits

Košice places strong emphasis on co-benefits. The city's leadership realized that focusing on co-benefits not only provides a more comprehensive evaluation of projects, but also helps in gaining support. *"We're mainly calculating co-benefits. And through co-benefits, we communicate with local citizens".*

To measure co-benefits, Košice has integrated various indicators such as:

- **Economic co-benefits**: for energy efficiency measures, the city closely tracks the financial savings. One message they prepare for the public is: *"Look, we did this and we saved two or three million euros per year just by better management."* Such cost savings support a narrative that that climate actions (like optimizing energy use in buildings) can directly benefit the city's budget and, by extension, taxpayers. Košice also monitors grants or private investments leveraged by climate projects as an indicator of economic activity spurred by the transition.
- **Environmental co-benefits**: the city has metrics for air quality in different parts of Košice, and it correlates those with traffic reduction measures. Similarly, when they plant trees or create green roofs, they note the area greened and even secondary effects like urban heat island mitigation or stormwater absorption (if data is available).
- **Social co-benefits**: perhaps the most important to Košice are those that directly affect citizens' well-being. Indicators here include public health statistics (e.g., asthma rates could be an indirect indicator of air quality improvements), mobility and accessibility (e.g., percentage of population with convenient access to public transport or bike paths), and general quality of life indices. Some of these are captured through surveys or indices compiled by the new Wellbeing Institute. Social equity is another dimension. Košice has considered whether benefits are reaching all groups, prompting metrics like distribution of investments among neighbourhoods, or how climate projects benefit vulnerable communities (for example, energy savings programs for low-income housing).

Košice acknowledges that quantifying co-benefits can be challenging, but they make a concerted effort to do so. They sometimes use proxies (like the sports facility usage example as a proxy for social benefit). They also lean on academic partners to help devise methodologies for measuring things like "culture of sustainability" or "community resilience" – more abstract concepts that nonetheless are important outcomes of a successful climate transition. The presence of universities in the MEL process helps in developing and validating such qualitative or composite indicators.

One insight Košice gained is that focusing on co-benefits requires breaking out of silos. Initially, *"in previous years, it was mainly technical – just to get numbers"* (e.g., tons of CO_2 reduced, kilowatts saved). Now, thanks to deliberate effort and external influences, the city is trying to think in *"several layers, not only technical or financial."* This shift is not easy – *"to change the course of the municipal office that worked for 50 years in some way, it's painful,"* an official noted. But through training and pilots, staff are starting to consider, for every project, not just *"Did it meet the energy*

target?" but also *"Did it improve something for the public? Did it strengthen our economy or community in some way?"* This multi-faceted evaluation is becoming the norm. And while the balance between quantitative and qualitative indicators is "not there yet" (the city admits that the system still leans towards what can be easily measured, like money and technical data), they have made a *"giant leap"* toward better balance by including co-benefits. The expectation is that over time, as the MEL system matures, Košice will refine these co-benefit metrics and perhaps become a model for integrated indicator frameworks that capture the full spectrum of climate action impacts.

Application of MEL Processes

Košice doesn't treat MEL as a box-ticking exercise; the city actively uses MEL processes and data to guide decision-making and improve implementation. The integration of MEL into everyday governance is deliberate and can be seen in how data influences policy, how the MEL system's purpose is articulated, how information is made accessible to stakeholders, and how technology is employed to enhance usage of MEL insights.

Dedicated sector-specific monitoring teams have been established to ensure detailed and accurate tracking across key focus areas, including energy, transportation, waste management, and green infrastructure. These specialized teams provide precise data and targeted analysis, facilitating timely identification of challenges and enabling informed decision-making throughout the climate action process.

Integration of MEL data into decision-making

Košice implements structured evaluation mechanisms to regularly assess the effectiveness of its climate policies and progress towards neutrality goals. Central to these mechanisms are the Annual Climate Reports, which systematically document reductions in greenhouse gas (GHG) emissions and evaluate the overall impact of implemented policies.

Mid-term Reviews scheduled for 2025 and 2027 will provide critical opportunities for adjusting strategies based on interim outcomes. These reviews will incorporate insights derived from ongoing monitoring, enabling the city to proactively refine its approaches and enhance policy efficacy.

Košice's has embedded MEL into the decision-making cycle of their climate program. Data and evaluation findings are regularly discussed among city leadership and influence the choices they make. A clear example of this is the adaptive management of the city's energy efficiency program. When Košice launched its pilot for building energy monitoring, they initially set modest goals: only a dozen buildings were to be included, and targets were cautious. This was due to uncertainty (they were creating a new Energy Management Department at the same time and weren't sure how well the system would work). However, because they had MEL processes in place from the get-go, they monitored the pilot closely and got results within months. The data showed substantial energy savings and cost reductions in those pilot buildings. With this evidence, the team gained confidence and quickly decided to scale up the program city-wide much faster than originally planned. As the official recounted, *"after four months we understood it works, let's do it for the whole portfolio [of buildings]."* This decision to invest more resources and expand the project was directly driven by MEL data (performance tracking in the pilot).

MEL data has helped reprioritize focus areas in the climate strategy. Analysis of baseline emissions and energy data (an MEL activity) highlighted the outsized role of the building sector in Košice's emissions profile. This finding influenced policy by convincing officials to channel more effort and funding into building-related actions (renovations, renewable heat, efficient lighting, etc.). By aligning policies with evidence (e.g., focusing on the largest sources of emissions first), Košice hopes to achieve quicker and more significant impacts on its path to climate neutrality. Furthermore, MEL data has been used to sequence projects: the city realized some "easy wins" should be tackled first to build momentum (like improving energy management in buildings they directly control).

Košice's leadership set a tone that data should drive policy, not politics alone. As one person put it, *"changes of government are so quick on the local level, but the data still stays."* This insight led them to create structures (like the data department and MEL system) that transcend political cycles. In practical terms, even if city leadership changes, the MEL data provides a non-partisan factual basis that can guide the new officials. It also means that strategic decisions (like which projects to invest in) can be justified with hard data, which helps maintain consistency and defend against whims or populist shifts. Košice essentially uses MEL as a stabilizing force in decision-making – ensuring that climate actions remain on track through evidence, even as elected administrations come and go.

By clearly defining these intentions Košice set up its MEL system as a central pillar of its climate program. The MEL design (indicators, tools, roles) was configured from the beginning to meet these purposes. For instance, the inclusion of both technical and well-being indicators is directly tied to the dual purpose of decision support and public communication. Likewise, situating the MEL lead in the Data Department and standardizing processes was aimed at fulfilling the learning and steering purposes by ensuring rigor and consistency.

Accessibility and use of data sources

Košice understands that for MEL to be effective, data must be accessible to those who need it: analysts, decision-makers, and sometimes the public. To tackle this the city is working on improving data accessibility in several ways.

The Data Analysis Department is creating centralized databases and dashboards. They are pulling data from various departments into a common platform. Over time, this will likely evolve into an open data portal or at least an internal data warehouse for the climate team. The idea is that anyone working on the climate plan can easily retrieve the latest figures without going through layers of bureaucracy. Already, the climate core team share data via common spreadsheets and presentations.

Addressing data gaps has been a recurring theme. Whenever gaps have been identified, such as a missing indicator, a sector not monitored, or poor data quality solutions have been sought out. For example, transportation data was a gap, so they are exploring modern traffic monitoring systems (like using mobile data or smart sensors) to supplement the old manual counts. Where the city doesn't have jurisdiction (like private industrial emissions), they use modelling or proxy data to estimate those figures.

One notable gap that Košice addressed was the initial lack of integration of city-owned companies' data. Because some city companies operated quite independently, their data (for instance, the public transport company's fuel use or the city forestry company's tree planting data) might not have been systematically funnelled into the city's climate MEL system. During the CCC development, Košice specifically worked to *harmonize approaches* with these companies. Part of that harmonization was agreeing on what data they will provide regularly to track progress. Those companies have now largely come on-board which effectively closes a data gap, ensuring the MEL system has coverage of their activities.

Use of real-time monitoring and digital tools

Košice is progressively incorporating real-time monitoring and advanced digital tools into its MEL practice. The city recognizes that timely data can significantly enhance responsiveness and understanding.

Košice is utilising digitisation to improve data collection. The city is in the process of developing a digital twin, which will integrate various data streams (GIS data, infrastructure information, real-time sensor data, etc.). The foundation for this was laid by digitizing the new urban master plan, the first time the city did a master plan entirely digitally, providing a spatial data framework.

Košice is actively exploring the integration of AI-driven analytics to enhance building energy monitoring and optimize its MEL processes. As part of its strategic innovation agenda, the city has applied for support under the European Urban Initiative to implement an automated energy monitoring system powered by artificial intelligence. This system would analyse energy usage patterns across more than 100 municipal buildings, using AI algorithms to identify underperforming assets, detect anomalies, and highlight optimization opportunities that may not be evident through manual analysis. Such capabilities are expected to significantly improve the targeting and efficiency of building-related interventions, transforming raw data into actionable insights.

Beyond analytics, the city seeks to address long-standing challenges in data fragmentation by creating a unified monitoring platform. Currently, Košice operates with "100 different databases [and] 100 different systems of how to record all the data," which complicates cross-sectoral monitoring and data integration. The proposed AI-powered system aims to consolidate these disparate sources, harmonising data collection across municipal departments, utilities, and assets. If successfully implemented, the platform will play a transformative role in Košice's monitoring infrastructure by automating data collection. This not only helps with internal efficiency but could also allow for integration of external data sources via APIs. For example, if the national weather service has an API, Košice can feed real-time weather data into its models (useful to normalize energy usage data by temperature, etc.). Or real-time public transport data can be piped in to see the effect of interventions like new bus lanes immediately on ridership numbers.

The energy management system in public buildings is a prime example of real-time monitoring in action. Instead of waiting for monthly utility bills to gauge energy usage (which was the old way), the city now gets continuous readings. Facility managers can log into a dashboard at any time and see current consumption levels, compare them to benchmarks, or get alerts if something is off (e.g., a spike in usage indicating a HVAC malfunction). This not only feeds into MEL (in terms of data recording) but also directly into operations, enabling quick fixes and efficiency gains. The MEL team uses the aggregated data from this system to update energy consumption indicators in near-real-time and even to run predictive models (e.g., projecting year-end savings based on current trends).

Another area is environmental monitoring. Košice uses sensors for things like air quality or temperature as part of its smart city efforts. Real-time air quality monitors, for instance, can provide data that MEL can correlate with traffic patterns or weather conditions. If not already in place, the digital twin initiative might integrate such sensors. A digital twin of Košice, once operational, would be continuously fed by real city data (traffic flows, energy grid status, etc.), effectively serving as a living, real-time MEL model of the city. City planners could use it to test scenarios (e.g., "what if we pedestrianize this street how does that affect emissions or traffic elsewhere?") and get immediate simulated results based on real data. This tool is still in development, but its potential for MEL application is significant: it will move Košice from *reactive* monitoring to *proactive* scenario planning.

Košice is pragmatic about their current status, not everything is real-time or digitized yet. They openly acknowledge that some processes remain manual or slow. However, the trend is clearly towards increasing the digitalization and immediacy of MEL. City staff are being trained on new software, and the culture is adapting to trust these tools. For example, with the building energy dashboard, facility managers had to learn to rely on it rather than paper logs; now it's becoming second nature. Similarly, as the digital twin gets built, urban planners will start using it as a routine part of planning meetings.

Košice is leveraging real-time monitoring and digital tools to make its MEL system more dynamic and effective. By getting data in real time (or near-real time) and using advanced analytics, the city can shorten the feedback loop allowing them to detect issues or successes faster, understand them better, and respond more quickly. Košice's embrace of technology thus directly supports its goal of being a learning, adaptive city on the journey to climate neutrality.

Continuous learning and the ability to adapt are at the heart of Košice's MEL approach. The city has put in place explicit mechanisms to capture lessons, reflect on them, and adjust its strategies and systems accordingly. Over time, Košice has shown a pattern of iterating on its MEL framework based on feedback and new information: refining indicators, processes, and even governance structures

Mechanisms for continuous improvement: An institutionalized mechanism is regular stakeholder review meetings. By convening the CCC signatories multiple times per year, Košice creates a forum to discuss what is working and what is not. These meetings are are designed as collaborative check-ins where data and experiences are shared. For example, a city-owned company might report that a certain emissions reduction measure isn't yielding as much benefit as expected, or a community representative might convey public concerns about a project's pace. Such feedback in real-time allows the city to troubleshoot and improve. If an issue is raised, the group can brainstorm solutions or, if needed, escalate it to political leadership for action. This stakeholder feedback loop also helps to recalibrate efforts: if a particular initiative is lagging, the city can decide to either support it more or perhaps shift focus to another approach if the original plan seems flawed.

Košice's climate team conducts periodic retrospectives after major milestones or projects, they evaluate outcomes and process. For instance, after finishing the initial CCC document, they evaluated the process of creating it: what went well in stakeholder engagement, what could be done better next time (like for future revisions or related plans). They identified, for example, that having detailed partnerships with faculties worked well (so they'll continue that), or that they struggled with communicating technical data to the public (so they know they need a better communications strategy). These retrospectives inform how they approach subsequent tasks. It's a very reflexive practice, almost treating the city as a learning organization.

There is a recognition that as the city's context and understanding evolve, so too should its MEL framework. One area of revision has been the indicator set. Through the first couple of years of implementation, they have been fine-tuning the indicators. For example, they might have added an indicator on "number of citizens engaged in climate events" after seeing that public engagement was crucial but not originally measured. An official described that *"we are not there yet"* but they are continuing to refine and improve the MEL system over time.

Continuous learning is also evident in the city's staff and team evolution. Košice has been adding more people to the data department as they realize the workload and importance (evidence that more capacity was needed). They also train existing staff based on identified gaps (for instance, if the MEL team notices that project managers aren't collecting the right data in the field, they'll train them on MEL requirements).

Outcomes and Success Stories

Košice's emphasis on MEL and adaptive management is starting to show results in terms of outcomes and impacts on the city's climate transition. While the journey to climate neutrality is long and many outcomes are still unfolding, we can already identify how MEL processes have influenced actions, what successes have emerged, and what challenges have been encountered along the way.

Evaluation of the impact of MEL processes on the city's climate transition: By using data to guide decisions, Košice is prioritizing initiatives that yield significant returns. This is making their climate transition more effective (focusing on big emissions sources like municipal buildings and heating systems) and more efficient (getting more output per input by choosing projects wisely). Košice identified a clear opportunity in optimizing energy management, which quickly led to cost savings and emissions cuts.

MEL processes have institutionalized a longer-term perspective in Košice's governance. Typically, city administrations might focus on short-term wins within electoral cycles. But with MEL showing patterns over five-year spans and beyond, Košice is investing in projects that may pay off more in the medium to long term (like deep building retrofits, which take years to implement fully). Because MEL provides data and justification, it helps city officials argue for these long-term investments. Thus, MEL is slowly shifting the political culture to value sustained outcomes over quick fixes.

Success stories: Košice has several early success stories that demonstrate the positive impact of its MEL-informed approach:

- **Stakeholder Co-Creation & Buy-in**: The process of co-designing the climate strategy with stakeholders is a success in itself. By the time Košice submitted its Climate City Contract, it had the endorsement of key players across sectors. The success is evidenced by the fact that stakeholders continue to engage (meeting regularly post-submission) and that many partners have taken ownership of specific actions. For example, universities have taken on monitoring and research tasks, NGOs are driving community projects, and companies are aligning investments with the plan. A concrete win from this co-creation is the memorandum of cooperation for geothermal heating – having the main heating company on board early means a historically difficult project (moving off coal/gas) is now moving forward with less resistance.
- **Energy Management Pilot & Savings**: The pilot project that connected buildings and streetlights to a smart energy system is a notable success. In a short timeframe, it demonstrated measurable savings. Internally, this was celebrated as proof that "data-driven management pays off." It not only saved money (important for the city budget) but also cut energy waste (important for climate).
- **Institutional Changes and Capacity Building**: Košice now has a Data Analysis Department, an Energy Department, and clearly assigned roles for climate action – none of which were in place a few years ago. These institutional developments mean the city is much better equipped to deliver on climate goals. The fact that they secured funding for new staff, got political approval for new departments, and trained people in new skills is a success in governance terms, largely driven by the recognized need through MEL planning. Not all cities manage to achieve that reorganization early in their climate journey.

Challenges: Košice's path is not without significant challenges and obstacles, some of which have become evident through the MEL process itself:

- **Cultural and Organizational Change**: Shifting the mindset of city staff and local institutions remains a challenge. Getting everyone to embrace data-driven, cross-sector thinking takes time. Some staff might still be inclined to follow old routines (for example, making budget decisions based on historical allocations rather than current data). Overcoming skepticism or inertia is an ongoing effort *"it's […] not easy to change the mindset of office workers to think in several layers"*. Košice has engaged with external experts and training to promote this new culture.

- **Data Gaps and Quality Issues**: Despite improvements, certain data gaps persist. For example, private industrial emissions (e.g., from the large steel plant near Košice) might not be fully transparent to the city. If a major emitter is outside the city's jurisdiction or unwilling to share data, it's hard for the MEL system to account for it or track progress. This can lead to an incomplete picture. Data quality is another technical challenge (notably transport). The city has to invest in better data collection methods or else accept a degree of uncertainty. There is also the challenge of keeping data up-to-date without overburdening staff, too frequent monitoring in every area could overwhelm the capacity. Košice is seeking to find balance, but it's a trial-and-error process.
- **Resource Constraints**: Košice needs to secure external funding and make tough choices in resource allocation. While MEL helps target resources efficiently, the sheer scale of needed investment (for deep retrofits, new infrastructure like geothermal plants, electrifying transport, etc.) is a challenge. If promised external funds don't materialize or if economic conditions change (e.g., energy prices, inflation affecting project costs), the city might struggle to finance all planned actions. This is a risk that the MEL process has to monitor (financial indicators, risk indicators) and the city must adapt by prioritizing or phasing projects. Košice's pragmatic is approach to include financed or realistic projects in the CCC.
- **Maintaining Public Engagement and Combatting Fatigue**: Engaging stakeholders and citizens is powerful, but over a long timeline, sustaining that engagement is challenging. People's interest can wane, especially if results are slow or if other issues (like economic troubles) dominate their attention. Košice has to continuously communicate and reinvigorate public interest.Similarly, stakeholders who participated actively in planning might lose interest if they feel their input isn't leading to visible change. Košice needs to show progress (through MEL data and stories) to keep them motivated, which underscores that MEL is crucial, to have those success metrics to share.

Despite these challenges, Košice's MEL framework helps in identifying and managing them. By surfacing issues early (e.g., data showing a project is delayed or an indicator not improving), the city can strategize on how to overcome obstacles. In some cases, the solution might be beyond MEL such as political negotiation or seeking new funding, but MEL ensures the challenges aren't hidden.

6.4 Porto

6.4.1 City Profile

City context

Porto is a historic and economically significant city located in northern Portugal. It sits along the Douro River estuary and extends to the Atlantic Ocean, making it both a riverine and coastal city. Porto is one of the oldest urban centers in Europe and has held UNESCO World Heritage Site status since 1996. It also serves as the economic and cultural core of the Porto Metropolitan Area, which includes over 1.7 million residents.

The city of Porto has a relatively small but densely populated urban area. As of 2021, the municipality of Porto had an estimated population of 231,800 people. Within the broader metropolitan region, over 1.7 million people reside, making Porto the fourth most populous municipality in Portugal and the third most densely populated.

Porto plays a central role in Portugal's economic landscape. It is a major national economic hub, hosting approximately 20% of the country's startups. The city's economy is supported by key industries, including technology and innovation, tourism, and sustainable energy. Porto maintains strong connections to research institutions and universities, further reinforcing its role in innovation. It is also a prominent tourist destination, recognized as the European Best Destination in 2012, 2014, and 2017.

The service sector is the dominant employer in Porto, supported by emerging and traditional industries. A large share of the city's workforce is engaged in the service sector, especially in tourism, technology, and trade. Manufacturing exists on a smaller scale in designated industrial zones in the metropolitan area. Porto's status as a commercial and tourist hub also supports a significant transport and logistics sector in the region.

Overview of the city's climate neutrality mission and objectives

Porto's greenhouse gas inventory establishes 2019 as the baseline year with total emissions of 937 ktCO_2eq. The city's main sources of emissions are buildings (the largest contributor), transport, waste management, and to a lesser extent, industrial processes and product use (IPPU). Despite its urban density, Porto benefits from a growing green infrastructure network that supports carbon sequestration within the city.

Porto has committed to an ambitious climate target of an 85% GHG emissions reduction by 2030. This target is benchmarked against 2019 levels, with residual emissions expected to reach 121 ktCO_2eq—primarily from the transport and waste sectors—which the city plans to offset. The long-term strategy includes expanding green infrastructure, accelerating sustainable mobility and transport electrification, increasing renewable energy use, and reinforcing circular economy practices.

The city's strategic initiatives are anchored in collective action and institutional coordination. The Porto Climate Pact, launched in 2022, is a voluntary, non-binding initiative with 538 individual and 228 institutional subscribers (at the time of submission). Today, the subscribers amount to 1577 individuals and 278 institutions. It promotes shared responsibility for climate action. Additionally, the Porto Transition Team—comprising 11 entities from municipal departments, agencies, and the private

sector—serves as the governance body overseeing climate action under the formal commitment "Towards Carbon Neutrality 2030."

Porto's investment strategy requires over €1.775 billion in capital expenditure by 2030. The largest investment areas are mobility (65%) and the built environment (22%). However, there remains an investment gap of approximately €1.747 billion, indicating the need for further financial mobilization to achieve the city's climate goals.

Porto's Monitoring, Evaluation, and Learning (MEL) framework is structured around a defined timeline and methodological approach. The baseline year for monitoring is 2019, with mid-term evaluations scheduled for 2025 and 2027, and a final evaluation in 2030. Emissions tracking is conducted using the City Inventory Reporting and Information System (CIRIS), supported by the development of sector-specific key performance indicators (KPIs) to monitor implementation progress across climate sectors.

Table 10 - Summary of Estimated GHG Impacts in Porto.

Sector	2019 Emissions	Actions to achieve expected Reduction by 2030
Buildings	Largest contributor	Energy efficiency and electrification measures
Transport	Second largest	Shift to electrification, shared mobility, and active transport
Waste Management	Significant	Circular economy initiatives, increased recycling rates
Industrial Processes	Low	Minimal contribution to emissions
Total Reduction Target	**416 ktCO2eq emissions gap**	**85% Reduction by 2030**

6.4.2 Porto's City MEL Processes and Application

Processes/Collaboration in Design and Operationalisation of MEL

Porto's journey toward climate neutrality has been rooted in strong collaborative governance and co-creation from the outset. An early step was establishing the dedicated transition team to drive the city's climate agenda, ensuring broad involvement across sectors.

> *"One of the initial priorities for Porto was to establish a transition team, which played a crucial role in driving the city's climate agenda. [The] team really gave a lot of importance to collaborating and bringing together various initiatives and actively involving key stakeholders, but also citizens in the process of co-creation and co-designing the city impact pathways."* .

The transition team comprises 11 key institutions including municipal companies. This includes the social housing company *Domus Social*, the city's association for innovation and digital transition *Porto Digital*, the *Porto Energy Agency*, and other public and private stakeholders working together. This transition team was involved in both the co-creation of the climate neutrality pathway and the MEL system to support its operationalisation.

> *"This transition team… comprises 11 institutions… which include municipal companies, such as the social housing company called Domus Social, Porto Digital… but also agencies like Porto Energy Agency and other private stakeholders in the city. And they have been working collaboratively through workshops and agreements to chart a clear pathway towards the goal of climate neutrality."*

The city deliberately brought diverse actors to the same table to co-design its MEL framework. Through this collaborative structure, Porto operationalised its MEL in a way that each stakeholder has a clear role yet works collaboratively (**Table 11**). The inclusive design (from co-planning to shared data responsibilities) has laid the groundwork for a MEL system that is not only technically robust but also widely supported and understood by those involved.

Table 11 - Key Actors in Porto's MEL System and Their Roles,

Actor	Role in MEL System
Municipality of Porto	Holds the political mandate and is responsible for appointing, supervising and monitoring the transition team.
Carbon Neutrality Directorate	Orchestrates the transition team's activities; acts as the key interface with private stakeholders who signed the Climate Commitment, collecting necessary monitoring data from them.
Porto Energy Agency	Manages the **city's emissions inventory and monitors climate measures implementation** (central role in tracking the Climate City Contract); provides data expertise and analysis. Manages the Energy Observatory.
Porto Digital	Manages the urban data platform that integrates data streams from various sectors for **integrated monitoring** of climate action (CCC implementation).
Porto Ambiente & LIPOR (municipal waste companies)	Provide sector-specific data (e.g. waste management data for the city) to the MEL system, supporting tracking of waste-related emissions and actions.
Other Municipal Companies (e.g. water and energy company, housing company)	Manage specific data streams in their sectors (transport, social housing retrofit, etc.) and implement climate measures; feed data on these actions/outcomes into the central monitoring framework.
University of Porto (Faculties of Engineering, Economics)	Contribute **technical expertise and research** to the MEL process, e.g. developing methodologies, analyzing data trends, and ensuring scientific rigor in evaluation.
Private stakeholders & Project partners (e.g. Climate Pact signatories, "Positive Energy District" pilot project like ACENDS)	Carry out on-the-ground climate actions (such as renewable energy districts) that contribute to Porto's climate goals; **provide data and deliverables from these initiatives for inclusion in the MEL monitoring**.
Transition Team (collective)	Emphasises a commitment to aligning human resources around a shared vision of sustainability leadership. As such, this team includes core competencies focused on achieving carbon neutrality by 2030. It holds workshops, agreements, and **regular meetings to co-create** strategy, align efforts, and keep the city on a "clear pathway towards climate neutrality." The team also synthesizes and communicates progress to political leaders and the public.

Citizen and stakeholder engagement is not limited to one-off input, and has been formalized through the Porto Climate Pact, a broad coalition for climate action. The Pact has *"over 700 subscribers, both individuals and institutions in the city and from the region"* , indicating widespread buy-in. It serves as a platform for ongoing co-creation and dialogue. For example, the city hosts a *Climate Pact Talk Series* as part of this initiative – public events where experts and citizens discuss climate actions and goals, thereby fostering continuous public participation. These talks and workshops ensure that the community is actively involved in refining and supporting Porto's climate efforts, making MEL a shared endeavor rather than a top-down exercise.

Collaborative design of the MEL system was facilitated by building on existing institutional strengths. Notably, Porto's Energy Agency (established in 2007) provided a strong foundation by managing the city's emissions inventory and coordinating energy/climate plans for years prior. This meant Porto entered the climate neutrality mission with experienced actors already in place. As one interviewee noted, the neutrality transition path idea *"started with Porto's Energy Agency, which since 2008 has taken on the role of managing Porto's emissions inventory… And we oversee the development and approval of energy and climate plans in this region. And with this, Porto has consistently set more and more ambitious targets, even more than the national Portuguese goals and those outlined by the Covenant of Mayors."* . Thus, the design of MEL leveraged pre-existing collaborations and a culture of ambition. Porto's targets and strategies were co-created with input from various departments and stakeholders, allowing the city to push beyond national commitments confidently.

Measurement and Monitoring

Porto has implemented a structured and regular measurement and monitoring cycle for its Climate City Contract (CCC) – the plan guiding the city to climate neutrality. Data collection is conducted annually, and the city performs formal evaluations on a multi-year schedule. As the team explained, *"we collect data every year. And then we will review the CCC every two years according to the evolution of the implementation."* . This means that every year new performance data (e.g. emissions, energy usage, project outputs) are gathered, and every two years the entire climate action plan is reviewed and updated based on these findings. Such a timeline ensures that monitoring is embedded as an ongoing process rather than a one-off, with short-term check-ins and medium-term reflections.

A core component of Porto's monitoring infrastructure is its integrated urban data platform, managed by Porto Digital (the city's digital services company). This platform aggregates data from various sectors to track the implementation of climate actions in real time or near-real-time. Porto Digital *"manages the urban data platform, which is very important to support an integrated monitoring of the implementation of the CCC"* . Through this platform, disparate data streams – from energy consumption to mobility patterns – can be combined to give a holistic view of progress. In practice, municipal companies supply data from their operations: for example, the transport company provides data on transit usage or fleet emissions, while the waste company (Porto Ambiente/LIPOR) provides data on waste management and recycling relevant to emission targets. The goal is that these inputs are standardized and accessible for analysis. Porto Digital also facilitates data integration, *"integrat[ing] those data streams if needed"* across different sources.

Porto's Energy Agency acts as the technical lead for monitoring. The agency *"plays the central role in the monitoring process and [in] monitoring the emissions inventory and the implementation of the measures under the CCC"* . With its specialized staff and experience, the Energy Agency collects and analyses emissions data (e.g. calculating the city's greenhouse gas inventory each year) and tracks how well implemented actions (in energy, transport, etc.) are contributing to emissions reduction. This ensures that there is a knowledgeable entity continuously checking *"whether we are making progress or not"* on the key goals. The Energy Agency's Energy Observatory provides further data capabilities, such as real-time monitoring of municipal building energy use (discussed later), which feeds into the overall MEL system.

Porto designated the Carbon Neutrality Directorate to coordinate the climate transition, also ensuring data collection from the private sector through their engagement in Porto's Climate Pact. Many private companies and institutions have voluntarily committed to climate actions under the Climate Pact/CCC, but *"not always have [they] established procedures for data collection"*. Recognizing this challenge, *"the directorate for climate neutrality does the interface with the private*

stakeholders and private signatories of the pact to collect the monitoring data needed". This involves reaching out to businesses or organizations that pledged emission reductions or other actions, and helping them report their progress in a compatible format. To this purpose, the transition team is working a reporting platform to align private data with the city's public monitoring system.

Obtaining consistent data from all partners, especially private sector, remains one of Porto's key monitoring challenges. The team noted that *"one of the main challenges regarding the monitoring process is related with the data collection from private stakeholders, which [do] not always have the established procedures for data collection."* Porto is actively working to improve its data governance and collection processes. A recently approved initiative called "A+Class" aims to strengthen monitoring by developing common data standards and practices across stakeholders. This project *"provides a blueprint for effective monitoring – emphasizing a timely, inclusive and science-based monitoring – while addressing challenges in the coordination of data ownership and interoperability"* . Porto is refining its MEL system architecture so that data flows from all sources (public or private) are smoother and more reliable. This includes clarifying data ownership issues, establishing data-sharing agreements, and ensuring different IT systems can talk to each other.

Porto's measurement approach is its move toward open data to enhance transparency and external engagement. Some of the city's climate action data is made available on the urban data platform for the public. *"We already have some data that are open data from the city in the urban data platform from Porto Digital. We already share a lot of specific indicators related with the city."* . These currently include general city indicators (e.g. transportation statistics) and will soon expand to cover more CCC-specific indicators as those monitoring processes mature. In addition, the Porto Energy Agency provides real-time energy data for the municipal buildings. The team expects that *"in the future we will have more indicators specifically related with the monitoring process of the CCC"* available openly. By publishing data, Porto not only holds itself accountable but also invites citizen science, academic research, and innovative uses of the data (discussed more in later sections). This openness is supported by data governance measures to manage what can be shared publicly vs. what must remain internal (for instance, some municipal data is not public by default, but can be requested by researchers on demand).

Porto's monitoring draws upon a legacy of climate planning and reporting. The city's first Sustainable Energy Action Plan (SEAP) was developed in 2010, and since then the "ecosystem is used to have a baseline… and to adapt it to new challenges, to new commitments" . In other words, local institutions are accustomed to regularly measuring emissions and updating plans (e.g. through Covenant of Mayors reporting, CDP questionnaires, etc.). This experience has yielded a *"quite well-oiled machine"* for emissions and energy data management. Each cycle of measurement, whether for the SEAP or the new CCC, Porto identifies data gaps and seeks new data sources to fill them. *"In each monitoring process we will look to [the baseline] and identify some data gaps or some new sources of data, because we are facing this constantly."* . For example, very recently the city was able to incorporate open data from the national energy distributor (utility) – such as quarterly energy production figures and a number of new energy systems installed in the municipality – which enriches their monitoring dataset. This continual improvement mindset means Porto's measurement system is dynamic and growing, ensuring that as new technologies or data become available, they are integrated to improve accuracy and completeness.

Indicators and Metrics

Porto's indicators and metrics for MEL are closely tied to its climate neutrality goals, with an emphasis on greenhouse gas reduction outcomes while also attempting to capture broader co-benefits. The headline indicator for the city is the reduction in GHG emissions (toward an 85% reduction target by 2030). Most of the indicators defined in the Climate City Contract originate from Porto's sectoral baseline in areas like transport, buildings, and waste, since those drive emissions. As one official described, the indicators *"generally stem from Porto's GHG baseline – transport, buildings,*

waste sectors, etc. – and [are] aligned with the outcomes of reducing emissions by 85%" . These core metrics (e.g. annual CO_2 emissions, energy consumption by sector, number of electric vehicles, waste recycling rate, etc.) are updated regularly and provide the quantitative backbone for tracking progress.

When developing the CCC's indicator framework, Porto prioritized indicators with available data to ensure feasibility. The list *"includes indicators that our municipal companies already work with and the ones we already report for the CDP, for instance, because we knew they would be available"* . This pragmatic approach meant leveraging existing datasets (from city departments or previous reporting commitments) as much as possible – for example, using energy usage stats that the utility or energy agency already collects, or transport ridership figures that the transit authority tracks. By doing so, they avoided the pitfall of choosing ideal indicators that are impractical to measure. It also helped integrate MEL into routine operations, since those indicators were familiar to the responsible agencies.

At the same time, Porto recognized that focusing only on easily available metrics might overlook important dimensions of the transition – particularly social and behavioral co-benefits that are less traditionally measured. The team *"tried to identify a couple more [indicators] and see which co-benefits they could also help measure"* . For instance, beyond pure emission numbers, they considered indicators related to quality of life, public health, or equity (implied by the term co-benefits). One concrete example that emerged is the Energy Poverty Index. A participant noted that *"the Energy Poverty Index is a thing that we never thought about 10 years ago. But right now for us, [at] the Energy Agency, it is one of our main concerns."* . This reflects a shift to include metrics that capture how the climate transition affects citizens' well-being (e.g. reducing energy poverty or improving access to clean energy) – something not on the radar in earlier plans but now recognized as crucial.

Porto's CCC indicator set is a mix of outcome indicators and output or process indicators. Outcome indicators include % emissions reduced, renewable energy generated, modal share of sustainable transport; while process indicators include the number of projects implemented, number of stakeholders engaged, etc., many of which indirectly link to co-benefits. However, the city is aware that the first iteration of indicators may not be fully sufficient. Before even completing the first full monitoring cycle, officials anticipated the need for refinement: *"I think only by [when] we do the first monitoring procedure, we will have a more clear view of how adequate and sufficient these indicators that we've identified are. Maybe we'll have to adapt or add other indicators, especially the ones regarding the measurements of co-benefits."* . This statement highlights that indicator relevance will be reviewed once real data comes in. It's essentially a built-in flexibility – they have set a starting point, but they do not consider it final.

One area of indicator development is capturing behaviour change and private-sector action. These can be hard to quantify, but Porto explicitly notes the importance of finding ways to measure them. There is a *"need to refine the indicators to better capture, for instance, behavioural change and also private sector engagement"*, which may involve developing new metrics (for example, percentage of citizens adopting certain climate-friendly behaviours, or number of companies achieving emission targets). The city is exploring how to use surveys or proxy indicators for such purposes, although specific examples were not detailed in the interview.

Porto distinguishes between indicators used for internal tracking vs. public communication (more on the communication aspect in the next section). The technical team might track detailed metrics like tons of CO_2 equivalent reduced, energy efficiency ratings of buildings, etc., but when presenting progress to citizens or politicians, they might highlight more tangible figures (e.g. trees planted, air quality index improvements, kilometers of bike lanes added). This is implied by their awareness that *"depending on the kind of stakeholders… we need to use a kind of language that people understand"* . For instance, saying *"we reduced 10% of our emissions"* may not resonate, so

they translate that into what it means on the ground. In essence, the underlying metrics remain the same, but the framing changes.

Porto's MEL indicators cover all major emission sectors and are aligned with its climate neutrality target. They smartly leveraged existing data (from municipal operations and global reporting frameworks like CDP) to kick-start monitoring, while also beginning to incorporate new indicators for co-benefits (like social equity measures) as the system evolves. The city treats its indicator set as living and iterative, planning to adjust it based on what the first rounds of data reveal about gaps or new priorities. This balance of environmental and social metrics, and the willingness to refine them, reflects a comprehensive approach to measuring what matters in the transition to neutrality.

Application of MEL Processes

MEL is actively used to guide decision-making, inform stakeholders, and adjust strategies on the path to climate neutrality. In Porto is not seen as a tick-box reporting exercise. The data and insights gained from monitoring and evaluation are applied in multiple ways:

Updating Plans and Policies: The most direct use of MEL is to periodically update the Climate City Contract and related action plans. As noted, the city will conduct a formal review every two years, using the collected data to assess which measures are on track and which need enhancement or correction. *"Yes, we collect data every year… and then we review the CCC every two years according to the evolution of the implementation."* These reviews can lead to reallocating resources, adding new actions, or tightening targets as needed. In other words, MEL creates a feedback loop where evidence shapes the next iteration of policy. The transition team and carbon neutrality directorate compile monitoring findings and *"report the findings to the municipal decision makers."* This ensures that the Mayor's office and city council are kept informed with up-to-date evidence, enabling them to make data-driven decisions (for example, approving a new incentive if a certain target is lagging, or adopting stricter measures if data shows an area of concern).

Porto has implemented an innovative policy that links MEL data to financial incentives for sustainable construction. The municipality introduced an environmental index based on four key domains: energy; green infrastructure and biodiversity; water and sustainable drainage; resources and circular economy. Construction companies that meet specific requirements across these categories are exempt from paying the municipal tax or have a tax reduction on new constructions. This approach not only encourages compliance with data collection but also actively uses monitoring data to drive behavioral change, creating a direct financial incentive for actions that support accelerated GHG reduction and other co-benfits.

1. **Internal Learning and Management**: Within the administration and its partners, MEL results are used to improve implementation. One interviewee described how data from the Energy Observatory (which gathers energy usage data, especially for municipal facilities) is applied: *"with this kind of platform… we could do a lot of specific analysis. For example, [we can] prioritize which municipal buildings… have more consumption, and also try to prioritize [their] rehabilitation. So I think [these] are very good examples."* In this case, the city can use monitoring data on building energy use to decide which buildings should be retrofitted first – targeting the worst performers to maximize impact. This is a clear example of evidence-based application: rather than selecting projects blindly, they use data to direct efforts where they are most needed. Similarly, if a particular neighbourhood is falling behind on renewable

energy adoption, the data would highlight that, and the city could respond perhaps with a targeted program in that area.

Another internal use is identifying and addressing data or performance gaps. Since Porto's team scrutinizes the indicators regularly, they treat any gap as a prompt for action (e.g. if an indicator cannot be reported due to missing data, they initiate work to obtain that data source, as mentioned earlier with the energy distributor data). They also launched the A+Class project (as noted) specifically because MEL analysis revealed a weakness in private data contributions. This shows how MEL doesn't just evaluate climate actions, it also reflexivity evaluates the MEL system itself, and the findings are used to improve over time.

2. **Engaging and Motivating Stakeholders**: Porto applies MEL as a tool for stakeholder engagement, turning data into compelling narratives to encourage further action by both citizens and partners. One approach is through public events and annual conferences to share results. *"The goal is to do events or conferences in order to present the main results and the main achievements each year."* These events serve multiple purposes: they celebrate successes, provide transparency, and facilitate knowledge exchange. For instance, the city invites private companies to see how others are performing: *"Porto also aims to use this event to show… to private entities… the results of this effort. [For example], to use good practices or good cases from one company in order for others to be inspired by them, and also to share… the development of these main projects."* In these forums, data and outcomes (such as a company significantly cutting emissions or a successful pilot project in a neighbourhood) are showcased so that peers can learn and possibly replicate the success. This is collective sense-making, where stakeholders reflect together on what the numbers mean and how to improve.

Porto's Climate Pact Talk Series provides another venue for MEL findings to be disseminated more widely. Experts might present latest emissions figures or co-benefit indicators to spark dialogue with citizens about progress and next steps. By doing so, Porto maintains public interest and trust: people see that the city is tracking progress and openly discussing it, which can inspire continued participation (like citizens sticking with new mobility habits or community groups proposing new initiatives).

3. **Communicating with Citizens**: The MEL process in Porto is also applied in targeted communication campaigns to drive behaviour change by highlighting data in relatable ways. A notable example was a campaign around public transportation. The city wanted to reinforce the importance of using transit, so they used MEL data to craft a message thanking residents and showing the impact. *"For instance, recently, we had [a campaign] regarding public transportation, where we tried to convey the message and thank the citizens for using public transport, and to show them what were the impacts of their increased use of public transportation."* By publicly sharing statistics – perhaps reductions in congestion or emissions due to higher bus/metro ridership – Porto both recognized citizens' efforts and provided positive feedback, which can encourage even greater use of sustainable transport.

Another communication-oriented application is seen in schools. Porto implemented a gamified display for solar PV performance in some schools: *"In some schools where we implement PV systems, we… have a display in [the] schools in which the students could see how the savings [are] during the day or during the month – what is the production of energy,*

of course, and what is the savings of CO2 emissions. It's a very specific and very small example, but I think that only with this kind of process or project we can reach [that] specific topic of the CCC." In this case, real-time MEL data (energy generated and CO_2 saved by the solar panels) is fed back to the users (students) in an interactive way. The intended use here is educational and motivational: students learn about renewable energy and see the direct impact of their school's panels, potentially influencing their attitudes and behaviour around energy. This shows how MEL data can be implemented into a learning tool at the community level.

4. **Transparency and External Collaboration**: By making a portion of its data open, Porto has enabled external actors to use MEL outputs for their own purposes. City officials observed that it's *"common for us to be approached by research centres and research teams… that take the opportunity of having this database available in Porto's Energy Agency to develop research and studies on this topic."* This means universities and innovators are using Porto's data to, say, analyse trends or develop apps. While this may be somewhat indirect, it is an application of MEL: the data collected for internal monitoring is being applied in broader research, which can loop back benefits to the city (e.g. if a university study finds a new insight about local climate impacts, or if a tech startup creates a citizen-facing app visualizing neighbourhood emissions). Additionally, various organizations sometimes request non-public data from the Energy Agency for specific projects, indicating that Porto's MEL system is seen as a valuable repository of information. By entertaining these requests, the city fosters a collaborative environment where MEL data catalyses action and inquiry outside the municipal government as well.

Learning and Adaptation

Continuous learning and adaptation are ingrained in Porto's MEL approach. The city treats the implementation of its Climate City Contract as an iterative process where each cycle of monitoring and evaluation provides lessons to refine the next cycle.

> *I think it will occur more or less depending on the impact of each measure and also with the opportunities that we can take because, for example, related with the transport, a lot of measures depends on very high investments. So there are also depending of grants or financial mechanisms. So I think we already prioritized the measures and the initiatives, but each two years we have to do this exercise once again and try to align this with the grants or the capital that the municipality has.*

Several mechanisms and mindsets illustrate how Porto learns and adapts:

- **Adjustment of Indicators and Targets**: Porto is prepared to modify its metrics after the first full monitoring cycle. They openly acknowledge that they *"will have to adapt or add other indicators"* based on initial results, especially to better capture co-benefits and other aspects that may be under-represented. This willingness to revise the indicator set is a learning practice. Already, the dialogue around needing indicators for behaviour change and energy poverty shows that the team is learning *during* implementation and planning those adjustments.
- **Addressing Challenges Proactively**: Whenever a challenge has been identified through MEL, Porto has taken steps to overcome it, effectively *learning-by-doing*. An example is the data collection gap from private stakeholders. The difficulty in getting consistent data from companies (a challenge flagged in monitoring) led to learning that more guidance and structure was needed for those partners. Porto adapted by initiating the "A+Class" project to create a common framework, indicating an institutional learning response to a technical

problem. Similarly, issues of data integration and ownership were confronted by improving the data platform and agreements, rather than ignoring them. Each challenge triggers an adaptation in process or tools, showing a feedback-informed evolution of the MEL system.

- **Building on Past Experiences**: Porto's climate team has a long history (over a decade) of working on energy and climate planning. They explicitly state that while the CCC monitoring is new, *"the first sustainable energy plan was made… in 2010. So I think the whole ecosystem is used to have a baseline… and to adapt it to new challenges, to new commitments."* This implies a culture of iterative planning: set a baseline, implement actions, review outcomes, and then update the plan – a cycle repeated multiple times (as seen with the Covenant of Mayors cycles). They have learned from earlier plans what works and what doesn't. For example, they now pay more attention to social indicators (like energy poverty) because over the years it became clear that exclusively focusing on technical indicators missed an important aspect of the transition. The fact that energy poverty is now a "main concern" shows learning from the community's needs and the broader discourse on just transition. Porto's MEL evolution is thus cumulative, incorporating lessons from each previous phase.
- **Periodic Reflection and Course-Correction**: The biennial CCC review is essentially a formalized learning checkpoint. By reviewing progress every two years, the city creates space to reflect on what the data is saying and to course-correct. For instance, if by the mid-term review (around 2025 or 2026) they find that emissions in the transport sector are not dropping as expected, they can analyse why and then adapt the plan accordingly. This built-in flexibility is crucial for learning in a long-term strategy like 2030 climate neutrality, where external conditions (technology, economy, public opinion) can change rapidly. Porto has essentially acknowledged that *"this is a very iterative process"* and built that into their governance processes.
- **Learning in Communication**: Porto also learned to adapt its engagement strategies by understanding its audience. Through experience, the team recognized the gap between technical reporting and public perception. As one team member insightfully put it, *"we reduce 10% of our emissions, but what does it mean, really? It's quite difficult [for people to grasp]… sometimes things people value most are not so relevant for our work… for example, we plant 200, 300 trees… it's very interesting in terms of awareness, but it doesn't change almost anything [in emissions]… If we talk only about technical aspects… but if we need to talk to the general public, we need to show things… that are very interesting for people."* This reflection shows the city learned that storytelling and framing of data must be adapted. As a result, they now emphasize co-benefits and visible achievements (like tree planting, solar schools, improved mobility) when communicating with citizens, reserving the complex percentage charts for internal discussions. Adapting communication in this way is a lesson in how to maintain public support and momentum, which is vital for the success of the overall program.
- **Incorporating New Data and Technology**: Each monitoring cycle, Porto looks for ways to improve data accuracy and coverage. They learned to be opportunistic with new data sources. For example, when the national energy distributor began releasing open data on a quarterly basis, Porto promptly integrated that into its MEL, enhancing their understanding of renewable adoption trends locally. They've also adapted to evolving international protocols for GHG inventories ("adapting the inventories based on the evolving protocol"), which means learning and applying new accounting rules to keep their measurements up-to-date with best practices. This technical learning ensures their reported outcomes are credible and comparable internationally.

Porto's MEL system is not static, it is designed to learn and improve continually. The city officials explicitly view it as an ongoing learning journey, adjusting indicators, processes, and even objectives as new information and contexts emerge. They combine formal review mechanisms

with a general culture of responsiveness to challenges. As one participant summarized, *"we already set the baseline frame for the MEL process. And I think in each monitoring process we will… identify some data gaps or some new sources of data… This kind of monitoring process also gives us the opportunity to look to other data or to increase our perspective of collecting data."* By remaining adaptable, Porto increases its chances of meeting its climate goals, since it can navigate around obstacles and seize new opportunities that arise during implementation.

Outcomes and Success Stories

Stronger Climate Commitments: One outcome of Porto's data-driven and collaborative approach is a sustained strengthening of climate commitments over time. Thanks to consistent monitoring and planning, *"Porto has consistently set more and more ambitious targets, even more than the national Portuguese goals and those outlined by the Covenant of Mayors."* This indicates that the city's MEL process has given leaders the confidence and evidence base to go beyond minimum requirements. By knowing their emissions profile well and seeing progress, they have been able to ratchet up ambition.

Stakeholder Engagement and Buy-in: The creation and growth of the Porto Climate Pact (with 700+ signatories) is a direct outcome of the collaborative approach. Having such a large number of local entities formally engaged in the climate effort is a significant impact in terms of governance and community support. These individuals and organizations have pledged to take action and be part of the monitoring process, which suggests a broad culture of climate responsibility in Porto. The regular events and communications have kept these stakeholders informed and motivated, which is evidenced by the ongoing participation in workshops. In practical terms, this helps maintain collective momentum for many businesses and institutions in implementing their own emission reduction measures.

Transparency and Public Trust: By sharing data and results openly (through open data platforms and public events), Porto has enhanced transparency. While hard to quantify, this likely translates into greater public trust in the city's climate initiatives. Citizens can see for themselves the trends and hold the city and partner organisations accountable. Use and application by researchers and students using the data, highlights that the data as reliable and useful. Over time, such transparency can contribute to a more informed public discourse on climate actions. The *Climate Pact Talk Series* dialogues are another good practice; which have created a new space for citizen-expert interaction. The impact here is increased awareness and knowledge among participants, which can ripple out as those participants share information in their communities.

Behaviour Change and Culture Shift: Porto's targeted communications and engagement campaigns seem to have yielded some behaviour changes, though not all are captured in numbers yet. The example of the public transport campaign implies that public transport use had increased. This suggests a positive trend in modal shift an impact on mobility behaviour. Similarly, the school gamification example, points to a culture shift in schools: students are more aware of energy usage. These young "climate citizens" could help increase public support or changes in behaviour and consumption leading to longer-term impacts (e.g., energy-saving habits, interest in sustainability careers). Another outcome is the normalization of data-driven discussions: citizens attending Climate Pact talks or seeing data dashboards become used to engaging with climate data, which is a societal change in how climate action is perceived (more evidence-based).

Policy and Investment Decisions: The MEL process has guided concrete decisions, such as prioritizing building retrofits based on data. The outcome here is that resources are being efficiently allocated. By tackling the worst-performing buildings first, Porto can achieve greater energy savings and emissions cuts sooner. If we consider that an outcome, it means the city likely reduced more emissions or saved more energy in its facilities than it would have without this targeted approach. Another example is that the identification of gaps (like lack of private data) led to investing in the

"A+Class" project – a decision to allocate effort/funding to a solution. This will have future impact by improving data flows and thereby improving the effectiveness of all subsequent monitoring and actions.

Interim Emissions Trends: While the document doesn't directly state how emissions have changed since adopting the CCC, we know Porto has a history of emissions inventory management. It's reasonable to assume they have seen downward trends in some sectors thanks to projects implemented (for instance, renewable energy installations, energy efficiency in city buildings, electric buses, etc. that are part of their plan). The impact on emissions will be fully measured in the coming monitoring cycles. Porto's MEL will capture these, and if targets are being met, one evaluated a percentage reduction in CO_2 (in relation to the planned 85% reduction by 2030). In the interim, specific project-level impacts can be noted: e.g., the Positive and Clean Energy District (ASCEND project) once operational will generate clean energy and cut emissions in that district; the expansion of public transport usage reduces traffic emissions; installation of PV in schools cuts those schools' grid energy consumption, etc. Each of these contributes to the aggregate impact.

Political and Institutional Impact: Another outcome is how MEL is affecting city governance. The fact that the transition team will report findings to municipal decision-makers means climate MEL is now embedded in the city's political decision cycle. It elevates climate action on the political agenda with hard numbers. This can impact budgeting (with data justification for climate projects) and cross-departmental collaboration (departments see the data and understand the need for their contribution).

Porto's MEL-driven climate program is supporting multi-faceted outcomes: higher ambition, broad engagement, informed decision-making, and early signs of behavioural and emissions impacts. One could say the most important outcome so far is a city that is institutionally and culturally mobilized for climate action, with MEL as the engine keeping it on track.

Porto's experience has potential impact beyond the city. As one of the 100 Climate Neutral Cities Mission participants, their approach, successes and lessons, may influence other cities' strategies (replication and learning). As Porto references cases like Madrid's low-emission zone debate, similarly Porto's approach provides valuable case for others, especially the way they integrate transparency, inclusion and emphasis on co-benefits to maintain political support.